

Grove GRT9165

Operator Manual





WARNING

California Proposition 65

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

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

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

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

California Spark Arrestor

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

The original language of this publication is English.

OPERATOR MANUAL

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

GRT9165

Crane Model Number

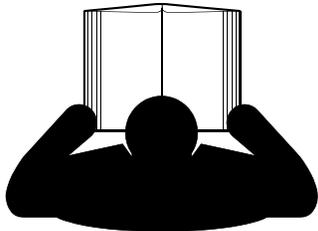
This Manual is divided into the following sections:

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

NOTICE

The crane serial number is the only method your distributor or the factory has of providing you with correct parts and service information.

The crane serial number is identified on the builder's decal attached to the operator cab. **Always furnish crane serial number** when ordering parts or communicating service problems with your distributor or the factory.

	<h2>! DANGER</h2> <p>An untrained operator subjects himself and others to death or serious injury. You must not operate this crane unless:</p> <ul style="list-style-type: none">• You have been trained in the safe operation of this machine.• You read, understand, and follow the safety and operating recommendations contained in the manufacturer's manuals, your employer's work rules, and applicable government regulations.• You are sure the machine is operating properly and has been inspected and maintained in accordance with the manufacturer's manuals• You are sure all safety signs, guards, and other safety features are in place and in proper condition. <p>Avoid Electrocution, tipping, two-blocking, and other operational hazards</p>
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*For
Reference
Only*

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Reference Only

SECTION 1 INTRODUCTION

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GENERAL

Throughout this *Operator Manual*, reference is made to left, right, front, and rear when describing locations. These reference locations are to be considered as those viewed from the operator seat with the superstructure facing forward over the front of the carrier frame.

This *Operator Manual* provides important information for the operation of the Model GRT9165 Grove Crane.

The GRT9165 rough terrain crane incorporates an all welded steel frame using planetary drive axles to provide four-wheel drive. Axle steering is accomplished utilizing hydraulic steer cylinders to provide six-wheel steering:

- 2-wheel front
- 4-wheel rear
- 6-wheel coordinated
- 6 wheel crab

The GRT9165 Grove crane can be driven in the Standard Driving Configuration—with the boom centered over the front single axle (Figure 1-1) or, in the Alternate Driving Configuration—with the boom centered over the rear tandem axles (Figure 1-2).

These two driving configurations, along with Rear Steering and Steering Reversal features, enable easy crane positioning, and precise maneuvering on the jobsite. These features assist the operator, and provide smooth control of the crane when reversing the driving controls and changing crane direction of travel.

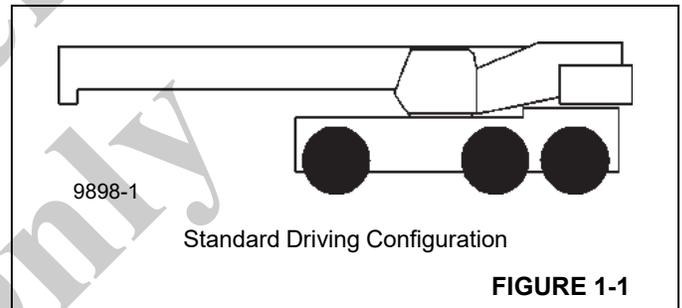


FIGURE 1-1

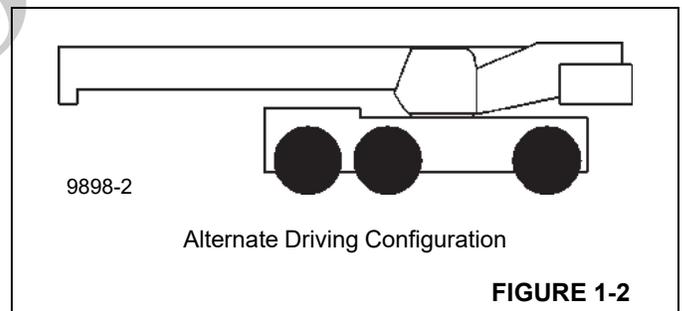


FIGURE 1-2

The GRT9165 introduces the new wider full vision cab, designed with operator comfort, visibility and productivity in mind.

Standard features include:

- Tilt/telescoping steering wheel
- Electronic seat adjustments, high output heating and air conditioning system

- USB charging port, windshield sun visor, and added storage behind the seat

The Rated Capacity Limiter Display Module (RDM) and the Operator Display Module (ODM) are full-color graphical displays on pivoting arms that provide maximum adjustability for the crane operator.

The RDM allows the operator to program the Rated Capacity Limiter (RCL) using the GRT9165 *Load Chart Manual* or the RCL setup wizard. The RDM provides electronic display of boom angle, boom length, load radius, boom tip height, maximum permissible load, actual load, and warning of impending two-block condition.

The Operator Display Module (ODM) allows the operator to:

- monitor performance of the crane systems
- select camera views displayed on the ODM screen
- telescope the boom
- extend and retract the outriggers
- remove and install the counterweight
- lock and unlock the superstructure
- operate the boom extension stowage actuators
- set the working range limits (WRL) operating indicators, levels, warnings and faults, prior to operating the crane, aiding the operator to avoid obstructions
- view engine, transmission, and crane fault codes
- set controller curves and maximum speeds
- engage and disengage Economy (ECO) mode
- inhibit operation of the engine cleaning system

The engine is mounted at the rear of the crane, and provides motive power through a transmission range-shift with six forward and six reverse speeds. Hydraulic, double box, sliding beam outriggers are integral with the frame. An ECO mode system supports intelligent power management and decreased fuel consumption.

The carrier frame incorporates an integral fifth wheel which provides axle oscillation. Axle oscillation lockout is automatic when the superstructure rotates from the travel position.

The front axle is rigid mounted. Rear axles oscillate up to 152 mm (6 in) with automatic lockout. Rear axles have a hydro-gas design that allows for compact height reduction when transporting without a counterweight.

The superstructure is capable of 360° rotation in either direction. All crane functions are controlled from the fully-enclosed cab mounted on the superstructure. The cab seat incorporates armrest-mounted electronic programmable single-axis or dual-axis controllers and a jog dial for easy data input. The crane is equipped with a six-section MEGAFORM™ boom with the TWIN-LOCK™ boom pinning system. Additional reach is obtained by utilizing an optional swingaway boom extension. Lifting is provided by a main hoist and an auxiliary hoist.

Customer Support

Grove and our distributor network want to ensure your satisfaction with our products and customer support. Your local distributor is the best equipped and most knowledgeable to assist you for parts, service, and warranty issues. They have the facilities, parts, factory trained personnel, and the information to assist you in a timely manner. We request that you first contact them for assistance. If you feel you need factory assistance, please ask the distributor's service management to coordinate the contact on your behalf.

A compact disc or USB flash drive, which includes sections on Operation, Safety and Maintenance for crane operators and owners, is supplied when the crane is purchased new. Additional copies are available from your Grove distributor.

New Owners

If you are the new owner of a Grove crane, please register it with Manitowoc Crane Care so we have the ability to contact you if the need arises.

Go to: <https://www.manitowoc.com/support/change-ownership> and complete the form.

NOISE/VIBRATION TEST RESULTS

Noise Level Test Results

With closed cab operation, the guaranteed sound power level at the operator's station is L_{wa} 105 dB(A) as measured by Directive 2006/42/EC. The guaranteed sound power level at the crane operator position is 80 dB(A) as measured by Annex G.1 of EN 13000:2010+A1:2014.

Vibration Level Test Results

With closed cab operation, vibration levels at the operator station are less than 0.5 m/s/s for Whole Body Vibration exposure and are less than 2.5 m/s/s for Hand Arm Vibration exposure when measured according to 89/392/EEC Community Legislation on Machinery per standard ISO 2631/1 – *Evaluation of Human Exposure to Work Body Vibration*, ISO 5349 – *Guidelines for the Measurement and*

Assessment of Human Exposure to Hand Transmitted Vibrations, and ISO/DIS 8041 – Human Response Vibration Measuring Instrumentation.

SERIAL NUMBER LOCATION

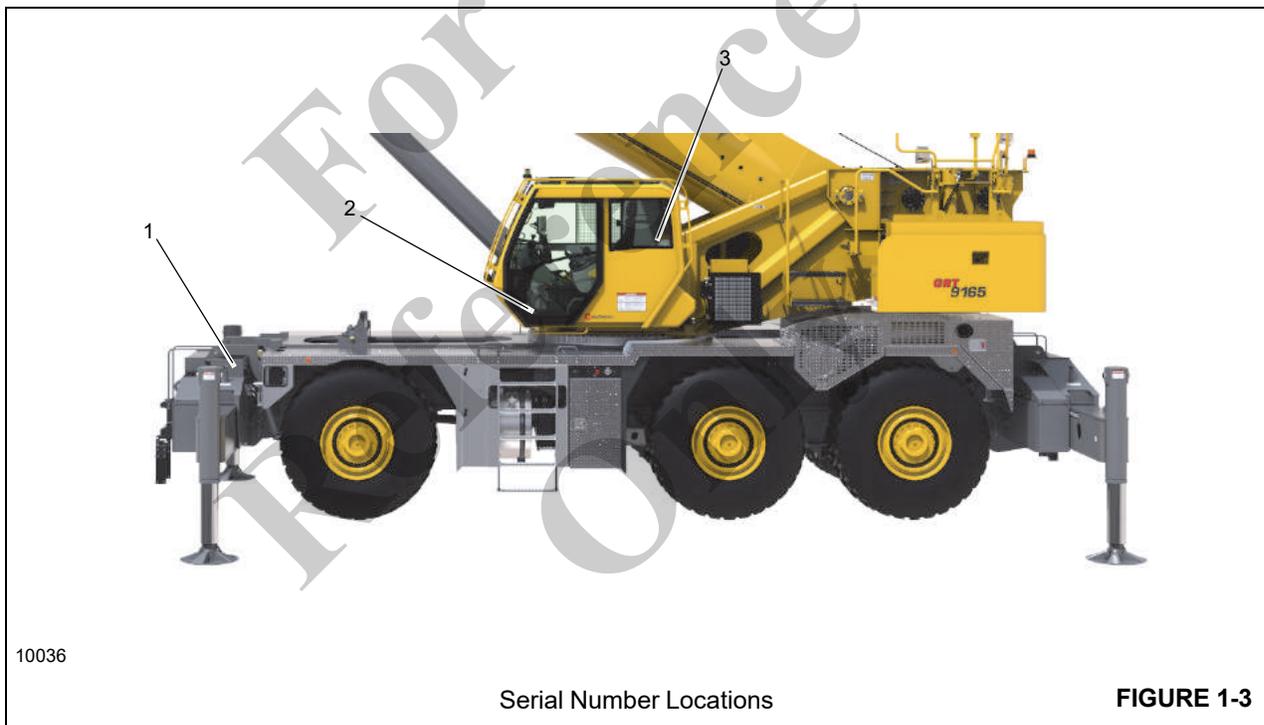
Refer to Figure 1-3.

When contacting your local Grove distributor or Manitowoc Crane Care, have the crane serial number available.

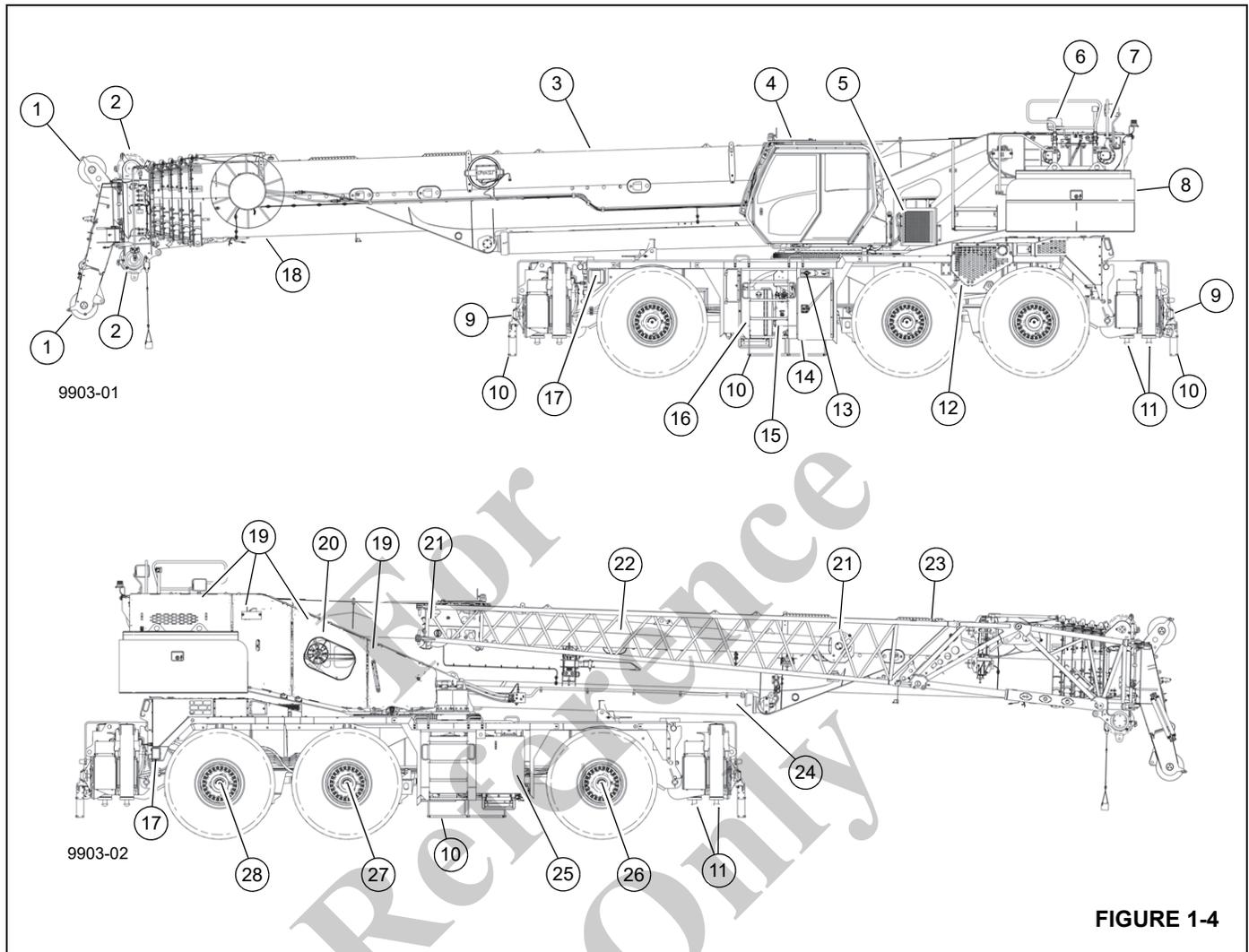
Serial numbers are located at these places on the crane:

1. Stamped on frame
2. Data plate inside cab
3. *Operator Manual* cover

Additionally, the crane serial number is located on the *Service Manual, Parts Manual, and Load Chart Manual.*



GRT9165 CRANE COMPONENTS



Item	Description	Item	Description
1	Auxiliary Boom Nose Sheaves	15	Diesel Exhaust Fluid (DEF) Tank*
2	Boom Nose Sheaves	16	Fuel Tank*
3	Boom	17	Outrigger Box Pinning Control
4	Cab	18	Boom Work Lights
5	Air Conditioning Condenser	19	Superstructure Valve Covers
6	Main Hoist	20	Hydraulic Oil Cooler
7	Auxiliary Hoist	21	Boom Extension Sheaves
8	Counterweight	22	Boom Extension Fly Section
9	Outrigger Pads	23	Boom Extension Base Section
10	Crane Steps and Grab Handles	24	Lift Cylinder
11	Outrigger Jack Cylinders	25	Hydraulic Tank
12	Exhaust Aftertreatment	26	Axle #1 (Front Drive and Steer)
13	Battery Disconnect Switch	27	Axle #2 (Steer only)
14	Battery and Control Module Compartment	28	Axle #3 (Rear Drive and Steer)
*Stage V/Tier 4F engines use Ultra Low Sulfur Fuel (Max 15 ppm) and Diesel Exhaust Fluid (DEF)			

For Reference Only

LIST OF SPECIFICATIONS

General

Model	GRT9165
Full Vision Cab	20° cab tilt
Rated Capacity	See <i>Load Chart Manual</i> in cab
Drive	6 x 4 x 6
Gross Weight	See Axle Weight Distribution Table

Dimensions

NOTE: Dimensions listed are for a crane with all components fully retracted in the travel mode.

Wheelbase	5000 mm (197 in)
Overall Crane Length	16021 mm (630.75 in)
Compact Transport Length	(8.5 m) (27.9 ft)
Overall Crane Width	
with Counterweight	3996 mm (157 in)
without Counterweight	3800 mm (149.6 in)
Overall Crane Height	
Ride Height	3792 mm (149.29 in)
Fully Lowered	3741 mm (147.29 in)
Outside Turning Radius	
(with Boom Extension Installed)	
2 Wheel Steer (in meters)	19.7 m (64 ft 8 in)
6 Wheel Steer (in meters)	15.0 m (49 ft 3 in)
Outside Turning Radius	
(without Boom Extension Installed)	
2 Wheel Steer (in meters)	19.0 m (62 ft 4 in)
6 Wheel Steer (in meters)	14.4 m (47 ft 3 in)
Outside Curb Clearance	
2 Wheel Steer (in meters)	15.6 m (51 ft 2 in)
6 Wheel Steer (in meters)	10.6 m (34 ft 9 in)

Capacities

Fuel Tank (Usable)	271 L (72 gal)
Engine Cooling System	42 L (11.1 gal)
Engine Cooling System (Liquid Coolant Conditioner)	(test and add, as necessary)
Engine Crankcase with filter (Tier 4)	15 L (4 gal)
Hydraulic Tank (Reservoir Capacity)	
Total	838.58 L (221.5 gal)
Full Level	729 L (192.6 gal)
Hoist Drums (each)	4 L (1 gal)
Swing Drive Gearboxes (each)	.4 L (4.2 qt)
Swing Drive Gearbox Brake Assemblies (each)	0.3 L (0.6 pt)
Axle Planetary Hubs and Wheel Bearings (each wheel end)	9.8 L (10.4 qt)
Axle Differentials (each)	44.8 L (11.8 gal)
Transmission (includes Torque Converter)	44.5 L (11.75 gal)
Diesel Exhaust Fluid (DEF) Tank	37.9 L (10 gal)

Transmission

Gear Ratios — Forward and Reverse	
Low Range	
1st	12.64:1
2nd	6.11:1
3rd	2.25:1
High Range	
4th	4.30:1
5th	2.08:1
6th	0.76:1

Torque Converter

Stall Ratio	1.784:1
Charge Pump Capacity	80 L/min (21 gal/min) @ 2000 rpm

Engine

Cummins QSB 6.7L - Stage V/Tier 4F

Type	4-cycle, Diesel with After-Treatment System
6-cylinder Turbocharged	After-Cooled Engine
Horse Power Rating	224kW (300 hp) @ 2500 rpm
Maximum Speed, No Load	2700 rpm
Max. Torque	1288 N·m (950 lbf-ft) at 1500 rpm
24 Volt Electrical System	two 12 Volt Batteries
Fuel	Maximum 15 ppm sulfur content (ULSD) plus Diesel Exhaust Fluid (DEF)

Cummins QSB 6.7L - Non-Certified

Type	4-cycle, Diesel
6-cylinder Turbocharged	After-Cooled Engine
Horse Power Rating	224kW (300 hp) @ 2500 rpm
Maximum Speed, No Load	2700 rpm
Max. Torque	1288 N·m (950 lbf-ft) at 1500 rpm
24 Volt Electrical System	two 12 Volt Batteries
Fuel	Maximum 5000 ppm Sulfur Diesel

Axles

Total Ratio	36.84:1
Carrier Ratio	6.14:1
Planetary Ratio	6:1

Steering

Type	Independent Hydraulic Power Steering
Front axle	controlled via steering wheel
Rear axles	mechanically linked and controlled via separate switch in cab
Rear steer	alignment indicator included
Coordinated Turning Radius	
Outside 6 Wheel Steer	10.2 m (22.5 ft)
Inside 6 Wheel Steer	7.4 m (24.2 ft)

Brakes

Type	6 Wheel Hydraulic Dry Disc
	Acting on all Wheels w/ Dual Calipers
Parking	Front Axle Mounted, Spring Applied Hydraulic Released

Wheels and Tires

Lugs per Wheel	24
Torque	610 to 678 N·m (450 to 500 lbf-ft)
Tire Size	26.5 x 25, 44 bias ply rating

NOTE: For roading and lifting pressures, refer to the *Load Chart Manual* in the cab.

Swing Gearbox

Reduction Ratio	37.5:1
Continuous Torque	381 N·m (281 lbf-ft)
Maximum Torque	762 N·m (562 lbf-ft)

Boom

Length	13.7 m to 62.5 m (44.9 ft to 205 ft)
Power	6 Section, MEGAFORM™
Pinning	TWIN-LOCK™ Boom Pinning
Max Tip Height without Extension	65.2 m (214 ft)
Elevation	-2° to +80°
Boom Extensions (Optional)	
Manual Bi-Fold Lattice Swingaway	
Length	11.2 m to 17.8 m (36.7 ft to 58.4 ft)
Manual Offsets at	0°, 15°, 30°, and 50°
Maximum Tip Height	83.2 m (273 ft)
Hydraulic Bi-Fold Lattice Swingaway	
Length	11.2 m to 17.8 m (36.7 ft to 58.4 ft)
Hydraulic Offsets from	0° to 50°
Maximum Tip Height	83.2 m (273 ft)
Hydraulic Heavy Duty	
Length	3.9 m (13.0 ft)
Hydraulic Offsets from	0° to 50°

Outriggers

Outrigger Spread	
Retracted	3558 mm (140 in)
Mid Extend	6022 mm (237 in)
Fully Extended	8486 mm (334 in)
Outrigger Pad Diameters	
Polymer	500 mm (19.68 in)
Aluminum	610 mm (24.06 in)
Max Individual Outrigger Pad Load	
	738.4 kN (166,000 lbf or 166 kip)

Swivel Assembly

Electrical	20 Slip Rings
Hydraulic	10 ports
Water	2 ports
Air Conditioning	2 ports

Hydraulic Pumps

NOTE: Pump flow rate (output) figures are theoretical.

Pump #1

Type	Piston
Sections	1
Output - @ loaded engine speed	
Section 1 flow rate	253 L/min (66.8 gal/min)

Pump #2

Type	Piston
Sections	1
Output - @ loaded engine speed	
Section 1 flow rate	184 L/min (48.6 gal/min)

Pump #3

Type	Gear
Sections	1
Output - @ loaded engine speed	
Section 1 flow rate	119 L/min (31.4 gal/min)

Pump #4

Type	Gear
Sections	1
Output - @ loaded engine speed	
Section 1 flow rate	58 L/min (15.3 gal/min)

Hoists

Drum Dimensions	
Diameter	371 mm (14.61 in)
Length	550 mm (21.63 in)
Cable, Main, 35x7 Steel	
Diameter	19 mm (0.75 in)
Length	294 m (964.5 ft)
Max Permissible	
Line Pull	7784 kg (17,160 lb)
Cable, Aux., 35x7 Steel	
Diameter	19 mm (0.75 in)
Length	233 m (764.4 ft)
Max. Permissible	
Line Pull	7784 kg (17,160 lb)
Max. Single Line Speed at:	140 m/min (459 ft/min)
Motor Displacement	80 cc (4.88 in ³)

*For
Reference
Only*

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SECTION 2

SAFETY INFORMATION

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SAFETY MESSAGES

General

The importance of safe operation and maintenance cannot be overemphasized. 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 safety alert symbol means **ATTENTION!** Become alert - **your safety is involved!** Obey all safety messages that follow this symbol to avoid possible death or injury.

Signal Words



DANGER

Identifies **hazards** that will result in death or serious injury if the message is ignored.



WARNING

Identifies **hazards** that may result in death or serious injury if the message is ignored.



CAUTION

Identifies **hazards** that could result in minor or moderate injury if the message is ignored.

CAUTION

Without the safety alert symbol, identifies **hazards** that could result in property damage if the message is ignored.

NOTE: Emphasizes operation or maintenance procedures.

GENERAL

It is impossible to compile a list of safety precautions covering all situations. However, there are basic principles that **must** be followed during your daily routine. Safety is **your primary responsibility**, since any piece of equipment is only as safe **as the person at the controls**.

Read and follow the information located in *Model Specific Information* near the end of this section.

This information has been provided to assist in promoting a safe working atmosphere for yourself and those around you. It is not meant to cover every conceivable circumstance which could arise. It is intended to present basic safety precautions that should be followed in daily operation.

Because you are the only part of the crane that can think and reason, your responsibility is not lessened by the addition of operational aids or warning devices. Indeed, you must guard against acquiring a false sense of security when using them. They are there to assist, not direct the operation. Operational aids or warning devices can be mechanical, electrical, electronic, or a combination thereof. They are subject to failure or misuse and should not be relied upon in place of good operating practices.

You are the only one who can be relied upon to assure the safety of yourself and those around you. Be a **professional** and follow the **rules of safety**.

Remember, failure to follow just one safety precaution could cause an accident that results in death or serious injury to personnel or damage to equipment. You are responsible for the safety of yourself and those around you.

ACCIDENTS

Following any accident or damage to equipment, the Grove distributor must be immediately advised of the incident and consulted on necessary inspections and repairs. Should the distributor not be immediately available, contact should be made directly with Grove Product Safety at the address below. 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 your Grove distributor and/or Manitowoc Crane Care.

If this crane becomes involved in a property damage and/or personal injury accident, **immediately** contact your Grove distributor. If the distributor is unknown and/or cannot be reached, contact Product Safety at:

Grove U.S. L.L.C.

1565 East Buchanan Trail
Shady Grove, PA 17256-0021

Phone: 888-777-3378 (888-PSR.DEPT)
717-597-8121

Fax: 717-593-5152

E-mail: product.safety@manitowoc.com

OPERATOR INFORMATION

You must **read** and **understand** this *Operator Manual* and the *Load Chart* before operating your new crane. You must also **view** and **understand** the supplied safety video. This manual and *Load Chart* must be readily available to the operator at all times and must remain in the cab (if equipped) or operator's station while the crane is in use.

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.

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

Allow **No One** other than the operator to be on the crane while the crane is operating or moving, unless they are seated in a two-man cab.



Do not remove the *Load Chart*, this *Operator Manual*, or any decal from this crane.

Inspect the crane every day (before the start of each shift). Make sure that routine maintenance and lubrication are being dutifully performed. Don't operate a damaged or poorly maintained crane. You risk lives when operating faulty machinery—including your own.

If adjustments or repairs are necessary, the operator shall notify the next operator and personnel responsible for the maintenance and repair of the crane.

OPERATOR QUALIFICATIONS

Qualified person is defined as one who by reason of knowledge, 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.

Make sure that all personnel working around the crane are thoroughly familiar with safe operating practices. You must be thoroughly familiar with the location and content of all decals on the crane. Decals provide important instructions and warnings and must be read prior to any operational or maintenance function.

You must be familiar with the regulations and standards governing this crane and its operation. Work practice requirements may vary slightly between government regulations, industry standards, and employer policies so a thorough knowledge of all such relevant work rules is necessary.



An untrained operator subjects himself and others to death or serious injury.

You must not operate this crane unless:

- You have been trained in the safe operation of this crane.
- You read, understand, and follow the safety and operating recommendations contained in the manufacturer's manuals, your employer's work rules, and applicable government regulations.
- You are sure the crane has been inspected and maintained in accordance with the manufacturer's manuals and is operating properly.
- You are sure that all safety decals, guards, and other safety features are in place and in proper condition.

Do not attempt to operate the crane unless you are trained and thoroughly familiar with all operational functions. Controls and design may vary from crane to crane; therefore, it is important that you have specific training on the particular crane you will be operating.

Training is ESSENTIAL for proper crane operation. Never jeopardize your own well-being or that of others by attempting to operate a crane on which you have not been trained.

You must be mentally and physically fit to operate a crane. Never attempt to operate a crane while under the influence of medication, narcotics, or alcohol. Any type of drug could impair physical, visual and mental reactions, and capabilities.

As operator of this crane, you are granted the authority to stop and refuse to lift loads until safety is assured.

OPERATIONAL AIDS

Operational aids are accessories that provide information to facilitate operation of a crane or that take control of particular functions without action of the operator when a limiting condition is sensed, as stated in the latest revision of the ASME B30.5, and ASME B30.8 standards. Examples of such devices include, but are not limited to, the following: anti-two-block device, rated capacity indicator, rated capacity limiter, boom angle or radius indicator, boom length indicator, crane level indicator, hoist drum rotation indicator, load indicator, and wind speed indicator.

Grove remains committed to providing reliable products that enable users and operators to safely lift and position loads. Grove has been an industry leader in the incorporation of operational aids into the design of its cranes. Federal law requires that cranes be properly maintained and kept in good working condition. The manuals that Grove provides that are specific for each crane and the manufacturer's manuals for the operational aids shall be followed. If an operational aid should fail to work properly, the crane user or owner must

assure that repair or recalibration is accomplished as soon as is reasonably possible. If immediate repair or recalibration of an operational aid is not possible and there are exceptional circumstances which justify continued short-term use of the crane when operational aids are inoperative or malfunctioning, the following requirements shall apply for continued use or shutdown of the crane:

- Steps shall be taken to schedule repairs and recalibration immediately. The operational aids shall be put back into service as soon as replacement parts, if required, are available and the repairs and recalibration can be carried out. Every reasonable effort must be made to expedite repairs and recalibration.
- When a *Load Indicator, Rated Capacity Indicator, or Rated Capacity Limiter* is inoperative or malfunctioning, the designated person responsible for supervising the lifting operations shall establish procedures for determining load weights and shall ascertain that the weight of the load does not exceed the crane ratings at the radius where the load is to be handled.
- When a *Boom Angle or Radius Indicator* is inoperative or malfunctioning, the radius or boom angle shall be determined by measurement.
- When an *Anti-Two-Blocking Device, Two-Blocking Damage Prevention Device or Two-Block Warning Device* is inoperative or malfunctioning, the designated person responsible for supervising the lifting operations shall establish procedures, such as assigning an additional signal person to furnish equivalent protection. This does not apply when lifting personnel in load-line supported personnel platforms. Personnel shall not be lifted when anti-two-block devices are not functioning properly.
- When a *Boom Length Indicator* is inoperative or malfunctioning, the designated person responsible for supervising the lifting operations shall establish the boom lengths at which the lift will be made by actual measurements or marking on the boom.
- When a *Level Indicator* is inoperative or malfunctioning, other means shall be used to level the crane.

Rated Capacity Limiter (RCL) Systems

Your crane is equipped with an RCL system which is intended to aid the operator. An RCL is a device that automatically monitors radius, load weight, and load rating and prevents movements of the crane, which would result in an overload condition.

Test daily for proper operation. Never interfere with the proper functioning of operational aids or warning devices.

Under **no condition** should it be relied upon to replace the use of *Load Charts* and operating instructions. Sole reliance

upon these electronic aids in place of good operating practices can cause an accident.

Know the weight of all loads and always check the capacity of the crane as shown on the *Load Chart* before making any lifts.

NEVER exceed the rated capacity shown on the *Load Chart*. Always check the *Load Chart* to make sure that the load to be lifted at the desired radius is within the rated capacity of the crane.

For detailed information concerning the operation and maintenance of the RCL system installed on the crane, see the appropriate section later in this manual or the RCL manufacturer's manual supplied with the crane. Manufacturers of rated capacity limiters may refer to them in their manuals as a load moment indicator (LMI), a hydraulic capacity alert system (HCAS), a safe load indicator (SLI), or an EKS5; Grove refers to these systems as a rated capacity limiter (RCL) throughout its *Operator* and *Service manuals*.

Anti-Two-Blocking Device

This crane should have a functional Anti-Two-Block and Control Lock-Out System. Test daily for proper operation.

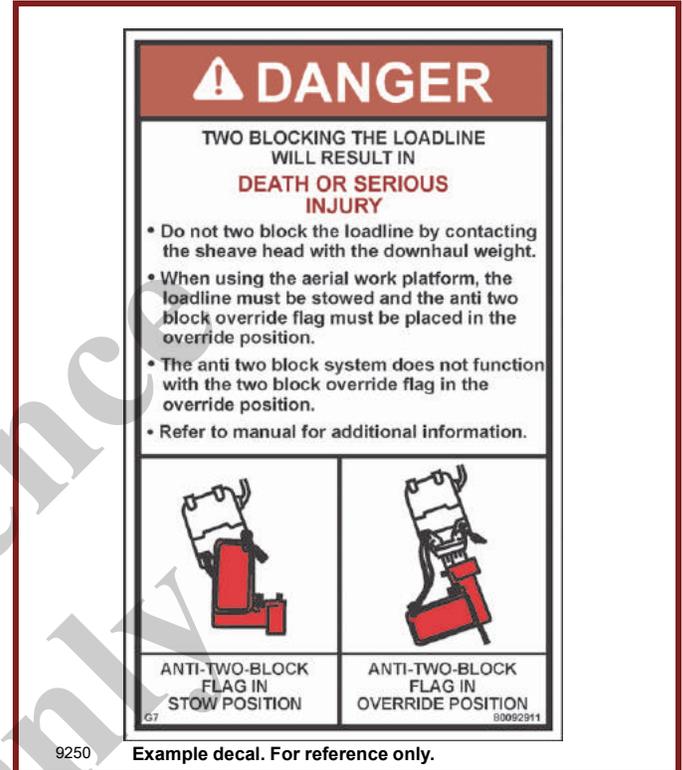
Two-blocking occurs when the load block (hook block, overhaul ball, rigging, etc.) comes into physical contact with the boom (boom nose, sheaves, boom extension, etc.). Two-blocking can cause hoist rope (wire rope or synthetic rope), rigging, reeving, and other components to become highly stressed and overloaded in which case the hoist rope may fail allowing the load, block, etc. to fall.

Two-blocking is more likely to occur when both the main and auxiliary hoist lines are reeved over the main boom nose and boom extension nose respectively. An operator, concentrating on the specific line being used, may telescope or lower the boom allowing the other hoist line attachment to contact the boom or boom extension nose, thus causing damage to the sheaves, or causing the hoist rope to fail, dropping the lifting device to the ground and possibly injuring personnel working below.

Caution must be used when lowering the boom, extending the boom or hoisting up. Let out load line(s) simultaneously to prevent two-blocking the boom tip(s) and the hook block, etc. The closer the load is carried to the boom nose the more important it becomes to simultaneously let out hoist rope as the boom is lowered. Keep load handling devices a minimum of 107 cm (42 in) below the boom nose at all times.

Two-blocking can be prevented. Operator awareness of the hazards of two-blocking is the most important factor in preventing this condition. An Anti-Two-Block System is intended to assist the operator in preventing dangerous two-block conditions. It is not a replacement for operator awareness and competence.

Never interfere with the proper functioning of operational aids or warning devices.

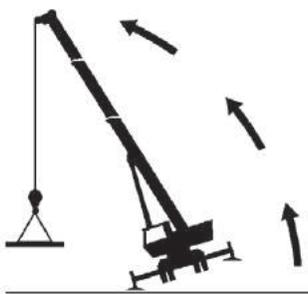


Working Area Limiter (If Equipped)

This crane may be equipped with a working area limiter as part of the RCL system, designated as either Work Area Definition System (WADS) or Working Range Limiter (WRL). You must read and understand the operator manual before operating the working area limiter system. Become familiar with all proper operating procedures and with the identification of symbol usage.

The working area limiter is intended to be used as an aid to the operator. It is not a substitute for safe crane operating practices, experience and good operator judgments.

! DANGER



TIPPING HAZARD

To avoid death or serious injury, ensure load and crane's configuration are within capacity as shown on crane's load rating chart and notes.

This crane should have a functional load moment indicator and control lock-out system. Test daily for proper operation.

POSITION CRANE ON FIRM SURFACE.
EXTEND OUTRIGGERS AND LEVEL CRANE.

TO AVOID DEATH OR SERIOUS INJURY:

NEVER handle personnel with this machine unless the requirements of the applicable national, state and local regulations and safety codes are met.

NEVER use this crane for bungee jumping or any form of amusement or sport.

NEVER permit anyone to ride loads, hooks, slings or other rigging for any reason.

NEVER get on or off a moving crane.

NEVER allow anyone other than the operator to be on this crane while it is operating or traveling.



TWO-BLOCKING HAZARD

To avoid death or serious injury, keep load handling devices away from boom/jib tip when extending or lowering the boom and when hoisting up.

This crane should have a functional anti-two-block and control lock-out system. Test daily for proper operation.

DO NOT PASS LOADS OR BOOM OVER
GROUND PERSONNEL.

ELECTRONIC EQUIPMENT on this crane is intended as an aid to the operator.

Under no condition should it be relied upon to replace the use of capacity charts and operating instructions. Sole reliance upon these electronic aids in place of good operating practices can cause an accident.

Do not remove any decal, the load chart, or the Operator's and Safety Handbook from this crane.

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FOLLOW INSTRUCTIONS IN OPERATOR'S AND SAFETY HANDBOOK.
7376 100 175

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CRANE STABILITY/STRUCTURAL STRENGTH

To avoid death or serious injury, make sure that the crane is on a firm surface with load and crane's configuration within capacity as shown on the crane's *Load Chart* and notes.

Make sure that all pins and floats are properly installed and outrigger beams are properly extended before lifting on outriggers. On models equipped with outriggers that can be pinned at the mid-extend position (vertical stripe, if applicable), the outriggers must also be pinned when operating from the mid-extend position.

Use adequate cribbing under outrigger floats to distribute weight over a greater area. Check frequently for settling.

Carefully follow the procedures in this *Operator Manual* when extending or retracting the outriggers. Death or serious injury could result from improper crane setup on outriggers.

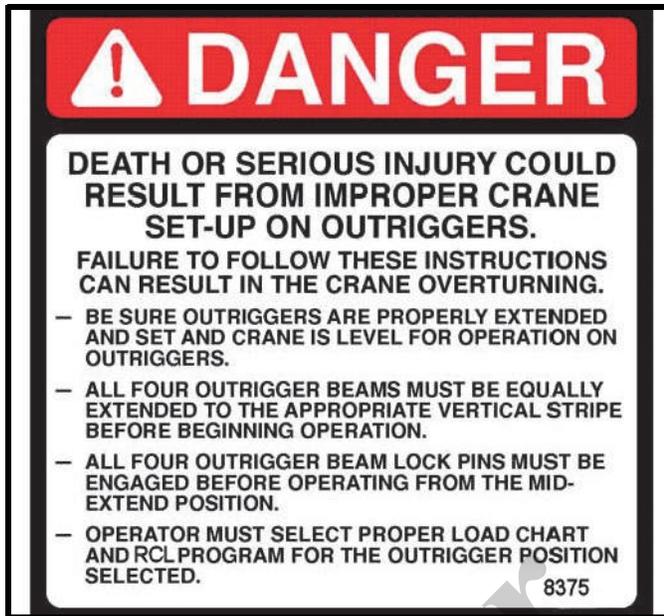
The operator must select the proper *Load Chart* and Rated Capacity Limiter (RCL) System program for the outrigger position selected.

Before swinging the superstructure over the side when the outriggers are retracted, check for backwards stability under the sub-section titled *Model Specific Information* later in this section.

Long cantilever booms can create a tipping condition when in an extended and lowered position. Retract the boom proportionally with reference to the capacity of the applicable *Load Chart*.

Check crane stability before lifting loads. Make sure that the outriggers (or tires if lifting on rubber) are firmly positioned on solid surfaces. Make sure that the crane is level, brakes are set, and the load is properly rigged and attached to the hook. Check the *Load Chart* against the weight of the load. Lift the load slightly off the ground and recheck the stability before proceeding with the lift. Determine the weight of the load before you attempt the lift.

Unless lifting within On Rubber capacities, outrigger beams and jack cylinders (plus center front stabilizer, if equipped) must be properly extended and set to provide precise leveling of the crane. Tires must be clear of the ground before lifting on outriggers.



KEEP THE BOOM SHORT. Swinging loads with a long line can create an unstable condition and possible structural failure of the boom.

Load Charts

Load Charts represent the absolute maximum allowable loads, which are based on either tipping or structural limitations of the crane under specific conditions. Knowing the precise load radius, boom length, and boom angle should be a part of your routine planning and operation. Actual loads, including necessary allowances, should be kept below the capacity shown on the applicable *Load Chart*.

Load Chart capacities are based on freely suspended loads.

You must use the appropriate *Load Chart* when determining the capability of the crane in the configuration required to perform the lift.

Maximum lifting capacity is available at the shortest radius, minimum boom length, and highest boom angle.

Do not remove the *Load Charts* from the crane.

Work Site

Prior to any operation, you must inspect the **entire** work site, including ground conditions, where the crane will travel and operate. Make sure that the surfaces will support a load greater than the crane's weight and maximum capacity.

Be aware of all conditions that could adversely effect the stability of the crane.

Be aware of the danger for people entering the working area. Do not allow unnecessary personnel in the vicinity of the crane while operating.

WIND FORCES

There are basic principles that must be followed while operating in windy conditions. This information has been provided to assist in determining safe operation in windy conditions.

Always use extreme caution when windy conditions exist. NEVER exceed the rated capacity shown on the *Load Chart*.

Always check the *Load Chart* to make sure that the load to be lifted is within the rated capacity of the crane.

Wind can have a significant effect on loads that may be lifted by a crane. Wind forces act differently on a crane depending upon the direction from which the wind is blowing (e.g., wind on the rear of the boom can result in decreased forward stability, wind on the underside of the boom can result in decreased backward stability, wind on the side of the boom can result in structural damages, etc.)

Wind forces can exert extreme dynamic loads. Grove recommends that a lift not be made if the wind can cause a loss of control in handling the load.

Wind forces can be determined by typical visible effects on the landscape. To assist you in determining prevailing wind conditions, refer to Table 2-1.

NOTE: The wind speed corresponding to the Beaufort scale in the table is mean wind speed at 10 m (33 ft) elevation over a period of 10 minutes.

Table 2-1 Beaufort Wind Scale

Beaufort Number	Description	Maximum Wind Speed			Visible Indicator Effects of wind as observed on land
		m/s	km/h	mph	
Zero (0)	Calm	0.3	1.1	0.7	Calm; smoke rises vertically
1	Light Air	1.5	5.4	3.4	Smoke drift indicates wind direction. Leaves and wind vanes are stationary.
2	Light Breeze	3.3	11.9	7.4	Wind felt on exposed skin. Leaves rustle. Wind vanes begin to move.
3	Gentle Breeze	5.4	19.4	12.1	Leaves and small twigs constantly moving. Light flags extended.
4	Moderate Breeze	7.9	28.4	17.7	Dust and loose paper raised. Small branches begin to move.
5	Fresh Breeze	10.7	38.5	23.9	Branches of a moderate size move. Small trees in leaf begin to sway.
6	Strong Breeze	13.8	49.7	30.9	Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult. Empty plastic bins tip over.
7	High Wind	17.1	61.6	38.3	Whole trees in motion. Effort needed to walk against the wind.
8	Gale	20.7	74.5	46.3	Some twigs broken from trees. Cars veer on road. Progress on foot is seriously impeded.
9	Strong Gale	24.4	87.8	54.6	Some branches break off trees, and some small trees blow over. Construction/temporary signs and barricades blow over.
10	Storm	28.4	102.2	63.5	Trees are broken off or uprooted, structural damage likely.

Wind Speeds

The maximum permissible wind speed referred to in the load charts is the 3-second wind gust speed measured at the boom tip height and is designated as $V(z)$. This value is either recorded at boom tip or calculated based on mean wind speed recorded at crane operation site. For lift planning purposes only, the 3-second wind gust speed, $V(z)$, may be calculated based on mean wind speed reported at <http://www.windfinder.com> "Super Forecast".

This 3-second wind gust is assumed to act on the entire crane and the load. The wind effect on the load can be conservatively estimated as:

- If $V(z)$ is ≤ 13.4 m/s (30 mph), then the **allowable** load is the published rated capacity from the Load Chart.
- If $V(z)$ is > 13.4 m/s (30 mph) and is ≤ 20.1 m/s (45 mph), the **allowable** load is the published rated

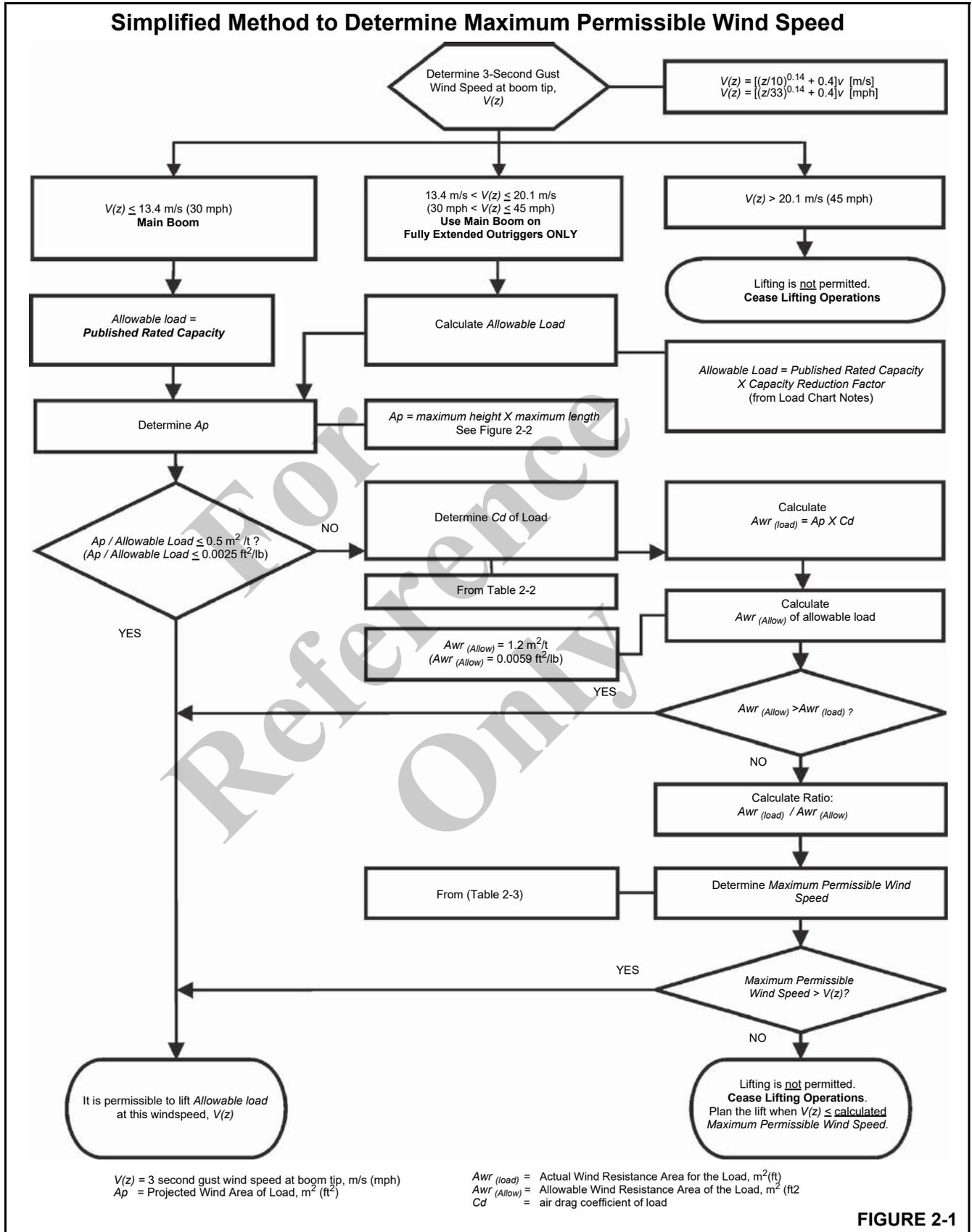
capacity multiplied by the Capacity Reduction Factor from Table 2-4 (metric) or (non-metric).

NOTE: This condition is limited to operation with the main boom on fully extended outriggers only.

- If $V(z)$ is > 20.1 m/s (45 mph), then lifting is **NOT** permitted. Cease lifting operations and lower and retract the boom.

In both cases **a)** and **b)** above, the lift may also be limited by the projected wind area of the load A_p and by the wind drag coefficient C_d : This limit can be determined by comparing the **Actual** wind resistance area with the **Allowable** wind resistance area.

Refer to Figure 2-1 for a simplified calculation method to determine permissible wind speed.



Determination of 3-second wind gust speed at boom tip height:

The following example illustrates how to calculate 3-second wind gust speed at boom tip height based on mean wind speed recorded by the device located at the crane operation site:

$V(z)$ is the 3-second wind gust speed at boom tip height Z then:

Metric, with Z [m] and V [m/s]

$$V(z) = [(Z/10)^{0.14} + 0.4] \times V \quad (2.1)$$

Non-metric, with Z [ft] and V [mph]

$$V(z) = [(Z/33)^{0.14} + 0.4] \times V \quad (2.2)$$

where:

V [m/s] [mph] - Mean wind speed at 10 m (22 ft) elevation (upper limit of Beaufort scale)

Example: Suppose you want to lift the load with the maximum boom tip height of 30 m (100 ft) and the recorded mean wind speed by the device located at the crane operation site is 5.5 m/s (13 mph). This mean wind speed of 5.5 m/s (13 mph) corresponds to Beaufort number 4 (see Table 2-1). The maximum wind velocity according to the Beaufort scale of 4 is 7.9 m/s (17.7 mph).

The mean wind speed (upper limit of Beaufort number) at 10 m (33 ft) height, to be used for calculation is:

$$V = 7.9 \text{ m/s (17.7 mph)}$$

Boom tip height for this lift is $Z = 30$ m (100 ft)

then:

Metric, with Z [m] and V [m/s]

$$V(z) = [(30/10)^{0.14} + 0.4] \times 7.9 = 12.4 \text{ m/s}$$

Non-metric, with Z [ft] and V [mph]

$$V(z) = [(100/33)^{0.14} + 0.4] \times 17.7 = 27.8 \text{ mph}$$

Since $V(z)$ is ≤ 13.4 m/s (30 mph), the allowable loads are the published rated capacities from the Load Chart and can be lifted at this condition.

Size and Shape of the load:

These rated capacities are also based on the assumption that the Wind Resistance Area of load, $Awr_{(load)}$ is not more than 0.0012 square meters per kilogram (0.0059 sq.ft per pound of load. (See below Formulas 2.4 and 2.5.)

The load capacities shall be reduced to account for the larger wind resistance area of load and 3-second wind gust speed at boom tip height. Use tag lines when the wind gust speed is above 13.4 m/s (30 mph) to help control the movement of the load. **Grove recommends that a lift not be made if the wind can cause a loss of control in handling the load.**

The lift may also be limited by the projected wind area of the load Ap and by the wind drag coefficient Cd . This limit can be determined by comparing the actual wind resistance area of the load with the allowable wind resistance area.

$$Awr_{(load)} = Ap \times Cd \quad (2.3)$$

where:

$Awr_{(load)}$ [m²] [ft²] - Wind resistant area of the load

Ap [m²] [ft²] - projected wind area,

Cd - wind drag coefficient.

Ap is determined by using the calculation of maximum height x maximum length (see Figure 2-2).

For Cd , refer to Table 2-2. If the Cd cannot be calculated or estimated, use a value of 2.4.

The allowable wind resistant area of the load $Awr_{(allow)}$ is equal to 0.0012 square meters per kilogram (0.0059 sq.ft per pound) of allowable load:

Metric, with $m_{(load)}$ [kg] - Mass of the allowable load

$$Awr_{(allow)} = 0.0012 \times m_{(load)} \quad (2.4)$$

Non-metric, with $m_{(load)}$ [lb] - Mass of the allowable load

$$Awr_{(allow)} = 0.0059 \times m_{(load)} \quad (2.5)$$

If $Awr_{(load)}$ is greater than $Awr_{(allow)}$, then lifting this load at this wind speed $V(z)$ is NOT permitted.

Calculation of Projected Wind Area (A_p):

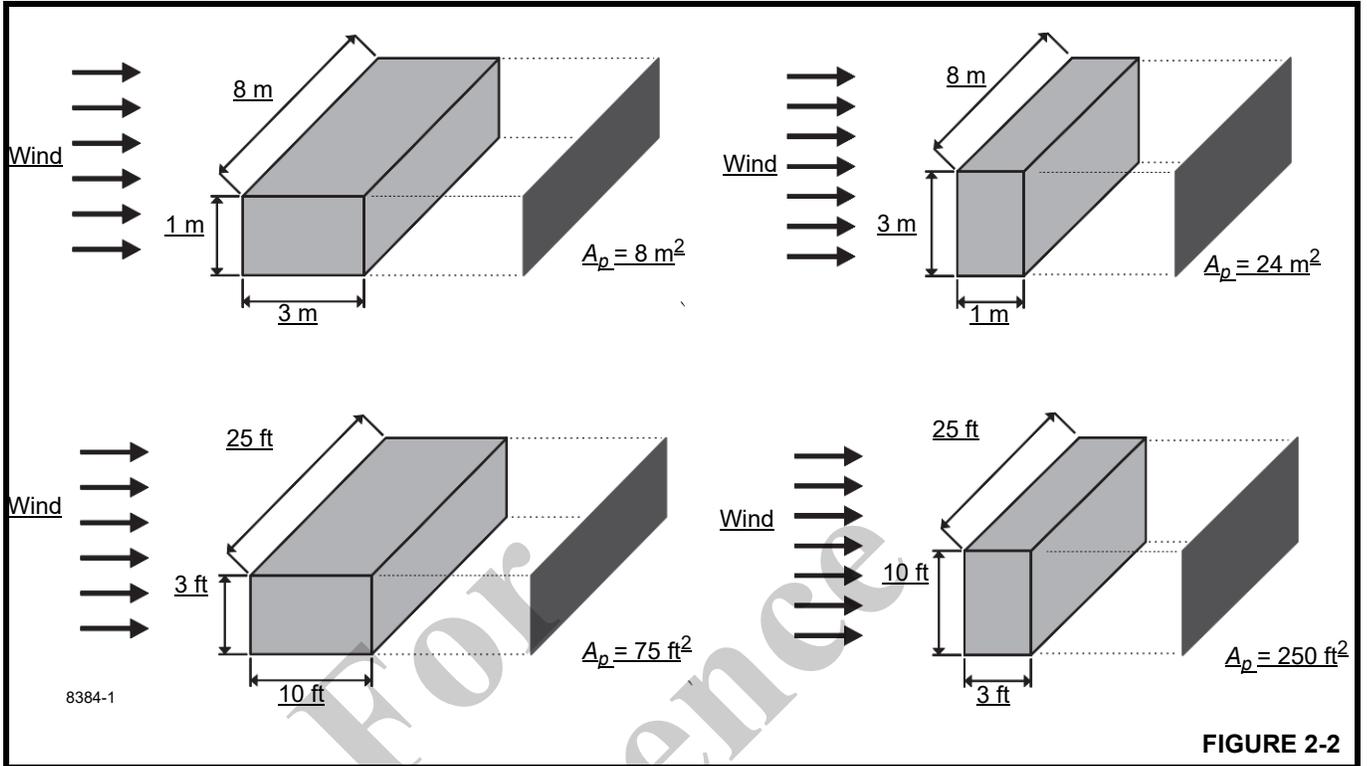


FIGURE 2-2

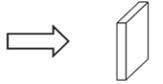
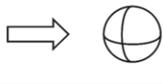
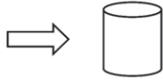
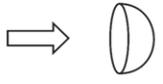
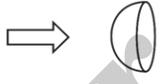
Determining Wind Drag Coefficient (C_d)

Table 2-2 shows the typical Shapes and corresponding Wind Drag Coefficient (C_d) values.

If the exact Wind Drag Coefficient of a shape is not known, use the maximum value of the shape's range (Table 2-2).

If the wind drag coefficient of the load cannot be estimated or determined, it shall be assumed that (C_d) = 2.4.

Table 2-2 Wind Drag Coefficient

Shape	C_d
	1.1 to 2.0
	0.3 to 0.4
	0.6 to 1.0
	0.8 to 1.2
	0.2 to 0.3
	0.05 to 0.1
	Approximately 1.6

Turbine Blade or Complete Rotor

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Maximum Permissible Wind Speed

If the wind resistant area of the load $A_{wr}(load)$ is greater than the allowable wind resistant area $A_{wr}(allow)$, the ratio can be used to determine a permissible wind speed $V(z)$ for the load using Table 2-3.

Table 2-3 A_{wr} Ratio and Permissible Wind Speed $V(z)$ - Imperial units

Note: Permissible and rated wind speeds in this table are the 3-second gust wind speeds at boom tip height.					
Ratio:	1.2	1.4	1.6	1.8	2
	Maximum Permissible Wind Speed (mph)				
For Rated Capacity at 30 mph	27.4	25.4	23.7	22.4	21.2
For Allowable Capacity at 45 mph	41.1	38.0	35.6	33.5	31.8

Rated Load Chart Example - Metric

RATED LIFTING CAPACITIES IN KILOGRAMS
10.9 m - 33.5 m BOOM
ON OUTRIGGERS FULLY EXTENDED - 360°

Radius in Meters	#001									
	Main Boom Length in Meters									
	10.9	12.2	15.2	**18.4	21.3	24.4	27.4	30.5	33.5	
3	+60,000 (69.5)	40,950 (72)	40,950 (76)							
3.5	53,000 (66.5)	40,950 (69.5)	40,950 (74)	28,350 (78)						
4	47,450 (63.5)	40,950 (66.5)	40,950 (72)	28,350 (75.5)	*18,225 (78)					
4.5	42,875 (60.5)	40,950 (64)	40,950 (70)	28,350 (73.5)	18,225 (76)					
5	39,050 (57.5)	39,025 (61.5)	38,300 (67.5)	28,350 (72)	18,225 (75)	*18,225 (78)				
6	32,950 (50.5)	32,925 (55.5)	32,825 (63.5)	28,350 (68.5)	18,225 (72)	18,225 (75)	*18,225 (78)			
7	28,325 (42.5)	28,300 (49)	28,225 (59)	26,250 (65)	18,225 (69)	18,225 (72)	18,225 (74.5)	*16,725 (78)	*11,400 (78)	
8	24,150 (32.5)	24,150 (42)	23,975 (54.5)	23,275 (61)	18,225 (69.5)	18,225 (72)	16,575 (74.5)	15,250 (74.5)	11,400 (76)	
9	20,600 (16.5)	20,550 (33.5)	20,375 (49.5)	20,250 (55)	18,225 (63)	16,575 (67)	15,050 (70)	13,875 (72.5)	11,400 (74.5)	
10		17,200 (20.5)	17,125 (41)	17,025 (54)	17,325 (60)	15,125 (66.5)	13,725 (67.5)	12,700 (70.5)	11,400 (72.5)	
12			14,025 (35)	12,575 (45.5)	12,575 (53.5)	12,125 (60)	11,600 (63)	10,725 (66.5)	10,050 (69)	
14				9,000 (35)	9,360 (46)	9,730 (53.5)	9,955 (58.5)	9,205 (62)	8,620 (65)	
16				6,750 (19)	7,110 (37.5)	7,470 (47)	7,920 (53)	7,980 (57.5)	7,470 (61.5)	
18					5,960 (47)	5,960 (39.5)	6,340 (47.5)	6,525 (53)	6,530 (57.5)	
20						4,755 (30.5)	5,145 (41)	5,320 (48)	5,495 (53)	
22							3,790 (16.5)	4,210 (33.5)	4,380 (42.5)	4,545 (48.5)
24								3,435 (23.5)	3,620 (36)	3,780 (43.5)
26									2,975 (28)	3,150 (37.5)
28									2,400 (16)	2,620 (31)
30										2,135 (22)
Minimum boom angle (°) for indicated length (no load)										0
Maximum boom length (m) at 0° boom angle (no load)										33.5

NOTE: () Boom angles are in degrees.
#RCL operating code. Refer to RCL manual for operating instructions.
*This capacity is based on maximum boom angle.
+ 9 parts line required to lift this capacity (using aux. boom nose) when using wire rope with a minimum breaking strength of 36,287 kg. Refer to Operator's & Safety Handbook for reeving diagram.
NOTE: For allowable capacities while operating in 3-second wind gust speeds greater than 13.4 m/s and up to 20.1 m/s, refer to Capacity Reduction Factors for wind speed (3-second gust speed) V(z) greater than 13.4m/s.

Lifting Capacities at Zero Degree Boom Angle									
Boom Angle	Main Boom Length in Meters								
	10.9	12.2	15.2	**18.4	21.3	24.4	27.4	30.5	33.5
0°	13,775 (9.2)	11,675 (10.4)	8,145 (13.5)	5,930 (16.6)	4,565 (19.6)	3,535 (22.6)	2,860 (25.7)	2,220 (28.7)	1,770 (31.8)

NOTE: () Reference radii in meters.
** Boom length is with inner-mid fully extended and outer-mid & fly fully retracted.



Table 2-4 Example-Capacity Reduction Factors for Wind Speed V(z) Greater than 13.4 m/s - Metric

(Only for lifting with main boom on fully extended outriggers, with or without stowed extension)
 For wind speed $V(z)$ (3-second gust speed at boom tip height) $V(z) > 13.4 \text{ m/s} \leq 20.1 \text{ m/s}$, the Reduced Capacity shall be calculated by multiplying the Published Rated Capacity by the following factors:

Wind Speed $V(z) > 13.4 \text{ m/s}$ $\leq 20.1 \text{ m/s}$	Main Boom Length in Meters								
	10.9	12.2	15.2	18.4	21.0	24.4	27.4	30.5	33.5
Factor	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.7	0.6

Wind resistance area of load, $Awr_{(load)}$ shall not exceed maximum allowable wind resistance area $Awr_{(allow)}$.
 Maximum allowable wind resistance area, $[m^2] Awr_{(allow)} = 0.0012 \times \text{calculated reduced capacity in kg}$.
 Wind resistance area of load, $Awr_{(load)}$ = projected wind area Ap x wind drag coefficient Cd for the load.
 For wind resistance Area of load, $Awr_{(load)} >$ maximum allowable wind resistance area, $Awr_{(allow)}$ refer to crane Operator Manual.

Table 2-5 Awr Ratio and Permissible Wind Speed V(z) - Metric

Note: Permissible and rated wind speeds in this table are the 3-second gust wind speeds at boom tip height.

Ratio:	1.2	1.4	1.6	1.8	2
	Maximum Permissible Wind Speed (m/s)				
For Rated Capacity at 13.4 m/s	12.2	11.4	10.6	10.0	9.5
For Allowable Capacity at 20.1 m/s	18.3	17.0	15.9	15.0	14.2

Example and Sample Calculations (metric)

The following example illustrates how to calculate allowable load while operating in wind speed (3-second wind gust speed) above 13.4 m/s (30 mph) and maximum permissible wind speeds with various combinations of lifted load and wind resistance area.

NOTE: Permissible and calculated wind speeds in this example are the **3-second wind gust speeds at boom tip height V(z)**.

Example 1: Crane Configuration:

- boom length = 27.4 m,
- load radius = 9 m,
- wind speed is measured at $V(z) \leq 20.1 \text{ m/s}$.

From the **Rated Load Chart Example - Metric** (Figure 2-3), at maximum permissible wind speed, $V(z) = 13.4 \text{ m/s}$, the rated lifting capacity $m_{(allow)}$ for this configuration is 15,050 kg.

The maximum allowable wind resistance area of load is:

$$Awr_{(allow)} = 0.0012 \times m_{(load)} \tag{2.4}$$

$$Awr_{(allow)} = 0.0012 \times 15,050 = 18.06 \text{ m}^2$$

Lifting Limits at wind speed $V(z) \leq 13.4 \text{ m/s}$ at this configuration:

- Maximum load 15,050 kg
- Maximum wind resistance area of load 18.06 m²

For the allowable wind speed $> 13.4 \text{ m/s}$ and $\leq 20.1 \text{ m/s}$, reduce the allowable load. Per Table 2-4, the Factor for main boom length of 27.4 m is 0.8, the allowable load is:

$$m_{(allow)} = 0.8 \times 15,050 = 12,040 \text{ kg}$$

This reduced capacity load has an allowable wind resistance area of:

$$Awr_{(allow)} = 0.0012 \times 12,040 = 14.45 \text{ m}^2$$

Lifting Limits at wind speed $V(z) > 13.4 \text{ m/s}$ and $\leq 20.1 \text{ m/s}$, at this configuration:

- Maximum load 12,040 kg
- Maximum wind resistance area of load 14.45 m²

At wind speeds greater than 13.4 m/s, it is not permissible to lift a load greater than 12,040 kg, even if the wind resistance area of the load is less than 14.45 m².

Refer to the information from the above crane configuration, examine several load conditions.

Load example 1.1:

With known Wind Drag Coefficient of the load **Cd**, and

- load to be lifted of 11,200 kg,
- Projected Wind Area **Ap** = 9.20 m²,
- Wind Drag Coefficient **Cd** = 1.5

wind resistance area of load can be estimated as

$$Awr_{(load)} = Ap \times Cd = 9.2 \times 1.5 = 13.8 \text{ m}^2$$

Refer to the above **Lifting Limits at wind speed V(z) > 13.4 m/s and ≤ to 20.1 m/s**. Comparing the load and wind resistant area to the allowable:

- Is the load to be lifted less than allowable load?
11,200 kg ≤ 12,040 kg YES
- Is **Awr_(load)** less than **Awr_(allow)** ?
13.8 m² ≤ 14.45 m² YES

Conclusion: This load is permissible to lift in wind speed up to 20.1 m/s.

Load example 1.2:

With unknown Wind Drag Coefficient of the load **Cd**,

- Load to be lifted of 10,000 kg,
- Projected Wind Area **Ap** = 5.45 m²,
- Wind Drag Coefficient **Cd** = unknown

NOTE: If exact Wind Drag Coefficient is not known, it shall be assumed as 2.4.

- the wind resistance area of load can be estimated as

$$Awr_{(load)} = Ap \times Cd = 5.45 \times 2.4 = 13.08 \text{ m}^2$$

Refer to the above **Lifting Limits at V(z) > 13.4 m/s and ≤ 20.1 m/s**. Comparing the load and wind resistant area to the allowable:

- Is the load to be lifted less than allowable load?
10,000 kg ≤ 12,040 kg YES
- Is **Awr_(load)** less than **Awr_(allow)** ?
13.08 m² ≤ 14.45 m² YES

Conclusion: This load is permissible to lift in wind speed up to 20.1 m/s.

Load example 1.3a:

With large wind resistance area of the load **Awr_(load)**,

- Load to be lifted of 14,000 kg,
- Projected Wind Area **Ap** = 21.85 m²,
- Wind Drag Coefficient **Cd** = 1.2

the wind resistance area of load can be estimated as:

$$Awr_{(load)} = Ap \times Cd = 21.85 \times 1.2 = 26.22 \text{ m}^2$$

Refer to the above **Lifting Limits at wind speed V(z) > 13.4 m/s and ≤ 20.1 m/s**. Comparing the load to the allowable:

- Is the load to be lifted less than allowable load?
14,000 kg ≤ 12,040 kg NO

Conclusion: This load is NOT permissible to lift in wind speed up to 20.1 m/s.

Refer to the above **Lifting Limits at wind speed V(z) < 13.4 m/s**. Comparing the load to the allowable:

- Is the load to be lifted less than allowable load?
14,000 kg ≤ 15,050 kg YES

The maximum permissible wind speed for this load is 13.4 m/s, depending on the wind resistance area of the load.

- Is **Awr_(load)** less than **Awr_(allow)** ?
26.22 m² ≤ 18.06 m² NO

Conclusion: This load is NOT permissible to lift in wind speed at 13.4 m/s, but is permitted to lift at a reduced wind speed calculated as follows:

$$\text{Ratio} = \frac{Awr_{(load)}}{Awr_{(allow)}} = \frac{26.22}{18.06} = 1.45$$

From Table 2-5, the maximum permissible wind speed at ratio of 1.45 (rounded to next higher table value of 1.6) is 10.6 m/s.

Conclusion: This load is permissible to lift in wind speed up to 10.6 m/s only.

Load example 1.3b:

With large wind resistance area of the load **Awr_(load)**,

- Load to be lifted of 8,000 kg,
- Projected Wind Area **Ap** = 15.25 m²,
- Wind Drag Coefficient **Cd** = 1.3

the wind resistance area of load can be estimated as

$$Awr_{(load)} = Ap \times Cd = 15.25 \times 1.3 = 19.83 \text{ m}^2$$



Refer to the above **Lifting Limits at wind speed $V(z)$ > 13.4 m/s and ≤ 20.1 m/s**. Comparing the load and wind resistant area to the allowable:

- Is the load to be lifted less than allowable load?
8,000 kg \leq 12,040 kg YES
- Is $Awr_{(load)}$ less than $Awr_{(allow)}$?
19.83 m² \leq 14.45 m² NO

Conclusion: This load is NOT permissible to lift in wind speed up to 20.1 m/s, but permitted to lift at a reduced wind speed calculated as follows:

$$\text{Ratio} = \frac{Awr_{(load)} = 19.83}{Awr_{(allow)} = 14.45} = 1.37$$

From Table 2-5, the maximum permissible wind speed at ratio of 1.37 (rounded to next higher table value of 1.4) is 17.0 m/s.

Conclusion: This load is permissible to lift in wind speed up to 17.0 m/s only.

For
Reference
Only

Rated Load Chart Example - Non-metric

RATED LIFTING CAPACITIES IN POUNDS
36 FT. - 110 FT. BOOM
ON OUTRIGGERS FULLY EXTENDED - 360°

Radius in Feet	#0001								
	Main Boom Length in Feet								
	36	40	50	**60	70	80	90	100	110
10	130,000 (69.5)	90,300 (71.5)	90,300 (75.5)	*62,500 (78)					
12	112,500 (65.5)	90,300 (68.5)	90,300 (73)	62,500 (76.5)	*40,200 (78)				
15	93,250 (60)	90,300 (63.5)	90,250 (69.5)	62,500 (73.5)	40,200 (76)	*40,200 (78)			
20	71,550 (49.5)	71,500 (55)	71,300 (63)	62,500 (68)	40,200 (71.5)	40,200 (74.5)	40,200 (78)	*36,900 (78)	
25	56,650 (38.5)	56,600 (45)	56,350 (56)	53,650 (83)	40,200 (67)	40,200 (70.5)	37,950 (73)	34,900 (75)	*25,150 (78)
30	43,500 (11.5)	44,300 (32)	43,950 (48.5)	43,650 (57.5)	40,200 (62.5)	37,050 (66)	32,750 (69.5)	30,200 (72)	25,150 (74)
35			33,550 (40)	33,700 (51.5)	34,700 (58)	33,550 (62)	28,550 (66)	26,400 (69)	24,700 (71.5)
40			25,800 (28)	26,150 (44.5)	26,300 (52.5)	27,300 (58.5)	25,200 (62.5)	23,300 (66)	21,800 (68.5)
45				20,300 (36.5)	21,450 (47)	22,300 (54)	22,400 (59)	20,700 (62.5)	19,400 (65.5)
50				15,500 (25)	17,400 (41)	18,200 (49)	19,100 (55)	18,550 (59.5)	17,350 (62.5)
55					14,300 (33.5)	15,300 (44)	16,000 (51)	16,400 (56)	15,800 (60)
60					11,000 (23.5)	12,700 (38)	13,550 (46.5)	13,950 (52.5)	14,100 (56.5)
65					9,000 (31.5)	10,000 (41.5)	11,550 (48.5)	11,950 (53.5)	12,300 (58.5)
70						9,010 (22.5)	9,920 (36)	10,250 (44)	10,650 (50)
75							8,510 (29.5)	8,890 (39.5)	9,250 (46)
80							7,260 (21)	7,690 (34.5)	8,050 (42.5)
85								6,620 (28.5)	7,010 (38)
90								5,630 (20)	6,100 (33)
95									5,240 (27)
100									4,480 (19.5)
Minimum boom angle (°) for indicated length (no load)									0
Maximum boom length (ft.) at 0° boom angle (no load)									110

NOTE: () Boom angles are in degrees.
#RCL operating code. Refer to RCL manual for operating instructions.
*This capacity is based on maximum boom angle.
NOTE: For allowable capacities while operating in 3-second wind gust speeds greater than 30 mph and up to 45 mph, refer to Capacity Reduction Factors for wind speed (3-second gust speed) V(z) greater than 30 mph.

Lifting Capacities at Zero Degree Boom Angle									
Boom Angle	Main Boom Length in Feet								
	36	40	50	**60	70	80	90	100	110
0°	30,350 (30.1)	25,700 (34.2)	17,950 (44.2)	13,050 (54.6)	10,050 (64.2)	7,790 (74.2)	6,300 (84.2)	4,900 (94.2)	3,900 (104.2)

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NOTE: () Reference radii in feet.
** Boom length is with inner-mid fully extended and outer-mid & fly fully retracted.

FIGURE 2-4



Table 2-6 Example-Capacity Reduction Factors for Wind Speed V(z) Greater than 30 mph - Non-metric

(Only for lifting with main boom on fully extended outriggers, with or without stowed extension)

For wind speed **Vz** (3-second gust speed at boom tip height) is greater > 30 mph and ≤ 45 mph, the Reduced Capacity shall be calculated by multiplying the Published Rated Capacity by the following factors:

	Main Boom Length in Feet								
Wind Speed Vz > 30 mph ≤ 45 mph	36	40	50	60	70	80	90	100	110
Factor	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.7	0.5

Wind resistance area of load, **Awr_(load)**, shall not exceed maximum allowable wind resistance area **Awr_(allow)**.

Maximum allowable wind resistance area of load, **Awr_(allow)** = 0.0059 x calculated reduced capacity in lb.

Wind resistance area of load, **Awr_(load)** = projected wind area **Ap** x wind drag coefficient **Cd** for the load.

For wind resistance area of load, **Awr_(load)** > maximum allowable wind resistance, **Awr_(allow)**, refer to crane Operator Manual.

Table 2-7 Awr Ratio and Permissible Wind Speed V(z) - Non-Metric

Note: Permissible and rated wind speeds in this table are the 3-second gust wind speeds at boom tip height.

Ratio:	1.2	1.4	1.6	1.8	2
	Maximum Permissible Wind Speed (mph)				
For Rated Capacity@ 30 mph	27.4	25.4	23.7	22.4	21.2
For Allowable Capacity@ 45 mph	41.1	38.0	35.6	33.5	31.8

Example and Sample Calculations (Non-metric)

The following example illustrates how to calculate allowable load while operating in wind speed (3-second wind gust speed) above 13.4 m/s (30 mph) and maximum permissible wind speeds with various combinations of lifted load and wind resistance area.

NOTE: Permissible and calculated wind speeds in this example are the **3-second wind gust speeds at boom tip height V(z)**.

Example 2:

A crane is configured with:

- boom length = 90 ft,
- load radius = 40 ft, and
- wind speed is measured at **V(z)** ≤ 45 mph.

The **Rated Load Chart Example - Non-metric** (Figure 2-4), at maximum permissible wind speed, **V(z)** = 30 mph, the rated lifting capacity **m_(allow)** for this configuration is 25,200 lb.

The maximum allowable wind resistance area of load is:

$$Awr_{(allow)} = 0.0059 \times m_{(load)} \tag{2.5}$$

$$Awr_{(allow)} = 0.0059 \times 25,200 = 149 \text{ ft}^2$$

Lifting Limits at wind speed V(z) < 30 mph at this configuration:

- Maximum load 25,200 lb
- Maximum wind resistance area of load 149 ft²

For the allowable wind speed > 30 mph and ≤ 45 mph, reduce the allowable load. , the Factor for a main boom length of 90 ft is 0.8, thus the allowable load is:

$$m_{(allow)} = 0.8 \times 25,200 = 20,160 \text{ lb}$$

This reduced capacity load has an allowable wind resistance area of:

$$Awr_{(allow)} = 0.0059 \times 20,160 = 119 \text{ ft}^2$$

Lifting Limits at wind speed V(z) > 30 mph and ≤ 45 mph at this configuration:

- Maximum load 20,160 lb
- Maximum wind resistance area of load 119 ft²

Example, wind speeds greater than 13.4 m/s is **NOT** permissible to lift a load greater than 20,160 lb, even if the wind resistance area of the load is less than 119 ft².

Refer to the above crane configuration for the following load conditions:

Load example 2.1:

With known Wind Drag Coefficient of the load **Cd**,

- load to be lifted of 19,500 lb,
- Projected Wind Area **Ap** = 70 ft²,
- Wind Drag Coefficient **Cd** = 1.5

then the wind resistance area of load can be estimated as

$$Awr_{(load)} = Ap \times Cd = 70 \times 1.5 = 105 \text{ ft}^2$$

Refer to the above **Lifting Limits at wind speed V(z) > 30 mph and ≤ 45 mph**. Comparing the load and wind resistant area to the allowable:

- Is the load to be lifted less than allowable load?
19,500 lb ≤ 20,160 lb YES
- Is **Awr_(load)** less than **Awr_(allow)**?
105 ft² ≤ 119 ft² YES

Conclusion: This load is permissible to lift in wind speed up to 45 mph.

Load example 2.2:

With unknown Wind Drag Coefficient of the load **Cd**,

- Load to be lifted of 18,000 lb,
- Projected Wind Area **Ap** = 45 ft²,
- Wind Drag Coefficient **Cd** = unknown

NOTE: If exact Wind Drag Coefficient is not known, it shall be assumed as 2.4.

the wind resistance area of load can be estimated as

$$Awr_{(load)} = Ap \times Cd = 45 \times 2.4 = 108 \text{ ft}^2$$

Refer to the above **Lifting Limits at wind speed V(z) > 30 mph and ≤ 45 mph**. Comparing the load and wind resistant area to the allowable:

- Is the load to be lifted less than allowable load?
18,000 lb ≤ 20,160 lb YES
- Is **Awr_(load)** less than **Awr_(allow)**?
108 ft² ≤ 119 ft² YES

Conclusion: This load is permissible to lift in wind speed up to 45 mph.

Load example 2.3a:

With large wind resistance area of the load **Awr_(load)**,

- Load to be lifted of 22,000 lb,
- Projected Wind Area **Ap** = 180 ft²,
- Wind Drag Coefficient **Cd** = 1.2

the wind resistance area of load can be estimated as:

$$Awr_{(load)} = Ap \times Cd = 180 \times 1.2 = 216 \text{ ft}^2$$

Refer to the above **Lifting Limits at wind speed V(z) > 30 mph and ≤ 45 mph**. Comparing the load to the allowable:

- Is the load to be lifted less than allowable load?
22,000 lb ≤ 20,160 lb NO

Conclusion: This load is **NOT** permissible to lift in wind speed up to 45 mph.

Refer to the above **Lifting Limits at wind speed V(z) up to 30 mph**. Comparing the load to the allowable:

- Is the load to be lifted less than allowable load?
22,000 lb ≤ 25,200 lb YES

The permissible wind speed for this load is 30 mph, depending on the wind resistance area of the load.

- Is **Awr_(load)** less than **Awr_(allow)**?
216 ft² ≤ 149 ft² NO

Conclusion: This load is **NOT** permissible to lift in wind speed at 30 mph, but permitted to lift at a reduced wind speed calculated as follows:

$$\text{Ratio } \frac{Awr_{(load)}}{Awr_{(allow)}} = \frac{216}{149} = 1.45$$

From Table 2-7, the maximum permissible wind speed at ratio of 1.45 (rounded to next higher table value of 1.6) is 23.7 mph.

Conclusion: This load is permissible to lift in wind speed up to 23.7 mph only.

Load example 2.3b:

With large wind resistance area of the load **Awr_(load)**,

- Load to be lifted of 12,000 lb,
- Projected Wind Area **Ap** = 125 ft²,
- Wind Drag Coefficient **Cd** = 1.3

the wind resistance area of load can be estimated as:

$$Awr_{(load)} = Ap \times Cd = 125 \times 1.3 = 162 \text{ ft}^2$$

Refer to the above **Lifting Limits at wind speed $V(z) > 30$ mph and ≤ 45 mph**. Comparing the load and wind resistant area to the allowable:

- Is the load to be lifted less than allowable load?
12,000 lb \leq 20,160 lb YES
- Is $Awr_{(load)}$ less than $Awr_{(allow)}$?
162 ft² \leq 119 ft² NO

Conclusion: This load is NOT permissible to lift in wind speed up to 45 mph, but permitted to lift at a reduced wind speed calculated as follows:

$$\text{Ratio} = \frac{Awr_{(load)}}{Awr_{(allow)}} = \frac{162}{119} = 1.37$$

From Table 2-7, the maximum permissible wind speed at ratio of 1.37 (rounded to next higher table value of 1.4) is 38.0 mph.

Conclusion: This load is permissible to lift in wind speed up to 38.0 mph only.

Lifting Operations

Before lifting, position the crane on a firm surface, properly extend and set the outriggers, and level the crane. Depending on the nature of the supporting surface, adequate cribbing may be required to obtain a larger bearing surface.

The crane is equipped with a bubble level that should be used to determine whether the crane is level. The load line can also be used to estimate the levelness of the crane by checking to make sure that it is in-line with the center of the boom at all points on the swing circle.

If the boom extension, or auxiliary boom nose is to be used, make sure that the electrical cable and the weight for the Anti-Two-Block Switch are properly installed and the Rated Capacity Limiter (RCL) is programmed for the crane configuration. Refer to the RCL operator manual supplied with the crane.

Verify the crane's capacity by checking the *Load Chart* against the weight of the load. Then, lift the load slightly at first to ensure stability before proceeding with the lift.

Make sure that the load is properly rigged and attached. Always determine the weight of the load before you attempt to lift it and remember that all rigging (slings, etc.) and lifting devices (hook block, boom extension, etc.) must be considered part of the load.

Measure the load radius before making a lift and stay within approved lifting areas based on the range diagrams and working area diagrams on the crane's *Load Chart*.

Always keep the load as near to the crane and as close to the ground as possible.

Do not overload the crane by exceeding the capacities shown on the appropriate *Load Chart*. Death or serious injury could result from the crane tipping over or failing structurally from overload.

The crane can tip over or fail structurally if:

- The load and crane's configuration is not within the capacity as shown on the applicable *Load Chart* and notes.
- The ground is soft and/or the surface conditions are poor.
- Outriggers are not properly extended and set. On models equipped with outriggers that can be pinned at the mid-extend position, the outriggers must also be pinned when operating from the mid-extend position.
- Cribbing under the outrigger pads is inadequate.
- The crane is improperly operated.

Do not rely on the crane's tipping to determine your lifting capacity.

Make sure that the hoist line is vertical before lifting. Do not subject the crane to side loading. A side load can tip the crane or cause it to fail structurally.

Load Chart capacities are based on freely suspended loads. Do not pull posts, pilings, or submerged articles. Make sure that the load is not frozen or otherwise attached to the ground before lifting.

If you should encounter a tipping condition, immediately lower the load with the hoist line and retract or elevate the boom to decrease the load radius. Never lower or extend the boom; this will aggravate the condition.

Use tag lines whenever possible to help control the movement of the load.

When lifting loads, the crane will lean toward the boom and the load will swing out, increasing the load radius. Make sure that the crane's capacity is not exceeded when this occurs.

Do not strike any obstruction with the boom. If the boom should accidentally contact an object, stop immediately. Inspect the boom. Remove the crane from service if the boom is damaged.

Never push or pull with the crane boom.

Avoid sudden starts and stops when moving the load. The inertia and an increased load radius could tip the crane over or cause it to fail structurally.

Using only one hoist at a time when lifting loads is recommended. See "Tilt-Up Panel Lifting" on page 2-21 for additional lifting instructions.

Always use enough parts-of-line to accommodate the load to be lifted. Lifting with too few parts-of-line can result in failure of the hoist rope.

Multiple Crane Lifts

Multiple crane lifts are not recommended.

Any lift that requires more than one crane must be precisely planned and coordinated by a qualified person. If it is necessary to perform a multi-crane lift, the operator shall be responsible for assuring that the following minimum safety precautions are taken:

- Secure the services of a qualified person to direct the operation.
- Make sure that all signals are coordinated through the lift director or person in charge of the lift.
- Coordinate lifting plans with the operators, designated person, and signal person prior to beginning the lift.
- Maintain communication between all parties throughout the entire operation. If possible, provide approved radio equipment for voice communication between all parties engaged in the lift.
- Use outriggers on cranes so equipped.
- Calculate the amount of weight to be lifted by each crane and attach slings at the correct points for proper weight distribution.
- Make sure that the load lines are directly over the attach points to avoid side loading and transfer of loading from one crane to the other.
- Do not travel. Lift only from a stationary position.

Lifting Multiple Loads

Grove recommends lifting only one load at a time.

Lifting two or more separately rigged loads at one time is only permitted during steel erection in accordance with 29CFR1926.753 when the following criteria are met:

1926.753(e)(1) A multiple lift shall only be performed if the following criteria are met:

- 1926.753(e)(1)(i) A multiple lift rigging assembly is used;
- 1926.753(e)(1)(ii) A maximum of five members are hoisted per lift;
- 1926.753(e)(1)(iii) Only beams and similar structural members are lifted; and
- 1926.753(e)(1)(iv) All employees engaged in the multiple lift have been trained in these procedures in accordance with § 1926.761(c)(1).
- 1926.753(e)(1)(v) No crane is permitted to be used for a multiple lift where such use is contrary to the manufacturer's specifications and limitations.

1926.753(e)(2) Components of the multiple lift rigging assembly shall be specifically designed and assembled with a maximum capacity for total assembly and for each individual attachment point. This capacity, certified by the manufacturer or a qualified rigger, shall be based on the manufacturer's specifications with a 5 to 1 safety factor for all components.

1926.753(e)(3) The total load shall not exceed:

- 1926.753(e)(3)(i) The rated capacity of the hoisting equipment specified in the hoisting equipment load charts;
- 1926.753(e)(3)(ii) The rigging capacity specified in the rigging rating chart.

1926.753(e)(4) The multiple lift rigging assembly shall be rigged with members:

- 1926.753(e)(4)(i) Attached at their center of gravity and maintained reasonably level;
- 1926.753(e)(4)(ii) Rigged from top down; and
- 1926.753(e)(4)(iii) Rigged at least 7 feet (2.1 m) apart.

1926.753(e)(5) The members on the multiple lift rigging assembly shall be set from the bottom up.

1926.753(e)(6) Controlled load lowering shall be used whenever the load is over the connectors.

Tilt-Up Panel Lifting

Requirements and recommendations regarding operation and use of Grove cranes are stated on decals and in the Operator Manual provided with each specific model machine. Using the subject crane to perform tilt-up panel lifting with two hoist lines poses new and different hazards than does normal lifting use.

Therefore, the following additional precautions must be taken if it is necessary for the crane to be used to perform tilt-up panel lifting using a crane equipped with two hoists:

- The crane must be set up and operated in accordance with Grove's instructions in the Operator Manual, Load Capacity Chart, and decals affixed to the crane.
- The hoist rope from the main hoist shall be reeved over the main boom nose reeved for two parts of line.
- The hoist rope from the auxiliary hoist shall be reeved over the auxiliary boom nose reeved for one part of line or up to two parts of line depending on the applicable load chart ratings.
- The load shall be connected with the main hoist line connected to the end closest to crane and the auxiliary hoist line connected to the end farthest from the crane.

- The anti-two-block system shall be installed and inspected to confirm that it is active to monitor both hoist lines.
- The RCL hoist selection shall be set to main hoist and two parts of line.
- The wire rope and sheaves shall be inspected prior to and following the lifting operations for chaffing or scrubbing.
- The total gross load shall not exceed 80% of the standard load chart. The operator shall be responsible to control this as the RCL does not have a feature to set reduced lifting limits.
- The auxiliary hoist line shall be considered part of the deducts to determine net allowable load.
- The panel shall be lifted so that the hoist lines are in line with the crane.
- The load shall be controlled to prevent rotation of the load and to make sure that the load stays in line with the boom.
- The load must be balanced with the auxiliary: load line not taking more than half the load at any time during the lift. The RCL will not be providing coverage for the line pull of the auxiliary hoist line.
- The effect of wind loads on the crane and panel shall be taken into consideration. Operations shall be halted if the wind can cause a loss of control in handling the load.
- The main hoist line shall be used to raise the panel into the vertical position.

Make sure that all personnel working on and around the crane are properly trained and thoroughly familiar with operational functions of the crane and safe operating and work practices. Personnel should be thoroughly familiar with regulations and standards governing cranes and their operation. Work practices may vary slightly between government regulations, industry standards, local and job-site rules and employer policies so a thorough knowledge of and compliance with all relevant work rules is necessary.

Counterweight

On cranes equipped with removable counterweights, make sure that the appropriate counterweight sections are properly installed for the lift being considered.

Do not add material to the counterweight to increase capacity. United States Federal law prohibits modification or additions which affect the capacity or safe operation of the equipment without the manufacturer's written approval. [29CFR 1926.1434]

Outrigger Lift Off

Regarding "lifting" of an outrigger pad during craning activities, be advised that the rated loads for these cranes, as indicated on the crane's *Load Chart*, do not exceed 85% of the tipping load on outriggers as determined by SAE J765 "Cranes Stability Test Code." An outrigger pad may lift off the ground during operation of the crane within the capacity limits of the *Load Chart*, yet the crane will not have reached instability. The "balance point" for stability testing according to SAE and Grove criteria is a condition of loading wherein the load moment acting to overturn the crane is equal to the maximum moment of the crane available to resist overturning. This balance point or point of instability for a crane does not depend on "lifting" of an outrigger but rather on comparison of the "opposing" load moments.

The occurrence of an outrigger lifting from the ground is often attributed to the natural flex in the crane's frame. This may happen when lifting a load in certain configurations within the capacity limits of the *Load Chart* and is not necessarily an indication of an unstable condition.

Provided the crane is properly set up, the crane is in good working condition, that all operator's aids are properly programmed, that the qualified crane operator adheres to the instructions found in the applicable *Load Chart*, *Operator Manual* and decals on the crane, the crane should not be unstable.

PILE DRIVING AND EXTRACTING

Pile driving and extracting are applications approved by Grove, provided all equipment is operated within factory guidelines. The following operating requirements must be used during pile driving and extracting with a Grove mobile hydraulic crane:

Pile driving and pile extraction using a mobile crane introduces many variable and unknown factors that must be considered when using a crane for this application. Because of these factors, discretion must be exercised when pile driving or pile extraction is being considered.

It is not the intention of Grove to recommend specific types or makes of pile driving and pile extraction equipment, but rather to advise of the operational requirements to help avoid the detrimental effects that pile driving and pile extraction can have on the crane.

In addition to the operating requirements that are detailed in the operating manuals and on the load capacity chart, pile driving and extracting operations are approved by Grove, provided all guidelines outlined below are followed:

- All pile driving and extracting operations shall be restricted to fully extended outriggers with all tires clear of the ground.

- The combined weight of the driver or extractor, piling, leads, attachments, etc., shall not exceed 80% of the published load chart values for on-outriggers operation.
- The pile driver or pile extractor and attachments shall be kept clear of the boom nose at all times.
- The pile driver and piling shall be suspended from a hoist cable with sufficient line speed to meet or exceed the rate of descent of the driver and piling to preclude impact loading or vibration from being induced into the boom and crane structure.
- Pile driving or extracting shall be restricted to over the main boom only and shall not be permitted over a boom extension.
- Pile extraction using only the crane's hoist line is unsafe and not permitted since load values cannot be accurately determined. Only pile extraction devices that do not transmit vibration or shock loading into the crane are permitted. All possible precautionary measures shall be taken to prevent shock loads or vibration from being imposed on crane components, either directly through the hoist cable or indirectly from ground borne vibration.
- The load lines shall be kept vertical at all times during pile driving and pile extraction operations.
- The operator and other personnel associated with the pile driving and pile extraction operation shall have read and understood all safety standards applicable to crane operations as well as being thoroughly trained in the safe operation of pile driving and extracting equipment.

Crane Equipment

- Hoists shall be equipped with a cable follower to aid in proper spooling of cable.
- All cable retainer pins and cable guides/retainers shall be in place.
- All boom extensions must be removed from the machine before pile driving or extraction begins.
- All hoist hooks shall be equipped with a positive locking latch.

Crane Inspection

- In addition to the crane's frequent and periodic inspections, dated daily records shall be maintained

showing inspections were performed on the crane during the time it was used for pile driving or extraction.

- All anti-two-block warning devices and RCL systems shall be inspected daily and verified to be functional.
- All areas of the crane subject to fatigue shall be inspected monthly, and before the crane is to return to lifting service.
- The boom shall be inspected daily to make sure that all wear pads remain in place. Cranes which utilize pinned boom sections shall be inspected daily to make sure that the pinning mechanism operates properly and to check for undue wear at the pins and pinning plates.
- The hoist cable shall be inspected daily to make sure that no chafing or wear is occurring.

ELECTROCUTION HAZARD

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

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

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



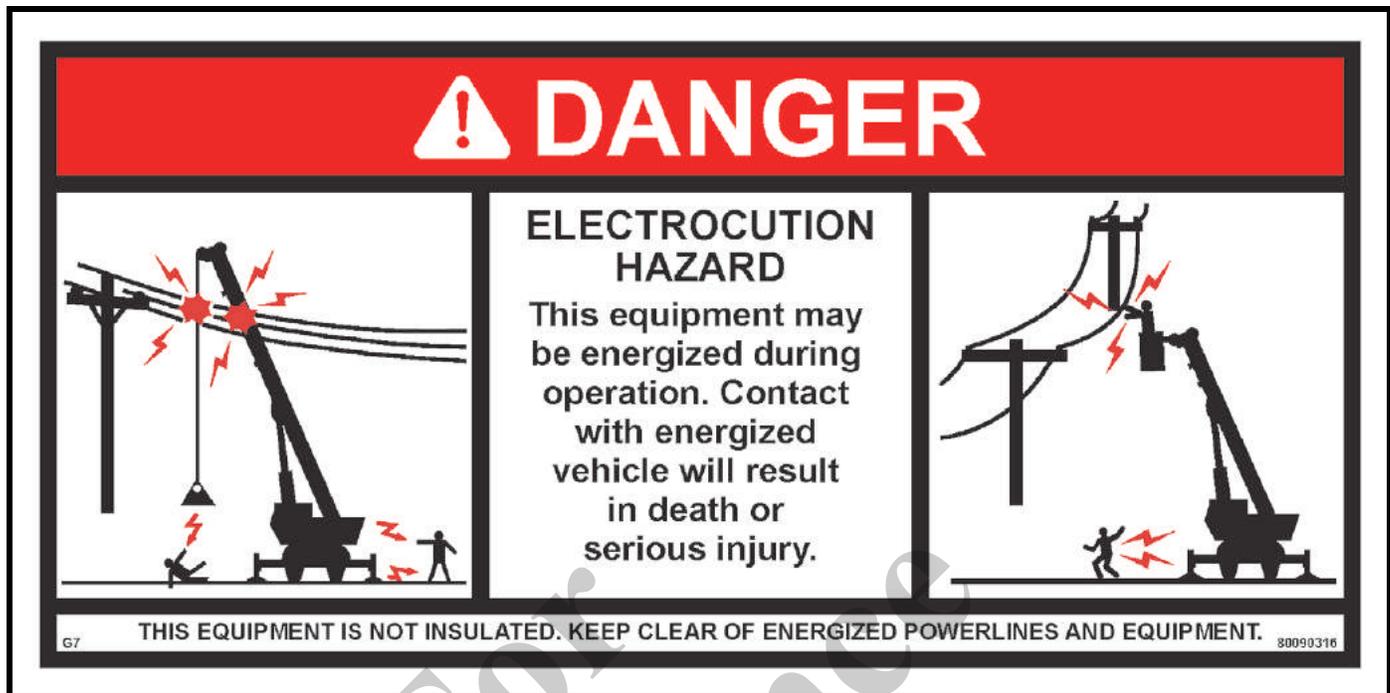
DANGER

Electrocution Hazard!

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

If operation within 3 m (10 ft) of any power lines cannot be avoided, the power utility **must** be notified and the power lines **must** be de-energized and grounded **before** performing any work.

Electrocution **can occur** even without direct contact with the crane.



Crane operation is dangerous when close to an energized electrical power source. Exercise extreme caution and prudent judgement. Operate slowly and cautiously when in the vicinity of power lines.

Before operating this 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.

This crane is **not insulated**. Always consider all parts of the load and the crane, including the hoist rope, wire rope, pendant cables, and tag lines, as conductors. You, the operator, are responsible for alerting all personnel of dangers associated with electrical power lines and equipment. 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, tag lines, or rigging gear.

If the load, hoist 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.

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 *Operator Manual* must be followed at all times, even if the electrical power lines or equipment have been de-energized.

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

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

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

Set up the crane in a position such that the load, boom, or any part of the crane and its attachments cannot be moved to within 6 m (20 ft) of electrical power lines or equipment. This includes the crane boom (fully extended to maximum height, radius, and length) and all attachments (boom extensions, rigging, loads, etc.). Overhead lines tend to blow in the wind so allow for lines' movement when determining safe operating distance.

A suitable barricade should be erected to physically restrain the crane and all attachments (including the load) from entering into an unsafe distance from electrical power lines or equipment.

Plan ahead and always plan a safe route before traveling under power lines. Rider poles should be erected on each side of a crossing to assure sufficient clearance is maintained.

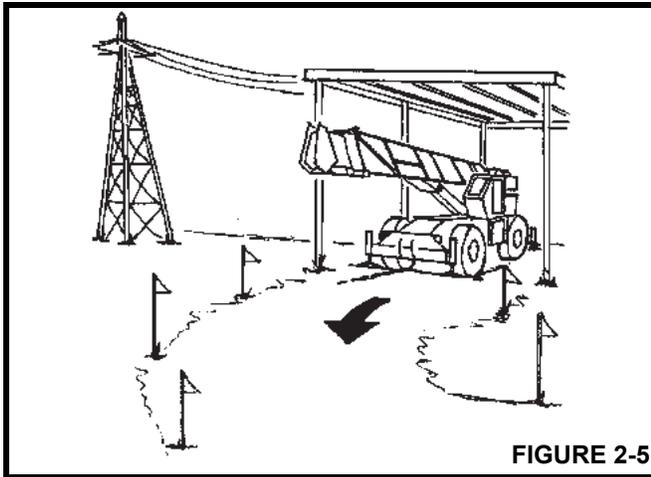


FIGURE 2-5

United States OSHA regulations require a flagman when operating in close proximity to energized power lines.

Appoint a reliable and qualified signal person, equipped with a loud signal whistle or horn and voice communication equipment, to warn the operator when any part of the crane or load moves near a power source. This person shall have no other duties while the crane is working.

Tag lines should always be made of non-conductive materials. Any tag line that is wet or dirty can conduct electricity.

Do not store materials under power lines or close to electrical power sources.

Electrocution Hazard Devices

The use of insulated links, insulated boom cages/guards, or proximity warning devices does not assure that electrical contact will not occur. Even if codes or regulations require the use of such devices, failure to follow the rules listed here may result in serious injury or death. You should be aware that such devices have limitations and you should follow the rules and precautions outlined in this manual at all times even if the crane is equipped with these devices.

Insulating links installed into the load line afford limited protection from electrocution hazards. Links are limited in their lifting abilities, insulating properties, and other properties that affect their performance. Moisture, dust, dirt, oils, and other contaminants can cause a link to conduct electricity. Due to their capacity ratings, some links are not effective for large cranes and/or high voltages/currents.

The only protection that may be afforded by an insulated link is below the link (electrically downstream), provided the link has been kept clean, free of contamination, has not been scratched or damaged, and is periodically tested (just before use) for its dielectric integrity.

Boom cages and boom guards afford limited protection from electrocution hazards. They are designed to cover only the

boom nose and a small portion of the boom. Performance of boom cages and boom guards is limited by their physical size, insulating characteristics, and operating environment (e.g. dust, dirt, moisture, etc.). The insulating characteristics of these devices can be compromised if not kept clean, free of contamination, and undamaged.

Proximity sensing and warning devices are available in different types. Some use boom nose (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. Much reliance is placed upon you, the operator, in selecting and properly setting the sensitivity of these devices.

Never rely solely on a device to protect you and your fellow workers from danger.

Some variables you must know and understand are:

- Proximity devices are advertised to detect the existence of electricity and not its 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; 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.

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

Electrical Contact

If the crane should come in contact with an energized power source, you must:

1. Stay in the crane cab. **Don't panic.**
2. Immediately warn personnel in the vicinity to stay away.
3. Attempt to move the crane away from the contacted power source using the crane's controls which may have remained functional.
4. Stay in the crane until the power company has been contacted and the power source has been de-energized. **No one** must attempt to come close to the crane or load until the power has been turned off.

Only as a last resort should an operator attempt to leave the crane upon contacting a power source. If it is absolutely necessary to leave the operator's station, **jump completely clear of the crane. Do not step off.** Hop away with both feet together. **Do not** walk or run.

Following any contact with an energized electrical source, the Grove distributor must be immediately advised of the incident and consulted on necessary inspections and repairs. Thoroughly inspect the hoist rope and all points of contact on the crane. Should the distributor not be immediately available, contact Manitowoc Crane Care. 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 your Grove distributor or Manitowoc Crane Care.

Special Operating Conditions and Equipment

Never operate the crane during an electrical thunderstorm.

When operating near transmitter/communication towers where an electrical charge can be induced into the crane or load:

- The transmitter shall be deenergized OR,
- Tests shall be made to determine if an electrical charge will be induced into the crane or load.
- The crane must be provided an electrical ground.
- If taglines are used, they must be non-conductive.
- Every precaution must be taken to dissipate induced voltages. Consult a qualified RF (radio frequency) Consultant. Also refer to local, state, and federal codes and regulations.

When operating cranes equipped with electromagnets, you must take additional precautions. Permit no one to touch the magnet or load. Alert personnel by sounding a warning signal when moving a load. Do not allow the cover of the electromagnet power supply to be open during operation or at any time the electrical system is activated. Shut down the crane completely and open the magnet controls switch prior to connecting or disconnecting magnet leads. Use only a non-conductive device when positioning a load. Lower the magnet to the stowing area and shut off power before leaving the operator's cab (if equipped) or operator's station.

Grounding the Crane

The crane may become charged with static electricity. This may occur especially when using outrigger pads made of

plastic or when the outrigger pads are cribbed with insulating material (e.g., wooden planks).



WARNING

Risk of accidents due to electric shock!

Ground the crane before you start to work with it

- Near strong transmitters (radio transmitters, radio stations, etc.)
- Near high-frequency switching stations
- If a thunder storm is forecast

Use electrically conducting material for grounding.

1. Hammer a metal rod (3, Figure 2-6) (length of approximately 2.0 m (6.6 ft)) at least 1.5 m (5 ft) into the ground.
2. Moisten the soil around the metal rod (3) for better conductivity.
3. Clamp an insulated cable (2) to the metal rod (3), cross-section of at least 16 mm² (0.025 in²) (AWG 5).
4. Connect the free end of the cable with a clamp (1) to a good electrically conductive location on the frame.

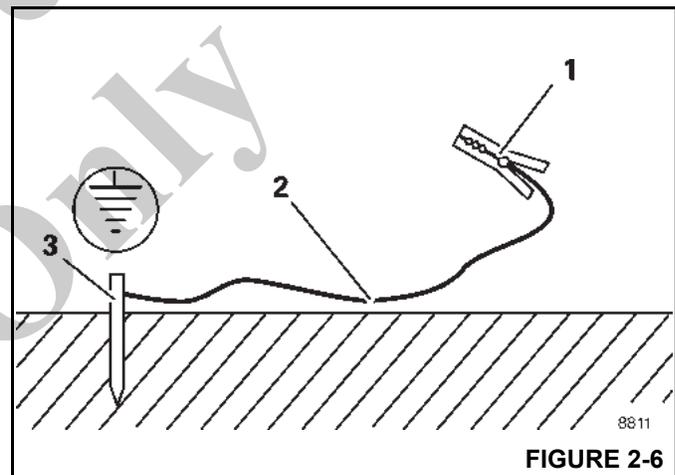


FIGURE 2-6



WARNING

Risk of accidents due to electric shock!

Make sure that the connections between the cable and the clamp are electrically conductive.

Do not attach the clamp to parts that are screwed on, such as valves, covers or similar parts.

PERSONNEL HANDLING

The American Society of Mechanical Engineers published the American National Standard entitled, *Personnel Lifting Systems*, ASME B30.23:

This Volume establishes the design criteria, equipment characteristics, and operational procedures that are required when hoisting equipment within the scope of the ASME B30 Standard is used to lift personnel. Hoisting equipment defined by the ASME B30 Standard is intended for material handling. It is not designed, manufactured, or intended to meet the standards for personnel handling equipment, such as ANSI/SIA A92 (Aerial Platforms). The equipment and implementation requirements listed in this Volume are not the same as that established for using equipment specifically designed and manufactured for lifting personnel. Hoisting equipment complying with the applicable Volumes of the ASME B30 Standard shall not be used to lift or lower personnel unless there are no less hazardous alternatives to providing access to the, area where work is to be performed. The lifting or lowering of personnel using ASME B30-compliant hoisting equipment is prohibited unless all applicable requirements of this volume have been met.

This standard is consistent with the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) regulations for Construction that state, in 29CFR1926.1431:

General requirements. 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 worksite, 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 worksite conditions.

Additional requirements for crane operations are stated in ASME B30.5, *Mobile and Locomotive Cranes*, ASME B30.8, *Floating Cranes and Floating Derricks*, and in OSHA regulations 29CFR1910.180 for *General Industry* and 29CFR1926.1431 for *Construction*.

Use of a Grove crane to handle personnel is acceptable, provided:

- The requirements of the applicable national, state and local regulations and safety codes are met.
- A determination has been made that use of a crane to handle personnel is the least hazardous means to perform the work.
- The crane operator shall be qualified to operate the specific type of hoisting equipment used in the personnel lift.
- The crane operator must remain at the crane controls 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.
- The crane must be equipped with a boom angle indicator that is visible to the crane operator.
- The crane's *Load Chart* is affixed at the operator's station and readily accessible to the operator. The total weight of the loaded personnel platform and related rigging shall not exceed 50 percent of the rated capacity for the radius and configuration of the crane.
- The crane is level within one percent of level grade and located on a firm footing. Cranes with outriggers shall have them all deployed following manufacturer's specifications.
- The crane's *Operator Manual* and other operating manuals are at the operator's station and readily accessible to the operator.
- The platform meets the requirements as prescribed by applicable standards and regulations.
- For hoist rope suspended platforms:
 - The crane is equipped with a hook that can be closed and locked, eliminating the throat opening.
 - The crane is equipped with a functional anti-two-block device.
 - The platform is properly attached and secured to the load hook.
- For boom mounted platforms:
 - The platform is properly attached and secure.

To avoid death or serious injury:

- NEVER use this crane for bungee jumping or any form of amusement or sport.
- NEVER handle personnel on the loadline unless the requirements of applicable national, state and local regulations and safety codes are met.
- NEVER permit anyone to ride loads, hooks, slings or other rigging for any reason.
- NEVER get on or off a moving crane.
- NEVER allow anyone other than the operator to be on this crane while the machine is operating or traveling.
- NEVER allow anyone on the hoist access platform while traveling.

The following standards and regulations regarding personnel handling are available by mail at the following addresses:

- *ASME (formerly ANSI) B30 Series American National Safety Standards For Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings; ASME B30.5, Mobile And Locomotive Cranes, and ASME B30.23, Personnel Lifting Systems*, are available by mail from the ASME, 22 Law Drive, Fairfield, New Jersey, 07007-2900.

- or - check online at:

<https://www.asme.org/codes-standards/find-codes-standards>

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

ENVIRONMENTAL PROTECTION

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

Potentially harmful waste used in Grove 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, observe the following:

- 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 clean up any spills.

MAINTENANCE

The crane must be inspected prior to use on each work shift. The owner, user, and operator must make sure that routine maintenance and lubrication are being dutifully performed. **Never** operate a damaged or poorly maintained crane.

Grove continues to recommend that cranes be properly maintained, regularly inspected and repaired as necessary. Grove reminds crane owners to make sure that all safety decals are in place and legible. Grove continues to urge crane owners to upgrade their cranes with rated capacity limiter and control lever lockout systems for all lifting operations.

Shut down the crane while making repairs or adjustments.

Always perform a function check after repairs have been made to ensure proper operation. Load tests should be performed when structural or lifting members are involved.

Follow all applicable safety precautions in this manual when performing crane maintenance as well as crane operations.

Keep the crane free of mud, dirt, and grease at all times. Dirty equipment introduces hazards, wears-out faster, and makes proper maintenance difficult. Cleaning solutions used should be non-flammable, non-toxic and appropriate for the job.

Routine maintenance and inspection of this crane must be performed by a qualified person(s) according to the recommendations in the *Inspection and Lubrication Service Log*. Any questions regarding procedures and specifications should be directed to your Grove distributor.

Service and Repairs



WARNING

Fall Hazard!

Working at elevated heights without using proper fall protection can result in severe injury or death.

Always use proper fall protection as required by local, state or federal regulations.

Service and repairs to the crane must only be performed by a qualified person. All service and repairs must be performed in accordance with manufacturer's recommendations, this manual, and the service manual for this machine. If there is any question regarding maintenance procedures or specifications, contact your Grove distributor for assistance.

Qualified person is defined as one who by reason of knowledge, 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.

All replacement parts must be Grove approved.

Any modification, alteration, or change to a crane which affects its original design and is not authorized and approved by Grove is **strictly prohibited**. Such action invalidates all warranties and makes the owner/user liable for any resultant accidents.

Hydraulic Fluid

- Do not use your hand or any part of your body to check for hydraulic fluid leaks when the engine is running or the hydraulic system is under pressure. Fluid in the hydraulic system can be under enough pressure that it will penetrate the skin, causing serious injury or death. Use a piece of cardboard, or piece of paper, to search

for leaks. Wear gloves to protect your hands from spraying fluid.

- If any hydraulic fluid is injected into the skin, obtain medical attention immediately or gangrene may result.
- Do not attempt to repair or tighten any hydraulic hose or fitting while the engine is running, or when the hydraulic system is under pressure.
- Never disconnect any hydraulic lines unless the boom is fully lowered, the engine is shut off, and the hydraulic pressure is relieved. To relieve hydraulic pressure, stop the engine, turn the ignition switch to RUN and move the hydraulic controls in both directions several times.



WARNING

Pressurized Fluid Hazard!

Hydraulic pressure may still be present in portions of the hydraulic system due to accumulators or trapped circuitry.

- Hot hydraulic fluid will cause severe burns. Wait for the fluid to cool before disconnecting any hydraulic lines.
- Hydraulic fluid can cause permanent eye injury. Wear appropriate eye protection.

Moving Parts

- Do not place limbs near moving parts. Amputation of a body part may result. Turn off the engine and wait until the fan and belts stop moving before servicing crane.
- Pinch points, which result from relative motion between mechanical parts, are areas of the machine that can cause personal injury or death. Do not place limbs or your body in contact with pinch points either on or around the machine. Care must be taken to prevent motion between pinch points when performing maintenance and to avoid such areas when movement is possible.
- Do not allow persons to stand near extending or lowering outriggers. Foot crushing could occur.

Before maintenance or repairs

Before performing any maintenance, service or repairs on the crane:

- The boom should be fully retracted and lowered and the load placed on the ground.
- Do not get under a raised boom unless the boom is blocked up safely. Always block up the boom before doing any servicing that requires the boom to be raised.

- Stop the engine and disconnect the battery.
- Controls should be properly tagged. Never operate the crane if it is **tagged-out** nor attempt to do so until it is restored to proper operating condition and all tags have been removed by the person(s) who installed them.

After maintenance or repairs

- Replace all guards and covers that have been removed.
- Remove all tags, connect the battery, and perform a function check of all operating controls.
- Consult with Manitowoc Crane Care to determine if load testing is required after a structural repair is performed.

Lubrication

The crane must be lubricated according to the manufacturer's recommendations for lubrication points, time intervals, and types. Lubricate at more frequent intervals when working under severe conditions.

Exercise care when servicing the hydraulic system of the crane, as pressurized hydraulic oil can cause serious injury. The following precautions must be taken when servicing the hydraulic system:

- Follow the manufacturer's recommendations when adding oil to the system. Mixing the wrong fluids could destroy seals, causing component failure.
- Be certain all lines, components, and fittings are tight before resuming operation.

Tires



WARNING

Possible equipment damage and/or personal injury!

Driving the crane with a tire and split-rim assembly under inflated at 80% or less of its recommended pressure can cause the wheel and/or tire to fail. Per *OSHA Standard 1910.177(f)(2)*, when a tire has been driven under inflated at 80% or less of its recommended pressure, it must first be completely deflated, removed from the axle, disassembled, and inspected before re-inflation.

Inspect the tires for nicks, cuts, embedded material, and abnormal wear.

Make sure that all lug nuts are properly torqued.

Make sure that pneumatic tires are inflated to the proper pressure (refer to the *Load Chart*). When inflating tires, use a tire gauge, clip-on inflator, and extension hose which will permit standing clear of the tire while inflating.

HOIST ROPE

Synthetic Hoist Rope

For detailed information concerning synthetic hoist rope, refer to K100™ Synthetic Crane Hoist Line Manual P/N 9828100734 available by contacting Manitowoc Crane Care.

During installation and setup, care must be taken to avoid overlap and crossing of wire rope and synthetic hoist ropes.

Always make daily inspections of the hoist rope, keeping in mind that all hoist rope will eventually deteriorate to a point where it is no longer usable. Refuse to work with worn or damaged hoist rope.

During regular inspections, operator shall make sure that crane surfaces such as wear pads, sheaves, etc have not been damaged in a manner that can then damage the synthetic hoist rope.

NOTE: Example; if usage of a wire rope has cut grooves with sharp edges in a wear pad, they need to be addressed before the synthetic hoist rope is used in that same position.

Use **only** the hoist rope specified by Grove as indicated on the crane's *Load Chart*. Substitution of an alternate hoist rope may require the use of a different permissible line pull and, therefore, require different reeving.

NOTE: Hoist rope may be purchased by contacting Manitowoc Crane Care.

Wire Rope

Always make daily inspections of the rope, keeping in mind that all wire rope will eventually deteriorate to a point where it is no longer usable. Refuse to work with worn or damaged wire rope. Rope shall be taken out of service when any of the following conditions exist:

- For rotation-resistant running ropes: more than two (2) broken wires in a length of rope equal to six (6) times the rope diameter, or more than four (4) broken wires in a length of rope equal to thirty (30) times the rope diameter.
- For running ropes other than rotation resistant: six (6) broken wires in one rope lay or three (3) broken wires in one strand.
- One valley break where the wire fractures between strands in a running rope is cause for removal.
- Abrasion of the rope resulting in a 5% reduction in the original wire diameter.
- Any kinking, bird caging, crushing, corrosion, or other damage resulting in distortion of the rope structure.
- Rope that has been in contact with a live power line or has been used as a ground in an electric circuit (e.g.,

welding) may have wires that are fused or annealed and must be removed from service.

- In standing ropes, more than three (3) breaks in one rope lay in sections beyond the end connection or more than two (2) broken wires at an end connection.
- Core deterioration, usually observed as a rapid reduction in rope diameter, is cause for immediate removal of the rope.

The following is a brief outline of the basic information required to safely use wire rope.

- Wire ropes wear out. The strength of a rope begins to decrease when the rope is put to use and continues to decrease with each use. Rope will fail if worn-out, overloaded, misused, damaged or improperly maintained.
- The nominal strength, sometimes called catalog strength, of a wire rope applies only to a new, unused rope.
- The nominal strength of a rope should be considered the straight line pull which will actually break a new unused rope. The nominal strength of a rope should never be used as its working load.
- Each type of fitting attached to a rope has a specific efficiency rating which can reduce the working load of the rope assembly or rope system.
- If an operator hoists the hook block up or down too fast when reeved with multiple parts of line and no hook load, the wire rope can bird cage and damage the rope.
- Never overload a rope. This means never use the rope where the load applied to it is greater than the working load determined by the rope manufacturer.
- Never "shock load" a rope. A sudden application of force or load can cause both visible external and internal damage. There is no practical way to estimate the force applied by shock loading a rope. The sudden release of a load can also damage a rope.
- Lubricant is applied to the wires and strands of a wire rope when it is manufactured. The lubricant is depleted when the rope is in service and should be replaced periodically. Refer to the *Service Manual* for more information.
- In the U.S.A., regular inspections of the rope and keeping of permanent records signed by a qualified person are required by OSHA for almost every wire rope application. The purpose of the inspection is to determine whether or not a rope may continue to be safely used on the application. Inspection criteria, including number and location of broken wires, wear and elongation, have been established by OSHA, ANSI,

ASME and similar organizations. See the *Service Manual* for inspection procedures.

When inspecting ropes and attachments, keep all parts of your body and clothing away from rotating hoist drums and all rotating sheaves. Never handle the rope with bare hands.

Some conditions that lead to problems in wire rope systems include:

- Sheaves that are too small, worn or corrugated cause damage to a wire rope.
- Broken wires mean a loss in strength.
- Kinks permanently damage a rope and must be avoided.
- Ropes are damaged by knots. Rope with knots must never be used.
- Environmental factors such as corrosive conditions and heat can damage a wire rope.
- Lack of lubrication can significantly shorten the useful life of a wire rope.
- Contact with electrical wires and resulting arcing will damage a wire rope.
- An inspection should include verification that none of the specified removal criteria for this usage are met by checking for such things as:
 - Surface wear; nominal and unusual.

- Broken wires; number and location.
- Reduction in diameter.
- Rope stretch (elongation).
- Integrity of end attachments.
- Evidence of abuse or contact with another object.
- Heat damage.
- Corrosion.

NOTE: A more detailed rope inspection procedure is given in the *Service Manual*.

- ***When a rope has been removed from service because it is no longer suitable for use, it must not be reused on another application.***

Installing a new rope

- Keep all parts of your body and clothing away from rotating hoist drums and all rotating sheaves.
- Never handle the wire rope with bare hands.
- Follow proper instructions for removing rope from a reel.
- Apply back tension to the storage/payoff reel of the new rope to ensure tight, even, spooling onto the hoist drum.
- Operate the new rope—first through several cycles at light load—then through several cycles at intermediate load, to allow the rope to adjust to operating conditions.

When using a wedge socket

- Always inspect socket, wedge, and pin for correct size and condition.
- Do not use parts that are damaged, cracked, or modified.
- Assemble the wedge socket with live end of rope aligned with the centerline of pin, and assure proper length of tail (dead end) protrudes beyond the socket.

Sheaves

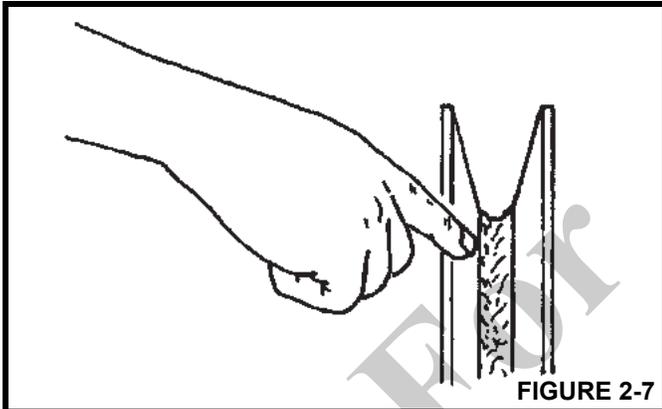


FIGURE 2-7

Inspect the boom nose and hook block sheaves for proper operation, excessive wear, and damage every 50 hours or weekly. Inoperable, damaged and/or worn sheaves cause rapid deterioration of rope.

Make sure that sheaves carrying ropes, that can be momentarily unloaded, are equipped with close fitting guards or other devices to guide the rope back into the groove when the load is reapplied. Make sure that sheaves in the lower load block are equipped with close fitting guards that will prevent the ropes from becoming fouled when the block is lying on the ground with loose ropes.

To attain maximum hoist rope life and minimize hook block rotation, it is recommended that even numbers of parts-of-line be used in multiple-part reeving whenever possible.

The use of nylon (polyamide) sheaves, as compared with metallic sheaves, may change the replacement criteria of rotation-resistant hoist rope.

NOTE: The use of cast nylon (polyamide) sheaves will substantially increase the service life of rope. However, conventional rope retirement criteria based only upon visible wire breaks may prove inadequate in predicting rope failure. The user of cast nylon sheaves is therefore cautioned that a retirement criteria should be established based upon the user's experience and the demands of his application.

Batteries

Battery electrolyte must not be allowed to contact the skin or eyes. If this occurs, flush the contacted area with water and consult a doctor immediately.

When checking and maintaining batteries, exercise the following procedures and precautions:

- Wear safety glasses when servicing batteries.
- If equipped, disconnect battery with the battery disconnect switch before disconnecting the ground battery cable. For cranes with a Cummins engine using an engine ECM:
 - a. Make sure that the key switch has been off for 2 minutes.
 - b. Turn the battery disconnect switch to the OFF position.
 - c. Remove the ECM power fuse.
 - d. Remove negative battery cables.
- Do not break a live circuit at the battery terminal. Disconnect the ground battery cable first when removing a battery and connect it last when installing a battery.
- Do not short across the battery posts to check charge. Short circuit, spark, or flame could cause battery explosion.
- If applicable, maintain battery electrolyte at the proper level. Check the electrolyte with a flashlight.
- If applicable to your crane, check battery test indicator on maintenance-free batteries.
- Check battery condition only with proper test equipment. Batteries shall not be charged except in an open, well-ventilated area that is free of flame, smoking, sparks, and fire.

Super Capacitor (If Equipped)

Capacitor electrolyte must not be allowed to contact the skin or eyes. If this occurs, flush the contacted area with water and consult a doctor immediately.

When checking and maintaining capacitor, exercise the following procedures and precautions:

- Wear safety glasses when servicing.
- If equipped, disconnect battery with the battery disconnect switch before disconnecting the ground battery cable. For cranes with a Cummins engine using an engine ECM:
 1. Make sure that the key switch has been off for 2 minutes.
 2. Turn the battery disconnect switch to the OFF position.

3. Remove the ECM power fuse.
 4. Remove negative battery cables.
 5. Remove positive capacitor cable.
- Do not short across the capacitor posts to check charge. Short circuit will cause capacitor terminal damage. Spark or flame could cause capacitor explosion.
 - Check capacitor charge level with proper test equipment.

General Maintenance

Fuel the crane only with the engine turned off. Do not smoke while fueling the crane. Do not store flammable materials on the crane.

Be familiar with the location and use of the nearest fire extinguisher.

Be careful when checking the engine coolant level. The fluid may be hot and under pressure. Shut down the engine and allow the radiator time to cool before removing the radiator cap.

Shut down the engine and disconnect the battery before performing maintenance. If unable to do so for the task required, keep hands clear of the engine fan and other moving parts while performing maintenance.

Be careful of hot surfaces and hot fluids when performing maintenance on or around the engine.

Do not use ether to start the engine on cranes equipped with intake manifold grid heaters.

The engine can enter into an engine exhaust cleaning mode where the exhaust temperature can be high, make sure that the exhaust is not pointed at materials that can melt, burn, or explode.

TRANSPORTING THE CRANE

Before transporting the crane, check the suitability of the proposed route with regard to the crane height, width, length, and weight.

Check load limits of bridges on the travel route, and make sure that they are greater than the combined weight of the crane and transporting vehicle.

When loading or unloading the crane on a trailer or railroad car, use a ramp capable of supporting the weight of the crane.

Make sure that the crane is adequately secured to the transporting vehicle.

Do not use the dead end lug (1, Figure 2-8) on the boom nose for tying down the boom during transport. Damage to the lug and boom can result from usage as a tie down point.

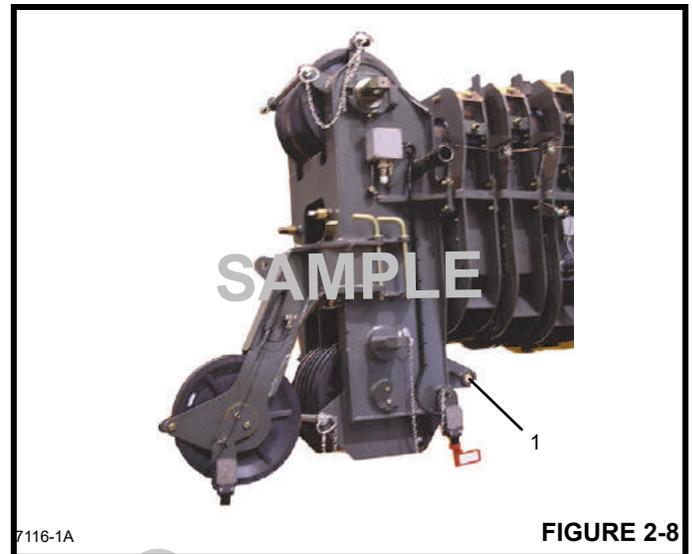


FIGURE 2-8

Before transporting the crane on a road or highway, first check state and local restrictions and regulations.

Either the hook block may be reeved over the main boom nose or the overhaul ball may be reeved over the main boom nose or auxiliary boom nose; the other must be removed. If the hook block or overhaul ball remains reeved on the boom, it must be secured at the tie down on the carrier to prevent swinging.

When using hookblock tie downs, excessive loading can be applied by pulling the cable too tight, particularly when reeved with multiple part lines. When the cable is hooked into the hookblock tie down, the cable should be merely "snugged-up" with adequate slack provided at the center line of sheave to anchor point. Do not draw cable taut. Care must be exercised anytime any crane function is being performed while the cable is hooked into the hookblock tie down.

TRAVEL OPERATION

Only the crane operator shall occupy the crane when traveling.

When traveling, the boom should be completely retracted and lowered to the travel position and the turntable pin swing lock, if equipped, should be engaged. If equipped with boom rest, lower the boom into the boom rest and engage the turntable lock.

Strictly adhere to the guidelines and restrictions in the *Load Chart* for pick and carry operations.

GRT cranes are manufactured without an axle suspension system. Traveling at high speeds, especially on rough ground, may create a bouncing effect that can result in loss of control. If bouncing occurs, reduce travel speed.

**WARNING**
Crushing Hazard!

Death or serious injury could result from being crushed by revolving tires.

Keep clear of revolving tires.

Stunt driving and horse-play are strictly prohibited. Never allow anyone to hitch a ride or get on or off a moving crane.

Follow the instructions in this manual when preparing the crane for travel.

If using a boom dolly/trailer, thoroughly read and understand all the steps and safety precautions in this manual for setup and travel.

When driving the crane make sure that the cab is down, if equipped with a tilting cab.

Secure the hook block and other items before moving the crane.

Watch clearances when traveling. Do not take a chance of running into overhead or side obstructions.

When moving in tight quarters, post a signal person to help guard against collisions or bumping structures.

Before traveling a crane, check suitability of proposed route with regard to crane height, width, and length.

Never back up without the aid of a signal person to verify the area behind the crane is clear of obstructions and/or personnel.

On cranes equipped with mirrors or camera systems, make sure these components are in working order and are properly adjusted.

On cranes equipped with air-operated brakes or hydraulically operated brakes, do not attempt to move the crane until brake system air pressure or hydraulic pressure is at operating level.

Check load limit of bridges. Before traveling across bridges, make sure that they will carry a load greater than the crane's weight.

If it is necessary to take an RT crane on a road or highway, check state and local restrictions and regulations.

Keep lights on, use traffic warning flags and signs, and use front and rear flag vehicles when necessary. Check state and local restrictions and regulations.

Always drive the crane carefully, obeying speed limits and highway regulations.

Stay alert at the wheel.

If equipped, make sure that the hoist access platform hand rail and step are in the travel configuration.

Slopes

- Pick and carry on level surfaces only.
- Refer to the *Operation Section* for more detailed information on traveling on slopes.
- Driving across a slope is dangerous, as unexpected changes in slope can cause tip over. Ascend or descend slopes slowly and with caution.
- When operating on a downhill slope, reduce travel speed and downshift to a low gear, to permit compression braking by the engine, and aid the application of the service brakes.

WORK PRACTICES

Personal Considerations

Always adjust the seat and lock it in position, and fasten the seat belt securely before you start the engine.

Do not wear loose clothing or jewelry that can get caught on controls or moving parts. Wear the protective clothing and personal safety gear issued or called for by the job conditions. Hard hat, safety shoes, ear protectors, reflective clothing, safety goggles, and heavy gloves may be required.

Crane Access



WARNING

Fall Hazard!

Working at elevated heights without using proper fall protection can result in severe injury or death.

Always use proper fall protection as required by local, state or federal regulations.

You must take every precaution to make sure that you do not slip and/or fall off the crane. Falling from any elevation could result in serious injury or death.

Never exit or enter the crane cab or deck by any other means than the access system(s) provided (i.e., steps and grab handles). Use the recommended handholds and steps to maintain a three-point contact when getting on or off the crane.

If necessary, use a ladder or aerial work platform to access the boom nose.

Do not make modifications or additions to the crane's access system that have not been evaluated and approved by Grove Crane.

Do not step on surfaces on the crane that are not approved or suitable for walking and working. All walking and working surfaces on the crane should be clean, dry, slip-resistant, and have adequate supporting capacity.

Do not walk on a surface if slip-resistant material is missing or excessively worn.

Do not use the top of the boom as a walkway.

Do not step on the outrigger beams or outrigger pads (floats) to enter or exit the crane.

Use the hoist access platform (if equipped) when working in the hoist area.

Wear shoes with a highly slip-resistant sole material. Clean any mud or debris from shoes before entering the crane cab/operator's station or climbing onto the crane superstructure. Excessive dirt and debris on the handholds, access steps, or walking/working surfaces could cause a slipping accident. A shoe that is not clean might slip off a control pedal during operation.

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.

Job Preparation

Before crane use

- Barricade the entire area where the crane is working and keep all unnecessary personnel out of the work area.
- Make sure that the crane is properly equipped, including access steps, covers, doors, guards, and controls.
- Conduct a visual inspection for cracked welds, damaged components, loose pins/bolts, and wire connections. Any item or component that is found to be loose or damaged (broken, chipped, cracked, worn-through, etc.) must be repaired or replaced. Inspect for evidence of improper maintenance (consult your *Service Manual*).
- Check for proper functioning of all controls and operator aids (for example, RCL).
- Check all braking (for example, wheel, hoist, and swing brakes) and holding devices before operation.

You must make sure that the outriggers and jack cylinders are properly extended and set before performing any lifting operations. On models equipped with outriggers that can be pinned at the mid-extend position, the outriggers must also be pinned when operating from the mid-extend position.

Clear all personnel from the outrigger area before extending or retracting the outriggers. Carefully follow the procedures in this *Operator Manual* when extending or retracting the outriggers. Death or serious injury could result from improper crane set up on outriggers.

Be familiar with surface conditions and the presence of overhead obstructions and power lines.

Working

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

Know the location and function of all crane controls.

Make sure that all persons are away from the crane and the Travel Select Lever is in the "N" (Neutral) position with the Parking Brake engaged before starting the engine.

Sparks from the crane's electrical system and/or engine exhaust can cause an explosion. **Do not** operate this crane in an area with flammable dust or vapors, unless good ventilation has removed the hazard.

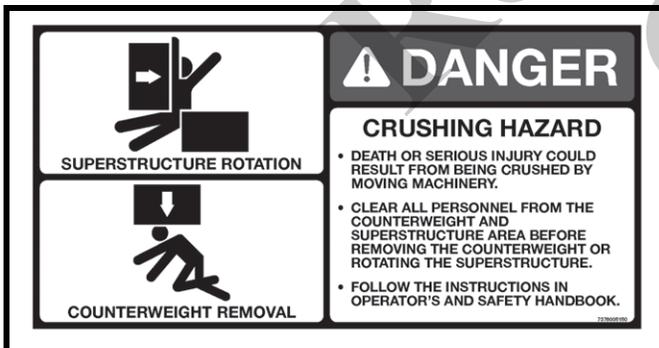
Carbon monoxide fumes from the engine exhaust can cause suffocation in an enclosed area. Good ventilation is very important when operating the crane.

Before actuating swing or any other crane function, sound the horn and verify that all personnel are clear of rotating and moving parts.

Never operate the crane when darkness, fog, or other visibility restrictions make operation unsafe. Never operate a crane in thunderstorms or high winds.

Always be aware of your working environment during operation of the crane. Avoid contacting any part of the crane with external objects.

Clear all personnel from the counterweight and superstructure area before removing the counterweight.



Keep unauthorized personnel clear of the working area during operation.

Only the crane operator shall occupy the crane when in operation.

You must always be aware of everything around the crane while lifting or traveling. If you are unable to clearly see in the direction of motion, you must post a look out or signal person before moving the crane or making a lift. Sound the horn to warn personnel

Operate the crane only from the operator's seat. Do not reach in a window or door to operate any controls.

Operate the crane slowly and cautiously, looking carefully in the direction of movement.

A good practice is to make a "dry run" without a load before making the first lift. Become familiar with all factors peculiar to the job site.

Make sure that the hoist rope is properly routed on the hook block and boom nose (Figure 2-9), and that all rope guards are in place.

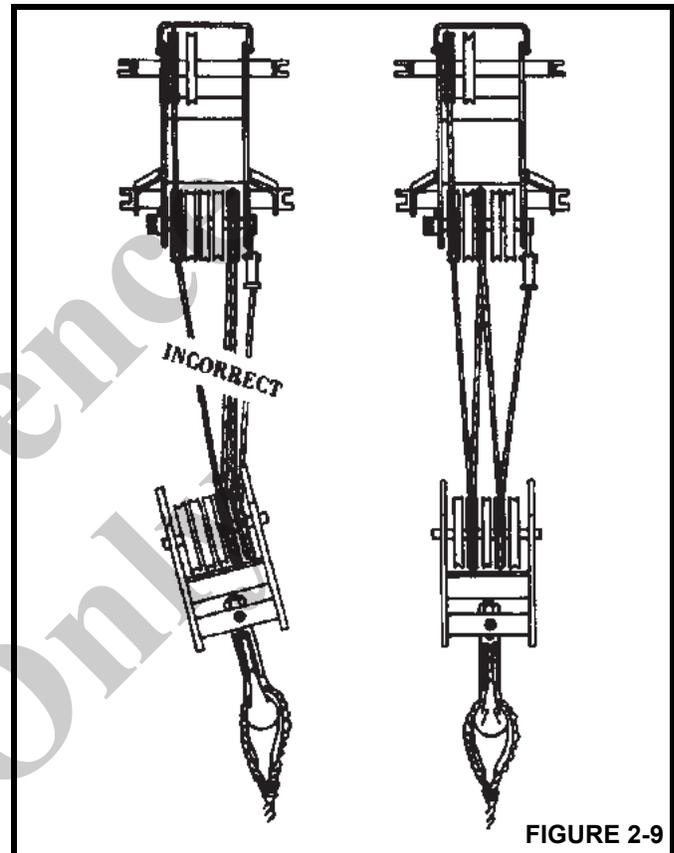


FIGURE 2-9

Lifting

Grove Crane recommends lifting only one load at a time. See "Lifting Operations" on page 2-20.

Use enough parts of line for all lifts and check all lines, slings, and chains for correct attachment. To obtain maximum lifting capacities, the hook block must be set up with enough parts of line. Too few parts of line can result in failure of the hoist rope or hoist. **No less than three wraps of rope** should remain on the hoist drum. When slings, ties, hooks, etc., are used, make sure that they are correctly positioned and secured before raising or lowering the loads.

Make sure that the rigging is adequate before lifting. Use tag lines when possible to position and restrain loads. Personnel using tag lines should be on the ground.

Make sure good rigging practices are being used. Refuse to use any poorly maintained or damaged equipment. Never wrap the hoist cable around a load.

If using a clam bucket, do not exceed 80 percent of the crane's capacity.

Make certain the boom tip is centered directly over the load before lifting.

Make sure the load is well secured and attached to the hook with rigging of proper size and in good condition.

Check the hoist brake by raising the load a few inches, stopping the hoist and holding the load. Make sure that the hoist brake is working correctly before continuing the lift.

When lowering a load always slow down the load's descent before stopping the hoist. Do not attempt to change speeds on multiple-speed hoists while the hoist is in motion.

Watch the path of the boom and load when swinging. Avoid lowering or swinging the boom and load into ground personnel, equipment, or other objects. Never leave the crane with a load suspended. Should it become necessary to leave the crane, lower the load to the ground and stop the engine before leaving the operator's station.

Remember, all rigging equipment must be considered as part of the load. Lifting capacities vary with working areas. If applicable, permissible working areas are listed in the *Load Chart*. When swinging from one working area to another, make sure that *Load Chart* capacities are not exceeded. Know your crane!

Stop the hook block from swinging when unhooking a load.

Swinging rapidly can cause the load to swing out and increase the load radius. Swing the load slowly. Swing with caution and keep the load lines vertical.

Look before swinging your crane. Even though the original setup may have been checked, situations do change.

Never swing or lower the boom into the carrier cab (if applicable).

Never push or pull loads with the crane's boom. Never drag a load.

Do not subject crane to side loading. A side load can tip the crane or cause it to fail structurally.

If the boom should contact an object, stop immediately and inspect the boom. Remove the crane from service if the boom is damaged.

When lifting a load the boom may deflect causing the load radius to increase—this condition is made worse when the boom is extended. Make sure that the weight of load is within the crane's capacity on *Load Chart*.

Avoid sudden starts and stops when moving the load. The inertia and an increased load radius could tip the crane over or cause it to fail structurally.

Use tag lines (as appropriate) for positioning and restraining loads. Check the load slings before lifting.

Make sure that everyone is clear of the crane and work area before making any lifts.

Never swing over personnel, regardless of whether load is suspended from or attached to the boom.

Hand Signals

A single qualified signal person shall be used at all times when:

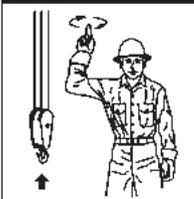
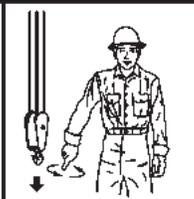
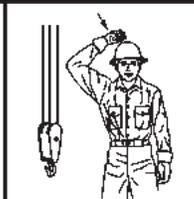
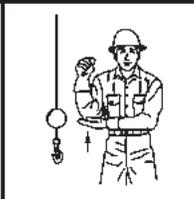
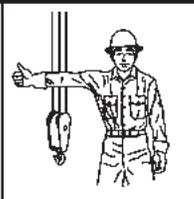
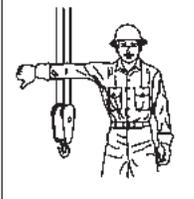
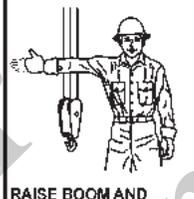
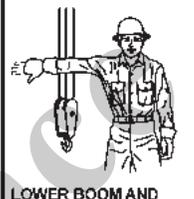
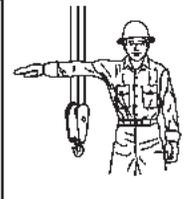
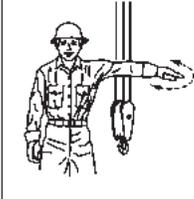
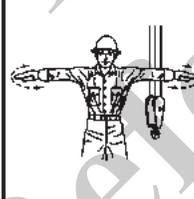
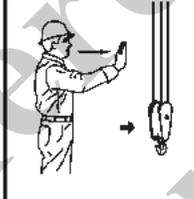
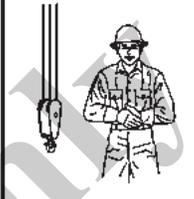
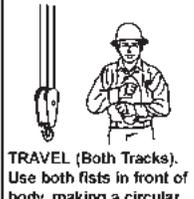
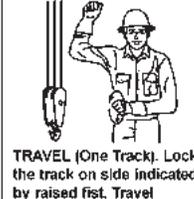
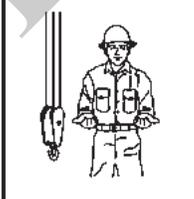
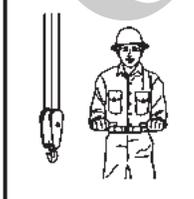
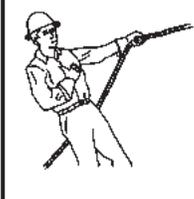
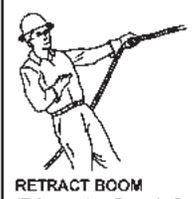
- Working in the vicinity of power lines.
- The crane operator cannot clearly see the load at all times.
- Moving the crane in an area or direction in which the operator cannot clearly see the path of travel.

At all times use standardized hand signals (Figure 2-10) that have been previously agreed upon and completely understood by the operator and signal person.

If communication with the signal person is lost, crane movement must be stopped until communications are restored.

Keep your attention focused on the crane's operation. If for some reason you must look in another direction, stop all crane movement first.

Obey a signal to stop from anyone.

STANDARD HAND SIGNALS FOR CONTROLLING CRANE OPERATIONS				
Complies with ASME B30.5-2014				
				
HOIST. With forearm vertical, forefinger pointing up, move hand in small horizontal circle.	LOWER. With arm extended downward, forefinger pointing down, move hand in small horizontal circle.	USE MAIN HOIST. Tap fist on head; then use regular signals.	USE WHIPLINE (Auxiliary Hoist). Tap elbow with one hand; then use regular signals.	RAISE BOOM. Arm extended, fingers closed, thumb pointing upward.
				
LOWER BOOM. Arm extended, fingers closed, thumb pointing downward.	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).	RAISE BOOM AND LOWER LOAD. With arm extended, thumb pointing up, flex fingers in and out as long as load movement is desired.	LOWER BOOM AND RAISE LOAD. With arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired.	SWING. Arm extended, point with finger in direction of swing of boom.
				
STOP. Arm extended, palm down, move arm back and forth horizontally.	EMERGENCY STOP. Both arms extended, palms down, move arms back and forth horizontally.	TRAVEL. Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.	DOG EVERYTHING. Clasp hands in front of body.	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.)
				
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.)	EXTEND BOOM (Telescoping Booms). Both fists in front of body with thumbs pointing outward.	RETRACT BOOM (Telescoping Boom). Both fists in front of body with thumbs pointing toward each other.	EXTEND BOOM (Telescoping Boom). One Hand Signal. One fist in front of chest with thumb tapping chest.	RETRACT BOOM (Telescoping Boom). One Hand Signal. One fist in front of chest, thumb pointing outward and heel of fist tapping chest.
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FIGURE 2-10

BOOM EXTENSION

To avoid death or serious injury, follow the procedures in this manual during erection, stowage, and use of the boom extension.

Install and secure all pins properly.

Control movement of the boom extension at all times.

Do not remove right side boom nose pins unless boom extension is properly pinned and secured on front and rear stowage brackets.



DANGER

Boom Extension Hazard!

To avoid death or serious injury, follow procedures in *Load Chart*, safety, and operation manuals during erection, stowage and use of boom extension. Install and secure all pins properly and control boom extension movement at all times.

Do not remove the pins from the front stowage bracket unless the boom extension is pinned to the right side of the boom nose.

Properly inspect, maintain, and adjust boom extension and mounting.

When assembling and disassembling boom extension sections, use blocking to adequately support each section and to provide proper alignment.

Stay outside of boom extension sections and lattice work.

Watch for falling or flying pins when they are being removed.

PARKING AND SECURING



DANGER

Tipping Hazard!

When parking the crane and leaving it unattended follow the instructions in Section 4 of this manual.

Failure to comply with these instructions may cause death or serious injury.

When parking on a grade, apply the parking brake and chock the wheels.

Section 4 of this manual provides instructions for parking and securing a crane when it is to be left unattended. These instructions are intended to allow the crane to be placed in the most stable and secure position. However, Grove recognizes that certain jobsite conditions may not permit the boom and boom extension of a crane to be fully lowered to the ground. When a qualified person at a jobsite determines

that it is not practical to lower the boom to the ground, we recommend the following additional instructions be followed:

- The crane should be left in the smallest, most stable, valid operational configuration that the job site practically allows.
- The crane can not be left running, with a load on the hook, or with the jib deployed, or in wind conditions in excess of allowed values.
- The boom should be retracted as far as is practical, the crane configured in as stable a configuration as possible (boom angle, superstructure orientation, boom extension angle, etc.)
- In high winds the boom and boom extension should be lowered, or secured. Changing weather conditions including, but not limited to, wind, ice accumulation, precipitation, flooding, lightning, etc., should be considered when determining the location and configuration of a crane when it is to be left unattended.

SHUT-DOWN

Use the following steps when shutting down the crane:

- Engage the parking brake.
- Fully retract and lower the boom.
- Engage the swing lock pin or 360 degree swing lock (if equipped).
- Disable all crane functions using the crane function Enable/Disable switch (if equipped).
- Place controls in neutral position.
- Shut down the engine and remove the ignition key.
- Wait a minimum of 2 minutes and then turn the battery disconnect switch to the OFF position.
- Chock the wheels, if not on outriggers.
- Lock the operator's cab (if applicable) and install vandal guards, if used.

COLD WEATHER OPERATION

Cold weather operation requires additional caution on the part of the operator.

Check operating procedures in this manual for cold weather starting.

Don't touch metal surfaces that could freeze you to them.

Clean the crane of all ice and snow.

Allow at least 30 minutes of engine run time for hydraulic oil to warm up.

Plastic components (battery casings, heater controls, dash controls, etc.) are extremely brittle in extreme cold. Use

caution handling and operating these components in sub-zero temperatures, avoiding shock loading.

In freezing weather, park the crane in an area where it cannot become frozen to the ground. The drive line can be damaged when attempting to free a frozen crane.

If applicable to your crane, frequently check all air tanks for water in freezing weather.

If applicable to your crane, always handle propane tanks according to the supplier's instructions.

Never store flammable materials on the crane.

If cold weather starting aids are provided on your crane, use them. The use of aerosol spray or other types of starting fluids containing ether/volatiles can cause explosions or fire.

TEMPERATURE EFFECTS ON HOOK BLOCKS

The Hook Block Working Load Limit (WLL) is valid between 60°C (140°F) and the low temperature limit given on the hook block identification plate with normal lifting precautions.

Lifting above 75% of the Working Load Limit, at temperatures between the service temperature given on the identification plate and -40°C (-40°F), must be done at a slow and steady rate to avoid stress spikes.

75% of the Working Load Limit must not be exceeded when lifting in temperatures below -40°C (-40°F).

For
Reference
Only

TEMPERATURE EFFECTS ON HYDRAULIC CYLINDERS

Hydraulic oil expands when heated and contracts when cooled. This is a natural phenomena that happens to all liquids. The coefficient of expansion for API Group 1 hydraulic oil is approximately 0.00077 cm³ per cm³ of volume for 1°C of temperature change (0.00043 in³ per in³ of volume for 1°F of temperature change). **Thermal contraction will allow a cylinder to retract as the hydraulic fluid which is trapped in the cylinder cools.**

The change in the length of a cylinder is proportional to the extended length of the cylinder and to the change in temperature of the oil in the cylinder. For example, a cylinder extended 7.6 m (25 ft) in which the oil cools 15.5°C (60°F) would retract approximately 196 mm (7 3/4 in) [see Table 2-9 and Table 2-8]. The rate at which the oil cools depends on many factors and will be more noticeable with a larger difference in oil temperature verses the ambient temperature.

Thermal contraction coupled with improper lubrication or improper wear pad adjustments may, under certain conditions, cause a “stick-slip” condition in the boom. This “stick-slip” condition could result in the load not moving smoothly. Proper boom lubrication and wear pad adjustment is important to permit the boom sections to slide freely. Slow

movement of the boom may be undetected by the operator unless a load is suspended for a long period of time. To minimize the effects of thermal contraction or “Stick-slip” it is recommended that the telescope control lever is activated periodically in the extend position to mitigate the effects of cooling oil.

If a load and the boom is allowed to remain stationary for a period of time and the ambient temperature is cooler than the trapped oil temperature, the trapped oil in the cylinders will cool. The load will lower as the telescope cylinder(s) retracts allowing the boom to come in. Also, the boom angle will decrease as the lift cylinder(s) retracts causing an increase in radius and a decrease in load height.

This situation will also occur in reverse. If a crane is set up in the morning with cool oil and the daytime ambient temperature heats the oil, the cylinders will extend in similar proportions.

Table 2-8 and Table 2-9 have been prepared to assist you in determining the approximate amount of retraction/extension that may be expected from a hydraulic cylinder as a result of change in the temperature of the hydraulic oil inside the cylinder. The chart is for dry rod cylinders. If the cylinder rod is filled with hydraulic oil, the contraction rate is somewhat greater.

Reference Only

Table 2-8: Boom Drift Chart (Cylinder length change in inches)

Coeff. = 0.00043 (in ³ /in ³ /°F)											
STROKE	Temperature Change (°F)										
(FT.)	10	20	30	40	50	60	70	80	90	100	
5	0.26	0.52	0.77	1.03	1.29	1.55	1.81	2.06	2.32	2.58	
10	0.52	1.03	1.55	2.06	2.58	3.10	3.61	4.13	4.64	5.16	
15	0.77	1.55	2.32	3.10	3.87	4.64	5.42	6.19	6.97	7.74	
20	1.03	2.06	3.10	4.13	5.16	6.19	7.22	8.26	9.29	10.32	
25	1.29	2.58	3.87	5.16	6.45	7.74	9.03	10.32	11.61	12.90	
30	1.55	3.10	4.64	6.19	7.74	9.29	10.84	12.38	13.93	15.48	
35	1.81	3.61	5.42	7.22	9.03	10.84	12.64	14.45	16.25	18.06	
40	2.06	4.13	6.19	8.26	10.32	12.38	14.45	16.51	18.58	20.64	
45	2.32	4.64	6.97	9.29	11.61	13.93	16.25	18.58	20.90	23.22	
50	2.58	5.16	7.74	10.32	12.90	15.48	18.06	20.64	23.22	25.80	
55	2.84	5.68	8.51	11.35	14.19	17.03	19.87	22.70	25.54	28.38	
60	3.10	6.19	9.29	12.38	15.48	18.58	21.67	24.77	27.86	30.96	

Length change in inches = Stroke (Ft.) X Temperature Change (°F) X Coeff. (in³/in³/°F) X 12 in/ft

Table 2-9 Boom Drift Chart (Cylinder length change in millimeters)

Coeff. = 0.000774 (1/°C)		<i>Metric</i>									
STROKE	Temperature Change (°C)										
(m)	5	10	15	20	25	30	35	40	45	50	55
1.5	6	12	17	23	29	35	41	46	52	58	64
3	12	23	35	46	58	70	81	93	104	116	128
4.5	17	35	52	70	87	104	122	139	157	174	192
6	23	46	70	93	116	139	163	186	209	232	255
7.5	29	58	87	116	145	174	203	232	261	290	319
9	35	70	104	139	174	209	244	279	313	348	383
10.5	41	81	122	163	203	244	284	325	366	406	447
12	46	93	139	186	232	279	325	372	418	464	511
13.5	52	104	157	209	261	313	366	418	470	522	575
15	58	116	174	232	290	348	406	464	522	581	639
16.5	64	128	192	255	319	383	447	511	575	639	702
18	70	139	209	279	348	418	488	557	627	697	766

Length change in mm = Stroke (m) X Temperature Change (°C) X Coeff. (1/°C) X 1000 mm/m

HOIST PLATFORM



DANGER

Do not use platform for hauling passengers. Death or serious injury could occur.

No storage of components are allowed on the platform.

Only one person at a time is allowed on the platform.

OVERLOAD INSPECTION

When the Rated Capacity Limiter (RCL) system has acknowledged an overload on your crane, you must carry out specified inspections on the crane.

These inspections apply only to overloads up to 50%. For overloads of 50% or higher, crane operation must be stopped immediately and Crane Care must be contacted for corrective action.

The following illustrations may not be an exact representation of your crane and are to be used for reference only.

WARNING

Overload Hazard!

To avoid an accident caused by overload damage to your crane:

- Perform the inspections outlined in this publication for overloads up to 50%.
 - Stop operating the crane and contact Manitowoc Crane Care immediately for overloads of 50% and higher.
-

NOTE: If your crane is equipped with CraneSTAR, an overload warning will be posted to the web site for review by the crane owner.

Overload warnings do NOT indicate real time events! Warnings could be sent 24 hours (or more) after the actual event.

For
Reference
Only

Boom Inspection

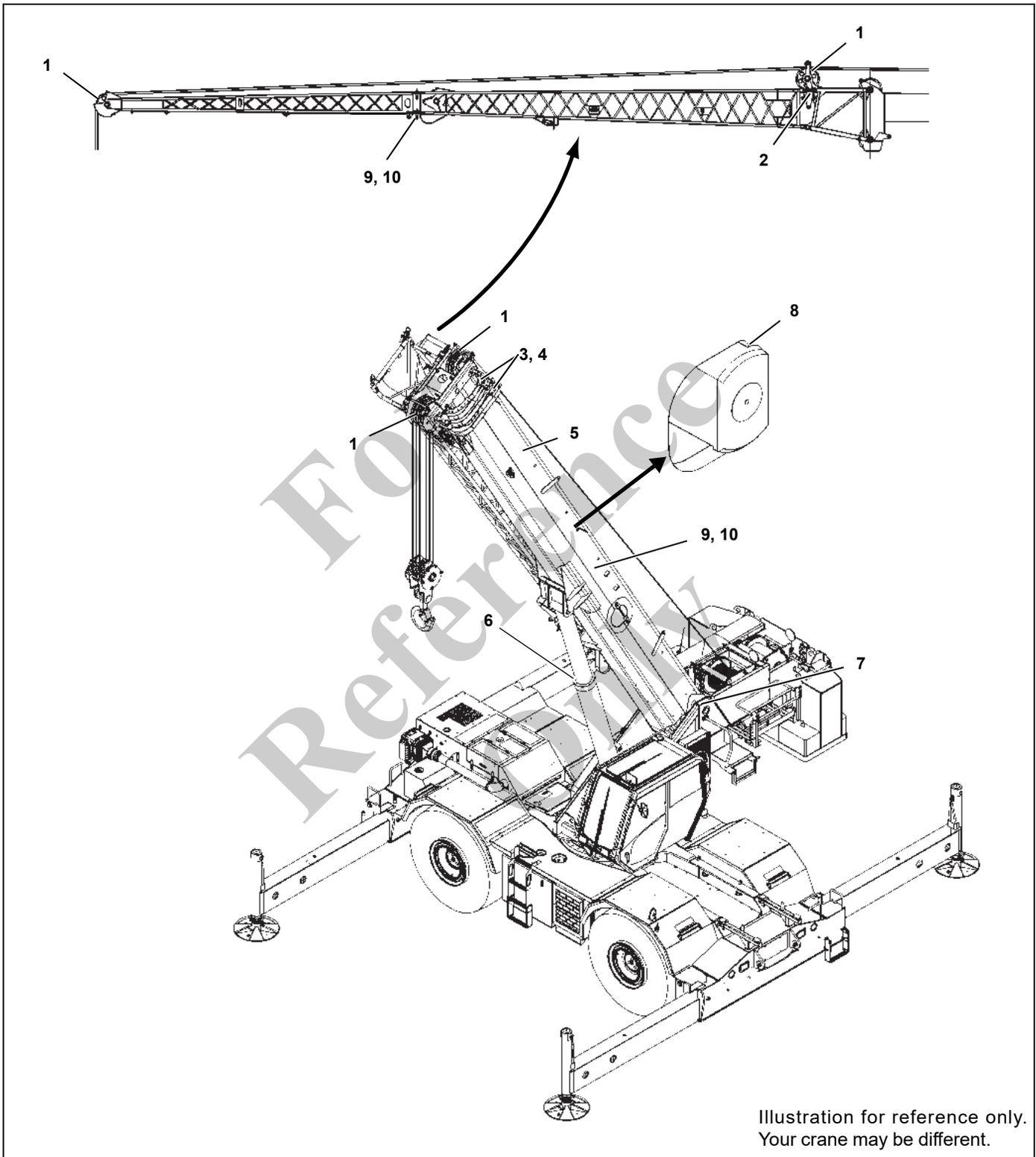
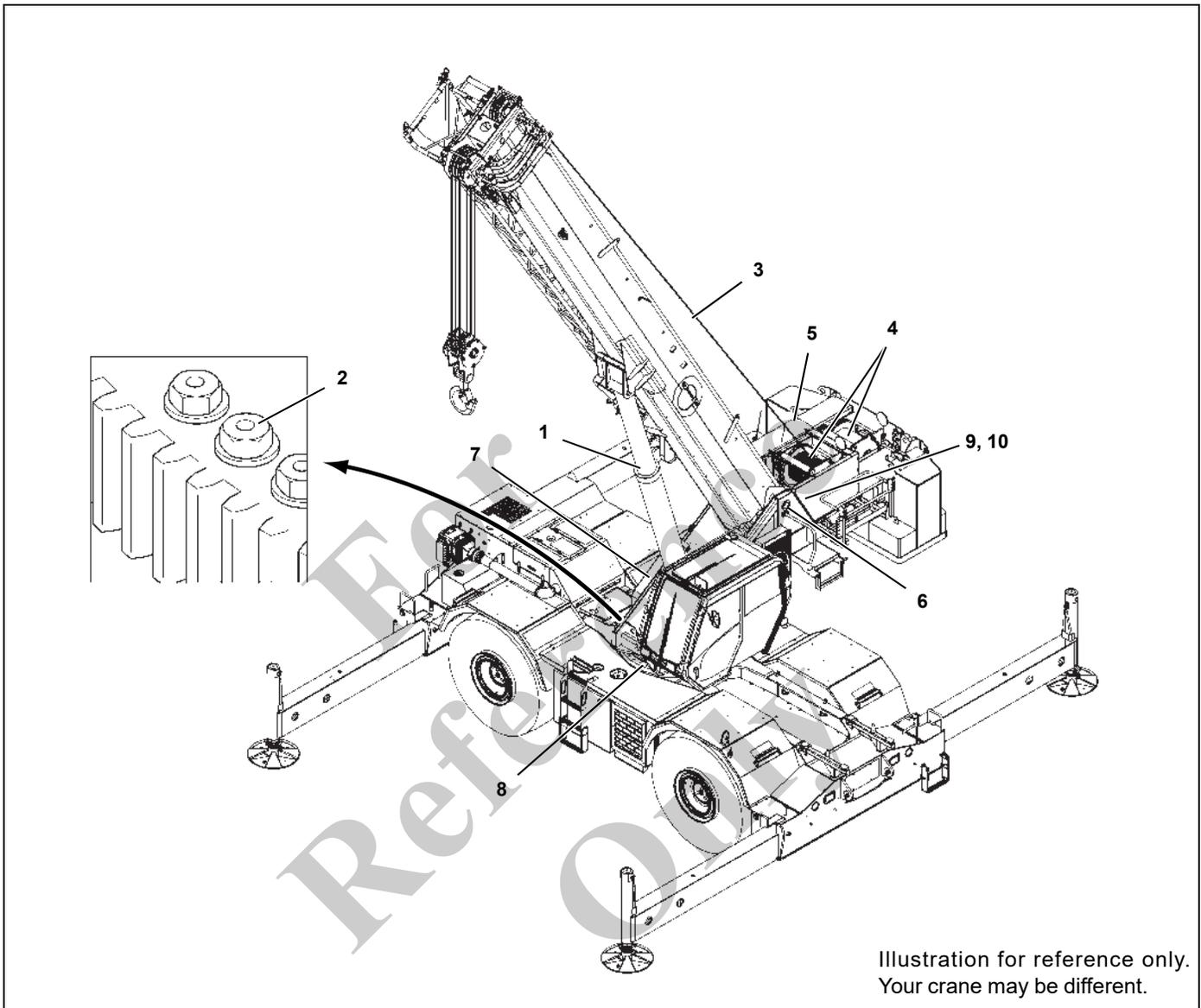


Illustration for reference only.
Your crane may be different.

NOTE: The following checklist includes all features that can be found on Grove cranes. Your crane may not have some features.

Overload less than 25%			
1	Sheaves	Inspect all for damage.	
2	Boom Extension Offset Mechanism/ Cylinder	Inspect for damage/leaks.	
3	Collar-wear pads	Inspect all for damage.	
Overload from 25% to 49%			
1	Sheaves	Inspect all for damage.	
2	Luffing Mechanism/ Cylinder	Inspect for damage/leaks.	
3	Collar-wear pads	Inspect all for damage.	
4	Collar-welds	Inspect all for cracks.	
5	Telescopic Sections	Inspect for bent or twisted sections. Check the boom for straightness.	
6	Lift Cylinder Head Area	Inspect for bends or cracked welds.	
7	Turntable	Inspect for cracked welds.	
8	Locking Area (Pin Booms)	Inspect for elongated holes.	
9	Welds	Inspect for cracks.	
10	Paint	Inspect for cracked paint which could indicate twisted, stretched, or compressed members.	

Superstructure Inspection



NOTE: The following checklist includes all features that can be found on Grove cranes. Your crane may not have some features.

Overload less than 25%			
1	Lift Cylinder	Inspect for leaking.	
2	Turntable Bearing	Check bolts for proper torque.	See topic in Swing section of Service Manual.
3	Wire Rope	Inspect all for damage.	See topic in Introduction section of Service Manual.
Overload from 25% to 49%			
1	Lift Cylinder	Inspect for leaking.	
2	Turntable Bearing	Check bolts for proper torque.	See topic in Swing section of Service Manual.
3	Wire Rope	Inspect all for damage.	See topic in Introduction section of Service Manual.
4	Hoist/Drums	Inspect each for damage.	
5	Hoist Brakes	Brakes must hold rated line pull.	
6	Bearing Main Boom Pivot Pin	Inspect for deformation, cracked welds.	
7	Lift Cylinder-lower mount	Inspect pin and welds.	
8	Turntable	Inspect for deformation, cracked welds.	
9	Welds	Inspect for cracks.	
10	Paint	Inspect for cracked paint which could indicate twisted, stretched, or compressed members.	

Carrier Inspection

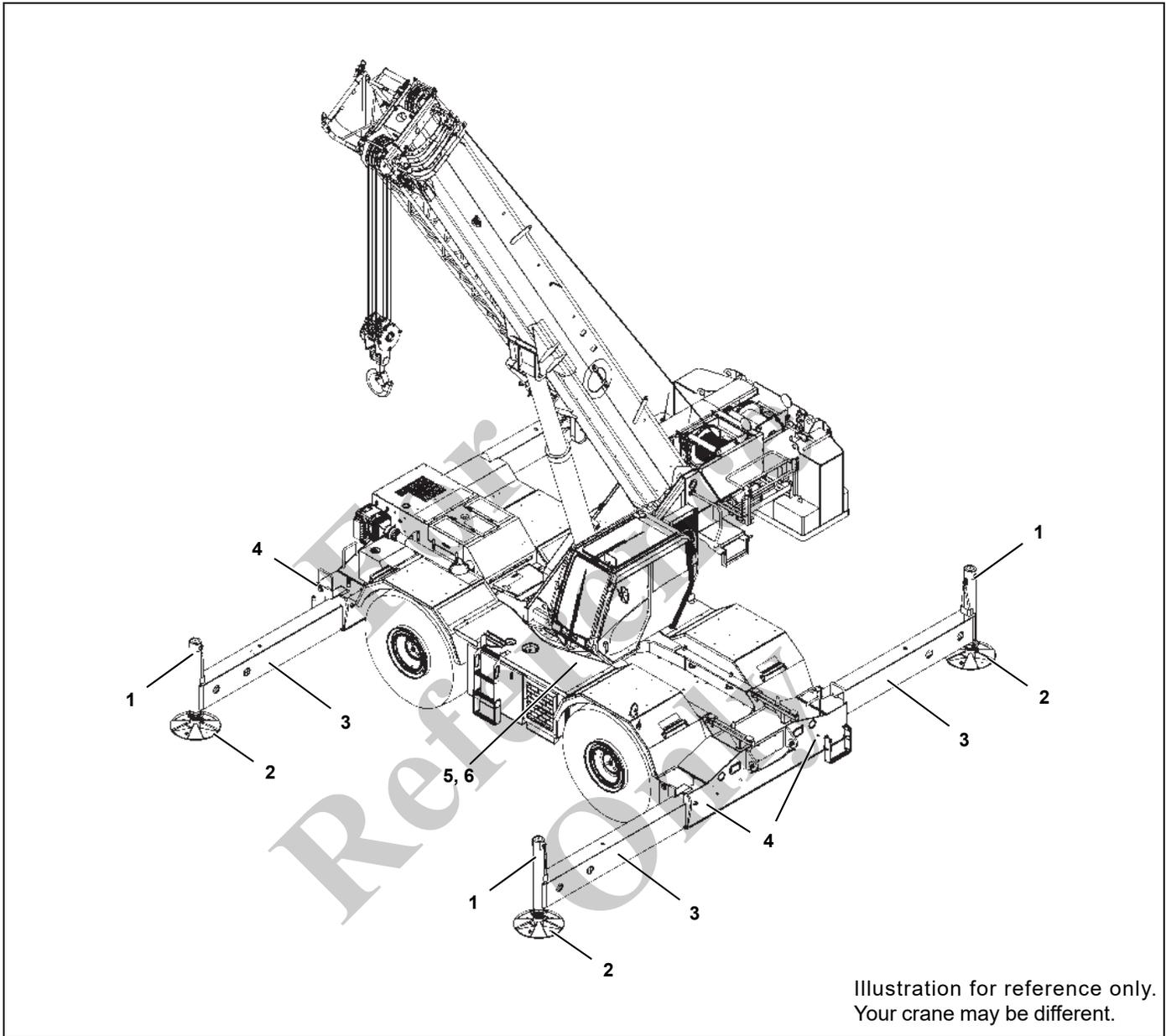


Illustration for reference only.
Your crane may be different.

NOTE: The following checklist includes all features that can be found on Grove cranes. Your crane may not have some features.

Overload less than 25%			
1	Jack Cylinders	Inspect for leaking.	
2	Outrigger Pads	Inspect for deformation and/or cracked welds.	
Overload from 25% to 49%			
1	Jack Cylinders	Inspect for leaking.	
2	Outrigger Pads	Inspect for deformation and/or cracked welds.	
3	Outrigger Beams	Inspect for deformation and/or cracked welds.	
4	Outrigger Boxes	Inspect for deformation and/or cracked welds.	
5	Welds	Inspect for cracks.	
6	Paint	Inspect for cracked paint which could indicate twisted, stretched, or compressed members.	

Reference Only

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SECTION 3

OPERATING CONTROLS AND FEATURES

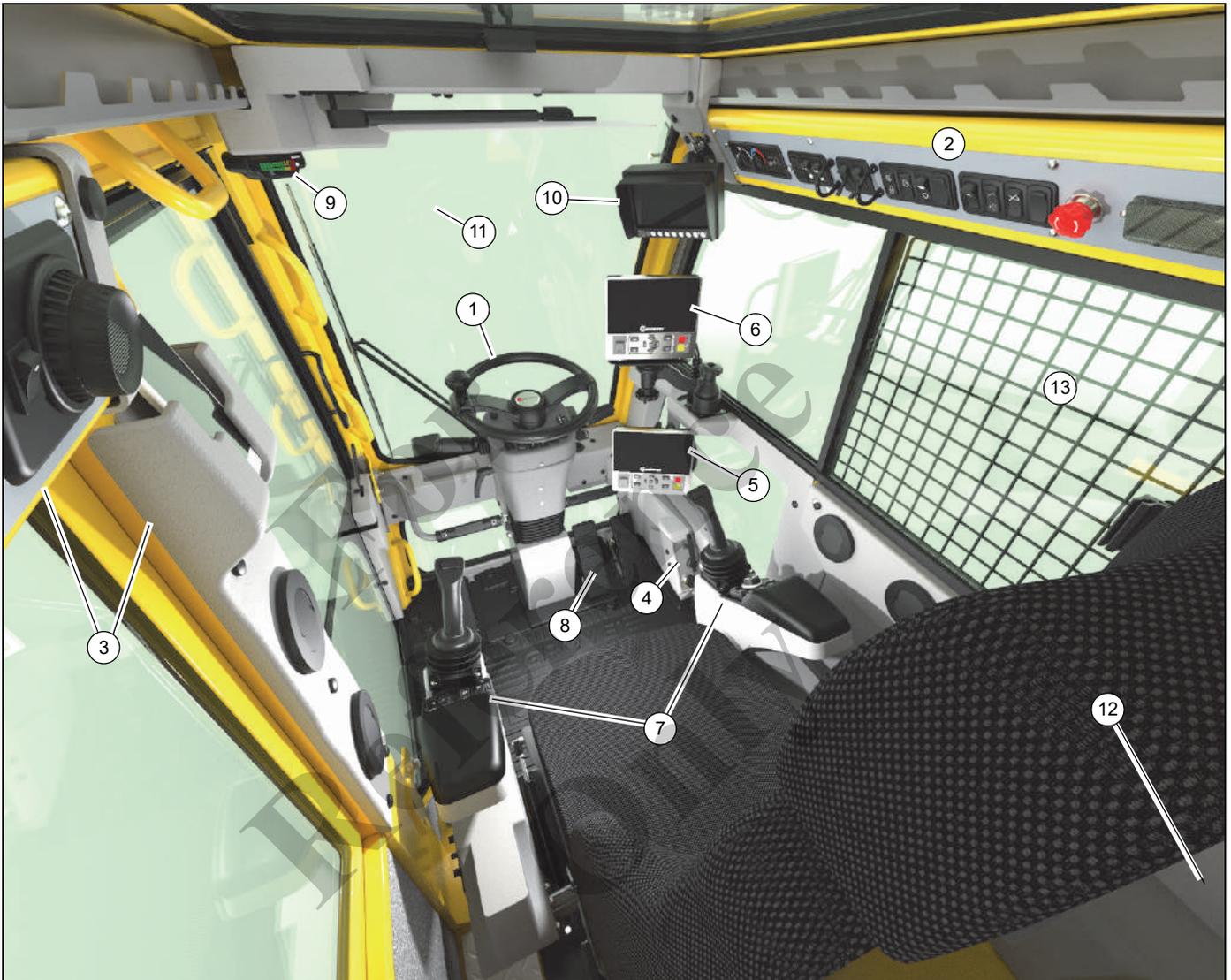
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OPERATOR CAB OVERVIEW

Most of the controls and indicators that are used to operate and monitor crane functions are found inside the operator cab (Figure 3-1).



3

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FIGURE 3-1

STEERING WHEEL AND COLUMN

The steering wheel and column assembly is a pedestal style tilt and telescoping steering column. It can tilt rearward 30° or telescope 60 mm (2.3 in). The steering column includes the ignition switch, as well as levers, and switches for driving the crane (Figure 3-2).



9838-6

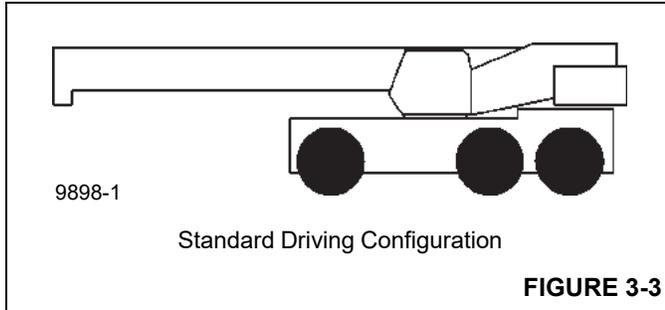
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FIGURE 3-2

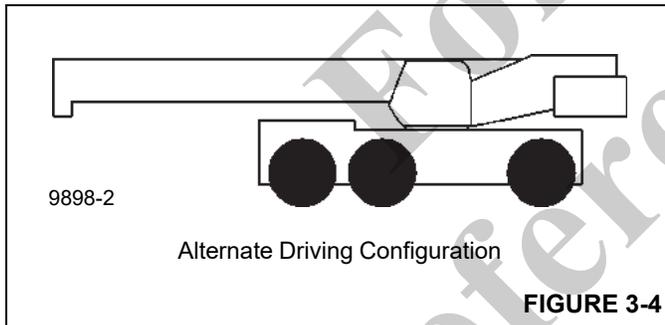
Steering Wheel

The Steering Wheel (1, Figure 3-2) is used to turn the wheels on the front single axle.

The GRT9165 crane can be driven with the boom centered over the front (single axle). This Standard Driving Configuration is shown in Figure 3-3.



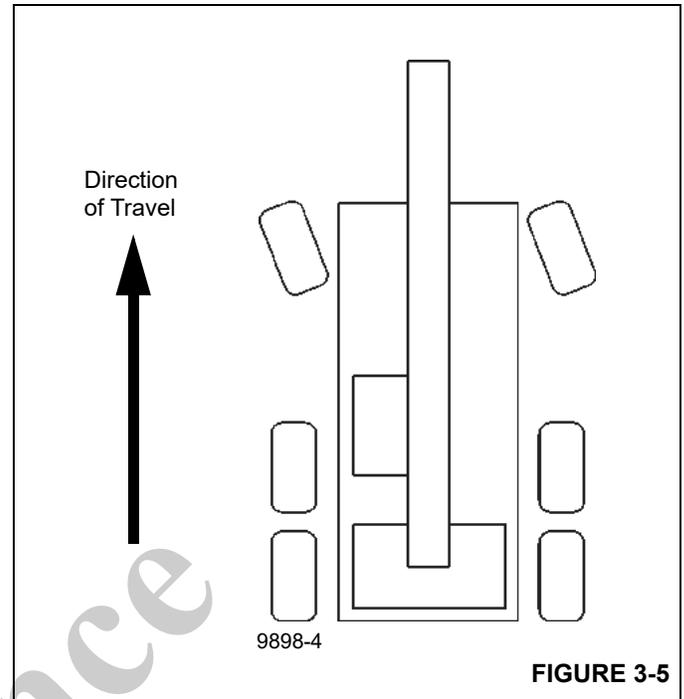
The GRT9165 crane can also be driven with the boom centered over the rear (tandem axles). This Alternate Driving Configuration is shown in Figure 3-4.



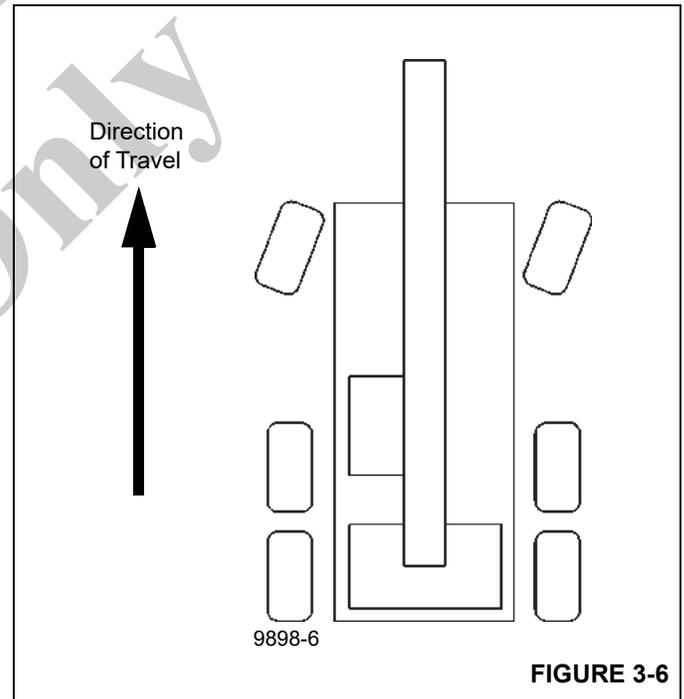
Standard Driving Configuration

The Standard Driving Configuration for the GRT9165 is with the boom centered over the front single axle.

In this Standard Driving Configuration, turning the steering wheel counterclockwise turns the wheels on the front single axle to the left, which causes the crane to turn left (Figure 3-5).



Turning the steering wheel clockwise turns the wheels on the front single axle to the right, which causes the crane to turn right (Figure 3-6).



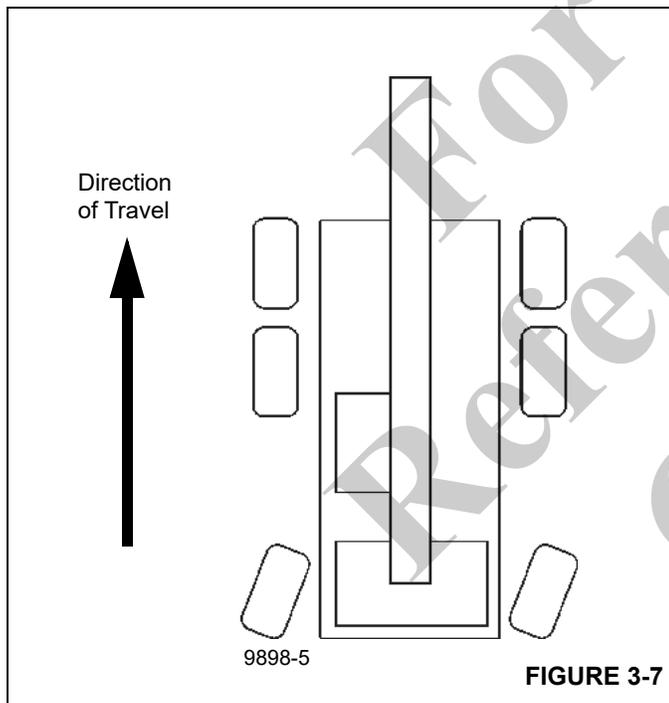
Alternate Driving Configuration

The Alternate Driving Configuration for the GRT9165 is with the boom centered over the rear tandem axles.

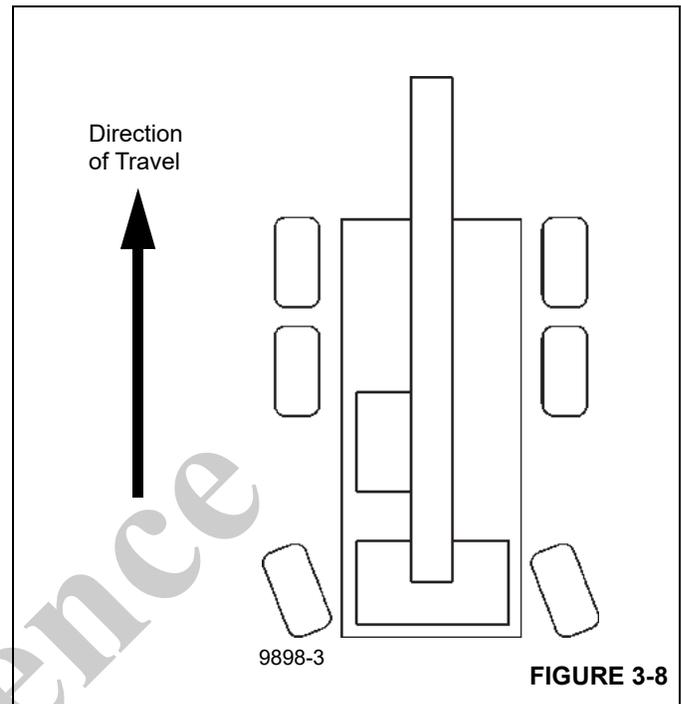
Before driving the crane in the Alternate Driving Configuration—with the boom centered over the rear tandem axles—push the Steering Reversal Switch (16, Figure 3-9), located in the Right Overhead Control Panel, one time to reverse all driving controls, including the steering wheel control.

The Steering Reversed Indicator in the Alerts Area (1, Figure 4-74) and Crane Status Area (4, Figure 4-74) of the Operator Display Module (ODM) comes on to indicate the steering wheel control is reversed.

In this Alternate Driving Configuration, the steering wheel continues to turn the wheels of the single axle, which are now behind the operator. Thus, turning the steering wheel counterclockwise turns the wheels on the single axle to the right, which causes the crane to turn left (Figure 3-7).



Turning the steering wheel clockwise turns the wheels on the single axle to the left, which causes the crane to turn right (Figure 3-8).



NOTE: When driving the crane with the boom centered over the rear tandem axles, the steering axle and wheels are behind the operator. Thus, the operator must become familiar with the steering characteristics of a rear-steering axle, including the tail-swing of the crane, before driving the crane at higher speeds and around obstacles.

Before driving the crane, read, understand, and follow the directions found in these sections of this *Operator Manual*:

- *Steering Wheel*, page 3-5
- *Standard Driving Configuration*, page 3-5
- *Alternate Driving Configuration*, page 3-6
- *Turn Signal Lever and Horn Controls*, page 3-6
- *Transmission Shift Lever*, page 3-8
- *Steering Reversal Switch*, page 3-14
- *Rear Steer Switch*, page 3-28

Turn Signal Lever and Horn Controls

The Turn Signal Lever (2, Figure 3-2) is located on the left side of the steering column. The Horn Control is located on the end of the Turn Signal Lever.

Push the small button on the end of the turn signal lever to operate the horn.

Push the Turn Signal Lever down. The turn signal lights on the carrier, to the left of the operator, will flash. Push the Turn Signal Lever up. The turn signal lights on the carrier, to the right of the operator, will flash.

The GRT9165 crane can be driven in the Standard Driving Configuration—with the boom centered over the front (single axle) or, in the Alternate Driving Configuration—with the boom centered over the rear (tandem axles).

The turn signal lever control can be reversed to allow it to operate intuitively when driving in these two directions,

Before driving the crane in the Alternate Driving Configuration—with the boom centered over the rear (tandem axles), push the Steering Reversal Switch (16, Figure 3-9) one time to reverse all driving controls, including the turn signal lever control. The Steering Reversed Indicator in the Alerts Area (1, Figure 4-74) and Crane Status Area (4, Figure 4-74) of the Operator Display Module (ODM) comes on to indicate that all driving controls, including the turn signal lever control, are reversed.

When the boom is swung back and centered over the front (single axle), push the Steering Reversal Switch again to set the turn signal lever control back to its normal operation. The Steering Reversed Indicator on the ODM goes off to indicate that the turn signal lever control is not reversed.

Before driving the crane, read, understand, and follow the directions found in these sections of this *Operator Manual: Steering Wheel*, page 3-5

- *Standard Driving Configuration*, page 3-5
- *Alternate Driving Configuration*, page 3-6
- *Turn Signal Lever and Horn Controls*, page 3-6
- *Transmission Shift Lever*, page 3-8
- *Steering Reversal Switch*, page 3-14
- *Rear Steer Switch*, page 3-28

Parking Brake Switch

CAUTION

Avoid Crane Damage!

Do not engage the parking brake while the vehicle is moving. Damage to the crane can occur.

Disengage the parking brake before driving. Damage to the crane can occur.

The Parking Brake Switch (3, Figure 3-2) is located on the front of the steering column.

This two-position, locking rocker switch (ON/OFF) is used to apply and release the parking brake on the drive line.

To apply parking brake, first slide the red switch at bottom of rocker switch forward, then push top of rocker switch. Push bottom of switch to release the parking brake.

The Parking Brake Indicator in the Alerts Area (1, Figure 4-74) and Crane Status Area (4, Figure 4-74) of the Operator Display Module (ODM) comes on to indicate the parking brake is applied.

The buzzer comes on if the parking brake is applied and the Transmission Shift Lever (7, Figure 3-2) is in the forward (up) or reverse (down) position. Always place Transmission Shift Lever in neutral (center) position before applying the parking brake.

NOTE: Parking brake must be applied before outriggers can be operated.

Headlights Switch

The Headlights Switch (4, Figure 3-2) is located on the front of the steering column.

This three-position rocker switch (OFF/Park/Headlight) controls the operation of the switch LEDs as well as the headlights, marker lights, and taillights on the front and rear of the crane.

Push bottom of switch to cause the headlights, marker lights, and taillights to go off. Set rocker switch to center position to cause the marker and taillights to come on. Push top of switch to cause the headlights on the front and back of the crane to come on.

Drive Axle Selector Switch

The Drive Axle Selector Switch (5, Figure 3-2) is located on the front of the steering column.

This two-position rocker switch is used to select two-wheel drive (high range) or four-wheel drive (low range).

Push top of switch to engage four-wheel drive (low range). Push bottom of switch to engage two-wheel drive (high range).

NOTE: To change between drive modes, operator must set the Transmission Shift Lever (7, Figure 3-2) to the center Neutral position and push and hold the Service Brake Pedal (2, Figure 3-26).

The Four-Wheel Drive Indicator in the Crane Status Area (4, Figure 4-74) of the Operator Display Module (ODM) comes on to indicate that the drive mode is set to four-wheel drive. The indicator changes back to the Two-Wheel Drive Indicator when the drive mode is set to two-wheel drive.

The Transmission Not-In-Neutral Indicator in the Alerts Area (1, Figure 4-74) of the ODM comes on when the operator attempts to shift between drive modes without first shifting the transmission shift lever to neutral and pushing and holding the service brake pedal.

NOTE: Transmission must be shifted to four-wheel drive (low range) before outriggers can be operated.

Hazard Lights Switch

The Hazard Lights Switch (6, Figure 3-2) is located on the front of the steering column.

The switch is a two-position rocker switch (ON/OFF).

Push top of switch to cause the turn signal lights on the front and back of the crane, and the turn signal indicator lights on the steering column, to flash at the same time. Push bottom of switch to cause these lights and indicators to go off.

Transmission Shift Lever

CAUTION

Transmission Damage!

To prevent transmission damage, shift between two-wheel and four-wheel drive only with crane is stopped, transmission in Neutral (center) position, and service brake pedal pushed.

The Transmission Shift Lever (7, Figure 3-2) is located on the right side of the steering column. The lever is used to shift the transmission between forward, neutral, and reverse.

Push Transmission Shift Lever up to shift transmission to forward gear. Push Transmission Shift Lever down to shift transmission to reverse gear.

The lever sits in a detent when in the center neutral position. Thus, operator must first lift up on lever before pushing it up or down.

A shift interlock system prevents the transmission from being shifted between forward, neutral, and reverse without first pushing and holding the Service Brake Pedal (2, Figure 3-26). Thus, crane must be stopped, and Service Brake Pedal pushed and held before shifting between forward and reverse gears.

NOTE: Transmission Shift Lever must be in Neutral (center position) before the following operations can be performed:

- Shifting transmission between two-wheel drive (high range) and four-wheel drive (low range)
- Operating the outriggers
- Reversing the driving controls (refer to *Steering Reversal Switch*, page 3-14)

To shift transmission to first, second, or third gear, rotate knob at end of the lever to I, II, or III.

The transmission has six forward gears and six reverse gears. To use the three low gears, set Drive Axle Selector Switch (5, Figure 3-2) to four-wheel drive. To use the three

high gears, set Drive Axle Selector Switch to two-wheel drive.

The Direction/Gear Indicator in the Crane Information Area (3, Figure 4-74) of the Operating Display Module (ODM) shows the chosen direction of travel and chosen gear to which the transmission is shifted.

The GRT9165 crane can be driven in the Standard Driving Configuration with the boom centered over the front (single axle) or in the Alternate Driving Configuration with the boom centered over the rear (tandem axles).

The transmission shift lever control can be reversed to allow it to operate intuitively when driving in either of these two directions,

Before driving the crane in the Alternate Driving Configuration, with the boom centered over the rear (tandem axles), push the Steering Reversal Switch (16, Figure 3-9) one time to reverse all driving controls, including the transmission shift lever control. The Steering Reversed Indicator in the Alerts Area (1, Figure 4-74) and Crane Status Area (4, Figure 4-74) of the Operator Display Module (ODM) comes on to indicate that all driving controls, including the transmission shift lever control, are reversed.

When the boom is swung back and centered over the front (single axle), push the Steering Reversal Switch again to set the transmission shift lever control back to its normal operation. The Steering Reversed Indicator on the ODM goes off to indicate that the transmission shift control lever is not reversed.

Before driving the crane, read, understand, and follow the directions found in these sections of this *Operator Manual*:

- *Steering Wheel*, page 3-5
- *Standard Driving Configuration*, page 3-5
- *Alternate Driving Configuration*, page 3-6
- *Turn Signal Lever and Horn Controls*, page 3-6
- *Transmission Shift Lever*, page 3-8
- *Steering Reversal Switch*, page 3-14
- *Rear Steer Switch*, page 3-28

Ignition Switch

The Ignition Switch (8, Figure 3-2) is located on the right side of the steering column, below the Transmission Shift Lever (7, Figure 3-2).

The Ignition Switch is key-operated and has three positions: 0 (OFF), I (RUN), and II (START).

In the OFF(0) position, most electrical power is off. Electrical items that continue to operate include the horn, headlights, turn signal/hazard/stop lights, dome light, and work lights.

Turn Ignition Switch to the RUN (I) position to energize all electrical components except the starting circuit.

Turn Ignition Switch to the START (II) position to energize the start circuit and crank the engine for starting. Release ignition switch when the engine starts.

The Ignition Switch is spring-returned from START (II) to RUN (I). Turn Ignition Switch to the OFF (0) position to stop the engine.

The Ignition Switch has an anti-restart feature. After a failed attempt to start the engine, the crane control system

prevents the engine from cranking again for approximately six seconds.

Steering Column Tilt and Telescope Lock Lever

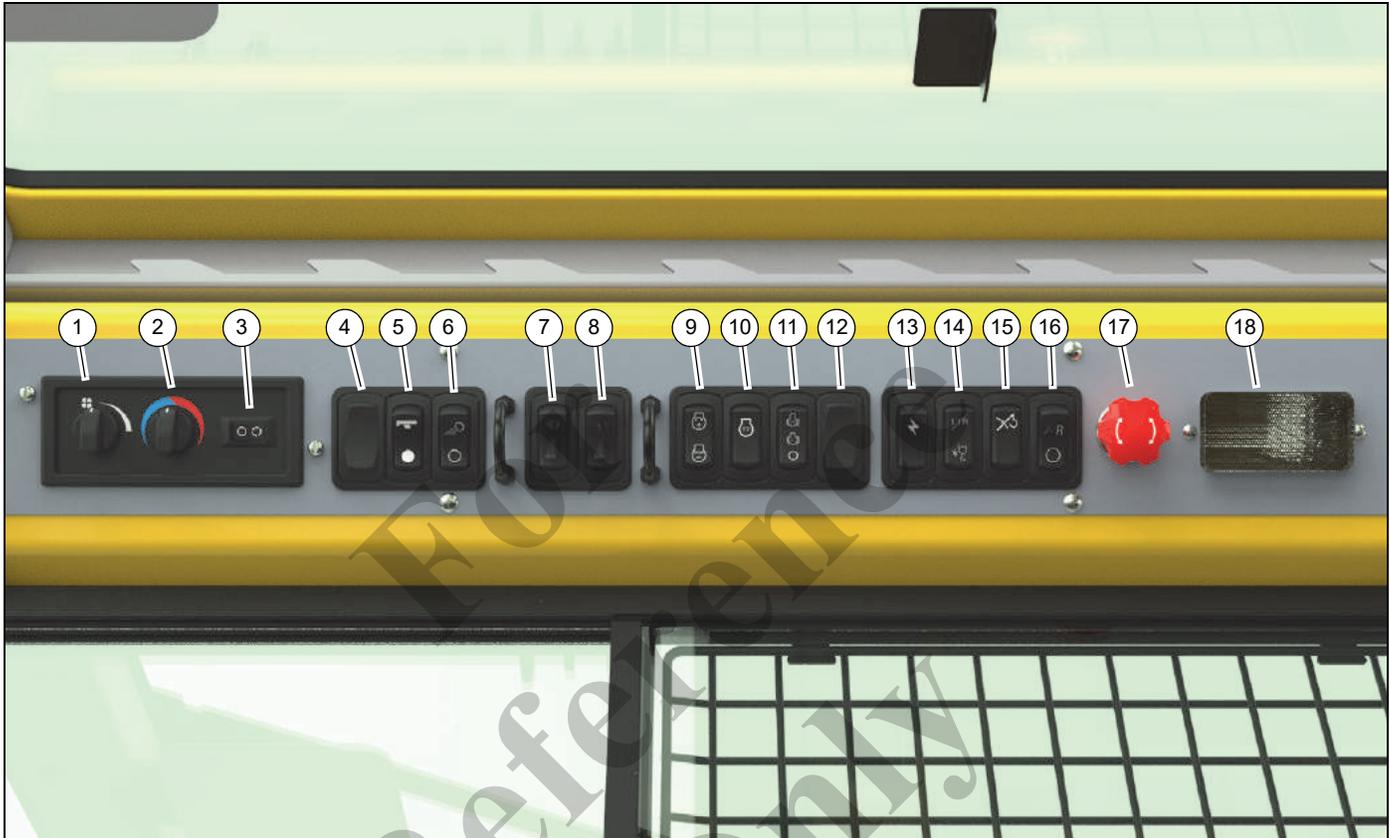
The steering control column can be rotated rearward approximately 30° and telescoped approximately 60 mm (2.3 in).

Rotate the Lock Lever (9, Figure 3-2) clockwise to lock the steering column in place. Rotate the lever counterclockwise to release the steering column for adjustment.

For
Reference
Only

RIGHT OVERHEAD CONTROL PANEL

The right overhead control panel (Figure 3-9) includes controls for operating the heating and air conditioning system, front and skylight window wipers, engine, and craning functions.



9838-3c

Item	Description	Page	Item	Description	Page
1	Heater/Air Conditioner Fan Speed Switch	3-11	11	Engine Brake Switch (Optional)	3-12
2	Heater/Air Conditioner Temperature Control Switch	3-11	12	Remote Control Enable/Disable Switch	3-12
3	Fresh Air/Recirculation Air Switch	3-11	13	Crane Function Enable/Disable Switch	3-12
4	Boom-Mounted Lights Motor Switch (Optional)	3-11	14	Momentary Limit Bypass Switch (Non-CE Certified Cranes)	3-13
5	Boom-Mounted Lights Switch (Optional)	3-11	14	Limit Bypass Set-up Switch (CE Certified Cranes)	3-13
6	Cab-Mounted Lights Switch	3-11	15	Boom Up Bypass Switch	3-14
7	Front Window Wiper and Washer Switch	3-11	16	Steering Reversal Switch	3-14
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FIGURE 3-9

Heater/Air Conditioner Fan Speed Switch

The Heater/Air Conditioner Fan Speed Switch (1, Figure 3-9) is located on the right overhead control panel.

The rotary switch controls the cab fan speed and volume of heated or cooled air output. Settings are off, low speed, medium speed, and high speed.

Turn the rotary switch clockwise to increase fan air speed. Turn rotary switch counterclockwise to reduce fan air speed. Turn rotary switch to the fully counterclockwise position to stop fan.

Heater/Air Conditioner Temperature Control Switch

The Heater/Air Conditioner Temperature Control Switch (2, Figure 3-9) is located on the right overhead control panel.

The rotary switch controls the temperature of the air coming out of the heater/air conditioner vents.

Turn the rotary switch clockwise to increase the air temperature. Turn the rotary switch counterclockwise to decrease the air temperature.

Fresh Air/Recirculation Air Switch

The Fresh Air/Recirculation Air Switch (3, Figure 3-9) is located on the right overhead control panel.

The switch controls how outside air is drawn into the cab. Use Recirculation mode for maximum air conditioner performance in warm climates.

Push left side of the switch to draw outside air into the cab, when operating the heater system or air conditioner system. Push right side of the switch to recirculate the air inside the cab, and bring a small amount of outside air into the cab.

Boom-Mounted Lights Motor Switch (Optional)

The Boom-Mounted Lights Motor Switch (4, Figure 3-9) is located on the right overhead control panel.

The switch controls the direction to which the boom-mounted lights point. The switch is a three-position momentary rocker switch with center maintained position being OFF.

Push and hold top of the switch to point the lights up. Push and hold bottom of the switch to point the lights down. Release the switch when the lights are pointing in the desired direction.

Boom-Mounted Lights Switch (Optional)

The Boom-Mounted Lights Switch (5, Figure 3-9) is located on the right overhead control panel.

The switch controls the work lights mounted to the boom base section.

Push top of the switch to cause the lights to come on. Push bottom of switch to cause the lights to go off.

Cab-Mounted Lights Switch

The Cab-Mounted Lights Switch (6, Figure 3-9) is located on the right overhead control panel.

The switch controls the work lights mounted on the bottom front of the superstructure cab.

Push top of switch to cause the lights to come on. Push bottom of switch to cause the lights to go off.

Front Window Wiper and Washer Switch

The Front Window Wiper and Washer Switch (7, Figure 3-9) is located on the right overhead control panel.

The switch is a six-position toggle switch with integral rocker switch that controls the front window wiper and washer.

Push toggle switch up to operate the front window wiper at a slow intermittent speed. Push toggle switch farther up to operate the wiper at a faster speed. Pull toggle switch down to stop operating the front window wiper.

Push and hold top of rocker switch to spray the windshield with windshield washer fluid for cleaning. Release switch after the desired amount of windshield washer fluid has been sprayed onto the windshield.

Skylight Wiper and Washer Switch

The Skylight Wiper and Washer Switch (8, Figure 3-9) is located on the right overhead control panel.

The switch is a six-position toggle switch with integral rocker switch that controls the skylight wiper and washer on top of the cab.

Push toggle switch up to operate the skylight window wiper at a slow intermittent speed. Push toggle switch farther up to operate the wiper at a faster speed. Pull toggle switch down to stop operating the skylight window wiper.

Push and hold top of rocker switch to spray the skylight window with window washer fluid for cleaning. Release switch after the desired amount of window washer fluid has been sprayed onto the skylight.

Increment/Decrement – Start/Stop Switch

The Increment/Decrement – Start/Stop Switch (9, Figure 3-9) is located on the right overhead control panel.

The switch is a three-position momentary rocker switch with center maintained position being OFF. Use this switch to adjust engine operating speed and to start and stop the engine.

Quickly push and release top of switch to increase engine speed to high idle. Quickly push and release bottom of switch to decrease engine speed to low idle.

Push and hold top of switch to incrementally increase engine speed. Push and hold bottom of switch to incrementally decrease engine speed. Release switch when desired engine speed is reached.

With engine speed at low idle, push and hold bottom of switch until engine stops. To restart engine, push and hold top of switch until engine starts. Unlike the Ignition Switch, the Increment/Decrement – Start/Stop Switch can be used to stop the engine without disconnecting power to the electrical systems. Thus, using this switch to start and stop the engine during short breaks in craning operation saves time, as the ODM and RDM remain fully powered and programmed. The Increment/Decrement – Start/Stop Switch is also used to set the engine speed when using the Economy (ECO) Mode feature. Refer to *ECO Mode*, page 4-153 for details of its operation.

Engine Wait-To-Start Indicator

The Engine Wait-To-Start Indicator (10, Figure 3-9) is located on the right overhead control panel.

When the Ignition Switch (7, Figure 3-2) is turned to the RUN (I) position, the Engine Wait-to-Start Indicator will come on if the outside ambient temperature is low and preheating of the air inside the air-intake manifold is required.

Do not start the engine until the Wait-to-Start Indicator goes off (refer to *Start-Up Procedure*, page 4-8).

Engine Brake Switch (Optional)

The Engine Brake Switch (11, Figure 3-9) is located on the right overhead control panel.

The three-position switch (Off–Low–High) controls the engine Variable Geometry Turbo (VGT) brake.

Push top of switch (High) to cause the engine brake to operate with full braking action. Set switch to its center position (Low) to cause the engine brake to operate at its intermediate engine braking action. Push bottom of switch to set engine brake to off.

Use engine brake to help slow the crane when traveling down a slope. Using the engine brake will help reduce the risk of the service brakes overheating.

Remote Control Enable/Disable Switch

The Remote Control Enable/Disable Switch (12, Figure 3-9) is located on the right overhead control panel.

The switch is a two-position maintained switch that enables and disables the Remote Control Unit.

Push top of switch to enable the Remote Control Unit. Push bottom of switch to disable the Remote Control Unit.

When the Remote Control Unit is enabled, the Remote Control Unit Enabled Indicator shows green in the Status Bar (6, Figure 4-74) of the Operator Display Module (ODM).

Always position switch to the disabled position when Remote Control Unit is not in use.

If Remote Control Unit is enabled and one of the crane function enable/disable switches in the cab is pushed, the Remote Control Unit will be disabled.

Refer to *Remote Control Unit*, page 3-56 for an overview of the Remote Control Unit. Refer to *Using the Remote Control Unit*, page 4-53 for information pertaining to the operation of the Remote Control Unit.

Crane Function Enable/Disable Switch

The Crane Function Enable/Disable Switch (13, Figure 3-9) is located on the right overhead control panel.

The switch is a momentary switch that lets the operator enable and disable the default crane functions that are operated by the controllers on the armrests. These default crane functions include auxiliary hoist, swing, main hoist, and boom lift.

A crane function must be enabled before the function will operate.

The left controller operates the auxiliary hoist and swing functions. The right controller operates the main hoist function on one axis and the boom lift, telescope, and optional luffing boom extension function on the other axis. Only one of the three functions – boom lift, telescope, or luffing boom extension – can be enabled at a time.

An individual Enable/Disable Switch is provided to enable and disable each of the different crane functions. Alternatively, the Crane Function Enable/Disable Switch can be used to quickly enable the four default crane functions at the same time.

Push and release Crane Function Enable/Disable Switch one time to enable the four default crane functions. Push and release the switch again to disable the crane functions that are currently enabled.

Always disable all crane functions to prevent accidental operation, such as bumping the controllers while roading, or any other similar operation.

Enabling craning functions with the Crane Function Enable/Disable Switch will cause the engine speed to increase to 1200 rpm. Disabling craning functions with the switch will cause the engine speed to decrease to 750 rpm.

Momentary Limit Bypass Switch (Non-CE Certified Cranes)



WARNING

Overload Hazard!

The Limit Bypass Switch is used to override the RCL system during some rigging activities.

When the Limit Bypass Switch is activated, the operator must make sure that the crane is not overloaded.

Do not operate the crane with the RCL overridden during normal operations.

The Rated Capacity Limiter (RCL) system, when programmed accurately, will lock out the following crane functions—boom up/down, telescope extend, and hoist up—when a lift is attempted at or above crane capacity, or when a two-block condition exists.

Locking out these functions prevents the overload or two-block condition from worsening.

These same crane functions are locked out initially after the crane engine is started and before the RCL system has been programmed.

The Limit Bypass Switch (14, Figure 3-9) is a three-position, momentary type rocker switch located on the right overhead control panel.

During certain rigging work or to recover the crane, push and hold the top or bottom of the rocker switch to bypass the following limiter systems on the crane.

Push and hold bottom of rocker switch to bypass the following limiter systems and their crane function lockouts:

- Anti-Two-Block System (boom up/down, telescope extend, hoist up)
- 3rd Wrap Limiter System (hoist down)

The following indicators come on to indicate the limiters are bypassed:

- Anti-Two-Block Indicator is flashing (7, Figure 3-14)
- 3rd Wrap Indicator is flashing (in Alerts Area of ODM, Figure 4-74)

Push and hold top of rocker switch to bypass the following limiter systems and their crane function lockouts:

- RCL System (boom up/down, telescope extend, hoist up)
- Anti-Two-Block System (boom up/down, telescope extend, hoist up)
- 3rd Wrap Limiter System (hoist down)

- Working Range Limiter (WRL) System
- Carrier Avoidance System
- -29°C Temperature Limiter System (optional)

The following indicators come on to indicate the limiters are bypassed:

- Bypass 1 Pressed Indicator is on (2, Figure 4-208)
- RCL Bypass Active Indicator is on (1, Figure 4-208)
- RCL Shutdown Warning Indicator is flashing (5, Figure 3-14)
- Anti-Two-Block indicator is flashing (7, Figure 3-14)
- 3rd Wrap indicator is flashing (Figure 4-75)
- Working Range Limiter (WRL) indicator is flashing (Figure 4-75 and Figure 4-78)
- Low Boom Angle Indicator is flashing (Figure 4-75)
- -29°C Temperature Limiter Indicator is flashing (Figure 4-75)

All crane function lockouts are bypassed while the Limit Bypass Switch is held in the actuated position.

Limit Bypass Set-Up Switch (CE Certified Cranes)



WARNING

Overload Hazard!

The Limit Bypass Switch prevents the function lockouts from activating.

When the Lift Bypass Switch is activated, the operator must make sure that the crane is not overloaded.

Do not operate the crane with the RCL overridden during normal operations.

The Rated Capacity Limiter (RCL) system, when programmed accurately, will lock out the following crane functions—boom up/down, telescope extend, and hoist up—when a lift is attempted at or above crane capacity, or when a two-block condition exists.

Locking out these functions prevents the overload or two-block condition from worsening.

These same craning functions are locked out initially after the crane engine is started, and before the RCL system has been programmed.

The Limit Bypass Set-up Switch (14, Figure 3-9) is a three-position, momentary type rocker switch located on the right overhead control panel.

During certain rigging work or to recover the crane, push and release top or bottom of rocker switch to bypass the following limiter systems on the crane.

Push and release bottom of rocker switch to bypass the following limiter systems and their crane function lockouts:

- Anti-Two-Block System (boom up/down, telescope out, hoist up)
- 3rd Wrap Limiter System (hoist down)

The following indicators come on to indicate the limiters are bypassed:

- Anti-Two-Block Indicator (7, Figure 3-14) is flashing
- 3rd Wrap Indicator (Figure 4-75) is flashing

When the bottom of the rocker switch is pushed and released, all crane functions—boom up/down, telescope out/in, hoist up/down, and swing left/right—will operate at 50% of normal speed when actuated.

Push and release top of rocker switch to bypass the following limiter systems and their crane function lockouts:

- RCL System (boom up/down, telescope out, hoist up)
- Working Range Limiter (WRL) system
- Carrier Avoidance System

If RCL is programmed and active and the top of the limit bypass rocker switch is pushed and released, the swing left/right function pressure is reduced to 25% and the boom up/down, hoist up/down, and telescope extend/retract function speeds are reduced to 15% when actuated. If the load exceeds 110% of the indicated capacity, all craning functions will lock out.

The following indicators come on to indicate the limiters are bypassed:

- Bypass 1 Pressed Indicator (2, Figure 4-208) is on
- RCL Bypass Active Indicator (1, Figure 4-208) is on
- RCL Shutdown Warning Indicator (5, Figure 3-14) is flashing
- Working Range Limiter (WRL) Indicator (Figure 4-75 and Figure 4-78) is on
- Low Boom Angle Indicator (Figure 4-75) is flashing

If RCL has not been programmed and the top of the limit bypass rocker switch is pushed and released, the swing left/right, boom up/down, hoist up/down, and telescope extend/retract functions operate at normal speeds when actuated.

The following indicators come on to indicate the limiters are bypassed:

- Bypass 1 Pressed Indicator (2, Figure 4-208) is on

- RCL Bypass Active Indicator (1, Figure 4-208) is on
- RCL Shutdown Warning Indicator (5, Figure 3-14) is flashing
- Working Range Limiter (WRL) Indicator (Figure 4-75 and Figure 4-78) is on
- Low Boom Angle Indicator (Figure 4-75) is flashing

All craning functions locked out are bypassed until one of the following occurs:

- Top of the Limit Bypass Switch is again pushed and released while the controllers are in the neutral position
- Controllers are in the neutral position for 10 seconds

Boom Up Bypass Switch

The Boom Up Bypass Switch (15, Figure 3-9) is a two-position momentary rocker switch that is located on the right overhead control panel.

While boom lift function is enabled and in an RCL lockout condition, push and release the Boom Up Bypass Switch to enable boom lift up.

The following indicators come on to indicate the limiter is bypassed:

- Bypass 2 Pressed Indicator (2, Figure 4-208) is on constant (only when switch is pushed)
- RCL Bypass Active Indicator (1, Figure 4-208) is on constant
- RCL Shutdown Warning Indicator (5, Figure 3-14) is on constant when crane capacity is greater than 100%

For CE certified cranes only, the speed of the boom up function is reduced by 50% when actuated. For non-CE Certified cranes, the boom up function operates at normal speed when actuated.

The boom up function lockout is bypassed until one of the following occurs:

- Boom Up Bypass Switch is again pushed and released while controllers are in neutral position
- Boom up controller is in neutral position for 10 seconds, and load is greater than 90% crane capacity and less than or equal to 100% crane capacity
- Load is reduced to less than 90% of crane capacity

Steering Reversal Switch

The Steering Reversal Switch (16, Figure 3-9) is a momentary two-position rocker switch that is located on the right overhead control panel.

The Steering Reversal Switch is used to reverse the driving controls when changing crane direction of travel.

The GRT9165 crane can be driven in the Standard Driving Configuration—with the boom centered over the front (single axle). This Standard Driving Configuration is shown in Figure 3-10.

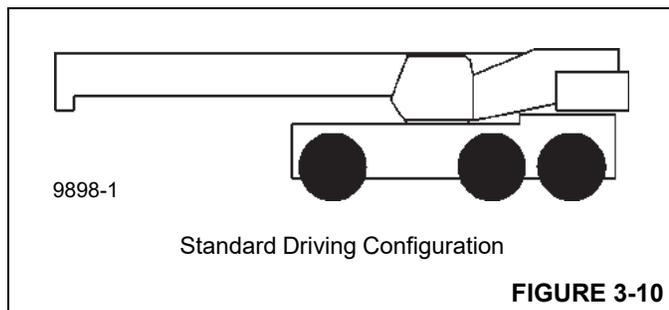


FIGURE 3-10

The GRT9165 crane can also be driven in the Alternate Driving Configuration—with the boom centered over the rear (tandem axles). This Alternate Driving Configuration is shown in Figure 3-11.

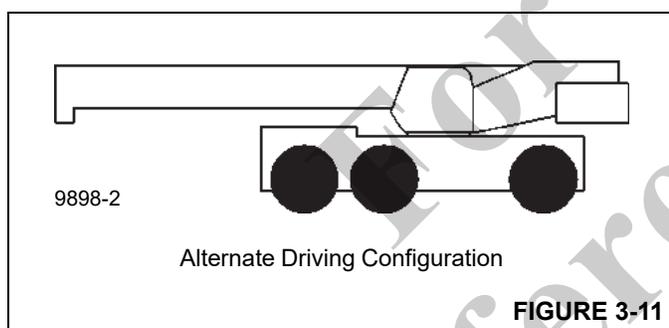


FIGURE 3-11

The Steering Reversal Switch is used to reverse the driving controls when changing between Standard Driving Configuration and Alternate Driving Configuration.

In the Standard Driving Configuration, all driving controls, including the steering wheel, turn signal lever control, transmission shift lever control, and the rear steer switch operate in a certain manner.

In the Alternate Driving Configuration, the operation of these same driving controls can be reversed for them to continue to operate in the same manner. Thus, before driving in the Alternate Driving configuration, the operator will use the Steering Reversal Switch to reverse these driving controls.

Before the driving controls can be reversed, the following conditions must be met:

- Crane is stopped
- Service Brake pedal is pushed and held

- Transmission Shift Lever is in Neutral position

Before driving the crane in the Alternate Driving Configuration with the boom centered over the rear (tandem axles), push the Steering Reversal Switch one time to reverse all driving controls including the steering wheel, turn signal lever control, transmission shift lever control, and the rear steer switch. The Steering Reversed Indicator in the Alerts Area (1, Figure 4-74) and Crane Status Area (4, Figure 4-74) of the Operator Display Module (ODM) comes on to indicate that these driving controls are reversed.

When the boom is swung back and centered over the front (single axle), push the Steering Reversal Switch again to set the driving controls back to normal operation. The Steering Reversed Indicator on the ODM goes off to indicate that these driving controls are not reversed.

Before driving the crane, read, understand, and follow the directions found in these sections of this *Operator Manual*:

- *Steering Wheel*, page 3-5
- *Standard Driving Configuration*, page 3-5
- *Alternate Driving Configuration*, page 3-6
- *Turn Signal Lever and Horn Controls*, page 3-6
- *Transmission Shift Lever*, page 3-8
- *Steering Reversal Switch*, page 3-14
- *Rear Steer Switch*, page 3-28

Emergency Stop Button

The Emergency Stop Button (17, Figure 3-9) is located on the right overhead control panel.

Push red button in to stop the engine and all crane functions. When Emergency Stop Button is pushed in, the Emergency Stop Active Indicator in the Alerts Area (1, Figure 4-74) of the Operator Display Module (ODM) comes on.

Rotate and pull out Emergency Stop Button to allow engine to be re-started and resume normal operation.

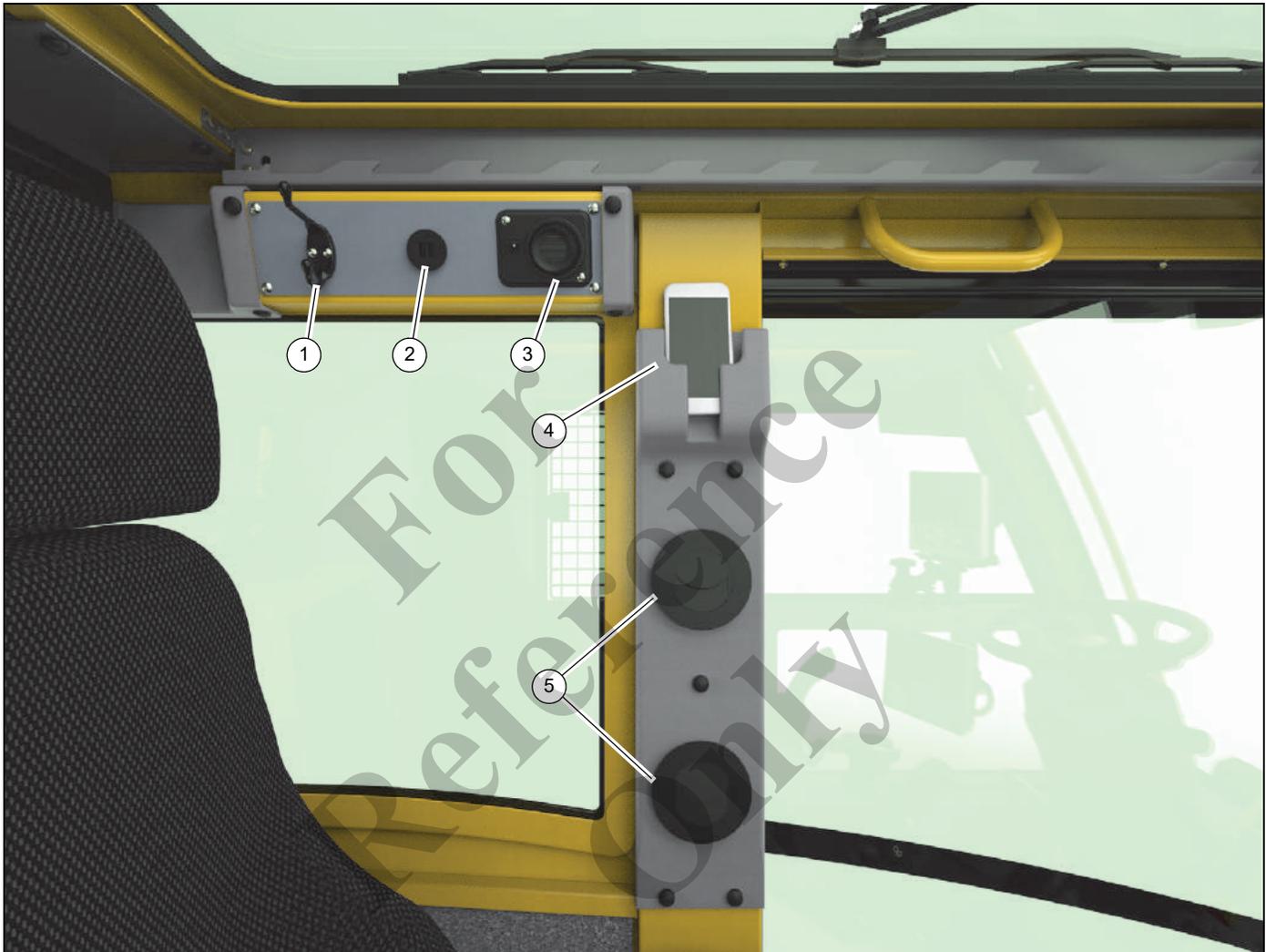
Cab Dome Light

The Cab Dome Light (18, Figure 3-9) is located on the right overhead control panel.

The dome light has a touch control feature. Touch the light one time to cause it to come on. Touch the light again to cause it to go off.

LEFT OVERHEAD AND SIDE PANEL

The left overhead and side panel (Figure 3-12) includes a coat hook, USB charging ports, auxiliary light, cell phone holder, and heater/air conditioner vents.



9838-8

Item	Description	Page
1	Coat Hook	3-17
2	USB Charging Ports	3-17
3	Auxiliary Light and Switch	3-17
4	Cell Phone Holder	3-17
5	Heater/Air Conditioner Vents	3-17

FIGURE 3-12

Coat Hook

A Coat Hook (1, Figure 3-12) is located on the left overhead and side panel, near the rear of the cab.

USB Charging Ports

Two USB Charging Ports (2, Figure 3-12) are located on the left overhead and side panel.

The ports can be used to charge small electronic devices, such as a cell phone.

Auxiliary Light and Switch

An Auxiliary Light and Switch (3, Figure 3-12) is located on the left overhead and side panel.

The auxiliary light switch is a two-position switch.

Press top of switch to cause the light to come on. Press bottom of switch to cause the light to go off.

The auxiliary light can be adjusted by hand if necessary.

Cell Phone Holder

A Cell Phone Holder (4, Figure 3-12) is located on the left overhead and side panel.

Heater/Air Conditioner Vents

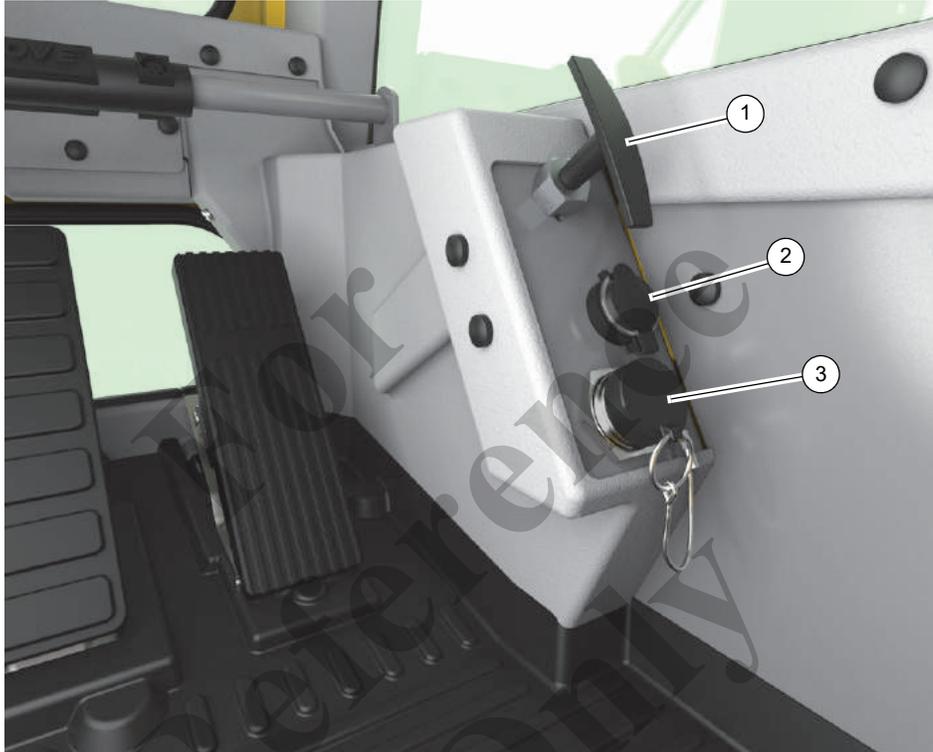
Two Heater/Air Conditioner Vents (5, Figure 3-12) are located on the left overhead and side panel.

The vents can be adjusted to control the amount and direction of air passing through them.

For
Reference
Only

RIGHT LOWER CONTROL PANEL

The right lower control panel (Figure 3-13) includes the turntable swing lock pin control, 12-volt outlet, and on-board diagnostic (OBD) connector.



9838-9

Item	Description	Page
1	Turntable Swing Lock Pin Control Handle	3-19
2	12-Volt Outlet	3-19
3	Engine On-Board Diagnostic (OBD) Connector	3-19

FIGURE 3-13

Turntable Swing Lock Pin Control Handle

The Turntable Swing Lock Pin Control Handle (1, Figure 3-13) is located on the right lower control panel.

To lock superstructure in position, perform the following steps:

1. Center superstructure over the front or rear of the carrier.
2. Turn Swing Lock Pin Control Handle counterclockwise to unlock it.
3. Push forward on the control handle to cause the swing lock pin to drop into the socket on the carrier frame.
4. Turn control handle clockwise to lock it in position.

To unlock superstructure, perform the following steps:

1. Turn control handle counterclockwise to unlock it.
2. Pull rearward on the control handle to cause the swing lock pin to pull out of the socket.
3. Turn control handle clockwise to lock it in position.

NOTE: Before driving crane, always make sure that the boom is centered over the front or rear of the carrier and that the turntable swing lock pin is engaged.

12-Volt Outlet

The 12-Volt Outlet (2, Figure 3-13) is located on the right lower control panel.

The 12-volt Outlet can power and charge electronic devices that have a maximum current draw of 15 amps or less.

Engine On-Board Diagnostic (OBD) Connector

The Engine On-Board Diagnostic (OBD) Connector (3, Figure 3-13) is located on the right lower control panel.

The connector allows the Cummins service software tool to be connected to the engine electronic control unit (ECU) for diagnosing issues that may occur.

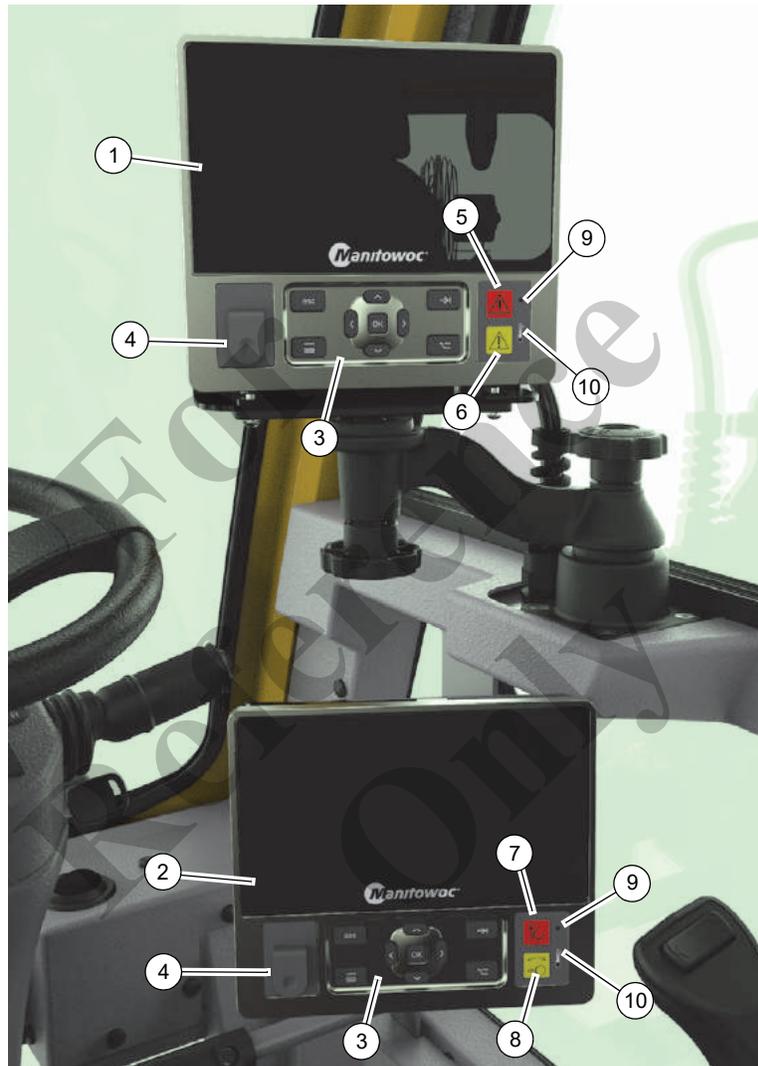
A second Engine OBD Connector is located in the battery box.

For Reference Only

RATED CAPACITY LIMITER DISPLAY MODULE AND OPERATOR DISPLAY MODULE

Each module consists of a display screen, navigation control pad, warning indicators, screen brightness sensor, and USB diagnostic connector.

The Rated Capacity Limiter Display Module (RDM) and the Operator Display Module (ODM) (Figure 3-14) are located to the right of the steering column.



9838-10

Item	Description	Page	Item	Description	Page
1	Rated Capacity Limiter Display Module (RDM)	3-21	6	RCL Early Warning Indicator	3-22
2	Operator Display Module (ODM)	3-21	7	Anti-Two-Block (A2B) Indicator	3-22
3	Navigation Control Pad	3-21	8	Swing Brake Engaged Indicator	3-23
4	USB Connector	3-22	9	Brightness Sensor	3-23
5	RCL Shutdown Warning Indicator (Non-CE Certified Cranes)	3-22	10	Internal Temperature Warning Indicator	3-23
5	RCL Shutdown Warning Indicator (CE Certified Cranes)	3-22			

FIGURE 3-14

Rated Capacity Limiter Display Module (RDM)

The Rated Capacity Limiter Display Module (RDM) (1, Figure 3-14) allows the operator to easily program the RCL by entering a code number from the *Load Chart Manual* or by using the RCL setup wizard.

Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-159 for more information regarding the use of the module in the operation of the crane.

Operator Display Module (ODM)

The Operator Display Module (ODM) (2, Figure 3-14) allows the operator to do the following actions:

- Monitor performance of crane systems
- Telescope the boom (semi-automatic and manual modes)
- Extend/retract the outriggers
- Remove/install the counterweight
- Operate the 360° superstructure lock mechanism
- Operate the boom extension stowage actuators
- Raise/lower the suspension
- Set the working range limits (WRL)
- View engine, transmission, and crane fault codes
- View software versions, license information, and hours of operation for each crane function
- Set controller curves and maximum speeds, engage/disengage ECO mode, and inhibit operation of the engine cleaning system
- Set units of measure (metric/imperial), screen display brightness, and time (24 hour or AM/PM)

Refer to *Using the Operator Display Module (ODM)*, page 4-72 for more information regarding the use of the module in the operation of the crane.

Navigation Control Pad

The Navigation Control Pads (3, Figure 3-14) on the RDM and ODM allow the operator to navigate through the function screens of the related module. The control buttons on the two Navigation Control Pads are identical in configuration and perform the same navigation functions.

The Tab Button (2, Figure 3-15) on the Navigation Control Pad of the ODM and RDM can be pushed to temporarily silence active audible alarms.

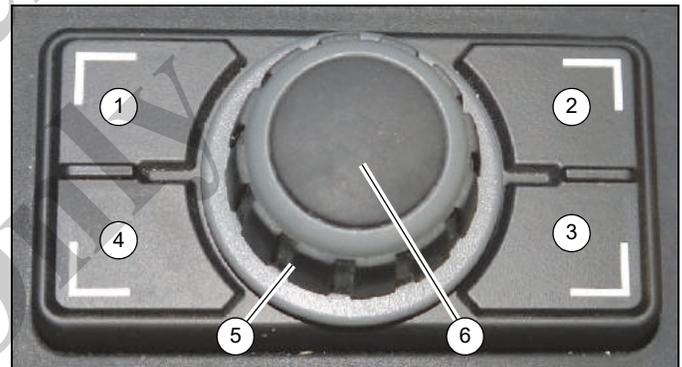


9221-1

Item	Description
1	Escape Button
2	Tab Button
3	Menu Button
4	Left/Right/Up/Down Arrow Buttons
5	OK Button

FIGURE 3-15

The Jog Dial (Figure 3-16), mounted on the right armrest (see *Jog Dial*, page 3-26), can be used to navigate the two modules in a similar manner as the Navigation Control Pads.



9221-2

Item	Description
1	Escape Button
2	Tab Button
3	Screen Toggle Button
4	Menu Button
5	Jog Dial (Rotate dial to move cursor)
6	OK Button (Press Jog Dial to select)

FIGURE 3-16

Refer to *Navigating the Operator Display Module and Rated Capacity Limiter Display Module*, page 4-71 for information on how the Navigational Controls Pads and Jog Dial are used in the operation of the crane.

USB Connector

The RDM and ODM each have a USB Connector (4, Figure 3-14) located immediately below and to the left of its related display module screen.

The USB Connectors allow a service technician to connect to the display modules and update its software or download the data logger from the RDM, which records certain events that can occur when operating the crane.

NOTE: These USB Connectors are not powered and will not charge a phone or tablet.

RCL Shutdown Warning Indicator (Non-CE Certified Cranes)

The RCL Shutdown Warning Indicator (5, Figure 3-14) is located immediately below and to the right of the RDM screen.

The RCL Shutdown Warning Indicator comes on (red) when the RCL senses a lift that is greater than 100% of crane capacity for the programmed configuration.

When the RCL senses a lift that is greater than 100% of crane capacity, the crane control system will lock out the boom up/down, telescope extend, and hoist up crane functions, which would worsen the overload condition.

RCL Shutdown Warning Indicator (CE Certified Cranes)

The RCL Shutdown Warning Indicator (5, Figure 3-14) is located immediately below and to the right of the RDM screen.

The RCL Shutdown Warning Indicator comes on (red) when the RCL senses a lift that is between 100% to 110% of crane capacity for the programmed configuration.

When the RCL senses a lift between 100% to 110% of crane capacity, the crane control system will lock out the boom up/down, telescope extend, and hoist up crane functions, which would worsen the overload condition.

RCL Early Warning Indicator

The RCL Early Warning Indicator (6, Figure 3-14) is located immediately below and to the right of the RDM screen.

The RCL Early Warning Indicator comes on (amber) and the buzzer will repeatedly come and go off when the RCL senses a lift that is between 90% to 100% of crane capacity for the programmed configuration.

Anti-Two-Block (A2B) Indicator

The Anti-Two-Block Indicator (7, Figure 3-14) is located immediately below and to the right of the ODM screen.

The A2B Indicator comes on (red) when a two-block condition occurs.

When a two-block condition occurs, the crane control system will lock out the hoist up, boom down, and telescope out crane functions, which would worsen the two-block condition if operated.

Swing Brake Engaged Indicator

The Swing Brake Engaged Indicator (8, Figure 3-14) is located immediately below and to the right of the ODM screen.

The swing brake engaged indicator comes on (amber) when the swing brake is applied. The indicator goes off when the swing brake is released.

The swing brake is automatically released when the swing controller is actuated. The swing brake is automatically applied when the superstructure stops rotating.

Brightness Sensor

A Brightness Sensor (9, Figure 3-14) is located immediately below and to the right of the RDM screen and ODM screen.

The Brightness Sensors sense the amount of light in the operator cab. As the amount of light inside the cab changes, the RDM screen and the ODM screen will brighten and darken automatically, making the screens easier for the operator to see.

Internal Temperature Warning Indicator

An Internal Temperature Warning Indicator (10, Figure 3-14) is located immediately below and to the right of the RDM screen and ODM screen.

When the Ignition Switch is turned to the RUN (I) position and the internal temperature of either the RDM or the ODM is below -30°C (-22°F), the related module Internal Temperature Warning Indicator will come on (blue) and the module screen will remain blank.

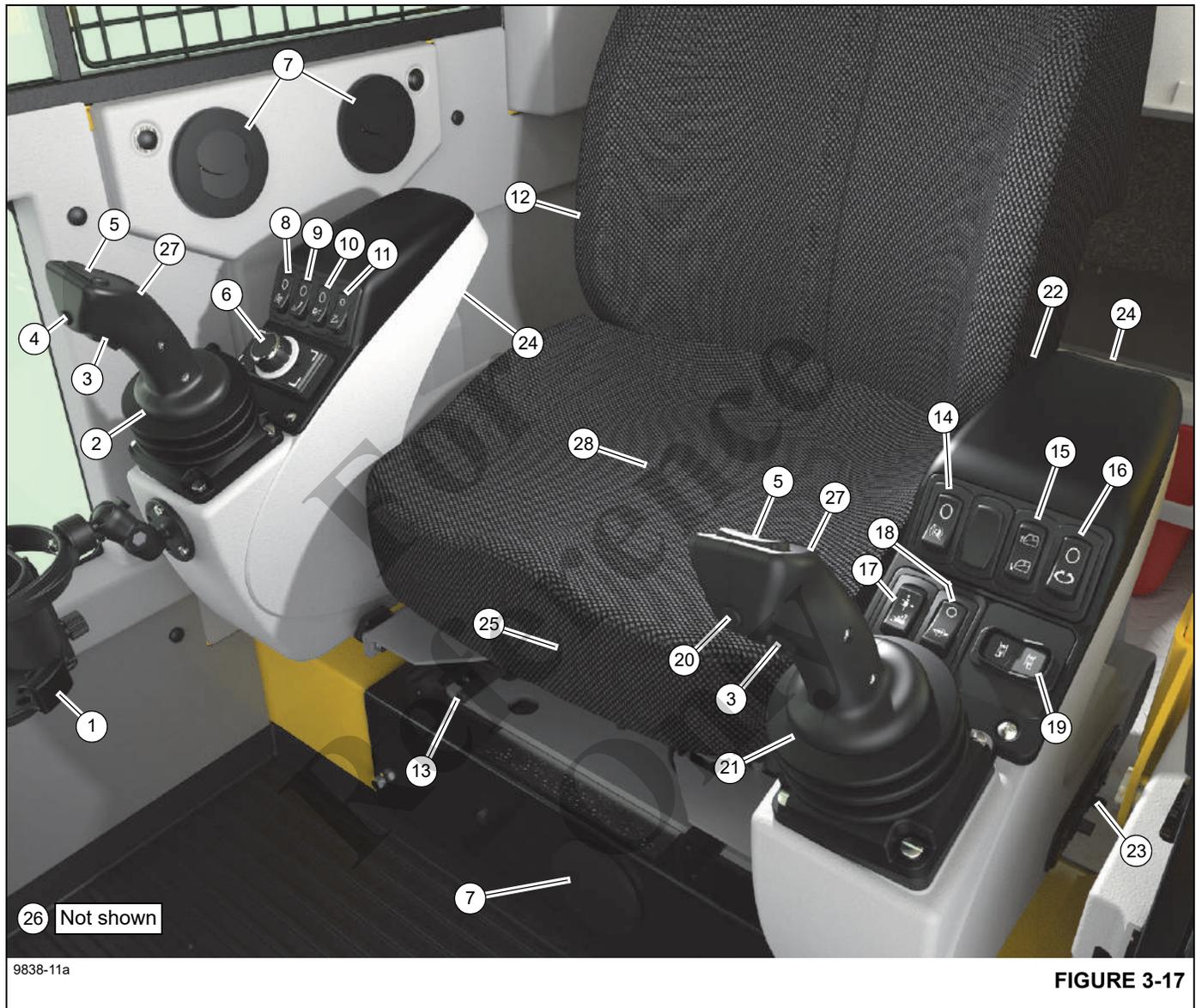
When the ignition switch is turned to the position and the internal temperature of either the RDM or the ODM is above 70°C (158°F), the related module Internal Temperature Warning Indicator will come on (red) and the module screen will remain blank.

For the RDM and ODM screens to come on, their internal temperatures must be between -30°C (-22°F) and 70°C (158°F).

For Reference Only

OPERATOR SEAT AND ARMREST CONTROLS (DUAL AXIS)

The operator seat and armrest controls (Figure 3-17) include most of the controls for performing craning operations.



Item	Description	Page	Item	Description	Page
1	Cup Holder	3-26	15	Cab Tilt Switch	3-27
2	Main Hoist - Boom Lift - Telescope - Luffing Boom Extension Controller (Dual Axis)	3-26	16	Swing Enable/Disable Switch	3-28
3	Deadman Switches (Optional) (Dual Axis)	3-26	17	Outrigger Extend/Retract Switch	3-28
4	Horn Button	3-26	18	Differential Lock Switch	3-28
5	Hoist Speed Toggle Switches	3-26	19	Rear Steer Switch	3-28
6	Jog Dial	3-26	20	Free Swing Button	3-30
7	Heater/Air Conditioner Vents	3-26	21	Auxiliary Hoist - Swing Controller (Dual Axis)	3-31
8	Main Hoist Enable/Disable Switch	3-26	22	Seat Backrest Adjustment Lever	3-31
9	Luffing Boom Extension Enable/Disable Switch (Optional)	3-27	23	Seat Adjustment Control Panel	3-31
10	Boom Telescope Enable/Disable Switch	3-27	24	Armrest Adjustment Button	3-31
11	Boom Lift Enable/Disable Switch	3-27	25	Seat Heat Switch (Optional)	3-31
12	Seat Lumbar Support Adjustment Lever	3-27	26	Seat Headrest (Not shown)	3-31
13	Seat Slide Lever	3-27	27	Hoist Rotation Indicators	3-32
14	Auxiliary Hoist Enable/Disable Switch	3-27	28	Seat Switch	3-32

Reference Only

Cup Holder

The adjustable Cup Holder (1, Figure 3-17) is attached to the front of the right armrest.

Turn knob counterclockwise to loosen cup holder for adjustment. After adjusting, turn knob clockwise to lock cup holder in position.

Main Hoist – Boom Lift – Telescope – Luffing Boom Extension Controller (Dual Axis)

The Main Hoist – Boom Lift – Telescope – Luffing Boom Extension Controller (2, Figure 3-17) is located on the right armrest. The controller operates the main hoist, boom lift, telescope, and optional luffing boom extension functions.

Push controller forward to lower the main hoist rope. Pull controller rearward to raise the main hoist rope.

The boom lift, telescope, and optional luffing boom extension functions are actuated by the same left to right controller motion. Only one of these functions can be operated at a time.

Operator must enable the boom lift, telescope, or luffing boom extension function using the related Enable/Disable Switch for the function to operate.

When the boom lift function is enabled, push controller to the left to raise the boom. Push controller to the right to lower the boom.

When the telescope function is enabled, push controller to the left to retract the boom. Push controller to the right to extend the boom.

When the luffing boom extension function is enabled, push controller to the left to raise the boom extension. Push controller to the right to lower the boom extension.

Move controller in a diagonal direction to operate two enabled functions at the same time.

Deadman Switches (Optional) (Dual Axis)

Deadman Switches (3, Figure 3-17) (Optional) (Dual Axis) are located on the front of both controllers.

Either Deadman Switch can be used to keep the crane functions active when the operator stands up out of the seat (causing the seat switch to open and stop craning functions). Refer to *Seat Switch*, page 3-32.

Horn Button

The Horn Button (4, Figure 3-17) is located on the upper front of the right controller.

Push button to operate the horn.

Hoist Speed Toggle Switches

The Hoist Speed Toggle Switches (5, Figure 3-17) are thumb operated three-position center spring return switches located on top of each dual axis controller.

Push and hold switch closest to the operator to change hoist speed to high – release switch to return hoist speed to normal.

Push and release switch farthest from the operator to change hoist speed to high – push and release switch again to return hoist speed to normal.

NOTE: Hoist speed cannot be changed while hoist is operating. Before changing hoist speed, the controller must be in the Neutral (center) position.

Jog Dial

The Jog Dial (6, Figure 3-17) is located on the right armrest.

The Jog Dial is used to select and perform functions through the Operator Display Module (ODM) and the Rated Capacity Limiter Display Module (RDM). (Refer to *Navigating the Operator Display Module and Rated Capacity Limiter Display Module*, page 4-71 for more information on jog dial operation).

Heater/Air Conditioner Vents

Two Heater/Air Conditioner Vents (7, Figure 3-17) are located on the right side of the cab, and one vent is located under the seat assembly.

The vents can be adjusted to control the amount and direction of air passing through them.

Main Hoist Enable/Disable Switch

The Main Hoist Enable/Disable Switch (8, Figure 3-17) is a two-position momentary switch that is located on the right armrest.

Push switch one time to enable the main hoist function. Push switch again to disable the main hoist function.

Quickly push the switch two times to enable the main hoist function at high speed. The high speed function can also be enabled by pushing and holding the switch for approximately 2 seconds.

The Main Hoist Enable/Disable Indicator in the Status Bar area (6, Figure 4-74) of the Operating Display Module (ODM) comes on (green) when the main hoist function is enabled. The indicator goes off when the main hoist function is disabled.

The Main Hoist High Speed Indicator in the Status Bar area (6, Figure 4-74) of the ODM comes on when the high speed function is enabled.

Enabling one craning function (hoist, lift, telescope, or swing) using its related Enable/Disable Switch will cause the engine speed to increase to 1200 rpm. Disabling all craning functions will cause the engine speed to decrease to 750 rpm.

Luffing Boom Extension Enable/Disable Switch (Optional)

The Luffing Boom Extension Enable/Disable Switch (9, Figure 3-17) (Optional) is a two-position momentary switch that is located on the right armrest.

Push switch one time to enable the luffing boom extension function. Push switch again to disable the luffing boom extension function.

The Luffing Boom Extension Enable/Disable Indicator in the Status Bar area (6, Figure 4-74) of the Operating Display Module (ODM) comes on (green) when the luffing boom extension function is enabled. The indicator goes off when the luffing boom extension function is disabled.

Boom Telescope Enable/Disable Switch

The Boom Telescope Enable/Disable Switch (10, Figure 3-17) is a two-position momentary switch that is located on the left armrest.

Push switch one time to enable the boom telescope function. Push switch again to disable the boom telescope function.

The Telescope Enable/Disable Indicator in the Status Bar area (6, Figure 4-74) of the Operating Display Module (ODM) comes on (green) when the telescope function is enabled. The indicator goes off when the telescope function is disabled.

Enabling one craning function (hoist, lift, telescope, or swing) using its related Enable/Disable Switch will cause the engine speed to increase to 1200 rpm. Disabling all craning functions will cause the engine speed to decrease to 750 rpm.

Boom Lift Enable/Disable Switch

The Boom Lift Enable/Disable Switch (11, Figure 3-17) is a momentary switch that is located on the right armrest.

Push switch one time to enable the boom lift function (boom up and boom down). Push switch again to disable the boom lift function.

The Boom Lift Enable/Disable Indicator in the Status Bar area (6, Figure 4-74) of the Operating Display Module (ODM) comes on (green) when boom lift function is enabled. The indicator goes off when boom lift function is disabled.

Enabling one craning function (hoist, lift, telescope, or swing) using its related Enable/Disable Switch will cause the engine speed to increase to 1200 rpm. Disabling all craning

functions will cause the engine speed to decrease to 750 rpm.

Seat Lumbar Support Adjustment Lever

The Seat Lumbar Support Adjustment Lever (12, Figure 3-17) is located at the right side of the seat backrest.

The lever can be set to three lumbar support positions.

Rotate lever clockwise to increase the lumbar support. Rotate lever counterclockwise to reduce the lumbar support.

Seat Slide Lever

The Seat Slide Lever (13, Figure 3-17) is located at the lower front of the seat.

Push Seat Slide Lever to the left and hold to allow the seat to be moved forward or backward relative to the armrests. Release lever when the seat is in the desired position. Make sure that seat has reached a locked position.

Auxiliary Hoist Enable/Disable Switch

The Auxiliary Hoist Enable/Disable Switch (14, Figure 3-17) is a two-position momentary switch located on the left armrest.

Push switch one time to enable the auxiliary hoist function. Push switch again to disable the auxiliary hoist function.

Quickly push the switch two times to enable the auxiliary hoist function at high speed. Pushing and holding the switch for approximately 2 seconds will also enable the auxiliary hoist function at high speed.

The Auxiliary Hoist Enable/Disable Indicator in the Status Bar area (6, Figure 4-74) of the Operating Display Module (ODM) comes on (green) when the auxiliary hoist function is enabled. The Indicator goes off when the auxiliary hoist function is disabled.

The Auxiliary Hoist High Speed Indicator in the Status Bar area (6, Figure 4-74) of the ODM comes on when the high speed function is enabled.

Enabling one craning function (hoist, lift, telescope, or swing) using its related Enable/Disable Switch will cause the engine speed to increase to 1200 rpm. Disabling all craning functions will cause the engine speed to decrease to 750 rpm.

Cab Tilt Switch

The Cab Tilt Switch (12, Figure 3-17) is located on the left armrest.

The switch is a three-position, momentary rocker switch that is used to tilt the cab up for easy viewing of an elevated boom and load.

Push and hold front of switch to tilt the cab up. Push and hold rear of switch to tilt the cab down. Release switch when cab is tilted to the desired position.

When cab is tilted up, the Cab Not Fully Lowered Indicator in the Alerts Area (1, Figure 4-74) of the Operating Display Module (ODM) comes on.

NOTE: Cab must be in the fully lowered position for the drive functions to be enabled.

Swing Enable/Disable Switch

The Swing Enable/Disable Switch (16, Figure 3-17) is a momentary switch that is located on the left armrest.

Press switch one time to enable the swing function. Press switch another time to disable the swing function.

The Swing Enable/Disable Indicator in the Status Bar area (6, Figure 4-74) of the Operating Display Module (ODM) comes on (green) when the swing function is enabled. The indicator goes off when the swing function is disabled.

Enabling one craning function (hoist, lift, telescope, or swing) using its related Enable/Disable Switch will cause the engine speed to increase to 1200 rpm. Disabling all craning functions will cause the engine speed to decrease to 750 rpm.

Outrigger Extend/Retract Switch

The Outrigger Extend/Retract Switch (17, Figure 3-17) is a three-position momentary switch that is located in the left armrest.

Use Outrigger Extend/Retract Switch in combination with the buttons on the Jog Dial or Navigation Control Pad, and the Outrigger Extend/Retract Function Screen on the Operator Display Module (ODM) to extend and retract the outrigger beams and jacks.

Refer to *Outrigger Extend/Retract*, page 4-100 for complete procedures on extending and retracting the outriggers.

NOTE: Push and hold the Outrigger Extend/Retract Switch to quickly change the ODM screen display to the Outrigger Extend/Retract Function Screen.

NOTE: Transmission Shift Lever must be in Neutral (center position) and parking brake must be applied before the outrigger controls will operate.

Differential Lock Switch

The Differential Lock Switch (18, Figure 3-17) is a two-position momentary switch that is located on the left armrest.

Use Differential Lock Switch to engage the differential lock for additional traction. The Differential Lock can be activated for a maximum of 60 seconds at a time.

NOTE: Crane must be in Four-Wheel-Drive to engage the Differential Lock (refer to *Drive Axle Selector Switch*, page 3-7).

Push and hold the Differential Lock Switch to engage the Differential Lock. Release the switch to disengage the Differential Lock. Refer to *Differential Lock Operation*, page 4-19 for more information on how and when to engage the differential lock.

The Differential Lock Indicator in the Alerts Area (1, Figure 4-74) of the Operating Display Module (ODM) comes on when the differential lock is engaged.

Rear Steer Switch

The Rear Steer Switch (19, Figure 3-17) is a three-position, spring centered to off, rocker switch located on the left armrest.

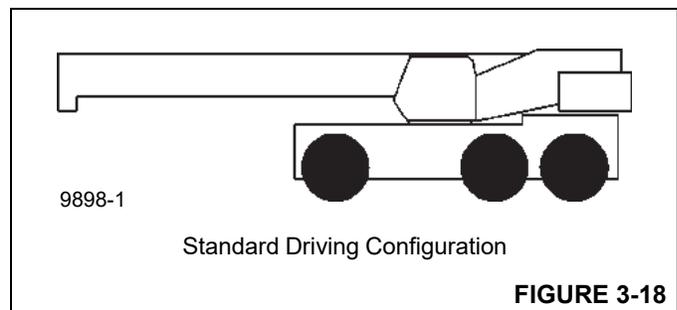
Use the Rear Steer Switch to turn the wheels on the rear tandem axles.

The Rear Steer Switch will only operate if one of the following conditions is met:

- Transmission is in two-wheel drive (high range) AND first gear is selected
- or -
- Transmission is in four-wheel drive (low range)

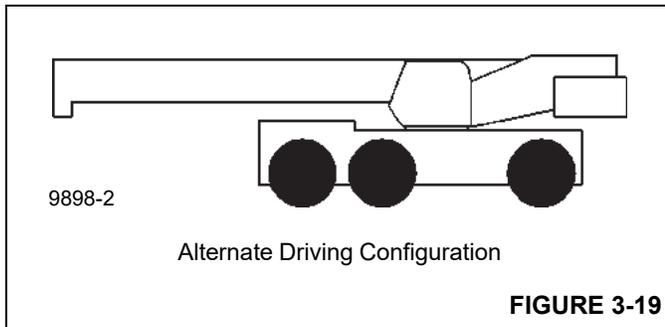
Rear Steer Switch will not operate if transmission is in two-wheel drive (high range) and second or third gear is selected. If operator pushes the Rear Steer Switch while transmission is in two-wheel drive (high range), and the current gear selection is second or third gear, the Direction/Gear Indicator in the Crane Information Area (3, Figure 4-74) of the ODM will alternate flashing between first gear (1) and the current gear (either 2 or 3).

The GRT9165 crane can be driven in the Standard Driving Configuration—with the boom centered over the front (single axle). This Standard Driving Configuration is shown in Figure 3-18.



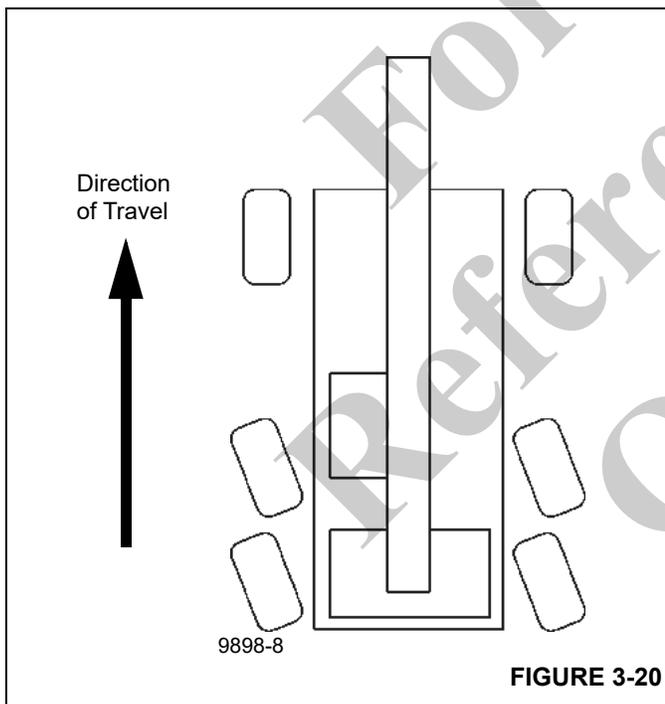
The GRT9165 crane can also be driven in the Alternate Driving Configuration—with the boom centered over the rear

(tandem axles). This Alternate Driving Configuration is shown in Figure 3-19.

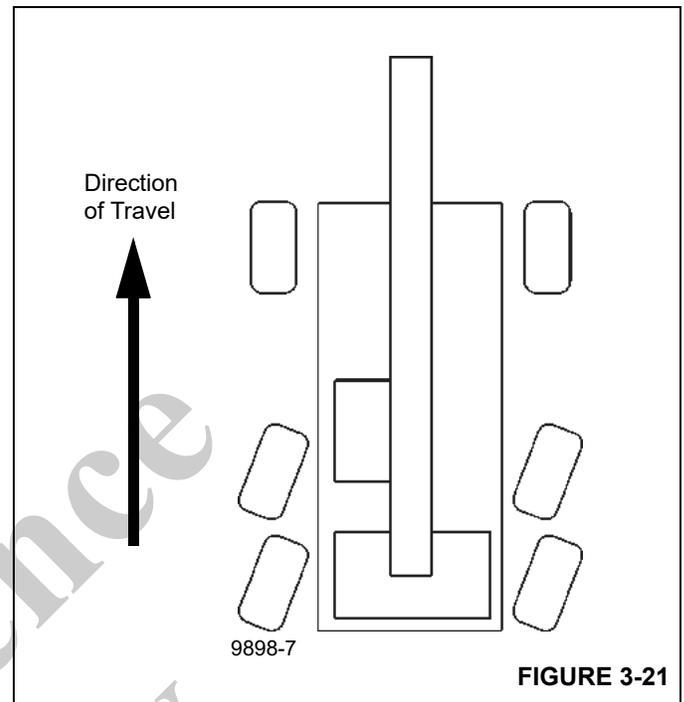


Standard Driving Configuration

In the Standard Driving Configuration, push and hold the right side of the Rear Steer Switch to cause the wheels on the rear tandem axles to turn left, causing the crane to turn right as shown in Figure 3-20. Release the switch when the rear wheels are pointed in the desired direction.



Push and hold the left side of the Rear Steer Switch to cause the wheels on the rear tandem axles to turn right, causing the crane to turn left as shown in Figure 3-21. Release the switch when the rear wheels are pointed in the desired direction.



When rear wheels are not centered, the Rear Wheels Not Centered Indicator in the Alerts Area (1, Figure 4-74) of the Operating Display Module (ODM) comes on.

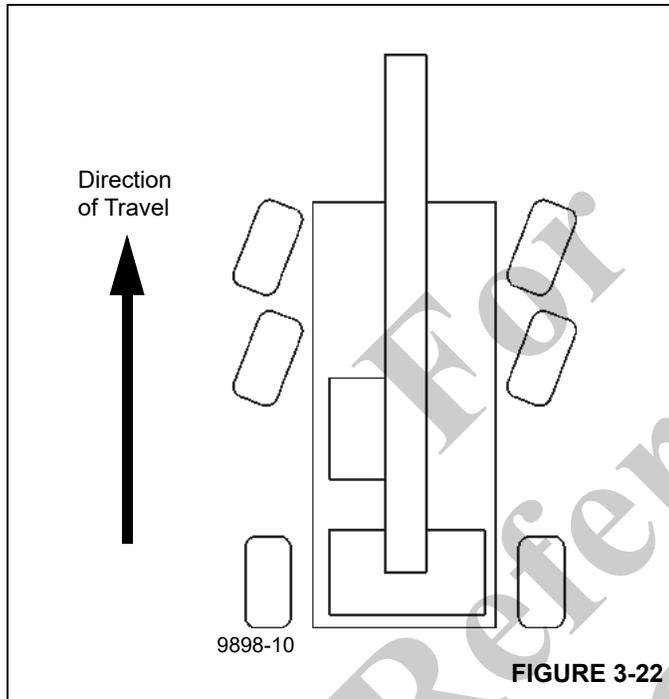
In the Standard Driving Configuration, if rear wheels are turned to the left, straighten the rear wheels by pushing and holding the left side of the switch (turns the wheels right) until the Rear Wheels Not Centered Indicator goes off.

In the Standard Driving Configuration, if rear wheels are turned to the right, straighten the rear wheels by pushing and holding the right side of the switch (turns the wheels left) until the Rear Wheels Not Centered Indicator goes off.

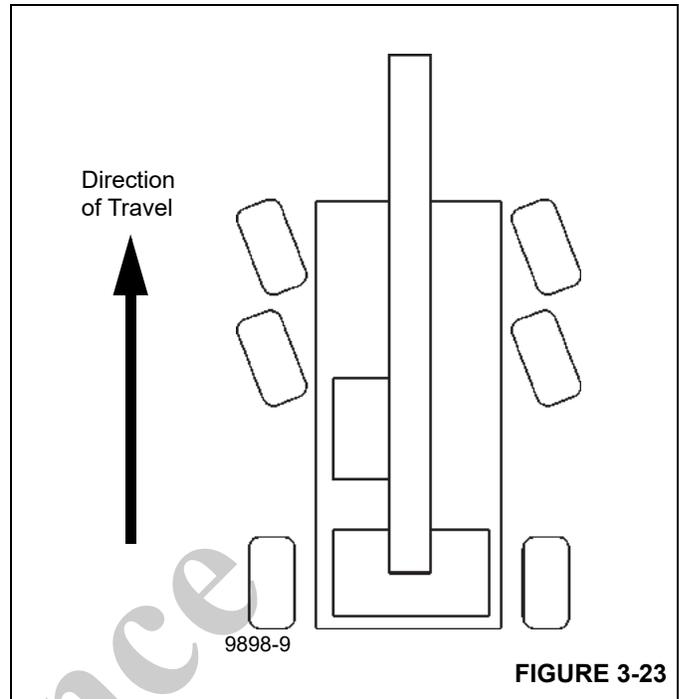
Alternate Driving Configuration

Before driving the crane in the Alternate Driving Configuration—with the boom centered over the rear tandem axles—push the Steering Reversal Switch (16, Figure 3-9), located in the Right Overhead Control Panel, one time to reverse all driving controls, including the rear steer control.

Push and hold the right side of the Rear Steer Switch to cause the wheels on the rear tandem axles to turn right, causing the crane to turn right as shown in Figure 3-22. Release the switch when the rear wheels are pointed in the desired direction.



Push and hold the left side of the Rear Steer Switch to cause the wheels on the rear tandem axles to turn left, causing the crane to turn left as shown in Figure 3-23. Release the switch when the rear wheels are pointed in the desired direction.



When rear wheels are not centered, the Rear Wheels Not Centered Indicator in the Alerts Area (1, Figure 4-74) of the Operating Display Module (ODM) comes on.

In the Alternate Driving Configuration, if rear wheels are turned to the left, straighten the rear wheels by pushing and holding the right side of the switch (turns the wheels right) until the Rear Wheels Not Centered Indicator goes off.

In the Alternate Driving Configuration, if rear wheels are turned to the right, straighten the rear wheels by pushing and holding the left side of the switch (turns the wheels left) until the Rear Wheels Not Centered Indicator goes off.

Free Swing Button

The Free Swing Button (20, Figure 3-17) is located on the upper front of the left controller.

The free swing function is used to align the boom over the center of the load.

Push and hold Free Swing Button to release the swing brake. While swing brake is released, slowly reel in hoist until boom centers itself over the load. Release button to re-apply the swing brake.

Auxiliary Hoist – Swing Controller (Dual Axis)

The Auxiliary Hoist – Swing Controller (21, Figure 3-17) is located on the left armrest. The controller operates the auxiliary hoist and swing functions.

Push controller forward to lower the auxiliary hoist rope. Pull controller rearward to raise the auxiliary hoist rope.

Push controller left or right for 360-degree continuous rotation of the superstructure in the desired direction.

Move controller in a diagonal direction to operate the two enabled functions at the same time.

Seat Backrest Adjustment Lever

The Seat Backrest Adjustment Lever (22, Figure 3-17) is located at the left rear of the seat.

Lift up the lever to allow the seat backrest angle to be pivoted fore and aft. Once seat backrest is in the desired position, release the lever to lock the backrest in position.

Seat Adjustment Control Panel

The Seat Adjustment Control Panel (23, Figure 3-17) is located at the bottom, left side of the seat.

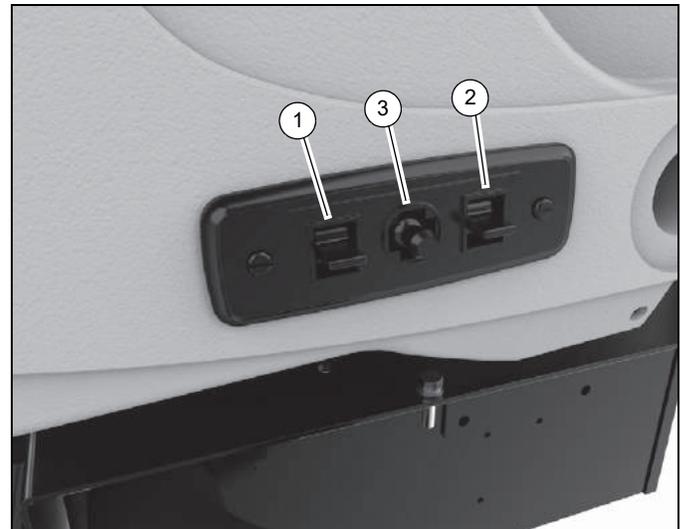
The panel has three electric switches which are used to adjust the position of the seat and armrest assembly.

The Front Adjustment Switch (1, Figure 3-17) controls the height of the front of the seat. Pull switch up to raise front of seat. Push switch down to lower front of seat.

The Rear Adjustment Switch (2, Figure 3-17) controls the height of the rear of the seat. Pull switch up to raise rear of seat. Push switch down to lower rear of seat.

The 4-Way Adjustment Switch (3, Figure 3-17) controls the height of the seat and the seat fore-to-aft position. Pull switch up to raise the seat and armrests. Push switch down to lower the seat and armrests. Push switch forward to move the seat and armrests forward. Push switch rearward to move the seat and armrests rearward.

To adjust the seat relative to the armrests, use the Seat Slide Lever (refer to *Seat Slide Lever*, page 3-27).



9838-12

Item	Description
1	Front Adjustment Switch
2	Rear Adjustment Switch
3	4-Way Adjustment Switch

FIGURE 3-24

Armrest Adjustment Buttons

The Armrest Adjustment Buttons (24, Figure 3-17) are located at the rear of the armrest.

The buttons allow the left and right armrest to be rotated.

Push and hold button to allow the entire armrest to be rotated. Release button to lock the armrest in the desired position.

Seat Heat Switch (Optional)

The Seat Heat Switch (25, Figure 3-17) is a three-position, rocker type switch located at the front of the seat cushion.

Push bottom of switch to cause seat heater to operate at a low temperature. Push top of switch to cause seat heater to operate at a high temperature. Set switch to center position to set seat heater to off.

Seat Headrest (Not Shown)

The Seat Headrest (26, Figure 3-17) is located at the top of the seat backrest.

Pull up to raise the head rest. Push down to lower the head rest.

Hoist Rotation Indicators

Hoist Rotation Indicators (27, Figure 3-17) for auxiliary and main hoists are located at mid-stick, facing the operator on each dual-axis hoist controller (2, 21, Figure 3-17).

The Hoist Rotation Indicator pulses on the auxiliary or main hoist controller (2, 21) when its related hoist is operating.

The pulsing, felt by the operator's hand, indicates to the operator that the hoist is operating.

The Hoist Rotation Indicator also makes an audible click when it pulses.

The frequency of the pulses and clicks increases and decreases as the hoist speed increases and decreases.

Seat Switch

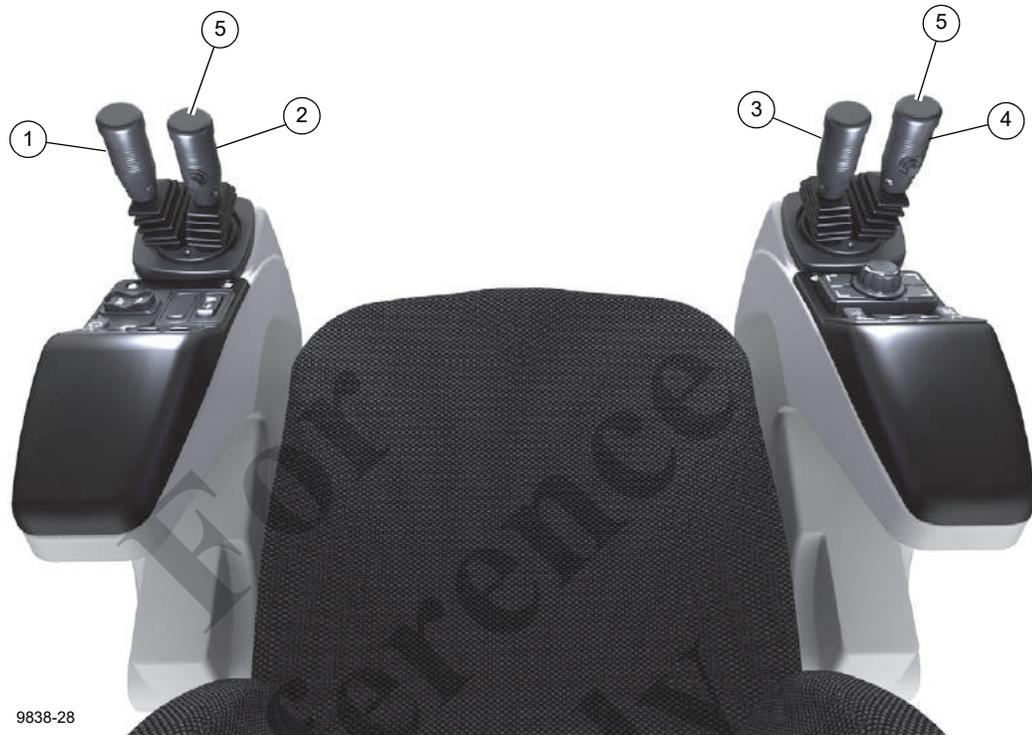
The Seat Switch (28, Figure 3-17) is located within the seat.

The operator must be sitting in the seat, enabling the switch, before any crane functions can be operated.

For
Reference
Only

OPTIONAL SINGLE AXIS CONTROLLERS

The following single axis controllers (Figure 3-25) are available as an option on the GRT9165 crane.



9838-28

Item	Description	Page
1	Swing Controller	3-34
2	Auxiliary Hoist Controller	3-34
3	Boom Lift – Telescope – Luffing Boom Extension Controller	3-34
4	Main Hoist Controller	3-34
5	Hoist Rotation Indicators (Not Shown)	3-34

FIGURE 3-25

Swing Controller

The Swing Controller (1, Figure 3-25) is located on the left armrest.

Push controller forward to cause the superstructure to rotate clockwise. Pull controller rearward to cause the superstructure to rotate counterclockwise.

The superstructure can be continuously rotated 360° in the desired direction.

Auxiliary Hoist Controller

The Auxiliary Hoist Controller (2, Figure 3-25) is located on the left armrest.

Push controller forward to extend the boom. Pull controller rearward to retract the boom.

Boom Lift – Telescope – Luffing Boom Extension Controller

The Boom Lift – Telescope – Luffing Boom Extension Controller (3, Figure 3-25) is located on the right armrest.

Operator must enable the boom lift or telescope function using the related Enable/Disable Switch for the function to operate.

Only one function can be enabled at a time.

When the Boom Lift function is enabled, push controller forward to lower the boom. Pull controller rearward to raise the boom.

When Telescope function is enabled, push controller forward to extend the boom. Pull controller rearward to retract the boom.

When crane is equipped with an optional luffing boom extension, the luffing boom extension function is also operated by the Boom Lift – Telescope – Controller.

Operator must enable the luffing boom extension function using the related Enable/Disable Switch for the function to operate.

Again, only one function can be enabled at a time.

When used for the luffing boom extension function, push controller forward to lower the boom extension. Pull controller rearward to raise the boom extension.

Main Hoist Controller

The Main Hoist Controller (4, Figure 3-25) is located on the right armrest.

Push controller forward to lower the hoist rope. Pull controller rearward to raise the hoist rope.

Hoist Rotation Indicators (Not Shown)

Hoist Rotation Indicators (5, Figure 3-25) for auxiliary and main hoists are located on top of each single-axis hoist controller (1, 3, Figure 3-25).

The Hoist Rotation Indicator pulses on the auxiliary or main hoist controller (1, 3) when its related hoist is operating.

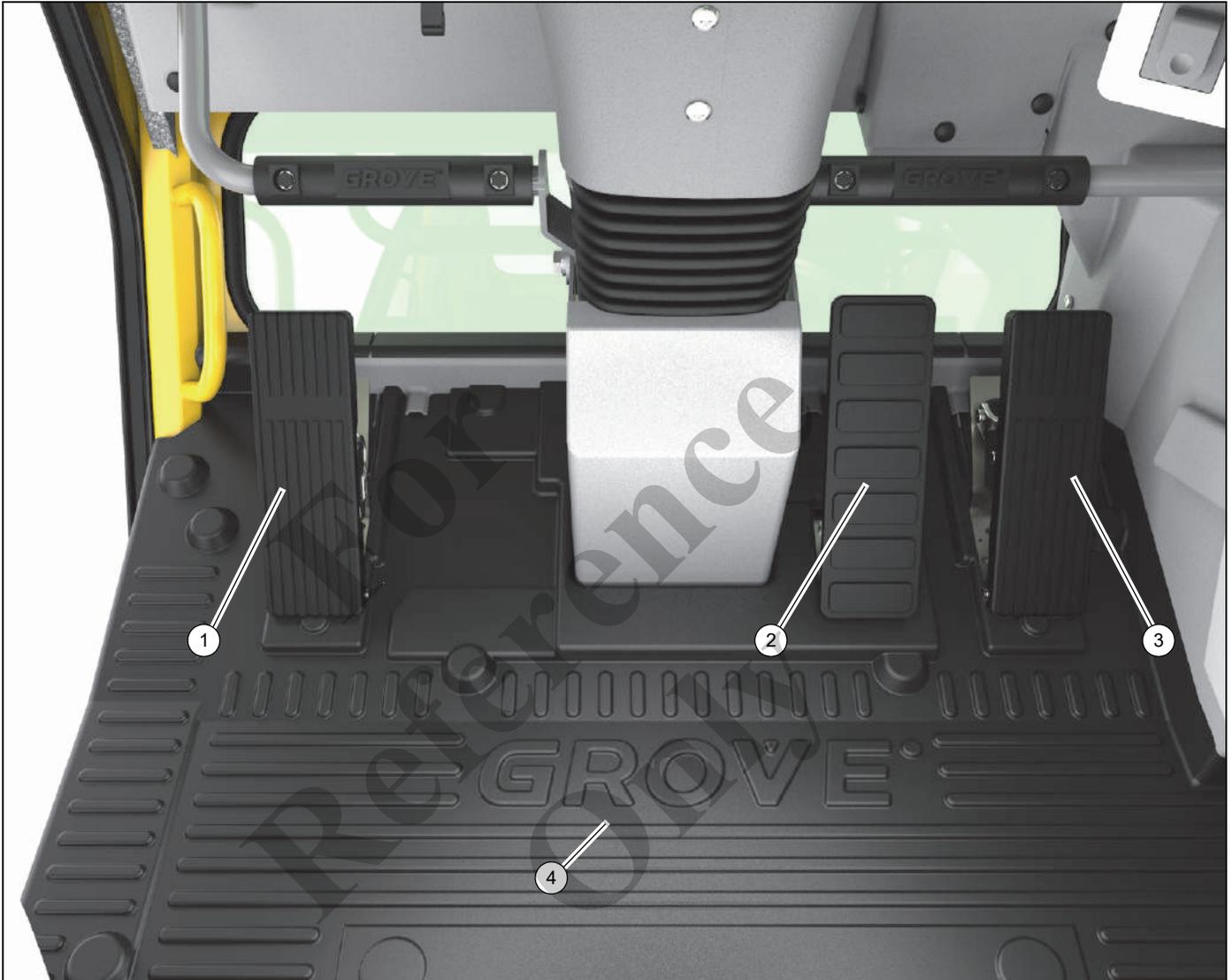
The pulsing, felt by the operator's hand, indicates to the operator that the hoist is operating.

The Hoist Rotation Indicator also makes an audible click when it pulses.

The frequency of the pulses and clicks increases and decreases as the hoist speed increases and decreases.

FOOT PEDAL CONTROLS

The foot pedal controls (Figure 3-26) include the swing brake pedal, service brake pedal, and throttle pedal.



3

9838-13

Item	Description	Page
1	Swing Brake Pedal	3-36
2	Service Brake Pedal	3-36
3	Throttle Pedal	3-36
4	Floor Mat	3-36

FIGURE 3-26

Swing Brake Pedal

The Swing Brake Pedal (1, Figure 3-26) is located on the left side of the cab floor.

Push Swing Brake Pedal to slow and stop the swing motion.

Braking increases or decreases proportionately with the amount of foot pressure applied to the pedal.

Service Brake Pedal

The Service Brake Pedal (2, Figure 3-26) is the second pedal from the right on the cab floor.

Push Service Brake Pedal to apply the service brakes.

Braking increases or decreases proportionately with the amount of foot pressure applied to the pedal.

NOTE: Crane must be stopped and service brake pedal pushed and held before changing between transmission drive modes (two-wheel drive and four-wheel drive) (refer to *Drive Axle Selector Switch*, page 3-7).

Crane must be stopped and service brake pedal pushed and held before the driving controls can be

reversed (refer to *Steering Reversal Switch*, page 3-14).

Throttle Pedal

The Throttle Pedal (3, Figure 3-26) is located on the right side of the floor.

Push Throttle Pedal to increase the engine speed.

Engine speed increases or decreases proportionately with the amount of foot pressure applied to the pedal.

Floor Mat

A Floor Mat (4, Figure 3-26) is provided to make cleaning the cab floor easier.

When dirty, remove floor mat from cab. Clean using water and a soft bristle brush.

Before operating the crane, make sure that the floor mat is in the correct position and does not interfere with the operation of the foot pedals.

For Reference Only

INTERNAL RATED CAPACITY LIMITER LIGHT BAR (OPTIONAL)

The optional Rated Capacity Limiter (RCL) Internal Light Bar (Figure 3-27) is located at the upper left corner of the crane cab.

The RCL Internal Light Bar is an operational aid that works with the RCL system to warn the operator of an approaching overload condition that could cause equipment damage, personal injury, or death.

The lights in the light bar come on in the following manner:

- Green LEDs – when the eight green LEDs are on, the load being lifted is less than 90% of crane RCL programmed capacity.
- Yellow LEDs – when the yellow LEDs are on, the load being lifted is between 90% to 100% of crane RCL programmed capacity.

- Red LEDs — when red LEDs are on, the load being lifted is greater than 100% of crane RCL programmed capacity.



9838-18a

FIGURE 3-27

For Reference Only

3-VIEW CAMERA DISPLAY

The 3-View Camera Display (Figure 3-28) is located at the upper right front corner of the cab on cranes equipped with the 3-View Camera option.

The display shows the three camera views that make up the 3-View Camera feature, which include the following:

- Hoist camera view
- Right rear camera view
- Back-up camera view

The default view shows a split-screen of the hoist camera and right rear camera views.

The hoist camera view shows the remaining rope on the hoists.

The right rear camera view simulates a rear-view mirror and shows the area to the right rear (as viewed from the operator's seat) of the crane.

The back-up camera view is shown full screen on the display when the transmission is shifted to reverse gear.

The camera display is automatically powered on and off through the Ignition Switch. Thus, the operator does not need to push a button to power the display on and off.

Refer to the display manufacturer's user manual for more information on the camera display operation and settings.



9838-14

FIGURE 3-28

CONTROLS AND FEATURES AT FRONT OF CAB

Controls and features located at the front of the cab (Figure 3-29) include the front windshield/emergency exit, sun visor, grab handles, and foot rests.



3

9838-18

Item	Description	Page
1	Front Windshield/Emergency Exit	3-40
2	Sun Visor	3-40
3	Grab Handles	3-40
4	Foot Rests	3-40

FIGURE 3-29

Front Windshield/Emergency Exit

The Front Windshield is the Emergency Exit (1, Figure 3-29).

In an emergency, if the door is blocked or cannot be opened, push out windshield and escape through opening.

Sun Visor

The Sun Visor (2, Figure 3-29) is located at the front of the cab toward the top of the windshield.

The sun visor can be folded down to reduce sunlight coming into the cab through the front windshield.

The sun visor can be rotated 90° to reduce sunlight coming into the cab through the door window.

Grab Handles

Grab Handles (3, Figure 3-29) are located around the entrance to the cab to help with entering and exiting the cab.

Always maintain a three-point contact with the crane when entering and exiting.

Foot Rests

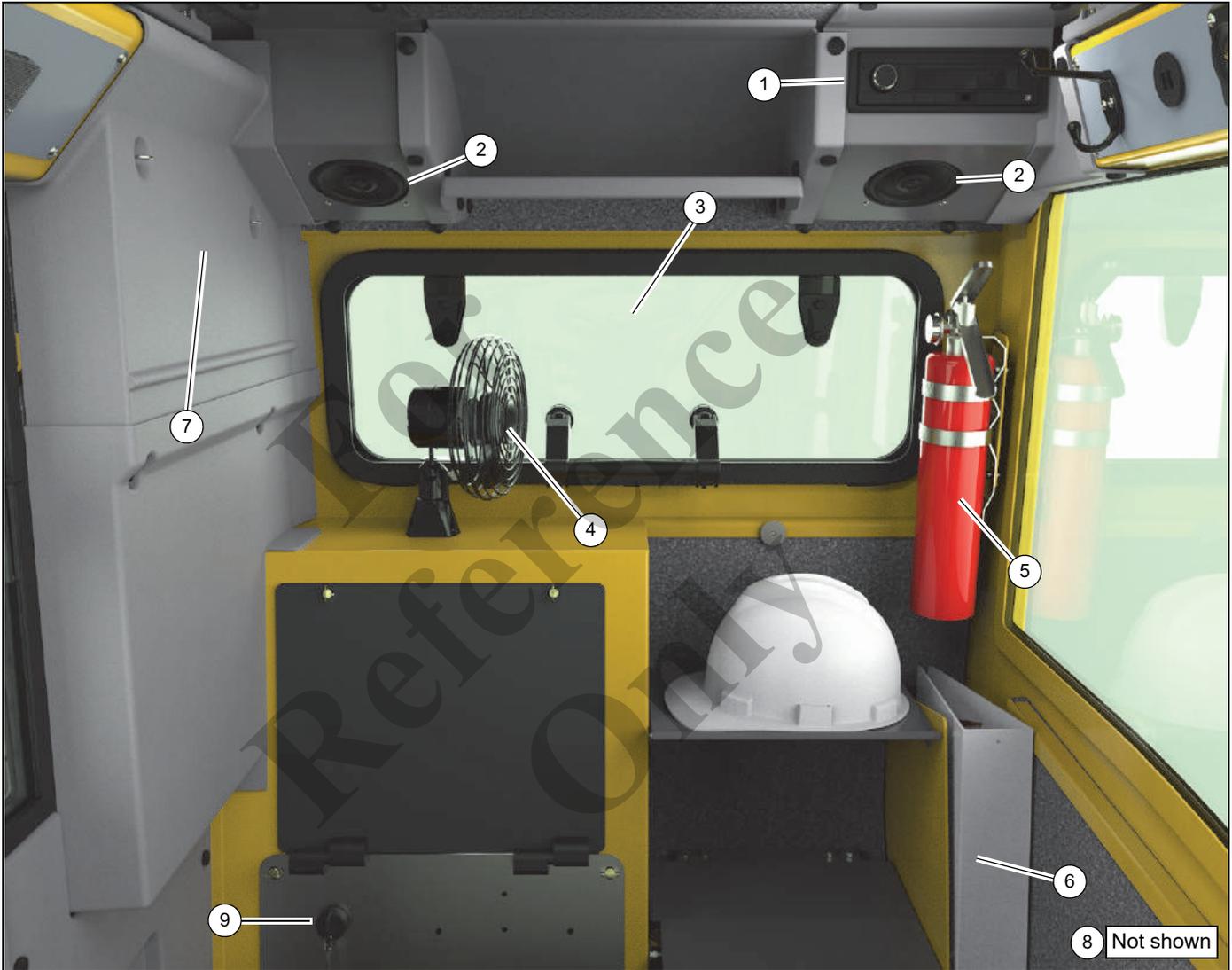
Foot Rests (4, Figure 3-29) are located above the foot pedals, to the left and right of the steering column.

The foot rests can be used by the operator to get a more comfortable position when performing craning functions.

For
Reference
Only

CONTROLS AND FEATURES AT REAR OF CAB

Controls and features located at rear of the cab (Figure 3-30) include the radio, fan, fire extinguisher, user manual holder, fuse and relay panel, and limit bypass switch for non-CE certified cranes.



3

9838-16a

Item	Description	Page	Item	Description	Page
1	Radio (Optional)	3-42	6	User Manual Holder	3-42
2	Speakers (Optional)	3-42	7	Fuse and Relay Panel	3-43
3	Rear Window	3-42	8	Buzzer (Not Shown)	3-44
4	Fan	3-42	9	Maintained Limit Bypass Switch (Non-CE Certified Cranes)	3-44
5	Fire Extinguisher	3-42			

FIGURE 3-30

Radio (Optional)

When equipped, the optional AM/FM Radio (1, Figure 3-30) is located at the upper left rear corner (as seated in the operator seat) of the cab.

Speakers (Optional)

If equipped with the optional radio, two Speakers (2, Figure 3-30) are located at the upper rear corners of the cab.

Rear Window

The Rear Window (3, Figure 3-30) can be opened for ventilation.

To open, push outward on the handle located at the bottom of the window.

Fan

The Cab Circulating Fan (4, Figure 3-30) is located at the right rear corner (as seated in the operator seat) of the cab.

The fan is mounted on a swivel that allows it to be adjusted.

The switch on the fan base controls the fan. It has high, low and off positions.

Fire Extinguisher

A Fire Extinguisher (5, Figure 3-30) is located at the left rear corner (as seated in the operator seat) of the cab.

User Manual Holder

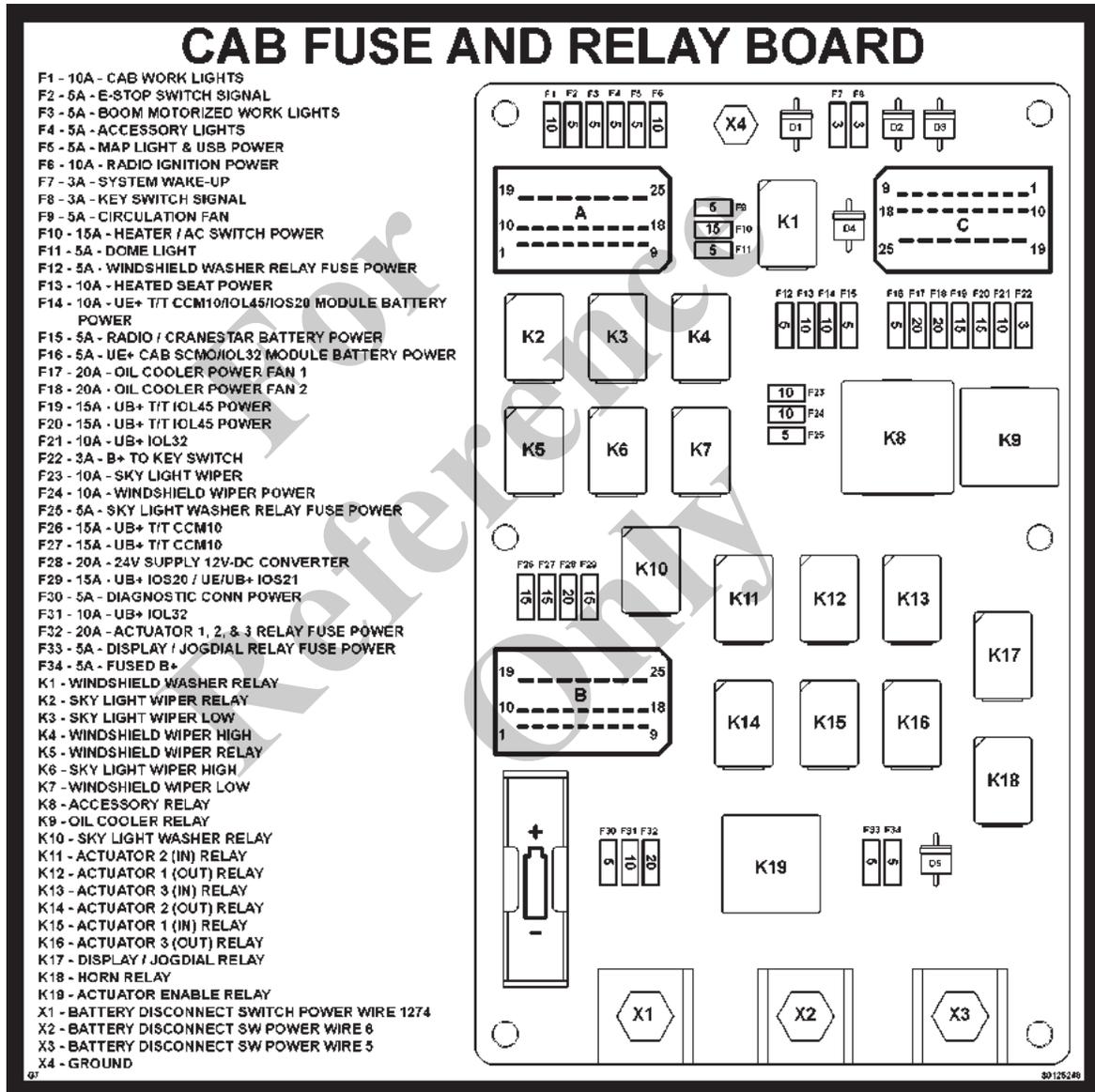
A User Manual Holder (6, Figure 3-30) is located at the lower left (as seated in the operator seat) corner of the cab for storing manuals such as this *Operator Manual* and the crane *Load Chart Manual*.

For
Reference
Only

Fuse and Relay Panel – Cab

The Fuse and Relay Panel (7, Figure 3-30) is located behind the operator seat in the right side upper compartment (as seated in the operator seat).

The cab fuse and relay panel contains the fuses and relays listed in Figure 3-31.



9904

FIGURE 3-31

Buzzer

The buzzer (8, Figure 3-30) comes on when one or more of the following conditions exist:

- Engine alarms
- Emergency Stop Switch activated
- Low brake pressure
- High hydraulic oil temperature
- High transmission oil temperature
- Low steer pressure condition (CE Certified cranes)
- Hoist 3rd wrap condition
- Anti-two-Block condition
- Rated Capacity Limiter (RCL) lockout condition

Maintained Limit Bypass Switch (Non-CE Certified Cranes)



The Limit Bypass Switch prevents the function lockouts from activating.

When the Limit Bypass Switch is activated, the operator must make sure that the crane is not overloaded.

Do not operate the crane with the RCL overridden during normal operations.

The Rated Capacity Limiter (RCL) system, when programmed accurately, will lock out the following crane functions—boom up/down, telescope extend, and hoist up—when a lift is attempted at or above crane capacity, or when a two-block condition exists.

Locking out these functions prevents the overload or two-block condition from worsening.

The Rear Maintained Limit Bypass Switch (9, Figure 3-30) is a two-position, maintained type key switch located behind the operator seat.

During maintenance or troubleshooting work, or to recover the crane, turn switch clockwise to bypass the following limiter systems and their crane function lockouts:

- RCL System (boom up/down, telescope extend, hoist up)
- Anti-Two-Block System (boom up/down, telescope extend, hoist up)
- 3rd Wrap Limiter System (hoist down)
- Working Range Limiter (WRL) System
- Carrier Avoidance System
- -29°C Temperature Limiter System (optional)

The following indicators come on to indicate the limiters are bypassed:

- Bypass 3 Pressed Indicator is on (2, Figure 4-208)
- RCL Bypass Active Indicator is on (1, Figure 4-208)
- RCL Shutdown Warning Indicator is flashing (5, Figure 3-14)
- Anti-two-block Indicator is flashing (7, Figure 3-14)
- 3rd Wrap Indicator is flashing (Figure 4-75)
- Working Range Limiter (WRL) Indicator is flashing (Figure 4-75 and Figure 4-78)
- Low Boom Angle Indicator is flashing (Figure 4-75)
- -29°C Temperature Limiter Indicator is flashing (Figure 4-75)

All craning functions locked out are bypassed while key switch is in the clockwise position.

Overriding the RCL with this switch should only be done by a qualified operator or technician.

NOTE: Before powering up the crane, make sure the RCL Override Switch is in the Normal (not Override) position to prevent an error code from being generated.

RIGHT WINDOW AND SKYLIGHT WINDOW

The right window and skylight window (Figure 3-32) can be opened for ventilation. The skylight sun shade can be adjusted to multiple positions to allow varying amounts of light into the cab.



3

9838-17

Item	Description	Page
1	Skylight Window Latch (If Equipped)	3-46
2	Skylight Sun Shade	3-46
3	Right Side Window Latch	3-46

FIGURE 3-32

Skylight Window Latch (If Equipped)

The Skylight Window Latch (1, Figure 3-32) is located at the front of the window.

Squeeze latch and slide window to the rear to open. To close, slide window forward until the latch engages.

Skylight Sun Shade

The Skylight Sun Shade (2, Figure 3-32) reduces direct sunlight coming into the cab.

The sun shade is self-retracting, and can be set to screen all sunlight coming into the cab. The sun shade can also be adjusted to reduce sunlight in the cab by moving it rearward, and securing it into the notches provided.

Right Side Window Latch

The window on the right side of the cab can be opened for ventilation.

Squeeze latch (3, Figure 3-32) to release and slide the window forward. To close, slide window rearward until the latch engages.

For
Reference
Only

CONTROLS AND FEATURES EXTERNAL TO THE CAB

Outrigger Removal Control Box

An Outrigger Removal Control Box (Figure 3-33) is located on the left front and right rear sides of the carrier.

The front and rear Outrigger Removal Control Boxes include switches for engaging and disengaging the large pins that secure the related outrigger box to the carrier.

Refer to *Outrigger Removal and Installation*, page 5-29 for complete procedures on removing and installing the outriggers boxes.

Pin Enable Switch

The Pin Enable Switch (1, Figure 3-33) is a momentary three-position switch with center position maintained.

The Pin Enable Switch is used to enable and disable the Pin Control Switch (2, Figure 3-33). Move switch to the upper or lower ON position and hold to enable the Pin Control Switch to operate. Release the switch and let it return to the center OFF (disable) position.

Pin Control Switch

The Pin Control Switch (2, Figure 3-33) is a momentary three-position switch with center position maintained.

The Pin Control Switch is used to engage and disengage the large pins that secure the related outrigger box to the carrier.

With the Pin Enable Switch (1, Figure 3-33) positioned to ON, move the Pin Control Switch to the left and hold to disengage the outrigger box pins. With the Pin Enable Switch positioned to ON, move the Pin Control Switch to the right and hold to engage the outrigger box pins.

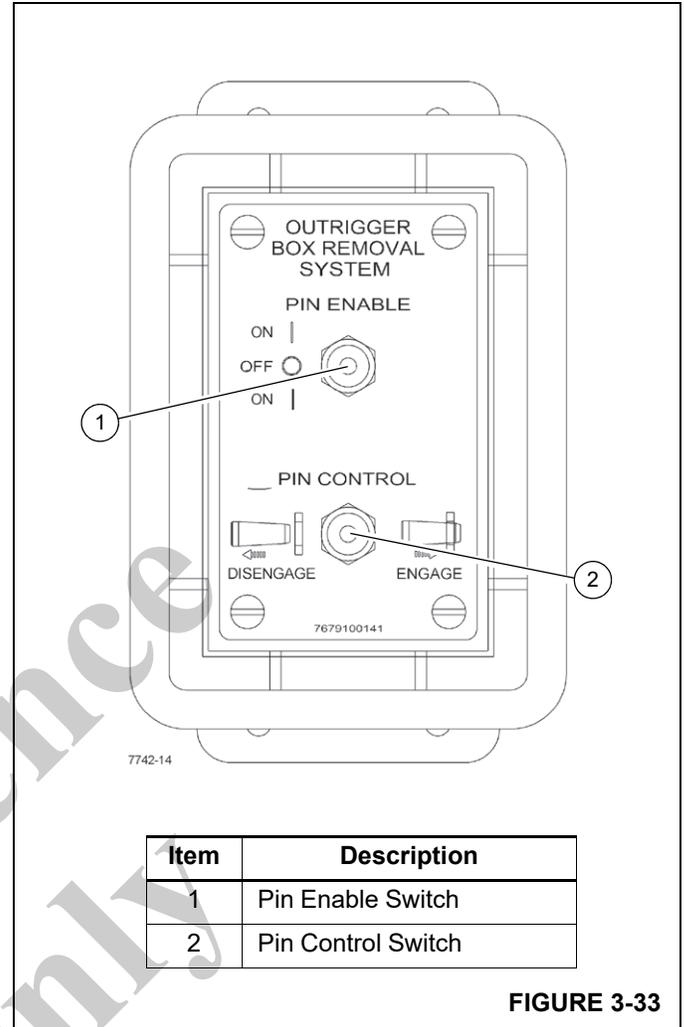


FIGURE 3-33

Bridging Switch (CE Certified Cranes)

! WARNING
Overload Hazard!

The Bridging Switch prevents the function lockouts from activating.

When the Bridging Switch is activated, the operator must make sure that the crane is not overloaded.

Do not operate crane with RCL overridden during normal operations.

The Rated Capacity Limiter (RCL) system, when programmed accurately, will lock out the following crane functions—boom up/down, telescope extend, and hoist up—when a lift is attempted at or above crane capacity, or when a two-block condition exists.

Locking out these functions prevents the overload or two-block condition from worsening.

The Bridging Switch is located inside a key-locked single-door enclosure (Figure 3-34) attached to the outside rear of the operator cab.

The switch is a two-position momentary rocker switch.

During maintenance or troubleshooting work, or to recover the crane, push and release the switch to bypass the following limiter systems and their crane function lockouts:

- RCL System (boom up/down, telescope extend, hoist up)
- Working Range Limiter (WRL) System
- Carrier Avoidance System

The following indicators come on to indicate the limiters are bypassed:

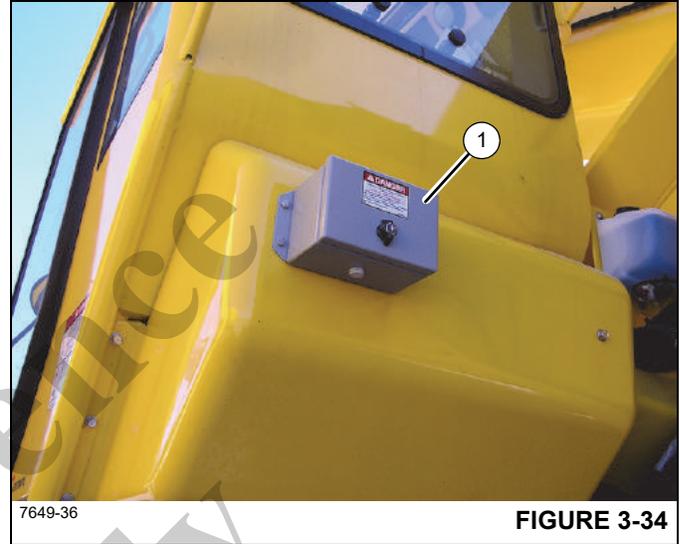
- Bypass 3 Pressed Indicator is on (only when pushed and held) (2, Figure 4-208)
- RCL Bypass Active Indicator is on (1, Figure 4-208)
- Working Range Limiter (WRL) Indicator is on (Figure 4-75 and Figure 4-78)
- Low Boom Angle Indicator is flashing (Figure 4-75)

Upon pushing the Bridging Switch, the swing left/right function pressure is reduced to 25%. The boom down, hoist up, and telescope extend function speeds are reduced to 15% when actuated. Boom up, hoist down, and telescope retract function speeds are not reduced.

Overriding the RCL with the Bridging Switch should only be done in an emergency.

All crane function lockouts are bypassed until one of the following occurs:

- Bridging Switch is again pushed and released.
- 30 minutes have passed since the Bridging Switch was initially pushed, and controllers are in the neutral position.
- Engine is stopped.



7649-36

FIGURE 3-34

External RCL Light Tower (Optional)

The Rated Capacity Limiter (RCL) External Light Tower (1, Figure 3-35) is located on the outside upper right corner of the crane cab.

The RCL External Light Tower is an operational aid. The external light tower works with the RCL system to warn the operator and external personnel of an approaching overload condition that could cause equipment damage, personal injury, or death.

The lights in the light tower come on in the following manner:

- Green LED – when the green LED is on, the load being lifted is less than 90% of crane RCL programmed capacity.
- Yellow LED – when the yellow LED is on, the load being lifted is between 90% to 100% of crane RCL programmed capacity.
- Red LED – when the red LED is on, the load being lifted is greater than 100% of crane RCL programmed capacity.



9838-26

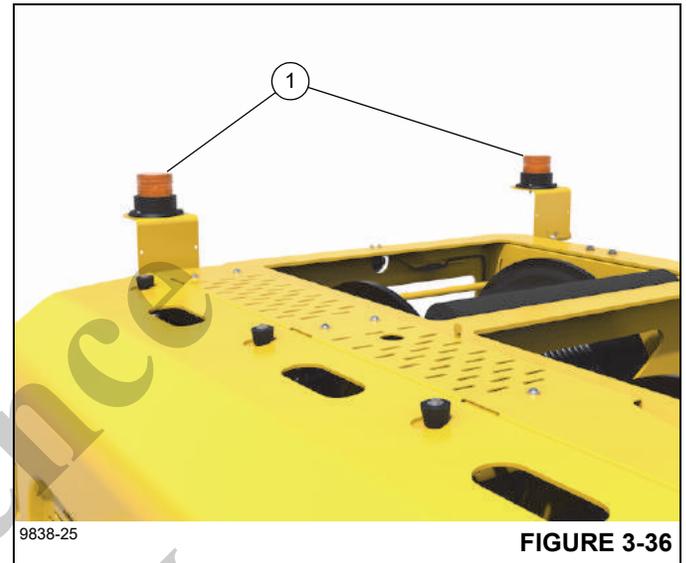
FIGURE 3-35

Strobe Light or Beacon

The standard Strobe Light or Beacon (1, Figure 3-36) is located at the right side of the superstructure.

The Beacon is on when the Ignition Switch is in the RUN (I) position.

A second Beacon is available as an option and is located at the left side of the superstructure.



9838-25

FIGURE 3-36

Backup Alarm

The Backup Alarm is an audio system used to warn personnel in the area that the crane is backing up.

The Backup Alarm is activated when the transmission is placed in reverse.

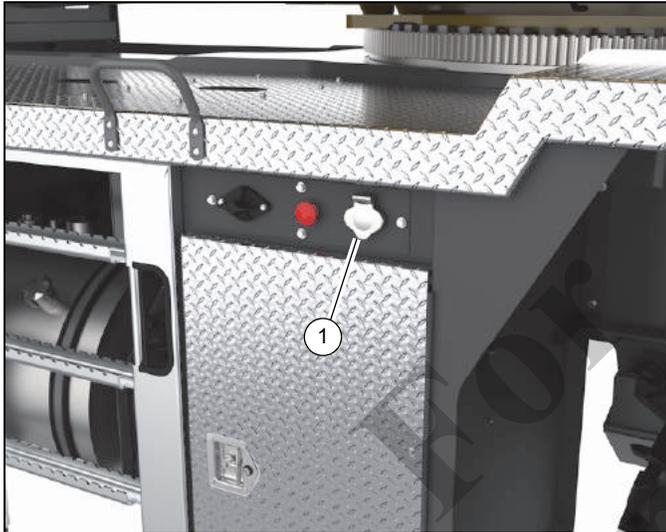
The Backup Alarm is installed at the rear of the superstructure.

120V/240V Engine Block Heater and Outlet

The crane is equipped with a 120V engine block heater for cold weather operation.

The electrical outlet (1, Figure 3-37) for connecting power to the engine block heater is located on the left side of the crane near the battery disconnect switch.

An optional 240V engine block heater and outlet is available in place of the 120V version.



9838-24

FIGURE 3-37

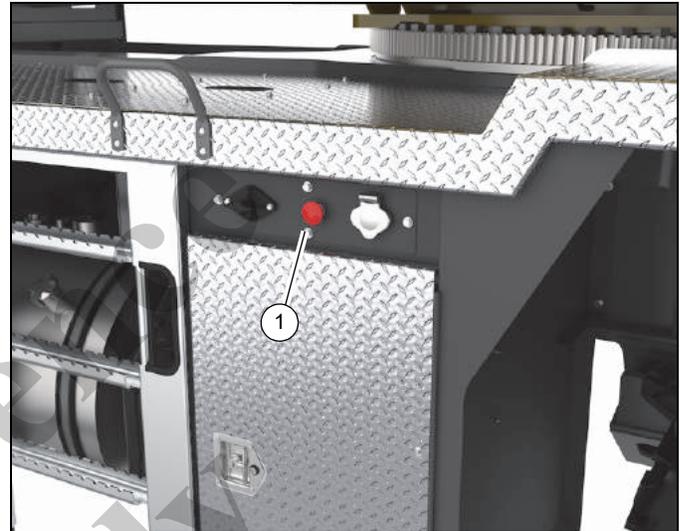
Emergency Stop Buttons (Optional)

The optional Emergency Stop Buttons (1, Figure 3-38) are located on the left and right sides of the carrier.

Push in the red button to stop the engine and all crane functions.

When the Emergency Stop Button is pushed in, the Emergency Stop Indicator in the Alerts Area (1, Figure 4-74) of the Operator Display Module (ODM) comes on.

Rotate and pull out button to allow the engine to be re-started and resume normal operation.



9838-24

FIGURE 3-38

Battery Disconnect Switch

The Battery Disconnect Switch (1, Figure 3-39) is located on the left side of the carrier.

The switch is a two-position ON/OFF rotary switch used to disconnect power from the batteries to the crane.

Turn switch clockwise to the ON position to connect the batteries. Turn switch counterclockwise to the OFF position to disconnect the batteries.

Always disconnect batteries using the Battery Disconnect Switch if crane will be inactive for over 24 hours.

The Battery Disconnect Switch has an integral lock feature that allows the switch to be held in the ON position (battery connected) or OFF position (battery disconnected) when used with a padlock (useful for lockout/tagout programs).

NOTE: To avoid possible engine fault codes and undesirable operation, make sure that the Ignition Switch, located on the right side of the steering column (refer to *Ignition Switch*, page 3-8), has been in the

OFF (0) position for 2 minutes before disconnecting the batteries from the crane.

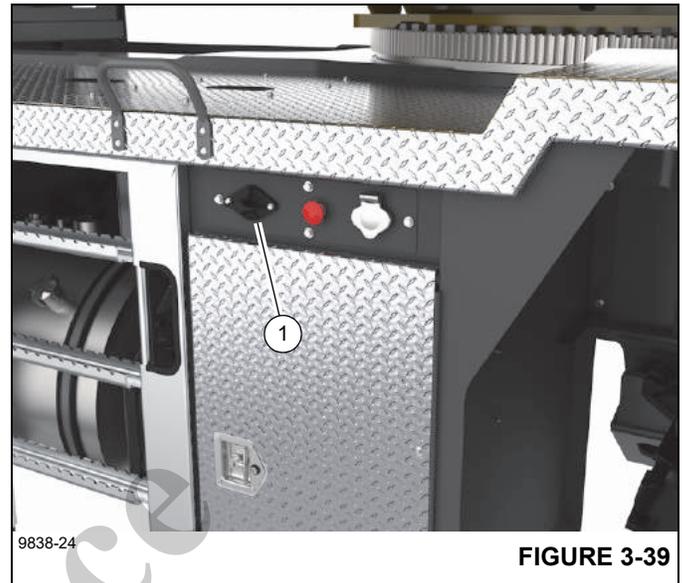
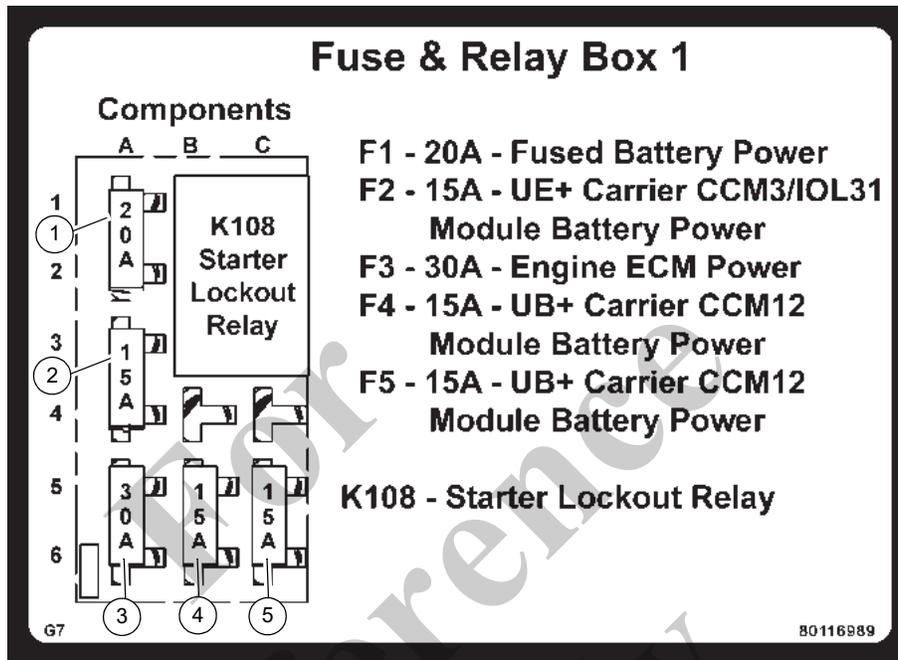


FIGURE 3-39

For Reference Only

Fuse and Relay Box #1 – Carrier

The Fuse and Relay Box #1 is located on the left side of the carrier in the battery box and includes fuses and the relay listed in Figure 3-40.



9861-1

Item	Description
1	Fuse F1
2	Fuse F2
3	Fuse F3
4	Fuse F4
5	Fuse F5

FIGURE 3-40

Fuse Box #2 – Carrier

The Fuse Box #2 is located on the left side of the carrier in the battery box and includes fuses listed in Figure 3-41.

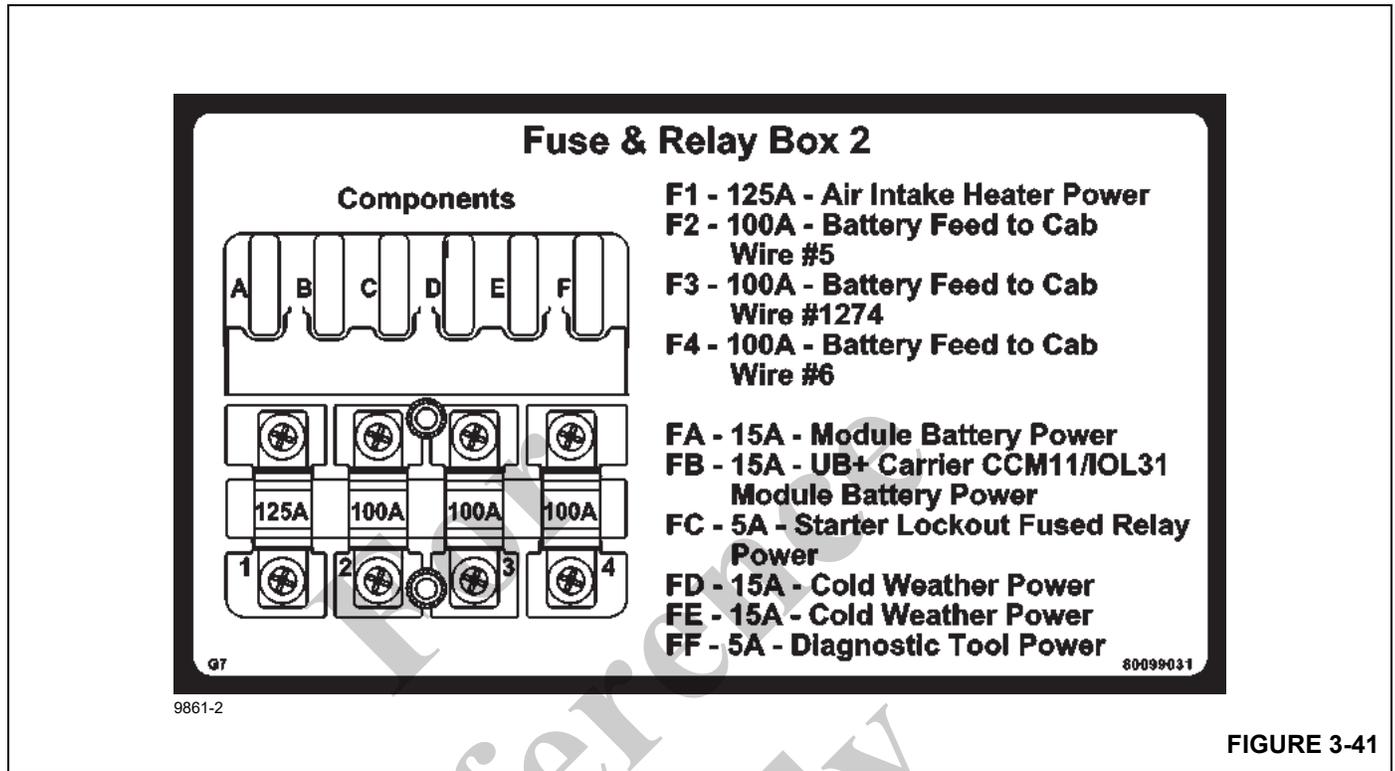


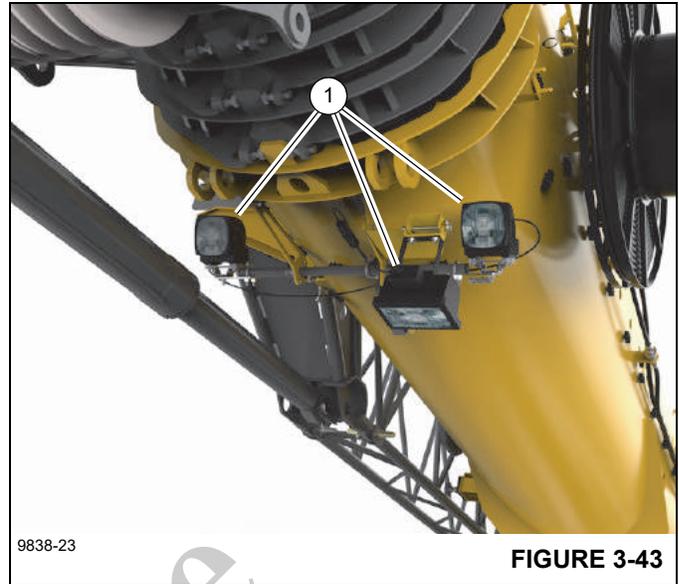
FIGURE 3-41

Reference Only

Cab-Mounted Working Lights

Adjustable Cab-Mounted Working Lights (1, Figure 3-42) are located on the front of the cab.

The lights are controlled by the *Cab-Mounted Lights Switch*, page 3-11.

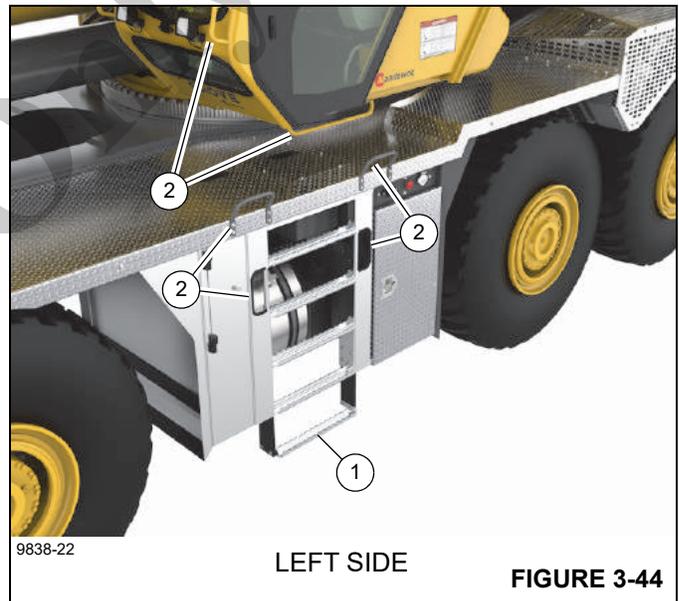


Ladders and Grab Handles

Ladders (1, Figure 3-44 to Figure 3-47) and grab handles (2) are located at the left and right sides of the crane as well as at the front and rear of the crane.

Use these ladders and grab handles to climb and access the carrier deck or the cab.

Always maintain a three-point contact to the crane when using the ladders and grab handles.

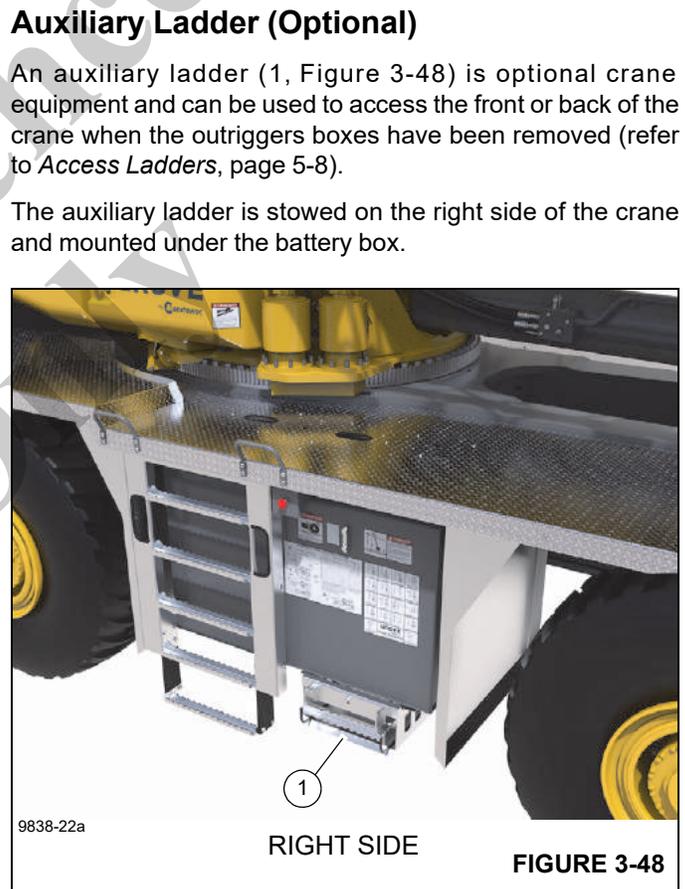
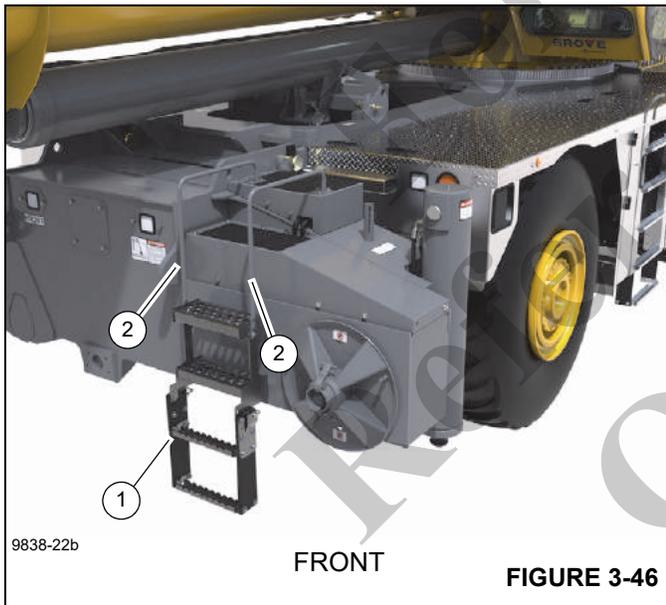
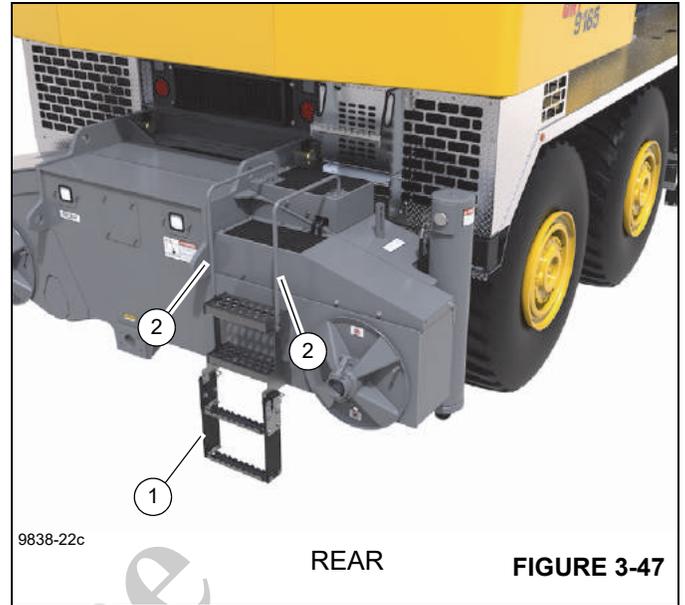
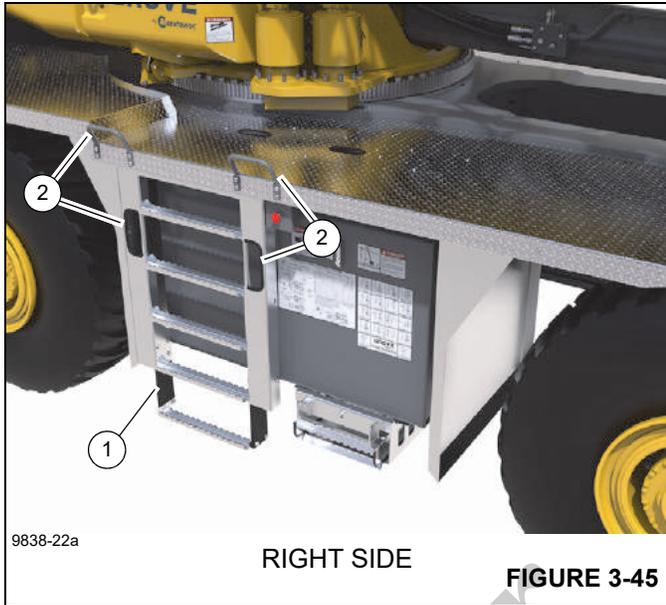


Motorized Boom-Mounted Working Lights

Motorized Boom-Mounted Working Lights (1, Figure 3-43) are optional crane equipment that are mounted to the bottom of the boom base section.

The working lights are controlled by the *Boom-Mounted Lights Switch (Optional)*, page 3-11.

The working lights are adjusted by the *Boom-Mounted Lights Motor Switch (Optional)*, page 3-11.



Auxiliary Ladder (Optional)

An auxiliary ladder (1, Figure 3-48) is optional crane equipment and can be used to access the front or back of the crane when the outriggers boxes have been removed (refer to *Access Ladders*, page 5-8).

The auxiliary ladder is stowed on the right side of the crane and mounted under the battery box.

REMOTE CONTROL UNIT

For operating information regarding the Remote Control Unit, refer to *Using the Remote Control Unit*, page 4-53.

Overview



FIGURE 3-49

The Remote Control Unit (Figure 3-49) is a rechargeable, hand-held device.

Use the Remote Control Unit only during crane set up. The Remote Control Unit is not intended to operate the crane during normal crane operations.

The Remote Control Unit operates the following crane functions:

- Outrigger Beams
- Outrigger Jacks
- Hoist (Main)
- Hoist (Auxiliary)
- Boom Lift
- Swing
- 360° Swing Lock
- Horn
- Engine Start/Stop
- Engine Throttle Control
- Hydraulic Luffing Boom Extension (optional)
- Boom Extension Stowage Actuators
- Counterweight Cylinders

When using the Remote Control Unit, all limiters and their crane function lockouts are inoperable, to include the following:

- RCL System (boom up/down, telescope extend, hoist up)
- Anti-Two-Block System (boom up/down, telescope extend, hoist up)
- 3rd Wrap Limiter System (hoist down)
- Working Range Limiter (WRL) System
- Carrier Avoidance System
- -29°C Temperature Limiter System (optional)

The Remote Control Unit has the following operating conditions:

Working Range	Approximately 30 m (100 ft)
Operating Temperature	-20°C to 70°C (-7°F to 158°F)
Storage Temperature	-40°C to 75°C (-40°F to 167°F)
Rechargeable Battery Life	Approximately 10 hours

Storage and Charging

The Remote Control Unit is powered by a 3.2 Ah lithium rechargeable battery pack, which provides approximately 10 hours of operation.

Two battery packs are provided – one battery pack is to be installed in the Remote Control Unit, while the other is to be kept in the charger.

For short-term storage, store the Remote Control Unit in the dashboard, in front of the steering column (1, Figure 3-50). For long-term storage, store the Remote Control Unit behind the seat or in the netting to the right of the seat.

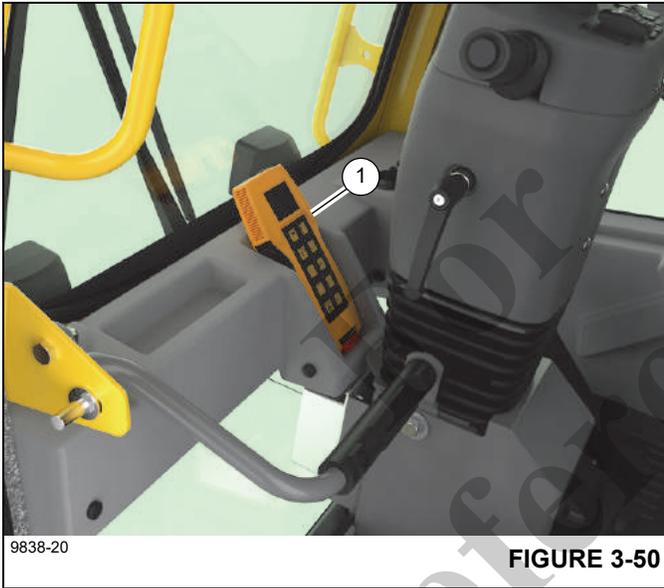


FIGURE 3-50

Keep the spare battery pack in the charger, which is located behind the seat (1, Figure 3-51).



FIGURE 3-51

The charger is always on and will charge the battery pack whether the engine is operating or not.

The charger is equipped with the following indicator lights to show the battery pack state of charge:

Status	Description
Four red lights	Battery pack is charging
Three green lights	Battery pack is fully charged

Controls and Features



Item	Description	Page	Item	Description	Page
1	Programming Port	3-59	11	Boom Lift Button	3-60
2	Power Button	3-59	12	Swing Button	3-60
3	Color Display	3-59	13	Option Button	3-60
4	Left Side Motion Button	3-59	14	Engine Button	3-60
5	Right Side Motion Button	3-59	15	Horn Button	3-60
6	Enable Buttons (left and right)	3-59	16	Information Button	3-60
7	Emergency Stop (E-Stop) Button	3-59	17	Escape Button	3-61
8	Outrigger Beam Button	3-60	18	Status Indicator	3-61
9	Outrigger Jack Button	3-60	19	Battery Pack (Not Shown)	3-61
10	Hoist Button	3-60			

Programming Port

The Programming Port (1, Figure 3-52) is for Grove factory authorized use only.

Power Button

The Power Button (2, Figure 3-52) is a pushbutton switch that switches the Remote Control Unit on and off.

Push the button one time to cause remote to come on. Push the button again to cause remote to go off.

Color Display

The Color Display (3, Figure 3-52) shows the function screen for the selected crane function being operated.

Refer to *Display Components*, page 3-62 for an example of a function screen and its related indicators.

Left Side Motion Button

The Left Motion Button (4, Figure 3-52) is a proportional pushbutton switch.

Push the button to cause the selected crane function to move in the direction indicated on the display screen.

The speed of the crane function operation is controlled by how far down the pushbutton switch is pushed.

For the crane function to operate, the left or right side Enable Button (6, Figure 3-52) must also be pushed at the same time that the Left Motion Button is pushed.

Right Side Motion Button

The Right Motion Button (5, Figure 3-52) is a proportional pushbutton switch.

Push the button to cause the selected crane function to move in the direction indicated on the display screen.

The speed of the crane function operation is controlled by how far down the pushbutton switch is pushed.

For the crane function to operate, the left or right side Enable Button (6, Figure 3-52) must also be pushed at the same time that the Right Motion Button is pushed.

Enable Buttons

The Enable Buttons (6, Figure 3-52) are two-position pushbutton switches.

Either the left or right side Enable Button must be pushed at the same time that the Left or Right Motion Button is pushed for the selected crane function to operate in the desired direction.

Emergency Stop Button

The Emergency Stop Button (7, Figure 3-52) is located at the bottom of the Remote Control Unit.

Push the red button to stop engine and all crane functions.

When the Emergency Stop Button is pushed, the Emergency Stop Indicator (Figure 3-53) in the Remote Control Unit display comes on (red).

Pull out the red button to allow engine to be re-started and normal operation resumed.



FIGURE 3-53

When the Remote Control Unit is enabled, the Emergency Stop Button in the cab and the optional Emergency Stop Buttons on the left and right sides of the carrier continue to operate normally.

Outrigger Beam Button

The Outrigger Beam Button (8, Figure 3-52) is a momentary pushbutton switch.

Push the button to cause the outrigger beam function screen to appear in the Remote Control Unit display.

From this function screen the outrigger beams can be extended and retracted.

Outrigger Jack Button

The Outrigger Jack Button (9, Figure 3-52) is a momentary pushbutton switch.

Push the button to cause the outrigger jack function screen to appear in the Remote Control Unit display.

From this function screen the outrigger jacks can be extended and retracted.

Hoist Button

The Hoist Button (10, Figure 3-52) is a momentary pushbutton switch.

Push the button to cause the hoist function screen to appear in the Remote Control Unit display.

From this function screen the hoist rope can be reeled in or out on the main and auxiliary hoists.

Boom Lift Button

The Boom Lift Button (11, Figure 3-52) is a momentary pushbutton switch.

Push the button to cause the boom lift function screen to appear in the Remote Control Unit display.

From this function screen the boom can be raised and lowered.

Swing Button

The Swing Button (12, Figure 3-52) is a momentary pushbutton switch. Push the button to cause the swing function screen to appear in the Remote Control Unit display.

From this function screen the boom and superstructure can be swung left and right.

Option Button

The Option Button (13, Figure 3-52) is a momentary pushbutton switch.

Push the Option Button several times to cause the luffing boom extension offset, boom extension stowage, and counterweight load/unload function screens to cycle through the Remote Control Unit display.

From these function screens the following functions can be performed:

- Set boom extension offset
- Deploy and stow boom extension
- Remove and install counterweight

Engine Button

The Engine Button (14, Figure 3-52) is a momentary pushbutton switch.

Push the button once to cause the engine start/stop function screen to appear in the Remote Control Unit display.

From this function screen the engine can be started or stopped.

Quickly push the button two times to cause the engine throttle function screen to appear.

From the engine throttle function screen the engine speed can be increased and decreased.

The throttle pedal and the Increment/Decrement – Start/Stop Switch in the cab will not operate when the Remote Control Unit is enabled.

Horn Button

The Horn Button (15, Figure 3-52) is a momentary pushbutton switch.

Push button to operate the horn.

The horn button in the cab will continue to operate when the Remote Control Unit is enabled.

Information Button

The Information Button (16, Figure 3-52) is a momentary pushbutton switch.

Push button to cause the information screen to appear in the Remote Control Unit display.

The information screen shows the Remote Control Unit software version and the crane serial number.

The serial number shown on the Remote Control Unit must match the serial number of the crane, as the two are paired with one another.

Escape Button

The Escape Button (17, Figure 3-52) is a momentary pushbutton switch.

Push button to cause the crane function screen, that currently appears in the display, to change back to the main screen.

Status Indicator

The Status Indicator (18, Figure 3-52) is a bi-colored LED that indicates the status of the Remote Control Unit.

The following statuses are possible:

Green (slow flash)	Radio frequency communication is Okay
Red (slow flash)	E-Stop Button is pushed in or wireless communication stopped
Red (fast flash)	Battery pack has low charge
Red (Constant)	Remote controlling system error

Battery Pack

The Battery Pack (19, Figure 3-52) is installed into the back of the Remote Control Unit.

For Reference Only

Display Components

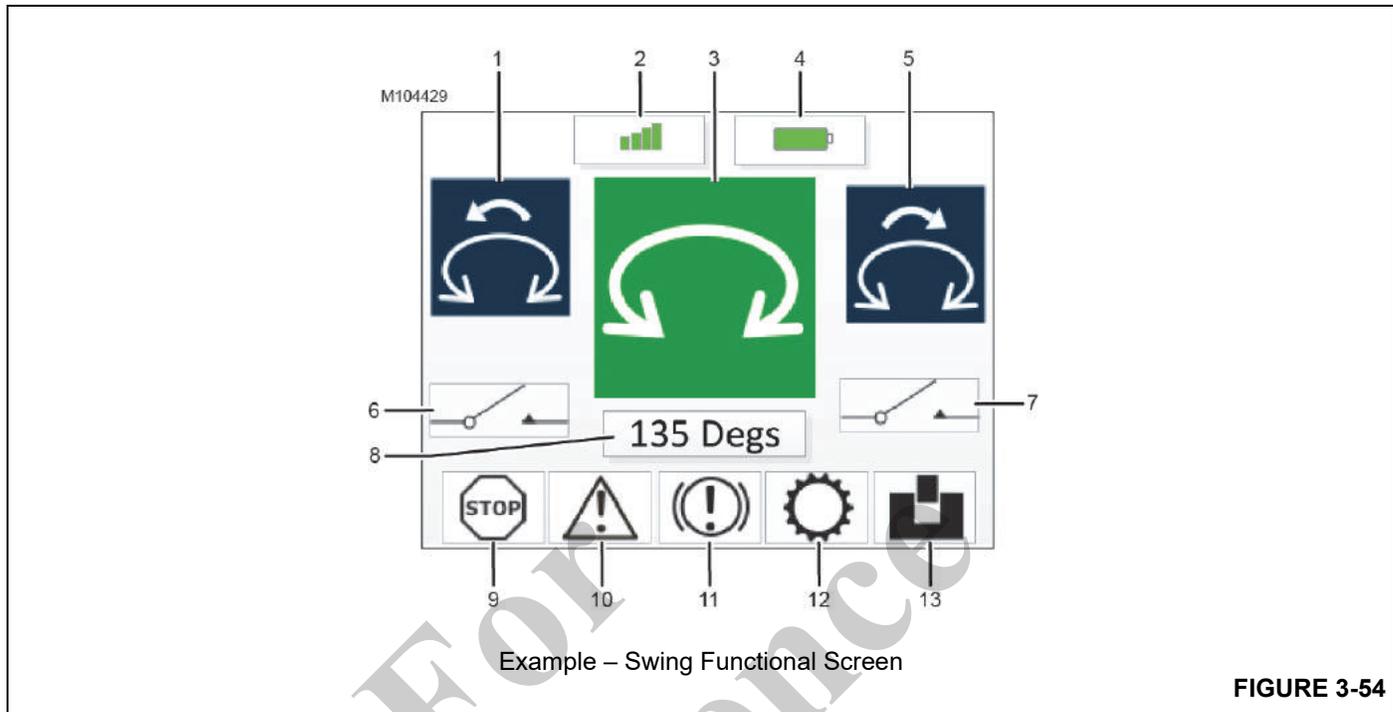


FIGURE 3-54

Item	Component	Description
1	Left Motion Command Indicator	Depicts the operation that is controlled by the left side motion button
2	Transmission Strength Indicator	More bars = greater strength, and vice versa
3	Function Screen Indicator	Depicts the function that is being operated (swing in this example)
4	Battery Pack Power Indicator	Green = fully charged Amber = discharging
5	Right Motion Command Indicator	Depicts the operation that is controlled by the right side motion button
6	Left Enable Indicator	White = enable button is not pushed (function cannot be operated)
7	Right Enable Indicator	Green = enable button is pushed (function can be operated)
8	DEG or RPM Indicator	When applicable, shows the position of the superstructure in degrees or the rotational speed of the selected motion
9	E-Stop Indicator	White = E-Stop button pulled out (operation is allowed) Red = E-Stop button pushed in (operation is not allowed)
10	Crane Fault Indicator	White = no active crane fault exists (operation is allowed) Red = active crane fault exists (operation is not allowed)
11	Parking Brake Indicator	White = parking brake is applied (operation is allowed) Red = parking brake is released (operation is not allowed)
12	Transmission Indicator	White = transmission is in neutral (operation is allowed) Red = transmission is in gear (operation is not allowed)
13	360° Swing Lock Indicator (Optional)	White = swing lock is engaged Red = swing lock is disengaged

SECTION 4 OPERATING PROCEDURES

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For Reference Only

PRE-STARTING CHECKS

A complete walk-around visual inspection of the crane should always be made with special attention to structural damage, loose equipment, leaks, or other conditions that would require immediate correction for safe operation.

The following items are suggested to be checked to make sure the crane is prepared for starting the day's work.

Fuel Supply

Fill fuel tank and make sure cap is on tight.

Engine Oil

CAUTION

Do not overfill.

Check oil level in the crankcase and make sure it is within the ADD and FULL marks on the dipstick. Do not overfill.

Engine Coolant



DANGER

Do not loosen radiator cap while engine and radiator are hot. Steam or hot coolant will cause severe burns.

Check surge tank coolant level sight gauge and fill to the proper level. Do not overfill. Make sure surge tank cap is secure.

Batteries

Check battery cables and clamps are tight and not corroded.

Hydraulic Reservoir and Filter

Check hydraulic level sight gauge and filter condition indicator on the hydraulic tank. Hydraulic fluid should be at normal operating temperature, with boom and outriggers in a retracted position, and boom level.

Check breather for cleanliness and make sure it is secure.

Hoist Rope

Inspect hoist rope in accordance with applicable Federal Regulations. Sheaves, guards, guides, drums, flanges, and any other surfaces that come in contact with the rope should be inspected for any condition that could cause possible damage to the rope.

Hook Block and Overhaul Ball

Inspect for nicks, gouges, cracks, and evidence of any other damage. Replace a hook that has cracks or shows evidence

of excessive deformation of the hook opening (including twist). Be sure safety latch is free and aligned.

Seats and Mirrors

Adjust seat and mirrors for clear vision and safe driving.

Seat Belts

Seat Belt Maintenance

Seat belt assemblies are maintenance-free, however, they should be periodically inspected to make sure they are not damaged and are in proper operating condition, especially if they have been subjected to severe stress.

Cleaning Seat Belt Webbing

Wash seat belt webbing with mild soap or detergent. Do not use commercial solvents. Bleaching or re-dyeing the webbing is not recommended because of possible loss of webbing strength.

Floor Mat

Make sure floor mat is correctly in place and does not interfere with the operation of the foot pedals.

Signal and Running Lights

Check all signal and running lights for proper operation. Replace lights that are not working with those of the same number, or equivalent.

Service and Parking Brakes

Check for proper operation.

Tires

Check for severe cuts, foreign objects embedded in treads, and for correct inflation pressures. A tire inflation chart, providing the correct air pressures, is located in the *Load Chart Manual* in the crane cab.

Wheels

Maintain proper torque on wheel lugs and check for proper wheel mounting. If equipped with steel or aluminum wheels, re-torque wheels 300 hours after initial installation or any time tires and wheels are removed. Doing this re-seats the lug nuts. Check lug nuts for proper torque every 500 hours thereafter.

Axle Oscillation Lock Outs Operation

The following procedure should be used to periodically check the axle oscillation system and make sure it is in proper working condition.

1. Make sure tires are inflated to recommended pressure. Refer to *Load Chart Manual* in the crane cab for proper inflation pressures.
2. Program the RCL with a travel rigging code based on the configuration of the crane:
 - 9816 – On Rubber, Boom Centered Over Front, without Counterweight
 - 9014 – On Rubber, Boom Centered Over Rear, with Standard Counterweight
 - 9016 – On Rubber, Boom Centered Over Front, with Standard Counterweight
3. Set the suspension to the Ride Height level (refer to *Suspension Raise/Lower*, page 4-107).
4. Center the rear wheels.
5. With hook unloaded, boom fully retracted and centered over the front or rear at no more than a 10° to 15° boom angle, position the two left or right side rear tires on blocks so that the rear tires are approximately 15 to 30 cm (6 to 12 in) above the level of the opposite tires.
6. Slowly swing the superstructure at least 2° to left or right of center to activate the axle oscillation lock out valve. Refer to the Suspension Control Indicator (5, Figure 4-78) to confirm the suspension is locked. Do not swing beyond tire track.
7. Slowly drive off of blocks and stop. Rear tires should be touching the road surface and the opposite front tire should be light or slightly off road surface.
8. Swing superstructure until it is centered over the crane again. If axle oscillation lock out valve is functioning properly, crane will re-level itself; if valve is not working properly, crane will not re-level itself.

**DANGER****Tipping Hazard!**

Do not operate crane if axle oscillation lock out system is not functioning properly.

Failure to comply with this warning may result in death or serious injury.

If rear axles do not lock or unlock properly, do not operate the crane until the lock out system has been evaluated and repaired as necessary.

Safety Equipment

Check all lights, windshield wipers, washers, washer liquid supply, horn, instruments, signaling devices, etc.

Daily Lubrication

Make sure all components requiring daily lubrication have been serviced. Refer to *Maintenance and Lubrication*, page 6-1.

Boom

Before extending boom, make sure access covers on top of boom base section and on face of boom nose are installed.

Air Intake Restriction Monitoring (AIRM) Communications System

The engine includes the Cummins AIRM Communications System. This system calculates real-time air filter restriction at operational flow rate using the temperature and pressure input from the TBAP sensor, which is included on the Direct Flow air cleaner.

When the air filter becomes dirty and should be replaced, a maintenance fault is generated and the Engine Warning Indicator in the Alerts Area (1, Figure 4-74) of the Operator Display Module (ODM) flashes for a period of time at every key on. Replace the air filter at the next maintenance interval.

If the air filter becomes more dirty, a severe warning fault is generated and the Engine Warning Indicator comes on (constant). A progressive engine derate will occur to protect the engine from damage.

The generated fault codes can be viewed on the Operator Display Module (ODM) (refer to *Engine Faults*, page 4-145).

COLD WEATHER OPERATION

The following recommendations are for operating Grove cranes in regions with ambient temperatures below -9°C (15°F) which are considered arctic.

NOTE: Additional information regarding engine cold weather operation is available through your Cummins dealer/service center under Service Bulletin 3379009.

Use particular care to make sure cranes operated in very cold temperatures are operated and maintained in accordance with procedures provided by Grove. Always make sure there is adequate lubrication during system warm-up. Regardless of crane lubricant viscosity, always follow cold weather warm-up procedures described in the section *Crane Warm-up Procedures*, page 4-11. For proper cold weather lubricants, refer to the section *Arctic Lubricants and Conditions*, page 6-5.

If in doubt of suitability for a specific fluid or lubricant, check with an authorized Grove distributor or Manitowoc Crane Care. Cranes should have appropriate hydraulic oil, lubricants, and other auxiliary items required for operation in arctic temperatures.

Grove recommends the crane be equipped with the following cold weather accessories:

Down to -29°C (-20°F) Package

- Battery heater
- Transmission heater
- In-line fuel heater
- Engine hood insulation
- Fan clutch
- Radiator shutters
- Air diverter
- Diesel fired cab heater
- Fluids suitable to -29°C (-20°F)
 - Arctic windshield washer fluid
 - Arctic fuel

Down to -40°C (-40°F) Package

- Coolant heater (to circulate warm coolant through heaters and engine)
- Transmission heater
- Hydraulic swivel heater
- Battery heater
- In-line Fuel heater
- Engine hood insulation
- Fan clutch
- Radiator shutters
- Air diverter
- Diesel fired cab heater
- Super-capacitor starting system
- Fluids suitable to -40°C (-40°F):
 - Arctic windshield washer fluid
 - Arctic fuel

Individual crane components must be sufficiently warmed prior to performing a lift. Follow the warm-up procedures found in section *Crane Warm-up Procedures*, page 4-11.

For crane operation below -40°C (-40°F), derate load chart capacities by 6.60% for each degree Celsius or by 3.67% for each degree Fahrenheit below -40°C (-40°F).

Operation of cranes at full rated capacities in ambient temperatures below -9°C (15°F) should be accomplished only by competent operators who possess the skill, experience, and dexterity to ensure smooth operation. Shock loading shall be avoided.

Coolant Heater

A diesel fueled coolant heater circulates warm coolant through engine and crane components when operating during arctic temperatures. The coolant heater should be activated 2 hours before starting the crane to allow sufficient time to preheat fluids and assist with easy start-up conditions.



WARNING

Explosion Hazard!

Before switching on, check if heater can be operated at current site of the crane. There is a danger of explosion when using heater around combustible objects! Do not park vehicle near objects that are flammable.

Use caution near heater exhaust tailpipe as it will also become very hot.

NOTE: Operation of heater is NOT allowed:

- At locations where flammable gas or vapors are found or can be formed (example: at fuel stations and chemical factories)
- At locations where explosive dust is found or can be formed (example: coal, wood or grain dust).
- There is a risk of suffocation when using the heater!
- Do not operate heater in enclosed spaces (example: garages).

To activate heater, make sure fuel supply valve from heater fuel reservoir is turned to the ON position. Make sure battery disconnect switch is turned to the ON position and push the activation button at the heater control panel. A green light will come on indicating system is activated. The start-up and shutdown cycles may take approximately 2 minutes for initialization. Make sure coolant, transmission heater, swivel, battery heater, in-line fuel pump, in-line fuel heater, and hydraulic reservoir heater are heating properly.

To deactivate heater, push button at heater control panel. The green light will go off indicating system is deactivated. Shutdown cycle takes approximately 2 minutes.

NOTE: Accelerated discharging of battery will occur when crane engine is switched off. If heater is operated with crane engine stopped, batteries will need to be recharged after a short period of time.

Radiator Shutters

When starting engine, radiator shutters close and then reopen when coolant temperature reaches 71°C (160°F).

Auxiliary Cab Heater

The crane cab is heated with an auxiliary air heating system that runs independently of the engine. Heat is generated by burning fuel taken from the heater fuel reservoir.

To heat the operator's cab, activate the auxiliary diesel heater and adjust temperature control switch mounted in the overhead panel. The heating system fan delivers warm air into an air distribution box. Air is circulated according to control settings and then delivered into the cab by a fan through various air extraction and air delivery vents.

Do not cover vents with bags, articles of clothing or any other objects. Keep hot air inlet and hot air outlet free of dirt and foreign material. Soiled or blocked hot air lines may cause overheating, and result in damage.

The crane auxiliary cab heater can be operated when engine is running or stopped as part of the programmable auxiliary heating system. Maximum cab temperature is achieved by running only the auxiliary heater and using the standard cab heater fan when engine is sufficiently warmed up. The standard hot water crane cab heater can also be turned on after engine has started and is warmed to operating temperature.

NOTE: When using heater at high altitudes, factory heater setting must be re-calibrated for proper heater operation.

- Heating at altitudes up to 1,500 m (4,900 ft)
Unlimited heating is possible
- Heating at altitudes over 1,500 m - 3,000 m (4,900 ft - 9,900 ft):
Heating is possible for short periods at this altitude (example: driving over a mountain pass or taking a break while traveling between job sites).

During longer stays, (example: construction job project), the fuel supply must be adjusted to the altitude or the heater will malfunction. This can be done by installing an air pressure sensor kit (Grove part number 90037674). Contact an authorized Grove distributor or Manitowoc Crane Care for additional assistance.

NOTE: Accelerated discharging of battery will occur when crane engine is switched off. If heater is operated

with crane engine stopped, batteries will need to be recharged after a short period of time.

Battery Heater

An in-line battery coolant heater circulates warm coolant under the battery when temperature is below -9°C (15°F). The battery coolant heater should be activated 2 hours before starting the crane to allow sufficient time to preheat batteries and provide easy start-up conditions.

Make sure battery heater coolant valve is turned OFF in ambient temperatures above -9°C (15°F).

Air Diverter

An air diverter directs warmed air collected from under the engine hood when temperature is below -9°C (15°F) to preheat the air intake going to the engine.

Make sure air diverter is switched to outside air intake in ambient temperatures above -9°C (15°F).

Super Capacitor

The super capacitor provides additional cranking current during cold weather startup. The super capacitor is connected to the standard batteries with an isolation relay. The positive relay feed is activated when the key is in the crank and run positions. The super capacitor allows the starter to be cranked for 30 seconds then cycled off for 60 seconds before cranking again until the engine starts.

If crane has been left with battery disconnected for an extended period of time, super capacitor will need up to 30 minutes to charge before having full cranking capacity.

Capacitor charge can be measured by the following:

- Set battery disconnect to ON position.
- Press black button located on top of capacitor:
- If light flashes green, capacitor is charging and may not successfully start machine.
- If light is solid green, capacitor is charged and ready for starting.

Any other color or flash pattern may indicate an error. Refer to decal located on capacitor.

Diesel Fuel

Diesel fuel with low temperature characteristics is required to operate the engine when ambient temperatures get near or below 0°C (32°F). Refer to the applicable engine manual for proper specifications.

Use correct grade of fuel for prevailing temperature. Diesel fuel should have a cloud point of 6°C (10°F) less than the lowest expected temperature. In case of emergency, kerosene may be added to the fuel to bring the cloud point down to the required temperature. This will minimize clogging of filters and small passages by wax crystals. Addition of kerosene is NOT recommended for general use. Refer to *Arctic Lubricants and Conditions*, page 6-5 of this operator manual.

CAUTION

Engine Damage Hazard!

If Ultra Low Sulfur fuel is not used in engines that require it, engine performance will quickly deteriorate and the engine may stop running. The engine warranty will also be voided.

ENGINE OPERATION

Start-up and shutdown procedures for most diesel engines are generally the same. Therefore, the following procedures can be applied, except where specific differences are noted. (Refer to applicable engine manufacturer's manual for detailed procedures).

Jump Starting Hazard

Do not attempt to jump start the crane.

CAUTION

Do not jump start the crane with a different vehicle, portable power pack, or other power source. The surge of power from these sources can damage the crane electronic controls and computer systems. Jump starting the crane batteries with a different vehicle while the engine is running can also damage the donor vehicle electronics.

This crane has multiple computer systems (crane control, RCL, engine & transmission control) that are highly susceptible to voltage/amperage surges in the electrical system.

The batteries should be completely disconnected from the crane electrical system and charged using a battery charger of appropriate voltage level or replace the batteries with fully charged batteries. Refer to *Charging the Batteries*, page 4-8.

Charging the Batteries

When charging the batteries, do not turn on the battery charger until the charging leads have been connected to the battery(s). Also, if the battery(s) are frozen, do not attempt to charge them. Remove the battery(s) from the crane, allow them to thaw, and then charge the battery(s) to full capacity.

“Slow charging” is preferred to “fast charging”. Fast charging saves time but risks overheating the battery(s). Slow charging at six (6) amps or less develops less heat inside the battery and breaks up the sulfate on the battery plates more efficiently to bring the battery up to full charge. The use of a “smart charger” that automatically adjusts the charging amperage rate is recommended.

Start-Up Procedure



DANGER

Diesel engine exhaust can be harmful to your health. Only operate engine in a well ventilated area or vent exhaust outside.

CAUTION

Never crank engine for more than 30 seconds during an attempted start. If engine does not start after 30 seconds, allow starter motor to cool for two minutes before attempting another start.

If engine does not start after four attempts, correct malfunction before attempting another start.

1. Make an under-the-hood inspection for fuel, oil, and coolant leaks, worn drive belts, and trash build-up.
2. Use the correct grade of oil in the crankcase for the prevailing temperature to prevent hard cranking.
3. Make sure diesel fuel has a cloud point of 6°C (10°F) less than the lowest expected temperature. In case of an emergency, white kerosene can be added to the fuel to bring the pour point down to the required temperature. This will prevent clogging of filters and small passages by wax crystals. The addition of kerosene is NOT recommended for general use.
4. Make sure battery disconnect switch handle is in the ON position.
5. Make sure emergency stop switch is not pressed.
6. Make sure parking brake is set to On position and the transmission shift lever is positioned to Neutral.

NOTE: Engine will not crank unless transmission shift lever is in neutral.

NOTE: An engine block heater and grid heater are provided to aid in cold-starting.

7. Turn ignition switch clockwise to position I (RUN).

The Engine Warning Indicator and the Engine Stop Indicator in the Alerts Area (1, Figure 4-74) of the Operator Display Module (ODM) will come on and go off in sequence after approximately two seconds (as a check).

If the Engine Wait-to-Start Indicator in the Alerts Area (1, Figure 4-74) is on, do not crank engine until the indicator goes off.

If the Engine Warning Indicator or the Engine Stop Indicator remains on, correct the malfunction before cranking the engine.

8. Operate the horn by pressing the button on the right controller or by pressing the button on the end of the turn signal lever on the steering column.

9. Turn the ignition switch clockwise to position II (START) and release immediately when the engine starts.

Do not push or hold the throttle pedal down. The ECM automatically provides the proper amount of fuel to start the engine.

CAUTION

If the Engine Warning Indicator or the Engine Stop Indicator is on, immediately stop the engine and correct the malfunction.

NOTE: The Ignition Switch has an anti-restart feature. After a failed attempt to start the engine, the crane control system prevents the engine from cranking again for approximately six seconds.

10. Warm up engine and all crane components following the procedures under *Crane Warm-up Procedures*, page 4-11.

Idling the Engine

Idling the engine unnecessarily for long periods of time wastes fuel and fouls injector nozzles. Unburned fuel causes carbon formation; oil dilution; formation of lacquer or gummy deposits on valves, pistons and rings; and rapid accumulation of sludge in the engine. These conditions become worse in colder climates.

NOTE: When prolonged engine idling is necessary, maintain at least 800 rpm.

Engine High Idle

Idling the engine for long periods of time results in the degradation of engine oil and damage to engine components, as described under *Idling the Engine*, page 4-9.

To reduce these adverse effects, the crane control system will automatically increase the engine idle speed to approximately 1200 rpm when the following conditions are met for a period of 5 minutes:

- Transmission is in neutral
- Parking brake is engaged
- Brake pedal is not pressed
- Engine speed is less than 1125 rpm
- Controllers are not actuated
- Engine coolant temperature is below 71°C (160°F)
- Manual exhaust system cleaning process has not been initiated
- Automatic exhaust system cleaning process is not active

The crane control system will automatically return the engine idle speed to its usual setting when one of the following conditions occur:

- Transmission is shifted to forward or reverse
- Parking brake is disengaged
- Brake pedal is pressed
- Controller is actuated
- Engine coolant temperature rises above 79°C (175°F)
- Exhaust System Cleaning Switch is set to the Manual Cleaning position
- Exhaust system cleaning process is active

Racing the Engine

DO NOT race engine during warm-up period or operate beyond governed speed (as might occur in downhill operation or down-shifting). Engine bearings, pistons, and valves may be damaged if these precautions are not taken.

Exhaust System Cleaning



WARNING Burn/Fire Hazard!

During the cleaning process, the exhaust and tailpipe become very hot. Keep personnel and flammable objects away from the exhaust. Do not park vehicle near flammable objects.

The exhaust system cleaning process can take place in three different modes:

- **Passive:** Exhaust is hot enough during normal working operation to burn off the hydrocarbon (soot) accumulation

- **Active:** Active cleaning occurs when there is insufficient heat in the exhaust system to convert all the hydrocarbon being collected in the exhaust system. Exhaust temperatures are raised by injecting a small amount of fuel. The resulting chemical reaction raises exhaust gas temperatures high enough to oxidize the hydrocarbon system. This is done without operator input.
- **Manual:** Manual, or stationary, cleaning is the same as active cleaning but takes place when crane is not being operated. It allows the operator to perform cleaning outside of the normal duty cycle.

If the exhaust system begins to clog and needs cleaned, the Engine Exhaust Cleaning Required Indicator comes on in the Alerts Area of the ODM Main Screen (refer to *Alerts Area*, page 4-74).

The indicator comes on (constant) during the early stages of required cleaning. If this condition continues, the indicator will begin to flash and a slight engine derate will occur.

If the exhaust system continues to clog, the Engine Warning Indicator in the Alerts Area comes on in addition to the Exhaust Cleaning Required Indicator and a severe engine derate will occur.

These above conditions can only occur if cleaning has been inhibited or a manual cleaning was interrupted.

When the Engine Exhaust Cleaning Required Indicator is on constant or flashing, start the manual cleaning process at the next opportune time. Refer to section titled *Exhaust System Cleaning (If Equipped)*, page 4-155 for procedures to manually clean the exhaust.

As a warning, the High Exhaust System Temperature (HEST) strobe light (1, Figure 4-1) near the exhaust pipe (2, Figure 4-1) will flash during exhaust system cleaning.

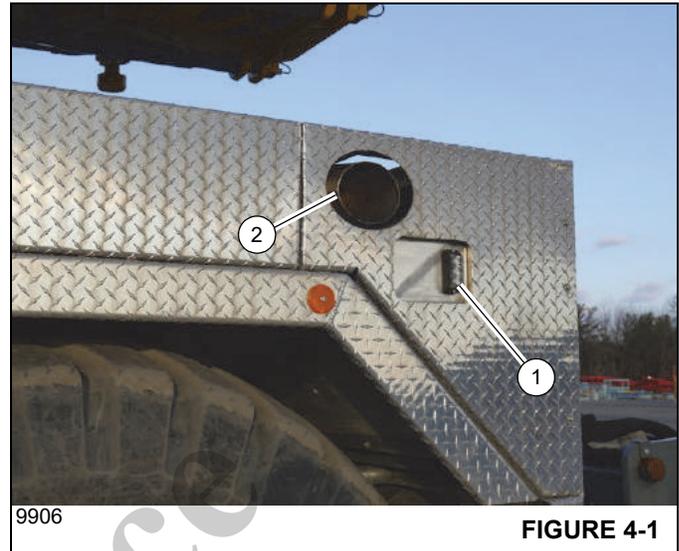


FIGURE 4-1

Shutdown Procedure

1. Allow engine to run at fast idle speed for about five minutes to avoid high internal heat rise and allow for heat dissipation.
2. Turn ignition switch counter-clockwise to the 0 (OFF) position.
3. Drain fuel filter-water separator.
4. If crane is to be inactive for more than 24 hours, disconnect the batteries using the battery disconnect switch.

To avoid possible engine fault codes and undesirable operation, make sure the keyswitch has been off for 2 minutes before disconnecting the batteries.

SUSPENSION HEIGHT

The suspension on the rear tandem axles is adjustable.

- Fully lower the suspension for transportation.
- Set the suspension to the Ride Height when traveling the crane or performing a pick and carry.
- Fully raise the suspension when performing an On-Rubber, Stationary, 360° lift (such as required for removing/installing the outrigger boxes).

Refer to the section titled *Suspension Raise/Lower*, page 4-107 for procedures on how to raise and lower the suspension.

CRANE WARM-UP PROCEDURES

The following procedures must be followed to properly warm different crane components before operating the crane.

NOTE: For temperatures below -9°C (15°F), refer to arctic lubricants and conditions in the Operator and Service Manuals.

Before starting crane, make sure appropriate lubricants are used for ambient temperatures in which the crane will operate (a list of lubricants and temperature ranges can be found in section titled *Maintenance and Lubrication*, page 6-1, by contacting your local Grove distributor, or by contacting Manitowoc Crane Care directly).

CAUTION

Crane Damage Hazard!

Operating crane with incorrect lubricants and fluids for the prevailing ambient temperature and/or failing to adequately warm crane before cold weather operation can lead to a failure of a crane component or system.

Always use Grove recommended lubricants and fluids for prevailing ambient temperature. Properly start and warm crane using cold weather procedures found in this Operator Manual and supplement before operating crane at full load.

Engine

Warm-up Procedures for All Temperature Ranges:

1. After starting, allow engine to idle for 3 to 5 minutes before operating with a load.
2. Cold Engine Startup: After allowing engine to warm by idling it for 3 to 5 minutes, slowly increase engine speed to provide adequate lubrication to bearings and to allow oil pressure to stabilize.

Transmission

For full-load functionality, a minimum sump temperature of 20°C (68°F) is required. Operating the transmission with a sump temperature less than 20°C (68°F) is limited to:

- operating in the neutral gear or
- driving with an unloaded crane while not exceeding 1500 engine RPM and not exceeding half throttle.

Warm-up Procedures for Rough Terrain (GRT) Cranes:

1. Setup crane on outriggers.
2. Engage transmission with four-wheel drive selected and allow crane to run at idle until the temperature of the transmission sump reaches 20°C (68°F).

NOTE: Warm-up operation of four-wheel drive transmission engaged in two-wheel drive only could cause transmission damage.

Alternate Warm-up Procedures for Rough Terrain (GRT) Cranes:

1. Engage parking brake and apply service brake.
2. Shift transmission into the highest gear and increase engine speed to 1500 for 15 seconds, then allow engine speed to return to idle.
3. Repeat Step 2 until the temperature of the transmission sump reaches 20°C (68°F).

Hoist

Warm-up procedures are recommended at every startup and required at ambient temperatures below 4°C (40°F).

Warm-up Procedures - Standard Hydraulic Oil:

1. Without operating the hoist function, warm the hydraulic oil (see *Hydraulic Oil System*, page 4-12).
2. Once hydraulic system is warm, operate the unloaded hoist, in both directions, at low speeds several times to prime all hydraulic lines with warm hydraulic oil and to circulate gear lubricant through the planetary gear sets.

Warm-up Procedures - Cold Weather Hydraulic Oil:

Operate the unloaded hoist, in both directions, at low speeds several times to circulate gear lubricant through the planetary gear sets.

Swing Drive and Turntable Bearing

Warm-up Procedures for Temperatures Above -7°C (20°F):

1. Setup crane on fully extended outriggers, with boom fully retracted and near maximum boom angle with no load applied.
2. Rotate superstructure at a speed of less than one RPM for at least one complete revolution in one direction, then rotate superstructure at a speed of less than one RPM for at least one complete revolution in opposite direction.

Warm-up Procedures for Temperatures Below -7°C (20°F):

1. Setup crane on fully extended outriggers, with boom fully retracted and near maximum boom angle with no load applied.
2. Rotate superstructure at a speed of less than one-half RPM for at least two complete revolutions in one direction, then rotate superstructure at a speed of less than one-half RPM for at least two complete revolutions in the opposite direction.

Axles

Warm-up Procedures for Temperatures Below -35°C (-30°F):

1. Setup crane on outriggers.
2. Engage transmission with four-wheel drive selected and allow crane to run at idle until transmission sump temperature reaches normal operating temperature.

NOTE: Warm-up operation of four-wheel drive transmission engaged in two-wheel drive only could cause transmission damage.

Hydraulic Oil System

Operating Limits and Warm-up Procedures:

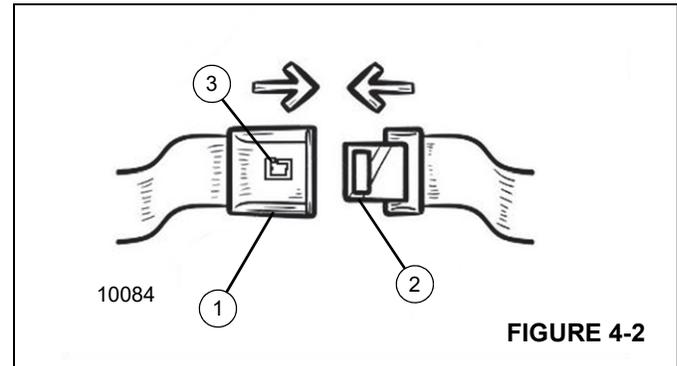
NOTE: Ambient temperatures between -10°C and -40°C (15°F and -40°F) require the use of a cold weather hydraulic oil (refer to cold weather lubricants in the section *Maintenance and Lubrication*, page 6-1). With cold weather hydraulic oil installed, warming the hydraulic oil before operating the crane is not required.

- **Hydraulic Oil Temperatures from 4°C to -10°C (40°F to 15°F):** Crane operation, less hoist, without a load is allowed with medium engine speed and medium function speed (controller position) until fluid reaches at least 10°C (50°F). It is then recommended that all crane functions be cycled to remove cold fluid from all components and cylinders of the hydraulic system. If any unusual sound comes from the crane's hydraulic pumps or motors, stop operation and engine immediately and contact a Grove distributor.
- **Hydraulic Oil Temperatures from 10°C to 4°C (50°F to 40°F):** Crane operation, less hoist, with a load is allowed with medium engine speed and medium function speed (controller position) until fluid reaches at least 10°C (50°F).
- **Hydraulic Oil Temperatures from 95°C to 10°C (200°F to 50°F):** Crane operation with a load is allowed with no restrictions.

Hydraulic oil temperature above 95°C (200°F): No crane operation is allowed. Let hydraulic oil cool by running engine at idle with no functions actuated.

DRIVING THE CRANE

Seat Belts



1. Before fastening the seat belt, always adjust driver's seat to position in which you will drive.
2. Pull belt across your lap and push latch plate (2) into buckle (1) until it clicks (Figure 4-2).
3. To reduce risk of sliding under belt during a collision, position belt across your lap as low on your hips as possible and pull it toward door to a snug fit.
4. To release seat belt, push the push button (3) at the buckle (1).

Traveling — General



WARNING

Accidental Operation Hazard!

Before traveling, make sure all crane functions are fully disabled by pressing the Crane Function Enable/Disable Switch. Disabling the crane functions will prevent accidental operation of the craning functions due to hitting the controllers while traveling.

Owner/lessee must take appropriate measures to make sure all persons operating or working with affected models are in compliance with Grove U.S. L.L.C. recommendations. Operator of the crane assumes responsibility for determining suitability of traveling conditions. Traveling under controlled conditions, specified in these guidelines, must be conducted with the utmost diligence and care to make sure safety of all personnel performing the operation and/or working around the crane.

When driving on roadways, the operator must follow all applicable regulations and/or restrictions.

Although Rough Terrain cranes are specifically designed for rough terrain, the operator should be extremely cautious and aware of terrain operating conditions.

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

Avoid holes, rocks, extremely soft surfaces, and any other obstacles which might subject crane to undue stresses or possible overturn.

Do not drive crane with boom off center because automatic oscillation lock out will occur, making crane subject to tipping on uneven surfaces. Center boom over front or rear, disable swing functions, and engage Turntable Swing Lock Pin.

Fully retract boom. Make sure swingaway boom extension is properly stowed and secured.

CAUTION**Machine Damage Hazard!**

Do not travel with an empty hook in a position where it can swing freely (except where noted). Remove hook block and/or overhaul ball from hoist rope and stow securely or make sure hook block or overhaul ball is properly secured to tie down provided for that purpose.

Do not drive crane with lift cylinder fully retracted. At a minimum, position boom to horizontal.

Fully retract outrigger beams and jacks and properly stow pads.

Disengage pumps (if applicable) for extended traveling.

Traveling is permitted with the boom over the front, with or without counterweight installed, and with boom over the rear with counterweight installed. Traveling is not permitted with boom over the rear with no counterweight installed.

- Use four-wheel drive only when greater traction is necessary or as instructed in the following sections. (Refer to *Four-Wheel Drive Operation*, page 4-19 for operating instructions.)
- Make sure outrigger beams and jacks are fully retracted with pads properly stowed.
- Conduct all travel with assistance of a ground person to warn operator of any change in terrain conditions.

Traveling – Towing/Pulling**CAUTION****Machine Damage Hazard!**

Grove recommends towing or pulling another vehicle with the optional pintle hook (if equipped) (rated at 45T) or by attaching at a point no higher than the pintle hook height, or severe damage may occur to the drivetrain.

Do not tow or pull by attaching to the tie-down lugs unless the attaching point is no higher than the pintle hook height.

Always use four-wheel drive (low range) to avoid severe damage to the drivetrain.

Should the crane become mired down, use a tow truck or tractor to free the vehicle. Severe damage to the drivetrain may occur if the operator attempts to free the crane unassisted.

To avoid severe damage to the drivetrain while using the crane to tow or pull another vehicle, follow these recommendations:

- Make sure boom is in a horizontal position and not elevated above 0°.
- Make sure outrigger beams and jacks are fully retracted with the pads properly stowed.
- Tow or pull on open ground when possible.
- Connect to the optional pintle hook (if equipped) (rated at 45T) or attach cables/straps to the crane at a point no higher than the pintle hook height.
- Select four-wheel drive (low range) (Refer to *Four-Wheel Drive Operation*, page 4-19 for operating instructions.)
- Should the crane become mired down, use a tow truck or tractor to free the vehicle. Severe damage to the drivetrain may occur if the operator attempts to free the crane unassisted.
- Conduct all travel with the assistance of a ground person to warn the operator of any changing conditions in the terrain being traversed.

Traveling — Being Towed/Pulled

Grove recommends connecting to a pintle hook (if equipped) (rated at 45T) or evenly attaching to the tie-down lugs on the outriggers (rated at 50T each) when being towed by another vehicle.

CAUTION**Machine Damage Hazard!**

It is recommended to attach cables/straps to the optional pintle hook (if equipped) or by attaching at a point no higher than the pintle hook height if being towed by another vehicle.

Do not attach to the tie-down lugs unless the attaching point is no higher than the pintle hook height.

Should the crane become mired down, use a tow truck or tractor to free the vehicle. Severe damage to the drivetrain may occur if the operator attempts to free the crane unassisted.

- Make sure boom is in a horizontal position and not elevated above 0°.
- Make sure outrigger beams and jacks are fully retracted with pads properly stowed.

To avoid severe damage to drivetrain while crane engine is disabled:

- Disconnect drivelines if towing crane for more than 75 m (250 ft).
- Disengage parking brake by manually turning parking brake adjustment until axle turns free.

**DANGER****Run-away Crane Hazard!**

Disabling parking brake may result in crane rolling away freely without the ability of the operator to stop the crane.

Make sure that the crane is attached to an adequately sized tow vehicle before disabling the parking brake.

Death or serious injury and damage to machinery could result from moving machinery.

- Secure steering to prevent turning while towing.
- Conduct all travel with assistance of a ground person to warn operator of any changing conditions in terrain being traversed.

Traveling on Slopes

Crane operators must exercise caution whenever operating the crane on uneven surfaces. Travel on slopes is permitted if the following conditions are met.

General Conditions

- Travel must be on an improved surface or hard-packed dry earth. Crane operators are required to inspect the surface for good tire adhesion.
- All boom sections must be fully retracted.

- Boom extension must be in stowed position or removed from the crane (if traveling with an erected boom extension, follow the requirements under the section *Traveling with Boom Extension Erected*, page 4-16).
- Do not travel on slopes with the boom positioned over the rear of the crane. Boom must be positioned over the front of the crane. Boom angle must be as follows:
 - For fore/aft travel on grades less than 15%, the maximum allowable boom angle is 20°.
 - For fore/aft travel on grades greater than 15%, the boom angle must be limited to horizontal (0°).
 - For side slope travel on grades less than 10%, the maximum allowable boom angle is 20°.
 - For side slope travel on grades greater than 10%, the boom angle must be limited to horizontal (0°).
- Swing brake must be applied and turntable lock pin engaged.
- Either the hook block may be reeved over the main boom nose, or the overhaul ball may be reeved over the main boom nose or auxiliary boom nose; the other must be removed. If hook block or overhaul ball remains reeved on the boom, it must be secured at the tie down on the carrier to prevent swinging.
- Tires must be inflated to the recommended pressure indicated in the *Load Chart Manual*.
- Hydraulic tank must be filled to specified level. Fuel tank must be over half full.
- Engine and transmission fluids must be filled to the specified levels.
- Axle differentials and planetary hub fluids must be filled to the specified levels.
- No loads may be supported by the boom (i.e., no pick and carry loads) while traversing a slope.
- All cribbing or other non-standard accessories must be removed from the crane.
- Avoid holes, rocks, extremely soft surfaces, and any other obstacles that might subject crane to undue stresses and possible overturn.
- Operator is to check for changing road conditions and utilize a ground person if deemed necessary.

Slope Limitations - Fore/Aft Travel:

- When traversing a fore/aft slope that is less than or equal to 15% (8.5°), follow the normal crane travel procedures outlined in this manual.
- When traversing a fore/aft slope that is greater than 15% (8.5°) and less than 25% (14°), transmission must be in four-wheel drive. If crane must be parked, make sure the

transmission is in 4-wheel drive and the wheels are chocked.

- When traversing a fore/aft slope that is equal to or greater than 25% (14°), use an assist vehicle and shift the crane's transmission to four-wheel drive. Do not park crane on a slope equal to or greater than 25% (14°).
- Travel on a fore/aft slope up to 30% (16°), such as ramps, is permitted for short distances at low speed. Consideration must be given for the terrain at the end of the slope (for example, does the terrain level out so that the crane can stop).
- For mine applications and similar, where the slopes and the travel distance can be significant, brake fade must

be taken into consideration. Also, refer to *Extended Traveling*, page 4-17 for precautions when driving the crane for long distances.

- For slope limitations when traveling with an elevated boom or an erected boom extension and inserts, refer to the specific traveling instructions in this section.

Slope Limitations - Side Slope Travel:

- Side slope shall not exceed 15% (8.5°).

Operator should carefully consider the conditions and travel at the appropriate speed given the condition and should not exceed the maximum speeds in the following tables taking into consideration both fore/aft slopes and side slope.

Table 4-1 Fore and Aft Travel - No Load

Crane Condition	0 - 15% (0 - 8.5°)	15 - 25% (8.5 - 14°)	25 - 30% (14 - 16.7°)
Two-Wheel Drive	Yes, no restrictions up to 12 kph (7.5 mph) with cwt installed or 4 kph (2.5 mph) with no cwt.	No	
Four-Wheel Drive/Low Range	Yes, up to 10 kph (6 mph) with cwt installed or 4 kph (2.5 mph) with no cwt.	Yes, up to 10 kph (6 mph) with cwt installed or 4 kph (2.5 mph) with no cwt.	Yes, up to 4 kph (2.5 mph)
Park using Park Brake only	Yes	No	No
Park using Park Brake, Chock Wheels, and Four-Wheel Drive		Yes	No, do not park on slopes greater than 25%
Assist Vehicle Required for Braking and Propulsion	No	No	Yes
Short Distance Travel allowed (on ramps)			Yes, but do not park on slopes greater than 25%
Consider Brake Fade possibility if traveling long distance	Yes	Yes	Yes

Table 4-2 Side Slope Travel - No Load

Crane Condition	0 - 5% (0 - 2.9°)	5 - 10% (2.9 - 5.7°)	10 - 15% (5.7 - 8.5°)	15% + (8.5° +)
Two-Wheel Drive	Yes, up to 12 kph (7.5 mph) with cwt installed or 4 kph (2.5 mph) with no cwt.	Yes, up to 12 kph (7.5 mph) with cwt installed or 4 kph (2.5 mph) with no cwt.	No	No
Four-Wheel Drive/Low Range	Yes, up to 10 kph (6 mph) with cwt installed or 4 kph (2.5 mph) with no cwt.	Yes, up to 10 kph (6 mph) with cwt installed or 4 kph (2.5 mph) with no cwt.	Yes, up to 1.6 kph (1 mph)	No



Owner/lessee must take appropriate measures to make sure all persons operating or working with affected models are in compliance with Grove U.S. L.L.C. recommendations. Crane operator assumes responsibility for determining suitability of traveling on a slope.

Traveling on a slope should only be attempted under controlled conditions specified in these guidelines, and must be conducted with the utmost diligence and care to make sure safety of all personnel performing the operation and/or working around the crane.

Should operator need to traverse slopes outside the criteria defined in the above guidelines, contact Grove U.S. L.L.C. for further guidance.

Traveling with Elevated Boom



WARNING

Overhead Objects Hazard

Contacting overhead objects while driving crane may result in death, severe injury, and/or equipment damage. Traveling with boom elevated should only be attempted under controlled conditions specified in this section.

Exercise caution whenever driving crane with boom elevated. Travel with the boom elevated is permitted as long as the following steps are followed.

- Limit travel to firm, level surfaces (if traveling on slopes, follow the requirements under the section *Traveling on Slopes*, page 4-14).
- Inspect route of travel before moving crane. Pay particular attention to any changing conditions of terrain being traversed. Avoid any overhead obstructions.
- Travel must be performed in a controlled fashion.
- Do not exceed the following speeds:
 - 16 kph (7.5 mph) with boom over front with counterweight installed
 - 4 kph (2.5 mph) with boom over front with no counterweight installed
 - 4 kph (2.5 mph) with boom over rear with counterweight installed
- Inflate tires to recommended pressure for travel operations.
- When using towing attachments, boom must remain horizontal.
- Fully retract all boom sections.
- Refer to *Traveling with Boom Extension Erected*, page 4-16 if boom extension is in the erected position.

- Position boom over front or rear of crane.
- Engage swing brake and turntable lock pin.
- Hook block may be reeved over the main boom nose. Overhaul ball may be reeved over the main boom nose or auxiliary boom nose. Block and ball may be suspended below the boom nose. It is also acceptable to secure the block or ball to carrier tie down point to prevent swinging if necessary.
- Limit boom angle to a maximum of 20°.
- Do not support any load from the boom (see Pick and Carry Load chart for limitations for this application).
- Remove all cribbing or other non-standard accessories from crane.
- Avoid holes, rocks, extremely soft surfaces and any other obstacles that might subject crane to undue stresses and possible overturn.
- Make sure adequate clearance to any overhead obstructions crane may be required to travel beneath.
- Make sure all personnel involved in the operation and those working around crane are aware of any hazards that may be encountered and are trained how to avoid them.

Traveling with Boom Extension Erected

- Boom Extension can be erected to 37 ft, 59 ft, or 85 ft length.

When set up for the 37 ft extension, the boom extension stinger section must be stowed on the boom base section.
- Main Boom shall be fully retracted.
- Boom Extension shall be erected at minimum (0 deg) offset.
- Jobsite travel shall be only on firm, level surface (if traveling on slopes, follow the requirements under the section *Traveling on Slopes*, page 4-14).
- Maximum travel speed: 2.5 mph.
- Main boom angle shall be between 0 degree and 20 degrees.
- Counterweight shall be installed.
- Auxiliary hoist or IPO counterweight must be installed.
- Boom shall be directly over front or rear. Swing lock shall be engaged.
- Tires shall be inflated to 94 psi.
- RCL shall be programmed to On Rubber, Pick and Carry, Boom Centered Over Front.

- Hook block must be removed from main boom nose.
- Overhaul ball may be reeved over boom extension, hanging 0.9 m (3 ft) below sheave.

Extended Traveling

CAUTION

Tire Damage Hazard!

For extended travel, check cold tire pressure before start. (Refer to tire inflation chart in *Load Chart Manual*.) After driving the following distances, regardless of ambient temperature, stop and allow tires to cool for at least 30 minutes:

- 4 km (2.5 mi) at a maximum speed of 16 kph (10 mph) with counterweight installed and boom over front single axle
- 75 m (250 ft) at a maximum speed of 4 kph (2.5 mph) with counterweight installed and boom over rear tandem axles

At destination, tires must be allowed to cool to ambient temperature before crane lifting on rubber.

For extended travel with counterweight removed, the following applies:

- Boom must be at 0° and centered over front single axle, no distance limit with a maximum speed of 4 kph (2.5 mph).
- Boom must be at 0° and centered over rear tandem axles, no distance limit with a maximum speed of 24 kph (15 mph).

For extended travel with both counterweight and outrigger boxes removed, the following applies:

- Boom must be centered over front single axle, no distance limit with a maximum speed of 4 kph (2.5 mph).
- Boom must be centered over rear tandem axle, no distance limit.

Traveling — Forward

CAUTION

Machine Damage Hazard!

Engage turntable lock pin for travel. Failure to engage lock pin may allow superstructure to swing uncontrolled, damaging machine and/or property.

NOTE: Cab must be in the fully lowered position for the drive functions to operate. If cab is not in the fully lowered position, the Cab Not Fully Lowered Indicator in the Alerts Area (1, Figure 4-74) of the Operator Display Module (ODM) is on.

NOTE: The standard driving configuration for the GRT9165 is with the boom centered over the single front axle. The crane can also be driven with the boom centered over the dual rear axles. Before driving with the boom over the rear of the crane, operator must press the Steering Reversal Switch to reverse the driving controls, including the transmission shift lever control. Thus, the direction the boom is pointing, and the operator is facing, is always considered forward.

For the description and location of the Steering Reversal Switch, refer to *Steering Reversal Switch*, page 3-14.

1. With Transmission Shift Lever in neutral (N) position and the parking brake set, start engine and allow it to adequately warm up.
2. Press Service Brake Foot Pedal.



WARNING

Run-away Crane Hazard!

Releasing the parking brake while the low service brake pressure indicator is on and the buzzer is sounding, indicating service brakes are inoperable, may result in the crane rolling away freely without the ability of operator to stop crane.

Never release parking brake while low service brake pressure indicator and buzzer are on.

3. Disengage parking brake.
4. Position Drive Axle Switch to two-wheel high or four-wheel low.

CAUTION

Use four-wheel drive only when more traction is required.

5. Lift Transmission Shift Lever up out of detent and push lever to the forward (F) position. Rotate the Transmission Shift Lever Knob to the first (1) gear position. Gear selection "F1" appears in the Operator Display Module (ODM) to indicate forward propulsion and first (1) gear are selected.

NOTE: If Service Brake Foot Pedal is not pressed before shifting to a gear, the gear selection will flash in the Operator Display Module (ODM) until the Transmission Shift Lever is returned to the neutral (N) position. Transmission will not shift.

6. Release Service Brake Foot Pedal and press Foot Throttle Pedal until maximum first gear speed is reached. Rotate Transmission Shift Lever Knob to the

second (II) gear position to continue to increase speed. For additional speed, continue shifting to a higher gear.

CAUTION

Possible Machine Damage!

Do not down-shift to a lower gear if road speed is greater than maximum speed of the lower gear.

Traveling — Reverse

CAUTION

Machine Damage Hazard!

Engage turntable lock pin for travel. Failure to engage lock pin may allow superstructure to swing uncontrolled, damaging machine and/or property.

CAUTION

Possible Machine Damage!

Apply service brakes and bring crane to a complete stop before shifting transmission into reverse.

NOTE: Cab must be in the fully lowered position for the drive functions to operate. If cab is not in the fully lowered position, the Cab Not Fully Lowered Indicator is on.

NOTE: The standard driving configuration for the GRT9165 is with the boom centered over the single front axle. The crane can also be driven with the boom centered over the dual rear axles. Before driving with the boom over the rear of the crane, operator must press the Steering Reversal Switch to reverse the driving controls, including the transmission shift lever control. Thus, the direction the boom is pointing, and the operator is facing, is always considered forward.

Traveling in reverse is similar to traveling forward, except for shifting Transmission Shift Lever to reverse (R). Refer to *Traveling — Forward*, page 4-17

Steering

Steering is accomplished by the Steering Wheel (1, Figure 3-2) and the Rear Steer Switch (19, Figure 3-17).

These two controls, used individually or together, provide front wheel steering (single axle), rear wheel steering (tandem axles), six-wheel steering, and crab steering (Figure 4-3).

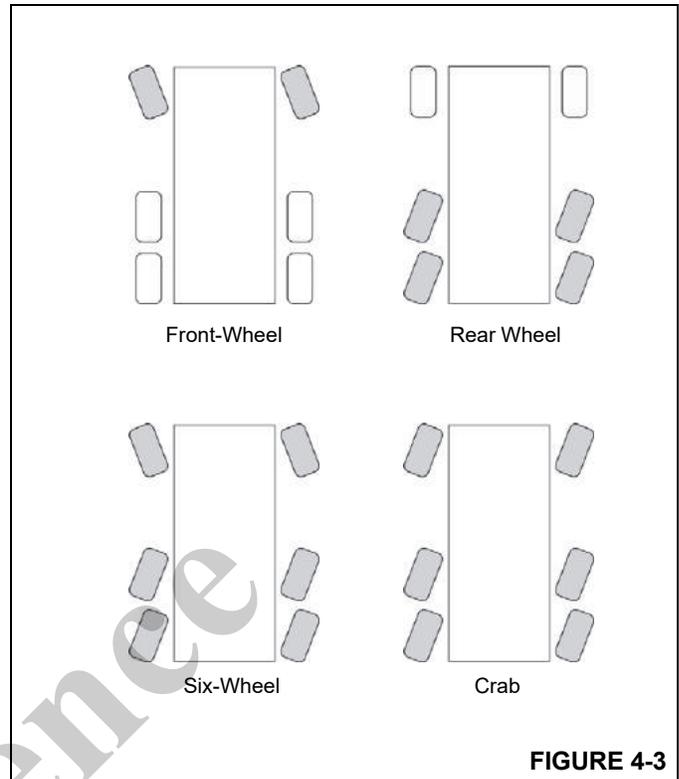


FIGURE 4-3

The Rear Steer Switch can only be operated when one of the following conditions exists:

- Transmission is in Neutral
- Transmission is in four-wheel drive (low range) and crane speed is less than 8 kph (5 mph)
- Transmission is in two-wheel drive (high range) and first gear is selected

If operator attempts to use the rear steer switch while transmission is in second or third gear, and two-wheel drive is selected, the following alerts come on:

- Gear Indicator (1, Figure 4-77) on ODM Main Screen flashes between “F1” and the current gear selected (or “R1” and the current gear selected if in reverse)
- Buzzer comes on and goes off in sequence with the flashing Gear Indicator

Front Wheel Steering

Conventional front wheel (single axle) steering is accomplished with the Steering Wheel. This method of steering should always be used when traveling at higher speeds.

Rear Wheel Steering



WARNING

Rollover Hazard!

Operate rear steer ONLY at slow speeds. Operation of rear steer at high speed may result in loss of steering control and/or rollover of the crane. Death or serious injury could occur.

Rear wheel (tandem axle) steering is controlled by the Rear Steer Switch. Pushing the left or right side of the switch activates the rear steer cylinders, steering crane in the selected direction.

Six-Wheel Steering

Six-wheel steering is accomplished with the steering wheel and Rear Steer Switch.

To perform six-wheel steering with the boom centered over the front (single axle) of the crane, the operator turns the steering wheel in the same direction as the Rear Steer Switch.

Before driving the crane with the boom centered over the rear tandem axle, operator must first reverse the driving controls using the Steering Reversal Switch. When driving controls are reversed, six-wheel steering is accomplished by turning the steering wheel in the same direction as the Rear Steer Switch.

This allows crane to turn or maneuver in close, restricted areas.

Crab Steering

Crab steering is accomplished with the steering wheel and Rear Steer Switch.

To perform crab steering with the boom centered over the front (single axle) of the crane, the operator turns the steering wheel in the opposite direction as the Rear Steer Switch.

Before driving the crane with the boom centered over the rear tandem axle, operator must first reverse the driving controls using the Steering Reversal Switch. When driving controls are reversed, crab steering is accomplished by turning the steering wheel in the opposite direction as the Rear Steer Switch.

This permits driving crane forward or backward in a crab-like manner.

Four-Wheel Drive Operation

CAUTION

Machine Damage Hazard!

Do not tow or pull in 1st gear with Drive Axle Selector Switch in two-wheel drive position. Severe damage to drivetrain will result. Always engage four-wheel drive.

If more traction is required due to slipping or spinning wheels, engage the rear axle drive as follows:

CAUTION

Possible Machine Damage!

Before shifting from two-wheel drive to four-wheel drive (or from four back to two), crane travel must be stopped.

1. Stop crane by pressing Service Brake Foot Pedal.
2. Position Transmission Shift Lever to neutral (N) position.
3. Position Drive Axle Selector Switch to four-wheel drive.

NOTE: If Drive Axle Selector Switch is positioned to four-wheel drive, Service Brake Foot Pedal is not pressed, and Transmission Shift Lever is not in neutral (N) position Four-Wheel Drive Indicator will flash and four-wheel drive function will not engage.

4. Select gear speed and direction of travel with Transmission Shift Lever and Knob.
5. Drive crane following *Traveling — Forward*, page 4-17.
6. Return Drive Axle Selector Switch to two-wheel drive position as soon as two-wheel traction will suffice and crane motion has stopped. Service Brake Foot Pedal must be pressed and Transmission Shift Lever must be in Neutral (N) position to shift from four-wheel drive to two-wheel drive.

Differential Lock Operation

CAUTION

Unexpected Operation!

When using differential lock, steering characteristics may be affected.

Try to use four-wheel drive to gain adequate traction before using differential lock.

Do not operate differential lock when traveling downhill; at speeds above 16.1 km/h (10 mph); on hard, dry surfaces; and/or during axle spin-out.

NOTE: Differential lock will not operate unless Drive Selector Switch is in four-wheel drive position.

General

The purpose of the differential lock is to provide maximum traction and control on poor road or highway surfaces. When differential locks are actuated, the clutch collar completely locks the differential case, gearing, and axle shafts together, maximizing traction to both wheels of each axle. The lock position will also protect against spinout.

When normal driving conditions exist (during periods of good traction), differential locks should not be actuated. Axles should be allowed to operate with differential action between both wheels.

Obey the following precautions when engaging/disengaging the differential lock function.

1. Lock/unlock differentials only when vehicle is standing still or moving at a constant low speed with wheels not slipping.

CAUTION

Possible Machine Damage!

When driving on hard, dry surfaces with differentials locked, do not turn the wheels. Damage to drive line components can result.

Do not lock differentials when wheels are slipping. Damage to differentials can result.

2. When traveling with differentials locked, do not deviate from a straight path more than absolutely necessary.
3. Locked differentials cause crane's turning radius to increase, creating an understeer condition. Use caution, good judgment, and drive at low speeds when operating vehicle with locked differentials.
4. Lock differentials only when maximum traction is needed on poor road or highway surfaces.



CAUTION

Possible Loss of Vehicle Stability!

Do not lock differentials when vehicle is traveling down steep grades and traction is minimal.

5. Always unlock differentials when the need for maximum traction has passed or when traveling on good road or highway surfaces.

Operation

The differential lock function should preferably be engaged when crane is stationary but may be engaged when moving, if the following conditions are met:

- Crane is moving very slowly (creep speed).
- Wheels are not slipping at time of engagement.

Engage differential locks by doing the following:

NOTE: The crane control system only allows the differential lock to be engaged for a maximum of 60 seconds at a time, regardless of whether the Differential Lock Switch is pushed and held for a longer time period.

1. Press and hold the Differential Lock Switch (located on the left armrest) in the locked position with crane stationary or moving at a slow speed.

If moving at a slow speed, let up momentarily on the Foot Throttle Pedal to relieve torque on the differential gearing. This will fully engage differential locks.

NOTE: When differentials are locked, the Axle Differential Locked Indicator in the Alerts Area (1, Figure 4-74) of the Operator Display Module (ODM) is on.

2. Proceed over poor road condition cautiously.

When adverse condition has passed, disengage differential locks by doing the following:

1. Release the Differential Lock Switch, allowing it to return to the unlocked position while maintaining a slow speed.
2. Let up momentarily on the Foot Throttle Pedal to relieve torque on the differential gearing, allowing differential to fully unlock.

NOTE: When differentials are unlocked, Axle Differential Locked Indicator will go off.

3. Resume driving at a normal speed using good driving judgment.

CRANING FUNCTIONS

Controller Operation

The controller operation for crane functions is proportional – that is, the closer the lever is to neutral (center), the slower the system responds.

NOTE: Always operate controllers with slow, even pressure.

Proper Crane Leveling

If a crane is not level within 1% of grade, allowable capacities must be reduced. Therefore, whether lifting on rubber or outriggers, it is essential the crane is level to within 1% of grade. The digital inclination indicator provided in the Operator Display Module (ODM) is calibrated to be accurate within 0.1% of grade.

To properly level the crane, the boom must be positioned over front of the crane, fully lowered to horizontal and fully retracted, and the cab must be in its fully lowered position. Raise and level crane following instructions for *Using the Outriggers*, page 4-21.

A working crane may settle during lifting operations. Frequently check the crane for level. When rechecking the crane for level, the boom must be positioned over the front of the crane, fully lowered to horizontal and fully retracted, and the cab must be in its fully lowered position. If necessary, level the crane again following instructions in the section *Using the Outriggers*, page 4-21.

Using the Outriggers

Outriggers are extended and retracted from the Operator Display Module (ODM) in the cab [refer to *Using the Operator Display Module (ODM)*, page 4-72].



DANGER

To prevent serious injury or death, keep clear of moving outrigger beams/jacks.



DANGER

Death or serious injury could result from improper crane setup on outriggers.



WARNING

Be sure the outriggers are properly extended and set, and the crane is level for operation on outriggers.

All four outrigger beams must be equally set to the fully retracted position, mid vertical stripe, or fully extended position before beginning operation. Mid extended outriggers must be pinned (locked) in position.



WARNING

When operating the crane on outriggers, the outriggers should always be extended and set in the proper position corresponding to the load capacity chart to be used.

Setting the Outriggers Manually

NOTE: ECO mode does not work when operating the outriggers.

1. Enable the outrigger functions by doing the following:
 - Shift transmission to neutral
 - Engage the parking brake
 - Engage four-wheel drive
 - Disable all crane functions
 - Fully lower cab
2. Position the outrigger pads directly out from each outrigger to where the outriggers will be properly extended.
3. If required, extend the outrigger beams to the mid-extend or fully extended position using the Outrigger Extend/Retract Switch and the Operator Display Module (Refer to *Extending/Retracting the Outriggers Beams*, page 4-102).

Refer to *Engaging the Outrigger Mid-Extend Lock Pin*, page 4-23 if the crane is to be operated with the outriggers at the mid-extend position.



DANGER

Tipping Hazard!

All four outrigger beams must be deployed to one of three positions before beginning operation, which include fully retracted, mid-extend, or fully extended. Do not operate the crane with the outriggers in any other position.

NOTE: More than one outrigger beam can be extended at a time. To make sure each outrigger is fully extended, repeat step 3 for each outrigger after a multi-outrigger extension.

4. Extend the outrigger jacks using the Outrigger Extend/Retract Switch and the Operator Display Module (ODM).

Refer to *Extending/Retracting Individual Outrigger Jacks*, page 4-103 to operate individual outrigger jacks.

Refer to *Extending/Retracting the Outrigger Jacks - x4*, page 4-104 to operate the four jacks at the same time.

Extend each outrigger jack until the locking levers of the pad engage the jack cylinder barrel.

5. Extend the jacks as necessary until all tires are clear of the ground and crane is level as indicated by the inclination indicator located on the ODM screen (7, Figure 4-97).

**DANGER****Tipping Hazard!**

The mid-extend outrigger beam lock pin must be engaged before operating on any beam from the mid-extend position.

Operator must select the proper rigging code from the load chart and RCL program for the outrigger position selected. The Outrigger Monitoring System (OMS) will NOT change the rigging code to match the existing outrigger position.

Setting the Outriggers Using the Auto-Level Feature

Start with outrigger beams and jacks retracted.

NOTE: ECO mode does not work when operating the outriggers.

1. Enable the outrigger functions by doing the following:
 - Shift transmission to neutral
 - Engage the parking brake.
 - Engage four-wheel drive
 - Disable all crane functions
 - Fully lower cab
2. Position the outrigger pads directly out from each outrigger to where the outriggers will be properly extended.
3. If required, extend the outrigger beams to the mid-extend or fully extended position using the Outrigger Extend/Retract Switch and the Operator Display Module (refer *Outrigger Extend/Retract*, page 4-100).

Refer to *Engaging the Outrigger Mid-Extend Lock Pin*, page 4-23 if the crane is to be operated with the outriggers at the mid-extend position.

**DANGER****Tipping Hazard!**

All four outrigger beams must be equally deployed to one of three positions before beginning operation, which include fully retracted, mid-extend, or fully extended. Do not operate the crane with the outriggers in any other position.

NOTE: More than one outrigger beam can be extended at a time. To make sure each outrigger is fully extended, repeat step 3 for each outrigger after a multi-outrigger extension.

4. Extend the outrigger jacks using the Outrigger Extend/Retract Switch and the Operator Display Module (refer to *Extending/Retracting Individual Outrigger Jacks*, page 4-103 or *Extending/Retracting the Outrigger Jacks - x4*, page 4-104).

Extend each outrigger jack until the locking levers of the pad engage the jack cylinder barrel.

5. Fully extend the four outrigger jacks.
6. Begin the automatic level process using the Outrigger Extend/Retract Switch and the Operator Display Module (refer to *Leveling the Crane Using Auto-level*, page 4-105).

The crane will react in the following manner:

- a. Briefly extend all four jacks
 - b. Briefly retract all four jacks
 - c. Begin adjusting by lowering two jacks at once until level position is reached.
 - d. There may be several long pauses after lowering for the inclination sensor to stabilize – keep holding the buttons through these.
7. Leveling is complete when out-of-level by less than 0.1 degrees and the Auto-level Indicator (1, Figure 4-104) flashes.

Outrigger Monitoring System (OMS)

The Outrigger Monitoring System (OMS) aids the operator in accurately programming the Rated Capacity Limiter (RCL) by automatically identifying the horizontal position of each outrigger beam. The OMS uses four sensors, one per outrigger beam, to indicate when an outrigger beam is positioned to one of three pre-defined locations, including fully retracted, mid-extend, and fully extended.

Outrigger setup is the same for cranes equipped with OMS; refer to *Setting the Outriggers Manually*, page 4-21.

If crane is setup on outriggers and “On Outriggers” is selected when programming the RCL, then the OMS indicates to the RCL the horizontal position of each of the four outrigger beams. If the outrigger beam configuration programmed by the operator does not match that which is detected by the Outrigger Monitoring System, an outrigger beam over-ride warning screen will appear [refer to *Outrigger Span*, page 4-162]. The RCL does not lock-out the crane or select a different load chart based on the outrigger beam position that is identified by the OMS.

Engaging the Outrigger Mid-Extend Lock Pin

NOTE: It may be necessary to jog the Outrigger Extend/Retract Switch slightly to get proper pin engagement.

1. With outriggers fully retracted, turn locking pin 90° from its stowed position (Figure 4-4) and allow pin to slip into the lock position (Figure 4-5).
2. Slowly extend outrigger beam until the locking pin drops into the hole in top of the outrigger beam, which secures the outrigger beam at the mid-extend position.



Mid-Extend Pin in Stowed Position

9329-1

FIGURE 4-4



Mid-Extend Pin in Locked Position

9329-2

FIGURE 4-5

Stowing the Outriggers

1. Enable the outrigger functions by doing the following:
 - Shift transmission to neutral
 - Engage the Parking Brake.
 - Engage four-wheel drive
 - Disable all crane functions
 - Fully lower cab
2. Retract the four outrigger jacks using the Outrigger Extend/Retract Switch and the Operator Display Module.

Refer to *Extending/Retracting Individual Outrigger Jacks*, page 4-103 to operate individual outrigger jacks.

Refer to *Extending/Retracting the Outrigger Jacks - x4*, page 4-104 to operate the four jacks at the same time.

Retract the four outrigger jacks until they have adequate clearance to remove the outrigger pads.



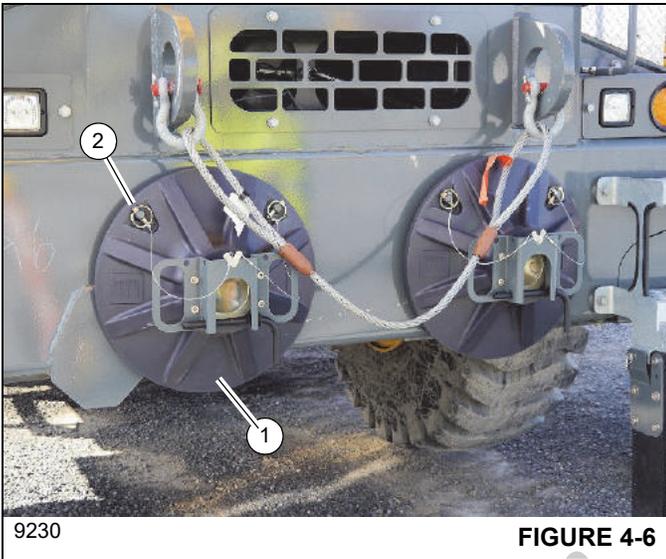
DANGER

Keep feet and hands clear of outrigger pads when unlocking the pads from the jacks.

3. Release locking levers and allow outrigger pads to drop to the ground.
4. Continue to retract jacks until all four jacks are fully retracted.
5. If required, fully retract the outrigger beams using the Outrigger Extend/Retract Switch and the Operator Display Module.

Disengage the Mid-Extend Lock Pin if outrigger beams are at the mid-extend position (refer to *Stowing the Outrigger Mid-Extend Lock Pin*, page 4-24).

- NOTE:** More than one outrigger beam may be retracted at a time.
6. Stow outrigger pads (Figure 4-6).



9230

FIGURE 4-6

Item	Description
1	Outrigger Pad Assembly
2	Quick Pin with Lanyard

Stowing the Outrigger Mid-Extend Lock Pin

NOTE: If lock pin is wedged in outrigger beam hole, it may be necessary to jog outrigger extend/retract switch slightly while pulling upward on pin.

1. From its locked position (Figure 4-7), lift the locking pin upward and turn 90° to the stowed position (Figure 4-8)
2. Continue to extend or retract the outrigger beam to the desired position (fully retracted or fully extended).



9329-2

Mid-Extend Pin in Locked Position

FIGURE 4-7



9329-1

Mid-Extend Pin in Stowed Position

FIGURE 4-8

Swinging the Boom and Superstructure

! DANGER
Crushing Hazard!

Death or serious injury could result from being crushed by moving machinery. Before activating swing, sound the horn and verify all personnel are clear of rotating and moving parts.

Make sure the area around the boom, turntable and counterweights are clear of all obstructions and personnel before swinging.

NOTE: The swing brake automatically disengages when the swing controller is moved from the center (neutral) position and it re-engages when the controller is returned to the center position.

The Swing Brake Engaged Indicator (8, Figure 3-14) on the Operator Display Module (ODM) comes on (amber) when the swing brake is engaged and goes off when the swing brake is disengaged.

NOTE: Always operate controller with a slow, even pressure.

NOTE: Swing Controller can be pushed through neutral and toward opposite direction of swing to help slow and stop the swing motion.

Dual Axis Controllers

1. Press the Swing Enable/Disable Switch on left armrest to enable the swing function.

The Swing Enable Indicator in the Status Bar area (Figure 4-80) of the Operator Display Module (ODM) will come on (green).

2. Push controller on left armrest to the right and hold to swing right (rotates turntable clockwise) or push controller to the left and hold to swing left (rotates turntable counterclockwise).
3. To stop swinging, let swing controller return to the center (neutral) position and apply the swing brake with the Swing Brake Pedal (refer to *Swing Brake Pedal*, page 3-36).

Single Axis Controller (Optional)

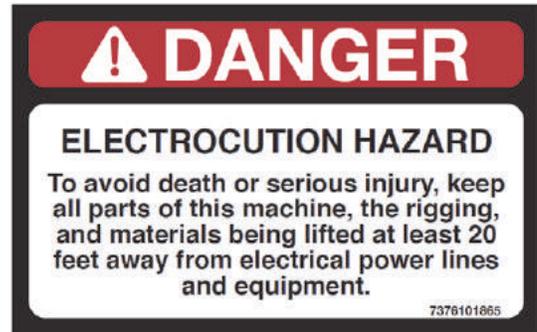
1. Press the Swing Enable/Disable Switch on left armrest to enable the swing function.

The Swing Enable Indicator will come on (green).

2. Push outer controller on left armrest forward and hold to swing right (rotates turntable clockwise) or pull controller rearward and hold to swing left (rotates turntable counterclockwise).
3. To stop swinging, let swing controller return to the center (neutral) position and apply the swing brake with the Swing Brake Pedal.

Raising and Lowering the Boom***Raising the Boom*****DANGER****Crushing Hazard!**

Keep area above and below boom clear of all obstructions and personnel when elevating the boom.

Dual Axis Controllers

1. Press the Boom Lift Enable/Disable Switch on right armrest to enable the boom lift function.

The Boom Lift Enable Indicator in the Status Bar area (Figure 4-80) of the Operator Display Module (ODM) will come on (green).

2. Push controller on right armrest to the left and hold to raise the boom.
3. When boom angle gets to the desired elevation, let controller return to the center (neutral) position to stop boom lift function.

Single Axis Controller (Optional)

1. Press the Boom Lift Enable/Disable Switch on right armrest to enable the boom lift function.

The Boom Lift Enable Indicator will come on (green).

2. Pull inner controller on right armrest rearward and hold to raise the boom.
3. When boom angle gets to the desired elevation, let controller return to the center (neutral) position to stop boom lift function.

Lowering the Boom



DANGER

Crushing and/or Tipping Hazard!

Keep area beneath boom clear of all obstructions and personnel when lowering boom.

Long cantilever booms can create a tipping condition, even when unloaded in an extended, lowered position.

DANGER

Two-Block Hazard!

To avoid death or serious injury, keep load handling devices away from tip of boom or boom extension when extending or lowering the boom and when hoisting up.

When lowering boom, simultaneously let out hoist rope to prevent two-blocking the boom nose and the hook block.

CAUTION

The closer the load is carried to the boom nose, the more important it becomes to simultaneously let out hoist rope as boom is lowered.

Dual Axis Controllers

1. Press the Boom Lift Enable/Disable Switch on right armrest to enable the boom lift function.

The Boom Lift Enable Indicator in the Status Bar area (Figure 4-80) of the Operator Display Module (ODM) will come on (green).

2. Push controller on right armrest to the right and hold to lower the boom.
3. When boom angle gets to the desired elevation, let controller return to the center (neutral) position to stop boom lower function.

Single Axis Controller (Optional)

1. Press the Boom Lift Enable/Disable Switch on right armrest to enable the boom lift function.

The Boom Lift Enable Indicator will come on (green).

2. Push inner controller on right armrest forward and hold to lower the boom.
3. When boom angle gets to the desired elevation, let controller return to the center (neutral) position to stop boom lower function.

Telescoping the Boom

The GRT9165 is equipped with a six-section Twin-Lock boom. It has five telescoping sections that can be extended or retracted independently from one another. Each

telescoping section has locking positions at 0%, 50% (T3, T4, T5), 55% (T1 and T2), 89% and 100% of extension.

Within the boom there is a single-stage hydraulic cylinder. It can be extended or retracted by enabling the telescoping function and commanding motion using the controller. See sections on *Extending the Boom* or *Retracting the Boom* for operational information.

Three interfaces are provided for telescoping the GRT9165. In normal operation the operator can select from *Semi-Automatic Mode* or *Manual Mode*. If necessary, the *Emergency Mode* can be used to perform maintenance on the boom or correct problems with the telescoping operation.

Descriptions of the telescoping modes

- *Semi-automatic Mode* is the preferred method for telescoping because it requires the least effort from the operator. The operator inputs the telescoping sequence, or “tele picture” into the Operator Display Module (ODM) by entering the locking position for each of the five telescoping sections. The Crane Control System (CCS) determines the order of operations required to achieve the entered telescoping sequence. To increase the boom length, the user moves the controller in the extend direction. To decrease the boom length the user moves the joystick in the retract direction. When the boom sections are moving their speed is controlled proportionally to the command given by the user. The CCS slows telescoping motion when the boom section is nearing the target locking position.

NOTE: Some movements of the telescoping cylinder are automated by the CCS. When CCS is controlling the movement of the telescoping cylinder a moving series of dots is displayed on the ODM.

- *Manual Mode* is a method of telescoping preferred by some operators because it gives them more control over the telescoping process. In this mode it is not necessary to enter the target telescoping sequence prior to starting the process. Rather, the operator can unlock the telescoping cylinder and position the telescoping cylinder within the boom using the controller. When the telescope cylinder is within range to engage a boom section, the symbol for locking the cylinder appears. The operator moves the telescoping cylinder to the desired boom section and then selects the symbol for locking the telescope cylinder. The CCS locks the telescoping mechanism to the boom section and then automatically unlocks the boom section from the neighboring boom section so it can be moved. The operator can then extend the boom section by moving the controller in the extend direction or retract it by moving the controller in the retract direction. As the boom section nears the 0%, 50% (T3, T4, and T5), 55% (T1 and T2), 89% or 100% locking positions it automatically slows down. When the boom section is at a locking position the icon to lock appears. If the operator selects Lock the CCS will lock

and “set down” the boom section. After the boom section has been locked the symbol to unlock cylinder appears. If the operator selects the symbol to unlock the telescoping cylinder it will disengage the boom section and move to the next boom section. When it arrives at the next boom section it will lock the cylinder to the section and then unlock the boom section from the neighboring boom section automatically.

- *Emergency Mode* is used to move the telescoping system for maintenance and service work, as well as when a problem occurs that affects the other telescoping modes. The *Emergency Mode* has two levels of access. The first level is the basic emergency mode, which is to be used to service or repair the pinning head. The basic emergency mode can only be used to extend a fully retracted boom for the purpose of aligning the pinning head with the hole in the base section. Moving the boom for all other reasons must be done in the extended emergency mode, which requires a special access code. In the *Emergency Mode* the operator has control over the locking and unlocking functions of the telescoping cylinder. The operator can also retract or extend the telescoping cylinder. The operator or technician may also see the sensor information for the complete telescoping system.

The operator must use the telescope controller with the automatic and manual telescope modes in the ODM to telescope the boom.

Extending the Boom



DANGER Crushing Hazard!

Check *Load Chart Manual* for maximum load at a given radius, boom angle, and length before extending boom with a load.

DANGER Two-Block Hazard

To avoid death or serious injury, keep load handling devices away from the tip of the boom or boom extension when extending or lowering the boom and when hoisting up.

When extending boom, simultaneously let out hoist rope to prevent two-blocking the boom nose and the hook block.

Dual Axis Controller

1. Press the Telescope Enable/Disable Switch on right armrest to enable the boom telescope function.

The Telescope Enable Indicator in the Status Bar area (Figure 4-80) of the Operator Display Module (ODM) will come on (green).

2. Push controller on right armrest to the right and hold to extend the boom.
3. When boom gets to the desired length, let controller return to the center (neutral) position to stop extending the boom.

Single Axis Controller (Optional)

1. Press the Telescope Enable/Disable Switch on right armrest to enable the boom telescope function.

The Telescope Enable Indicator in the Status Bar area (Figure 4-80) of the Operator Display Module (ODM) will come on (green).

2. Push inner controller on right armrest forward and hold to extend the boom.
3. When boom gets to the desired length, let controller return to the center (neutral) position to stop extending the boom.

Retracting the Boom



DANGER **Crushing Hazard!**

When retracting the boom, the load will lower unless the hoist rope is taken in at the same time

Dual Axis Controller

1. Press the Telescope Enable/Disable Switch on right armrest to enable the boom telescope function.

The Telescope Enable Indicator in the Status Bar area (Figure 4-80) of the Operator Display Module (ODM) will come on (green).

2. Push controller on right armrest to the left and hold to retract the boom.
3. When boom gets to the desired length, let controller return to the center (neutral) position to stop retracting the boom.

Single Axis Controller (Optional)

1. Press the Telescope Enable/Disable Switch on right armrest to enable the boom telescope function.

The Telescope Enable Indicator in the Status Bar area (Figure 4-80) of the Operator Display Module (ODM) will come on (green).

2. Push inner controller on right armrest rearward and hold to retract the boom.
3. When boom gets to the desired length, let controller return to the center (neutral) position to stop retracting the boom.

Telescoping - Theory of Operation

The following section describes the internal operation of a pinning boom.

The telescoping process requires locking and unlocking processes in the main boom. The main boom can be telescoped in different ways.

Manual Telescoping

For manual telescoping, the operator must initiate some locking and unlocking processes at the right time.

Semi-automatic Telescoping

When telescoping with semi-automation, the operator enters a telescoping sequence or “tele picture” and Crane Control System (CCS) controls all of the locking and unlocking processes automatically. This mode can also be used for intermediate lengths.

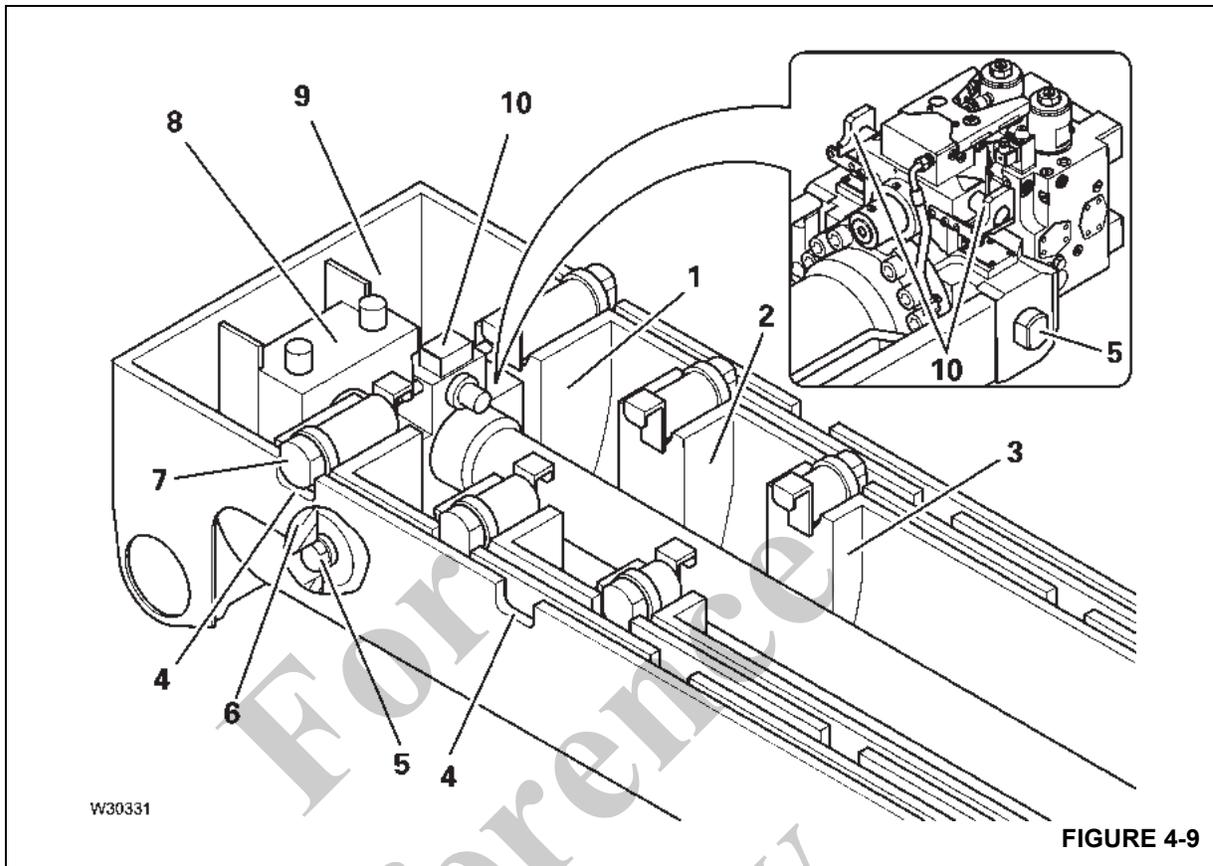
NOTE: For more information on telescoping with semi-automation refer to *Telescoping with Semi-automation*, page 4-39.

Extending with the Main Boom Configuration

The CCS display shows various sectional views of the main boom. To make you familiar with these representations more quickly, the following section begins with an overview of the telescoping mechanism and a telescoping process.

Overview

This illustration (Figure 4-9) shows the completely retracted main boom with the base section (9) and the first three telescopic sections I to III (1) to (3).



Each telescopic section is equipped with two section locking pins (7) which are extended by spring force.

The section locking pins (7) are pushed into the cutouts (4) of the telescopic section at the locking points – the telescopic section is locked.

The telescopic cylinder is attached to the base section (9) with the piston rod (8). The telescopic cylinder has two cylinder locking pins (5) at the bottom and a mechanism at the top (10).

When the telescopic cylinder is positioned at a locking point:

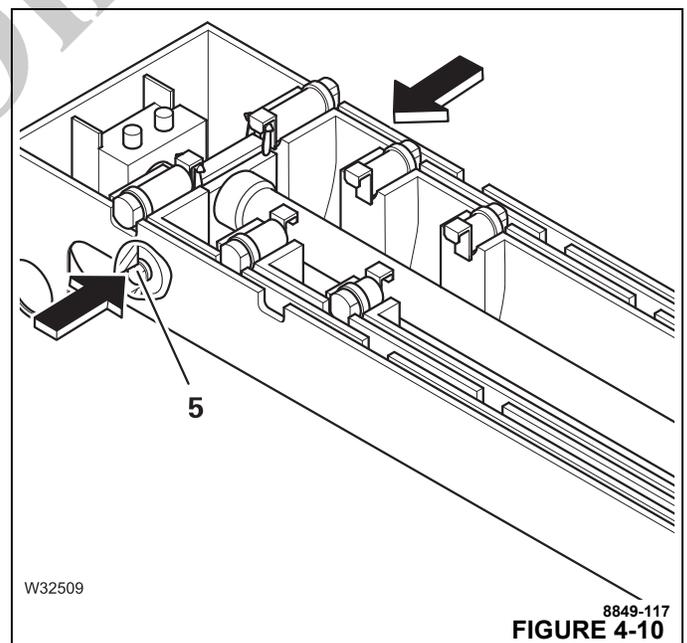
- The locking pins (5) can be extended into the cutouts (6) – the telescopic cylinder is locked.
- The mechanism (10) engages into the locking pins (7) and can retract them – the telescopic section is unlocked.

Telescoping Process

The state shown in Figure 4-10 should be the starting point for a telescoping process. The telescoping processes consist of 4 steps:

1. Unlocking the telescoping cylinder

The locking pins (5, Figure 4-10) retract – the telescoping cylinder is unlocked.



2. Moving and locking the telescoping cylinder

The telescoping cylinder moves into the section to be telescoped, e.g. telescopic section T3 (3, Figure 4-11).

The cylinder locking pins (5) extend – the telescoping cylinder is locked.

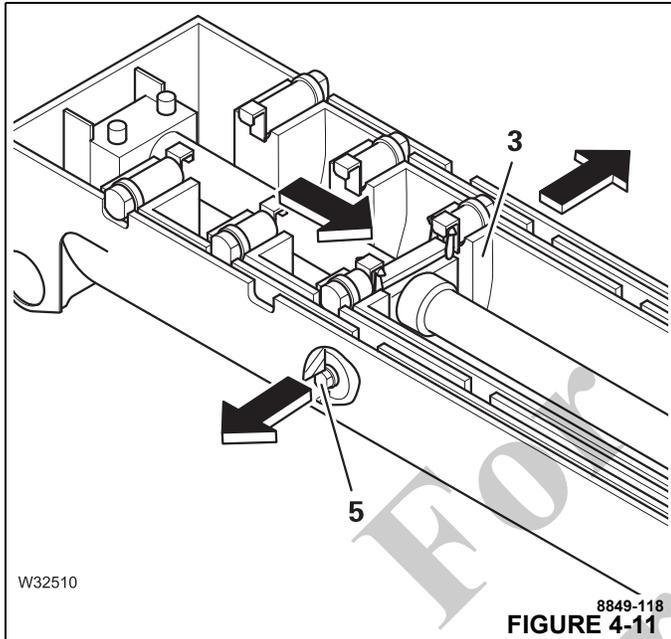


FIGURE 4-11

3. Unlocking the telescopic section

(A, Figure 4-12) – When a telescope section is locked at the 50% (T3, T4, and T5), 55% (T1 and T2), 89%, or 100% position, the telescoping cylinder extends until the

locking pins (7) for that section are clear. When a section is fully retracted and locked at the 0% position, there is no liftoff process. The boom section is supported at the front of the section by the stop blocks instead of by the locking pins. Because of this, the 0% locking holes are oversized, and the locking pin never touches the bottom of the hole.

(B) – The mechanism (10) retracts the locking pins (7) – the telescopic section is unlocked.

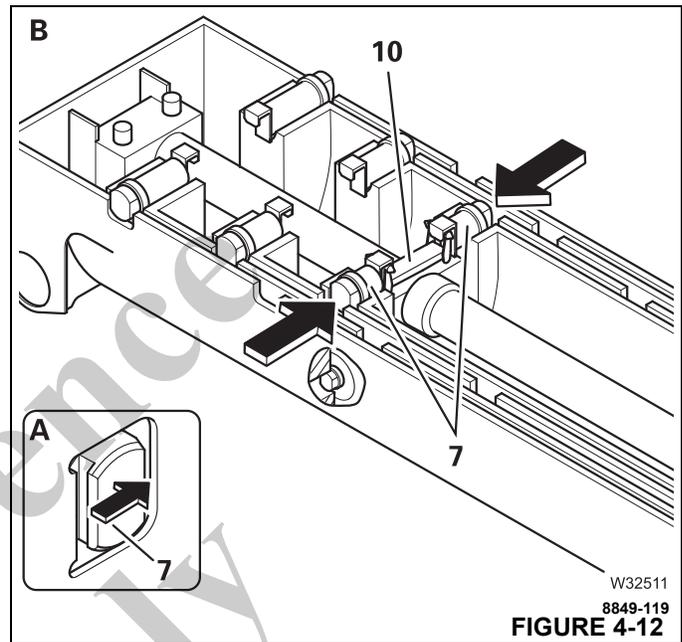


FIGURE 4-12

4. Telescoping, locking and setting down a telescopic section

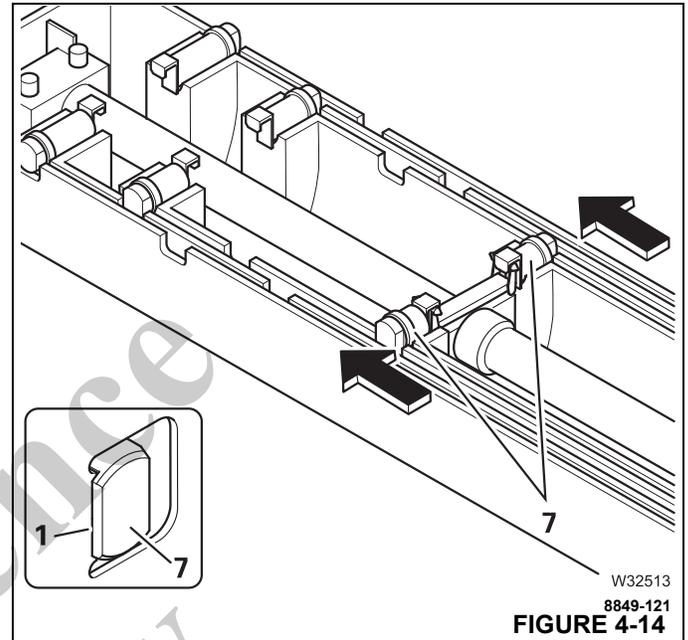
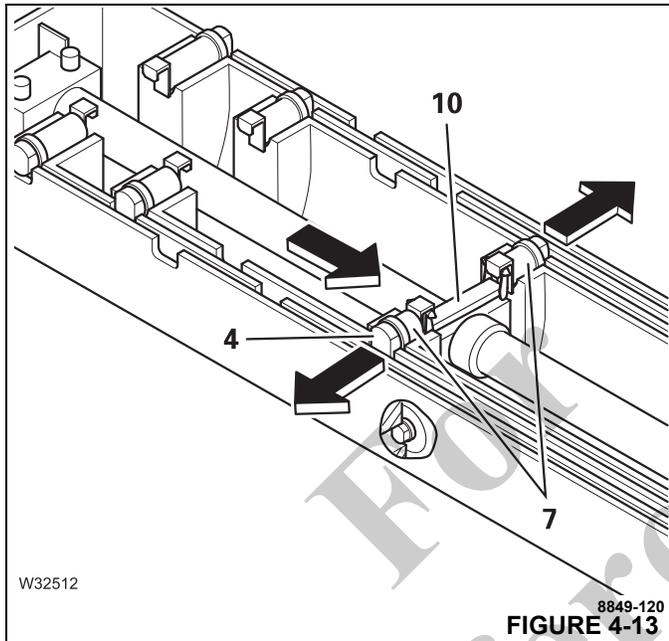
The telescoping cylinder pushes the telescopic section to a locking point.

The locking pins (7, Figure 4-13) of the mechanism (10) extend into the cutouts (4).

The telescopic section is automatically set down.

The telescoping cylinder retracts until the locking pins (7, Figure 4-14) are positioned on the above telescopic section (1).

The weight of the load is now on the telescopic sections and not on the telescoping cylinder.



Reference Only

Assignment for Display

The CCS display shows a sectional view of the main boom in the menus.

The following elements are displayed Figure 4-15:

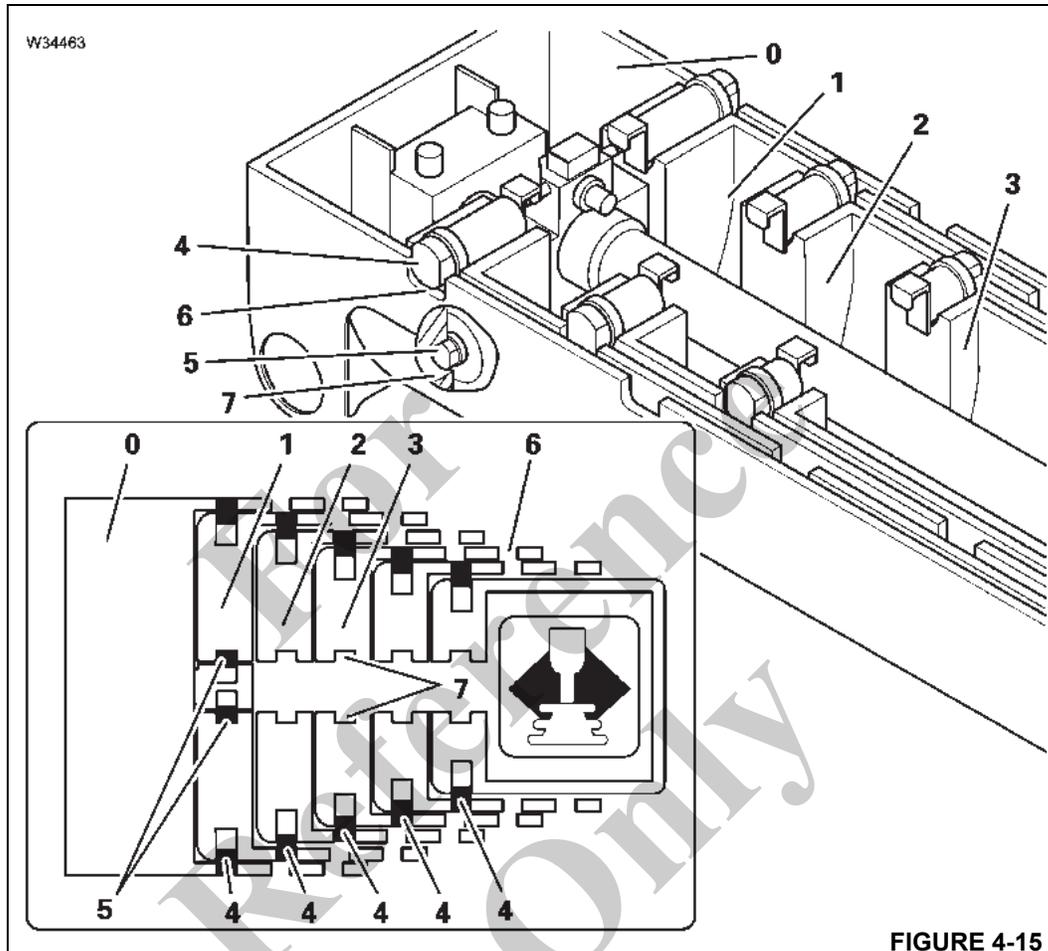


FIGURE 4-15

0	Base section
1	Telescopic section I
2	Telescopic section II
3	Telescopic section III
4	Section locking pin on the telescopic section
5	Cylinder locking pins on the telescoping cylinder
6	Section pin cutouts (holes)
7	Cylinder pin engagement cutouts (holes)

Fixed Length and Intermediate Length

There are lifting capacity tables for main boom fixed lengths, main boom intermediate lengths and main boom telescoping lengths.

The lengths are automatically detected by the Rated Capacity Limiter (RCL), and the corresponding lifting capacities according to the Lifting Capacity table are enabled and displayed automatically.

Main Boom Fixed Length

Main boom fixed lengths have the greatest lifting capacities. A main boom fixed length is reached if:

- All telescopic sections are locked to a fixed length
- All telescopic sections are set down.

Main Boom Intermediate Length

A main boom intermediate length is reached if not all telescopic sections are locked to fixed lengths.

Extend the main boom to the required length before hoisting the load.

Telescoping

The position of the telescopic sections, i.e. which telescopic section is extended to what extent, is referred to as the telescoping sequence or the telescope picture.

This section only deals with the displays on the RCL. The telescoping is also shown on the Operator Display Module (ODM), refer to *Telescoping the Tele Section*, page 4-38.

The RCL displays main boom fixed lengths and main boom intermediate/telescoping lengths in different ways.

Telescoping Sequence

The telescopic sections can only be telescoped individually, one after the other.

When extending, the operator must always extend the telescopic section with the highest numbering first, then the telescopic section with the second highest numbering, etc. (e.g. T5, T4, T3, T2, T1).

The telescopic sections are always retracted in the reverse order of extending.

Inspections Prior to Starting Operations

When the ignition is turned on, CCS registers the displayed telescoping status from the current status of the telescoping mechanism and the previously saved locking and unlocking procedures.

Normally, CCS detects differences between the current and the displayed telescoping and displays the corresponding error message.

If a malfunction results in saved values being deleted, CCS can no longer calculate the current telescoping and may not issue an error message.

CAUTION

Telescope mechanism damage!

If the telescope system position is different from the current telescoping shown on the display, damage could occur during operation of the telescope system.

Ensure that the actual indicated telescope status matches the current telescope position.

Before the first telescoping, compare the telescoping indicated on the ODM with the current telescoping.

Switching On the Telescoping Mechanism

Push the Boom Telescope Enable/Disable Switch on left armrest to enable the telescope function.

The Boom Telescope Enable Indicator in the Status Bar area (Figure 4-80) of the Operator Display Module (ODM) will come on (green).

Function of the Controller

This section only describes the function of the control lever. Before telescoping, a number of prerequisites need to be fulfilled as well.



WARNING

Risk of accidents due to unexpected crane movements!

In the case of multiple configuration, check whether the control lever function Telescoping is switched on before you move the control lever.

This prevents accidents caused by unexpected lifting/lowering.

The distance between the hook block and the boom nose changes during telescoping. Ensure that the hook block does not trigger the anti-two block switch or touch the ground.

To prevent two-blocking or slack rope conditions, perform the following functions as required:

- Lower hoist when extending
- Lift hoist when retracting.

The controller movements for telescoping vary depending on the crane configuration. Refer to *Extending the Boom*, page 4-27 and *Retracting the Boom*, page 4-28.

Telescoping will only start if left arrow for retracting (1, Figure 4-16) or right arrow for extending (2) is shown in the indicated location of the operating display screen (either the semi-automation or manual telescoping screen).

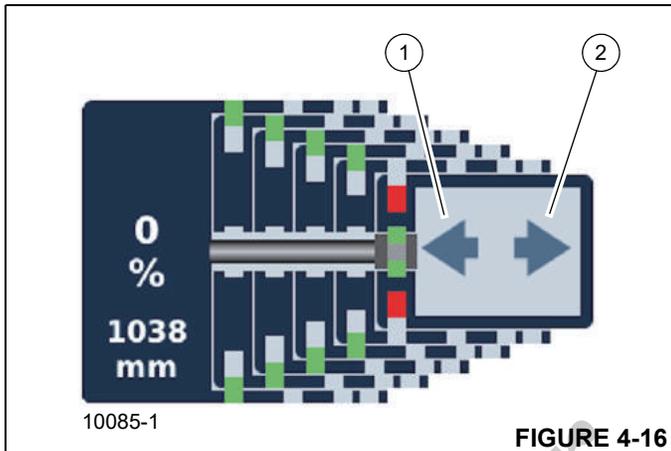


FIGURE 4-16

You can regulate the telescoping speed by moving the controller or changing the engine speed.

NOTE: With certain telescoping states, the RCL will switch telescoping off, e.g. when you leave the telescoping lengths or when the working range limit has been reached, refer to *RCL Shutdown*, page 4-168.

Switching Off the Telescoping Mechanism

If the telescoping function is not required, it should be disabled to avoid accidental use.

Push the Boom Telescope Enable/Disable Switch on left armrest to disable the boom lift function.

The Boom Telescope Enable Indicator in the Status Bar area (Figure 4-80) of the Operator Display Module (ODM) will change from green to blue.

Manual Telescoping

To telescope manually, the operator must initiate some locking and unlocking processes. The locking and unlocking processes are carried out automatically.

The following sections describe the operating procedures:

- Checking the initial position (page 4-34)
- Unlocking the telescoping cylinder (page 4-35)
- Extending/retracting the telescoping cylinder (without tele section) (page 4-36)
- Locking the telescoping cylinder (page 4-37)
- Unlocking the tele section (page 4-38)
- Telescoping the tele section (page 4-38)
- Locking the tele section, refer to (page 4-39)

NOTE: The operating order depends on the current initial position. For an overview of a telescoping process (example), refer to *Telescoping Process*, page 4-29.

NOTE: The lengths given in the following illustrations are sample values, and may differ from the current display.

Checking the Initial Position

Before telescoping, the operator must check the following:

- Current telescope status,
- Position of the telescoping cylinder,
- Position of the locking pins.

To do so, open the ODM main menu by pressing the button (1, Figure 4-17) or (2) once.

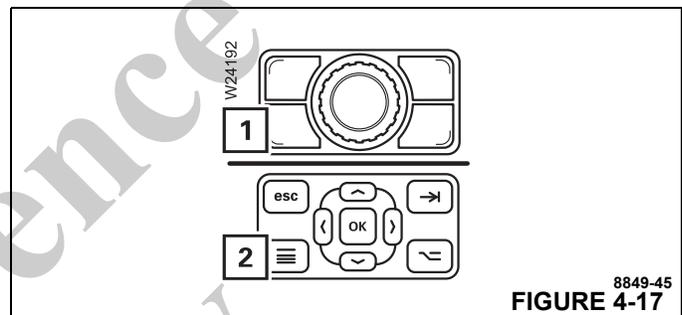


FIGURE 4-17

Open the Manual telescoping menu (1, Figure 4-18).

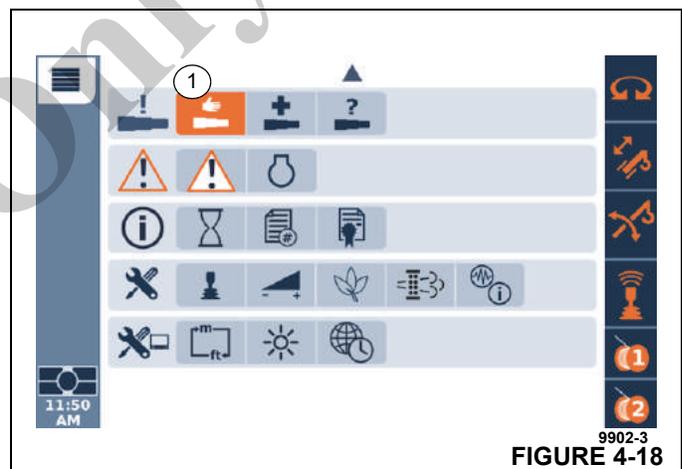


FIGURE 4-18

Current Telescoping

The display (1, Figure 4-19) shows how far the telescoping cylinder is extended, e.g. 1043 mm.

The display (2) shows the current main boom length, e.g. 13.7 m.

The display (3) shows the corresponding telescopic section, e.g. telescopic section 5.

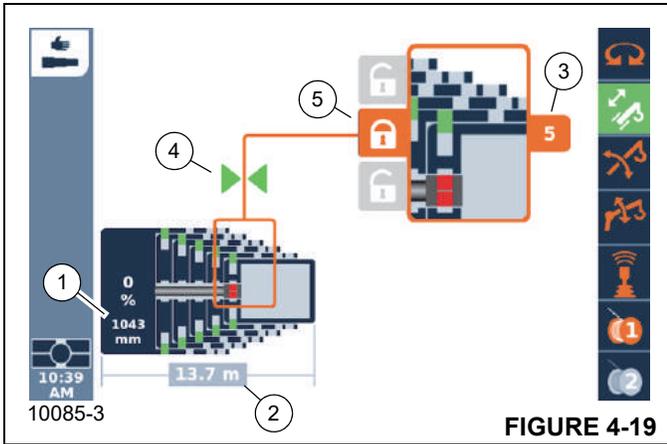


FIGURE 4-19

Position of the Telescoping Cylinder

If the telescoping cylinder is near a locking point:

- The display (3, Figure 4-19) shows the corresponding telescopic section, e.g. telescopic section 5.
- The display (4, Figure 4-19) shows one or two arrows, depending on the distance to the locking point. The display (4) shows two arrows and the display (5) lock symbol appears orange when the telescope cylinder is at the locking point.

Position of the Locking Pins

The current positions of the locking pins are (Figure 4-20):

1	on the telescopic section
2	on the telescoping cylinder

The area (3) shows an enlarged cut-out.

The current settings are shown in different colors.

Red:	Unlocked
Green:	Locked
Yellow:	Intermediate position

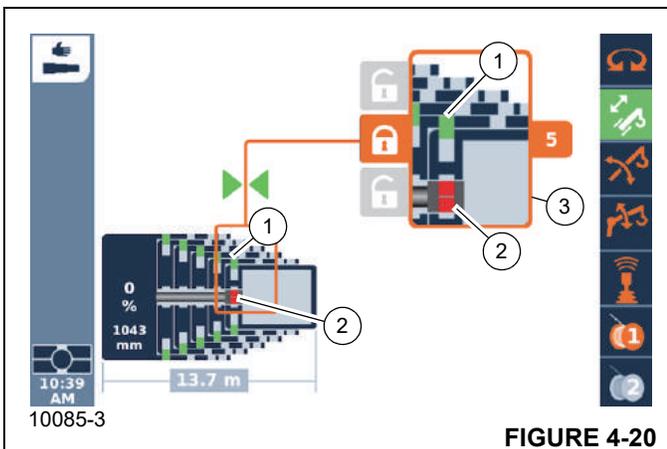


FIGURE 4-20

Unlocking the Telescoping Cylinder

Unlocking the telescoping cylinder is required for the telescoping cylinder to be moved separately (without the telescopic section).

The telescoping cylinder and the telescopic section cannot be unlocked simultaneously.

Prerequisites

Telescoping function enabled – symbol (3, Figure 4-21) green

Telescoping cylinder locked – symbol (2) green

Telescopic section locked – symbol (1) green

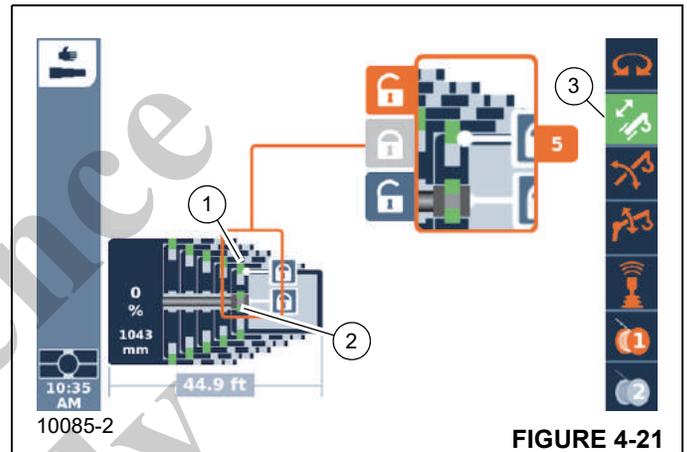


FIGURE 4-21

Unlock

1. Select the symbol (1, Figure 4-22).
2. Confirm the selection – the telescope cylinder locking pins (2, Figure 4-23) will retract.

Yellow:	Intermediate position
Red:	Unlocked

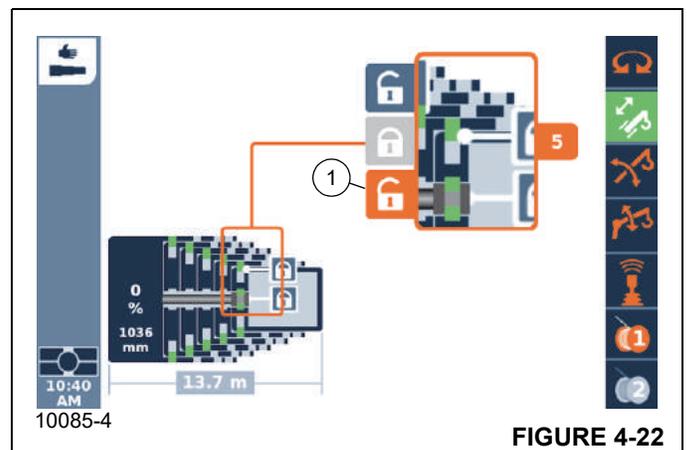


FIGURE 4-22

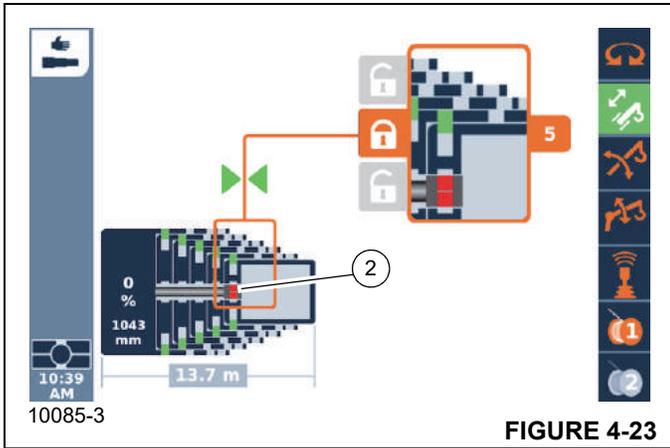


FIGURE 4-23

Extending/Retracting the Telescoping Cylinder

Prerequisites

- Telescoping function enabled – symbol (3, Figure 4-24) green
- Telescopic section locked – symbol (1) green
- Telescoping cylinder unlocked – symbol (2) red

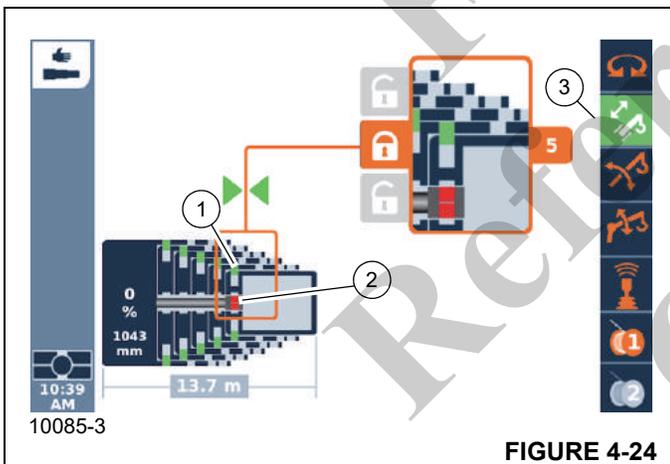


FIGURE 4-24

Extending/Retracting

Move the telescope controller in the corresponding telescoping direction.

The telescoping cylinder extends/retracts.

The display (1, Figure 4-25) shows the length, in millimeters, that the telescope cylinder is extended to.

Near a locking point, the symbols (3, Figure 4-26) show:

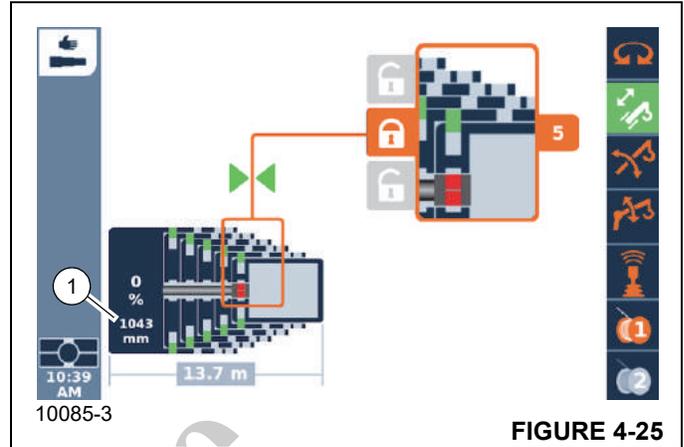


FIGURE 4-25

The direction of travel to the locking point Figure 4-26:

1	Extending
2	Retracting
3	At the locking point

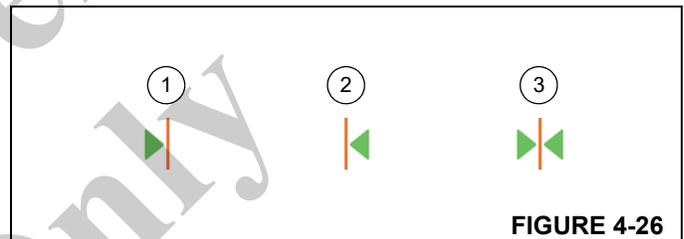


FIGURE 4-26

CAUTION

Boom System Damage!

If extending and retracting several times does not lead to the lock being released, you must not telescope any further against the stop.

If removing the load does not cause the lock to release, the operator must lock the telescoping cylinder and then restart unlocking.

Locking the Telescoping Cylinder

The telescoping cylinder must be locked to a telescopic section so that the telescopic section can be telescoped.

Prerequisites

Telescoping function enabled – symbol (3, Figure 4-27) green

Telescopic section locked – symbol (1) green

NOTE: Lock command available – symbol (4) orange

Telescoping cylinder unlocked – symbol (2) red

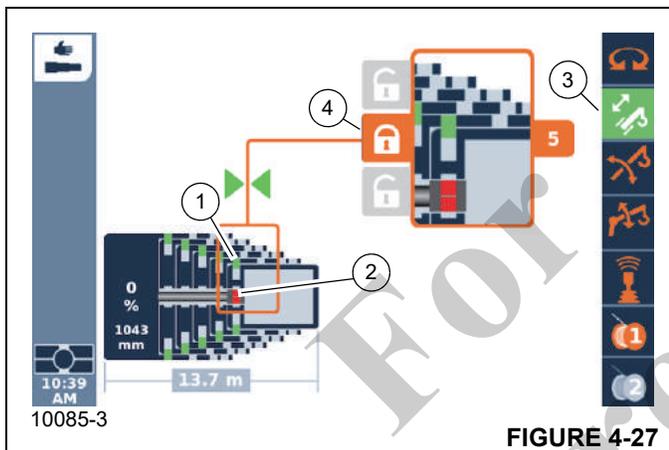


FIGURE 4-27

Lock

1. Move the telescoping cylinder to the desired locking point, e.g. to telescopic section 5 (Figure 4-28).

Wait until the display:

- shows the desired telescopic section (1, Figure 4-28)

and

- the symbols (2) are shown.
2. Select the symbol (3).
 3. Confirm the selection – the telescope cylinder locking pins will extend – symbol (4) green.

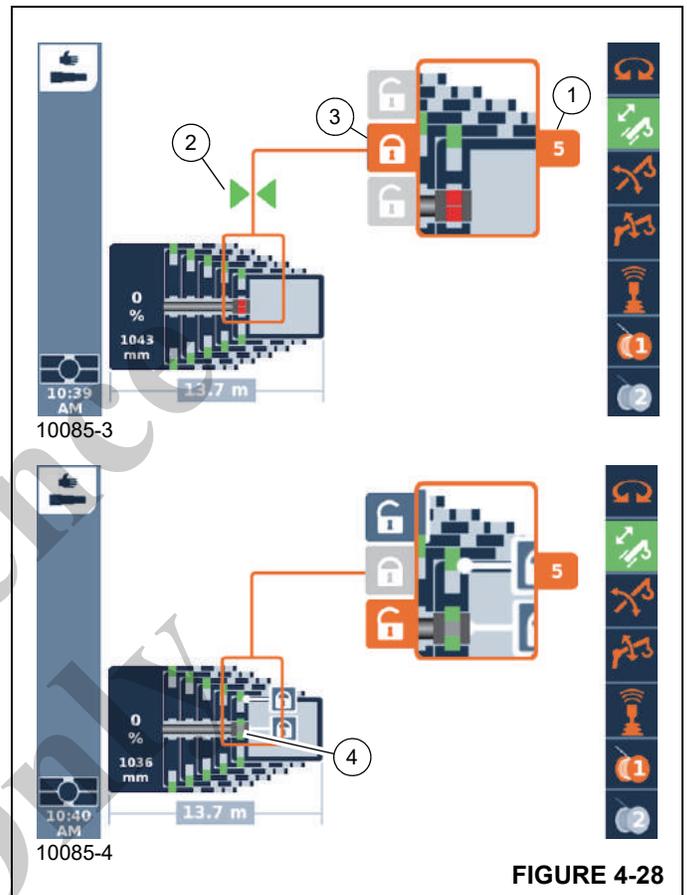


FIGURE 4-28

Unlocking the Telescopic Section

Unlocking a telescopic section is required for the telescopic section to be telescoped.

The telescoping cylinder and the telescopic section cannot be unlocked simultaneously.

Prerequisites

Telescoping function enabled – symbol (3, Figure 4-29) green

Telescopic section locked – symbol (1) green

Telescoping cylinder locked – symbol (2) green

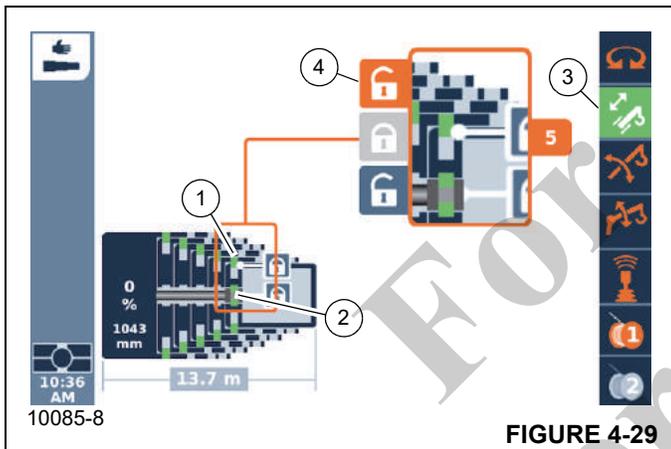


FIGURE 4-29

Unlock

1. Select the symbol (4, Figure 4-29).
2. Confirm the selection – the locking pins will retract. Symbol (2, Figure 4-30) red.

If symbol (2) is not red after approx. 10 seconds, this means that the locking pins are under load.

To relieve the load, carefully retract and extend a little.

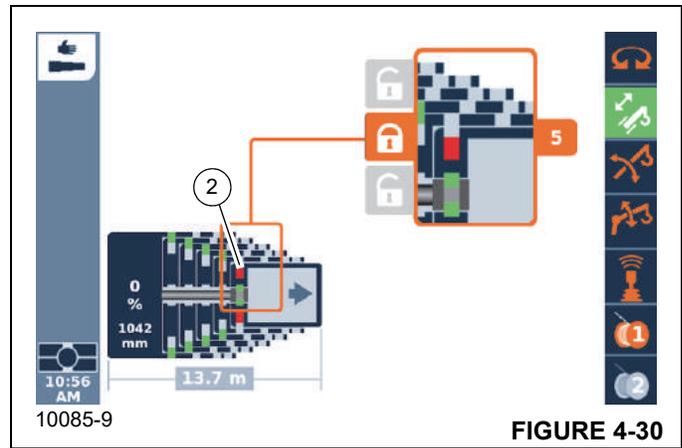


FIGURE 4-30

CAUTION

Boom System Damage!

If extending and retracting several times does not lead to the lock being released, you must not telescope any further against the stop.

If removing the load does not cause unlocking, you must lock the telescopic section (*Locking the Tele Section, page 4-39*) and restart unlocking.

Telescoping the Tele Section

The tele section can be telescoped once it is unlocked.

Prerequisites

- Telescoping mechanism enabled – symbol (3, Figure 4-31) green
- Telescoping cylinder locked – symbol (2) green
- Telescopic section unlocked – symbol (1) red

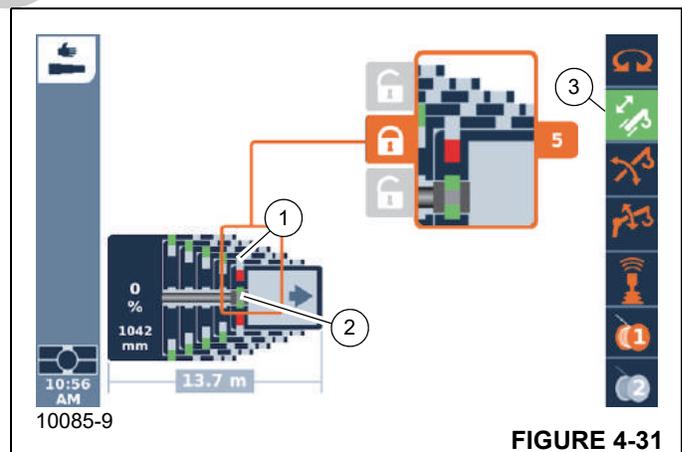


FIGURE 4-31

Telescoping

If the requirements for telescoping are met, the symbol (2, Figure 4-32) is shown.

Move the control lever in the desired telescoping direction.

The display (1, Figure 4-32) shows the current extended length of the boom.

The current telescope diagram on the display will change continually.

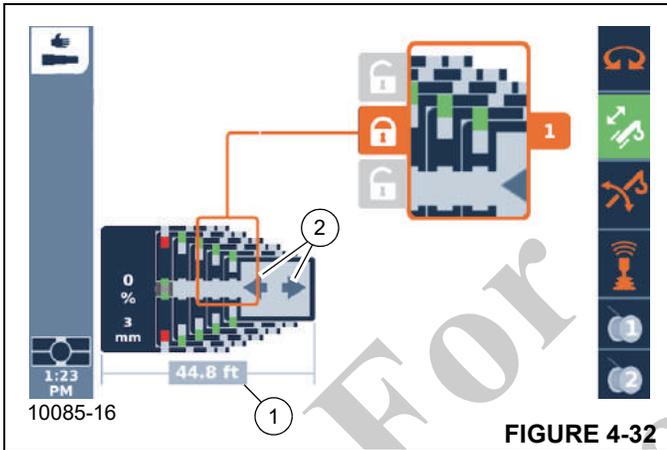


FIGURE 4-32

Locking the Tele Section

Every telescopic section can be locked at the fixed lengths, refer to *Main Boom Fixed Length*, page 4-33.

Prerequisites

Telescoping mechanism on – symbol (3, Figure 4-33) green

Telescopic section unlocked – symbol (1) red

Telescoping cylinder locked – symbol (2) green.

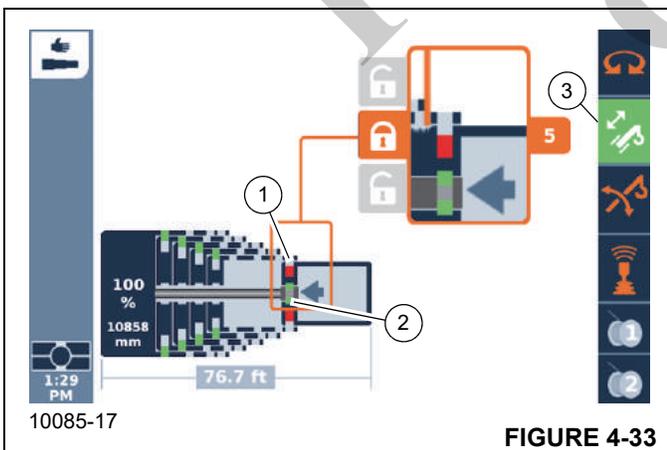


FIGURE 4-33

Lock

1. Telescope to the desired fixed length, e. g. telescopic section 5 to 100% (1, Figure 4-34).

If the symbol (3) is orange, the telescopic section can be locked.

2. Select the symbol (3).

3. Confirm the selection – the locking pins will extend – symbol (2) green.

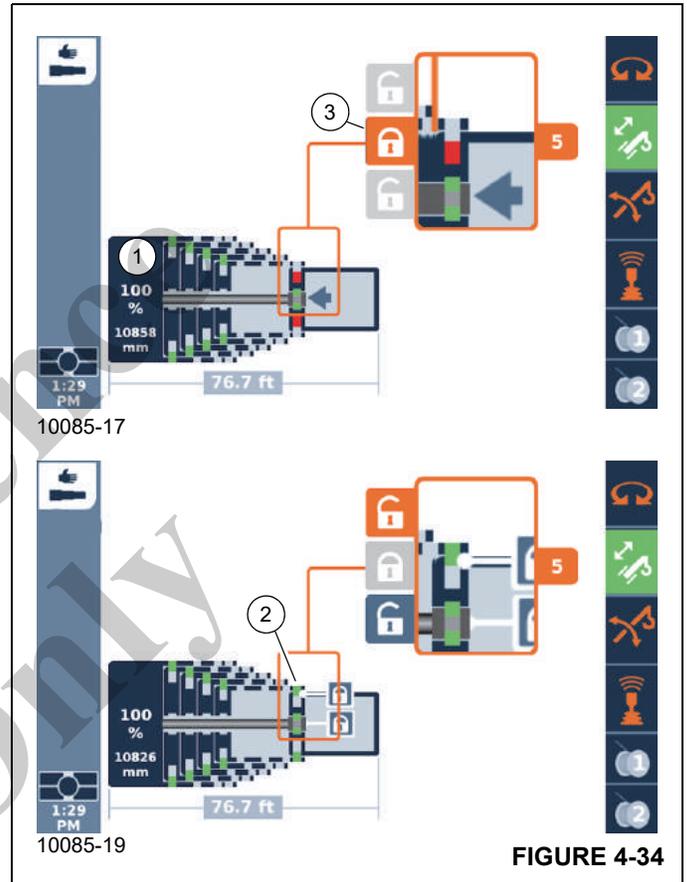


FIGURE 4-34

Telescoping with Semi-automation

When telescoping with semi-automation (or the semi-auto mode), the operator enters, on the Operator Display Module (ODM), the pinning location for each of the boom sections (a target or requested “tele picture”). If this pinning configuration is accepted by CCS, then the controller is used to move the boom sections to the pre-determined configuration. The telescoping cylinder moves between the boom sections automatically as needed.

NOTE: The entered boom configuration (“tele picture”) does not have to be completed for normal operation of the boom. For instance, if the requested boom configuration is 100-100-0-0-0, and just the T2 section is locked at 100% (T1 section still at 0%), then the boom can be operated

as if the configuration 0-100-0-0-0 was entered. The operator can just stop the telescoping function with the boom at 0-100-0-0-0.

If the boom is desired to be fully or partially retracted after just reaching 0-100-0-0-0 (and when 100-100-0-0-0 had originally been entered), the operator can just reverse the direction of the controller and the boom will retract. That is, it is not necessary to enter a boom configuration of 0-0-0-0-0 to retract the boom. The entered boom configuration (target or requested “tele picture”) is ALWAYS only a final destination or configuration.

The controller is ALWAYS used to indicate extending or retracting the boom itself, NEVER to indicate the extending or retracting of the telescoping cylinder. The allowed motion for the boom with the controller is indicated by arrows shown on the display. The telescoping direction arrow to the right is always extending the boom. The telescoping arrow to the left is always retracting the boom.

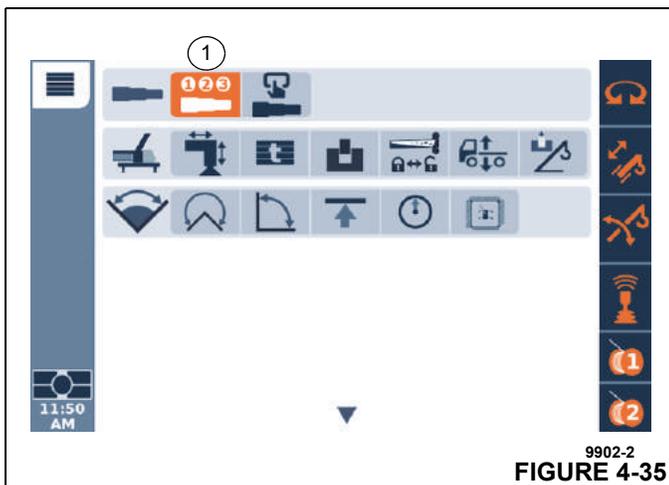
CAUTION

Boom Damage!

When a boom section is first unlocked, the boom section may automatically extend 50 mm (2 inches). The operator must be aware of this motion and have the crane in a position to anticipate this motion and prevent contact with nearby objects.

NOTE:

- Switch on the telescoping mechanism, refer to *Switching On the Telescoping Mechanism*, page 4-33.
- Open the Telescoping semi-automation menu (1, Figure 4-35).



Semi-automatic Telescope Mode

Introduction

The Semi-auto Mode is typically the standard method for telescoping the pinned boom.

It is important to understand that a pinned boom has a telescoping cylinder that can disconnect and reconnect (unlock/lock) to boom sections, as well as disconnect and connect (unlock/lock) boom sections to each other. This is accomplished by a pinning mechanism or pinning “head” at the near end of the barrel of the telescoping cylinder (the rod is fixed to the base section and the barrel extends within the boom). This pinning mechanism has a set of sensors and an electronic module to communicate with the crane control system. Using these sensors, as well as a precision length sensor for the location of the telescoping cylinder within the boom, the crane control system commands the pinning mechanism to perform the locking operations. The Semi-auto Mode is the simplest approach to operating the pinned boom, since it automatically handles the most complicated aspects of the pinning.

It is important to realize that the control system is performing automated motions within the boom at some points in the telescoping process. At other times the operator is able to move the boom components. Then the automated motions can occur once again after the operator has indicated the appropriate next action for telescoping the boom.

The Semi-auto screen of the operating display (refer to Figure 4-36) shows a graphic schematic near the bottom of the screen that indicates the current status of the boom computed by the control system (however the operator must continue to monitor the status of the physical boom to compare with this schematic). In Figure 4-36, there is a 100% (1) shown for the position of the telescoping cylinder (above the 10571 mm distance value). The graphical representation of the telescoping cylinder rod protrudes horizontally from the left end of the schematic (near item 1). The end of the graphical representation of the rod at the T4 boom section which is at the 100% pinning location. The slightly larger rectangular entity at the right end of the telescoping cylinder rod represents the pinning mechanism.

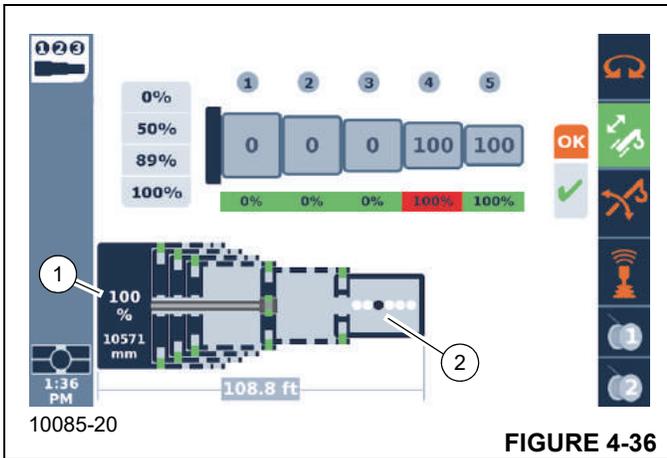


FIGURE 4-36

The example in Figure 4-36 shows the value of 10571 mm for the extension of the telescoping cylinder within the boom. This is the value from the precision length sensor. The example also shows a value of 108.8 feet as the overall boom length. The example shows the T5 boom section had been previously extended and locked at its 100% pinning location and the T4 boom section is being pinned at the 100% pinning location. The remaining boom sections are locked at their 0% pinning location.

As mentioned earlier, there are times when the control system is performing automated motions. The example in Figure 4-36 shows some dots at the end of the schematic graphic (2). These dots, as well as the one dark dot cycling back and forth to the left and right, indicates that automated motions are occurring.

Figure 4-37 shows the same screen when the operator is able to control motions of the boom sections. In this case, there is a left and/or right pointing arrow (1) (instead of the dots shown in Figure 4-36). As is consistent with the schematic's orientation, the left arrow indicates retracting the boom, the right arrow indicates extending the boom. The control device (typically the telescope controller in the standard controller option) would be moved to the left to retract the boom, and it would be moved to the right to extend the boom (while keeping in mind that only one boom section - the boom section the telescoping cylinder is locked to - would be moving).

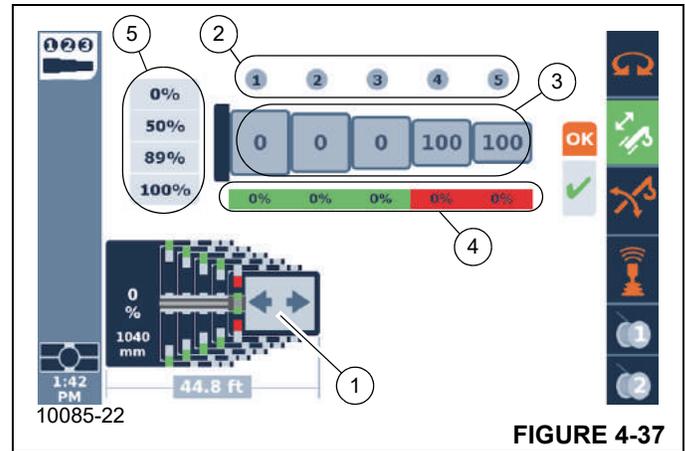


FIGURE 4-37

The arrows (1, Figure 4-37), at some point in the telescoping process, will blink. The blinking is an indication that an unlocking or locking event will occur if the operator holds the joystick in the direction of that arrow for at least 1 second. If this event begins, then the screen will change to the dots (as described for Figure 4-36) so that the operator knows that an automated motion or action is again occurring.

The RCL must be configured and activated in order to have automated motions or to have operator control of the telescoping function. If the Enter Rigging Mode screen on the RCL display is used (accessed with the '?' icon on the RCL display), then the telescoping action is paused. When the check-mark is used on the RCL display to re-activate the RCL, then the telescoping action resumes (whether automated motion or operator control).

As seen in Figure 4-37, there are sets of numerical values at the top portion of the screen above the graphical schematic of the boom.

First, there is a set of values in a top row with values of 1 to 5 in circles (2, Figure 4-37). The 1 to 5 in the circles indicate the telescoping boom sections (or "tele sections"). The 1 is for the boom section that is the largest and closest to the base section. This is referred to as T1. This then proceeds from T2 to T5 for the 2 to 5 values.

The values under these boom section indication numbers represent the requested final boom configuration (or "target tele picture") as a percentage. Figure 4-37 shows this set of values as 0-0-0-100-100 (3). This means that T4 and T5 are to be extended to the 100% pinning location, and T1, T2, and T3 are not to be extended. It is vital that the operator understand that this requested final boom configuration is the first step in operating the pinned boom in the Semi-auto Mode. Everything the control system performs with the Semi-auto Mode is dependent on this requested final boom configuration.

Second, there is a set of percentage values shown under the requested final boom configuration values. In Figure 4-37, these are shown as 0%-0%-0%-0%-0% (4). This represents the control system's currently computed actual boom

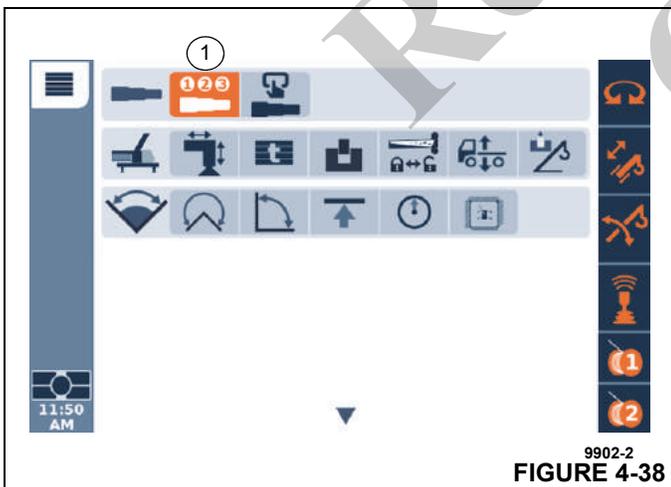
configuration (or “actual tele picture”). This can be understood as what the boom looks like “now” (but as mentioned above the operator must be aware of the physical boom to compare to these values). As the boom is operated this computed boom configuration will change (just as the schematic graphic for the boom system will change on the display). But the operator should realize that the requested final boom configuration will not be changing as the boom is operated (it is the final destination for the boom motion).

Third, there is a list of percentages on the left (0%, 50%, 89%, 100%) (5). These percentages are the available pinning locations for the boom sections. They represent an extent of the distance along the next larger boom section where the boom section can be pinned - i.e. locked to the next larger and encompassing boom section. The 100% is not the extreme end of the next larger boom section, but the farthest available pinning location (there will always be some overlap between boom sections). The list of percentages are command buttons in the control system interface; a value can be highlighted, and then an Enter button used to actually select the value in the list. When an Enter button is used in this manner, it sets all the values for the boom sections for the requested final boom configuration to that value. For example, if Enter is used on the 50% button, then all the values in the top row of the display will be set to 50/55 (thus requesting the final boom configuration of 55-55-50-50-50).

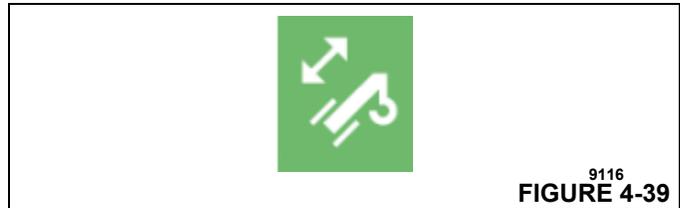
Semi-auto Mode Basic Operating Procedures

The following steps would be expected for extending the boom in Semi-auto Mode:

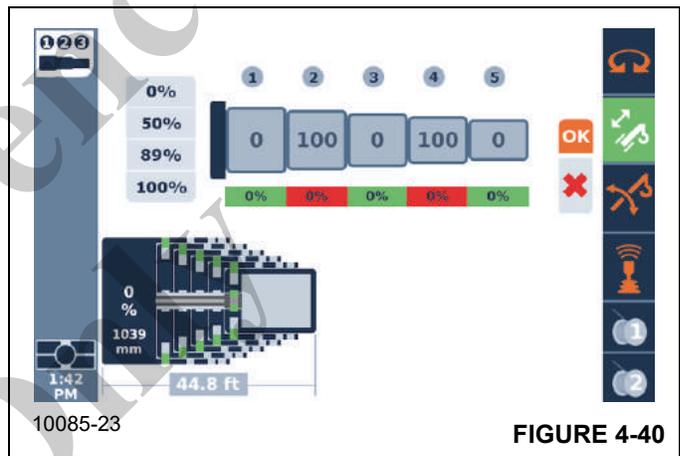
- Enter the Semi-auto screen on the Operating Display Module. The icon for this screen is (1) Figure 4-38.



- Verify that the telescoping function is enabled. This is confirmed by the green background for the icon for the telescoping function in the right margin area of the operating display. Refer to Figure 4-39.



- Using the ODM, enter the values for the requested final boom configuration (such as 0-0-0-100-100).
- Using the ODM, the Enter button is used for the OK shown on the screen. This sends the requested data to the control system. If this configuration is considered acceptable, a check-mark will be shown below the OK (as is seen in Figure 4-37). If the configuration is not considered acceptable, a red X will be shown instead of the check-mark (Figure 4-40). As an example, a requested final boom configuration of 0-100-0-100-0 is not allowed (the T3 section was “skipped” for having a non-0% pinning location).



- Depending on the current location of the telescoping cylinder, the cylinder may need to move to a different boom section. If this is needed, the automated motions will immediately occur.
- Once the telescoping cylinder is considered locked to the boom section that is to be first moved (T5 in the current example Figure 4-37) by the control system, the boom section will be unlocked (this is an automated action).
- Once the boom section is unlocked, the telescoping direction arrows (1), as shown in Figure 4-37, will appear.
- With the arrows present, the operator can telescope the first boom section to be moved (T5 in this example).
- The operator uses the telescope controller to extend the boom section. The boom motion will automatically be stopped at the 100% pinning location and the right arrow will be blinking. If the telescope controller is used in the

extend direction for at least 1 second, then the boom section will be locked at this pinning location. If the telescope controller is not used, then the boom section can remain at that location and not locked (note that the boom section could also now be retracted and the boom fully retracted, if desired, without changing the target tele picture / requested final boom configuration).

- Assuming that the boom section is requested to be locked, it is important to know that there are a few phases to the automated motion to lock the boom section. In particular, Figure 4-41 shows that there is a “lip” on the boom section pins (pointed to by the arrow in figure). The first phase for boom section locking is to release/extend the pins into the hole/cutout in the encompassing boom section. If this is successful, then there is a second phase of automated motion to set down the boom section on the proper flat surface of the pins that is next to the lip. In a final phase, the pin is confirmed to be engaged and the boom section locked by the control system commanding the telescoping cylinder to retract and then checking for no boom motion. If there is no motion, then it is confirmed as locked.

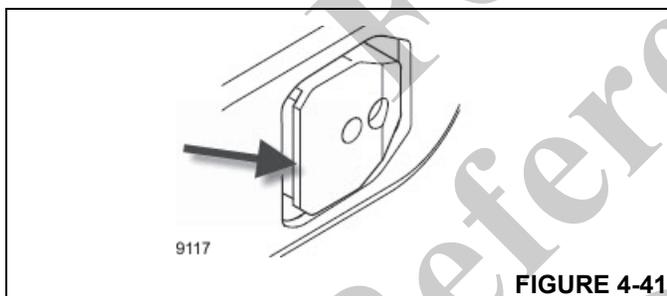


FIGURE 4-41

- After the boom section is locked, the left AND right arrows are shown blinking. This indicates to the operator that the boom can be retracted or extended, and that in either case, there will be automated motions and to be aware that it will take some time (the blinking is an indication to the operator that this time will be needed).
- Assuming the boom is to continue to be extended, the operator would use the telescope controller in the extend direction for at least 1 second. This is interpreted as the indication to change to extending the next boom section (T4 in this example). Therefore, the telescoping cylinder will automatically unlock from the T5 boom section, retract to the T4 boom section, lock to the T4 boom section, and then unlock the T4 boom section.
- When the T4 boom section is unlocked, the left and right telescoping direction arrows will appear again (as is shown in Figure 4-37).
- The operator can telescope the next boom section (T4).
- The T4 boom section operating process is the same as for the T5 boom section described above. When the T4 boom section is at its 100% pinning location, then it can be locked in the same manner (using the extend direction of the telescope controller for at least 1 second when the right arrow is blinking).
- With the T4 boom section at its requested final location, only the left arrow would be blinking. This is indicating that it is impossible to telescope the boom any further (the boom has arrived at its final configuration as requested).

The following steps would be expected for fully retracting the boom in Semi-auto Mode:

- DO NOT ENTER a new boom configuration or “target tele picture” (such as 0-0-0-0-0) just to fully retract the boom.
- At any point in the boom extending procedure (described above), when the left arrow is shown, the telescope controller can be used in the retract direction to retract the boom (partially or fully).
- The operator can use the telescope controller in the retract direction for at least 1 second, and then the automated motion to unlock the boom section (T4 in the example) will start. It is important to know that there are two phases for unlocking a boom section. As mentioned previously, and shown in Figure 4-41, there is a lip on the boom section pins. Therefore, the first phase of the automated motion is to lift up the boom section to have clearance from this lip. After the lift up is completed, then the pins are retracted. The boom section is now able to be retracted.
- The operator can retract the first boom section to move (T4). But note that the retract and extend arrows are again shown. It is possible for the operator to change direction once again and return to extending the boom, if desired.
- Assuming the boom is to be fully retracted, the operator would retract the first section. The boom section will slow down near the 0% pinning location. If the operator continues to retract the boom section to the 0% pinning location, the boom motion stops. The left arrow is shown blinking.
- The operator can command the retract direction for at least 1 second, and then the boom section will lock at 0%.
- The left and right arrows would be shown blinking.
- The operator can continue to command the retract direction for at least 1 second, and then the telescoping cylinder will automatically unlock from the boom section, extend to the next boom section to be retracted, and lock to that boom section. Then the automated motion to unlock the boom section will be used (now for boom

section T5 in this example). When unlocked, the left and right arrows will appear again.

- The operator can continue to command the retract direction and the second boom section to move will be retracted. And, as before, it can be locked at its 0% pinning location.
- Note that when the boom is fully retracted, the telescoping cylinder does not automatically move to another boom section (such as automatically moving to the T1 boom section). The telescoping cylinder will remain at the boom section that was the last to be retracted. However, this cylinder can be moved to another boom section with the Semi-auto Mode. Refer to *Semi-auto Mode for Shifting Cylinder within Fully Retracted Boom*, page 4-44 for shifting cylinder within a fully retracted boom.

Semi-auto Mode for Shifting Cylinder within Fully Retracted Boom

It may be desirable to have the telescoping cylinder locked to a particular boom section while the boom is fully retracted.

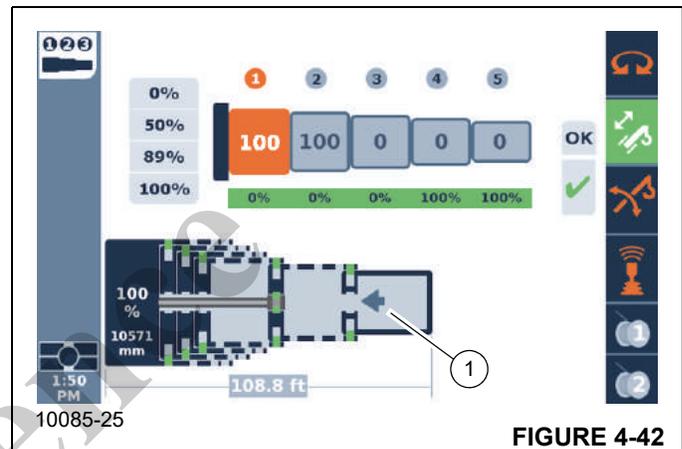
The following procedure can be used:

- Enter the Semi-auto screen of the ODM.
- Verify that the telescoping function is enabled.
- Enter a requested final boom configuration with 0% for each of the boom sections, EXCEPT for the boom section where the tele cylinder is desired to be locked to. For this one boom section, enter 50/55%. For example, if the telescoping cylinder is desired to be locked to the T1 boom section (and it is not located there currently), then 55-0-0-0-0 would be entered.
- If the telescoping cylinder is not at the boom section desired, it will shift to that boom section.
- When the telescoping cylinder is locked to the desired boom section, that boom section will be automatically unlocked (as if it is to be operated).
- Use the telescope controller to retract for at least 1 second. The boom section will re-lock, and the boom should still be fully retracted and locked, and the telescoping cylinder will be in the position desired (such as locked to T1 boom section).

Semi-auto Mode Requiring Boom to be Retracted

It is important to understand that a new requested final boom configuration (“target tele picture”) may require the boom to be retracted first. For example, if the requested final boom configuration is currently 0-0-0-100-100, and the boom is extended to this configuration, and then a new requested final boom configuration (such as 100-100-0-0-0) is entered,

it is impossible to use the new configuration unless the existing boom sections are retracted first. When this condition arises, only the left telescoping direction arrow (1) will be shown on the display (as seen in Figure 4-42). When the boom is fully retracted, then the automated motions should proceed to the new configuration. That is, for the example, when T6 is locked at 0% (after using the joystick to retract everything), then telescoping cylinder can move to the T2 boom section to be unlocked (since it is the first boom section to move for the new final boom configuration of 100-100-0-0-0).



Semi-auto Mode Screen Refresh

When the Semi-auto screen of the ODM is entered, the final boom configuration (“target tele picture”) that is shown is the one most recently ACCEPTED and is actually being used to control/operate the boom. If the screen is exited and re-entered, what is shown may not be the most recently REQUESTED final boom configuration.

As noted in the section of the document 'Semi-auto Mode Requiring Boom to be Retracted', there are cases where a newly requested final boom configuration can not be accepted until the current boom configuration is completed to have the boom fully retracted. If the Semi-auto Mode is currently requiring the boom to be retracted, and the ESC button is used to leave the Semi-auto screen, and then Semi-auto screen is entered again, the values shown for boom sections will revert to the original boom configuration, the ACCEPTED boom configuration (until the boom is fully retracted and the control system can then “shift” to the new REQUESTED final boom configuration).

Semi-auto Mode Warning Indications

The control system manages a fault indication system. This is characterized by a set of error codes or fault codes. When a fault condition is noted by the control system, the icon in Figure 4-43 is seen in the Alerts Area (Figure 4-75) of the ODM. There is also a screen of the operating display that uses this icon, and that screen will show the fault codes.



For the pinned boom control (such as in Semi-auto Mode), a fault may be noted that is momentary. For instance, there is a calculation of the difference between the calculated boom length (based on the calculated boom section positions in the control system) and the measured boom length (from the boom outer cable reel sensor). If this difference is too large, there is a fault condition. However, if the cable on the outer cable reel sensor is just moved momentarily by something near the boom, the cable may suddenly move and then return to the proper tension. In this case, the fault condition can appear momentarily. The icon in Figure 4-43 will appear, and this fault code could be viewed on the operating display, but it does not cause the telescoping function to shut-down, and the fault code can be cleared.

For the proximity switches that sense the position of the telescoping cylinder components and pinning mechanism, similar momentary conditions may appear. There may also be fault codes that appear when automated motions take longer than expected, but the control system automatically recovers from the condition.

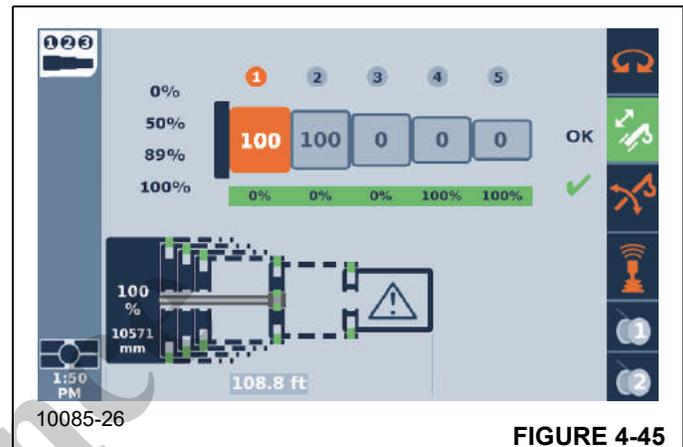
For these momentary and warning conditions, the telescoping function will continue to be available. If the left and/or right arrows appear, then the boom can be moved in the directions indicated by the arrows. The momentary or warning conditions might also be helpful in diagnosing faults that eventually cause the telescoping function to shut-down (refer to the section in the document 'Semi-auto Mode telescoping function shut-down'.

There are sensors in the telescoping cylinder that detect elevated pressure conditions for extending the boom (particularly for telescoping with significant hook loads). If the pressure is beyond a threshold (depending on the distance the telescoping cylinder has been extended), then the extend motion is slowed down. If the pressure approaches another threshold, then the extend motion is stopped. When these conditions are apparent, the icon shown in Figure 4-44 will be shown in the Alerts Area (Figure 4-75) of the ODM.



Semi-auto Mode Telescoping Function Shut-down

If the control system detects a fault that is not momentary and not a warning indication, then the telescoping function will be shut-down. In this case, the error icon (as seen in Figure 4-45) will appear in the graphical schematic for the boom (instead of the dots or the direction arrows described previously).



Typically shut-down condition indicates a failure in the components of the control system (such as sensors or modules or communications). If the only indication of faults is for the telescoping function, then the following steps can be used:

Cycle the power for the control system. When the power is restored, the control system will attempt to repeat the same procedure or automated motion that was interrupted by the fault condition. If the fault condition was not permanent, this may correct the condition, and if the error icon does not appear again, then the telescoping function can continue to be used.

If cycling the power for the control system is not effective, and there is a load on the hook while the control system is attempting an automated action or motion (such as unlocking the telescoping cylinder or a boom section), then lower the load, if possible. Without the load on the hook, cycle the power again to attempt the automated action or motion.

If the telescoping function is still not operable, then the manual telescoping mode can be attempted. In this mode, it is possible to command slight telescoping cylinder motions to assist with locking or unlocking.

If telescoping function is still not operable, then the fault can be assumed to be in the control system components, and control system diagnostic procedures should be utilized.

Semi-auto Mode Lost Boom Configuration

The Semi-auto Mode is expected to continuously monitor and record the positions of the telescoping boom sections. If

this process is interrupted, perhaps by communication interruption or repairing a component in the control system, then this recorded boom configuration (or “tele picture”) may be lost. The control system will not find components in the expected position. When this occurs, a question mark icon will appear in the screen as shown in Figure 4-46.

The operator can attempt to correct this condition by the procedure in section *Reset Telescoping Configuration*, page 4-46

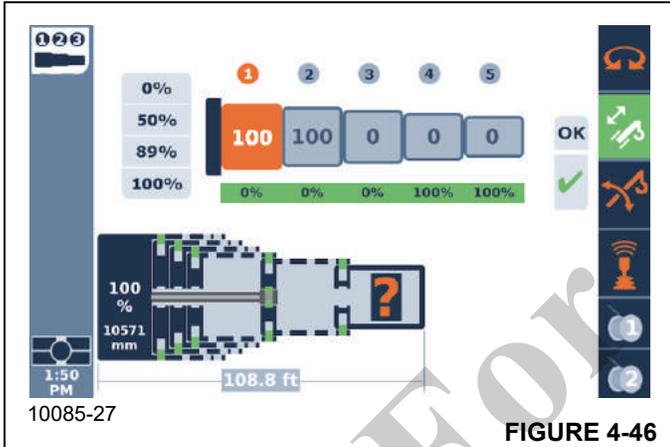


FIGURE 4-46

Reset Telescoping Configuration

If the actual boom configuration (or “actual tele picture”) is no longer considered valid by the control system (the question mark icon appears in the Semi-auto screen), then the following procedure can be used to reset (or “teach”) the telescoping configuration:

- Enter the request reset telescoping screen on the Operator Display Module (ODM). Figure 4-47 shows the icon for this screen.



FIGURE 4-47

The request reset telescoping screen appears as shown in Figure 4-48. This screen is for entering a confirmation code. The confirmation code is L-O-S-T. When these letters are entered on the screen, then an Enter button can be used on the OK shown on the screen. If this is the correct code, then the reset telescoping screen appears as shown in Figure 4-49.

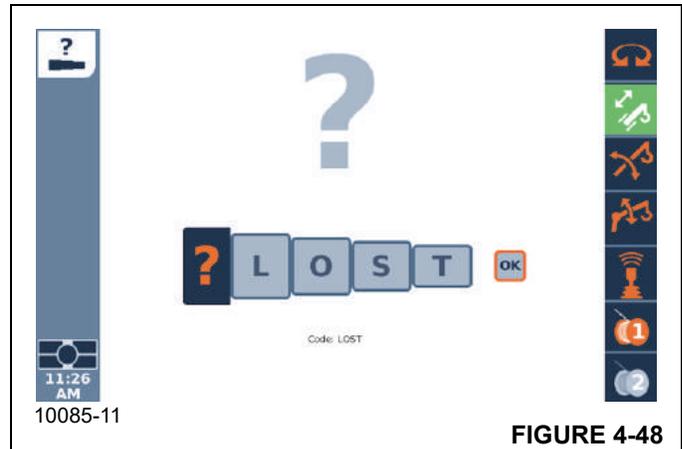


FIGURE 4-48

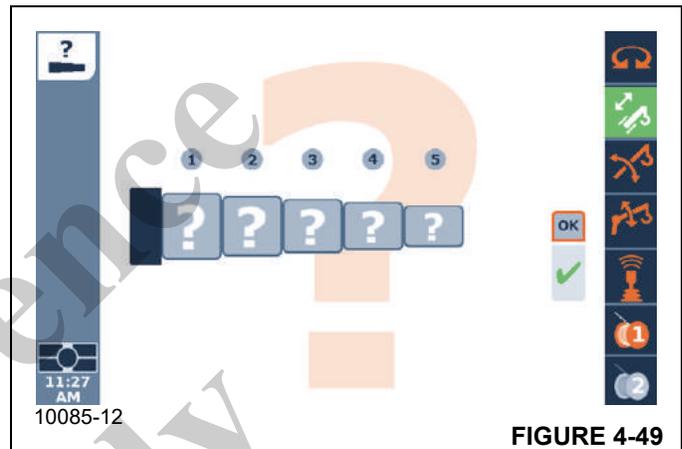


FIGURE 4-49

- In the reset telescoping screen, as shown in Figure 4-49, the operator can indicate the current boom configuration (“actual tele picture”). It is seen that there are 5 available boxes (for the 5 telescoping boom sections). Each of these spin boxes can be used to change to one of the following:
 - 0%
 - 50/55%
 - 89%
 - 100%
 - Unlock icon (appears when the 0% value is shown and then the jog dial or operating display arrow button is used to get a value below 0%).
- Each of the spin boxes needs to be set to a value or indication of the current actual configuration of the boom. If a boom section is locked at a 50/55% location, then that boom section spin box is to be set to the 50/55%. If a boom section is unlocked (and able to be operated by the telescoping cylinder), then that boom section spin box is to be set to the Unlock icon.
- When each of the spin boxes is set to the correct value or indication, then an Enter button can be used on the

OK in the screen. If the control system confirms this boom configuration, then a check-mark appears below the OK (as in Figure 4-50). Otherwise, the question mark shown under the OK (as in Figure 4-51) will remain; in this case, the operator should exit the screen and repeat an attempt to enter the actual boom configuration.

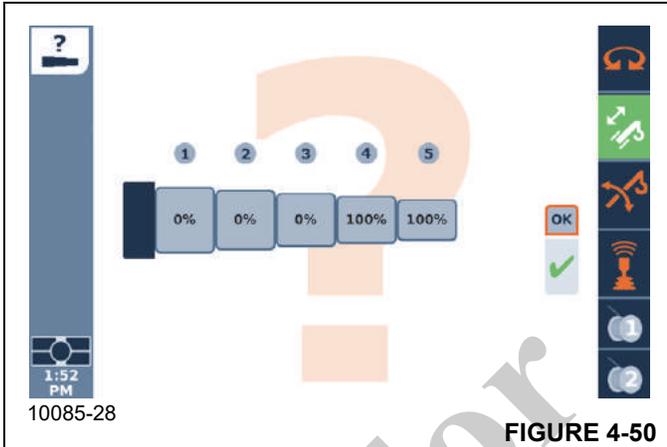


FIGURE 4-50

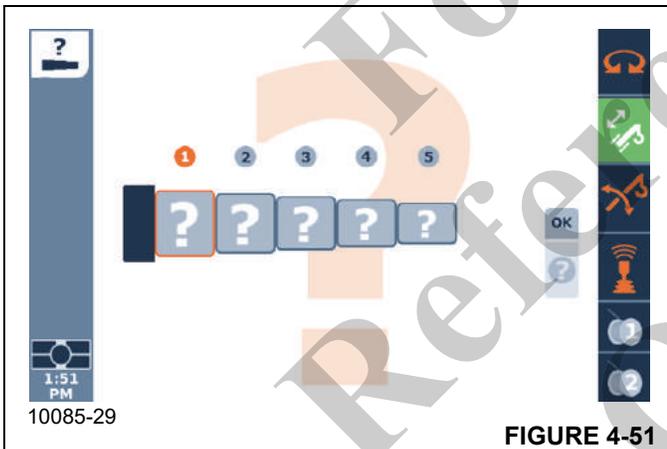


FIGURE 4-51

Semi-auto Mode vs. Manual Mode

The pinned boom can also be controlled with a Manual Mode. Although the Manual Mode allows some additional capabilities, the Manual Mode still requires some automated motions. The Manual Mode screen includes the same schematic graphical representation of the boom, and it uses the same dots indication for automated motions (as shown in Figure 4-35), as well as the telescoping direction arrows for operator control (as shown in Figure 4-36).

The following outlines differences between the Semi-auto Mode and the Manual Mode:

- The Manual Mode screen does not show the final boom configuration values (“target tele picture” or “actual tele picture”). In Manual Mode, the operator requests lock and unlock procedures and telescopes boom sections to desired pinning locations without an initial indication of

the final destination. However, the control system internally still creates such a final boom configuration for the instance where the operator changes to the Semi-auto Mode after using the Manual Mode. The control system sets the final destination for all boom sections not yet moved to 100%. Thus, when changing from Semi-auto Mode (where the operator may have entered 55-55-50-0-0) to Manual Mode (where only boom sections T1, T2, and T3 were operated), and then changing back to Semi-Auto Mode, the Semi-auto screen can show 100-55-50-0-0 (thus the control system automatically changed the destination of T1 from 55% to 100%). This is expected behavior. The operator can use the Semi-auto screen to change the 100% back to 55%, and in some cases, the boom can continue to be operated (but in other cases, the boom may have to be fully retracted first).

- The Manual Mode shows an expanded view of the telescoping cylinder pinning mechanism with the same unlock icons and a lock icon, as seen in Figure 4-52 (instead of the requested final boom configuration values for the Semi-auto Mode). When one of the unlock or lock icons becomes available to be selected (changes from the basic gray color to the focus color), then the operator can request the unlock command or the lock command. The top unlock icon is for the boom section unlocking, and at the proper time the lock icon would be used to again lock the boom section (the lock icon will become available as a command when the control system allows it). The bottom unlock icon is for the telescoping cylinder unlocking, and again at the proper time the lock icon would be used to again lock the telescoping cylinder (again the lock icon will become available as a command when the control system allows it). There is only one lock icon since the pinning mechanism is designed to either unlock the boom section or the telescoping cylinder (but not both at the same time). In this manner, the boom configuration and pinning locations are “built up” by the operator as the boom is operated.

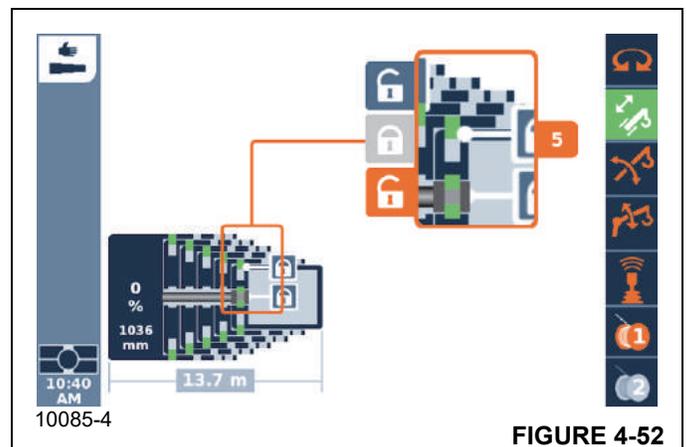


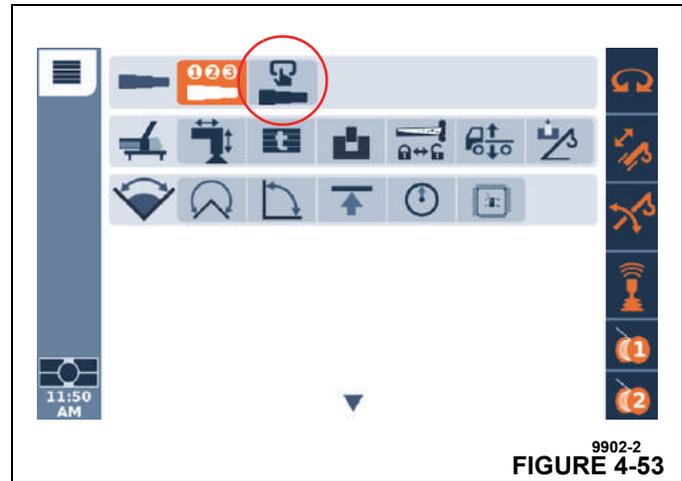
FIGURE 4-52

- In the Semi-auto Mode, the unlocking of the telescoping cylinder and boom sections is entirely automated. And when locking is completed in the Semi-auto Mode, the joystick (or other control device) does not affect the position of the telescoping cylinder (the joystick is used to confirm the next command when there is a blinking arrow). In the Manual Mode, the command buttons indicate the unlocking and locking, and the joystick can affect the position of the telescoping cylinder; however, with the components already in a locked condition, the position of the cylinder can only be slightly affected. But, making slight adjustments to the position of the cylinder can assist with the unlocking process.

Boom Configurator

There are many boom or pinning configurations available. The Boom Configurator can assist with previewing these boom configurations and making an appropriate selection. This screen is used when the boom is fully retracted. Switch on the telescoping mechanism, refer to *Switching On the Telescoping Mechanism*, page 4-33.

The Boom Configurator is selected from the menu system on the ODM as shown in Figure 4-53. Once selected, the Boom Configurator screen is shown (refer to Figure 4-54). This screen allows lift plan information such as hook radius, hook load, and boom length to be entered. The screen will then present a table of possible boom configurations to select from. The table will show the load chart based information for the configurations, as well as an approximate time (in seconds) to complete the telescoping to the boom configuration. Note that the boom configurations shown are dependent on the rigging information already entered on the RCL display, so be certain to set this rigging information correctly. If the rigging information is changed, all the selections on the Boom Configurator and data on the Boom Configurator may change. When the Boom Configurator data is updating (a waiting circle is shown on the screen), do not interact with the screen/display; wait until the data is completely updated before selecting the next action (although ESC can be used at any time to cancel the operation).



9902-2
FIGURE 4-53

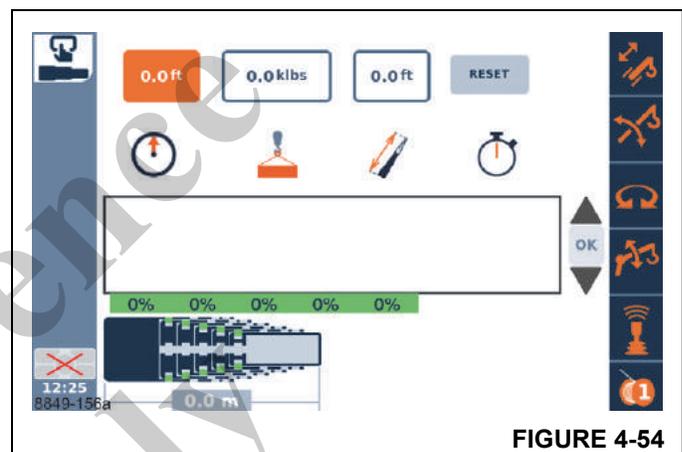


FIGURE 4-54

After a table of boom configurations is displayed, the arrow icons on the right side of the screen can be used to highlight a particular row in the table. For this highlighted row, the details of the boom configuration (“tele picture”) is shown below the table. If the OK button is pressed with a particular row highlighted, then the boom configuration is sent directly to the Semi-auto screen and the control system begins to work that selection and can begin unlocking the boom.

As an example, the RCL rigging information can be set as follows (including using the check-mark to activate this selection):

- Outriggers at 100% extension.
 - Counterweight of 25,764 kg (56,800 lb).
 - 2 parts of line on main hoist (no aux nose).
 - Boom extension stowed.
- Enter the Boom Configurator screen (should appear similar to Figure 4-54).
 - Highlight the first selection box at the top of the screen (for radius), and select Enter.

The value in the box can now be changed. Increase the value until 40.0 ft is shown.

3. Select Enter.

After a few moments, the boom configurations are searched and sorted and then shown in the table similar to Figure 4-55.

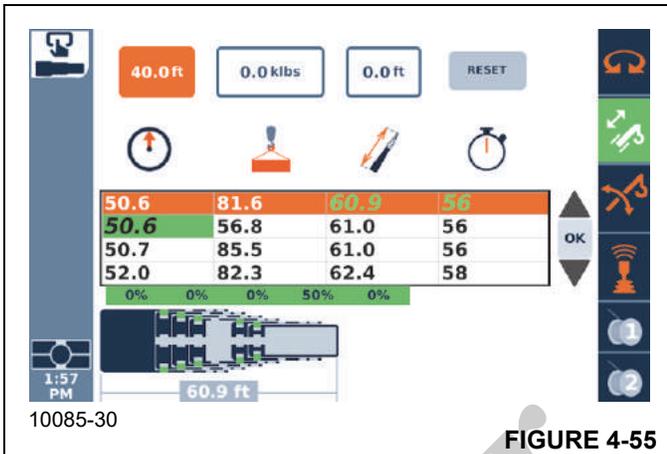


FIGURE 4-55

4. Highlight the second selection box (for hook load), and select Enter.

The value in the box can now be changed. Increase the value until 20.0 klbs is shown.

5. Select Enter.

The boom configurations are now a shorter list (since now matching for both radius and load).

6. Highlight the third selection box (for boom length), and select Enter.

The value in the box can now be changed. Increase the value until 150.0 (ft) is shown.

7. Select Enter.

The boom configurations are now an even shorter list.

Figure 4-56 shows the expected typical boom configurations for the three criteria that have been entered. Note that the second row has the radius and time to deploy the boom highlighted in green. These green values indicate the smallest radius and the shortest time to deploy the boom. For the column with the approximate time to extend the boom, the green highlighted value is actually the minimum value (since a shorter time is expected to be the most desirable). Also, note that the orange color for highlighting/selecting a row can "hide" the green color, but the italics is also used to try to distinguish these items. Use the up and down arrow icons at the right side of the screen to change the highlighted row and then see all the green colored items.

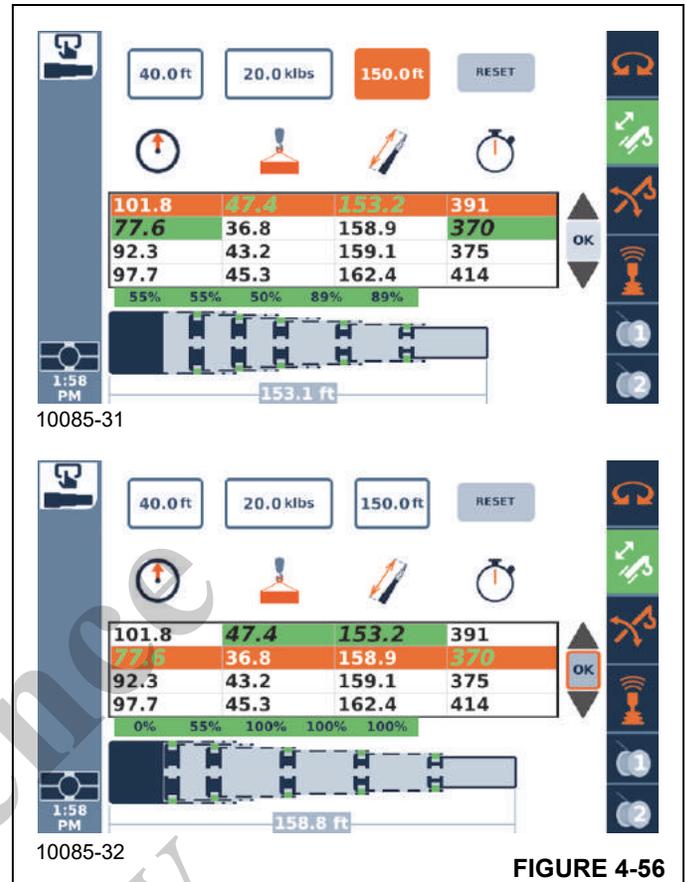


FIGURE 4-56

Again referring to Figure 4-56, the second row could be highlighted using the up and down arrows at the right side of the screen. This would be pinning combination 0-55-100-100-100. This may be considered the best selection since it can also proceed to fully extended, if desired. The first row might be desirable since the maximum lift capacity is the greatest and the overall boom length is the shortest. Once a selection is made, the OK button can be used (if the telescoping function has been enabled) to proceed to use the boom configuration in the Semi-auto mode. Another option is to change the rigging information as explained next.

The rigging information on the Rated Capacity Display Module (RDM) can be changed as follows:

- 10 parts of line on main hoist (no aux nose)
- Use the check-mark to activate new rigging.

If the Boom Configurator screen is still shown, the table of values should update.

Enter the following values with the selection boxes (the values in the selection boxes may show values within 0.1 of the desired value - just changing Load if retaining example from above):

Radius = 40

Load = 36.0 (a higher load than above)

Length = 150.0

A new table of available boom configurations can appear and a new selection can be made and sent to the Semi-auto telescoping mode.

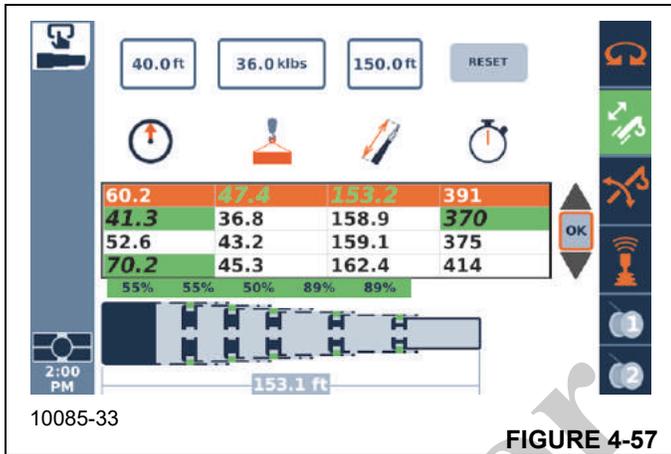


FIGURE 4-57

Finally, if it is desired to keep lifts within a criterion such as 75% of the maximum values for the load chart data, then the search can be based on a modified hook load. The modified hook load value would be the hook load divided by the decimal value for the desired limitation such as the following:

$$P_{\text{modified}} = P / 0.75$$

For example, if hook load is 10,000 lbs, and 0.75 is the modification desired, then the value to enter on the Boom Configurator screen would be the following:

$$P_{\text{modified}} = 10,000 / 0.75$$

$$P_{\text{modified}} = 13,333$$

Thus, enter the value of 13.5 klbs for the Boom Configurator.

Lowering and Raising the Main Hoist Rope

! DANGER
Crushing Hazard!

Keep area beneath load clear of all obstructions and personnel when lowering or raising rope (load).

! DANGER
Crushing Hazard!

Do not jerk controller when starting or stopping hoist. Jerking controller causes load to bounce, which could result in possible damage to the crane.

NOTE: When load is stopped at desired height, the automatic brake will engage and hold the load as long as the controller remains in neutral.

Lowering the Main Hoist Rope

Dual Axis Controllers

1. Press the Main Hoist Enable/Disable Switch on right armrest to enable the main hoist function.

The Main Hoist Enable Indicator in the Status Bar area (Figure 4-80) of the ODM will come on (green).

2. Push controller on right armrest forward and hold to lower the main hoist rope.
3. When hook block/overhaul ball gets to the desired height, let controller return to the center (neutral) position to stop lowering the main hoist rope.

NOTE: When the main hoist controller is pushed forward to lower the rope, the Hoist Rotation Indicator (27, Figure 3-17) pulses and the Main Hoist Lower Indicator (Figure 4-80) comes on to indicate to the operator that the main hoist is operating.

Single Axis Controller (Optional)

1. Press the Main Hoist Enable/Disable Switch on right armrest to enable the main hoist function.

The Main Hoist Enable Indicator in the Status Bar area (Figure 4-80) of the ODM will come on (green).

2. Push outer controller on right armrest forward and hold to lower the main hoist rope.
3. When hook block/overhaul ball gets to the desired height, let controller return to the center (neutral) position to stop lowering the main hoist rope.

NOTE: When the main hoist controller is pushed forward to lower the rope, the Hoist Rotation Indicator (5, Figure 3-25) pulses and the Main Hoist Lower Indicator (Figure 4-80) comes on to indicate to the operator that the main hoist is operating.

Raising the Main Hoist Rope

! DANGER
Two-Block Hazard!

To avoid death or serious injury, keep load handling devices away from the tip of the boom or boom extension when extending or lowering the boom and when hoisting up.

Dual Axis Controllers

1. Press the Main Hoist Enable/Disable Switch on right armrest to enable the main hoist function.

The Main Hoist Enable Indicator in the Status Bar area (Figure 4-80) of the ODM will come on (green).

2. Pull controller on right armrest rearward and hold to raise the main hoist rope.
3. When hook block/overhaul ball gets to the desired height, let controller return to the center (neutral) position to stop raising the main hoist rope.

NOTE: When the main hoist controller is pulled rearward to raise the rope, the Hoist Rotation Indicator (27, Figure 3-17) pulses and the Main Hoist Raise Indicator (Figure 4-80) comes on to indicate to the operator that the main hoist is operating.

Single Axis Controller (Optional)

1. Press the Main Hoist Enable/Disable Switch on right armrest to enable the main hoist function.

The Main Hoist Enable Indicator in the Status Bar area (Figure 4-80) of the ODM will come on (green).

2. Pull outer controller on right armrest rearward and hold to raise the main hoist rope.
3. When hook block/overhaul ball gets to the desired height, let controller return to the center (neutral) position to stop raising the main hoist rope.

NOTE: When the main hoist controller is pulled rearward to raise the rope, the Hoist Rotation Indicator (5, Figure 3-25) pulses and the Main Hoist Raise Indicator (Figure 4-80) comes on to indicate to the operator that the main hoist is operating.

Lowering and Raising the Auxiliary Hoist Rope**DANGER****Crushing Hazard!**

Keep area beneath load clear of all obstructions and personnel when lowering or raising rope (load).

**DANGER****Crushing Hazard!**

Do not jerk controller when starting or stopping hoist. Jerking controller causes load to bounce, which could result in possible damage to the crane.

NOTE: When load is stopped at desired height, the automatic brake will engage and hold the load as long as the controller remains in neutral.

Lowering the Auxiliary Hoist RopeDual Axis Controllers

1. Press the Auxiliary Hoist Enable/Disable Switch on left armrest to enable the auxiliary hoist function.

The Auxiliary Hoist Enable Indicator in the Status Bar area (Figure 4-80) of the ODM will come on (green).

2. Push controller on left armrest forward and hold to lower the auxiliary hoist rope.
3. When hook block/overhaul ball gets to the desired height, let controller return to the center (neutral) position to stop lowering the auxiliary hoist rope.

NOTE: When the auxiliary hoist controller is pushed forward to lower the rope, the Hoist Rotation Indicator (27, Figure 3-17) pulses and the Auxiliary Hoist Lower Indicator (Figure 4-80) in the Status Bar area of the ODM comes on to indicate to the operator that the auxiliary hoist is operating.

Single Axis Controller (Optional)

1. Press the Auxiliary Hoist Enable/Disable Switch on left armrest to enable the auxiliary hoist function.

The Auxiliary Hoist Enable Indicator in the Status Bar area (Figure 4-80) of the ODM will come on (green).

2. Push inner controller on left armrest forward and hold to lower the auxiliary hoist rope.
3. When hook block/overhaul ball gets to the desired height, let controller return to the center (neutral) position to stop lowering the auxiliary hoist rope.

NOTE: When the auxiliary hoist controller is pushed forward to lower the rope, the Hoist Rotation Indicator (5, Figure 3-25) pulses and the Auxiliary Hoist Lower Indicator (Figure 4-80) in the Status Bar area of the ODM comes on to indicate to the operator that the auxiliary hoist is operating.

Raising the Auxiliary Hoist Rope



DANGER

Two-Block Hazard!

To avoid death or serious injury, keep load handling devices away from the tip of the boom or boom extension when extending or lowering the boom and when hoisting up.

Dual Axis Controllers

1. Press the Auxiliary Hoist Enable/Disable Switch on left armrest to enable the auxiliary hoist function.

The Auxiliary Hoist Enable Indicator in the Status Bar area (Figure 4-80) of the ODM will come on (green).

2. Pull controller on left armrest rearward and hold to raise the auxiliary hoist rope.
3. When hook block/overhaul ball gets to the desired height, let controller return to the center (neutral) position to stop raising the auxiliary hoist rope.

NOTE: When the auxiliary hoist controller is pulled rearward to raise the rope, the Hoist Rotation Indicator (27, Figure 3-17) pulses and the Auxiliary Hoist Raise Indicator (Figure 4-80) in the Status Bar area of the ODM comes on to indicate to the operator that the auxiliary hoist is operating.

Single Axis Controller (Optional)

1. Press the Auxiliary Hoist Enable/Disable Switch on left armrest to enable the auxiliary hoist function.

The Auxiliary Hoist Enable Indicator in the Status Bar area (Figure 4-80) of the ODM will come on (green).

2. Pull inner controller on left armrest rearward and hold to raise the auxiliary hoist rope.

3. When hook block/overhaul ball gets to the desired height, let controller return to the center (neutral) position to stop raising the auxiliary hoist rope.

NOTE: When the auxiliary hoist controller is pulled rearward to raise the rope, the Hoist Rotation Indicator (5, Figure 3-25) pulses and the Auxiliary Hoist Raise Indicator (Figure 4-80) in the Status Bar area of the ODM comes on to indicate to the operator that the auxiliary hoist is operating.

Selecting the Hoist Speed Range

CAUTION

Do not change speeds while hoist is operating.

On dual axis controllers and single axis controllers (optional), the high speed hoist function can be enabled by doing one of the following:

- With the main hoist function disabled, hold the Main Hoist Enable/Disable Switch on right armrest for 1.5 seconds to enable the main hoist function at high speed.
- With the auxiliary hoist function disabled, hold the Auxiliary Hoist Enable/Disable Switch on left armrest for 1.5 seconds to enable the auxiliary hoist function at high speed.
- or -
- With the main hoist function disabled, double-click the Main Hoist Enable/Disable Switch to enable the main hoist function at high speed.
- With the auxiliary hoist function disabled, double-click the Auxiliary Hoist Enable/Disable Switch to enable the auxiliary hoist function at high speed.

NOTE: When the main or auxiliary hoist function is enabled at high speed, the respective Main Hoist High Speed Indicator or Auxiliary Hoist High Speed Indicator in the Status Bar area (Figure 4-80) of the ODM will come on.

On dual axis controllers (2, 21, Figure 3-17) only, press and hold the inside (closest to operator) of the respective Hoist Speed Toggle Switch (5, Figure 3-17) to temporarily enable high speed (momentary state) and release the switch to disable the high speed. Press and release the outside (farthest from operator) of the switch to enable high speed (maintained state).

USING THE REMOTE CONTROL UNIT

For an overview of the remote control unit's controls and features, and storage and charging information, refer to *Remote Control Unit*, page 3-56.

The hand-held Remote Control Unit is provided to operate the needed crane functions during crane set up only. The Remote Control Unit is not intended to operate crane functions during normal crane operation.

When operating the crane using the Remote Control Unit, all limiters and their crane function lockouts are inoperable, to include the following:

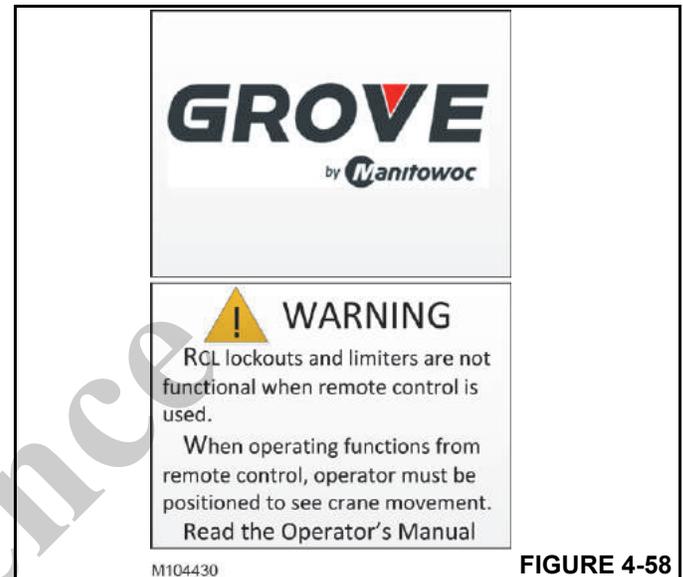
- RCL System (boom up/down, telescope extend, hoist up)
- Anti Two-Block System (boom up/down, telescope extend, hoist up)
- 3rd Wrap Limiter System (hoist down)
- Working Range Limiter (WRL) System
- Carrier Avoidance System
- -29°C Temperature Limiter System (optional)

Preparing for Remote Control Operation

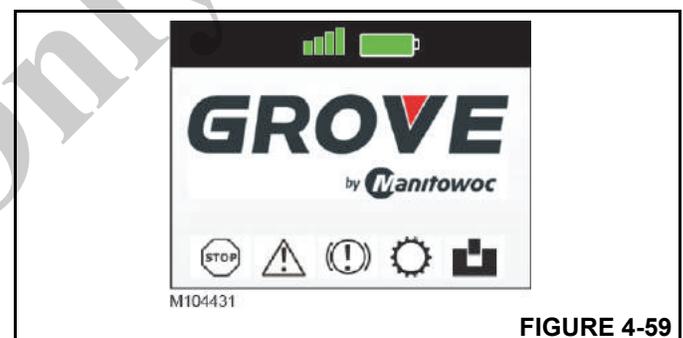
1. Position the crane in the desired location.
2. Apply the parking brake.
3. Shift the transmission to neutral.
4. Stop the engine with the ignition switch (the engine will be re-started with the remote control).
5. Set the ignition switch to RUN position.
6. Enable the Remote Control Unit by pressing the top of the Remote Control Enable/Disable Switch (12, Figure 3-9) on the Right Overhead Control Panel in the cab.

When enabled, power is supplied to the remote module and the E-Stop relay (in remote module) is added in series to the E-Stop electrical circuit.

7. Make sure the E-Stop Button on the Remote Control Unit is pulled out.
8. Set the Remote Control Unit to ON by pressing the Power Button.
9. The SPLASH screen will appear for a few seconds, followed by the WARNING screen (Figure 4-58).



10. Press the ESC Button on the Remote Control Unit to confirm that you have read the warning and to bring up the MAIN Screen (Figure 4-59).



11. Press the Engine Button on the Remote Control Unit. The Engine Screen appears in the display.

The operator must start the engine from the Remote Control Unit. Refer to *Engine Start/Stop/Throttle*, page 4-57.

Once the engine is started, the operator can operate the crane functions from the Remote Control Unit.

The Remote Control Unit remains ON until one of the following occurs:

- Operator presses the Power Button on the Remote Control Unit
- Battery power is too low

12. Set the Remote Control to OFF by doing the following:

- a. If desired, stop the engine with the Remote Control Unit. See *Engine Start/Stop/Throttle*, page 4-57.
- b. Set the Remote Control Unit to OFF by pressing the Power Button on the Remote Control Unit.
- c. Disable the Remote Control Unit by pressing the bottom of the Remote Control Enable/Disable Switch in the cab.

For
Reference
Only

Operating Remote Control

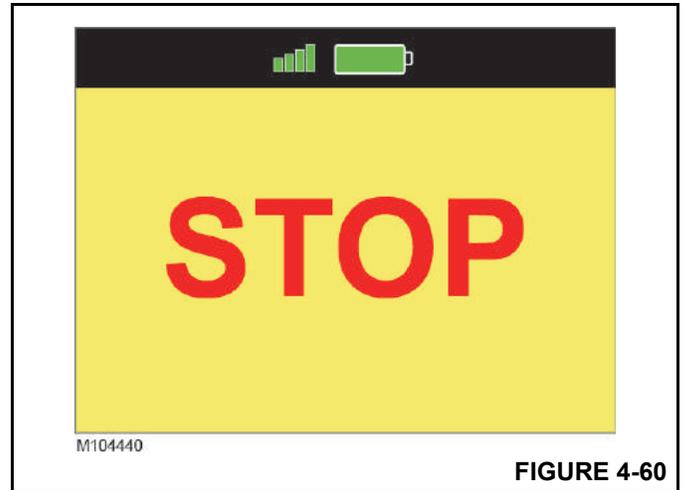
Superstructure Horn

Press and hold the horn button  on the remote control unit to sound the horn. The cab horn buttons can also be used to sound the horn.

Emergency Stop

Pushing in the E-stop button causes the following to occur:

- Engine stops
- All crane functions operating are stopped
- STOP screen appears.(Figure 4-60)



To restart the engine, the E-stop button must be pulled out.

For
Reference
Only

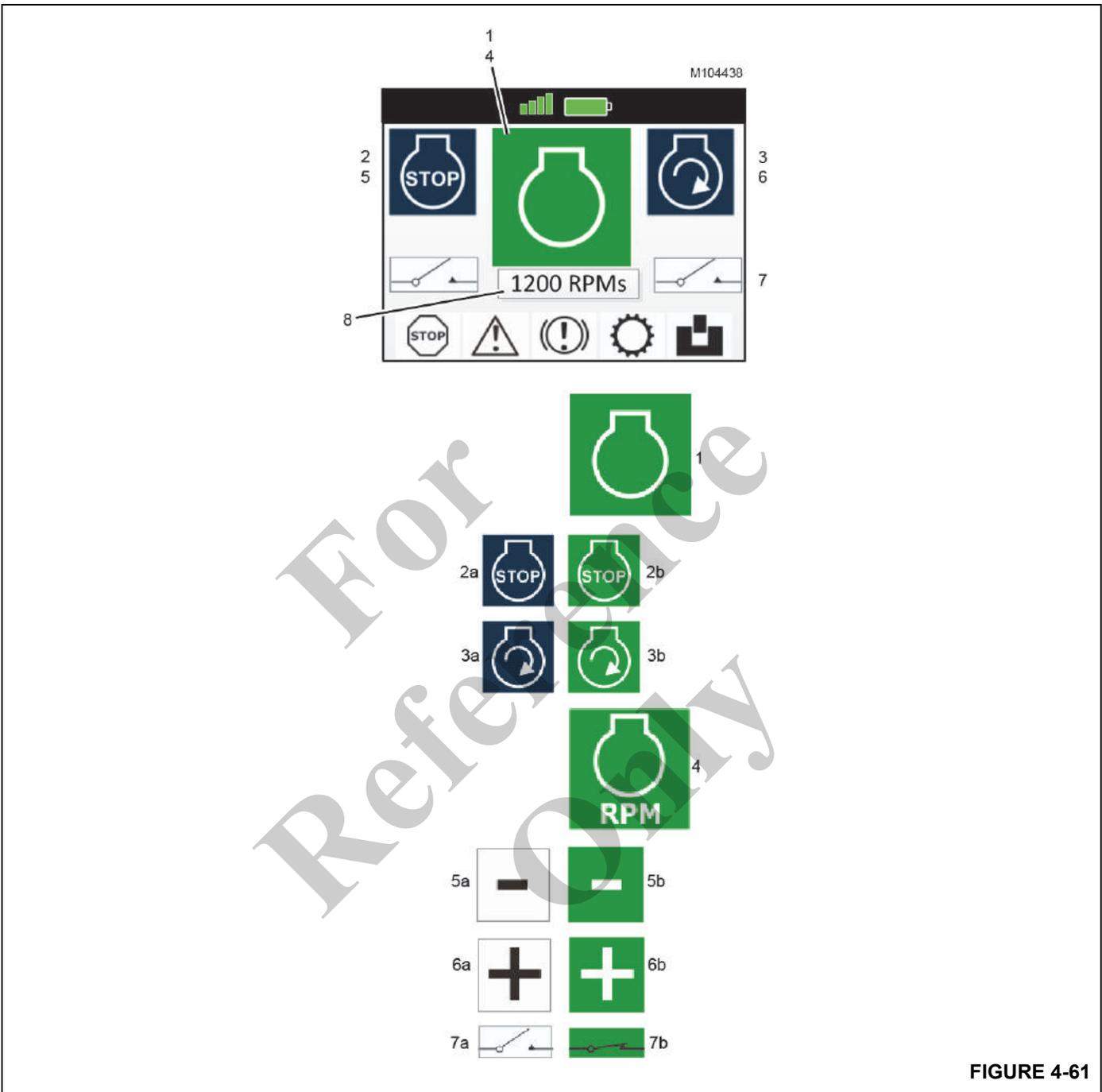


Table 4-1 – Engine Start/Stop/Throttle Function Screen

Item	Indicator Name	Description
1	Engine (start/stop) Function	1 - Green = engine can be started or stopped
2	Stop Engine	2a - Blue = engine cannot be stopped until either enable button is held down 2b - Green = engine can be stopped with left motion button
3	Start Engine	3a - Blue = engine cannot be started until either enable button is held down 3b - Green = engine can be started with right motion button
4	Engine Throttle Function	4 - Green = engine RPM can be changed
5	Decrease RPM	5a - White = engine RPM cannot be decreased until either enable button is held down 5b - Green = engine RPM can be decreased with left motion button
6	Increase RPM	6a - White = engine RPM cannot be increased until either enable button is held down 6b - Green = engine RPM can be increased with right motion button
7	Enable Button Status	7a - White = both enable buttons released (operation disabled) 7b - Green = either enable button held down (operation enabled)
8	RPM Screen	Shows the engine speed

Engine Start/Stop/Throttle

See Figure 4-61

Starting/Stopping Engine

1. Press the engine button  on the remote control unit ONCE. The engine start/stop screen (1) appears.
2. To START the engine, hold down either enable button and the right motion button at the same time. Release both buttons as soon as the engine starts.

If a condition exists that prevents the engine from being started, information will be provided in the display. Common conditions that prevent the engine from being started are: the carrier transmission is in gear or the parking brake is released.

3. To STOP the engine, hold down either enable button and the left motion button at the same time. Release both buttons once the engine stops.

Changing Engine Speed

1. Press the engine button  on the remote control unit ONCE if already at the engine screen, or TWICE if at the main screen. The throttle screen (4) appears.
2. To INCREASE engine speed, hold down either enable button and the right motion button at the same time.
3. To DECREASE engine speed, hold down either enable button and the left motion button at the same time.

The engine's speed is shown in the RPM screen (8).

When the remote control unit is on, engine speed cannot be controlled from the throttle pedal and increment/decrement switch in the crane cab.

Exiting Start/Stop/Throttle Screen

To exit this screen, press the ESC button  on the remote control unit. The main screen appears.

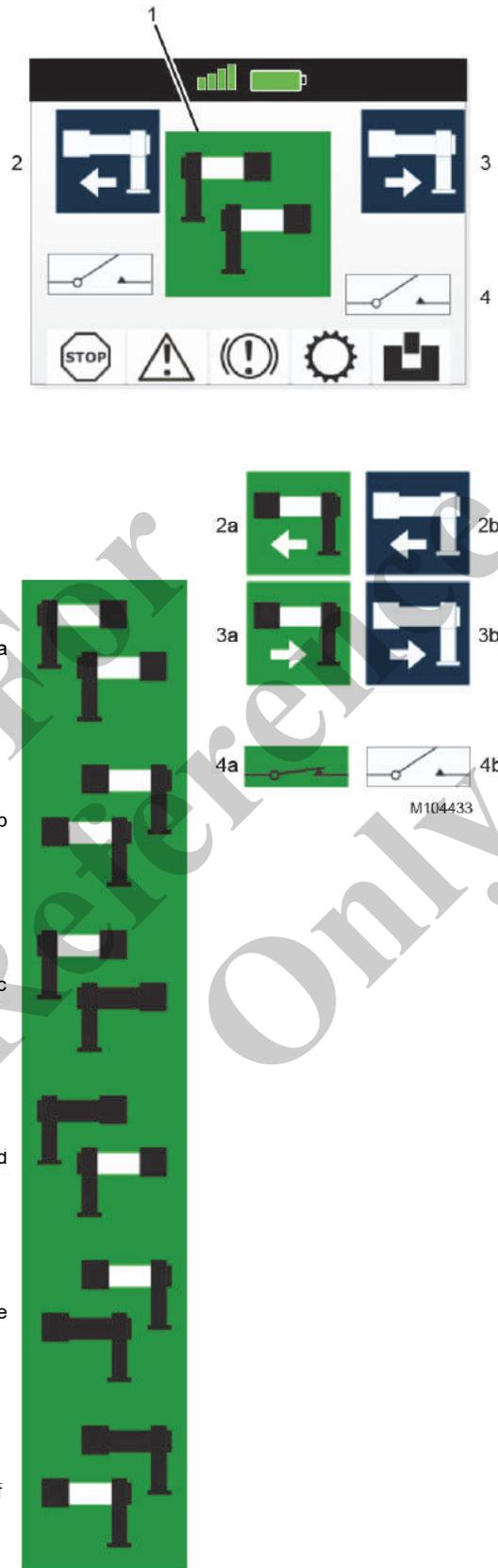


FIGURE 4-62

Table 4-2 – Outrigger Beams Function Screen

Item	Indicator Name	Description
1	Outrigger Beams Function	1a - Both left side beams will be operated 1b - Both right side beams will be operated 1c - Left front beam will be operated 1d - Left rear beam will be operated 1e - Right front beam will be operated 1f - Right rear beam will be operated
2	Retract Beams	2a - Green = beams can be retracted with left motion button 2b - Blue = beams cannot be retracted until either enable button is held down
3	Extend Beams	3a - Green = beams can be extended with right motion button 3b - Blue = beams cannot be extended until either enable button is held down
4	Enable Button Status	4a - Green = either enable button held down (operation enabled) 4b - White = both enable buttons released (operation disabled)

NOTE: The outriggers are to be deployed with the boom centered over the single front axle. In this configuration, the direction the operator is facing is considered the front of the crane.

The top of the remote control unit corresponds to the front of the crane. The terms left and right correspond to the operator's left and right sides when looking forward over the front (single axle) of the crane.

Outrigger Beams

NOTE: Outrigger controls are only active when the engine is on and the parking brake is engaged.

See Figure 4-62

1. Press the outrigger beams button  on the remote control unit as many times as needed until the desired beam screen (1) appears.
2. To RETRACT the selected beams, hold down either enable button and the left motion button at the same time. Release both buttons to stop the beams at the desired position.
3. To EXTEND the selected beams, hold down either enable button and the right motion button at the same time. Release both buttons to stop the beams at the desired position.
4. To exit this screen, press the ESC button  on the remote control. The main screen appears.

Table 4-3 – Outrigger Jacks Function Screen

Item	Indicator Name	Description
1	Outrigger Jacks Function	1a - All four jacks will be operated at same time 1b - Both left side jacks will be operated 1c - Both right side jacks will be operated 1d - Left front jack will be operated 1e - Left rear jack will be operated 1f - Right front jack will be operated 1g - Right rear jack will be operated
2	Retract Jack	2a - Green = jacks can be retracted with left motion button 2b - Blue = jacks cannot be retracted until either enable button is held down
3	Extend Jack	3a - Green = jacks can be extended with right motion button 3b - Blue = jacks cannot be extended until either enable button is held down
4	Enable Button Status	4a - Green = either enable button held down (operation enabled) 4b - White = both enable buttons released (operation disabled)

NOTE: The outriggers are to be deployed with the boom centered over the single front axle. In this configuration, the direction the operator is facing is considered the front of the crane.

The top of the remote control unit corresponds to the front of the crane. The terms left and right correspond to the operator’s left and right sides when looking forward over the front (single axle) of the crane.

Outrigger Jacks

NOTE: Outrigger controls are only active when the engine is on and the parking brake is engaged.

See Figure 4-63

1. Press the outrigger jacks button  on the remote control unit as many times as needed until the desired jack screen (1) appears.
2. To RETRACT the selected jacks, hold down either enable button and the left motion button at the same time. Release both buttons to stop the jacks at the desired position.
3. To EXTEND the selected jacks, hold down either enable button and the right motion button at the same time. Release both buttons to stop the jacks at the desired position.
4. To exit this screen, press the ESC button  on the remote control. The main screen appears.

Table 4-4 – Main/Auxiliary Hoist Function Screen

Item	Indicator Name	Description
1	Main Hoist Function	1 - Green = main hoist can be operated
2	Reel Out (lower)	2a - Blue = main hoist cannot be operated until either enable button is held down 2b - Green = hoist rope can be reeled out from main hoist with left motion button
3	Reel In (raise)	3a - Blue = main hoist cannot be operated until either enable button is held down 3b - Green = hoist rope can be reeled in on main hoist with right motion button
4	Auxiliary Hoist Function	4 - Green = auxiliary hoist can be operated
5	Reel Out (lower)	5a - Blue = auxiliary hoist cannot be operated until either enable button is held down 5b - Green = hoist rope can be reeled out from auxiliary hoist with right motion button
6	Reel In (raise)	6a - Blue = auxiliary hoist cannot be operated until either enable button is held down 6b - Green = hoist rope can be reeled in on auxiliary hoist with right motion button
7	Enable Button Status	7b - White = both enable buttons released (operation disabled) 7a - Green = either enable button held down (operation enabled)

Hoist Control (Main and Aux)

See Figure 4-64

1. Press the hoist button  on the remote control unit ONCE. The main hoist screen appears.
2. Press the hoist button on the remote control unit TWICE. The aux hoist screen appears.
3. To REEL OUT hoist rope from the selected hoist, hold down either enable button and the left motion button at the same time. Release both buttons to stop the hoist.
4. To REEL IN hoist rope on the selected hoist, hold down either enable button and the right motion button at the same time. Release both buttons to stop the hoist.
5. To exit this screen, press the ESC button  on the remote control unit. The main screen appears.

NOTE: The main hoist screen is the default.

Speed in either direction is proportional to how far the motion button is pressed.

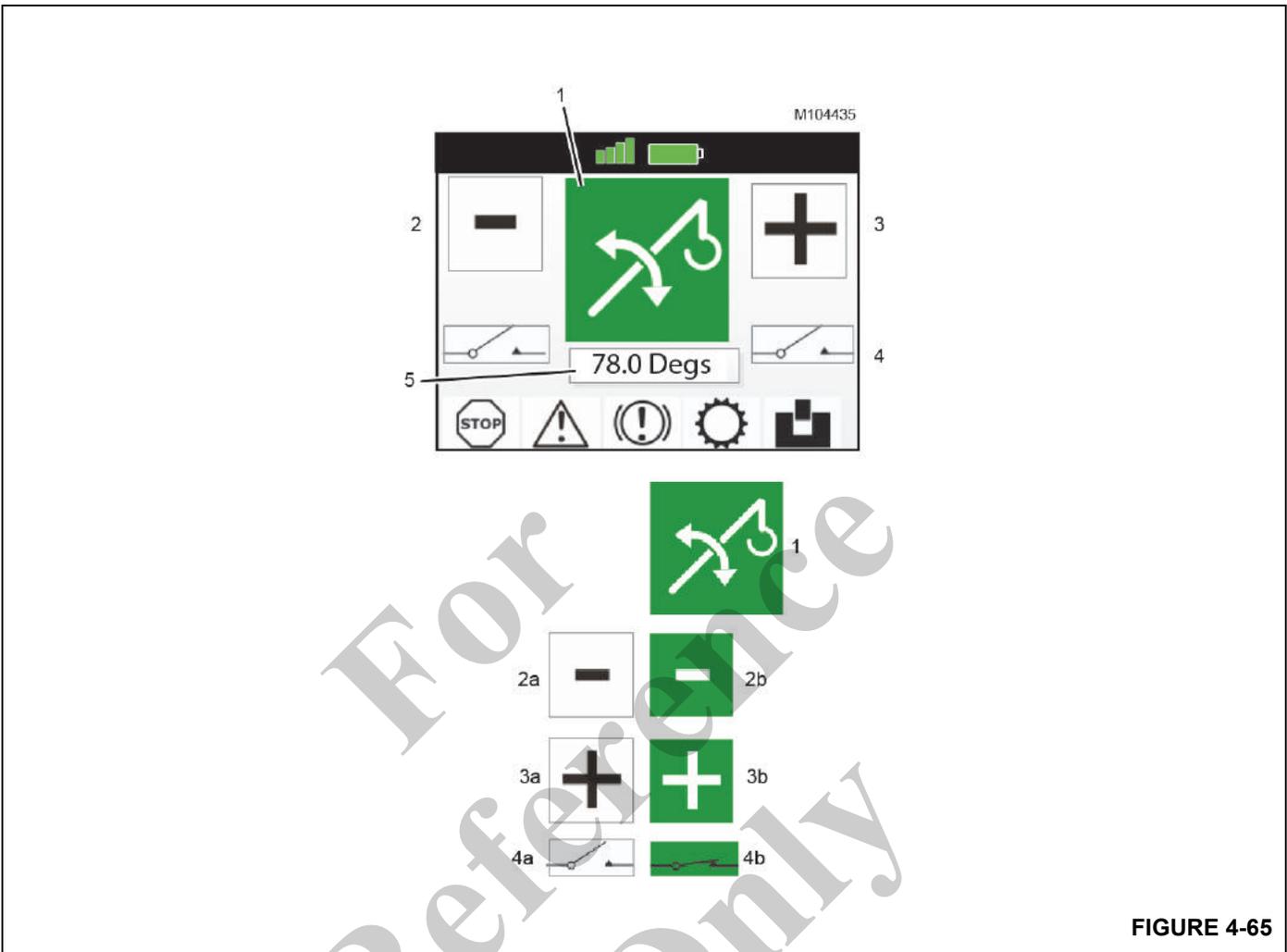


FIGURE 4-65

Table 4-5 – Boom Lift Function Screen

Item	Indicator Name	Description
1	Boom Lift Function	1 - Green = boom can be operated
2	Boom Down	2a - White = boom cannot be operated until either enable button is held down 2b - Green = boom can be lowered with left motion button
3	Boom Up	3a - White = boom cannot be operated until either enable button is held down 3b - Green = boom can be raised with right motion button
4	Enable Button Status	7a - White = both enable buttons released (operation disabled) 7b - Green = either enable button held down (operation enabled)
5	DEG Screen	Shows the boom angle in degrees

Boom Lift

See Figure 4-65

1. Press the boom lift button  on the remote control unit. The boom lift screen (1) appears.

NOTE: Speed in either direction is proportional to how far the motion button is pressed.

2. To LOWER the boom, hold down either enable button and the left motion button at the same time. Release both buttons to stop the boom.
3. To RAISE the boom, hold down either enable button and the right motion button at the same time. Release both buttons to stop the boom.
4. The boom's angle is shown in the DEG screen (5).
5. To exit this screen, press the ESC button  on the remote control unit. The main screen appears.

For Reference Only

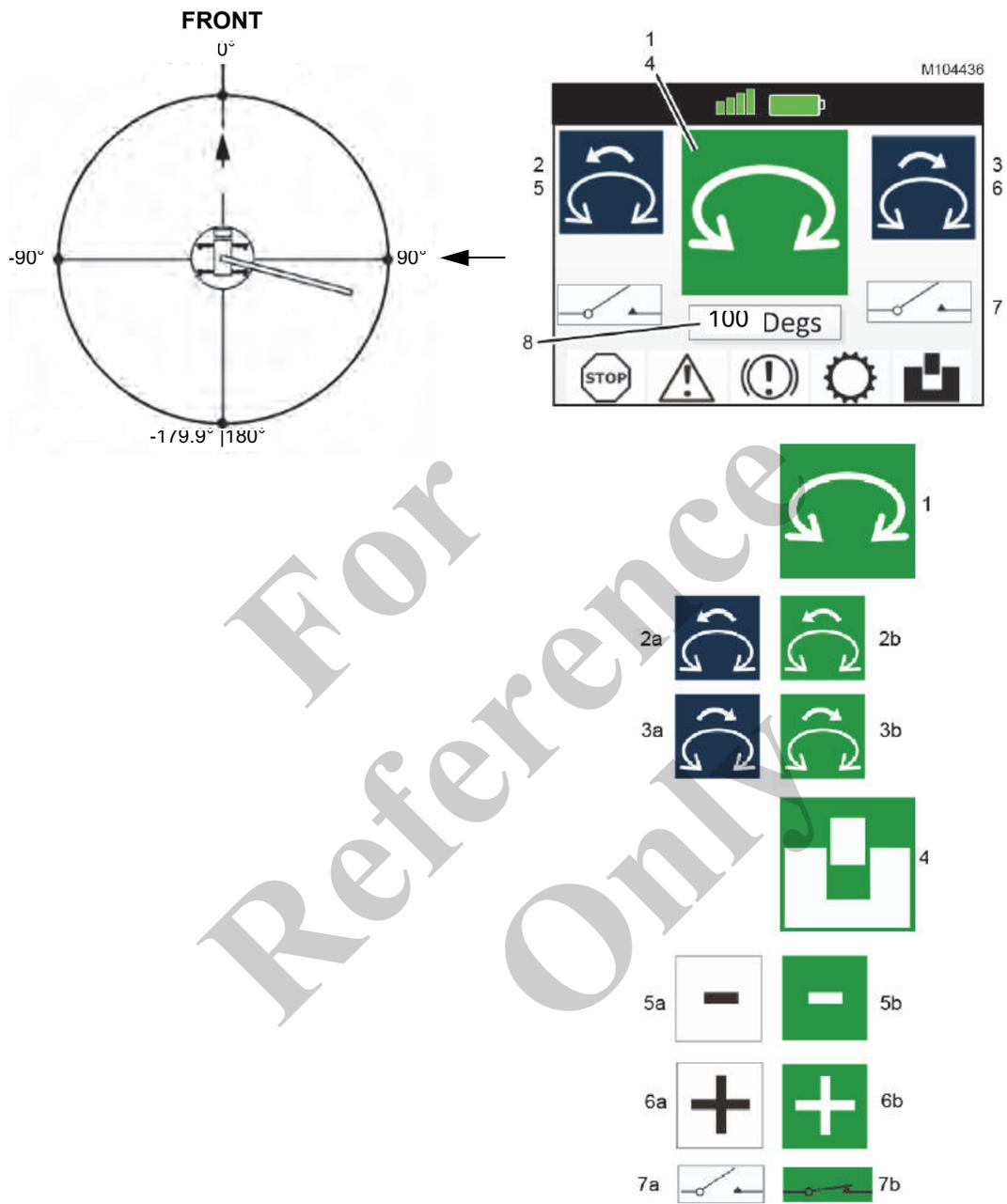


FIGURE 4-66

Table 4-6 – Swing Function Screen

Item	Indicator Name	Description
1	Swing Function	1 - Green = swing can be operated
2	Swing Left	2a - Blue = cannot swing left until either enable button is held down 2b - Green = can swing left with left motion button
3	Swing Right	3a - Blue = cannot swing right until either enable button is held down 3b - Green = can swing right with right motion button
4	360° Swing Lock Function	4 - Green = swing lock can be operated
5	Lock	5a - White = cannot engage swing lock until either enable button is held down 5b - Green = can engage swing lock with left motion button
6	Unlock	6a - White = cannot disengage swing lock until either enable button is held down 6b - Green = can disengage swing lock with right motion button
7	Enable Button Status	7a - White = both enable buttons released (operation disabled) 7b - Green = either enable button held down (operation enabled)
8	DEG Screen	Shows the swing angle in degrees

Swing and 360° Swing Lock

See Figure 4-66

Swinging

1. Press the swing button  on the remote control ONCE. The swing screen (1) appears.

NOTE: Speed in either direction is proportional to how far the motion button is pressed.

2. To swing LEFT, hold down either enable button and the left motion button at the same time.
3. To swing RIGHT, hold down either enable button and the right motion button at the same time.
4. The swing angle is shown in the DEG screen (8).

Operating 360° Swing Lock (Optional)

1. Press the swing button  on the remote control ONCE if already at the swing screen or TWICE if at the main screen. The 360° swing lock screen (4) appears.
2. To LOCK the 360° swing lock, hold down either enable button and the left motion button at the same time.
3. To UNLOCK the 360° swing lock, hold down either enable button and the right motion button at the same time.

Exiting Swing/360° Swing Lock Screen

To exit this screen, press the ESC button  on the remote control. The main screen appears.



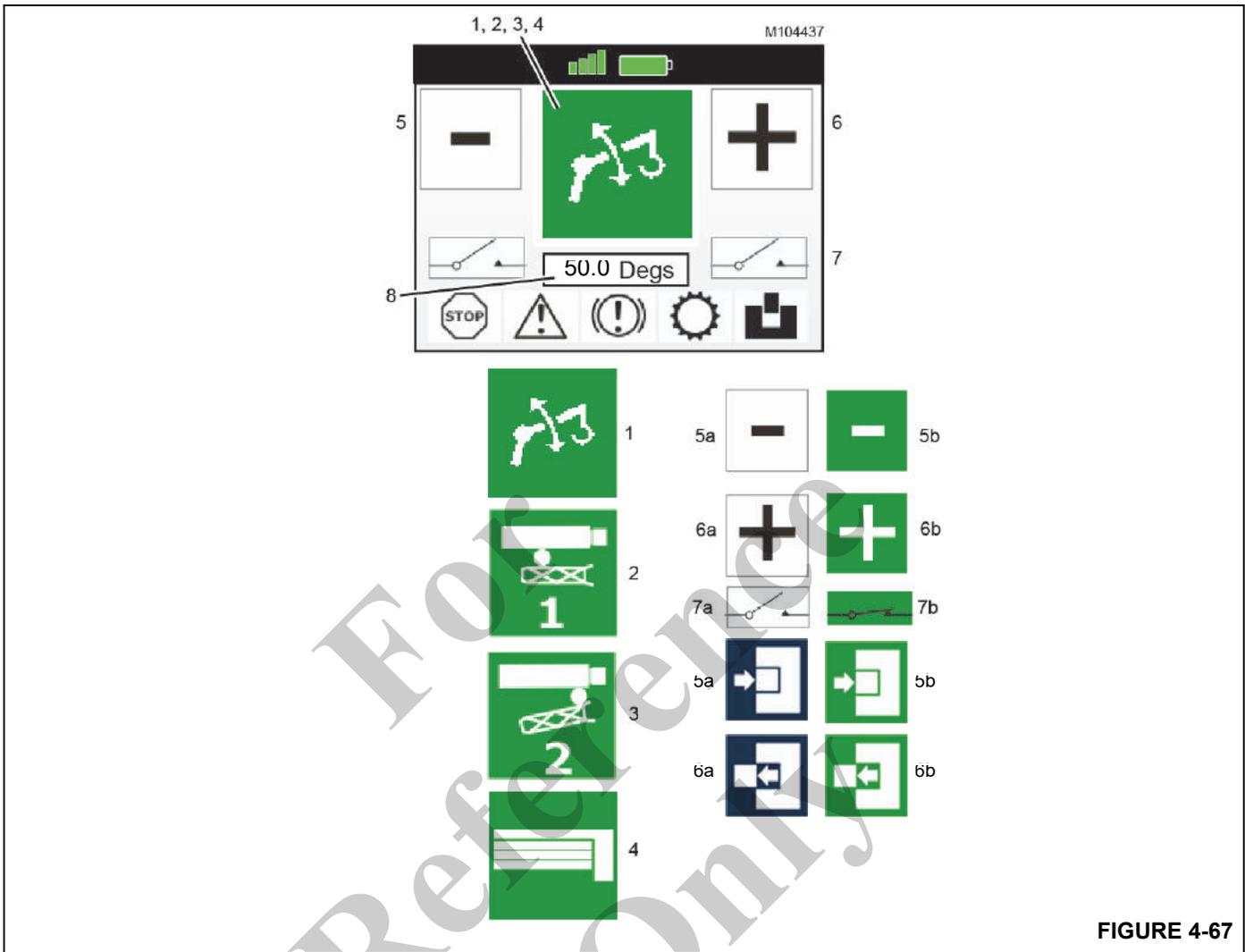


FIGURE 4-67

Table 4-7 – Option Function Screen

Item	Indicator Name	Description
1	Luffing Boom Extension Offset Function	Green = function can be operated
2	Rear Boom Extension Stowage Actuator Function	
3	Front Boom Extension Stowage Actuator Function	
4	Counterweight (Cwt) Function	
5	Retract Actuator Lower Cwt Pin Cwt Lower Boom Extension	5a - White = operation cannot be performed until either enable button is held down 5b - Green = operation can be performed with left motion button
6	Extend Actuator Raise Cwt Unpin Cwt Raise Boom Extension	6a - White = operation cannot be performed until either enable button is held down 6b - Green = operation can be performed with right motion button
7	Enable Button Status	7a - White = both enable buttons released (operation disabled) 7b - Green = either enable button held down (operation enabled)
8	DEG Screen	Shows the boom extension angle in degrees

OPT (options)

See Figure 4-67

The options function screen controls the following crane functions:

- Luffing Boom Extension Offset Cylinder (Optional)
- Boom Extension Stowage Actuators
- Counterweight Loading/Unloading Cylinders

Luffing Boom Extension Offset

1. Press the option button  on the remote control unit as many times as needed to access the luffing boom extension offset screen (1).
2. To LOWER the luffing boom extension, hold down either enable button and the left motion button at the same time.
3. To RAISE the luffing boom extension, hold down either enable button and the right motion button at the same time.

NOTE: Speed in either direction is proportional to how far the motion button is pressed.

4. The boom extension angle is shown in the DEG screen (8).

Boom Extension Stowage Actuators

The boom extension stowage feature has two actuators to assist the operator in deploying and stowing the boom extension option.

1. Press the option button  on the remote control unit as many times as needed to access the rear boom extension stowage actuator screen (2) See Figure 4-67.
2. To RETRACT the rear actuator, hold down either enable button and the left motion button at the same time.
3. To EXTEND the rear actuator, hold down either enable button and the right motion button at the same time.

NOTE: Speed in either direction is proportional to how far the motion button is depressed.

4. Repeat the above steps for the front boom extension stowage actuator screen (3).

Counterweight Loading/Unloading Cylinders

Refer to *Counterweight Removal and Installation*, page 5-12.

1. Press the option button  on the remote control unit as many times as needed to access the counterweight screen (4).
2. To LOWER the counterweight, hold down either enable button and the left motion button at the same time.
3. To RAISE the counterweight, hold down either enable button and the right motion button at the same time.

NOTE: The counterweight cylinders can be raised at any swing position outside of -3.9 to +3.9 degrees, or at 0.0 degrees. They can only be lowered at -4.0 degrees and +4.0 degrees if no counterweight is mounted, or at 0 degrees if a counterweight is mounted.

Counterweight Pinning/Unpinning Actuators

1. Press the option button  on the remote control unit as many times as needed to access the counterweight screen (4).
2. To PIN the counterweight, hold down either enable button and the left motion button at the same time.
3. To UNPIN the counterweight, hold down either enable button and the right motion button at the same time.

Exiting OPT Screen

To exit this screen, press the ESC button  on the remote control unit. The main screen appears.

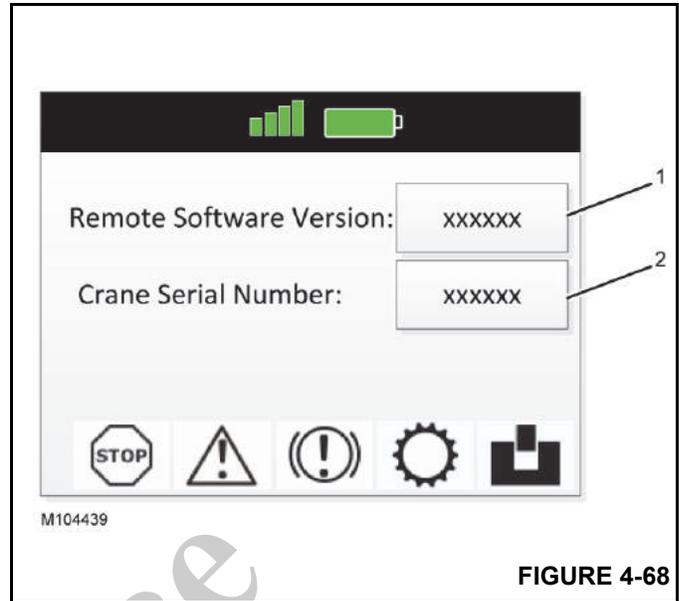


FIGURE 4-68

Information

To access the information screen, press the info button  on the remote control unit.

See Figure 4-68

The information screen shows the following:

- Remote control unit's software version (1)

You will need to know the software version when communicating with your Grove dealer or Manitowoc Crane Care.

- Crane Serial Number (2)

The remote control must remain with the crane it was supplied with. The serial number in the information screen must match the serial number on the crane.

NAVIGATING THE OPERATOR DISPLAY MODULE AND RATED CAPACITY LIMITER DISPLAY MODULE

For a description the Operator Display Module and Rated Capacity Limiter Display Module (ODM and RDM), refer to *Rated Capacity Limiter Display Module and Operator Display Module*, page 3-20

The ODM and RDM each have an integral Navigation Control Pad (Figure 4-69) which allows the operator to navigate through the function screens for that module. The buttons on the two Navigation Control Pads are identical in configuration and perform the same navigational functions.



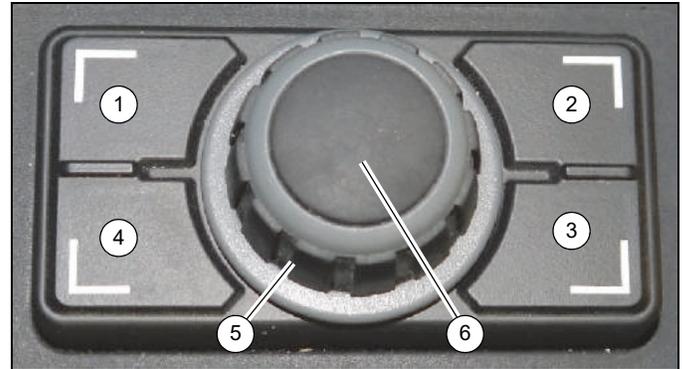
9221-1

Item	Description
1	Escape Button
2	Tab Button
3	Menu Button
4	Left/Right/Up/Down Arrow Buttons
5	OK Button

FIGURE 4-69

The Jog Dial (Figure 4-70), mounted on the right armrest, can also be used to navigate the ODM and the RDM in a similar manner:

- Rotating the Jog Dial performs the same function as pressing the Left/Right/Up/Down Arrow Buttons on the Navigational Control Pads.
- Pressing the Jog Dial performs the same function as pressing the OK Button on the Navigation Control Pads.
- Pressing one of the four buttons surrounding the Jog Dial performs the same function as pressing the respective button surrounding the Arrow and OK Buttons on the Navigational Control Pads.



9221-2

Item	Description
1	Escape Button
2	Tab Button
3	Screen Toggle Button
4	Menu Button
5	Jog Dial (Rotate dial to move cursor)
6	OK Button (Press Jog Dial to select)

FIGURE 4-70

The Jog Dial can control one display module at a time. A Jog Dial Status Indicator (2, Figure 4-74) appears in the lower left corner of either the ODM or RDM to indicate to the operator which display module is being controlled by the Jog Dial at that time. The Screen Toggle Button (3, Figure 4-70) is used to switch between controlling the ODM or RDM.

The ODM has a Main Screen and a Menu Screen. The operator can return to the Main Screen by pressing the Escape Button (1, Figure 4-69 and Figure 4-70) or return to the Menu Screen by pressing the Menu Button (3, Figure 4-69 and 4, Figure 4-70).

The RDM has a Setup Screen and a Menu Screen. The operator can return to the Setup Screen by pressing the Escape Button (1, Figure 4-69 and Figure 4-70) or return to the Menu Screen by pressing the Menu Button (3, Figure 4-69 and 4, Figure 4-70).

NOTE: When setting the outriggers using the Outrigger Extend/Retract function screen, the Escape Button and Menu Button are used to perform outrigger functions (refer to *Outrigger Extend/Retract*, page 4-100).

Rotating the Jog Dial or pressing the Arrow Buttons allow the operator to select the different function icons that are found on the Main Screens and Menu Screens of the ODM and RDM. When a function icon is selected, the icon will turn orange in color.

The Tab Button (2, Figure 4-69) on the ODM and RDM Navigation Control Pads can be pressed to temporarily silence active audible alarms.

USING THE OPERATOR DISPLAY MODULE (ODM)

NOTE: Refer to *Operator Display Module (ODM)*, page 3-21 for additional information.

The Operator Display Module (ODM) has two primary screens:

1. Main Screen



FIGURE 4-71

For detailed information on the Main Screen of the ODM, refer to the section titled *Main Screen*, page 4-73.

2. Menu Screen

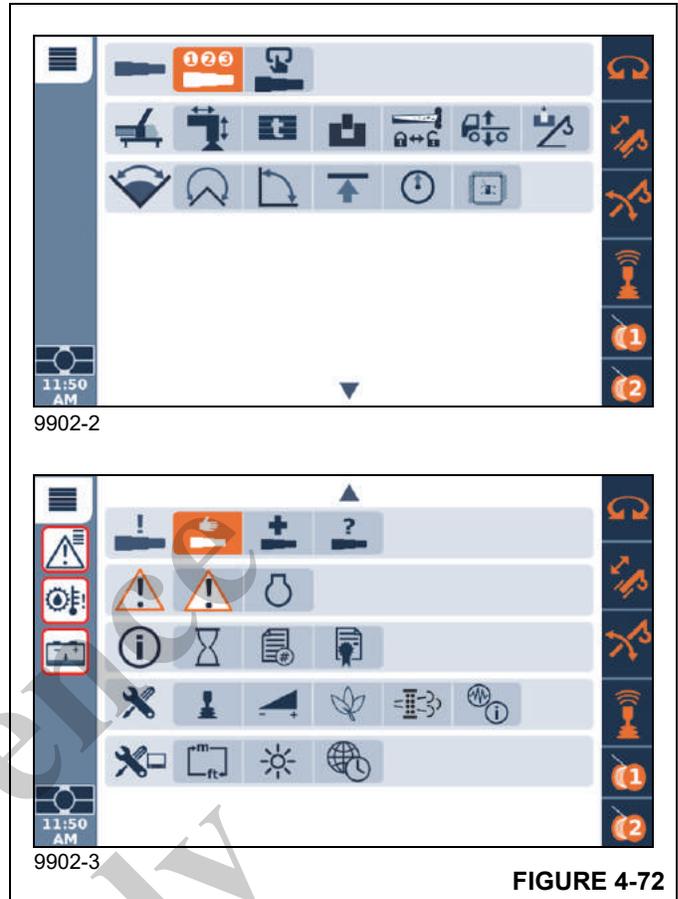


FIGURE 4-72

For detailed information on the Menu Screen of the ODM, refer to the section titled *Menu Screen*, page 4-93.

Main Screen

The Main Screen (Figure 4-74) appears on the ODM (lower screen) when the key switch is initially set to the ON position.

Navigating back to the Main Screen can be accomplished by doing one of the following procedures:

- Press the Screen Toggle Button (1, Figure 4-73) at the Jog Dial to select the ODM screen control, then press the Escape Button (2).

- or -

- Press the Escape Button (3, Figure 4-73) on the Navigation Control Pad at the ODM.

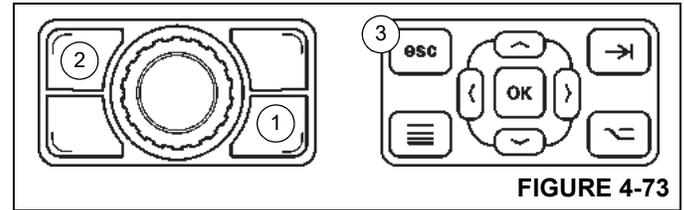


FIGURE 4-73

The Main Screen is separated into seven areas as shown in Figure 4-74.

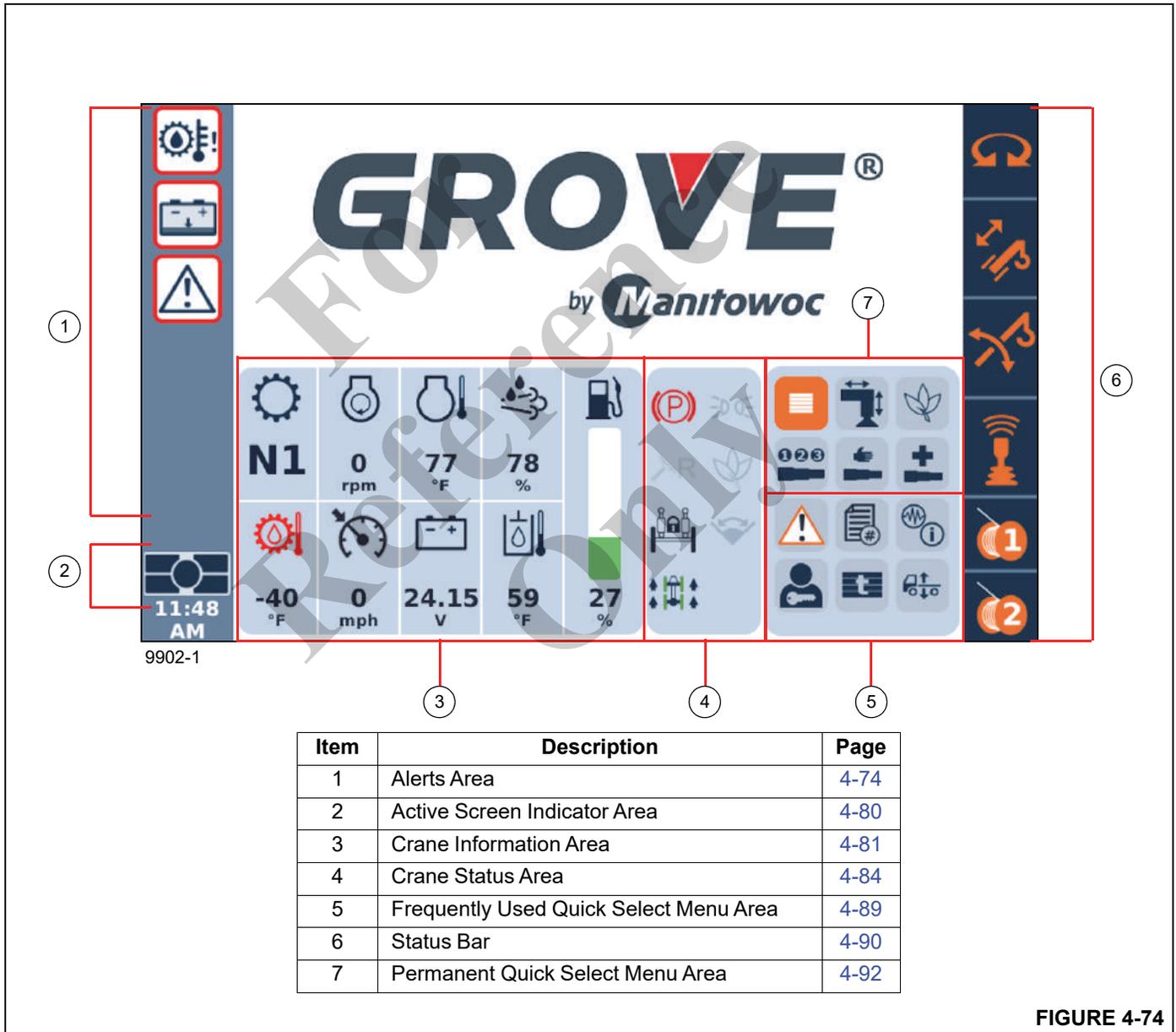


FIGURE 4-74

Alerts Area

The Alerts Area of the ODM Main Screen shows caution and warning alerts when a crane system is not operating normally. The following list identifies all possible alerts that can appear in the Alerts Area (1, Figure 4-75).

An alert can show with one of three outline colors to emphasize its importance:

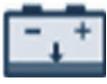
- Blue - Limit/Status
- Yellow - Non Critical
- Red - Critical

At the same time the alert can show constant on or flashing to indicate an additional level of importance.



FIGURE 4-75

Name	Symbol	Description
Crane Fault Active Alert		Indicates there is at least one active crane fault that has been viewed.
New Crane Fault Active Alert		Indicates there is at least one active crane fault that has not been viewed.
Low Fuel Level Alert		Indicates the fuel level is low.
Hydraulic Oil Temperature Warning Alert		Indicates the hydraulic oil temperature is too high. Safely stop crane operation and let hydraulic oil cool by running the engine at idle with no functions actuated.

Name	Symbol	Description
Hydraulic Oil Temperature Invalid Alert		Indicates the hydraulic oil temperature input to the crane control system is invalid.
Transmission Oil Temperature Warning Alert		Indicates the transmission oil temperature is too high. When safe to do so, move the crane to a location where it can be parked and secured, then let the transmission cool by running the engine at idle.
Transmission Oil Temperature Invalid Alert		Indicates the transmission oil temperature input to the crane control system is invalid.
Engine Coolant Temperature Warning Alert		Indicates the engine coolant temperature is too high. Safely stop the lifting operations, land and secure any load being lifted. If possible retract and lower boom. Shut down and secure crane.
Engine Coolant Temperature Invalid Alert		Indicates the engine coolant temperature input from the engine ECM is invalid.
Engine Oil Pressure Warning Alert		Indicates the engine oil pressure is too low. Safely stop the lifting operations, land and secure any load being lifted. If possible retract and lower boom. Shut down and secure crane.
Engine Fault Active Alert		Indicates there is at least one active engine fault that has been viewed.
New Engine Fault Active Alert		Indicates there is at least one active engine fault that has not been viewed.
Engine Speed Warning Alert		Indicates the engine speed is too fast, or the operator is attempting to raise or lower the suspension while the engine is off. Apply the service brake to reduce travel speed and RPM, or shift to a higher gear.
Engine Data Not Valid Alert		Indicates the crane control system is not receiving the expected data from the engine ECM.
Alternator Charge Error Alert		Indicates there is an alternator charge error.
Alternator Charge Low Alert		Indicates the system voltage is too low, or alternator is not charging.

Name	Symbol	Description
<p>Cab Not Fully Lowered Alert</p>		<p>Constant On – Indicates the cab is not in the fully lowered position.</p> <p>Flashing – Indicates one of the following has occurred:</p> <ul style="list-style-type: none"> - Operator is trying to tilt the cab while the parking brake is not applied, the transmission is not in neutral, or the seat switch is not active (operator is not sitting in the seat). - Engine is started while the parking brake is not applied and the cab is not fully lowered. - Operator is trying to operate the outriggers while the cab is not fully lowered. <p>Drive functions are disabled when this indicator is on.</p>
<p>-29°C (-20°F) Temperature Alert (Optional)</p>		<p>Indicates the ambient temperature is below -29°C (-20°F). All crane functions are locked out.</p>
<p>Third Wrap Alert - Main Hoist</p>		<p>Indicates the minimum number of wraps of rope required has been reached on the main hoist.</p> <p>When the indicator comes on (red), the warning buzzer will sound. The crane system will lock-out the hoist down and telescope out crane functions.</p>
<p>Third Wrap Alert - Auxiliary Hoist</p>		<p>Indicates the minimum number of wraps of rope required has been reached on the auxiliary hoist.</p> <p>When the indicator comes on (red), the warning buzzer will sound. The crane system will lock-out the hoist down and telescope out crane functions.</p>
<p>Engine Wait-To-Start Alert</p>		<p>Indicates the outside ambient temperature is low and preheating of the air inside the air-intake manifold is required.</p> <p>Do not start engine until indicator goes off.</p>
<p>Transmission Not-In-Neutral Alert</p>		<p>Indicates the operator is trying to perform an operation that requires the transmission to be in neutral, to include the following operations:</p> <ul style="list-style-type: none"> - Shifting the transmission between two-wheel drive (high range) and four-wheel drive (low range). - Starting the engine. - Tilting the cab. - Shifting the transmission to forward or reverse gear while the cab is not fully lowered, the brake pedal is not pressed, or the RCL is programmed with a non-travel rigging code. - Switching the steering direction using the Steering Reversal Switch. <p>Operator must first shift the transmission to neutral, then try the operation again.</p>
<p>Emergency Stop Active Alert</p>		<p>Indicates the Emergency Stop Switch is pushed in. When the indicator comes on, the warning buzzer will sound</p>

Name	Symbol	Description
<p>Low Boom Angle Alert</p>		<p>Constant On – Indicates the boom has reached the carrier avoidance area. When the indicator comes on, the warning buzzer will sound. The crane system will lock out the boom down and swing left or right crane functions.</p> <p>Flashing – Indicates the carrier avoidance area system and its lock outs (boom down and swing left and right) are actively bypassed by one of the Limit Bypass Switches.</p>
<p>Engine Stop Alert</p>		<p>Indicates there is one or more active engine faults. When the indicator comes on, the warning buzzer will sound.</p> <p>Safely stop the lifting operations, land and secure any load being lifted. If possible, retract and lower the boom. Shut down and secure the crane. Access the fault codes through the Menu Screen of the ODM</p>
<p>Engine Warning Alert</p>		<p>Indicates there is one or more active engine faults.</p> <p>Access the fault codes through the Menu Screen of the ODM. Correct malfunction as soon as possible.</p>
<p>Parking Brake Alert</p>		<p>Indicates the operator is trying to do one of the following operations:</p> <ul style="list-style-type: none"> - Tilting the cab while the parking brake is released. - Starting the engine while the parking brake is released. - Shifting the transmission to forward or reverse while the parking brake is engaged. - Operating the outrigger function while the parking brake is released. - Releasing the parking brake while rigging code 9810 (Stationary On Rubber) is active in the RCL.
<p>Auto-level Sensor Warning Alert</p>		<p>Indicates the operator is trying to auto-level the crane and there is a malfunction with sensor.</p>
<p>Tele Cylinder At Boom Nose Alert</p>		<p>Indicates the telescoping cylinder has extended too far and reached the boom nose. Tele extension is locked out.</p>
<p>Controller Speed/Curve Not Set To Factory Default Alert</p>		<p>Indicates one or more of the controller functions are not set to the factory default setting.</p>
<p>Free Swing Active Alert</p>		<p>Indicates the swing brake is released and the boom is free to swing.</p>
<p>Tele Extend Pressure Too High Alert</p>		<p>Indicates the pressure in the telescope extend circuit is too high for the given boom length. The crane control system will reduce the system pressure and eventually stop the telescope extend function to protect boom components.</p> <p>If the boom is not fully extended, the load must be relieved from the crane before continuing to extend the boom.</p>

Name	Symbol	Description
Suspension Not At Ride Height Alert		Indicates either a Travel-over-the-Front or Travel-over-the-Rear rigging code is active in the RCL, but the suspension is not at the Ride Height (approximately 50%).
Rear Wheels Not Centered Alert		Indicates the rear wheels are not centered.
Service Brake Pedal Not Pushed Alert		Indicates the service brake pedal is not pushed while doing one of the following operations: <ul style="list-style-type: none"> - Shifting the transmission between two-wheel drive (high range) and four-wheel drive (low range). - Shifting the transmission from neutral to forward or reverse. - Switching the steering direction using the Steering Reversal Switch while the parking brake is released.
Four-Wheel Drive Alert		Indicates one of the following conditions has occurred: <ul style="list-style-type: none"> - There is a malfunction in the four-wheel drive system. - Operator is trying to operate the outrigger function while the transmission is not in four-wheel drive (low range). - Operator is trying to engage the differential lock function while the transmission is not in four-wheel drive.
Differential Lock Alert		Constant On – Indicates the differential lock is engaged. Flashing – Indicates one of the following conditions has occurred: <ul style="list-style-type: none"> - Operator is trying to engage the differential lock while the transmission is not in four-wheel drive (low range). - Differential lock is engaged for more than 60 seconds. - There is a malfunction in the differential lock system.
High Exhaust System Temperature Alert		Indicates the exhaust temperature is above 640°C (1184°F) during the active exhaust system cleaning process. Indicator remains on until the temperatures falls below 625°C (1157°F). Indicator also is on constant during the manual exhaust system cleaning process.
Exhaust System Clogged Alert		Constant On – Indicates the exhaust system requires cleaning. When possible, stop and perform a manual exhaust system cleaning. Constant On while Engine Warning Indicator is on constant – Indicates the exhaust system requires cleaning or the engine will begin to derate. Immediately stop and perform a manual exhaust system cleaning. Flashing – Indicates the manual exhaust system cleaning is active or there is a communication loss with the engine ECM.
Inhibit Exhaust System Cleaning Alert		Constant On – Indicates the Exhaust System Cleaning Switch is set to the Inhibit Cleaning position, which prevents the exhaust cleaning process from automatically occurring. Flashing – Indicates there is a communication loss with the engine ECM.

Name	Symbol	Description
<p>Low Service Brake Pressure Alert</p>		<p>Indicates the hydraulic pressure in the service brake system is below normal operating requirements. When the indicator comes on (red), the warning buzzer will sound.</p> <p>Do not drive crane until brake pressure malfunction is corrected.</p>
<p>Steering Reversed Alert</p>		<p>Indicates the driving controls, to include the steering wheel, turn signal lever control, transmission shift lever control, and the rear steer switch, are reversed for driving the crane with the boom over the rear (tandem axles) of the crane.</p> <p>Refer to <i>Steering Reversal Switch</i>, page 3-14.</p>
<p>Suspension Oscillation Allowed Alert</p>		<p>Indicates the suspension can oscillate from side-to-side.</p>
<p>Swing Angle Not In Expected Range Alert</p>		<p>Indicates the steering reversal is enabled but the swing angle is not within 2° of -180°.</p>
<p>Unexpected Rigging Code Alert</p>		<p>Indicates one of the following conditions exist:</p> <ul style="list-style-type: none"> - Transmission is shifted to forward or reverse gear, or the parking brake is released, but the RCL is programmed with the load chart code number 9810 (Stationary On Rubber, 360°, No Counterweight). - Steering controls are reversed, but the RCL is <u>not</u> programmed with an Over-the-Rear load chart code number.
<p>Swing Caution Alert</p>		<p>Indicates the counterweight cylinders are not fully raised, thus the crane control system has reduced the speed of the swing function.</p>
<p>Low DEF Level Alert</p>		<p>Indicates the DEF level is low.</p>

Active Screen Indicator Area

The following indicator can appear in the Active Screen Indicator Area (1, Figure 4-76) of the ODM Main Screen:

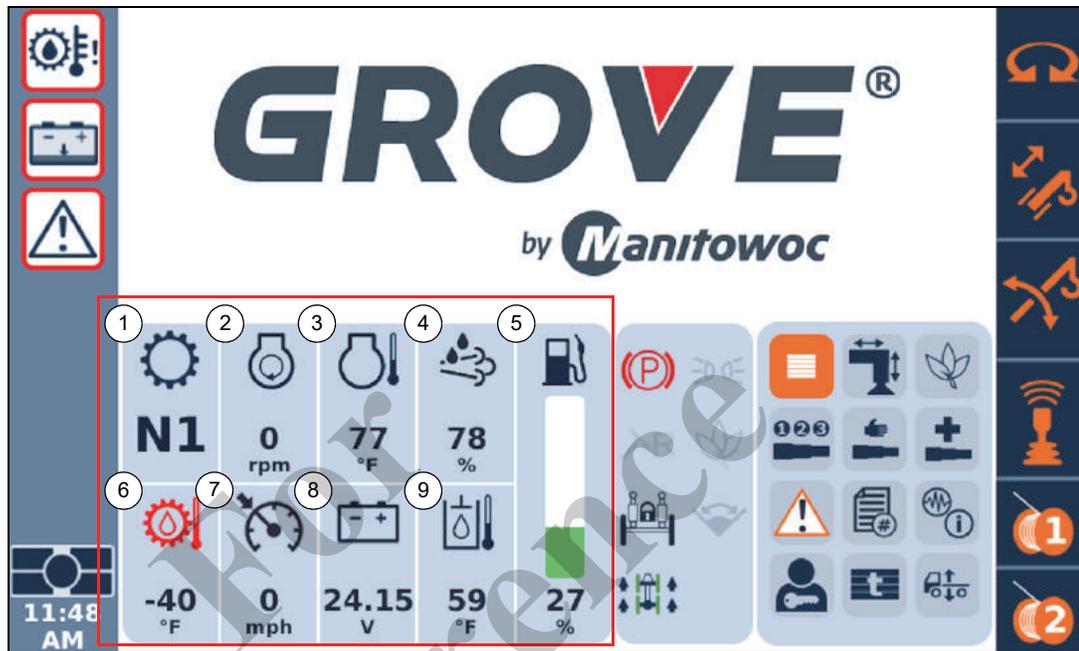


FIGURE 4-76

Name	Symbol	Description
Active Screen Indicator		Indicates the ODM screen is being controlled by the Jog Dial. Refer to <i>Navigating the Operator Display Module and Rated Capacity Limiter Display Module</i> , page 4-71.

Crane Information Area

The following indicators make up the Crane Information Area (Figure 4-77) of the ODM Main Screen.



9902-1

Item	Description	Item	Description
1	Direction/Gear Indicator	6	Transmission Oil Temperature Indicator
2	Engine Speed Indicator	7	Speedometer (Optional)
3	Engine Coolant Temperature Indicator	8	Battery/Charging Voltage Indicator
4	Diesel Exhaust Fluid (DEF) Level Indicator	9	Hydraulic Oil Temperature Indicator
5	Diesel Fuel Level Indicator		

FIGURE 4-77

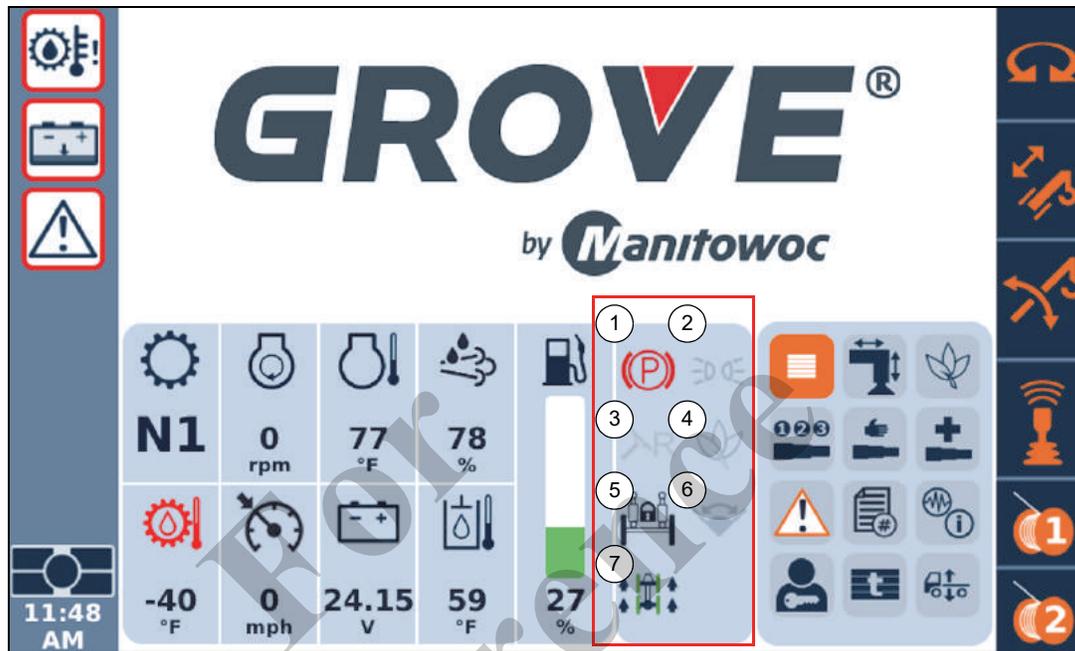
Item	Name	Symbol	Description
1	Direction/Gear Indicator		Indicates if the transmission is in neutral (N), forward (F), or reverse (R) and what gear is selected [first gear (1), second gear (2), or third gear (3)].
2	Engine Speed Indicator		Shows engine speed in revolutions per minute (RPM).
3	Engine Coolant Temperature Indicator		Shows engine coolant temperature in the selected unit of measure (°C / °F). If indicator is yellow or red, safely stop the lifting operation, land and secure the load being lifted. If possible, retract and lower the boom. Shut down and secure the crane.
4	Diesel Exhaust Fluid Level Indicator		Shows the DEF level as a percentage. Yellow Indicator - Indicates the DEF tank is between 5% to 10% full. Red Indicator - Indicates the DEF tank is 5% or less full.
5	Diesel Fuel Level Indicator		Shows the fuel level as a percentage. Yellow Bar - Indicates the fuel tank is between 5% to 15% full. Red Bar - Indicates the fuel tank is 5% or less full.
6	Transmission Oil Temperature Indicator		Shows the transmission oil temperature in the selected unit of measure (°C / °F). If indicator is yellow or red, then when safe to do so, move the crane to a location where it can be parked and secured. Let the transmission cool by running the engine at idle.

Item	Name	Symbol	Description
7	Speedometer		Shows the crane travel speed in the selected unit of measure (kph / mph).
8	Battery/Charging Voltage Indicator		Shows the battery voltage when the engine is off and the charging voltage when the engine is running. Red Indicator - Indicates the battery voltage is less than 20V or greater than 30V.
9	Hydraulic Oil Temperature indicator		Shows the hydraulic oil temperature in the selected unit of measure (°C / °F). If indicator is yellow or red, safely stop crane operation and let hydraulic oil cool by running engine at idle with no functions actuated.

For Reference Only

Crane Status Area

The following indicators make up the Crane Status Area (Figure 4-78) of the ODM Main Screen.



9902-1

Item	Description
1	Parking Brake Indicator
2	Marker Light/Headlight Indicator
3	Steering Reversed Indicator
4	Economy (ECO) Mode Indicator
5	Suspension Control Indicator
6	Working Range Limiter (WRL) Indicator
7	Two-Wheel Drive/Four-Wheel Drive Indicator

FIGURE 4-78

Item	Name	Symbol	Description
1	Parking Brake Indicator		Indicates the parking brake is not applied.
	Parking Brake Applied Indicator (Red)		Indicates the parking brake is applied (refer to <i>Parking Brake Switch</i> , page 3-7).
2	Marker Light/Headlight Off Indicator		Indicates the marker lights and headlights are off.
	Marker Light/Headlight On Indicator (Green)		Indicates that either the marker lights or headlights are on (refer to <i>Headlights Switch</i> , page 3-7).
3	Steering Reversed Indicator		Indicates reverse steering is disabled.
	Steering Reversed Enabled Indicator (Red)		Indicates the reverse steering function is enabled (refer to <i>Steering Reversal Switch</i> , page 3-14) and the driving controls, to include the steering wheel, turn signal lever, transmission shift lever, and rear steer switch are reversed for driving with the boom centered over the rear tandem axles.
4	Economy (ECO) Mode Indicator		Indicates ECO mode is disabled.
			Indicates ECO mode is enabled (refer to <i>ECO Mode</i> , page 4-153) but is not active.
			Indicates ECO mode is enabled and actively lowered the engine speed to 1200 rpm.
			Indicates ECO mode is enabled and actively lowered the engine speed to 750 rpm.
5	Suspension Control Indicator		Indicates the suspension is unlocked and the rear axles are free to oscillate from side to side.
			Indicates the suspension is locked and axle oscillation is prevented.

Item	Name	Symbol	Description
6	WRL Indicator		Indicates all working range limiters are off.
	WRL Indicator (Green)		Indicates one or more working range limiters are defined and enabled.
	WRL Bypassed Indicator (Amber - Flashing)		Indicates a WRL lock out function is bypassed by a Limit Bypass Switch.
6	WRL Boom Angle Enabled Indicator (Green)		Indicates that the minimum boom angle limit, the maximum boom angle limit, or both the minimum and maximum boom angle limits are defined.
	WRL Boom Angle Warning Indicator (Amber)		Indicates the boom angle is within 10° of a boom angle limit setpoint. The warning buzzer slowly beeps when the boom angle is within 10° of the boom angle limit setpoint and changes to a fast beep when the boom tip is within 5° of the boom height limit setpoint.
	WRL Boom Angle Stop Indicator (Red)		Indicates the boom angle is at a boom angle limit setpoint. The warning buzzer is on (constant). For cranes that are equipped with the WRL Lock Out Function, the boom up or boom down crane function is locked out, depending upon which limit is reached.
6	WRL Boom Height Enabled Indicator (Green)		Indicates the boom height limit is defined.
	WRL Boom Height Warning Indicator (Amber)		Indicates the boom tip height is within 3 m (10 ft) of the boom height limit setpoint. The warning buzzer slowly beeps when the boom tip is within 3 m (10 ft) of the boom height limit setpoint and changes to a fast beep when the boom tip is within 1.5 m (5 ft) of the boom height limit setpoint.
	WRL Boom Height Stop Indicator (Red)		Indicates the boom tip height is at the boom height limit setpoint. The warning buzzer is on (constant). For cranes that are equipped with the WRL Lock Out Function, the telescope out and boom up crane functions are locked out.

Item	Name	Symbol	Description
6	WRL Radius Enabled Indicator (Green)		Indicates that the minimum boom angle limit, the maximum boom angle limit, or both the minimum and maximum boom angle limits are defined.
	WRL Radius Warning Indicator (Amber)		Indicates the boom radius is within 3 m (10 ft) of a radius limit setpoint. The warning buzzer slowly beeps when the boom radius is within 3 m (10 ft) of the radius limit setpoint and changes to a fast beep when the radius is within 1.5 m (5 ft) of the radius limit setpoint.
	WRL Radius Stop Indicator (Red)		Indicates the boom radius is at a radius limit setpoint. The warning buzzer is on (constant). For cranes that are equipped with the WRL Lock Out Function, the boom up and telescope in, or boom down and telescope out, crane functions are locked out, depending upon which limit is reached.
6	WRL Swing Enabled Indicator (Green)		Indicates the left and right swing angle limits are defined.
	WRL Swing Warning Indicator (Amber)		Indicates the swing angle is within 10° of a swing angle limit setpoint. The warning buzzer slowly beeps when the swing angle is within 10° of the swing angle limit setpoint and changes to a fast beep when the swing angle is within 5° of the swing angle limit setpoint. For cranes that are equipped with the WRL Lock Out Function, when the swing angle is within 10° of the swing angle lock out setpoint, the swing function commanded by the controller may be reduced or suspended depending upon the weight of the load and the swing speed. Warning Due to the free-swing characteristic of the superstructure, the boom and load can potentially swing past the swing angle setpoint, even if the swing function commanded by the controller is reduced or suspended (locked out) by the WRL. This can happen for several reasons, including how level the crane is and environmental conditions, such as wind speed.
	WRL Swing Stop Indicator (Red)		Indicates the swing angle is at a swing angle limit setpoint. The warning buzzer is on (constant). For cranes that are equipped with the WRL Lock Out Function, the swing left or swing right crane function is locked out, depending upon which limit is reached.

Item	Name	Symbol	Description
6	WRL Virtual Walls Enable Indicator		Indicates that one or more virtual walls are defined.
	WRL Virtual Walls Warning Indicator		Indicates the boom tip is within 6 m (20 ft) of a virtual wall that has been set. The warning buzzer slowly beeps when the boom tip is within 6 m (20 ft) of a virtual wall and changes to a fast beep when the boom tip is within 1.5 m (5 ft) of a virtual wall.
	WRL Virtual Walls Stop Indicator		Indicates the boom tip is at a virtual wall that has been set. The warning buzzer is on (constant). For cranes that are equipped with the WRL Lock Out Function, the telescope out, boom down, and swing left or swing right crane functions are locked out.
7	Two-Wheel Drive/Four-Wheel Drive Indicator		Indicates the transmission is shifted to two-wheel high range.
			Indicates the transmission is shifted to four-wheel low range

Reference Only

Frequently Used Quick Select Menu Area

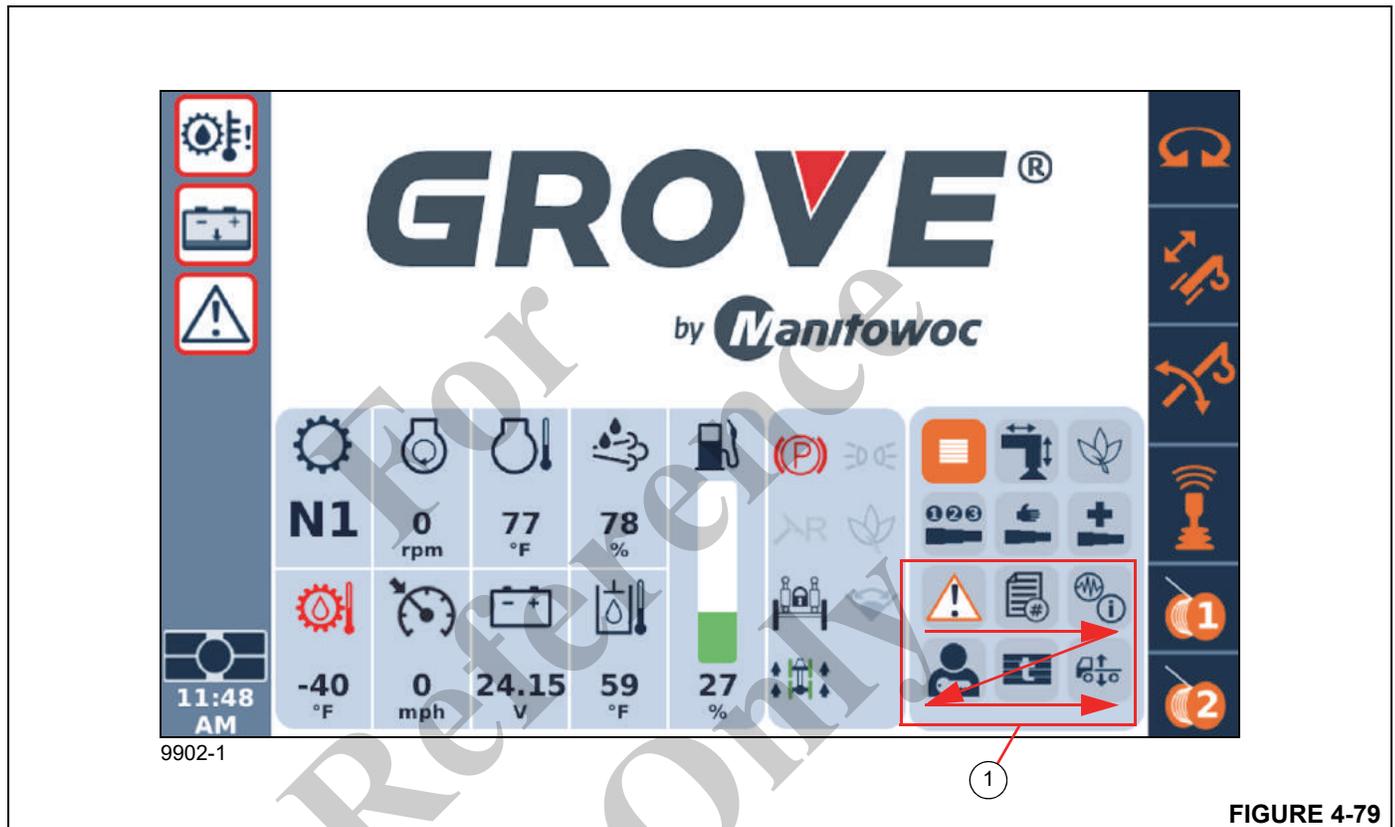
The Frequently Used Quick Select Menu Area (1, Figure 4-79) of the ODM Main Screen shows the six most often selected function icons from the Menu Screen.

These icons appear in descending order of usage, starting at the top left corner and descending to the bottom right corner, as shown by the red arrows in Figure 4-79.

During the operation of the crane, the function icons that appear in this area will change as their usage changes.

Use the Navigation Control Pad or Jog Dial to select one of the function icons in this area.

These six function icons can also be found in the Menu Screen of the ODM. Selecting one of the six icons in the Frequently Used Quick Select Menu Area or in the Menu Screen will open the same function screen.



Status Bar

The indicators in the Status Bar (Figure 4-80) represent the crane functions that are operated by the controllers on the armrests.

Crane functions are enabled and disabled by Enable/Disable Switches. As the status of a crane function changes (from disabled to enabled, or back), its related indicator on the Status Bar will change color.

The crane function indicators that show in the Status Bar (Figure 4-80) include the following:

1. Swing (1)
2. Telescope (2)
3. Boom Lift (3)
4. Luffing Boom Extension (Optional) (4)
5. Remote Control Unit (5)
6. Main Hoist (6)
7. Auxiliary Hoist (7)

Each crane function indicator can have the following status:

- Blue Indicator – Indicates the crane function is disabled.
- Yellow Indicator (Constant On) – Indicates the crane function is enabled, but is in a standby mode due to the operator not being seated (causing seat switch to open – refer to *Seat Switch*, page 3-32).

The crane function is re-enabled by either sitting in the operator seat or by actuating a dead-man switch on the left or right dual axis controllers [refer to *Deadman Switches (Optional) (Dual Axis)*, page 3-26].

- Yellow Indicator (Flashing) – Indicates the crane function is being commanded [controller is moved out of neutral (center) position] when the crane function is changed from disabled to enabled.

Allow controller to return to its neutral position, then re-enable the crane function.

- Green Indicator – Indicates the crane function is enabled.



FIGURE 4-80

Additionally, the main and auxiliary hoist indicators can have the following status:

Name	Symbol	Description
Main Hoist Raise Indicator (Green)		Indicates the main hoist rope is being reeled in.
Main Hoist Lower Indicator (Green)		Indicates the main hoist rope is being let out.
Main Hoist High Speed Indicator (Green)		Indicates the main hoist function and the high speed function are enabled.
Auxiliary Hoist Raise Indicator (Green)		Indicates the auxiliary hoist rope is being reeled in.
Auxiliary Hoist Lower Indicator (Green)		Indicates the auxiliary hoist rope is being let out.
Auxiliary Hoist High Speed Indicator (Green)		Indicates the auxiliary hoist function and the high speed function are enabled.

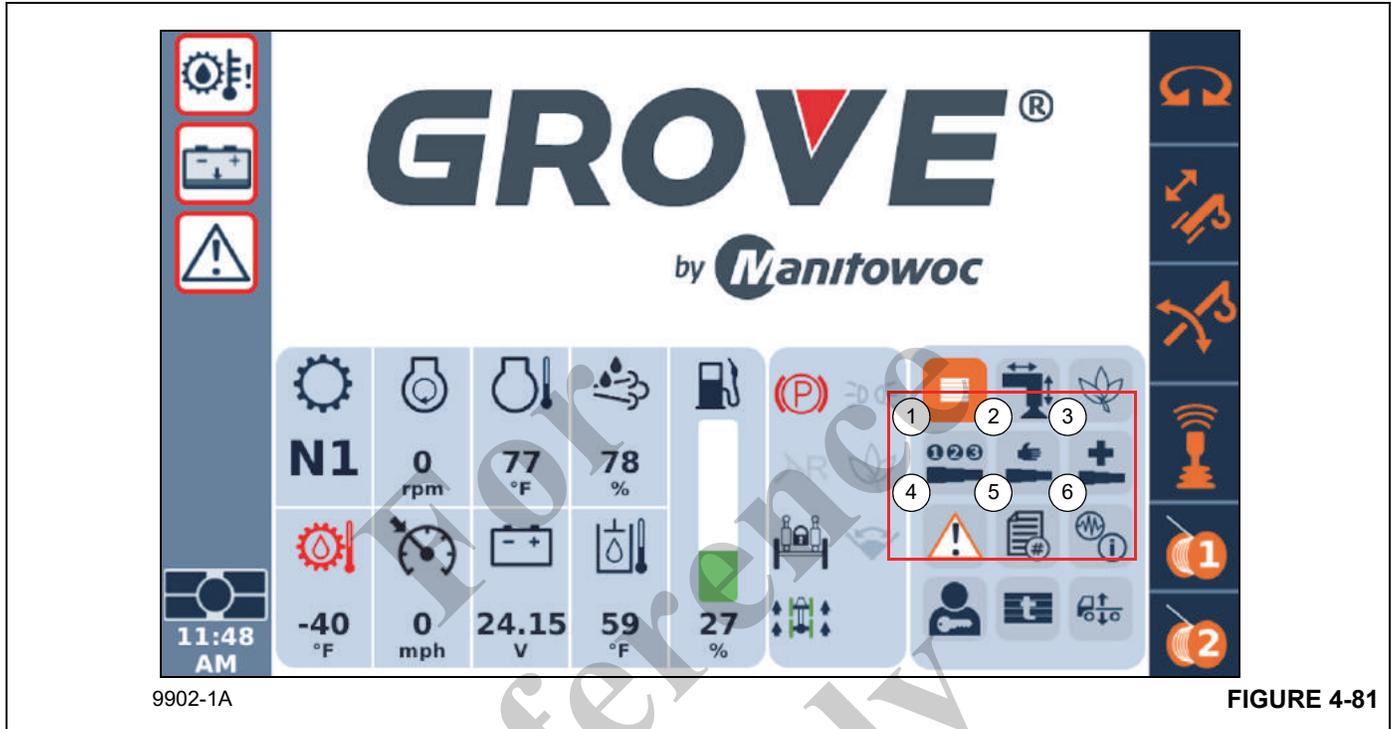
Reference Only

Permanent Quick Select Menu Area

The Permanent Quick Select Menu Area (Figure 4-81) of the ODM Main Screen shows six function icons that are frequently used in the operation of the crane. These six function icons are constantly shown and cannot be changed.

Use the Navigation Control Pad or Jog Dial to select one of the function icons.

These six function icons can also be found in the Menu Screen of the ODM. Selecting one of the six icons in the Permanent Quick Select Menu Area or in the Menu Screen will open the same function screen.



9902-1A

FIGURE 4-81

Item	Name	Symbol	Description
1	Menu Screen Icon		Opens the Menu Screen (page 4-93)
2	Outrigger Function Icon		Opens the Outrigger Extend/Retract function screen (page 4-100)
3	ECO Mode Function Icon		Opens the ECO Mode function screen (page 4-153)
4	Semi-automatic Telescope Mode Function Icon		Opens the Semi-automatic Telescope Mode function screen (page 4-96)
5	Manual Telescope Mode Function Icon		Opens the Manual Telescope Mode function screen (page 4-131)
6	Emergency Telescope Mode Function Icon		Opens the Emergency Telescope Mode function screen (page 4-133)

Menu Screen

The Menu Screen (Figure 4-83) of the ODM is accessed by doing one of the following:

- Press the Screen Toggle Button (1, Figure 4-82) at the Jog Dial to select the ODM screen control, then press the Menu Button (2).
- or -
- Press the Menu Button (3, Figure 4-82) on the Navigation Control Pad at the ODM.

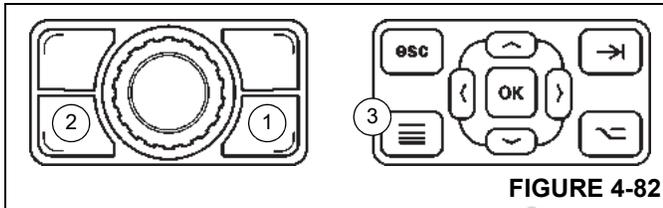
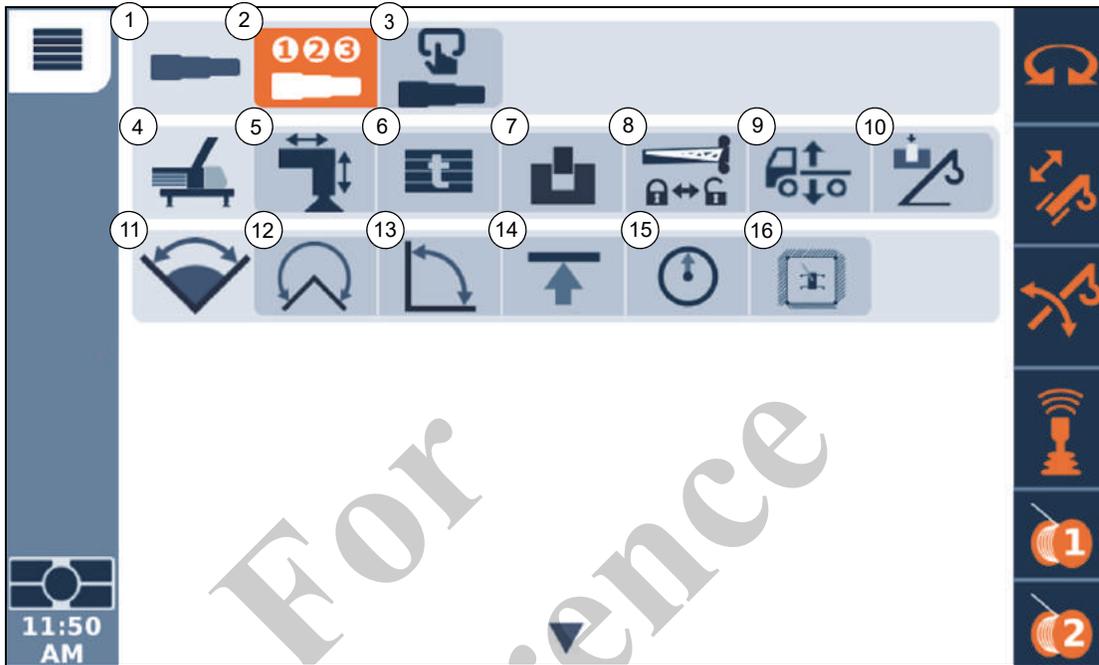


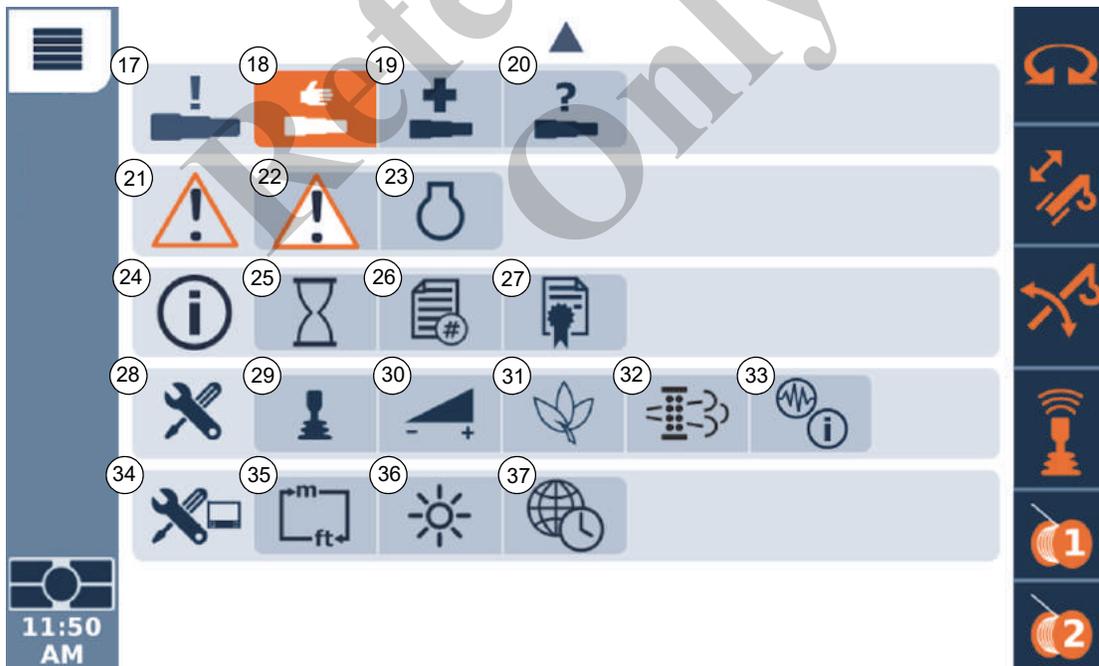
FIGURE 4-82

The ODM Menu Screen (Figure 4-83) has the following menu items for operating the crane:

- **Tele-automation Menu Group (1)**
 - Semi-Automatic Mode (2)
 - Boom Configurator Mode (3)
- **Crane Function Menu Group (4)**
 - Outrigger Extend/Retract (5)
 - Counterweight Removal/Installation (6)
 - 360° Superstructure Lock/Unlock (7)
 - Boom Extension Deployment/Stowage (8)
 - Suspension Raise/Lower (9)
 - Boom Removal/Installation (10)
- **Working Range Limiter Menu Group (11)**
 - Boom Height Limitation (12)
 - Boom Angle Limitation (13)
 - Radius Limitation (14)
 - Swing Angle Limitation (15)
 - Virtual Walls (16)
- **Emergency Program Menu Group (17)**
 - Manual Telescope Mode (18)
 - Emergency Telescope Mode (19)
 - Telescope Recovery Mode (20)
- **Faults Menu Group (21)**
 - Crane Faults (22)
 - Engine Faults (23)
- **Information Menu Group (24)**
 - Operating Hours (25)
 - Software Versions (26)
 - Legal Notices (27)
- **User Settings Menu Group (28)**
 - Controller Curve (29)
 - Controller Speed (30)
 - ECO Mode (31)
 - Exhaust System Cleaning (32)
 - Service Menu (33)
- **Screen Settings Menu Group (34)**
 - Units of Measure (Metric/Imperial) (35)
 - Display Screen Brightness (36)
 - Time Set (37)



9902-2



9902-3

FIGURE 4-83

Item	Description	Page	Item	Description	Page
1	Tele-automation Menu Group Icon	4-96	20	Telescope Recovery Mode Icon - Resetting Telescope Configuration	4-46
2	Semi-automatic Telescope Mode Icon	4-96	21	Faults Menu Group Icon	4-144
3	Boom Configurator Mode Icon	4-98	22	Crane Faults Icon	4-144
4	Crane Function Menu Group Icon	4-100	23	Engine Faults Icon	4-145
5	Outrigger Extend/Retract Icon	4-100	24	Information Menu Group Icon	4-146
6	Counterweight Removal/Installation Icon	4-106	25	Operating Hours Icon	4-146
7	360° Superstructure Lock/Unlock Icon	4-106	26	Software Versions Icon	4-148
8	Boom Extension Deployment/Stowage Icon	4-107	27	Legal Notice Icon	4-148
9	Suspension Raise/Lower Icon	4-107	28	User Settings Menu Group Icon	4-149
10	Boom Removal/installation Icon	4-108	29	Controller Curve Icon	4-149
11	WRL Menu Group Icon	4-110	30	Controller Speed Icon	4-152
12	Swing Angle Limitation Icon	4-124	31	ECO Mode Icon	4-153
13	Boom Angle Limitation Icon	4-119	32	Exhaust System Cleaning Icon	4-155
14	Boom Height Limitation Icon	4-117	33	Service Menu Icon	4-156
15	Radius Limitation Icon	4-122	34	Screen Settings Menu Group Icon	4-157
16	Virtual Walls Icon	4-127	35	Units of Measure (Metric/Imperial) Icon	4-157
17	Emergency Program Menu Group Icon	4-131	36	Display Screen Brightness Icon	4-157
18	Manual Telescope Mode Icon	4-131	37	Time Set Icon	4-158
19	Emergency Telescope Mode Icon	4-133			

Reference Only

Tele-automation Menu Group

The Tele-automation Menu Group (1, Figure 4-84) includes the following boom telescoping function icons:

- Semi-automatic Telescope Mode (2) (page 4-96)
- Boom Configurator (3) (page 4-98)

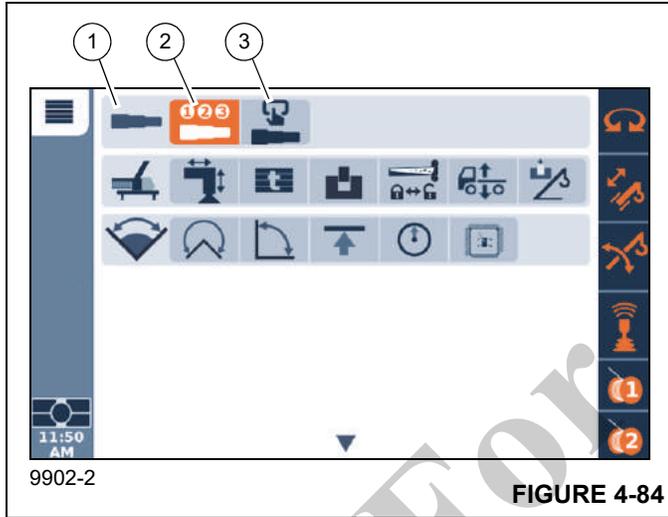


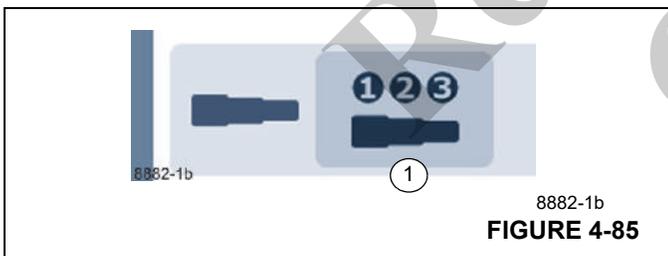
FIGURE 4-84

Semi-automation Telescope Mode

NOTE: For more information about telescoping with semi-automation refer to *Semi-automatic Telescoping*, page 4-28.

Open Menu

To open: Select symbol (1) and confirm – menu is opened



8882-1b
FIGURE 4-85

Telescope Diagram Display

Current relation of the telescopic sections to each other – section of top view Figure 4-86.

The image shown in Figure 4-86 shows the status of the section and cylinder pins. Green (1) indicates that the pin is locked, Yellow shows that it is in an intermediate position and Red (2) is unlocked. Additionally, if the hazard triangle (3) is present, an error exists.

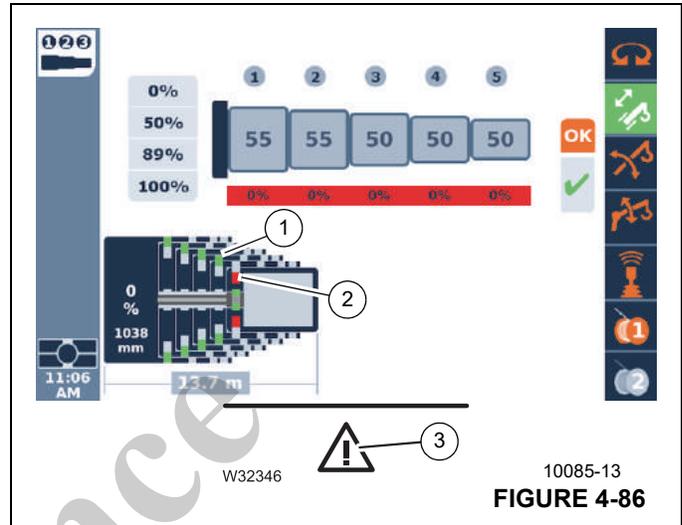


FIGURE 4-86

Telescoping Cylinder Length Display

Display:	Current extended length of the telescoping cylinder (1, Figure 4-87)
Unit of measurement:	Displayed in mm (millimeters)

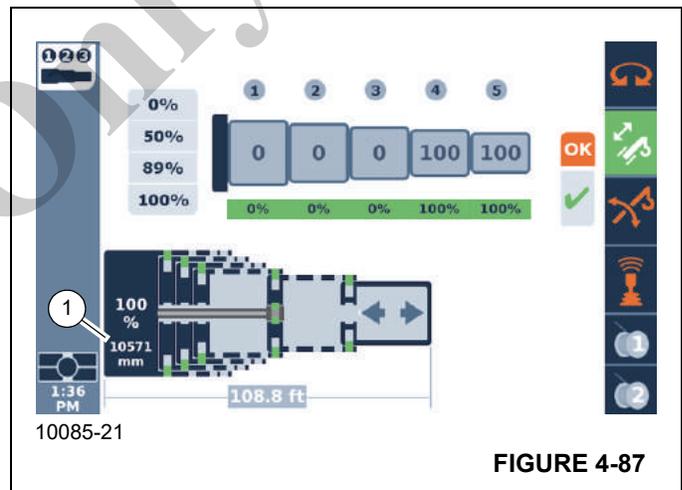
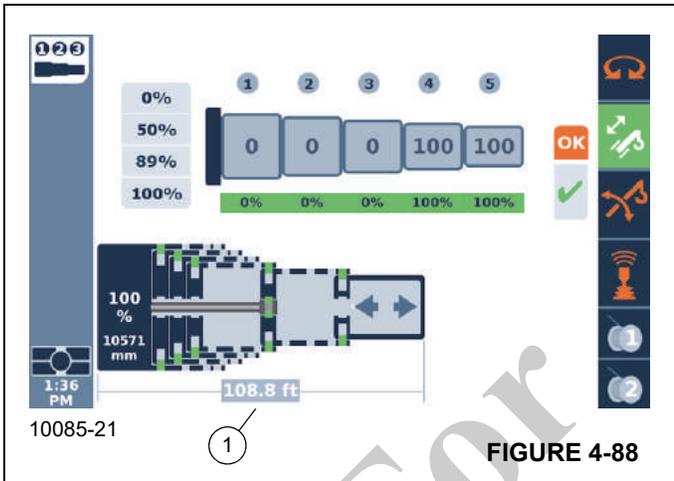


FIGURE 4-87

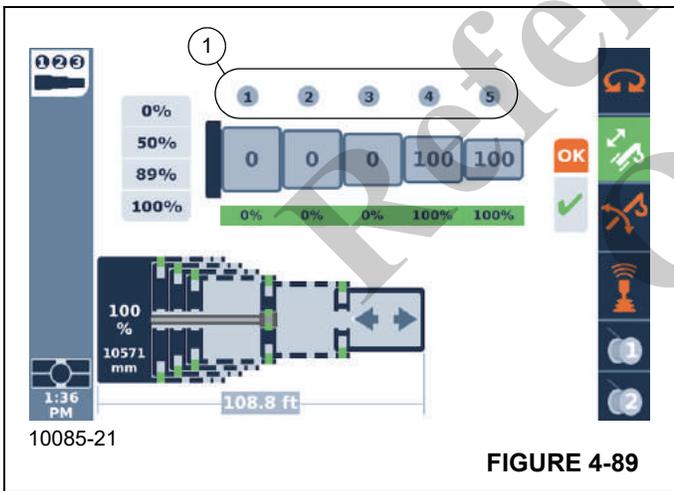
Main Boom Length Display

Display:	Current extended length of the main boom (1, Figure 4-88)
Unit of measurement:	Displayed depending on setting, m (meters) or ft (feet)



Telescopic Sections Display

1 - 5	Display of telescopic sections 1 to 5 (1, Figure 4-89)
-------	--

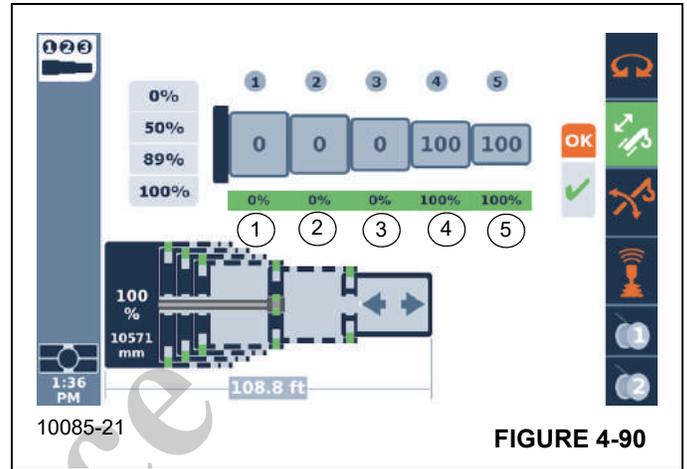


Refer to Pre-selection for all telescopic sections.

Current telescope Status Display

Extended length of the telescopic sections in percentage

1 - 5	Display of telescopic sections 1 to 5 (Figure 4-90)
-------	---

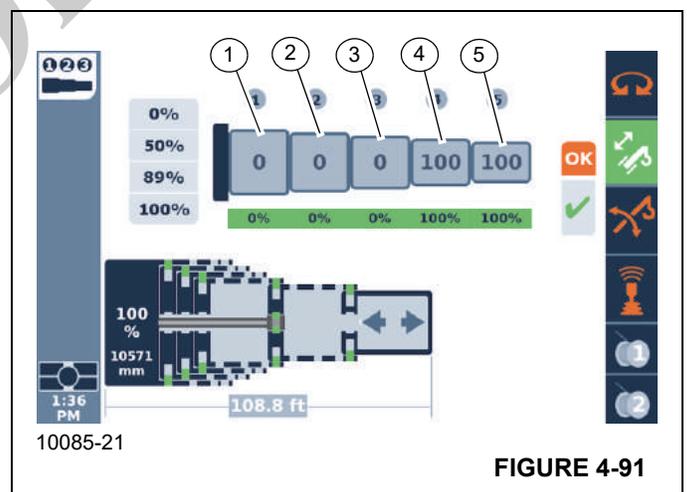


Pre-selection for Selected Telescopic Section

1	Pre-selection telescoping 0%
2	Pre-selection telescoping 50%/55%
3	Pre-selection telescoping 89%
4	Pre-selection telescoping 100%

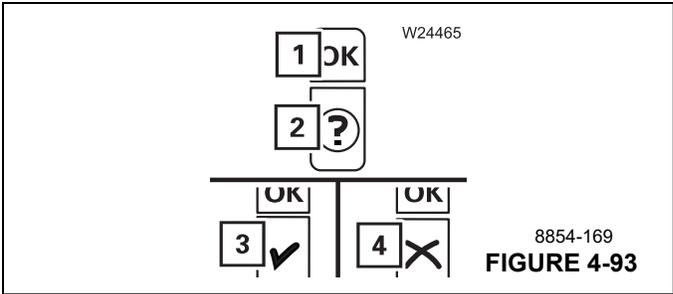
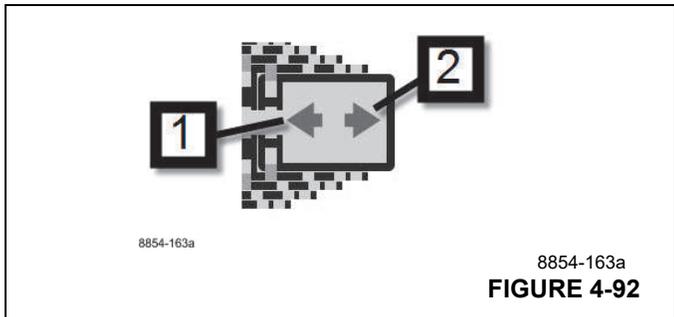
Pre-selection Individual Telescopic Sections

1 - 5	Display of telescopic sections 1 to 5 (Figure 4-91)
-------	---



Tele-automation Direction Display

1	Start telescoping with Retract (Figure 4-92)
2	Start telescoping with Extend



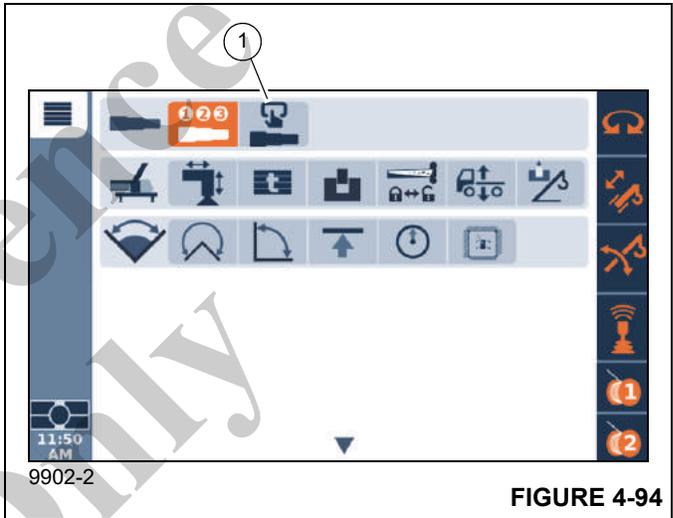
Boom Configurator Mode

NOTE: Refer to *Boom Configurator*, page 4-48 for more information on how the Boom Configurator screen is used in the telescoping operation.

To open: Select symbol (1, Figure 4-94) and confirm – menu is opened

Confirm Pre-selection

1	Confirm request to use entered telescoping values (Figure 4-93)
2	Once a new set of values are entered for telescoping, the question-mark appears until the OK is confirmed. Then the check-mark or the red-X is shown
3	Requested telescoping is accepted symbol
4	Requested telescoping not accepted symbol



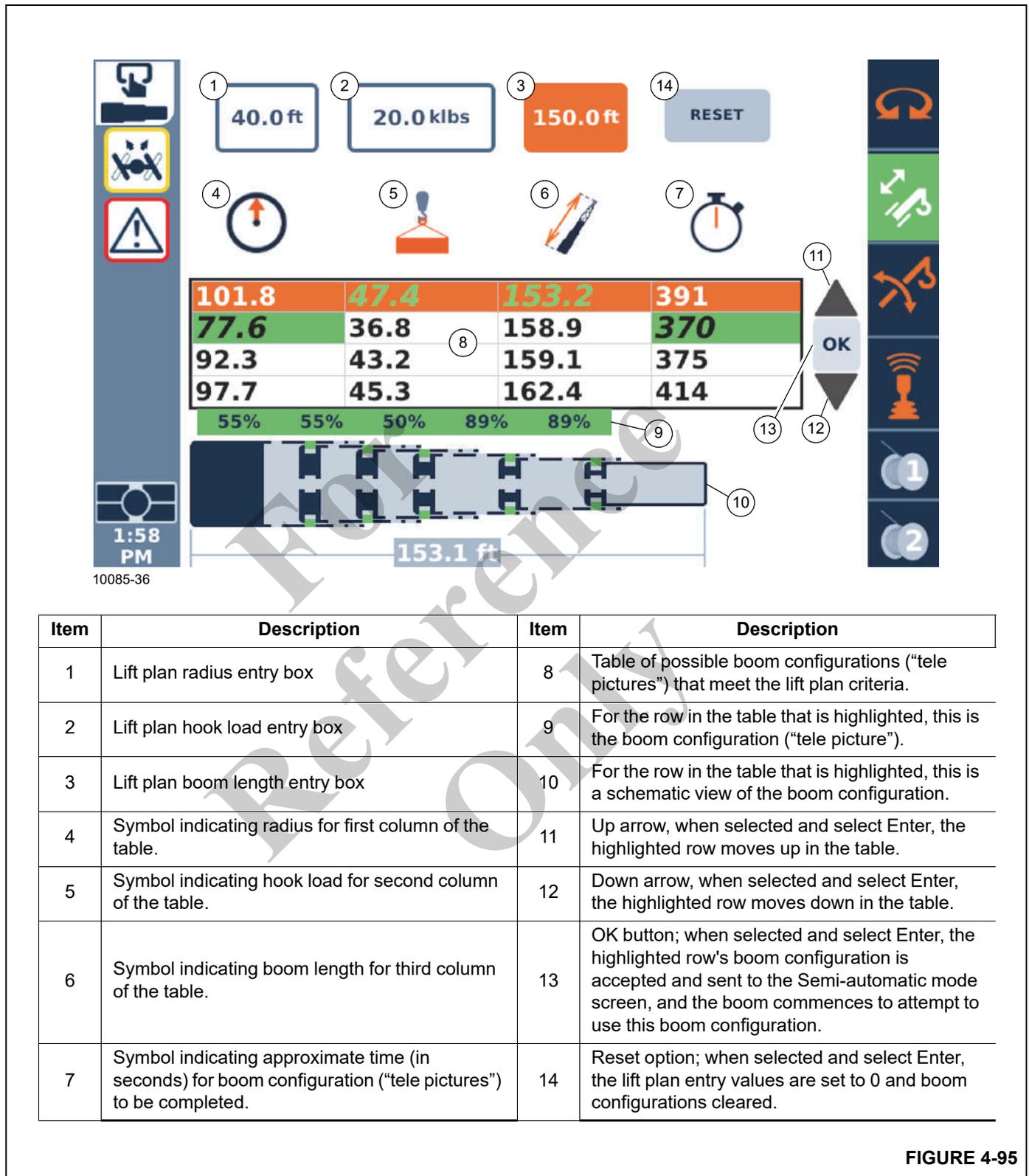


FIGURE 4-95

Crane Function Menu Group

The Crane Function Menu Group includes the following function icons:

- Outrigger Extend/Retract (page 4-100)
- Counterweight Removal/Installation (page 4-106)
- 360° Superstructure Lock/Unlock (page 4-106)
- Boom Extension Deployment/Stowage (page 4-107)
- Suspension Raise/Lower (page 4-107)
- Boom Removal/Installation (page 4-108)

Outrigger Extend/Retract

Select the Outrigger Extend/Retract icon (1, Figure 4-96) under the Crane Function Group to show the Outrigger Extend/Retract function screen.

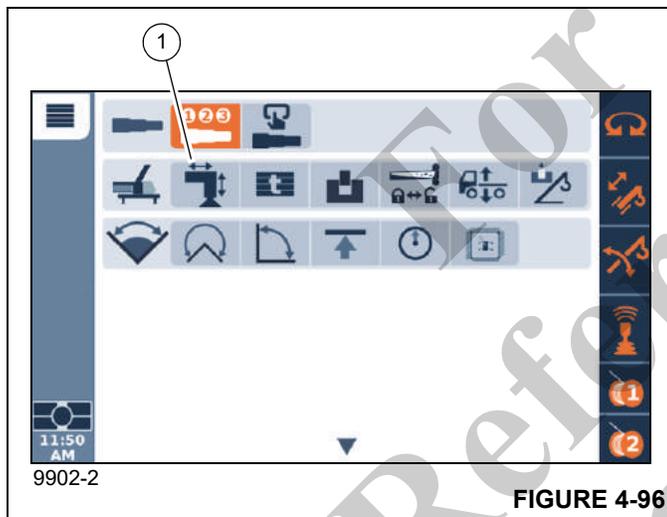


FIGURE 4-96

The Outrigger Extend/Retract function screen (Figure 4-97) allows the operator to set the outriggers and level the crane using either a manual or semi-automatic mode. The outriggers are also retracted and stowed from this function screen.

NOTE: The outriggers are to be deployed with the boom centered over the single front axle. In this configuration, the direction the operator is facing is considered the front of the crane.

The steering wheel symbol (6, Figure 4-97) shown on the Outrigger Extend/Retract function screen corresponds to the front of the crane. The terms left and right correspond to the operator's left and right sides when looking forward over the front (single axle) of the crane.

NOTE: Refer to *Using the Outriggers*, page 4-21 for complete procedures to set the outriggers and level the crane, and procedures to stow the outriggers.

NOTE: Outrigger controls are only enabled when the engine is on, the parking brake is applied, and the transmission is shifted to neutral and four-wheel low.

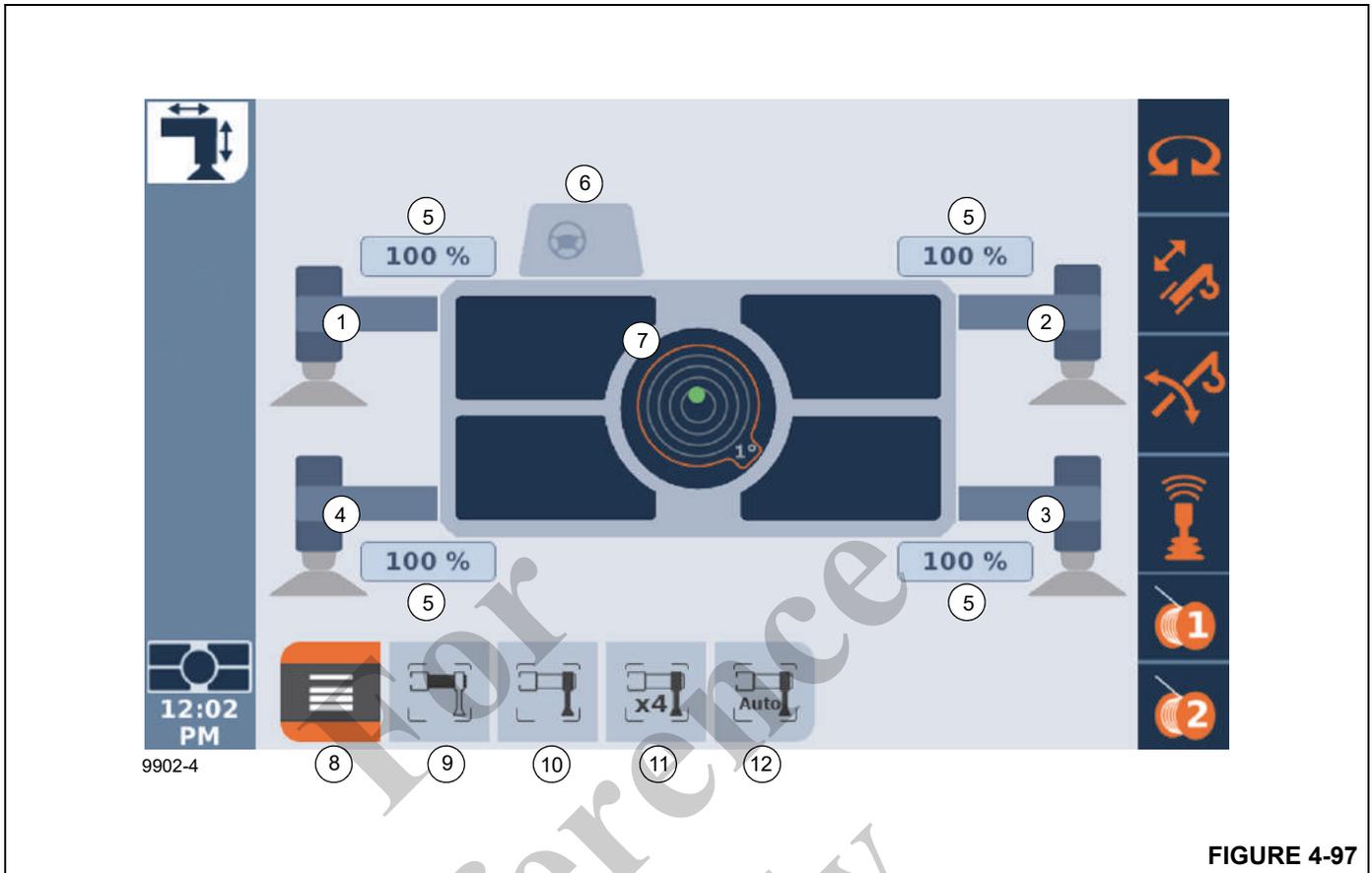


FIGURE 4-97

Item	Description	Item	Description
1	Left Front Beam/Jack	7	Inclination Indicator
2	Right Front Beam/Jack	8	Menu Screen Icon
3	Right Rear Beam/Jack	9	O/R Beams Icon
4	Left Rear Beam/Jack	10	O/R Jacks Icon
5	Percentage Outrigger Beam is Extended	11	O/R Jacks x4 Icon
6	Steering Wheel (to indicate front of crane)	12	Auto-level Icon

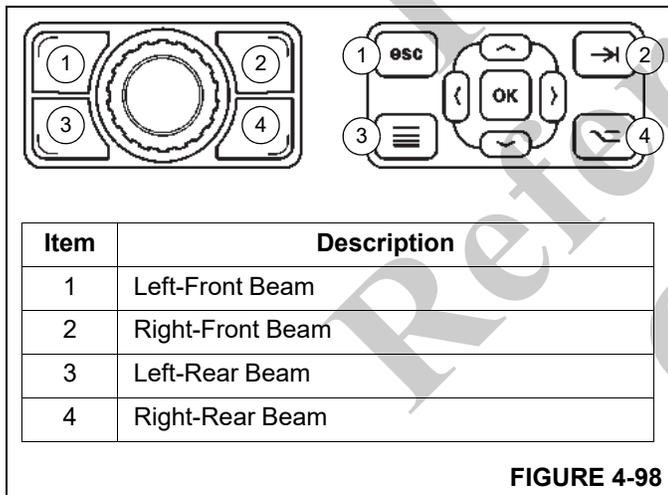
Extending/Retracting the Outriggers Beams

To extend or retract the O/R beams, perform the following procedure:

1. Using the Jog Dial, or the Arrow Buttons at the Navigation Control Pad, select the O/R Beam icon (6, Figure 4-99) (icon will turn orange when selected).
2. Press the Jog Dial, or the OK Button at the ODM, to make the O/R Beam icon active (icon will turn green when active).
3. To extend the O/R beams, position the Outrigger Extend/Retract Switch (17, Figure 3-17) on the left armrest to the extend position, then press and hold one or more of the four buttons at the Jog Dial or the Navigation Control Pad (Figure 4-98).

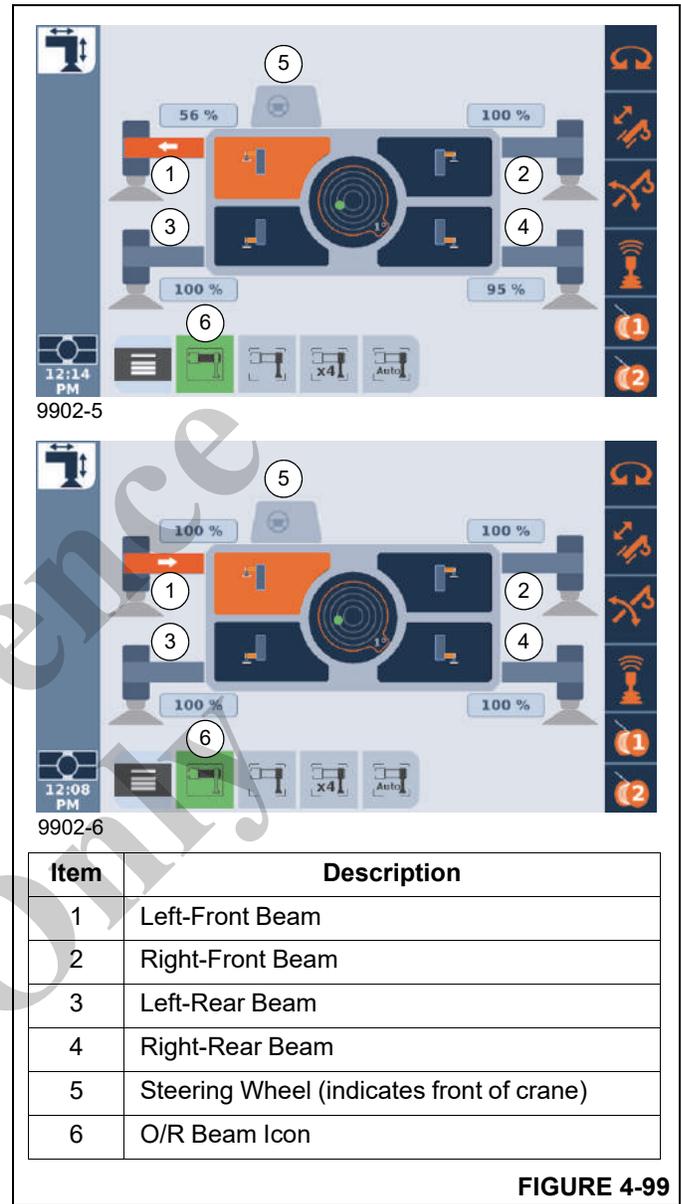
To retract the O/R beams, position the Outrigger Extend/Retract Switch to the retract position, then press and hold one or more of the four buttons at the Jog Dial or the Navigation Control Pad.

NOTE: The O/R beam positions correspond to the four buttons at the Jog Dial and the ODM Navigation Control Pad (Figure 4-98 and Figure 4-99).



When a button at the Jog Dial or Navigation Control Pad is pressed and held, the corresponding O/R beam image turns orange to indicate that it is actively moving. An arrow will

appear to indicate whether the beam is extending or retracting. In the following example (Figure 4-99), the top image shows the Left-Front O/R beam is extending and the bottom image shows the Left-Front O/R beam is retracting.



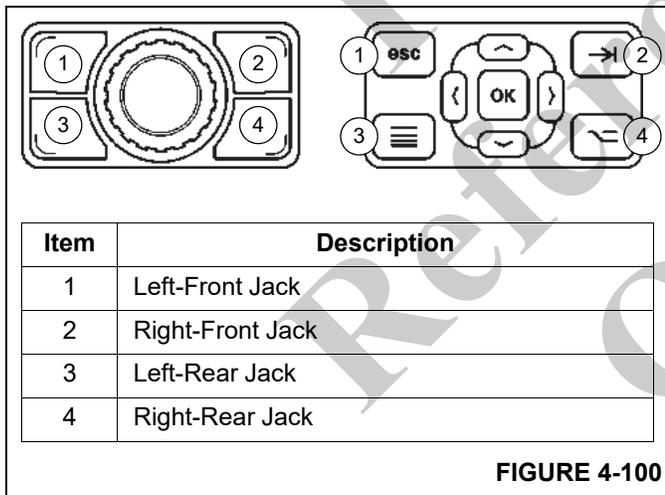
Extending/Retracting Individual Outrigger Jacks

To extend or retract an individual O/R jack, perform the following procedure:

1. Using the Jog Dial, or the Arrow Buttons at the Navigation Control Pad, select the O/R Jack icon (6, Figure 4-101) (icon will turn orange when selected).
2. Press the Jog Dial, or the OK Button at the ODM, to make the O/R Jack icon active (icon will turn green when active).
3. To extend the O/R jacks, position the Outrigger Extend/Retract Switch (17, Figure 3-17) on the left armrest to the extend position, then press and hold one or more of the four buttons at the Jog Dial or Navigation Control Pad.

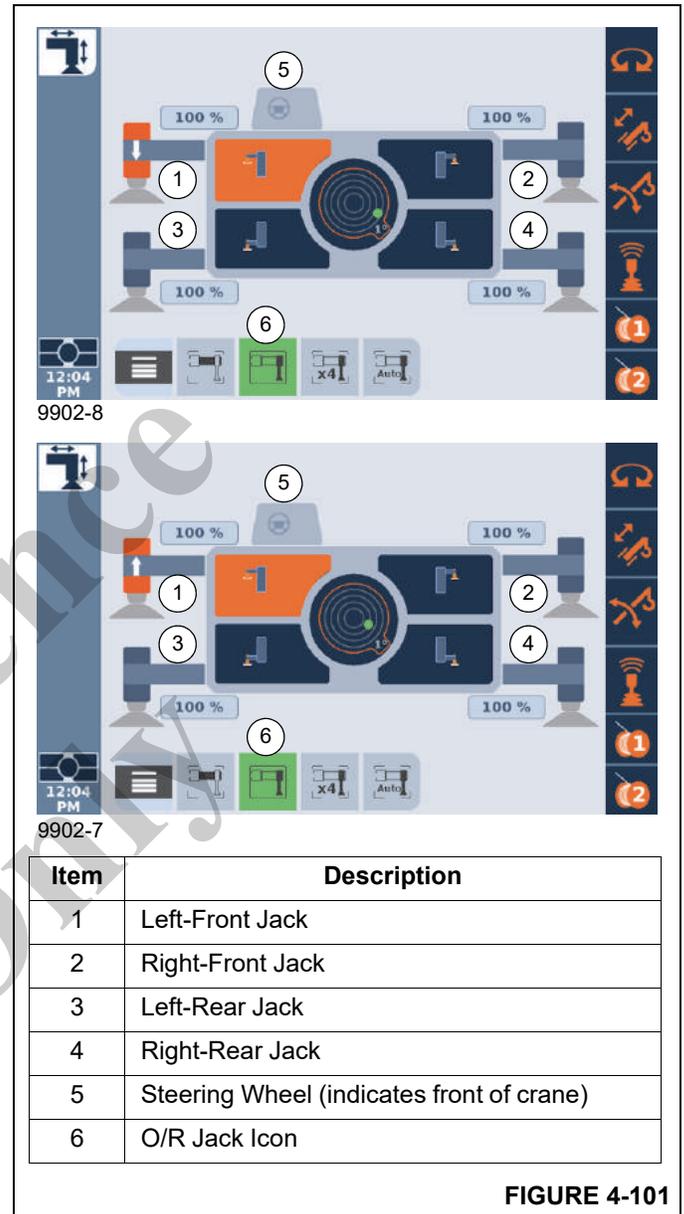
To retract the O/R jacks, position the Outrigger Extend/Retract Switch to the retract position, then press and one or more of the four buttons at the Jog Dial or Navigation Control Pad.

NOTE: The O/R jack positions correspond to the four buttons at the Jog Dial and the ODM Navigation Control Pad (Figure 4-100 and Figure 4-101).



When a button at the Jog Dial or Navigation Control Pad is pressed and held, the corresponding O/R jack image turns orange to indicate that it is actively moving. An arrow

appears to indicate whether the jack is extending or retracting. In the following example (Figure 4-101), the top image shows the Left-Front O/R jack is extending and the bottom image shows the Left-Front O/R jack is retracting.



Extending/Retracting the Outrigger Jacks - x4

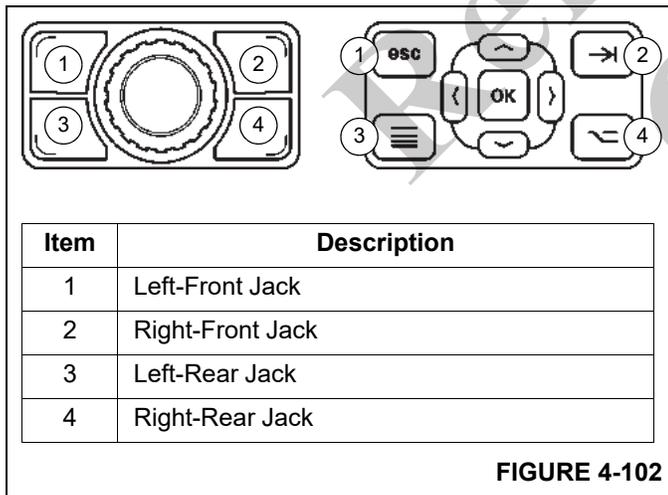
To extend or retract all four O/R jacks at the same time, perform the following procedure:

1. Using the Jog Dial, or the Arrow Buttons at the Navigation Control Pad, select the O/R Jack x4 icon (6, Figure 4-103) (icon will turn orange when selected).
2. Press the Jog Dial, or the OK Button at the ODM, to make the O/R Jack x4 icon active (icon will turn green when active).
3. To extend all four O/R jacks at the same time, position the Outrigger Extend/Retract Switch (17, Figure 3-17) on the left armrest to the extend position, then press and hold the Jog Dial or OK Button at the Navigation Control Pad.

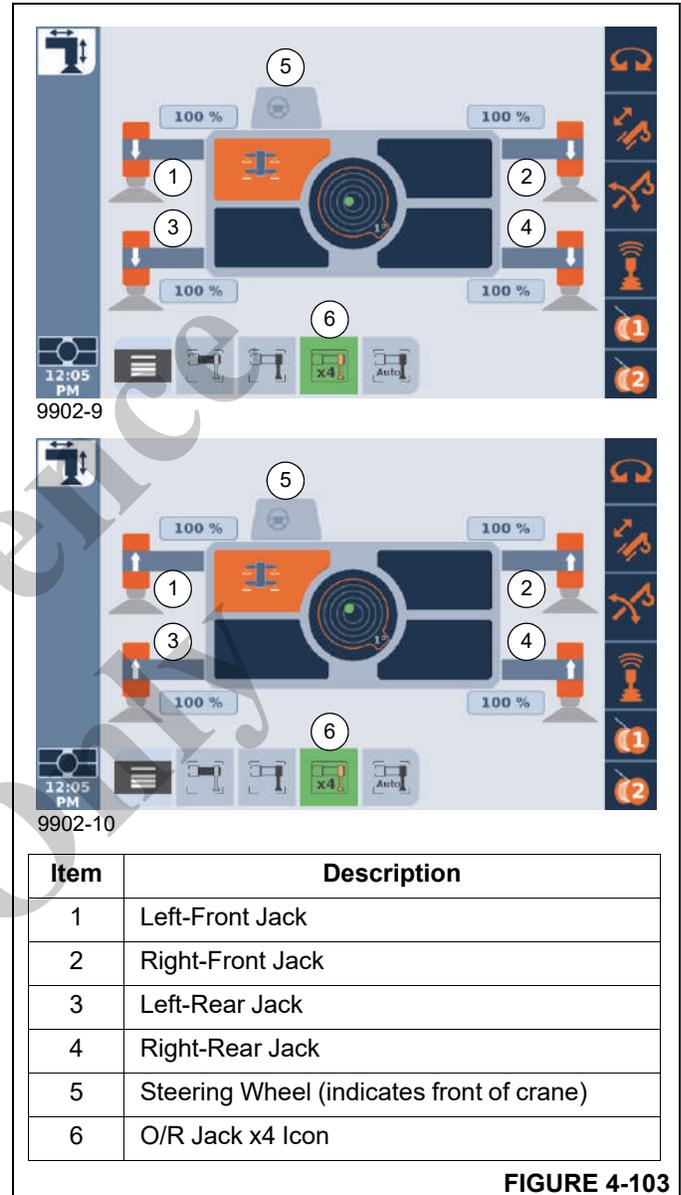
To retract all four O/R jacks at the same time, position the Outrigger Extend/Retract Switch to the retract position, then press and hold the Jog Dial or OK Button at the Navigation Control Pad.

NOTE: While the Outrigger Jack Extend/Retract x4 icon is active, individual outrigger jacks can be extended or retracted by positioning the Outrigger Extend/Retract Switch to the desired direction, then pressing and holding one of the four buttons at the Jog Dial or Navigation Control Pad (Figure 4-102).

The O/R jack positions correspond to the four buttons at the Jog Dial and the ODM Navigation Control Pad.



When extending or retracting all four outrigger jacks at the same time, the four O/R jack images turn orange to indicate that they are active. Arrows appear to indicate whether the jacks are extending or retracting. In following example (Figure 4-103), the top image shows all four outrigger jacks are extending and the bottom image shows all four outrigger jacks are retracting:

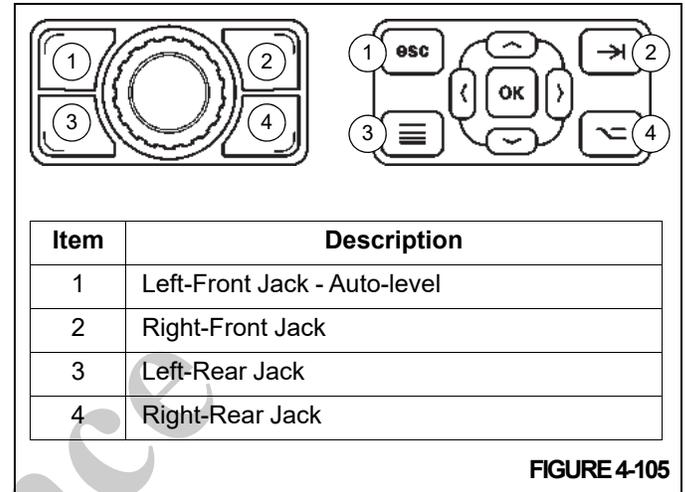
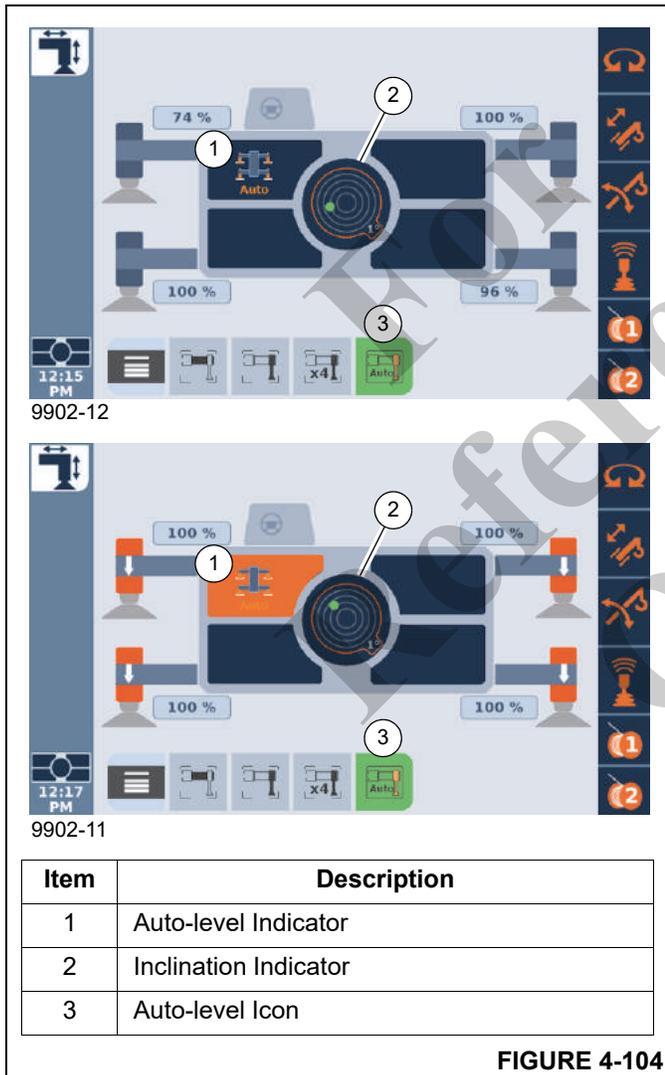


Leveling the Crane Using Auto-level

To level the crane using the auto-level function, perform the following procedure:

1. Fully extend the four outrigger jacks.
2. Using the Jog Dial, or the Arrow Buttons at the Navigation Control Pad, select the Auto-level icon (3, Figure 4-104) (icon will turn orange when selected).
3. Press the Jog Dial, or the OK Button at the ODM, to make the Auto-level icon active (icon will turn green when active). The Outrigger Extend/Retract function screen will also change to show the Auto-level indicator (1, Figure 4-104).

4. To begin the auto-level function, position the Outrigger Extend/Retract Switch (17, Figure 3-17) on the left armrest to the extend or retract position, then press and hold the button (1, Figure 4-105) at the Jog Dial or Navigation Control Pad that corresponds to the Auto-level Button on the screen.



With the two buttons pressed, the auto-level system will adjust the height of the jacks automatically as it levels the crane. Several adjustments may be necessary.

After an adjustment is made, the auto-level system will pause for a short time as it does a levelness check of the crane. The operator can watch the leveling process by viewing the inclination indicator (2, Figure 4-104).

If crane is still not level, the system will continue to make adjustments, with each adjustment followed by a pause for a level check.

When crane is level within 0.15°, the Auto-level Indicator (1, Figure 4-104) flashes. When this occurs, the auto-level process is complete and no further adjustments are made.

5. Release the Outrigger Extend/Retract Switch and the button (1, Figure 4-105) at the Jog Dial or Navigation Control Pad.

Counterweight Removal/Installation

Select the Counterweight Removal/Installation icon (1, Figure 4-106) under the Crane Function Group to show the Counterweight Removal/Installation function screen.

The Counterweight Removal/Installation function screen is used to semi-automatically remove and install the counterweight.

Complete procedures for the removal and installation of the counterweight, including the use of the Counterweight Removal/Installation function screen, are found in **SECTION 5 - SET-UP AND INSTALLATION**.

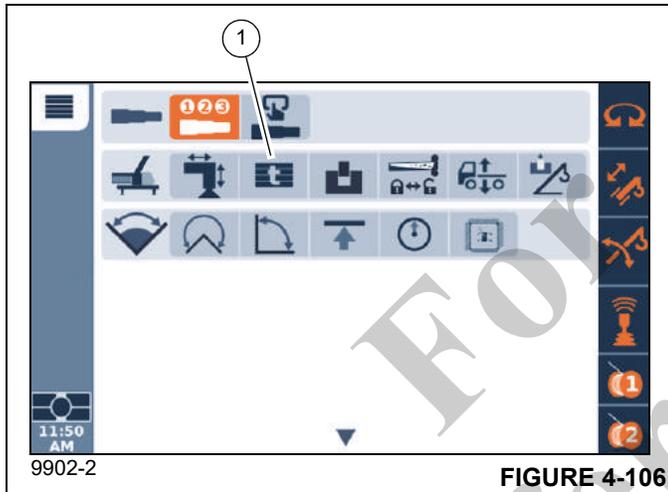


FIGURE 4-106

360° Swing Lock (Optional)

Select the 360° Swing Lock icon (1, Figure 4-107) under the Crane Function Group to show the 360° Superstructure Lock/Unlock function screen.

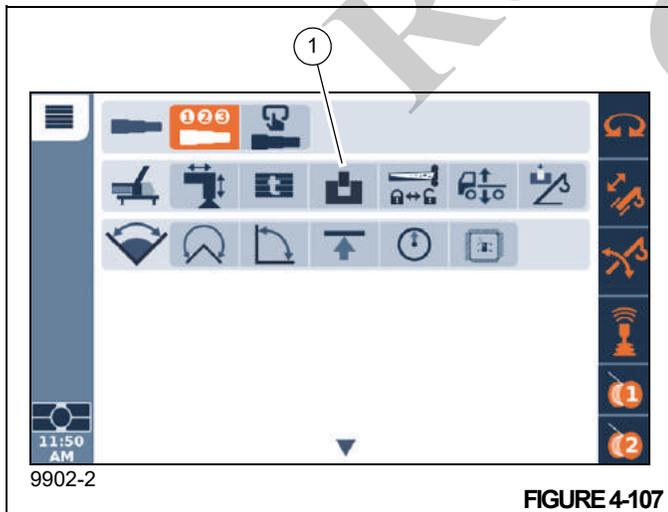


FIGURE 4-107

The 360° Superstructure Lock/Unlock function screen (Figure 4-108) is used to lock the superstructure in position any where throughout its 360° rotation.

The function screen (Figure 4-108) shows the current swing angle (1), the Lock and Unlock Icons for operating the lock function, and the Swing Lock Status Indicator (4) (locked/unlocked).

In Figure 4-108, the Swing Lock Status Indicator (4) shows the swing lock is in the unlocked position.

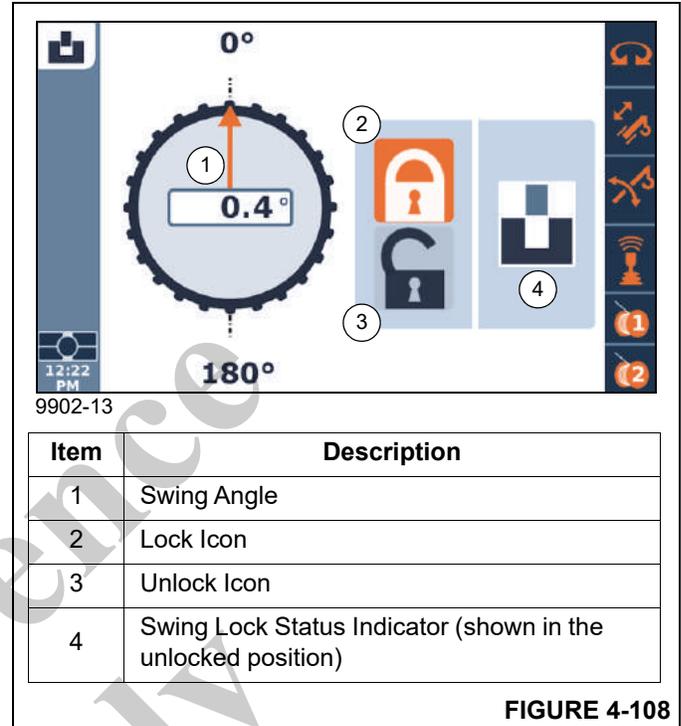


FIGURE 4-108

In Figure 4-109, the Swing Lock Status Indicator (4) shows the swing lock is in the locked position.

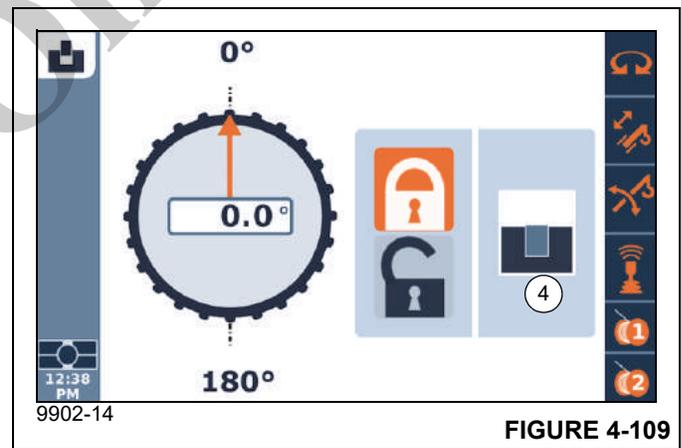


FIGURE 4-109

Locking the Superstructure

1. Swing the superstructure to the desired position.
2. Maintain superstructure position by pressing and holding the swing brake pedal.

3. Using the Jog Dial or the Arrow Buttons on the Navigation Control Pad, select the Lock icon (2, Figure 4-108).

4. Press the Jog Dial or the OK Button to start the locking process.

When the lock is engaged, the Locked Status Indicator (4, Figure 4-109) will appear.

Unlocking the Superstructure

1. Press and hold the swing brake pedal.

2. Using the Jog Dial or the Arrow Buttons on the Navigation Control Pad, select the Unlock icon (3, Figure 4-108).

3. Press the Jog Dial or the OK Button to start the locking process.

When the lock is disengaged, the Unlock Status Indicator (4, Figure 4-108) will appear.

Boom Extension Deployment/Stowage

Select the Boom Extension Deployment/Stowage icon (1, Figure 4-110) under the Crane Function Group to show the Boom Extension Deployment/Stowage function screen.

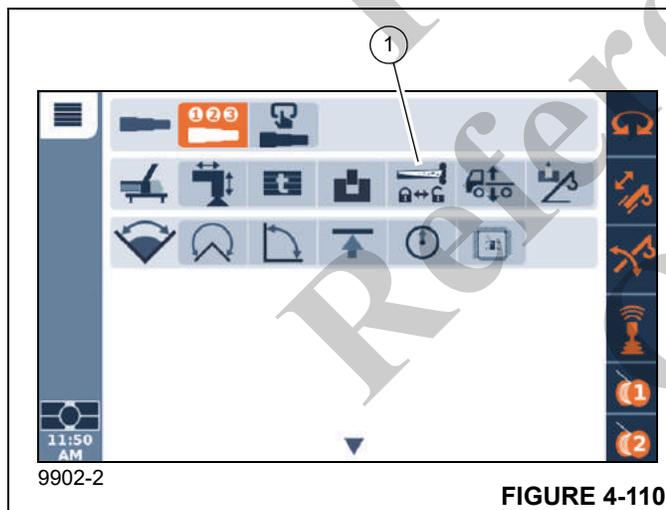


FIGURE 4-110

The Boom Extension Deployment/Stowage function screen is used to extend and retract the front and rear boom extension pins that secure the boom extension to the boom base section.

Complete procedures for the deployment and stowage of the boom extension, including the use of the Boom Extension Deployment/Stowage function screen, are found in *SECTION 5 - SET-UP AND INSTALLATION*.

Suspension Raise/Lower

Select the Suspension Raise/Lower icon (1, Figure 4-111) under the Crane Function Group to show the Suspension Raise/Lower function screen.

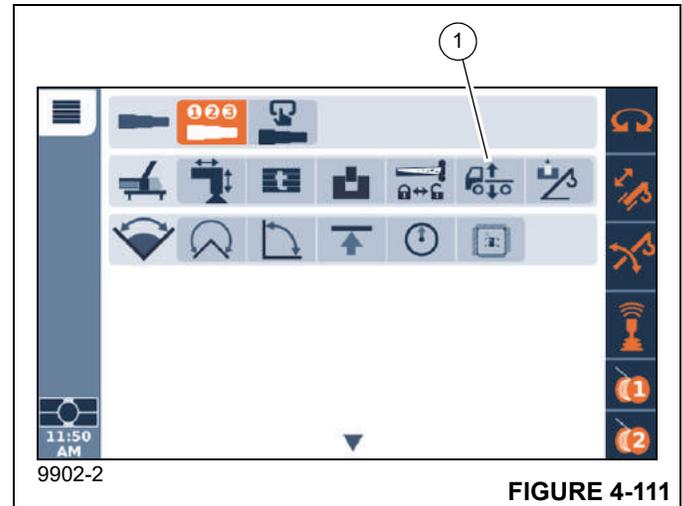


FIGURE 4-111

The Suspension Raise/Lower function screen (Figure 4-112) is used to lower and raise the crane suspension.

NOTE: When traveling the crane or performing a pick and carry, the suspension must be at the Ride Height, which is indicated by a green Suspension Ride Height Status Indicator (7, Figure 4-112). Fully raise the suspension when performing an On-Rubber, Stationary, 360° lift. When the suspension is not at the Ride Height, the Suspension Ride Height Status Indicator is red (5, Figure 4-112).

Before the suspension can be raised or lowered, the following conditions must be met:

- Boom must be centered over the front or rear of the carrier.
- Turntable Swing Lock Pin must be engaged.
- Rated Capacity Limiter (RCL) must be programmed with a *Travel*/load chart code number.
- Rear wheels must be centered.

Raise and lower the suspension by performing the following procedures:

1. Using the Jog Dial or Arrow Buttons on the Navigation Control Pad, select the Raise icon (1, Figure 4-112).
2. With focus on the Raise icon, press and hold the Jog Dial or the OK button.

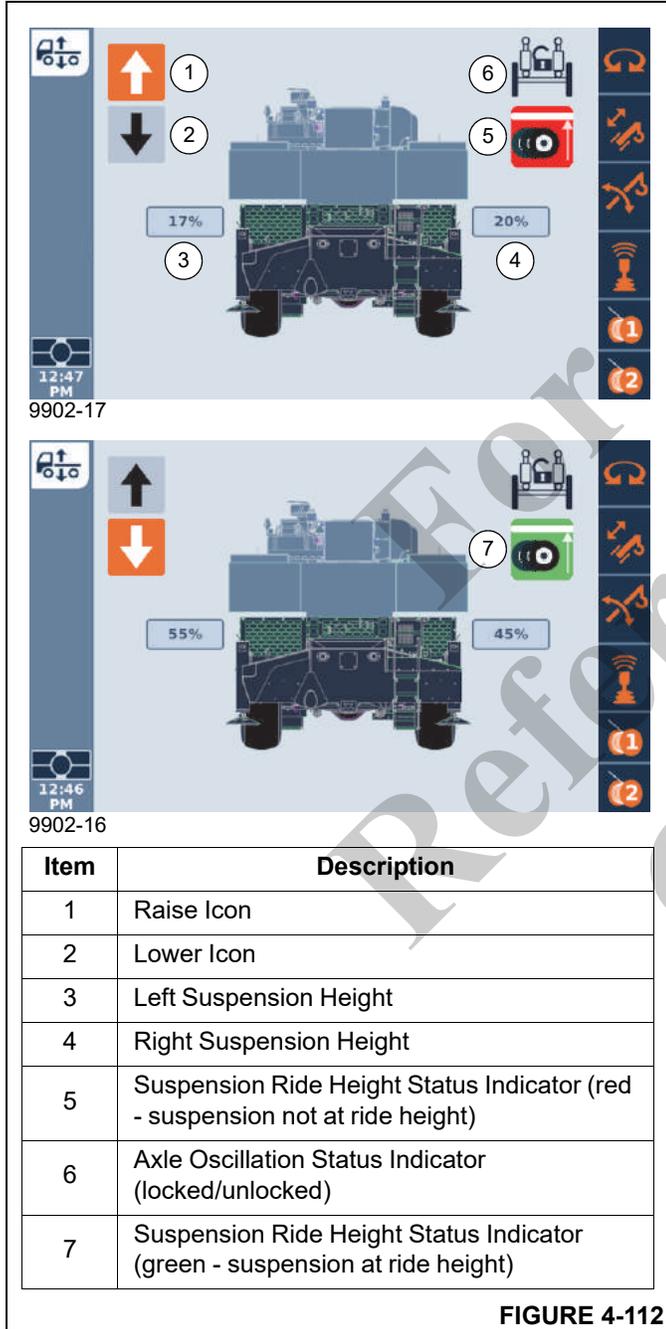
The left and right side suspension will begin to raise.

3. Release the Jog Dial or OK button when the Suspension Ride Height Status Indicator (5, Figure 4-112) changes from red to green, indicating the suspension is at the Ride Height.
4. Using the Jog Dial or Arrow Buttons on the Navigation Control Pad, select the Lower Suspension icon (2, Figure 4-112).

- With focus on the Lower Suspension icon, press and hold the Jog Dial or the OK button.

The left and right side suspension will begin to lower.

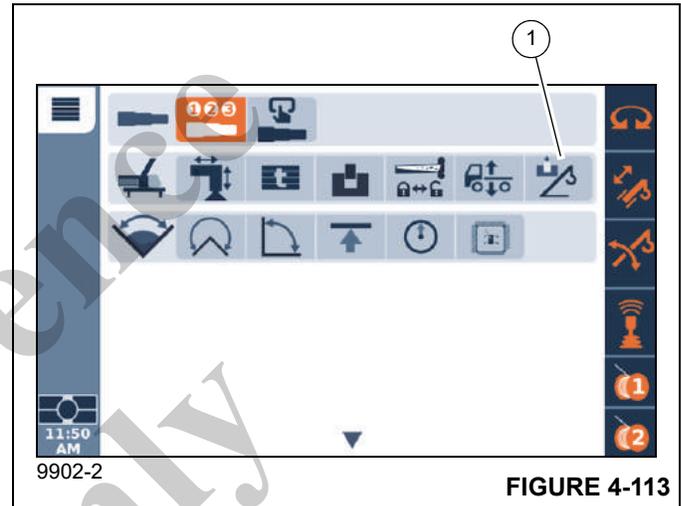
- Release the Jog Dial or OK button when both the Left and Right Side Suspension Height indicators (5 and 6, Figure 4-112) are at the desired height.



As previously indicated, the suspension is at the desired travel height when the Suspension Ride Height Status Indicator (7, Figure 4-112) appears green. Depending on the terrain the crane is sitting on, it may not be possible to adjust the suspension such that the Suspension Ride Height Status Indicator (7, Figure 4-112) appears green. In this condition, first make sure a crane wheel is not raised up on a curb or rock, then adjust the suspension such that the two suspension percentages (3, 4, Figure 4-112) are centered around 50%.

Boom Removal/Installation

Select the Boom Removal/Installation icon (1, Figure 4-113) under the Crane Function Menu Group to show the Boom Removal/Installation function screen.



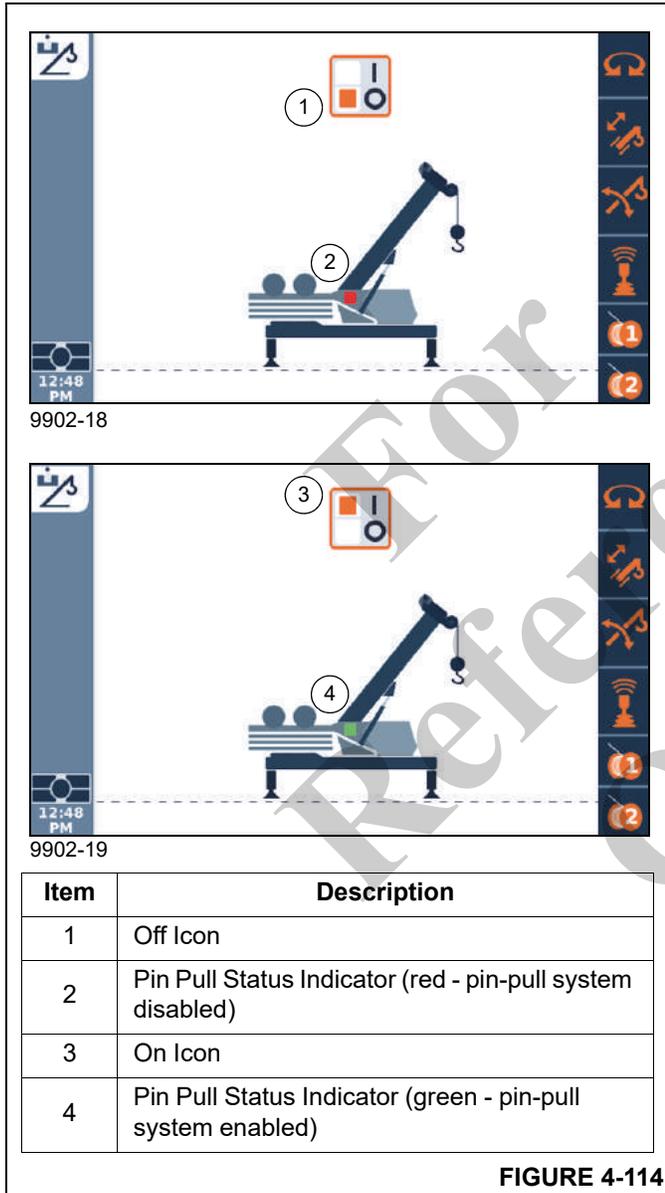
The Boom Removal/Installation function screen (Figure 4-114) is used to enable the hydraulic system that operates the pin-puller mechanism. The pin-puller is used to remove/install the boom pivot pins.

Before setting the Boom Removal/Installation function to On and enabling the system, make sure the Pin Pull mechanism is installed at the boom pivot pins and the hydraulic connections are made.

To enable the Pin Pull system, use the Jog Dial or Arrow Buttons at the Navigation Control Pad to select the On icon (3, Figure 4-114). Press the Jog Dial or the OK Button to set the system to On. The Pin Pull Status indicator shows green (4, Figure 4-114) to indicate the system is enabled.

To disable the Pin Pull system, use the Jog Dial or Arrow Buttons to select the Off icon (1, Figure 4-114). Press the Jog Dial or the OK Button to set the system to Off. The Pin Pull Status indicator shows red (2, Figure 4-114) to indicate the system is disabled.

Complete procedures for the removal and installation of the boom, including the use of the Pin Pull mechanisms, are found in the *Service Manual*.



Working Range Limiter Menu Group

Introduction

The Working Range Limiter (WRL) is a feature of the Crane Control System, located on the ODM, that allows the operator to define boundaries or limits for crane operation. With obstacles and limits accurately defined, the WRL will aid the operator in identifying when the boom and/or load is nearing an obstacle by giving both visual and audible alerts.

CAUTION

The WRL is an operator aid and should not be relied upon in place of good operating practice. The crane functions can be affected to slow and stop with respect to limitations. This behavior is referred to as lock-out. A qualified signal person to observe and direct the lifting operation should be used when necessary.

Refer to Table 4-8 – WRL Alarm Characteristics for alarm positions.

In addition, when the WRL Lock-Out Function is enabled, crane functions are expected to be used with the same caution as if the lock-out capability was not present. In particular, it must be noted that the swing function has a coasting or free-swing characteristic that will not be affected by the slow-down and lock-out of the swing function. As such, swing speeds are to be no more than 1 degree of swing per second. Again, refer to Table 4-8 – WRL Alarm Characteristics for swing position limitations and alarms.

DANGER

For standard cranes NOT equipped with the WRL Lock-Out Function, the WRL System is an audio/visual indicator only. The system will not stop the movement of the crane when the limit is reached. The operator must continue to control and stop the movement of the crane when alerted by the WRL Indicator.

If the crane's WRL is configured with the Lock-Out Function, the crane functions can be affected to slow and stop with respect to the programmed limits.

When the Lock-Out feature of the WRL System is enabled, the operator must continue to operate the crane functions with caution.

The WRL Menu Group (1, Figure 4-115) and sub-menu (2 thru 6) allows the operator to set limits on the location of the boom.

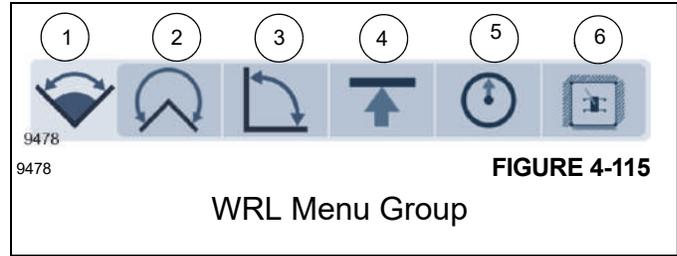


FIGURE 4-115

WRL Menu Group

Item	Description
1	WRL Menu Group
2	WRL Swing Angle Limitation
3	WRL Boom Angle Limitation
4	WRL Boom Height Limitation
5	WRL Working Radius Limitation
6	WRL Virtual Walls Limitation

The following limitations are available under the WRL Menu Icon (1, Figure 4-115) as noted below. The number next to the limitation indicates the Menu Limitation Icon reflective of that group as shown in Figure 4-115.

- Swing Angle Limitation Icon (2): Swing angle limits for swing left and swing right directions can be defined.
- Boom Angle Limitation Icon (3): Boom up/down limits can be defined for a minimum and maximum boom angle.
- Boom Height Limitation Icon (4): Boom height limit can be defined for a maximum boom elevation.
- Working Radius Limitation Icon (5): Working radius limits can be defined for minimum and maximum radius working zones.
- Virtual Wall(s) Limitation Icon (6): Up to five virtual walls can be defined to be jobsite objects or warning zones.

CAUTION

Turning off the power to the control system disables any WRL limitations. While powering OFF the control system will disable all WRL limitations, the limitation values (for example, Swing Angles) will be retained across power cycles.

WRL Limitations Overview

For each of the limitations, the limitation must first be ENABLED within the WRL feature of the Crane Control System software. This is done with particular screens and buttons on the Operating Display Module (ODM). Once the limitation is enabled using Item 3 in Figure 4-119, then it can be DEFINED (in terms of specific angles or locations). This is

also done with the screen and buttons on the ODM, as well as possibly operating the boom to define particular locations.

With the limitation enabled and defined, the control system can then provide the needed feedback and warnings based upon the defined limitations. When the crane is in such a position to cause warning, then the WRL Limitation is considered to be ACTIVE.

In summary, to turn on a WRL Limit, the following steps must be performed:

1. Enable the Limitation
2. Define the Limitation

When a limitation is enabled (but none are active), the ODM shows a green-colored alert indicator icon on it Main Screen (as shown below).

Icon	Description
	Working Range Limiter (WRL) Indicator (Green): Indicates one or more working range limiters are defined.

When a limitation is active, but the boom has not yet reached the requested limit position, the ODM shows an amber-colored alert indicator for the limitation (as shown below). In this condition, audible alarms, as well as slowing of the crane functions (if Lock-Out Function used) will also be apparent. For example, in this condition, the amber-colored Warning Indicator Icon shown below would appear for the swing limitation:

Icon	Description
	Swing Angle Warning Indicator (Amber): Indicates the swing angle is within 10° of a swing angle limit set point.

The warning buzzer slowly beeps when the swing angle is within 10° of the swing angle limit set point and changes to a fast beep when the swing angle is within 5° of the swing angle limit set point.

For cranes that are equipped with the WRL Lock-Out Function, when the swing angle is within 10° of the swing angle lock-out set point, the swing function commanded by

the controller may be reduced or suspended depending upon the weight of the load and the swing speed.

 **WARNING**

Due to the free-swing characteristic of the crane's superstructure, the boom and load can potentially swing past the swing angle set point, even if the swing function commanded by the controller is reduced or suspended (locked out) by the WRL. This can happen for several reasons, including how level the crane is and environmental conditions, such as wind speed.

When a limitation is active, and the boom has reached the requested limit position, the ODM shows a red-colored alert indicator for the limitation, again with a symbol for the particular type of limitation (refer to Figure 4-115 for the WRL Menu Icons). In this condition, audible alarms, as well as stopping of crane functions (if Lock-Out Function is used) will also be apparent. For example, for this condition, the following red Icon (shown below) would appear for the swing limitation:

Icon	Description
	Swing Angle Stop Indicator (Red): Indicates the swing angle is at a swing angle limit set point. The warning buzzer is on (constant). For cranes that are equipped with the WRL Lock-Out Function, the swing left or swing right crane function is locked out, depending upon which limit is reached.

If there are multiple limitations enabled, such as a swing limitation and a height limitation, the indicators (15, Figure 4-77) will alternate, showing one after the other in the ODM.

When a limitation is active, the warning buzzer inside the cab will sound. If there is a solid sound, this will signify being at the limitation.

The Alarm Characteristics are outlined in Table 4-8.

Table 4-8 – WRL Alarm Characteristics

LIMITATION	POSITION	ALARM	INDICATOR
Swing Angle Limitation	10 deg before limit	Slow beeping	Amber
	5 deg before limit	Fast beeping	Red
	At limit	Solid sound	
Boom Angle Limitation	10 deg before limit	Slow beeping	Amber
	5 deg before limit	Fast beeping	Red
	At limit	Solid sound	
Boom Height Limitation	10 ft before limit	Slow beeping	Amber
	5 ft before limit	Fast beeping	Red
	At limit	Solid sound	
Working Radius Limitation	10 ft before limit	Slow beeping	Amber
	5 ft before limit	Fast beeping	Red
	At limit	Solid sound	
Virtual Walls Limitation	10 ft before limit	Slow beeping	Amber
	5 ft before limit	Fast beeping	Red
	At limit	Solid sound	

NOTE: The audible alarm can be silenced using the Tab Button on the Navigation Control Pad (2, Figure 4-69). It can be silenced once the boom is no longer being moved. When a boom motion is sensed again by the control system, the warning buzzer (audible alarm) is sounded again.

To access the WRL Function Icon Screen, the Menu Function is used with the display. Once the Main Menu screen is shown, the WRL limitations are shown as a group, and one of the limitations can then be selected to work with that limitation screen. To move to the Icon you wish to select, use the Arrow Keys on the Navigational Control Pad or the Jog Dial to move to the corresponding Function Icon you wish to set the limitation on as shown in (Figure 4-115).

Accessing a WRL Limitation Screen

The WRL Group is made up of five (5) WRL Function Icons. To enable and define a limitation, access the related WRL Function Icon in the WRL Group (Figure 4-115).

Table 4-9 – WRL Limitation Screen Symbols

Symbol	Description
	Symbol represents the Working Range Limitation (WRL) Menu Group.
	Symbol represents the Swing Angle Limitation.
	Symbol represents the Boom Angle Limitation.
	Symbol represents the Boom Height Limitation.
	Symbol represents the Working Radius Limitation.
	Symbol represents the Virtual Walls Limitation Menu.
	This Symbol is an audible alert selection. If this symbol is shown, the audible alert is functioning. Hitting OK can change this symbol to the Lock-Out Option (shown as the next Symbol below).
	This Symbol is a Lock-Out Warning Symbol. If this symbol is shown, the optional Lock-Out is functioning. Hitting OK will change the function to the audible alert option (as shown above).

For Reference Only

Symbol	Description
	<p>Enable/Disable Switch (ON/OFF) Symbol - The Enable/Disable (ON/OFF) Switch Symbol with the orange box indicates the Icon is active and can change. The box in orange next to the “I” would indicate enabled. The orange box next to the “O” indicates disabled. This symbol is used for all of the WRL Limitation Screens.</p> <p>The gray Enable/Disable (ON/OFF) Switch Symbol or “O” without the orange highlight means the switch is not enabled (or not active). This symbol is used for all of the WRL Limitation Screens.</p>
	<p>Working Range Limiter (WRL) Swing Angle Enable Indicator (Green) - Indicates Swing Angle Limitation Enabled (Active).</p>
	<p>Working Range Limiter (WRL) Swing Angle Warning Indicator (Amber) - Indicates the swing angle is within 10° of a swing angle limit set point. (Refer to Table 4-8 – WRL Alarm Characteristics).</p> <p>The warning buzzer slowly beeps when the swing angle is within 10° of the swing angle limit set point and changes to a fast beep when the swing angle is within 5° of the swing angle limit set point.</p> <p>For cranes that are equipped with the WRL Lock-Out Function, when the swing angle is within 10° of the swing angle lock-out set point, the swing function commanded by the controller may be reduced or suspended depending upon the weight of the load and the swing speed.</p> <p>Warning</p> <p>Due to the free-swing characteristic of the crane’s superstructure, the boom and load can potentially swing past the swing angle set point, even if the swing function commanded by the controller is reduced or suspended (locked out) by the WRL. This can happen for several reasons, including how level the crane is and environmental conditions, such as wind speed.</p>
	<p>Working Range Limiter (WRL) Swing Angle Stop Indicator (Red) - Indicates the swing angle is at a swing angle limit set point. The warning buzzer is on (constant). For cranes that are equipped with the WRL Lock-Out Function, the swing left or swing right crane function is locked out, depending upon which limit is reached. This symbol is used for all of the WRL Limitation Screens.</p>
	<p>Working Range Limiter (WRL) Boom Angle Indicator - Active.</p>
	<p>Working Range Limiter (WRL) Boom Angle Indicator - Enabled.</p>

Symbol	Description
	Working Range Limiter (WRL) Boom Angle Indicator - Stop.
	Working Range Limiter (WRL) Boom Height Indicator - Active.
	Working Range Limiter (WRL) Boom Height Indicator - Enabled.
	Working Range Limiter (WRL) Boom Height Indicator - Stop.
	Working Range Limiter (WRL) Radius Icon - Active.
	Working Range Limiter (WRL) Radius Icon - Enabled.
	Working Range Limiter (WRL) Radius Icon - Stop.
	Working Range Limiter (WRL) Wall Icon - Active.
	Working Range Limiter (WRL) Wall Icon - Enabled.

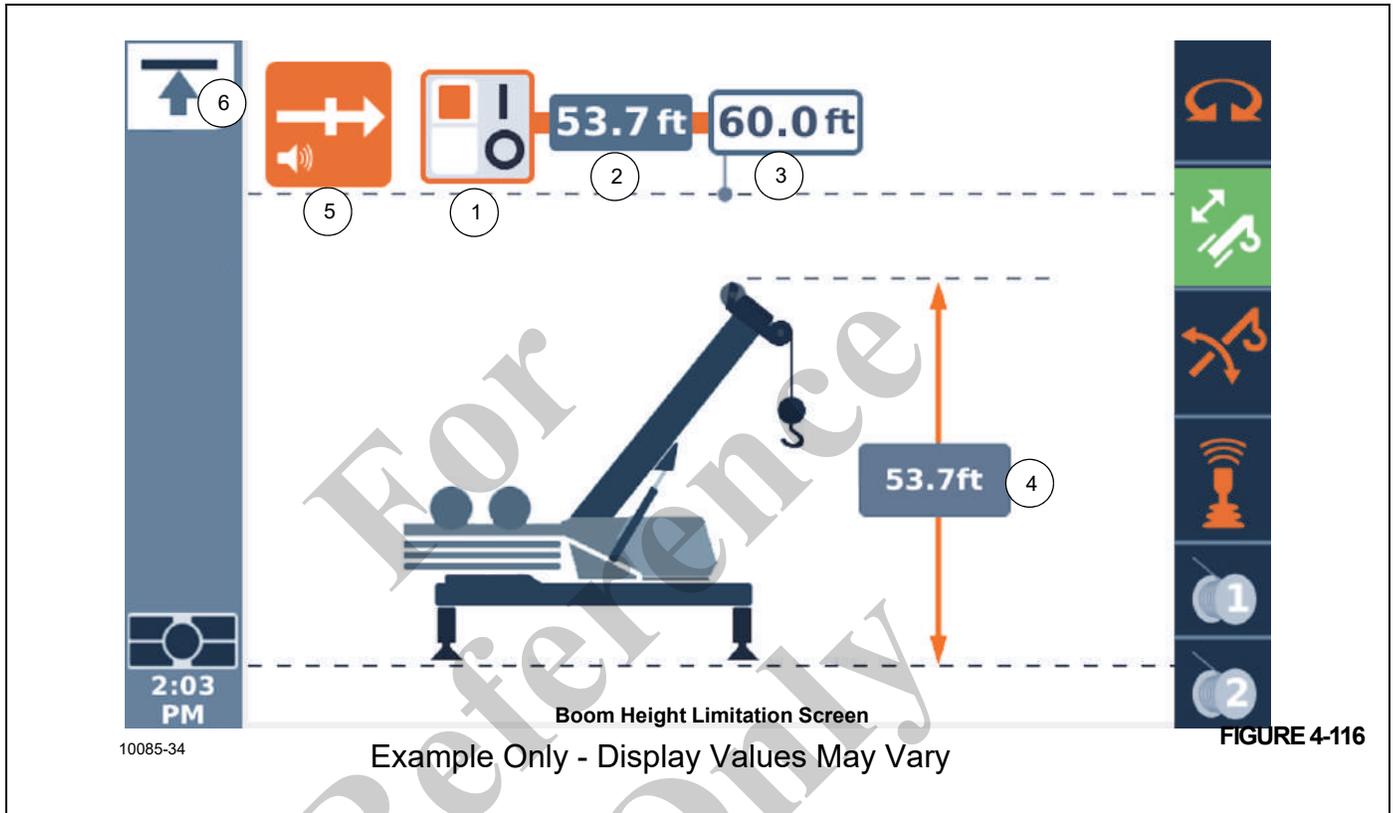
Symbol	Description
	<p>Working Range Limiter (WRL) Wall Icon - Stop.</p>
	<p>This is the inner or Minimum Radius Limitation Indicator.</p>
	<p>This is the outer or Maximum Radius Limitation Indicator.</p>
	<p>Virtual Wall Number - this is used to indicate the virtual wall that is being defined or altered (there can be up to 5 virtual walls). If the limitation is enabled, and this symbol is highlighted (orange background), the value can be changed with the Up Arrow and Down Arrow function on the display or jog dial (using an OK Button to begin and complete the value entry).</p>
	<p>Accept Crane Position Point A symbol - If the limitation is enabled, this symbol allows the acceptance of the current crane position (in terms of hook radius and swing angle) to be the first point (Point A) of a line that defines the position and orientation of the virtual wall. If this symbol is highlighted (as shown here with orange background), and the crane position is accepted with an OK Button, then the Point A is considered defined.</p>
	<p>Accept Crane Position Point B symbol - If the limitation is enabled, this symbol allows the acceptance of the current crane position (in terms of hook radius and swing angle) to be the second point (Point B) of a line that defines the position and orientation of the virtual wall. If this symbol is highlighted (as shown here with orange background), and the crane position is accepted with an OK Button, then Point B is considered defined. Note that if the Point A and Point B are not in allowable positions, the wall is not defined, and the procedure is to be repeated with different A and B Points. For instance, the 2 points may not be so close to each other that a virtual wall is not clearly defined; the 2 points should be at least 10 ft apart.</p>
	<p>Symbol indicates Wall Number.</p>
	<p>Remove Virtual Wall Symbol - If the limitation is enabled, and this symbol is highlighted (orange background), this symbol removes the definition of the current wall by clicking the Enter Key.</p>
	<p>Wall Proximity Value - this value is the approximate distance from the boom nose to the nearest wall. It becomes a negative value when the boom is protruding beyond the boundary of the wall. (The Value shown is for a typical example only).</p>

Boom Height Limitation

If the Boom Height Limitation is selected from the menu of WRL Limitations, then the Boom Height Limitation Screen will be shown (4, Figure 4-115).

Using the Left Arrow and Right Arrow Function keys (4, Figure 4-69) on the display or the Jog Dial

(5, Figure 4-70) changes the Icon highlighted on the screen. As the arrow keys are pressed, the highlight will move between the Icons, with the color orange typically meaning that the object is selected and can be affected by subsequent actions. In Figure 4-116, Item 5 is highlighted in orange.



Example Only - Display Values May Vary

FIGURE 4-116

Setting the Boom Height Limitation

The Boom Height Limitation Menu allows the operator to set a limit for the maximum boom height. Item (6, Figure 4-116) shows the Boom Height Limitation Icon. Table 4-9 lists the WRL Limitation Screen Symbols.

NOTE: The Boom Height can be “typed in” or set by boom position.

Item	Description	Refer to
1	Enable / Disable Switch	Figure 4-116
2	Current Boom Height	
3	Maximum Boom Height Limit	
4	Current Boom Height	
5	Audible Alert or Lock-out Icon	
6	Icon for WRL Boom Height Limitation	

NOTE: The Limitation is dependent on the accuracy of the Tip Height Calculation, which can be ±5%.

Setting the Boom Height Limitation Using Crane Position

To set parameters and enable the Boom Height Limitation, the following steps can be used:

1. Set the RDM screen parameters first. Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-159.
2. Using the Jog Dial (5, Figure 4-70), go to the ODM Main Menu Screen (Figure 4-83). Go to the Working Range Limiter (WRL) Group Menu Icon (4, Figure 4-115) by using the Arrow keys (4, Figure 4-69) or the Jog Dial (5, Figure 4-70).
3. Select the Boom Height Limitation Menu (4, Figure 4-115). **NOTE:** The Boom Height Limitation Icon (6, Figure 4-116) is shown on the top left side of the ODM screen.

4. Move the Boom tip to the desired position. This position will indicate the boom height current value (2 and 4) positions.
5. Enable the Limitation by using the Jog Dial (5, Figure 4-70), or the Arrow Keys (4, Figure 4-69) to move and select the Enable/Disable Switch Symbol ON/Off (1, Figure 4-117). **NOTE:** The Switch (1, Figure 4-116) is a toggle switch. Click OK (5, Figure 4-69), or the Jog Dial (5, Figure 4-70) to toggle the switch.

NOTE: The current value in Limitation (2) will automatically populate in the value for Limitation (3).

NOTE: The boom is near the limitation, so alarms will sound. The boom can now be moved away from the limit.

6. The Boom Height Limitation is now defined and enabled.

Setting the Boom Height Limitation by Value

To set parameters and enable the Boom Height Limits Menu using a “typed in” value as the limitation, the following steps can be used:

1. Set the RDM screen parameters first. Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-159.
2. Using the Jog Dial (5, Figure 4-70), go to the ODM Main Menu Screen. Then choose the Working Range Limiter (WRL) Group Menu Icon (4, Figure 4-115).
3. Select the Boom Height Limitation Menu Screen (4, Figure 4-115). **NOTE:** The Boom Height Limitation Icon (6, Figure 4-116) is shown on the top left side of the ODM screen.
4. Enable the limitation by using the Jog Dial (5, Figure 4-70) or the Arrow Keys (4, Figure 4-69) and

move to the Enable/Disable Switch (1, Figure 4-119). **NOTE:** The Switch (1, Figure 4-116) is the Enable/Disable Switch and is a toggle switch. Click OK (5, Figure 4-69), or the Jog Dial (5, Figure 4-70) to toggle the switch. Click OK.

NOTE: The alarm will sound if boom tip is above the limit, when enabled.

5. Use the Right Arrow Function key to highlight the Limitation Value (3, Figure 4-116). Use the OK Button (5, Figure 4-69) to begin entering the value. Use the Up Arrow or the Down Arrow or Jog Dial (5, Figure 4-70) to change the value (in tenths) to the desired tip height value.
6. Use the OK Button (5, Figure 4-69) to finish entering the value.

NOTE: The boom may now be near the limitation (depending on the value entered), so alarms may be active. The boom can now be moved away from the current tip height to cease the alarm, if needed.

7. The Overall Boom Height is now defined and enabled.

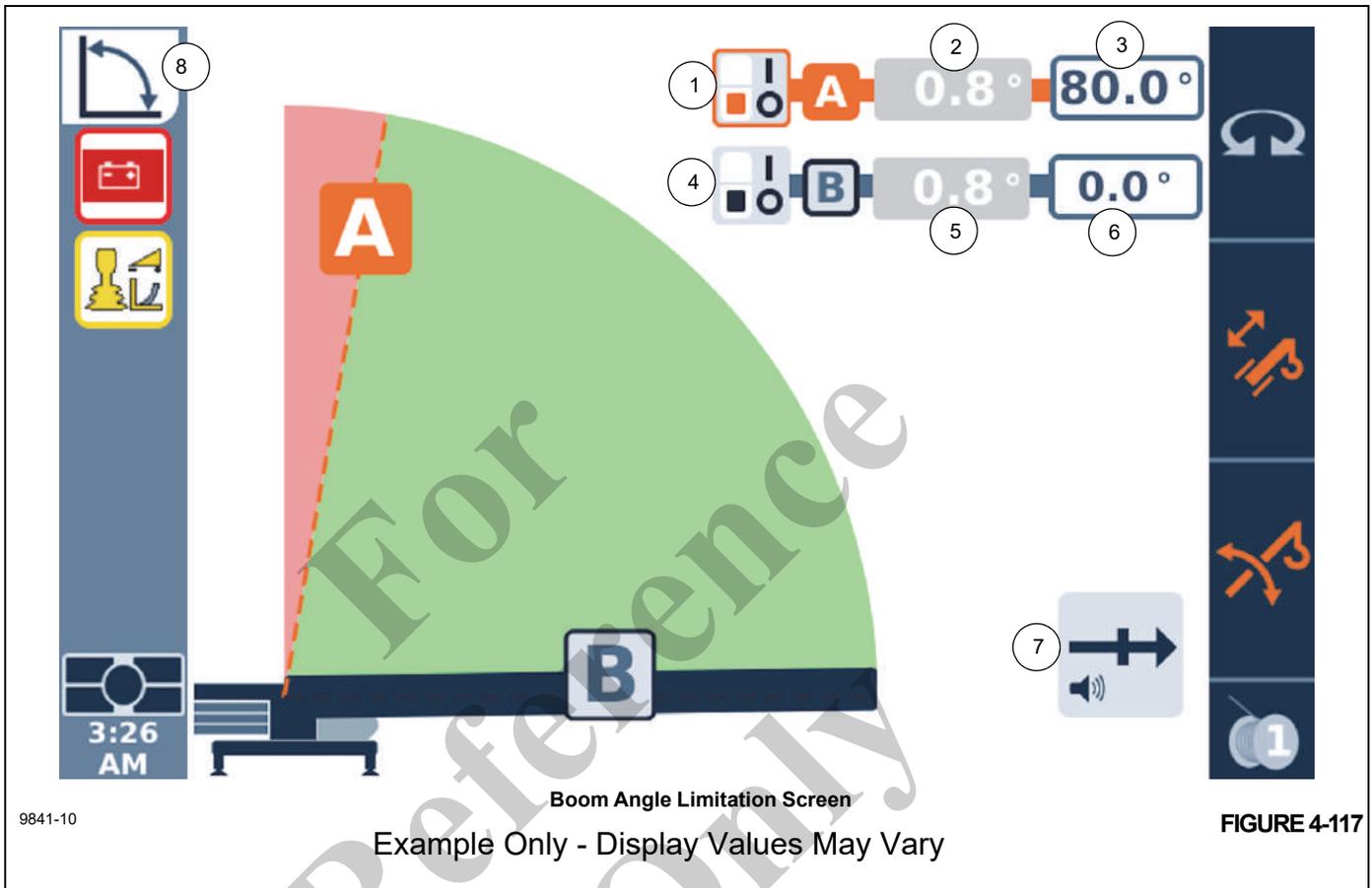
Boom Height Limitation Disable Procedure

To disable an active Overall Height, the following steps can be used (note that turning off the power to the control system also disables the WRL limitations):

1. Select the Overall Height Menu (4, Figure 4-115) screen on the Main Menu Screen.
2. Use the Left Arrow and/or Right Arrow Function keys (4, Figure 4-69) to highlight the Switch Enable/Disable Symbol (3, Figure 4-119). Enable is “I” and Disable is “O”.
3. Use the OK Button (5, Figure 4-69), or the Jog Dial (5, Figure 4-70) to toggle to disable the limitation.

Boom Angle Limitation

If the Boom Angle Limitation Menu is selected from the Main Menu of WRL Limitations (3, Figure 4-115), then the Boom Angle Limitation Screen will be shown (Figure 4-117).



Using the Left Arrow and Right Arrow Function keys on the Navigation Control Pad (4, Figure 4-69) or the Jog Dial (5, Figure 4-70) changes the Icon highlighted on the screen. As the arrow keys are pressed, the highlight will move between the Icons, with the color orange typically meaning that the Icon is selected and can be affected by subsequent actions. In Figure 4-117, you will see that the highlighted Icon in orange for the Enable/Disable Switch Symbol for the maximum boom angle is selected since it has the orange color highlighting. Table 4-9 lists the WRL Limitation Screen Symbols.

NOTE: The Boom Angle can be “typed in” or set by a boom position.

Setting the Boom Angle Limitation Menu

The Boom Angle Limitation Menu allows the operator to set the upper and/or lower limits for the boom to operate within.

Item	Description	Refer to
1	Upper A (Maximum Boom Angle) Limit ON/OFF	Figure 4-117
2	Current Boom Angle	
3	Maximum Boom Angle Limit	
4	Lower B (Minimum Boom Angle) Limit ON/OFF	
5	Current Boom Angle	
6	Minimum Boom Angle Limit	
7	Audible Alert or Lock-out Symbol	
8	Boom Angle Limitation Icon	

Setting the Boom Up Angle Limitation by Crane Position

To set parameters and enable the Boom Up Angle Limitation, the following steps can be used:

1. Set the RDM screen parameters first. Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-159.
2. Using the Jog Dial (5, Figure 4-70), go to the ODM Main Menu Screen (Figure 4-83). Go to the Working Range Limiter (WRL) Group Menu Icon (3, Figure 4-115) by using the Arrow keys (4, Figure 4-69) or the Jog Dial (5), (Figure 4-70).
3. Select the Boom Angle Limitation Menu Screen (3, Figure 4-115). **NOTE:** The Boom Up Limitation Screen (8, Figure 4-117) Icon is shown on the top left side of the ODM screen.
4. Move the Boom to the desired position. This position will indicate the boom angle current value A (2) position.

5. Enable the Limitation by using the Jog Dial (5, Figure 4-70), or the Arrow Keys (4, Figure 4-69) to move and select the Enable/Disable Switch Symbol ON/Off (1, Figure 4-117). **NOTE:** The Switch (1, Figure 4-117) is a toggle switch. Click OK (5, Figure 4-69), or the Jog Dial (5, Figure 4-70) to enable the switch.
6. Use the Jog Dial (5, Figure 4-70) or the Arrow Keys (4, Figure 4-69) and move to the Limitation Value (2, Figure 4-117). Click OK to set the current value Limitation A (2, Figure 4-117) position.

NOTE: The current value in Limitation A (2) will automatically populate in the value for Limitation A (3).

NOTE: The boom is now at the limitation, so alarms will sound. The boom can now be moved away from the current boom angle to cease the alarm.

Setting the Boom Down Limitation by Crane Position

To set parameters and enable the Lower Boom Angle Limitation, the following steps can be used:

1. Set the RDM screen parameters first. Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-159.
2. Using the Jog Dial (5, Figure 4-70), go to the ODM Main Menu Screen (Figure 4-83). Go to the Working Range Limiter (WRL) Group Menu Icon (3, Figure 4-115) by using the Arrow keys (4, Figure 4-69) or the Jog Dial (5, Figure 4-70).
3. Select the Boom Angle Limitation Menu (3, Figure 4-115). **NOTE:** The Boom Angle Limitation Icon (8, Figure 4-117) is shown on the top left side of the ODM screen.
4. Move the Boom to the desired position. This position will indicate the boom angle current value B (5) position.
5. Enable the Lower Boom Limitation Angle by using the Jog Dial (5, Figure 4-70), or the Arrow Keys (4, Figure 4-69) to move and select the Enable/Disable Switch Symbol ON/Off (4, Figure 4-117). **NOTE:** The Switch (4, Figure 4-117) is a toggle switch. Click OK (5, Figure 4-69), or the Jog Dial (5, Figure 4-70) to enable the switch.
6. Use the Jog Dial (5, Figure 4-70), or the Arrow Keys (4, Figure 4-69) and move to the Limitation Value (5, Figure 4-117). Click OK to set the current value Lower Boom Angle Limitation B (5, Figure 4-117) position.

NOTE: The current lower boom angle Limitation B (5) will automatically populate in the value for Limitation B (6).

- The lower boom angle is now at the limitation, so alarms will sound. The boom can now be moved away from the current boom angle to cease the alarm.

Setting the Boom Up Limitation by Value

To set parameters and enable the Boom Up Elevation Limits Menu using a “typed in” value as the limitation, the following steps can be used:

- Set the RDM screen parameters first. Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-159.
- Using the Jog Dial (5, Figure 4-70), go to the ODM Main Menu Screen. Then choose the Working Range Limiter (WRL) Group Menu Icon (11, Figure 4-83).
- Select the Boom Angle Limitation Menu Screen (3, Figure 4-115). **NOTE:** The Boom Angle Limitation Icon (8, Figure 4-117) is shown on the top left side of the ODM screen.
- Enable the limitation by using the Jog Dial (5, Figure 4-70) or the Arrow Keys (4, Figure 4-69) and move to the Enable/Disable Switch (1, Figure 4-119). **NOTE:** The Switch (1, Figure 4-117) is the Enable/Disable Switch and is a toggle switch. Click OK (5, Figure 4-69), or the Jog Dial (5, Figure 4-70) to set the switch.
- Use the Jog Dial (5, Figure 4-70), or the Right Arrow Key (4, Figure 4-69) to move and select the Maximum Boom Angle (3, Figure 4-117), Limitation A. Enable the value entry by clicking on OK (5, Figure 4-69). Enter a value by using the Jog Dial (5, Figure 4-70) or the upper and lower arrow keys (4, Figure 4-69) to change the value (in tenths) to the desired boom angle value (3, Figure 4-117).

NOTE: The Limitation is dependent on the accuracy of the Boom Angle Sensor, which can be ± 1 degree.

- Use the OK Button (5, Figure 4-69) to finish entering the value.

NOTE: The boom may now be near the limitation (depending on the value entered), so alarms may be active. The boom can now be moved away from the current boom elevation to cease the alarm, if needed.

- The Boom Up Limit is now defined and enabled.

Setting the Boom Down Limits Menu by Value

To define and enable the Boom Down Elevation Limits Menu using a “typed in” value as the limitation, the following steps can be used:

- Set the RDM screen parameters first. Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-159.
- Using the Jog Dial (5, Figure 4-70), go to the ODM Main Menu Screen. Then choose the Working Range Limiter (WRL) Group Menu Icon (11, Figure 4-83).
- Select the Boom Angle Limitation Menu Screen (3, Figure 4-115). **NOTE:** The Boom Angle Limitation Icon (8, Figure 4-117) is shown on the top left side of the ODM screen.
- Enable the limitation by using the Jog Dial (5, Figure 4-70) or the Arrow Keys (4, Figure 4-69) and move to the Enable/Disable Switch (4, Figure 4-117). **NOTE:** The Switch (4, Figure 4-117) is the Enable/Disable Switch and is a toggle switch. Click OK (5, Figure 4-69), or the Jog Dial (5, Figure 4-70) to set the switch.
- Use the Jog Dial (5, Figure 4-70), or the Right Arrow Key (4, Figure 4-69) to move and select the Minimum Boom Angle Symbol (6, Figure 4-117), Limitation B. Enable the value entry by clicking on OK (5, Figure 4-69). Enter a value by using the Jog Dial (5, Figure 4-70) or the upper and lower arrow keys (4, Figure 4-69) to change the value (in tenths) to the desired boom angle value (6, Figure 4-117).

NOTE: The Limitation is dependent on the accuracy of the Boom Angle Sensor, which can be ± 1 degree.

- Use the OK Button (5, Figure 4-69) to finish entering the value.

NOTE: The boom may now be near the limitation (depending on the value entered), so alarms may be active. The boom can now be moved away from the current boom elevation to cease the alarm, if needed.

- The Boom Down Limit is now defined and set.

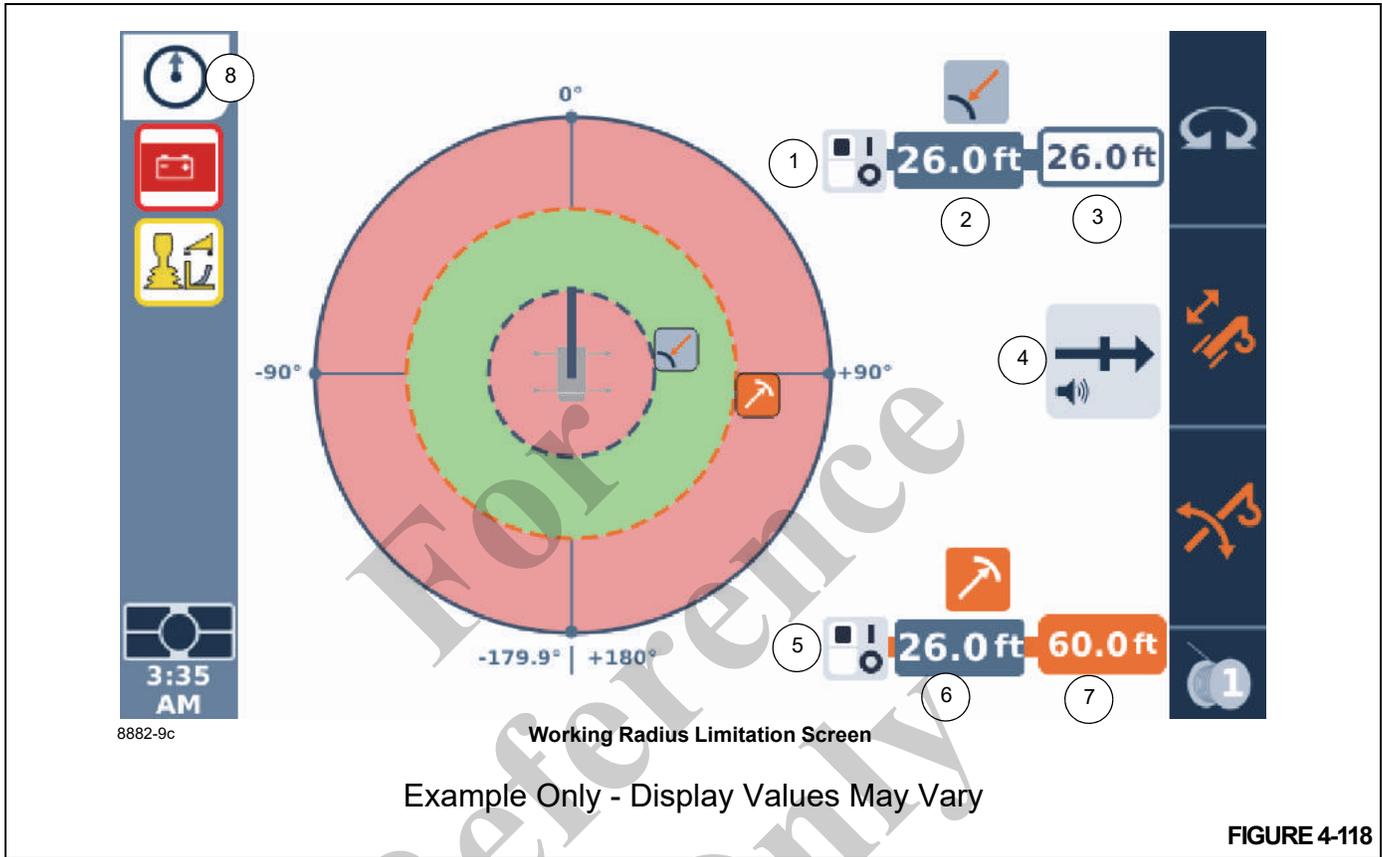
Boom Up/Down Limitation Disable Procedure

To disable an active Boom Up or Boom Down Limitation, the following steps are to be used (note that turning off the power to the control system also disables the WRL limitations):

- Select the Boom Up or Boom Down Limitation Menu (3, Figure 4-115) Screen.
- Use the Left Arrow and/or Right Arrow Function keys (4), (Figure 4-69) to highlight the Switch Enable/Disable Symbol (1, 4, Figure 4-117). Enable is “I” and Disable is “O”.
- Use the OK Button (5, Figure 4-69), or the Jog Dial (5, Figure 4-70) to toggle to disable the limitation.

Radius Limitation

If the Radius Limitation is selected from the Menu of WRL Limitations, then the Radius Limitation Screen will be shown (5, Figure 4-115).



Using the Left Arrow and Right Arrow function on the display or the jog dial changes the Icon highlighted on the screen. As the Icons, with the color orange typically meaning that the Icon is selected and can be affected by subsequent actions.

WRL - Working Radius Limit Menu

The Working Radius Menu allows the operator to set minimum and maximum working radii limits.

Table 4-9 lists the WRL Limitation Screen Symbols.

NOTE: The Working Radius can be “typed in” or set by boom position.

Item	Description	Refer to
1	Minimum Radius Enable/Disable Switch	Figure 4-1 18
2	Current Working Radius	
3	Minimum Working Radius Limit	
4	Audible Alert or Lock-out Icon	
5	Maximum Radius Enable/Disable Switch	
6	Current Working Radius	
7	Maximum Working Radius Limit	
8	Icon for WRL Working Radius Limitation	

Setting the Inner/Outer Working Radius Limitation by Crane Position

To define and enable the Inner Radius Limitation using the crane current hook radius as the limitation, the following steps can be used:

1. Set the RDM screen parameters first. Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-159.
2. Using the Jog Dial (5, Figure 4-70), go to the ODM Main Menu Screen Figure 4-119. Then choose the Working Range Limiter (WRL) Group Menu Icon (5, Figure 4-115) by using the Arrow keys (4, Figure 4-69) or the Jog Dial (5, Figure 4-70).
3. Select the Working Radius Limitation Menu Screen (5, Figure 4-115). **NOTE:** The Working Radius Limitation Icon (8, Figure 4-118) is shown on the top left side of the ODM screen.
4. Move the Boom to the desired position. This position will indicate the inner or minimum radius limitation current value (2, Figure 4-118) position.
5. Enable the limitation by using the Jog Dial (5, Figure 4-70) or the Arrow Keys (4, Figure 4-69) and move to the Enable/Disable Switch (1, Figure 4-118). **NOTE:** The Switch (1, Figure 4-118) is the Enable/Disable Switch and is a toggle switch. Toggle to "I" and click OK (5, Figure 4-69), or the Jog Dial (5, Figure 4-70) to enable the switch.
6. Use the Jog Dial (5, Figure 4-70) or the Arrow Keys (4, Figure 4-69) and move to the Limitation Value (2, Figure 4-118). Click OK to set the current value Limitation (2, Figure 4-118) position.

NOTE: The current value in Limitation (2) will automatically populate in the value for Limitation (3).

7. Repeat Steps 4 thru 6, in a similar manner, to set the Outer or Maximum Radius Limitation (6), (Figure 4-118) value.

NOTE: The boom is near the limitation so an alarm will sound. The boom can now be moved away from the current angle to cease the alarm.

8. The Working Radius Limitation is now defined and enabled.

Setting the Inner/Outer Working Radius Limitation by Value

To set parameters and enable the Inner/Outer Working Radius Limitations using a "typed in" value as the limitation, the following steps can be used:

1. Set the RDM screen parameters first. Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-159.
2. Using the Jog Dial (5, Figure 4-70), go to the ODM Main Menu Screen. Then choose the Working Range Limiter (WRL) Group Menu Icon (5, Figure 4-115).
3. Select the Working Radius Limitation Menu Screen (5, Figure 4-115). **NOTE:** The Working Radius Limitation Icon (8, Figure 4-118) is shown on the top left side of the ODM screen.
4. Enable the limitation by using the Jog Dial (5, Figure 4-70) or the Arrow Keys (4, Figure 4-69) and move to the Enable/Disable Switch (1, Figure 4-118). **NOTE:** The Switch (1, Figure 4-118) is the Enable/Disable Switch and is a toggle switch. Toggle to "I" and click OK (5, Figure 4-69), or the Jog Dial (5, Figure 4-70) to set the switch. Click OK.
5. Use the Jog Dial (5, Figure 4-70), to move and select the Limitation (3, Figure 4-118) to set the Inner or Minimum Radius Limitation value. Enter a value by using the Jog Dial (5, Figure 4-70) or the upper and lower arrow keys (4, Figure 4-69) to change the value (in tenths) to the desired radius value. Use the OK Button (5, Figure 4-69) to finish entering the values.

NOTE: The Limitation is dependent on the accuracy of the Hook Radius Calculation, which can be 10%.

6. Once the value is changed to your desired value, again click OK to finish entering the value. (Note: The alarm will sound if boom tip is above limit, when enabled).
7. Repeat Steps 4 thru 6, in a similar manner, to set the Outer or Maximum Radius Limitation (7, Figure 4-118) value.

NOTE: The boom may now be at the limitation (depending on the value entered), so alarms may be active. The boom can now be moved away from the current boom elevation to cease the alarm, if needed.

Working Radius Limitation Disable Procedure

To disable an active Inner or Outer Radius Limitation, the following steps are to be used (note that turning off the power to the control system also disables the WRL limitations):

1. Select the Radius Limitation Screen (Figure 4-118) on the Main Menu Screen.
2. Use the Left Arrow and/or Right Arrow Function keys (4, Figure 4-69) to highlight the Switch Enable/Disable Symbol (3, Figure 4-119). Enable is "I" and Disable is "O".
3. Use the OK Button (5, Figure 4-69), or the Jog Dial (5, Figure 4-70) to toggle to disable the limitation.

Swing Angle Limitation

If the Swing Angle Limitation is selected from the menu of WRL Limitations, then the Swing Angle Limitation Screen will be shown (6, Figure 4-119).

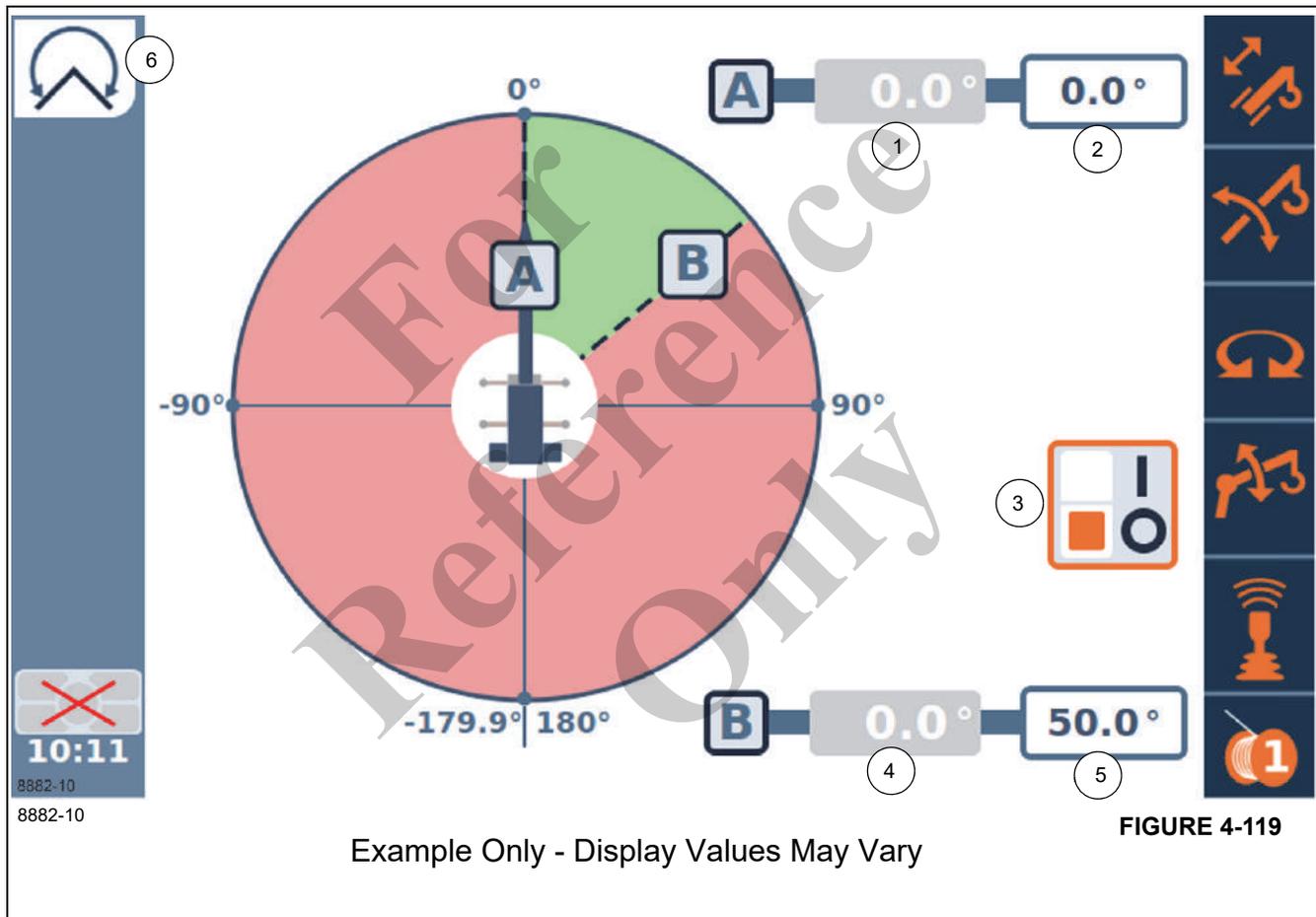
Using the Left Arrow and Right Arrow Function keys (4, Figure 4-69) on the Navigation Control Pad or the Jog Dial (5, Figure 4-70) changes the object highlighted on the screen. As the arrow keys are pressed, the highlight will move between the objects, with the color orange typically meaning that the object is selected and can be affected by subsequent actions. In Figure 4-119, the orange icon (Item 3) symbol is selected since it has the orange color

highlighting. Table 4-9 lists all of the symbols for the Limitation Menus that are available on the WRL Limitation Screens.

Setting the Swing Angle Limitation

The Swing Angle Menu allows the operator to set limits for the swing angles which the crane is expected to operate within. Refer to Figure 4-115 for the WRL Menu and sub-menu. Table 4-9 lists the WRL Limitation Screen Symbols.

The Swing Angle can be “typed in” or set by a boom position.



The Swing Angle Limitation Menu

The Swing Angle Limitation Menu allows the operator to set the limits for the boom to operate within.

Item	Description	Refer to
1	Current Swing Angle	Figure 4-119
2	Swing Angle Limit Left Direction - A	
3	Enable / Disable Switch	
4	Current Swing Angle	
5	Swing Angle Limit Right Direction - B	
6	Screen Icon for WRL Swing Angle Limitation Menu	

Setting Swing Angle Limitation by Crane Position

To set parameters and enable the Swing Angle Limitation, the following steps can be used:

1. Set the RDM screen parameters first. Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-159.
2. Using the Jog Dial (5, Figure 4-70), go to the ODM Main Menu Screen (Figure 4-83). Then choose the Working Range Limiter (WRL) Group Menu Icon (1, Figure 4-115) by using the Arrow keys (4, Figure 4-69) or the Jog Dial (5, Figure 4-70).
3. Select the Swing Angle Menu Screen (2, Figure 4-115). **NOTE:** The Swing Angle Screen (6, Figure 4-119) Icon is shown on the top left side of the ODM screen.
4. Enable the limitation by using the Jog Dial (5, Figure 4-70) or the Arrow Keys (4, Figure 4-69) and move to the Enable/Disable Switch ON/OFF (3, Figure 4-119). **NOTE:** The Switch (3, Figure 4-119) is the Swing Enable/Disable Switch ON/OFF and is a toggle switch. Click OK (5, Figure 4-69), or the Jog Dial (5, Figure 4-70) to toggle the switch.
5. Move the Boom to the desired position. This position will indicate the swing angle current value Limitation A (1) swing (left) position.
6. Use the Jog Dial (5, Figure 4-70) or the Arrow Keys (4, Figure 4-69) and move to the Limitation Value (1, Figure 4-119). Click OK to set the current value Limitation A (1, Figure 4-119) position.

NOTE: The Limitation is dependent on the accuracy of the Swing Angle Sensor, which can be ± 2 degrees.

NOTE: The current value in Limitation A (1) will automatically populate the value for Limitation A (2).

7. Repeat Steps 4 thru 6 to set the Limitation B (4, Figure 4-119) Swing (Right) Direction value.

NOTE: The boom is now at the limitation so an alarm will sound. The boom can now be moved away from the current swing angle to cease the alarm.

8. The Swing Limitation is now defined and enabled.

Setting Swing Angle Limitation by Value

To set parameters and enable the Swing Angle Menu using a "typed in" value as the limitation, the following steps can be used:

1. Set the RDM screen parameters first. Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-159.
2. Using the Jog Dial (5, Figure 4-70), go to the ODM Main Menu Screen. Then choose the Working Range Limiter (WRL) Group Menu Icon (11, Figure 4-83).
3. Select the Swing Angle Menu Screen (12, Figure 4-83). **NOTE:** You know you are on the Swing Angle Screen by looking at the Icon on the top left side of the ODM screen. The Icon (6, Figure 4-119) at the top of the screen should show the Swing Angle Limitation Icon.
4. Enable the limitation by using the Jog Dial (5, Figure 4-70) or the Arrow Keys (4, Figure 4-69) and move to the Enable/Disable Switch ON/OFF (3, Figure 4-119). **NOTE:** The Switch (3, Figure 4-119) is the Enable/Disable Switch ON/OFF and is a toggle switch. Click OK (5, Figure 4-69), or the Jog Dial (5, Figure 4-70) to toggle the switch.
5. Use the Jog Dial (5, Figure 4-70) to move and select the Swing Angle Left Limitation A (2, Figure 4-119) to set the Left Angle Limitation value. Use OK to begin changing the value shown. Enter a value by using the Jog Dial (5, Figure 4-70) or the upper and lower arrow keys (4, Figure 4-69) to change the value (in tenths) to the desired swing angle value. Use the OK Button (5, Figure 4-69) to finish entering the values.

NOTE: The Limitation is dependent on the accuracy of the Swing Angle Sensor, which can be ± 2 degrees.

NOTE: The current value in Limitation A (1) will automatically populate in the value for Limitation A (2).

6. Repeat Steps 5 to set the Limitation B (5, Figure 4-119) Swing Left Direction value.

NOTE: The boom may now be near the limitation (depending on the value entered), so alarms may be active. The boom can now be moved away from the current boom elevation to cease the alarm, if needed.

Swing Angle Limitation Disable Procedure

To disable an active Swing Angle Limitation, the following steps are to be used:

NOTE: Turning off the power to the control system also disables the WRL Limitations but it will remember the set points (2) and (5) as shown in (Figure 4-119).

NOTE: If you deactivate controls with the crane function switch, the WRL is not disabled but it will disable the functions.

1. Select the Swing Angle Menu Screen (2, Figure 4-115).
NOTE: The Swing Angle Screen (6, Figure 4-119) Icon is shown on the top left side of the ODM screen.
2. Use the Left Arrow and/or Right Arrow Function keys (4, Figure 4-69) to highlight the Switch Enable/Disable Symbol (3, Figure 4-119). Enable is "I" and Disable is "O".
3. Use the OK Button (5, Figure 4-69) or the Jog Dial (5, Figure 4-70) to toggle to disable the limitation.

Swing Angle Limitation with Lock-Out Function Enabled

For cranes that are equipped with the WRL Lock-Out Function, when the swing angle is within 10° of the swing angle lock-out set point (Value previously defined), the swing function commanded by the controller may be reduced or suspended depending upon the weight of the load and the swing speed.



WARNING

Due to the free-swing characteristic of the crane's superstructure, the boom and load can potentially swing past the swing angle set point (Value), even if the swing function commanded by the controller is reduced or suspended (locked out) by the WRL. This can happen for several reasons, including how level the crane is and environmental conditions, such as wind speed.

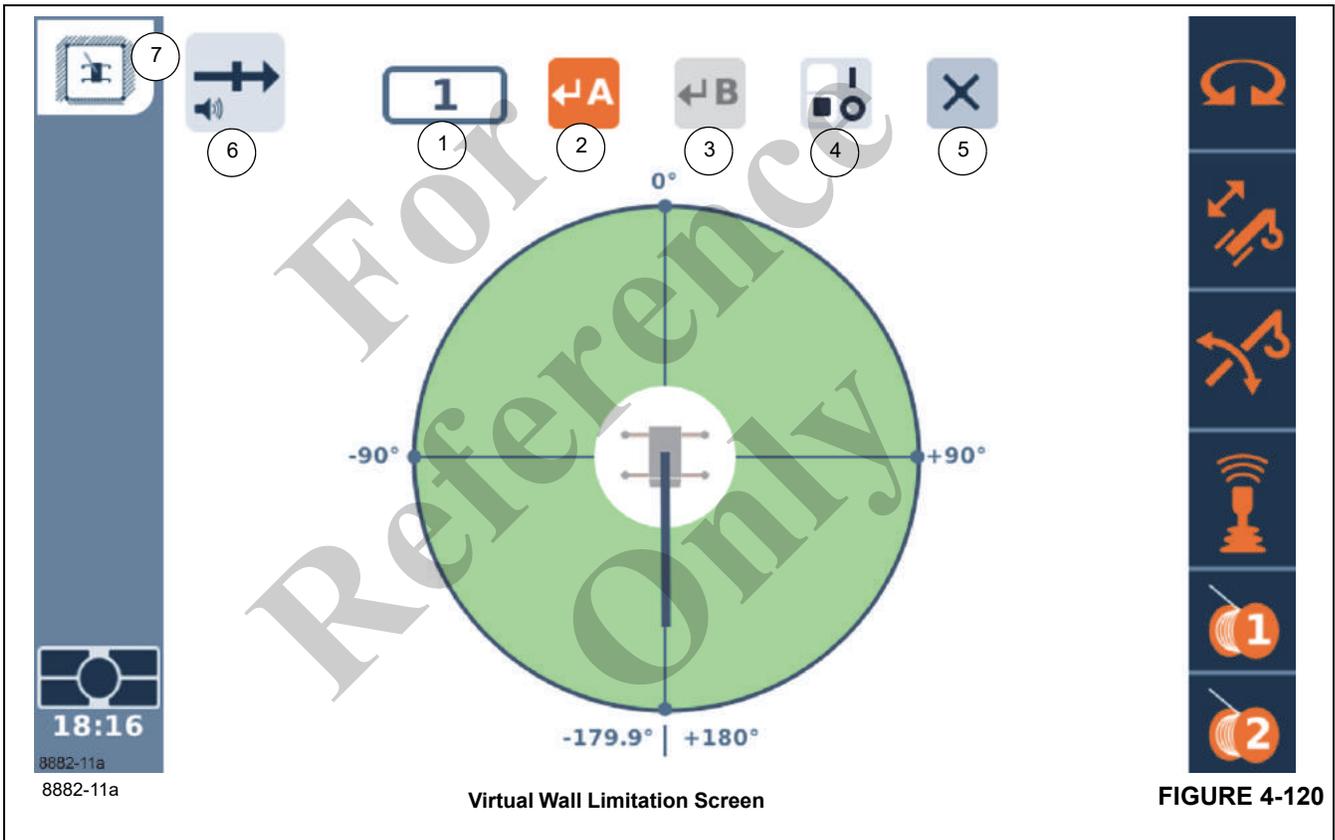
For Reference Only

Virtual Walls Limitation

If the Virtual Wall Limitation is selected from the menu of WRL Limitations, then the Virtual Wall Limitation Screen will be shown (Figure 4-120).

Using the Left Arrow and Right Arrow (4, Figure 4-69) Function Keys on the Display or the Jog Dial (5, Figure 4-70) changes the object highlighted on the screen.

As the arrow keys are pressed, the highlight will move between the objects, with the color orange typically meaning that the object is selected and can be affected by subsequent actions. In Figure 4-120, one can see that the wall Point "A" Symbol is selected since it has the orange color highlighting.



The Virtual Walls Limitation Menu allows the operator to define up to five walls or barriers in which the boom is not expected to operate.

Table 4-9 lists the WRL Limitation Screen Symbols.

Item	Description	Refer to
1	Virtual Wall Number (up to 5)	Figure 4-1 20
2	Virtual Wall Start Point A	
3	Virtual Wall End Point B	
4	Enable / Disable Switch	
5	Delete Virtual Wall	
6	Audible Alert or Lock-out Icon	
7	Icon for WRL Virtual Walls Limitation	

Defining the First Virtual Wall

To define and enable the first Virtual Wall (assuming no Virtual Walls are already defined), the following steps can be used:

1. Select the Virtual Walls Limitation Screen (6, Figure 4-115) on the Main Menu Screen (and in this case there would not be any virtual walls shown as defined or active) as noted in the Virtual Walls Number (1, Figure 4-120). (Note: The number “1” indicates the number of virtual walls and can be up to “5” five virtual walls defined.)
2. Position the crane so that the hook is located at the position to define the first (start) point of the Virtual Wall (Point A or Symbol 2).
3. Use the Right Arrow (4, Figure 4-69) Function key to highlight the Accept Crane Position Point A Symbol (2), Figure 4-120.
4. Use an OK Button (5, Figure 4-69) to accept the current crane position to be Point A (2). The location of the point

should now be shown on the screen with a label of '1a' as indicated in the yellow box in the sample in Figure 4-121.

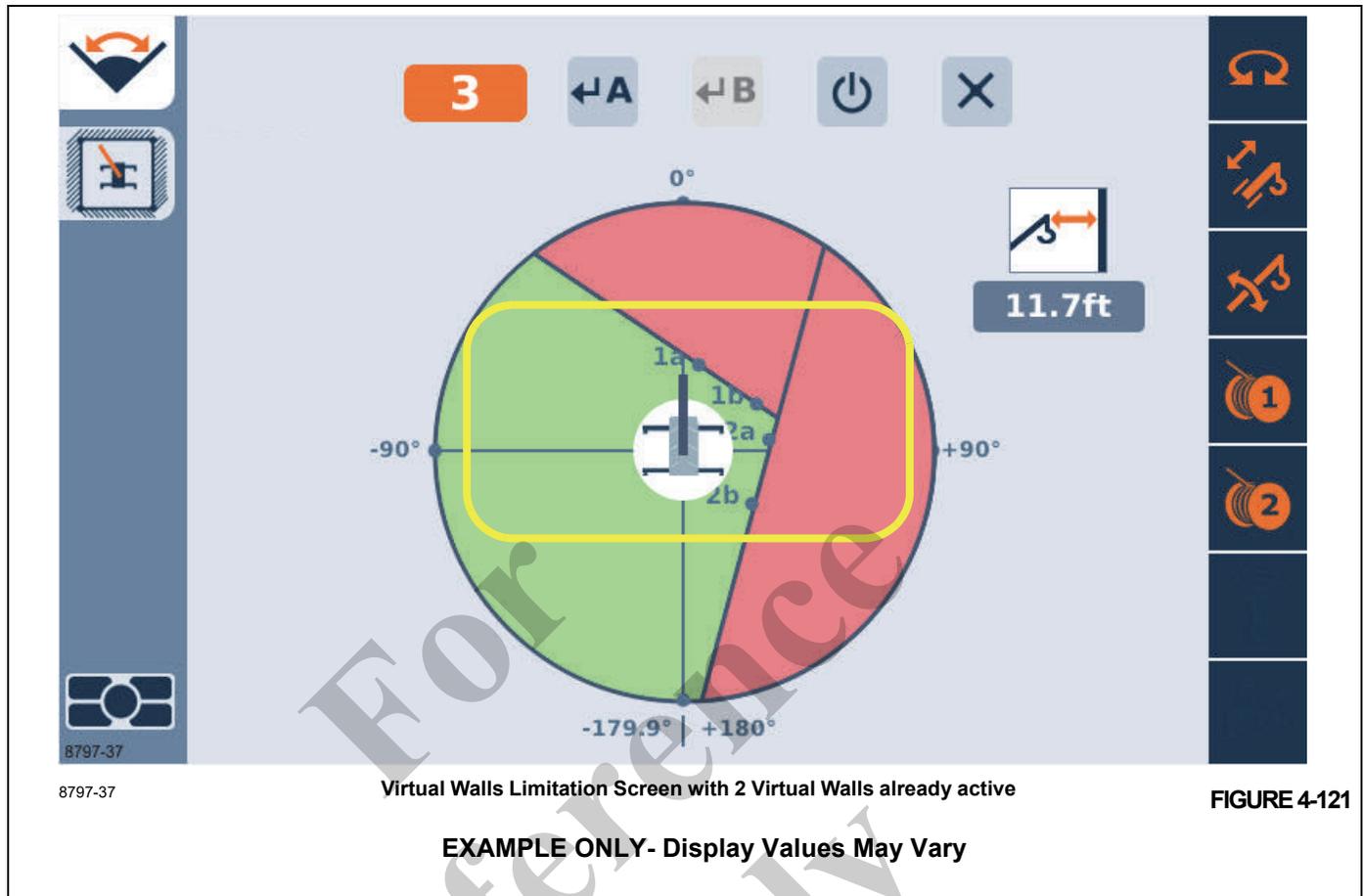
5. Position the crane so that the hook is located at the position to define the second point of the Virtual Wall (Point B), or Item 3 (Figure 4-120). **NOTE:** The two points may not be so close to each other that a virtual wall is not clearly defined. The two points should be at least 10 ft apart.
6. Use the Right Arrow (4, Figure 4-69) Function key to highlight the Accept Crane Position Point B Symbol (3, Figure 4-120).
7. Use an OK Button (5, Figure 4-69) to accept the current crane position to be Point B. The location of the point should now be shown on the screen with a label of '1b' as indicated in the yellow box in the sample Figure 4-121.

NOTE: As each Virtual Wall is defined, you will have a wall number and “a” and “b” defined for each wall.

NOTE: The screen should also show a “forbidden zone” for the area beyond the Virtual Wall. Use a visual inspection of the screen and the area around the crane to verify that the Virtual Wall is providing the desired zone correctly. Also, note that the boom is now at the wall limitation, so alarms will sound. The boom can now be moved away from the wall to cease the alarm.

8. The Virtual Wall #1 is now defined and enabled. Crane operations can be resumed with the WRL working with this specified limitation.

NOTE: The Virtual Wall Number 3, as shown in the EXAMPLE in the orange box in Figure 4-121, increments if the second wall was just defined, so that it is ready to define a subsequent Virtual Wall, if so desired.



Defining Subsequent Virtual Walls

To define and enable further Virtual Walls (such as Virtual Walls 2 through 5), the following steps can be used:

1. Be sure you are on the Virtual Walls Limitation Screen Icon (7, Figure 4-120).
2. Use the Right Arrow (4, Figure 4-69) function key to highlight the Virtual Wall Number Item (1, Figure 4-120).
3. If the wall number shown is not the correct number for the new wall (note that it increments automatically when the previous wall was defined). Use an OK Button (5, Figure 4-69) to allow modifying the value. Use the Up/Down Arrow Keys (4, Figure 4-69) to alter the Virtual Wall number to the desired value. Use an OK Button (5, Figure 4-69) to finish entering the value.
4. Position the crane so that the hook is located at the position to define the first point of the Virtual Wall (Point A or Item 2) as shown in Figure 4-120.
5. Use the Right Arrow (4, Figure 4-69) Function key to highlight the Accept Crane Position Point A Symbol (2, Figure 4-120).
6. Use an OK Button (5, Figure 4-69) to accept the current crane position to be Point A as shown in Figure 4-120.

The location of the point should now be shown on the screen with a label that shows the wall number and the letter 'a' as shown in the yellow highlight in the sample Figure 4-121.

7. Position the crane so that the hook is located at the position to define the second point of the Virtual Wall (Point B or Item 3), (Figure 4-120).

NOTE: The 2 points may not be so close to each other that a virtual wall is not clearly defined; the 2 points should be at least 10 ft apart.

8. Use the Right Arrow (4, Figure 4-69) Function key, if needed, to highlight the Accept Crane Position Point B Item (3, Figure 4-120).
9. Use an OK (5, Figure 4-69) Button to accept the current crane position to be Point B (3, Figure 4-120). The location of the point should now be shown on the screen with a label (1b) as shown in yellow highlight in Figure 4-121.

NOTE: The screen should also show another "forbidden zone" for the area beyond the Virtual Wall. Use a visual inspection of the screen and the area around the crane to verify that the Virtual Walls are providing the desired zone correctly. Again, note

that the boom is now at the wall limitation, so alarms will sound. The boom can now be moved away from the wall to cease the alarm.

10. Multiple Virtual Walls are now defined and enabled.

Virtual Walls Limitation Disable Procedure

To disable the active Virtual Walls Limitation, the following steps can be used:

1. Using the Jog Dial (5, Figure 4-70) go to the Working Range Limiter (WRL) Group Menu (1), (Figure 4-115). Then choose the Virtual Walls Limitation Menu (6), (Figure 4-115).
2. Use the Right Arrow (4), (Figure 4-69) key and to highlight the Virtual Wall Number (1), (Figure 4-120).
3. If the wall number shown is not the correct number for wall to be disabled, use an OK Button (5, Figure 4-69) to allow you to modify the value. (In other words, be sure that the number of walls you set matches the Virtual Walls Number (1), (Figure 4-120).
4. Use the Up/Down Arrows (4, Figure 4-69) to alter the Virtual Walls number to the desired value. Use an OK Button (5, Figure 4-69) to finish entering the value.

5. Use the Left Arrow and/or Right Arrow (4, Figure 4-69) keys or the Jog Dial (5, Figure 4-70) to highlight the Enable/Disable Switch Symbol (4, Figure 4-120).
6. Use an OK Button (5, Figure 4-69) to toggle the symbol to the Limitation being disabled.

Delete Virtual Walls Limitation Procedure

To delete a Virtual Wall the following steps can be used:

1. Select the Virtual Wall Limitation Screen (6, Figure 4-115) on the WRL Menu Group Screen (Figure 4-115).
2. Use the Right Arrow (4, Figure 4-69) Function to highlight the Virtual Wall Number (1, Figure 4-120).
3. If the wall number shown is not the correct number for wall to be disabled, use an OK Button (5, Figure 4-69) to allow you to modify the value. (In other words, be sure that the number of walls you set matches the Virtual Walls Number (Item 1), (Figure 4-120).
4. Use the Left Arrow and/or Right Arrow (4, Figure 4-69) key to highlight the "X" or the Remove Virtual Walls Symbol (5, Figure 4-120). Use an OK Button (5, Figure 4-69) or the Jog Dial (5, Figure 4-70) to delete the wall.

For Reference Only

Emergency Program Menu Group

The Emergency Program Menu Group (1, Figure 4-122) includes the following boom telescoping function icons:

- Manual Mode (2)
- Emergency Mode (3)
- Tele Recovery (4)

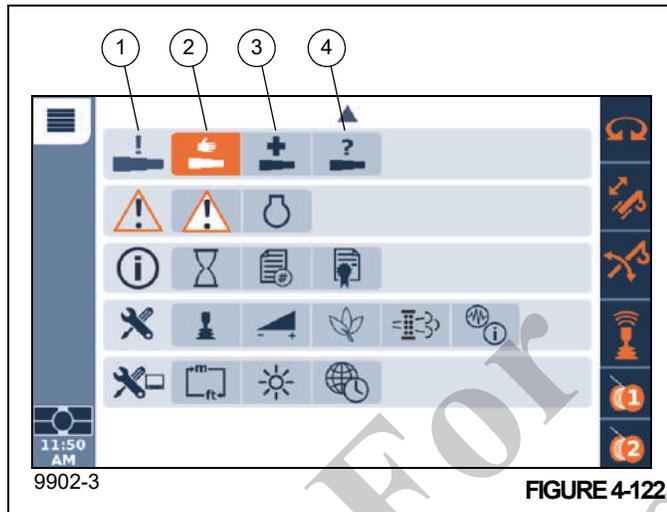


FIGURE 4-122

Manual Telescope Mode

NOTE: Refer to *Boom Configurator*, page 4-48 for more information on how the Boom Configurator screen is used in the telescoping operation.

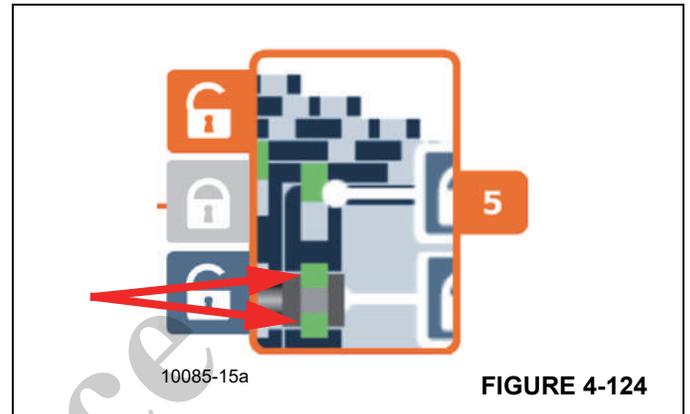
To open: Select symbol (1) and confirm – menu is opened Figure 4-123.



8882-2e
FIGURE 4-123

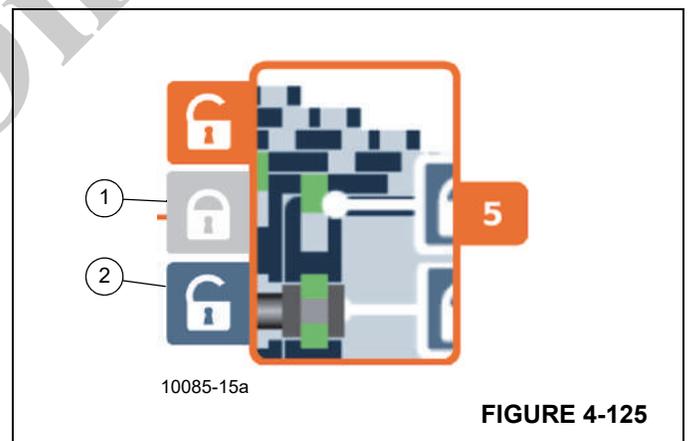
Telescoping Cylinder Locked/Released

Display	Yellow:	Locking pins intermediate position Figure 4-124
	Green:	Telescoping cylinder locked
	Red:	Telescoping cylinder unlocked



Locking/releasing the Telescoping Cylinder

To lock:	Telescopic section locked: Select symbol (1, Figure 4-125) and confirm – telescoping section is locked
To unlock:	Telescopic section locked: Select symbol (2) and confirm – telescoping section is unlocked



Lock/release Telescopic Section Indication

Display	Yellow:	Locking pins intermediate position Figure 4-126
	Green:	Telescopic section locked
	Red:	Telescopic section unlocked

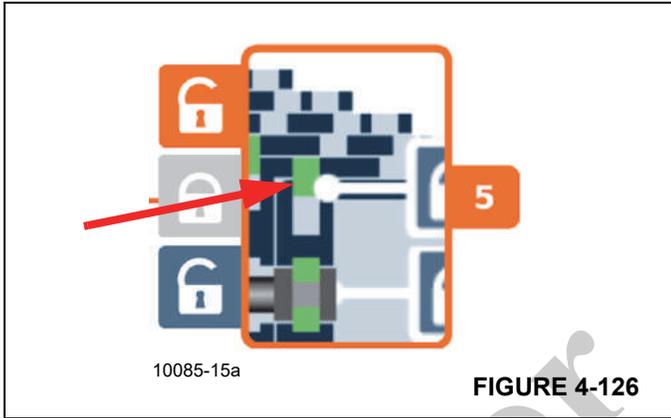


FIGURE 4-126

Locking/releasing the Telescopic Section

To lock:	Select symbol (2) Figure 4-127 and confirm – telescopic section locked
To unlock:	Select symbol (1) and confirm – telescopic section is unlocked

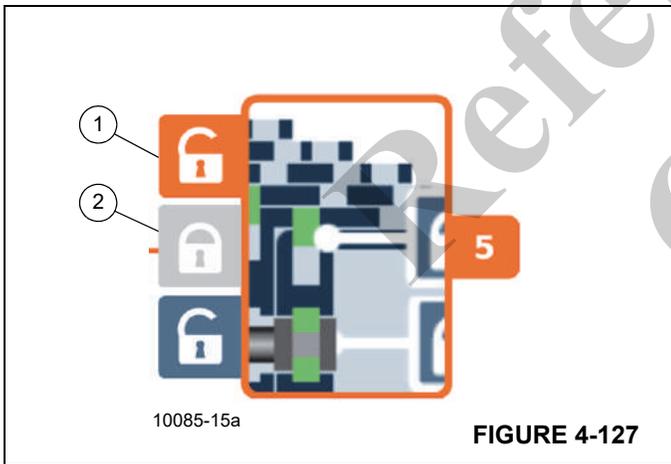


FIGURE 4-127

Telescoping Cylinder Length Display

Display:	Current extended length of the telescoping cylinder (1, Figure 4-128)
Unit of measurement:	Displayed in mm (millimeters)

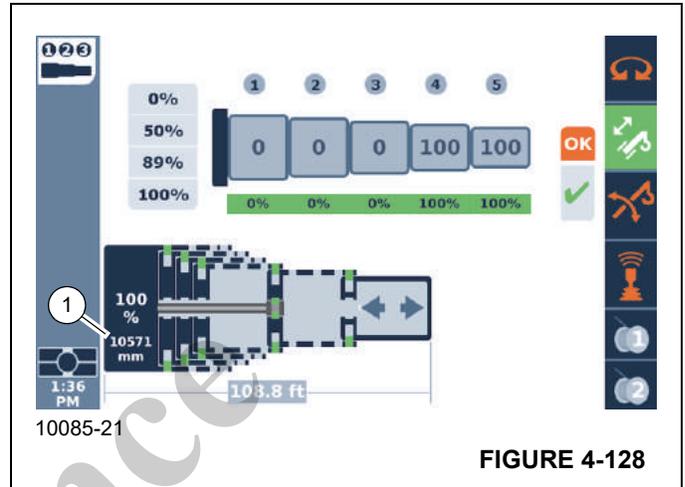


FIGURE 4-128

Main Boom Length Display

Display:	Current extended length of the main boom (1, Figure 4-129)
Unit of measurement:	Displayed depending on setting, m (meters) or ft (feet)

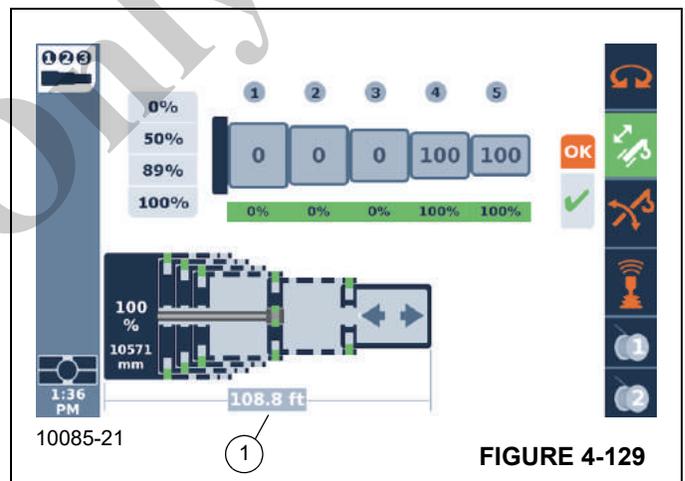


FIGURE 4-129

Telescoping Section in the Telescopic Section Display

Displayed telescopic section, e.g. telescopic section 5 Figure 4-130

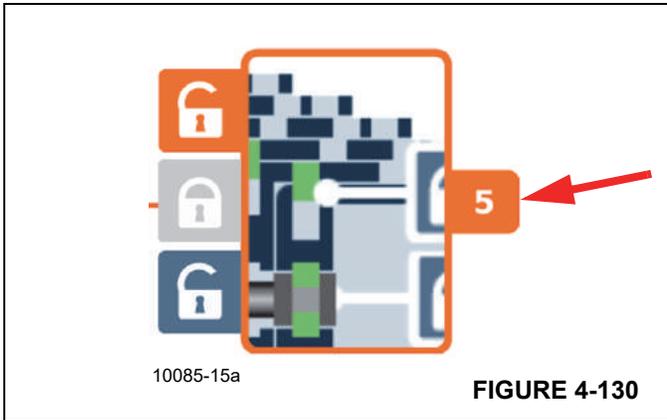


FIGURE 4-130

Telescoping Direction Display

1	Start with Retract Figure 4-131
2	Start with Extend

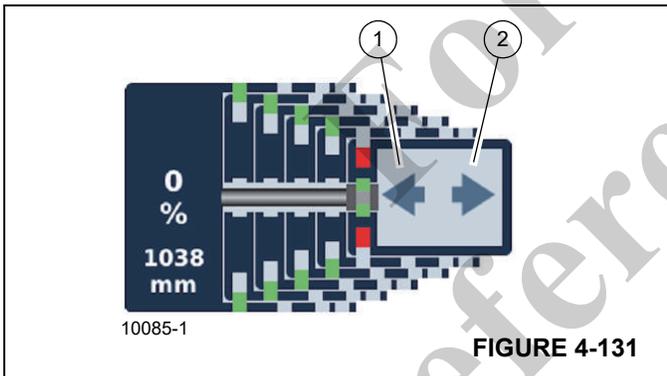


FIGURE 4-131

Emergency Telescope Mode

In the event of a malfunction in the telescoping mechanism, or if maintenance is needed for the tele cylinder mechanism, you can manipulate the main boom with the Telescoping emergency program.

The emergency program is not intended for crane operation and is therefore restricted to approximately 1000 seconds (or 16 minutes). After that allotted time, the password must be entered again.

If possible, set down the load before starting the emergency program.

There is a standard control level for the emergency program, and there is an extended control level for the emergency program. The standard control level or standard emergency program is accessed with the password as shown (HELP).

The extended control level or extended emergency program is accessed with the passcode (a set of numbers provided to the customer as described below).

The standard emergency program is intended for standard maintenance, such as bringing the telescoping cylinder to the access hole. In this case, all boom sections are fully retracted, the T1 telescoping section can be unlocked, and then this boom section can be extended to the first locking position, and then this boom section can be locked there, and then the telescoping cylinder can be retracted to the hole. The standard emergency program will only allow extending the telescoping cylinder if the boom length is not longer than this particular configuration (i.e. T1 at first locking position and all other boom sections fully retracted and locked). If the boom is completely retracted, then the telescoping cylinder can be manipulated between the boom sections; this can be used to test the operation of the locking mechanism and the telescoping cylinder.

The extended emergency program has no logical restrictions for the operation of the locking mechanism or the motion of the telescoping cylinder. This level of control is expected to be used when there has been a condition that is not handled by the control system (such as difficulties with hardware, communication loss, or entrapped air in the telescoping system). It is entirely the responsibility of the operator to be aware of the location of the boom components and to use the appropriate commands and motions.

Open Sub-menu Emergency program

- Select and confirm the letters H-E-L-P (1, Figure 4-134) – the screen to access the standard Telescoping emergency program is opened.

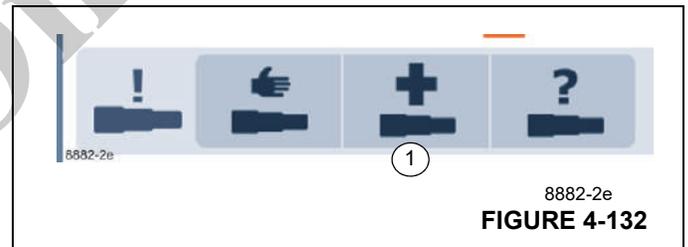
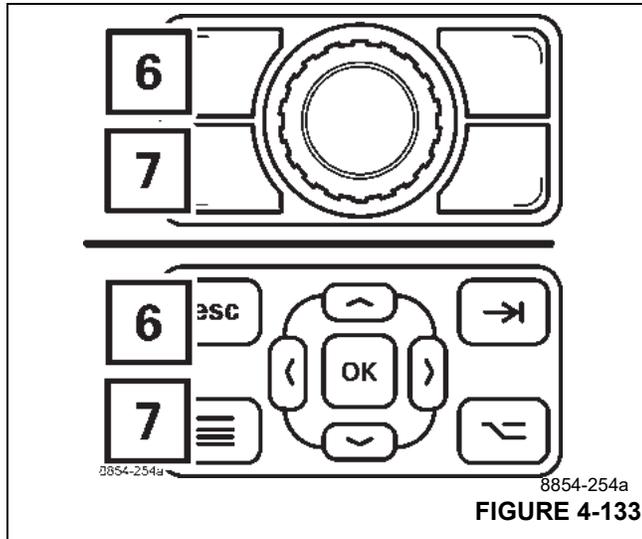


FIGURE 4-132

- If Manitowoc Crane Care or Local Distributor has provided a passcode for the extended emergency program, then the passcode can be entered by using the down-arrow on the display, or the jog-dial rotation, to find the numbers for entry prior to the letter A.
- Confirm the entry with the symbol (2, Figure 4-134).

Operator can cancel the entry at any time using the (6 or 7, Figure 4-133) buttons.



The telescoping mechanism can be operated with the emergency program within this time.

If the time is not sufficient then you must restart the emergency program.

Access Telescoping Emergency Program Menu

Enter a password to open the telescoping emergency program menu.

After the correct entry has been made, the Telescoping emergency program is started.

The emergency program has a time limit. The display (1, Figure 4-135) shows the remaining time for operating the emergency program.

It runs for approx. 1000 seconds (or 16 minutes).

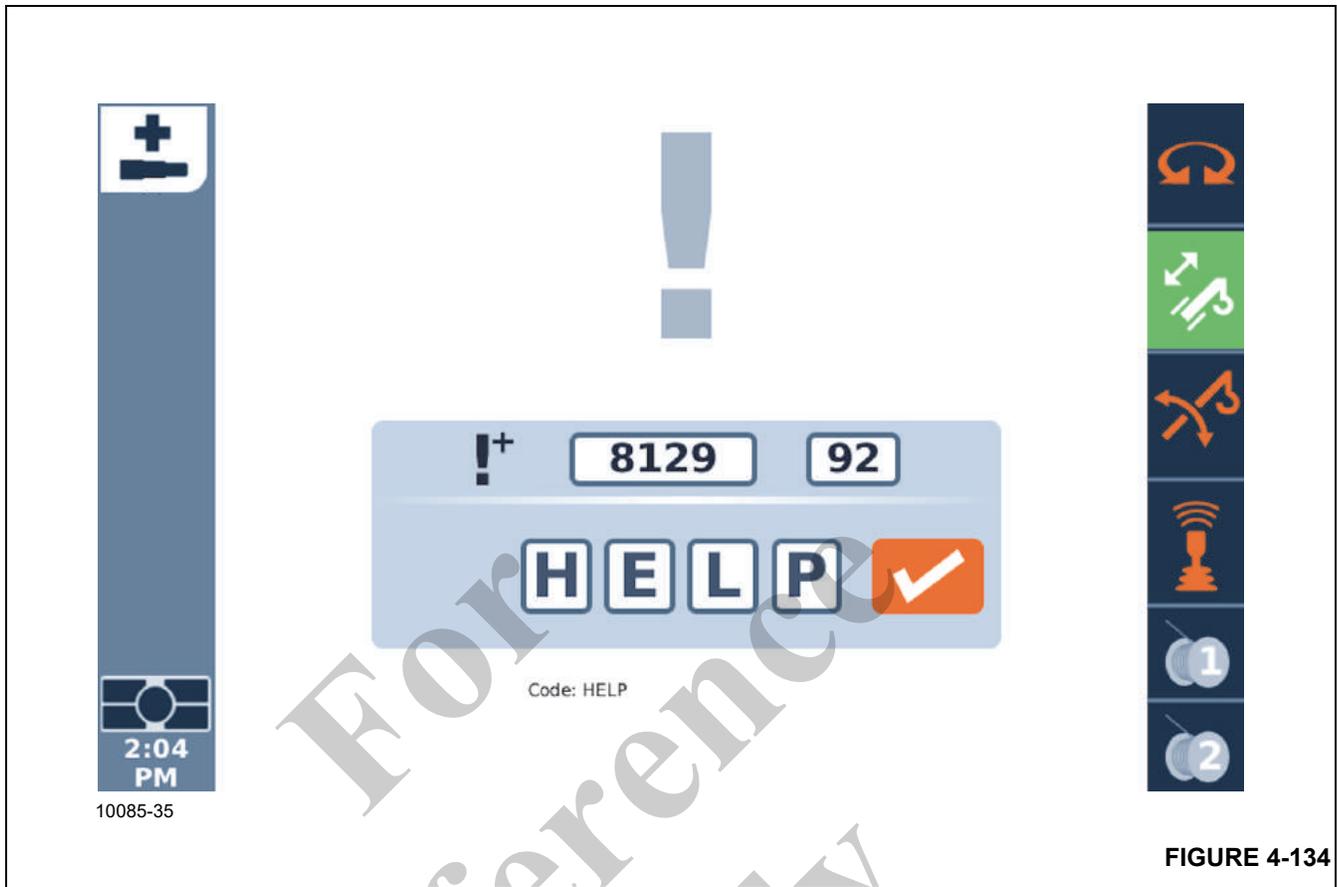


FIGURE 4-134

Item	Description	Refer to
1	Enter the password HELP to access the Telescoping emergency program with basic controls. To enter the password, highlight a letter, select Enter to alter the letter, dial the new letter, and select Enter again. ¹⁾	
2	Select the check-mark after entering the password.	
3	Telescoping emergency program seed value.	
4	Counter for time limit for entering passcode.	

¹⁾ In order to enter a passcode (numbers), instead of a password (letters), manipulate the standard letters for the first position (the H position for H-E-L-P) until a selection is shown prior to the letter A, then the digits 0 to 9 will appear.

extend slightly (moving the right joystick to the right, if using the dual axis controller arrangement). If S2116N is ON in this near connection condition, then the cylinder needs to retract slightly (moving the previously mentioned joystick to the left). These motions are logical with respect to what is shown on the screen.

Proximity switch S2114N is for the left cylinder pin being extended and proximity switch S2115N is for the right cylinder pin being extended. Proximity switch S2120N is a redundant switch for the left cylinder pin being extended. Proximity switch S2112N is for the left cylinder pin being retracted and proximity switch S2113N is for the right cylinder pin being retracted.

Figure 4-136 has further explanation for the telescoping emergency program screen. Item 1 is the graphical representation of the tele cylinder pins that connect to a telescoping boom section. When these cylinder pins are considered retracted, an unlock symbol will appear in this location.

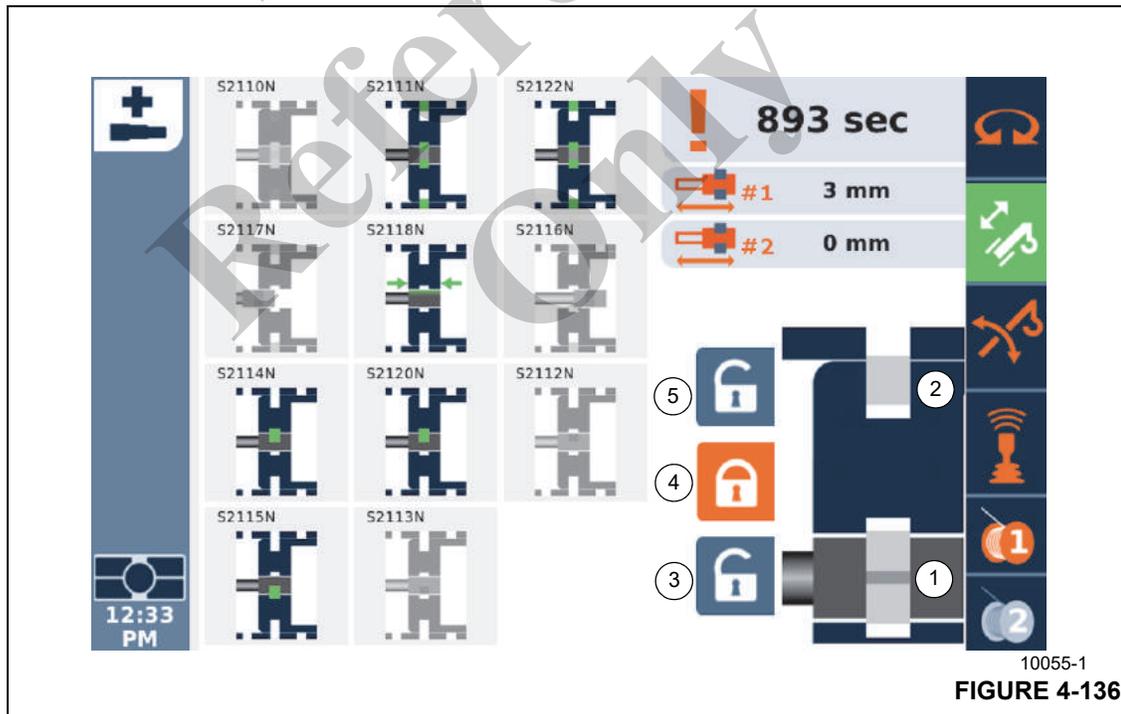
Item 2 is the graphical representation of the boom section and its pins that connect to the next telescoping boom section. Note that in the telescoping emergency program, the actual boom section that the cylinder is no longer able to be determined; the crane operator must determine this. When these section pins are considered retracted (at least

the actuator has moved to attempt this), an unlock symbol will appear in this location.

Item 3 is the indicator for a command to attempt to retract the cylinder pins. The arrow buttons on the display or the jog dial can be used to highlight this, and hitting the OK/Enter button will then attempt to execute the command. The lock/unlock symbol on the button does not change based on the cylinder operations (refer to Items 1 and 2).

Item 4 is the indicator for a command to release or re-extend pins. This command works for both the cylinder pin retracting and the section pin retracting. There is a mechanical interlock device internal to the pinning head/cylinder that only allows for either the cylinder pins or the section pins to be retracted but not both at the same time. The arrow buttons on the display or the jog dial can be used to highlight this, and hitting the OK/Enter button will then attempt to execute the command. The lock/unlock symbol on the button does not change based on the cylinder operations (refer to Items 1 and 2).

Item 5 is the indicator for a command to attempt to retract the section pins. The arrow buttons on the display or the jog dial can be used to highlight this, and hitting the OK/Enter button will then attempt to execute the command. The lock/unlock symbol on the button does not change based on the cylinder operations (refer to Items 1 and 2).



CAUTION

Machine damage hazard!

Telescoping the main boom when there is an error on the precision length indication and malfunctioning proximity switches can result in damage to the main boom, contact Manitowoc Crane Care or your Local Distributor to determine if you are permitted to start the telescoping process. They can provide the passcode to use in the telescoping emergency program with extended capabilities.

A situation could arise in which the main boom can no longer be extended or retracted.

CAUTION

Machine damage hazard!

When an override switch is used there is no monitoring of boom up and down, swing, telescoping, or hoist operation.

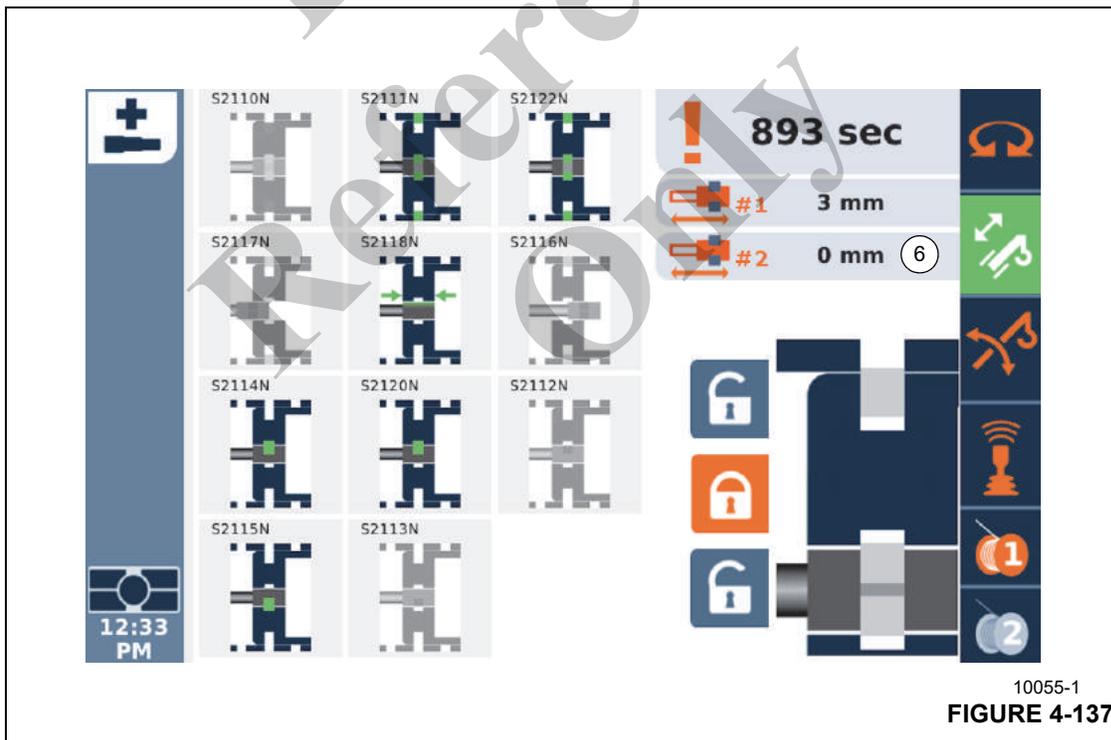
NOTE: In the Telescoping emergency program, all functions for retracting the main boom remain

enabled as long as there are no other errors (hydraulic or mechanical). However, extending boom sections may require use of a override switch, and only the telescoping emergency program with extended capabilities can be expected to extend any boom section at any time. The telescoping emergency program with basic capabilities is intended to be able to get the tele cylinder to the configuration where the tele cylinder pinning head can be serviced from the access hole in the base section, not to fully retract the boom after failures of sensors or mechanical components.

NOTE: The telescoping speed is restricted to approx. 30% of the maximum speed.

Error on Length Indicator

- If the precision length sensor for the tele cylinder does not show a reasonable value, then the second length sensing can be referred to (6, Figure 4-137). This is from a length potentiometer from the power cable reel in the boom (it is separate from the precision length sensor). This length potentiometer is not as accurate as the precision length sensor. Thus, the two reels may not always show the same values.



Checks before Telescoping

Before telescoping, the following conditions are expected to be met (but depending on what components may have failed the conditions may not be met):

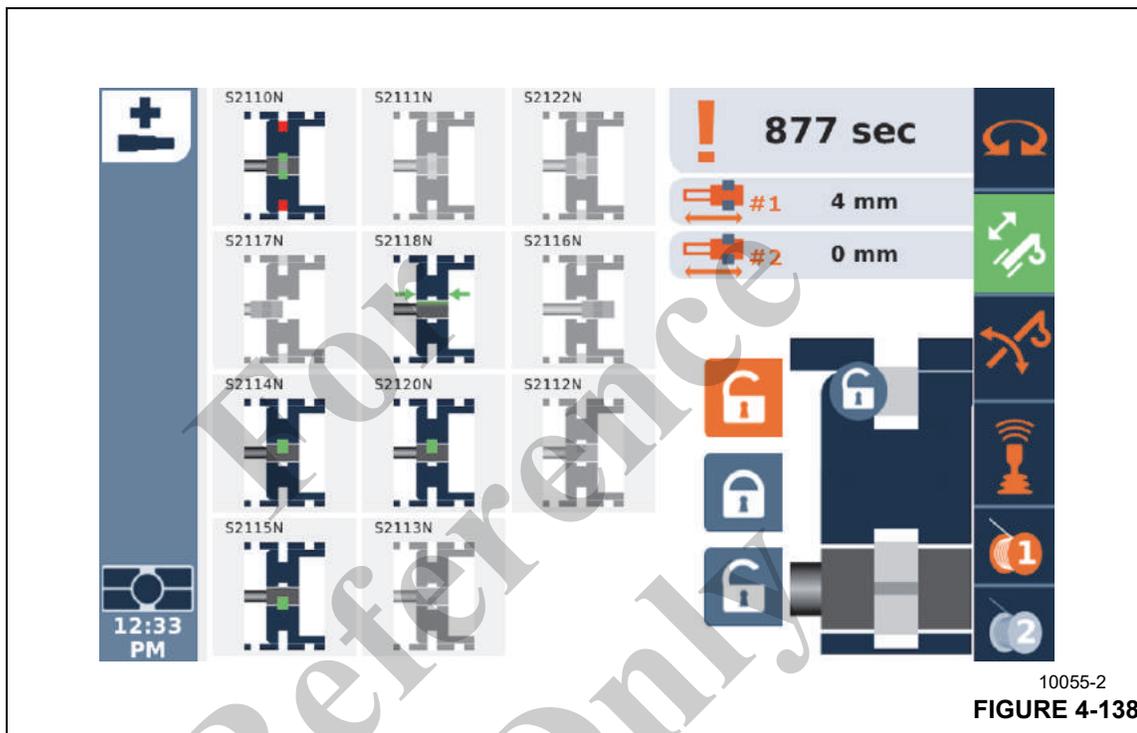
The telescoping emergency program screen should appear as in Figure 4-138.

The telescoping cylinder is locked to a telescoping boom section (no unlock symbol shown near the graphical

representation of the tele cylinder - refer to Item 1 in Figure 4-136).

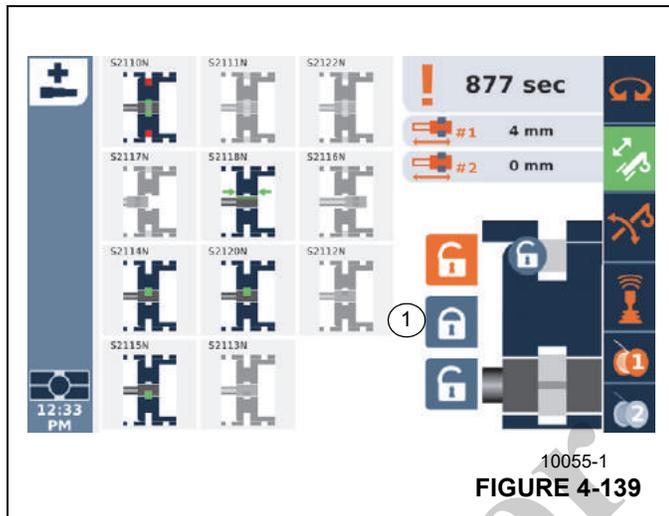
The telescoping boom section is unlocked (the unlock symbol is shown near the graphical representation of the section pins - refer to Item 2 in Figure 4-136).

In the top row of the proximity switches, S2110N is on, the others in the row are off. In the middle row of the proximity switches, S2118N is on, and the others in the row are off.



Retracting and locking a telescopic section

During telescoping motion you are not to select Lock. Under no circumstances, while the tele cylinder is moving, should you select and press the symbol (4, Figure 4-136).



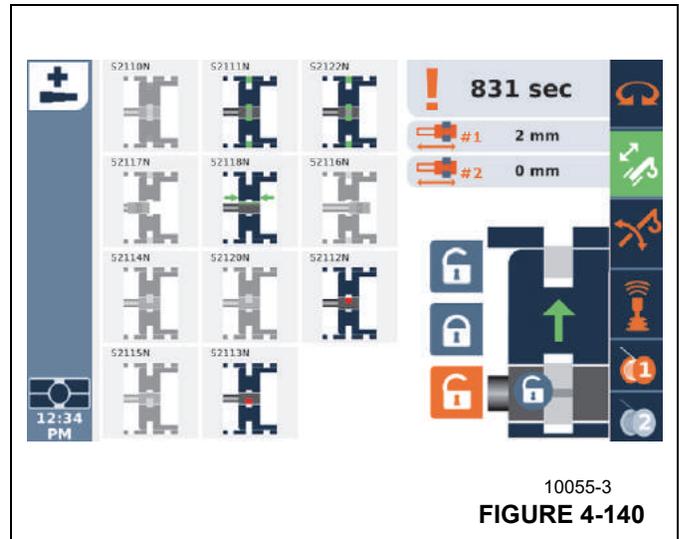
CAUTION

Machine damage hazard!

If you select Lock during telescoping, the locking pins on the telescopic section are slid out immediately and they can damage or tear the electrical or hydraulic components in the main boom.

- Make sure section pins are retracted (unlocked), then retract the telescopic section slowly and as far as possible; refer to (Table 4-1) for the expected value for the precision length sensor (Item 2 in Figure 4-135) when the boom sections are at the different locking positions.
- Now select and confirm the symbol (1, Figure 4-139).
- After tele section has been locked to outer section, retract the tele cylinder approximately 15mm to 30mm to set down the tele section (refer to *Locking points for the telescopic sections*, page 4-142).

The telescopic section can be locked (if the actuator is able to release the section pins, and the telescoping boom section is actually aligned with a pinning hole). The screen should appear as shown in Figure 4-140. In particular, S2110N should be OFF and S2111N and S2122N should be ON.



Unlocking the Telescopic Cylinder

If the telescopic section is locked (typically indicated by Figure 4-137), you can now attempt to unlock the telescoping cylinder.



WARNING

Risk of damage to main boom!

You can select and confirm the symbol for unlocking the telescopic cylinder. If this does not start the unlocking procedure, contact your local distributor or Manitowoc Crane Care.

- Select and confirm the symbol (3, Figure 4-136).
The telescopic cylinder is unlocked. In the unlocked position, the screen should appear as indicated by Figure 4-140. The telescopic cylinder is unlocked from any telescoping boom section (unlock symbol shown near the graphical representation of the tele cylinder - refer to Item 1 in Figure 4-136).

The telescoping boom section is locked (the unlock symbol is not shown near the graphical representation of the section pins - refer to Item 2 in Figure 4-136).

In the top row of the proximity switches, S2111N and S2122N are on, the other in the row is off. In the middle row of the proximity switch S2118N is on, but the others are on or off depending on the location of the tele cylinder with respect to telescoping boom sections.

You can now move the telescoping cylinder into the next telescopic section, refer to Table 4-2 for the expected value for the precision length sensor (Item 2 in Figure 4-135) when the tele cylinder is near a connection to a boom section.

Table 4-1 Locking point distances for telescopic boom sections

	T1 (mm)	T2 (mm)	T3 (mm)	T4 (mm)	T5 (mm)
0%	0	280	539	798	1033
55%/50%	5363	5664	5481	5714	5959
92%	8660	8974	9312	9525	9778
100%	9727	10045	10393	10600	10855

Table 4-2 Locking point distances for telescoping cylinder

	T1 (mm)	T2 (mm)	T3 (mm)	T4 (mm)	T5 (mm)
0%	0	280	539	798	1033
55%/50%	5333	5634	5451	5684	5929
92%	8630	8944	9282	9495	9748
100%	9697	10015	10363	10570	10825

For Reference Only

Extending and locking the telescoping cylinder

Under no circumstances should you select and press the lock symbol (1, Figure 4-139) while the tele cylinder is in motion.

CAUTION

Machine damage hazard!

If you select Lock while the telescoping cylinder is moving, the locking pins on the telescopic section are slid out immediately and they can damage or tear the electrical or hydraulic components in the main boom.

Slowly move the telescoping cylinder into the next extended telescopic section.

At the locking point:

- The display (2, Figure 4-135) shows the length for the current locking point, refer to (Table 4-2)
- The proximity switch indicators for S2117N, S2118N, and S2116N are used to align the tele cylinder to the hole in the boom section. S2118N is on whenever the tele cylinder pins are in the “foot section” or the near end of the boom section weldment where the hole is located. S2116N comes on when the tele cylinder has extended beyond the hole. S2117N comes on when the tele cylinder is not extended enough to reach the hole. Therefore, one would operate the tele cylinder until S2118N is on, and S2116N and S2117N are off. This is what is shown in Figure 4-140.
- Select and confirm the symbol shown as Item 4 in Figure 4-136.

The telescoping cylinder is locked if the actuator is able to release the cylinder pins, and the tele cylinder is actually aligned with a pinning location hole in the boom section. The screen should appear as shown in Figure 4-137.

- With the tele cylinder locked to the section, extend the tele cylinder approximately 15mm to 30mm to clear the

cut out on the tele section locking pins (refer to *Locking points for the telescopic sections*, page 4-142). You can now unlock the tele section from its outer section, then operate the telescopic cylinder. Refer to *Retracting and locking a telescopic section*, page 4-140.

Tables for approaching the locking points

The extent to which the telescoping cylinder has to be extended in order to reach a locking point depends on whether you want to lock:

- the telescoping cylinder or
- a telescopic section.

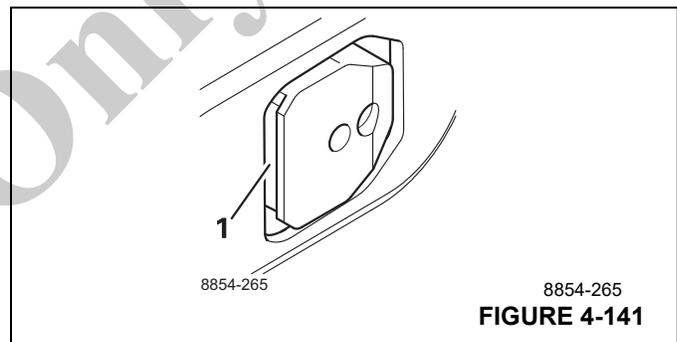
Locking points for the telescoping cylinder

Table 4-2 shows the extended length for locking the telescoping cylinder.

Locking points for the telescopic sections

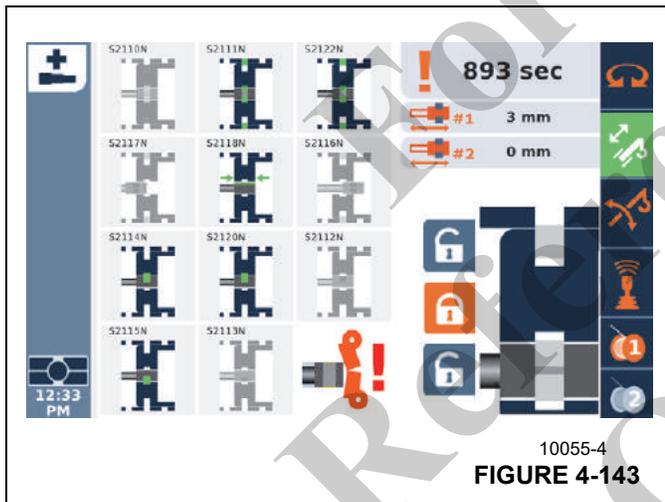
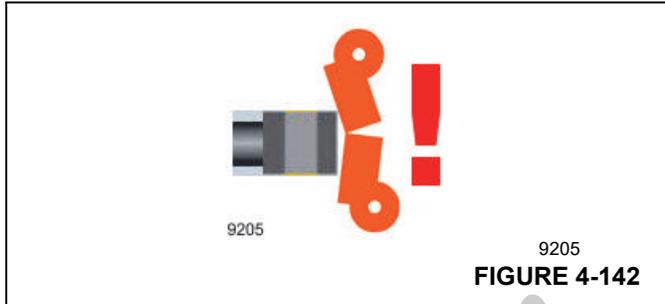
Table 4-1 shows the extended length for locking the telescopic boom sections together. Lengths for locking the telescope boom sections at 50%, 55%, 92%, and 100% are 30 mm greater than those in Table 4-2.

This added length is needed for the tele section locking pins to first clear the holes in the outer tele section. After the tele section locking pins are extended and locked into the outer holes, the tele cylinder is to be retracted 30 mm to set down the tele section and bring the tele section locking pins into contact with the bottom of the holes in the outer tele section (1 .Figure 4-141).



Telescoping cylinder boom nose switch

A whisker-style trigger switch is installed at the boom to detect the tele cylinder barrel being too close to the boom nose. When this switch is triggered, the symbol shown in Figure 4-142 should appear on the left side of the ODM display and in the middle of the Emergency Mode screen Figure 4-143.



In this triggered condition, the telescoping cylinder is no longer expected to be able to extend. If the extended emergency telescoping mode is being used, then it is possible to still extend the cylinder (such as when the switch is malfunctioning or disconnected), but this should only be done with physical verification of the location of the telescoping cylinder with respect to the boom nose. If the telescoping cylinder impacts the boom nose, the boom system will be damaged.

With the telescoping cylinder not moving, and with the joystick not being used, then the bypass switch Figure 4-144 can be used. The telescoping cylinder will now extend, but when the telescoping cylinder stops moving, or if the joystick is no longer used, then the same steps must be repeated to use the bypass switch.



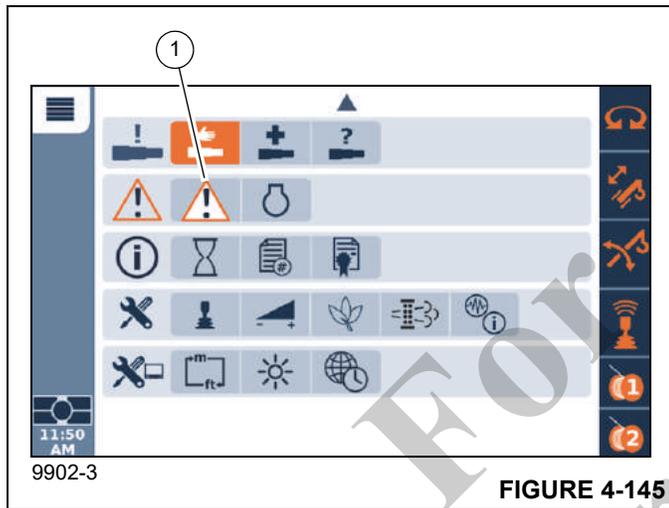
Faults Menu Group

The Fault Menu Group includes the following function icons:

- Crane Faults (page 4-144)
- Engine Faults (page 4-145)

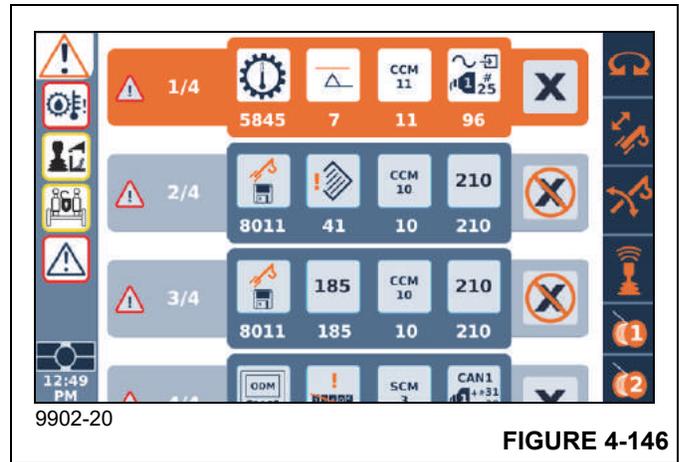
Crane Faults

Select the Crane Faults icon (1, Figure 4-145) under the Faults Menu Group to view active crane fault codes.



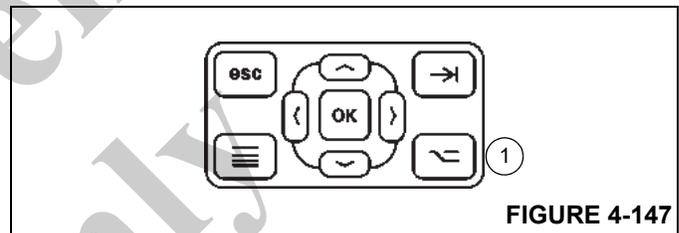
The Crane Fault Code function screen (Figure 4-146) displays active crane fault codes.

If several fault codes are active, use the Jog Dial or Arrow Buttons on the Navigation Control Pad to select the arrow at the top or bottom of the screen to scroll through the codes



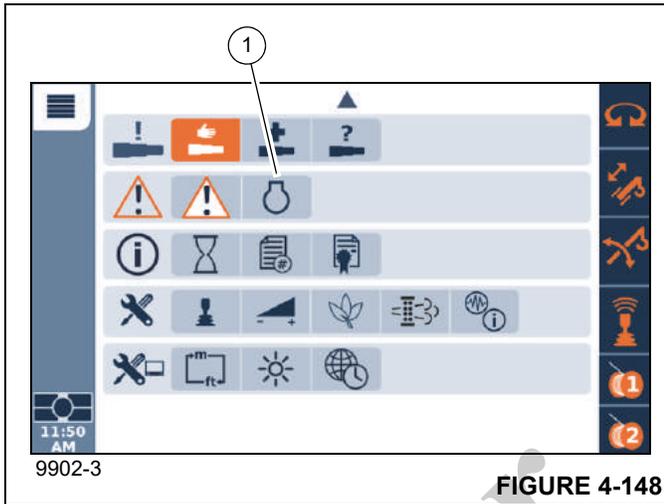
Crane fault codes with an “X” beside them can be cleared by the operator. Crane fault codes with an “X” surrounded by a red circle with strike-through cannot be cleared without first correcting the malfunction, then cycling the ignition key to the Off position and back to the On position.

Additional information about the fault can be accessed by first highlighting a fault code, then pressing the lower right button (1, Figure 4-147) at the ODM Navigation Control Pad.

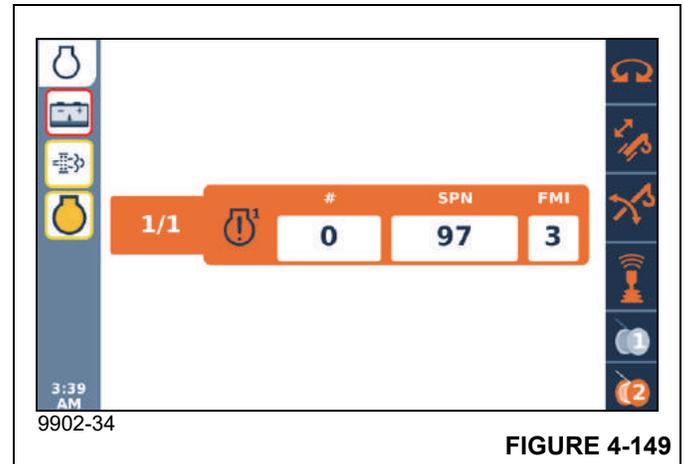


Engine Faults

Select the Engine Faults icon (1, Figure 4-148) under the Faults Menu Group to view active engine fault codes.



The Engine Fault Code function screen (Figure 4-149) displays active engine fault codes.



If several fault codes are active, use the Jog Dial or Arrow Buttons on the Navigation Control Pad to select the arrow at the top or bottom of the screen to scroll through the codes

Engine fault codes cannot be cleared by the operator without first correcting the malfunction, then cycling the ignition key to the Off position and back to the On position.

For Reference Only

Information Menu Group

The Information Menu Group includes the following function icons:

- Operating Hours (page 4-146)
- Software Versions (page 4-148)
- Legal Notice (page 4-148)

Operating Hours

Select the Operating Hours icon (1, Figure 4-150) under the Information Menu Group to show the Operating Hours function screen.

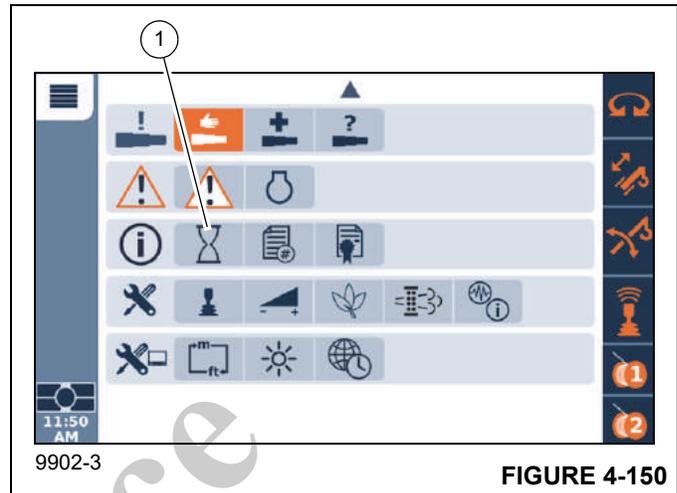
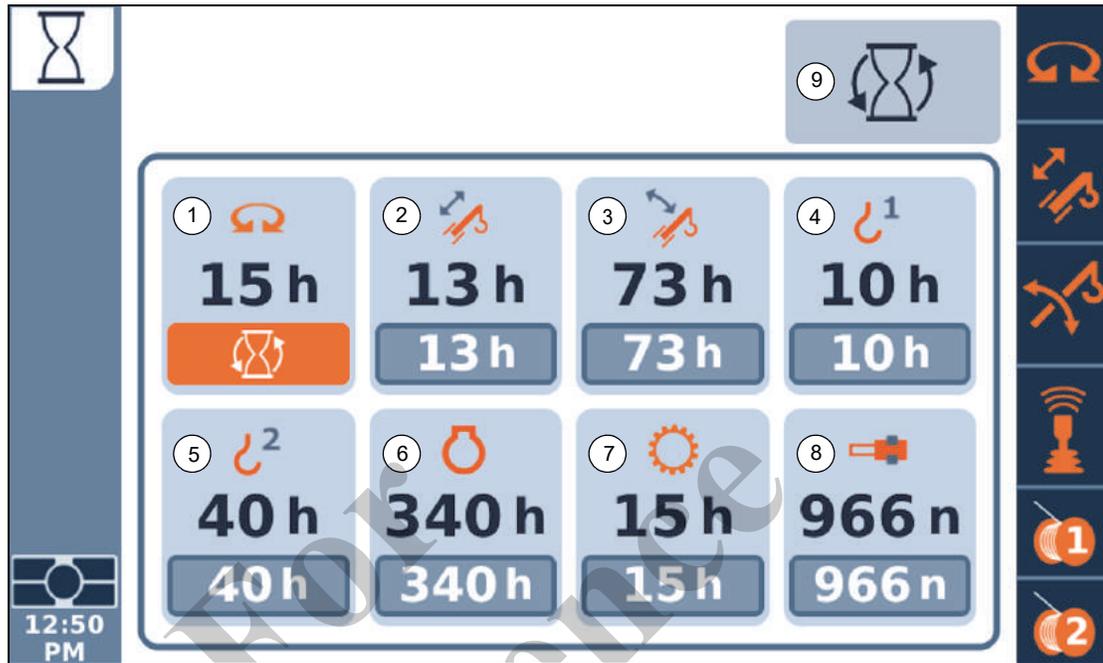


FIGURE 4-150

The Operating Hours function screen (Figure 4-151) shows the total accumulated operating hours for the different crane functions as well as offers a resettable trip meter for each crane function.



Item	Description	Item	Description
1	Swing Operating Hours	6	Engine Operating Hours
2	Boom Telescope Operating Hours	7	Transmission Operating Hours
3	Boom Lift Operating Hours	8	Boom Pinning Count
4	Main Hoist Operating Hours	9	Reset All Icon
5	Auxiliary Operating Hours		

FIGURE 4-151

The top number for each crane function shows the total accumulated hours (1, Figure 4-152). The bottom number is a trip meter and shows total hours since the last reset (2).



FIGURE 4-152

The Boom Pinning Count (8, Figure 4-151) shows how many times the boom has been pinned. All others are in hours.

Reset the trip meter for a crane function by doing the following:

- Using the Jog Dial or Arrow Buttons on the Navigation Control Pad, select the hours under the crane function icon that is to be reset (hours will turn to an orange hour-glass).
- Press the Jog Dial or OK Button on the Navigation Control Pad to reset the hours to zero (0).

NOTE: Allow up to 8 seconds for the trip meter to reset to 0.0 hours.

To reset all crane function operating hours and counts to zero (0), select the Reset All icon (9, Figure 4-151) (icon will turn orange) on the Operating Hours function screen and then press the Jog Dial or the OK Button.

Software Versions

Select the Software Versions icon (1, Figure 4-153) under the Information Menu Group to view the Software Versions function screen.

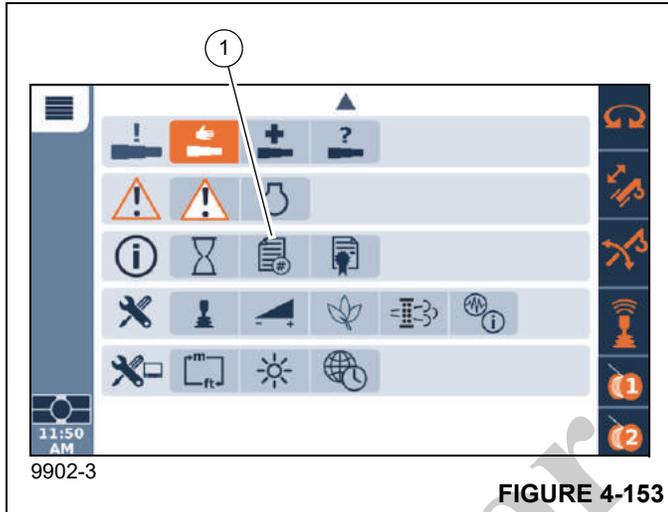


FIGURE 4-153

The Software Versions function screen shows the current software revisions for all of the software installed on the crane.

Legal Notice

Select the Legal Notice icon (1, Figure 4-154) under the Information Menu Group to view the Legal Notice screen.

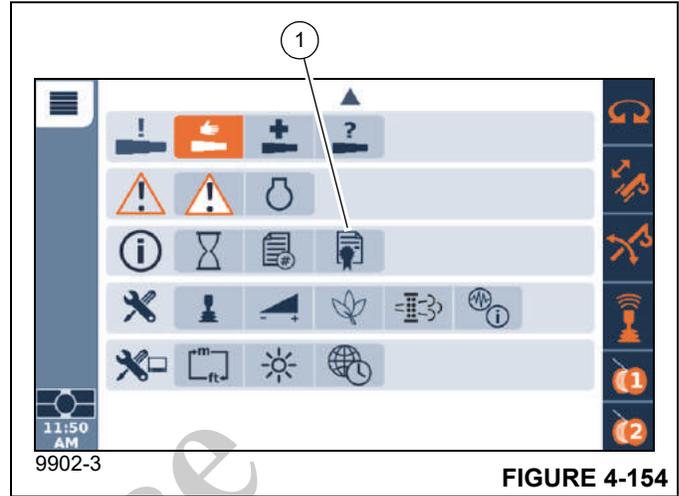
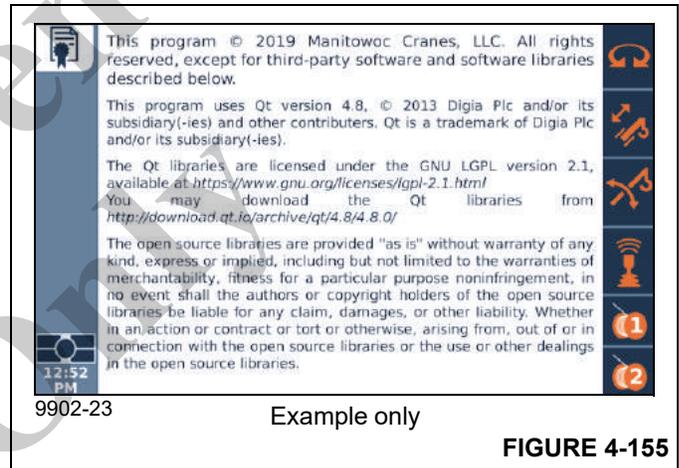


FIGURE 4-154

The Legal Notice screen (Figure 4-155) displays the software licensing notice for the crane software.



Example only

FIGURE 4-155

User Settings Menu Group

The User Settings Menu Group includes the following function icons:

- Controller Curve (page 4-149)
- Controller Speed (page 4-152)
- ECO Mode (page 4-153)
- Exhaust System Cleaning (page 4-155)
- Service Menu (page 4-156)

Controller Curve

Select the Controller Curve icon (1, Figure 4-156) under the User Settings Menu Group to show the Controller Sensitivity function screen.

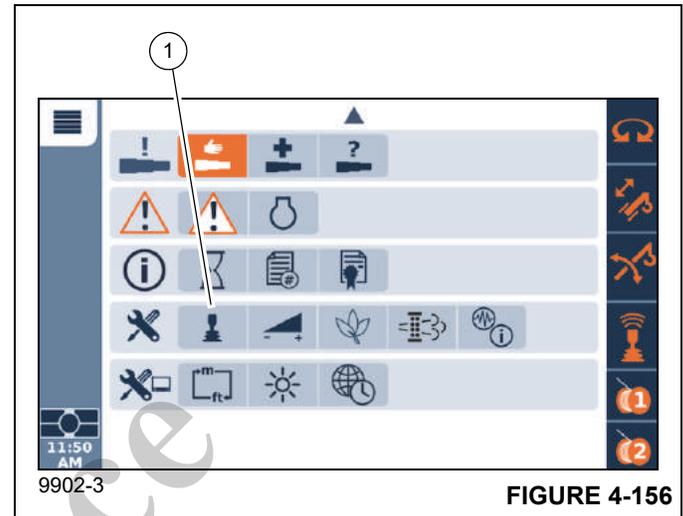
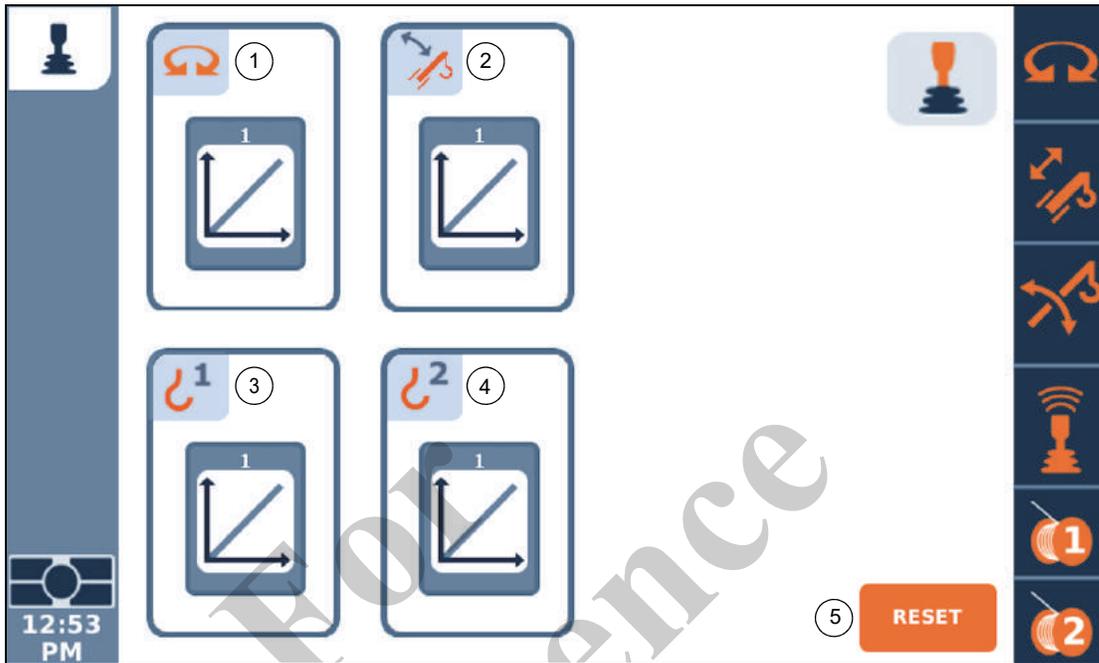


FIGURE 4-156

The Controller Sensitivity function screen (Figure 4-157) allows the operator to adjust the sensitivity of the controllers.

For Reference Only

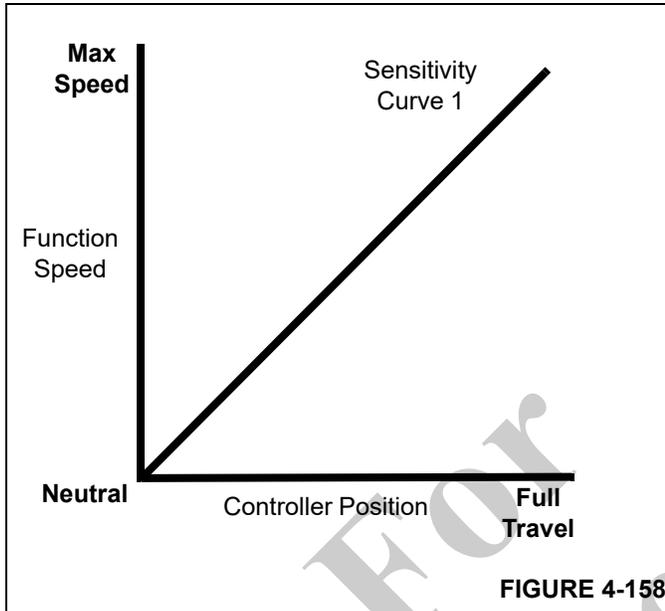


9902-24

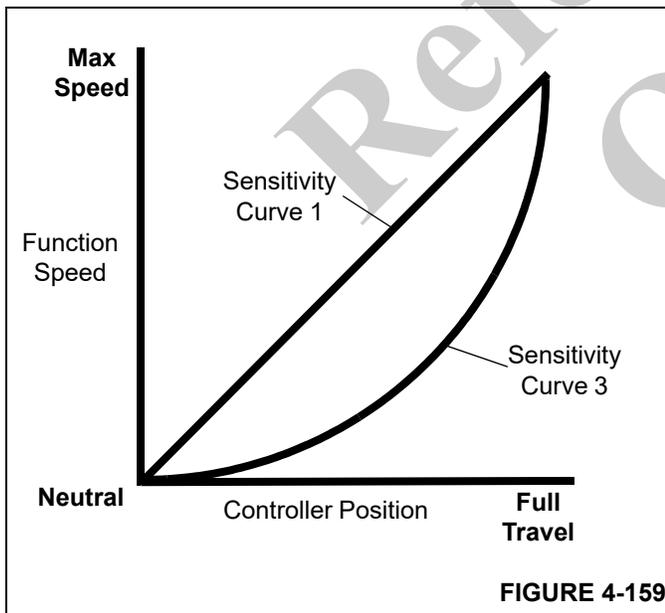
Item	Description	Item	Description
1	Swing Curve	4	Auxiliary Hoist Curve
2	Boom Lift Curve	5	Reset All Icon
3	Main Hoist Curve		

FIGURE 4-157

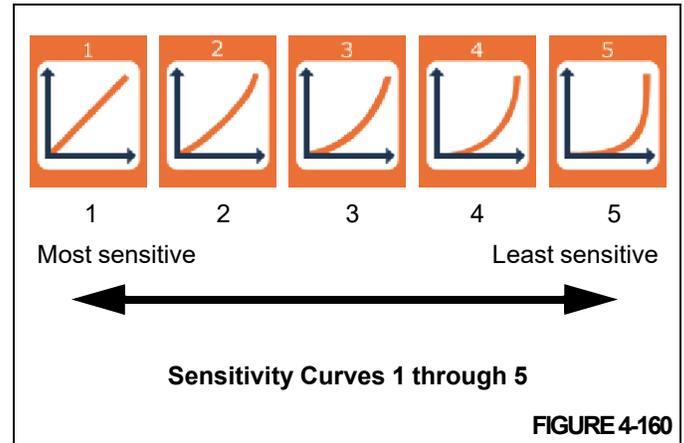
Five different sensitivity curves are available to select from (curves 1 through 5). Sensitivity curve 1 is the default curve and causes the function speed to increase or decrease equally with an equal amount of movement of the controller (Figure 4-158).



Selecting a sensitivity curve of 2 through 5 causes the function speed to be reduced, from the default sensitivity curve 1, relative to the same controller position over the full travel of the controller (Figure 4-159).



Sensitivity curve 1 (default) is the most sensitive and sensitivity curve 5 is the least sensitive (Figure 4-160).



Adjust the sensitivity of a controller function by doing the following:

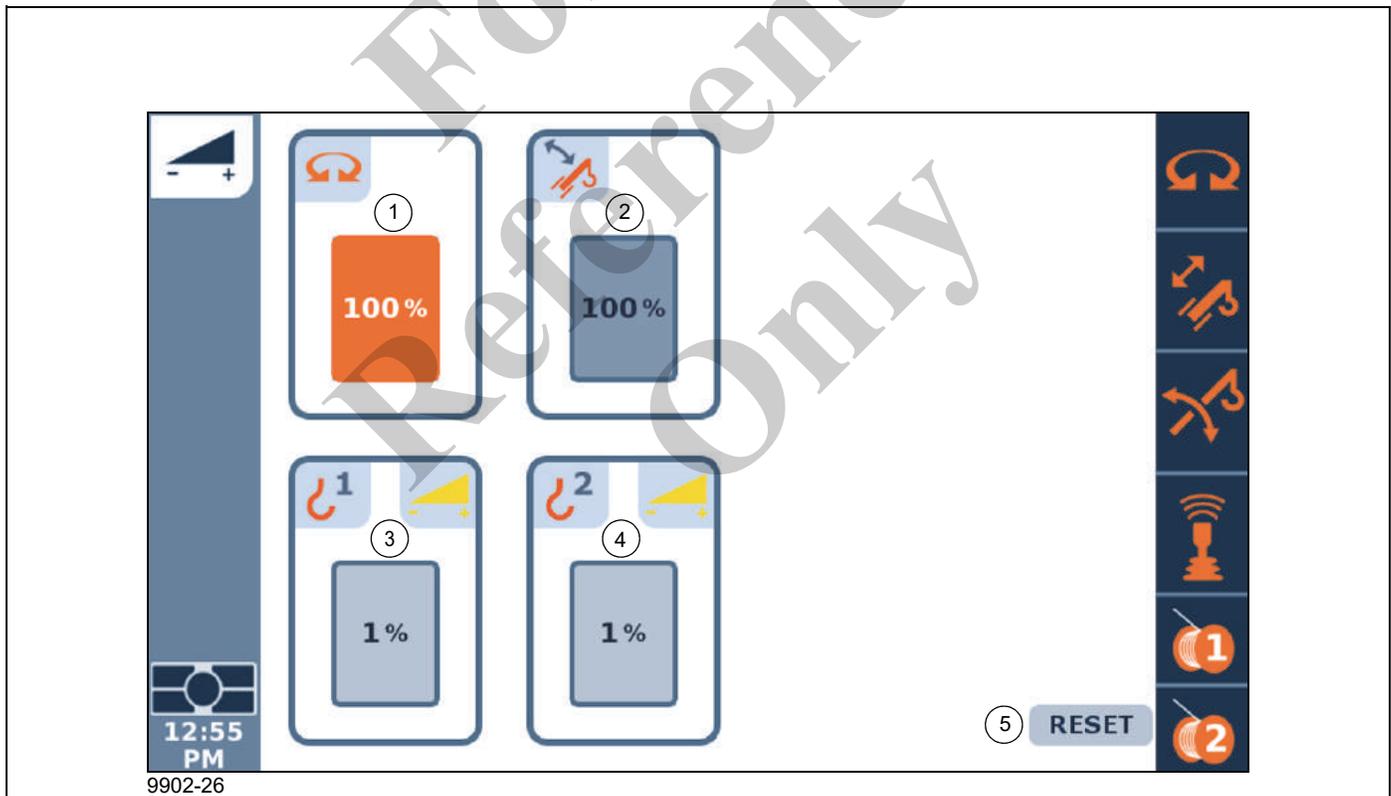
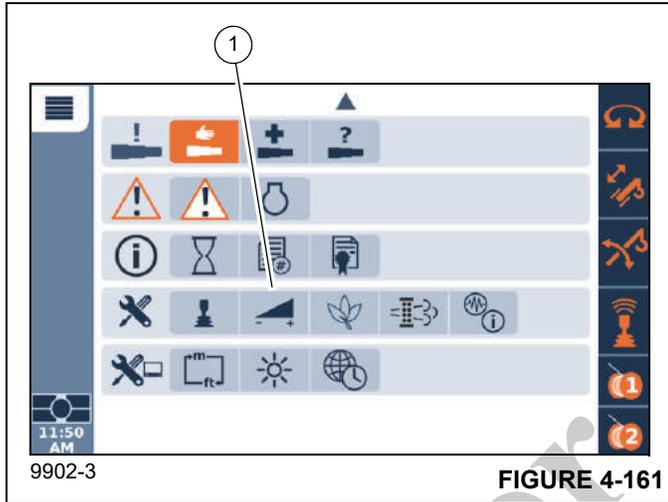
1. Using the Jog Dial or Arrow Buttons on the Navigation Control Pad, select the controller function icon that is to be adjusted (icon will turn orange).
2. Press the Jog Dial or OK Button on the Navigation Control Pad to make the controller function icon active (icon background will turn gray).
3. Using the Jog Dial or the Up/Down Arrow Buttons, select one of the five possible sensitivity curves (Figure 4-160).
4. Press the Jog Dial or OK Button to accept the new setting.

Select the Reset All icon (5, Figure 4-157) on the Controller Sensitivity function screen and press the Jog Dial or the OK Button to set the sensitivity of all functions to the factory default setting (default setting = Curve 1).

Controller Speed

Select the Controller Speed icon (1, Figure 4-161) under the User Settings Menu Group to show the Controller Speed function screen.

The Controller Speed function screen (Figure 4-162) allows the operator to adjust the crane function speeds relative to the positions of the controllers. Adjustment is made as a percentage of full rated speed.



Item	Description	Item	Description
1	Swing Speed	4	Auxiliary Hoist Speed
2	Boom Lift Speed	5	Reset All Icon
3	Main Hoist Speed		

FIGURE 4-162

A setting of 100% results in the crane function moving at full rated speed relative to the position of the controller. A setting of 75% results in the crane function moving at 75% of full rated speeds throughout the range of the controller.

Adjust the speed of a controller function by doing the following:

1. Using the Jog Dial or Arrow Buttons on the Navigation Control Pad, select the controller function icon that is to be adjusted (icon will turn orange).
2. Press the Jog Dial or OK Button to make the controller function icon active (icon background will turn gray).
3. Using the Jog Dial or the Up/Down Arrow Buttons, adjust the percentage to the desired setting.

Adjustments are made in 1% increments/decrements. To quickly make large adjustments, hold down the Jog Dial while rotating it.

4. Press the Jog Dial or OK Button to accept the new setting.

Select the Reset All icon (5, Figure 4-162) on the Controller Speed function screen and press the Jog Dial or the OK Button to set all function speeds to the factory default setting of 100%.

NOTE: A crane function speed can be set to 0 (zero) to prevent movement of that function. Crane functions set to a speed of 0 cannot be enabled by way of the related Enable/Disable Switch.

This is useful in a situation where, for example, a hoist is wound with rope and the rope is tied-off at the hoist. The operator can prevent that hoist from operating by setting its speed to 0.

ECO Mode

Select the ECO Mode icon (1, Figure 4-163) under the User Settings Menu Group to show the ECO Mode function screen.

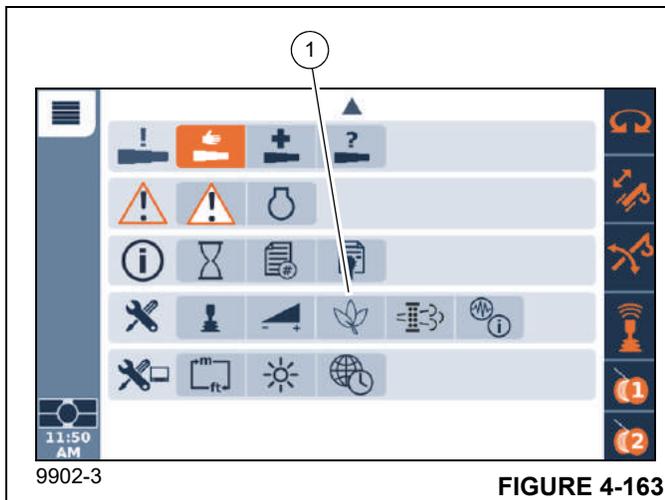


FIGURE 4-163

The Economy (ECO) Mode function offers the operator a convenient way to reduce noise and fuel consumption during craning operation. ECO Mode does this by automatically increasing the engine speed to an operator specified engine working speed when craning functions are operated and then decreasing the engine speed to idle speeds when no craning functions are operated.

The ECO Mode function screen (Figure 4-164) allows the operator to set the ECO Mode function to on or off. The function screen also allows the operator to specify the lengths of time of crane function inactivity before the crane's engine speed is reduced from the working engine speed to the two idle speeds.

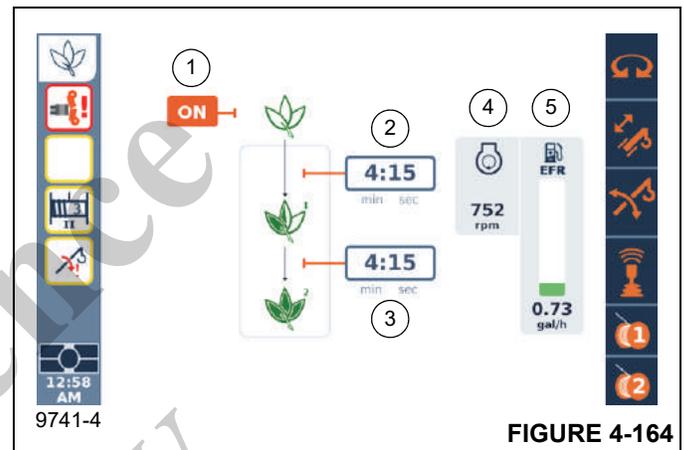


FIGURE 4-164

Item	Description
1	ON/OFF icon
2	Idle Speed 1 Time Delay Setting
3	Idle Speed 2 Time Delay Setting
4	Current Engine Speed icon
5	Fuel Usage Rate graph

The ON/OFF icon (1, Figure 4-164) is used to set the ECO Mode function to on or off.

The Idle Speed 1 Time Delay Setting (2) is used to specify the period of time the craning functions must be inactive (controllers in neutral position) before the engine speed is reduced from the operator specified working engine speed to the idle speed of 1200 rpm.

The Idle Speed 2 Time Delay Setting (3) is used to specify the period of time the craning functions must be inactive (controllers in neutral position) before the engine speed is reduced from the operator specified working engine speed to the idle speed of 750 rpm.

The Current Engine Speed icon (4) indicates the current engine speed in revolutions per minute.

The Fuel Usage Rate graphic (5) indicates fuel usage rate in the selected unit of measure.

The following terms are related to the ECO Mode function:

Term	Definition
ECO Mode OFF	ECO Mode is disabled and will not control engine speed.
ECO Mode ON	ECO Mode is enabled and will automatically control (increase and decrease) engine speed based on the operator's inputs.
Engine Working Speed	Engine speed set by the operator using the Increment/Decrement Switch

By default, ECO Mode is set to off from the factory. Once set to on by the operator, ECO Mode remains on until the operator sets it to off. The crane software maintains the ECO Mode setting of on or off regardless of whether the engine is shut off or if the battery disconnect switch is set to the off position.

If the crane's transmission is shifted to forward or reverse, or when if all crane functions are enabled, ECO Mode will stay on, but the Engine Working Speed setting will decrease and reset to idle. When this occurs, the operator must again set the Engine Working Speed using the Increment/Decrement Switch (refer to *Increment/Decrement – Start/Stop Switch*, page 3-11).

Whether ECO Mode is on or off, the operator can always increase the engine speed above the current engine speed by using the Foot Throttle Pedal.

NOTE: ECO Mode only operates when operating craning functions and does not operate when operating the outriggers.

When ECO Mode is set to OFF, the crane operates in the following manner:

- Engine will idle at 750 rpm when no craning functions are enabled.
- Engine speed will increase and idle at 1200 rpm when a craning function is enabled.
- Engine speed will return to 750 rpm when all crane functions are disabled.
- Foot Throttle Pedal and Increment/Decrement Switch can be used to set the engine speed between the system specified minimum and maximum engine speeds.

When ECO Mode is set to ON and the two time delays have been specified in the ECO Mode function screen, the crane operates in the following manner:

- Engine will idle at 750 rpm when no craning functions are operated.

- Working Engine Speed is set using the Increment/Decrement Switch.
- Engine speed will automatically increase from idle to the Working Engine Speed when a craning function is operated (controller is moved out of neutral position).
- Engine speed will stay at the Working Engine Speed while craning functions are operated.
- Engine speed will automatically decrease to the idle speed of 1200 rpm after all craning functions have stopped (controllers in neutral position) and the time period that was specified in the Idle Speed 1 Time Delay Setting (2, Figure 4-164) has past.
- Engine speed will automatically decrease to the idle speed of 750 rpm after all craning functions are disabled and the time period that was specified in the Idle Speed 2 Time Delay Setting (3, Figure 4-164) has past.
- Engine speed can be increased above current engine speed using the Foot Throttle Pedal.

Set ECO Mode to ON and specify the two ECO Mode time delays using the ECO Mode function screen:

1. Press the Screen Toggle Button (1, Figure 4-165) at the Jog Dial to select the ODM screen control. Using the Jog Dial (2, Figure 4-165), select one of the time delay number fields (box around number will turn orange, Figure 4-164), then press the Jog Dial (2) (number will turn white with orange background).

- or -

Using the Arrow Buttons (3, Figure 4-165) on the Navigation Control Pad at the ODM, select one of the time delay number fields (box around number will turn orange, Figure 4-164), then press the OK Button (4) (number will turn white with orange background).

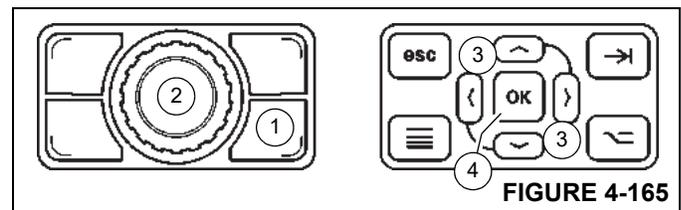
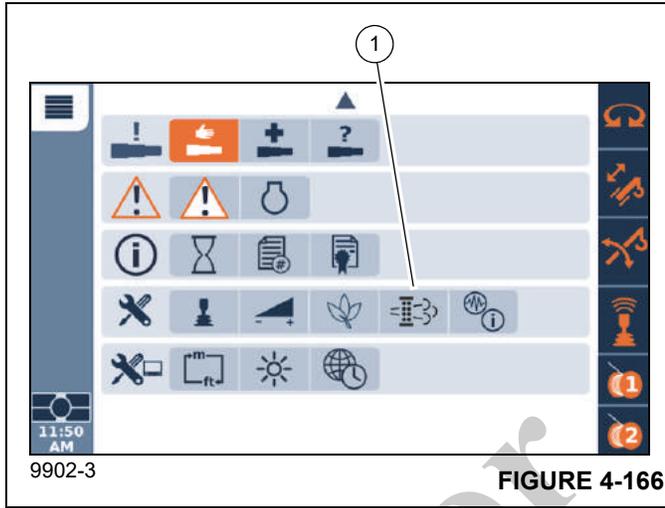


FIGURE 4-165

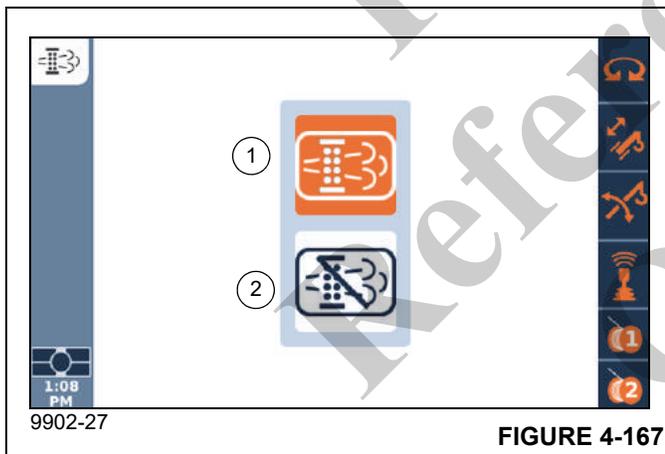
2. Using the Jog Dial or the Up/Down Arrow Buttons, set the time delay.
3. Press the Jog Dial or OK Button on the Navigation Control Pad to accept the time delay setting.
4. Repeat steps 1 through 3 until the minutes and seconds are set for the time delay.
5. Using the Jog Dial or the Arrow Buttons, select the OFF icon (icon will turn orange), then press the Jog Dial or the OK Button to set ECO Mode to ON.

Exhaust System Cleaning (If Equipped)

Select the Exhaust System Cleaning icon (1, Figure 4-166) under the User Settings Menu Group to show the Exhaust System Cleaning function screen.



The Exhaust System Cleaning function screen (Figure 4-167) allows the operator to initiate or inhibit the exhaust system cleaning process.



Item	Description
1	Initiate Manual Cleaning Process Icon
2	Inhibit Cleaning Process Icon

Manual Exhaust System Cleaning

If the Engine Exhaust Cleaning Required Indicator comes on in the Alerts Area of the ODM, perform the following manual exhaust cleaning process as soon as possible.

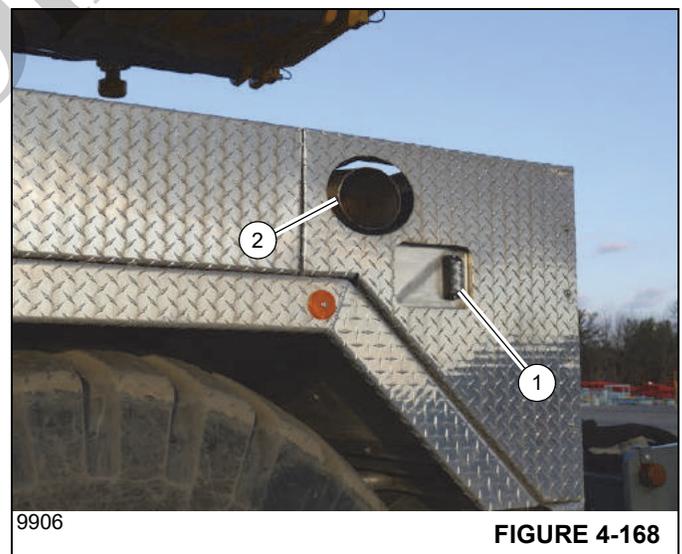
WARNING
Burn/Fire Hazard!

During the cleaning process, the exhaust and tailpipe become very hot. Keep personnel and flammable objects away from the exhaust. Do not park vehicle near flammable objects.

1. Make sure crane is not parked near flammable objects.
2. Set up a safe area around the crane's exhaust. Remove tools, rags, grease, or any debris from engine exhaust area.
3. Place transmission into neutral.
4. Engage the crane parking brake,
5. Release the service brake pedal and throttle pedal.
6. Using the Jog Dial or the Up/Down Arrow Buttons on the Navigation Control Pad, select the Initiate Manual Cleaning Process Icon (1, Figure 4-167) (icon turns orange).
7. Press the Jog Dial or OK Button on the Navigation Control Pad to start the cleaning process.

Within 5 seconds the engine speed will increase to 1000 to 1400 rpm. The engine will continue to run at this speed for up to 45 minutes.

As a warning, the strobe light (1, Figure 4-168) near the exhaust pipe (2) will flash during exhaust system cleaning.



Pressing the service brake pedal or throttle pedal during cleaning or selecting the Inhibit Cleaning Process Icon

(2, Figure 4-167) will interrupt the manual cleaning process.

Make sure the crane and surrounding area are monitored during manual cleaning. If any unsafe condition occurs, stop engine immediately.

Engine will return to normal idle speed when the manual cleaning process is complete.

Inhibit Exhaust System Cleaning

**CAUTION
Crane Damage!**

Exhaust system damage can occur if crane is operated for long periods of time with the exhaust cleaning system set to inhibit.

During normal operation of the crane, do not set the exhaust system cleaning to inhibit.

NOTE: Refer to section *Exhaust System Cleaning*, page 4-9 for information on the manual and automatic exhaust cleaning modes.

To inhibit, or prevent, the exhaust system from entering the active cleaning mode or to stop the exhaust cleaning process that was manually initiated, do the following:

1. Using the Jog Dial or the Up/Down Arrow Buttons on the Navigation Control Pad, select the Inhibit Cleaning Process Icon (1, Figure 4-169) (icon changes to orange).
2. Press the Jog Dial or OK Button on the Navigation Control Pad to set the cleaning process to inhibit (Inhibit Cleaning Process Icon changes to green).

The Inhibit Exhaust System Cleaning Indicator comes on in the Alerts Area of the ODM, and the active and manual modes of exhaust system cleaning are prevented.

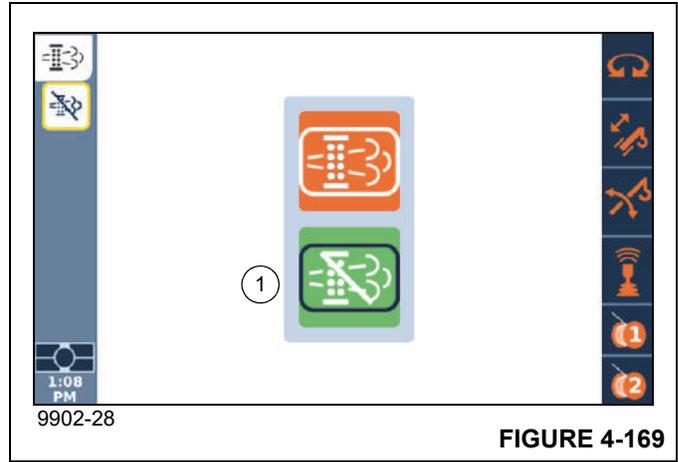


FIGURE 4-169

Service Menu

Select the Service Menu icon (1, Figure 4-170) under the User Settings Menu Group to show the Service Menu function screen.

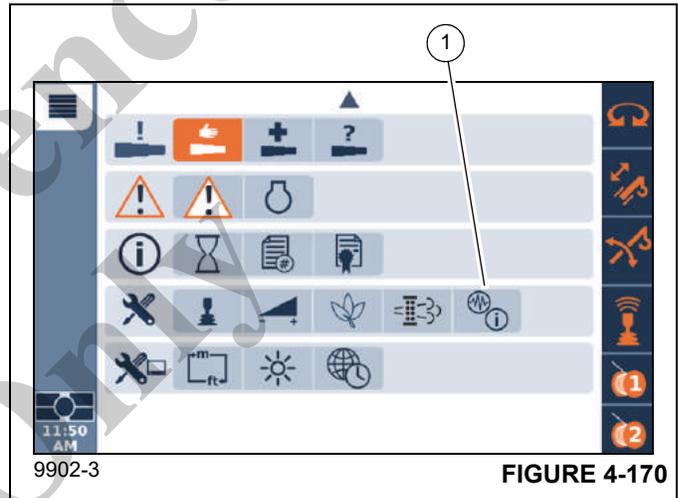


FIGURE 4-170

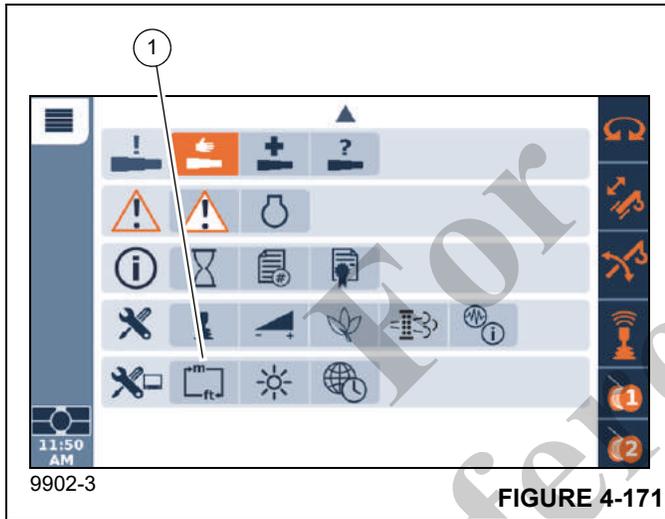
Display Settings Menu Group

The Display Settings Menu Group includes the following function icons:

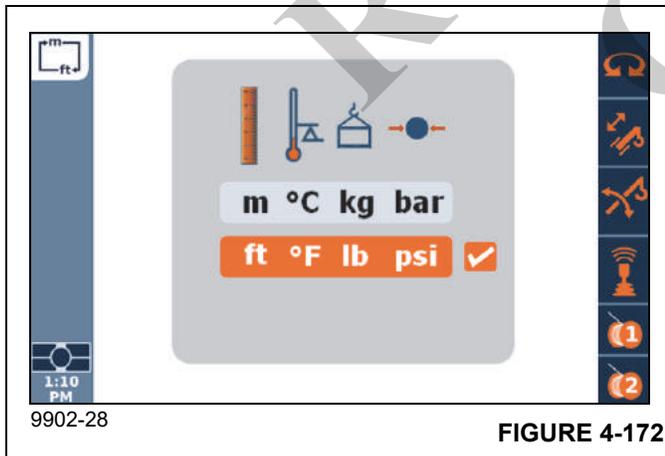
- Units of Measure (page 4-157)
- Display Screen Brightness (page 4-157)
- Time Set (page 4-158)

Units of Measure

Select the Units of Measure icon (1, Figure 4-171) under the Display Settings Menu Group to show the Units of Measure function screen.



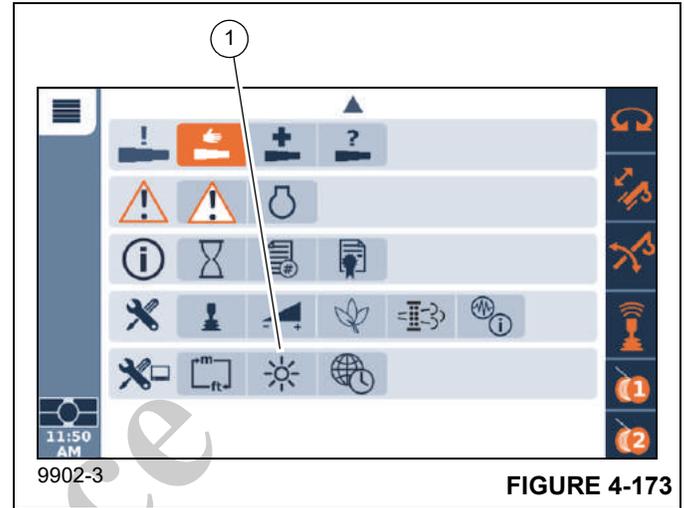
The Units of Measure function screen (Figure 4-172) allows the operator to change the units of measure (metric/imperial) that are used throughout the ODM and RDM.



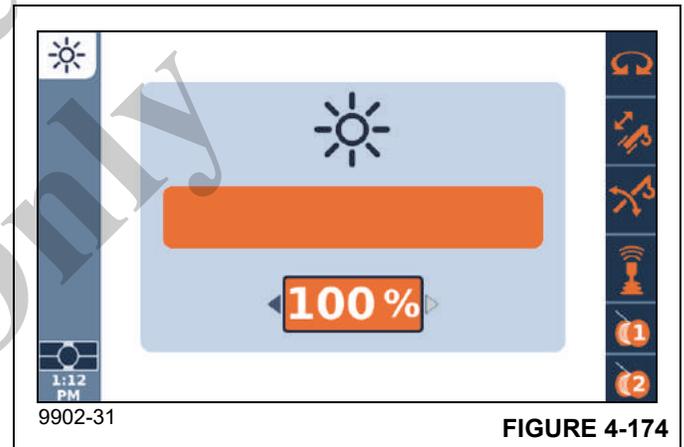
Use the Jog Dial or Arrow Buttons on the Navigation Control Pad to select the desired unit of measure, then press the Jog Dial or the OK Button to accept the new setting.

Display Screen Brightness

Select the Display Screen Brightness icon (1, Figure 4-173) under the Display Settings Menu Group to show the Display Screen Brightness function screen.



The Display Screen Brightness function screen (Figure 4-174) allows the operator to adjust the brightness of the ODM and RDM display screens.



Press the Jog Dial or OK Button on the Navigation Control Pad, then use the Jog Dial or Arrow Buttons to increase or decrease the screen brightness. Once the desired value is selected, press the Jog Dial or OK Button to accept the value.

Time Set

Select the Set Time icon (1, Figure 4-175) under the Display Settings Menu Group to show the Time Set function screen.

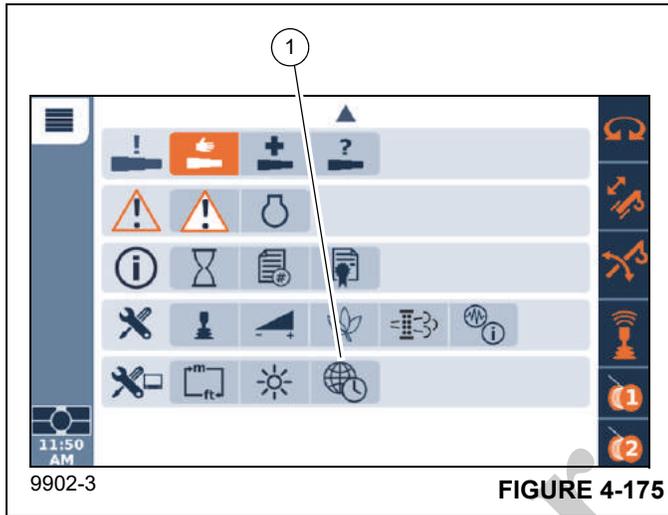


FIGURE 4-175

The Time Set function screen (Figure 4-176) allows the operator to set the time and the time format that is displayed on the ODM and RDM screens.

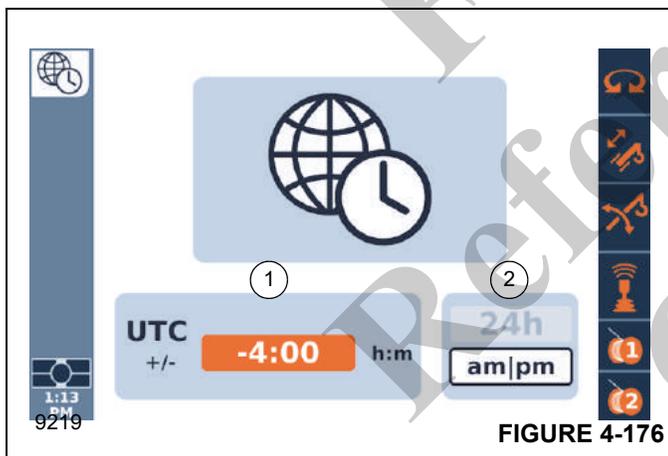


FIGURE 4-176

Item	Description
1	UTC Offset
2	Time Format

Coordinated Universal Time (UTC) is used as the basis for setting the time. The usage of UTC is based upon a twenty four hour clock and the 0 degrees longitude meridian, referred to as the Greenwich meridian in Greenwich, England. Thus, to set the time the operator must know what time zone he or she is in relative to the UTC.

The following is a list of the United States GMT/UTC Offsets:

US Time Zone	UTC Offset Standard Time	UTC Offset Daylight Savings Time
Atlantic	UTC - 4h	
Eastern	UTC - 5h	UTC - 4h
Central	UTC - 6h	UTC - 5h
Mountain	UTC - 7h	UTC - 6h
Pacific	UTC - 8h	UTC - 7h
Alaska	UTC - 9h	UTC - 8h
Hawaii - Aleutian	UTC - 10h	UTC - 9h

To set the time and time format, do the following:

- Using the Jog Dial or Arrow Buttons on the Navigation Control Pad, select the UTC Offset field (1, Figure 4-176).
- Press the Jog Dial or the OK Button.
- Turn the Jog Dial or press the Up/Down Arrow Buttons until the correct UTC Offset is shown.
- Press the Jog Dial or OK Button to accept the value.
- Using the Jog Dial or Arrow Buttons, select the Time Format field (2, Figure 4-176).
- Press the Jog Dial or the OK Button.
- Using the Jog Dial or Arrow Buttons, select the desired time format, either 24 hour or AM/PM.
- Press the Jog Dial or OK Button to accept the value.

USING THE RATED CAPACITY LIMITER DISPLAY MODULE (RDM)

NOTE: Refer to *Rated Capacity Limiter Display Module (RDM)*, page 3-21 for additional information.

The Rated Capacity Limiter (RCL) is an electro-mechanical sensing system designed to alert the crane operator of impending capacity when the system has been accurately programmed. When an overload condition is sensed, the system provides the operator with a visual and audible warning, and locks out the controller functions to prevent raising and lowering the boom, extending the boom, or raising the main or auxiliary (optional) hoist ropes.

! DANGER

Electronic equipment on this crane is intended as an aid to the operator. Under no condition should it be relied on to replace the use of Load Charts and operating instructions.

Sole reliance on these electronic aids in place of good operating practices can cause an accident.

The RCL Setup Screen (Figure 4-177) appears on the RDM when the ignition key is set to the On position.

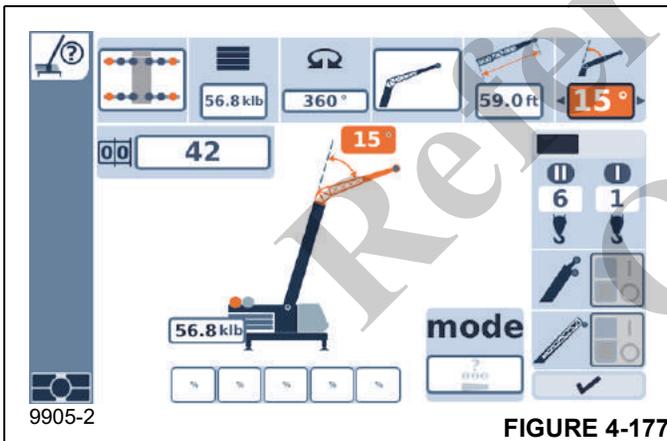


FIGURE 4-177

From the RCL Setup Screen, the operator can program the RCL either by entering a rigging code number from the *Load Chart Manual* or by entering the crane configuration using the setup wizard

Enter Rigging Code

For a complete rigging code input, operator must enter, confirm and accept the rigging code and the reeving.

There are two ways of entering the current rigging mode.

- Either enter the individual components (1, Figure 4-178) to (8) one after the other.
- Or enter the RCL code (9) and the reeving (8).

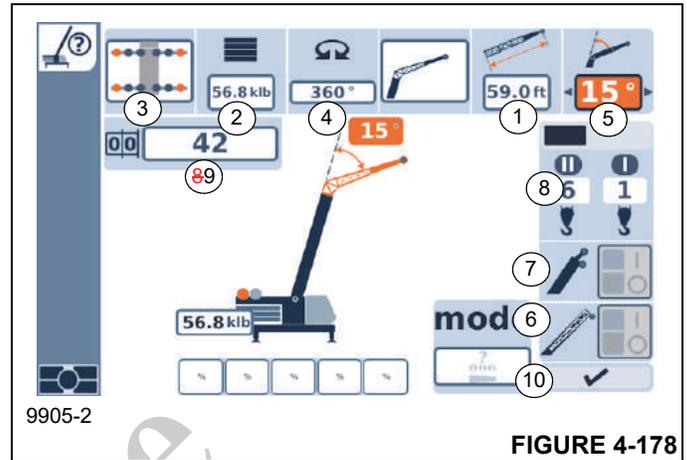


FIGURE 4-178

The newly entered rigging mode must then be confirmed

- with (10)

The following section describes the input procedure based on the individual components. If you want to enter the rigging mode based on the RCL code, refer to *Entering the RCL Code*, page 4-163.

Entering Individual Components

With this type of input, select all the components of the rigging mode one after the other.

! DANGER

Overload/Tipover hazard!

The RCL is an operator aid. If it is programmed incorrectly, the system may not warn the operator of impending overload and may not activate function lockouts.

Ensure the RCL is properly programmed to correspond to the actual crane configuration being used.

When re-entering the rigging mode completely, you can prevent already entered components from changing by making entries in the following order:

- Counterweight (2, Figure 4-179)
- Boom system (1)
- Outrigger span (3)

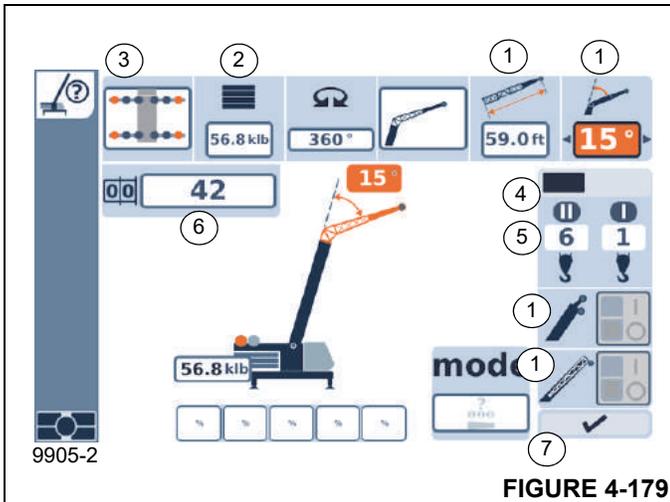


FIGURE 4-179

In this order, the values that can be selected for the current entry are always restricted by the previous entry. As a result, already entered values do not change.

When entering the components, the corresponding RCL code (6) is displayed at the same time.

Then you must enter the current hoist selection (4) and reeving (5) and confirm the indicated rigging mode (7).

Switching on Input Mode

- Select one of the desired components (1, Figure 4-180) to (4).

The corresponding symbol goes orange.

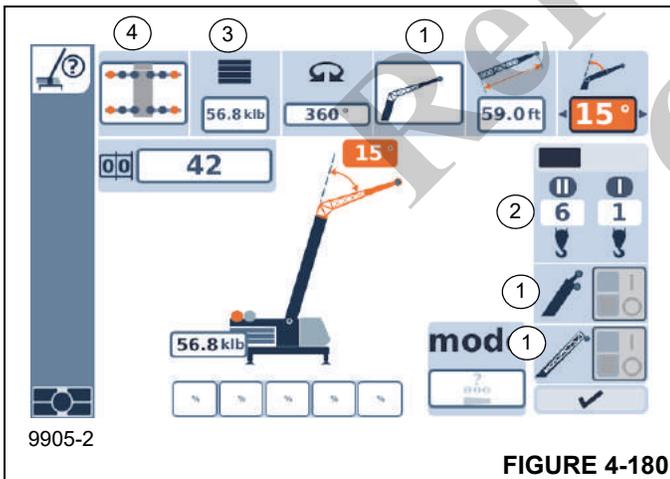


FIGURE 4-180

- Confirm the selection.

Direction arrows appear on the display.

Input mode is switched on.

Selecting Values

With the input mode switched on, you can select values that are permissible according to the Lifting Capacity Table.

The selection process is described using reeving as an example.

- Select and confirm the symbol (1, Figure 4-181) – arrows on the left and right are displayed.
- Select using the left or right buttons on the control panel until the display shows the rigged reeving.

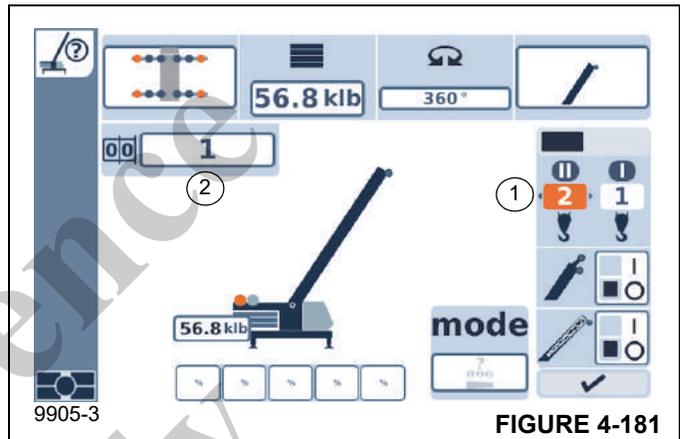


FIGURE 4-181

- Confirm the selection.

The display shows the corresponding RCL code (2).

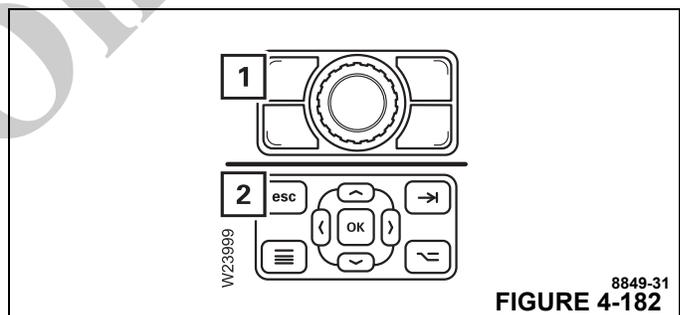
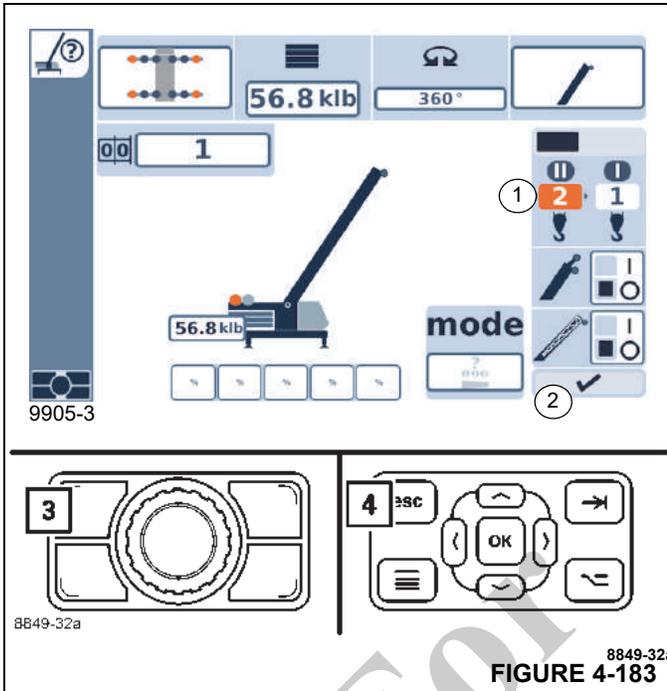


FIGURE 4-182

You can cancel the input at any time. Press button (1, Figure 4-182) or (2).

After the selection procedure, there are three options:

- Cancel input mode:
 - Press the button (3, Figure 4-183) or (4) once – the config menu is opened.



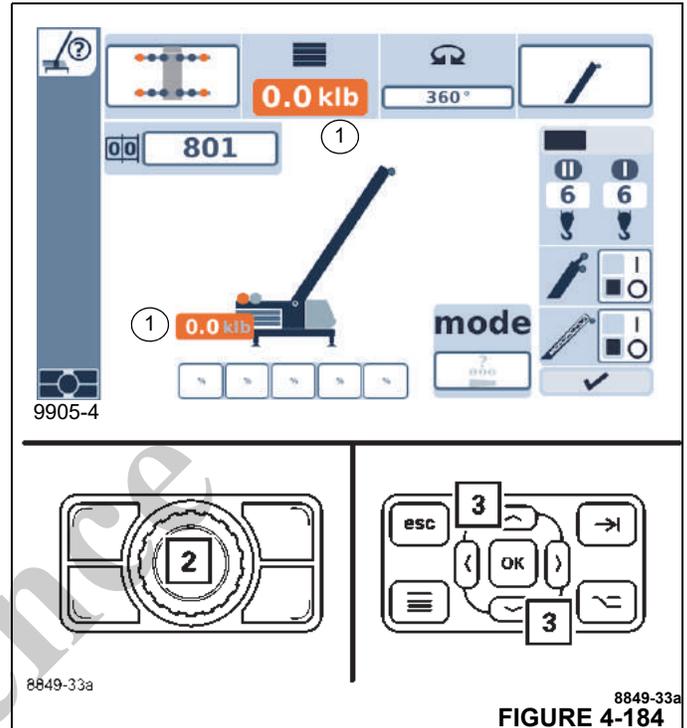
8849-32a
FIGURE 4-183

- Switching over the input mode:
 - Select and confirm a symbol (1) for the next component – symbol red.
- Accept the displayed rigging mode:
 - Select and confirm the symbol (2), refer to *Accepting the Rigging Code, page 4-164*.

Enter the other components of the current rigging mode in the same way.

Counterweight

- Select and confirm the symbol (1, Figure 4-184).



8849-33a
FIGURE 4-184

- Use the buttons (2) or (3) to select the required counterweight combination, e.g. 0.0 klb.
- Confirm the selection.

Boom System

- Select and confirm the symbol (1, Figure 4-185).

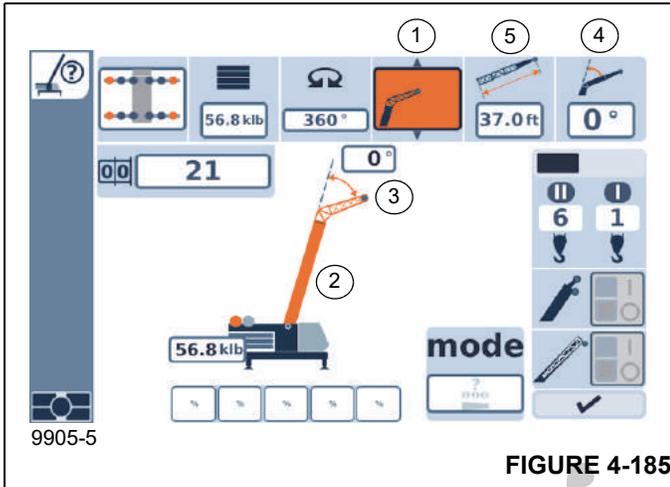


FIGURE 4-185

- Use symbol (1, Figure 4-185) to select the rigged boom system.

2	Main boom
3	Main boom with lattice extension
4	Angle of the manual lattice extension
5	Length of lattice extension

- Confirm each selection.

Outrigger Span

- Select and confirm the symbol (1, Figure 4-186).
- Use the buttons (2) or (3) to select the rigged outrigger span.
- Confirm the selection.

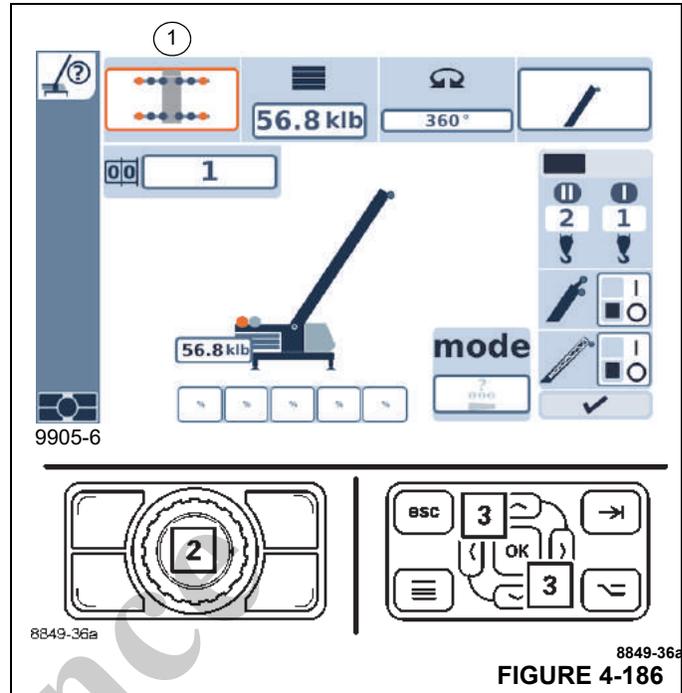


FIGURE 4-186

The outrigger span is monitored when outrigger monitoring is installed. You must check the outrigger span when entering the rigging mode.

If the OMS does not match the selected positions an additional screen opens after selecting the check mark at the bottom right corner of this screen. The detected positions and selected positions are shown side by side Figure 4-187. The operator has the choice of 1) Returning to this setup screen to change the selection –OR– 2) Verifying that the chosen outrigger position is the one to use even though it doesn't match the OMS, in which case the screen transitions to the main viewing screen.

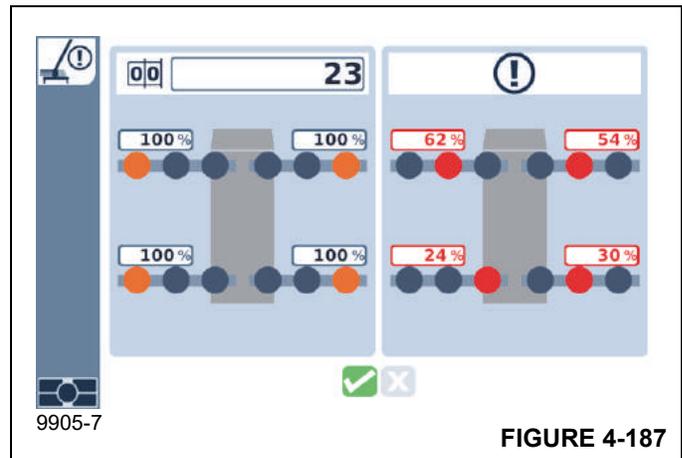
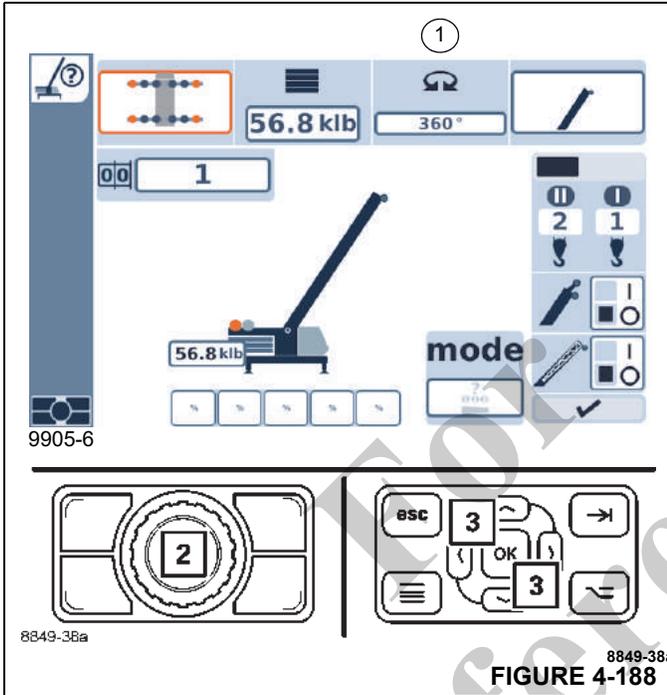


FIGURE 4-187

Swing Range

- Select and confirm the symbol (1, Figure 4-188).
- Use the buttons (2) or (3) to select the required swing range, e.g. 360°.
- Confirm the selection.

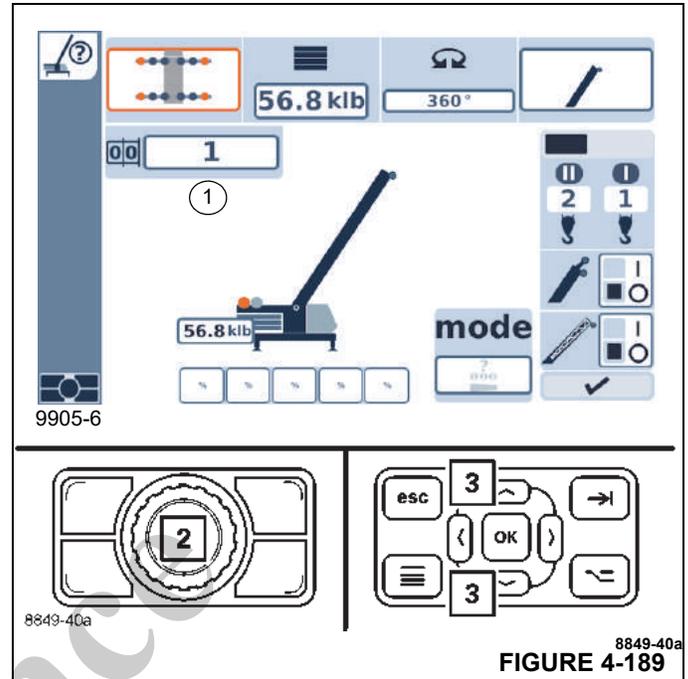


Entering the RCL Code

You may enter the RCL code for the rigging mode according to the Lifting capacity table.

Refer to the Lifting capacity table for the current rigging mode. The corresponding RCL code is specified at the top of the table (e.g. 1100).

- Select and confirm the symbol (1, Figure 4-189).
- Use the buttons (2) or (3) to select the required RCL code.
- Confirm the selection.

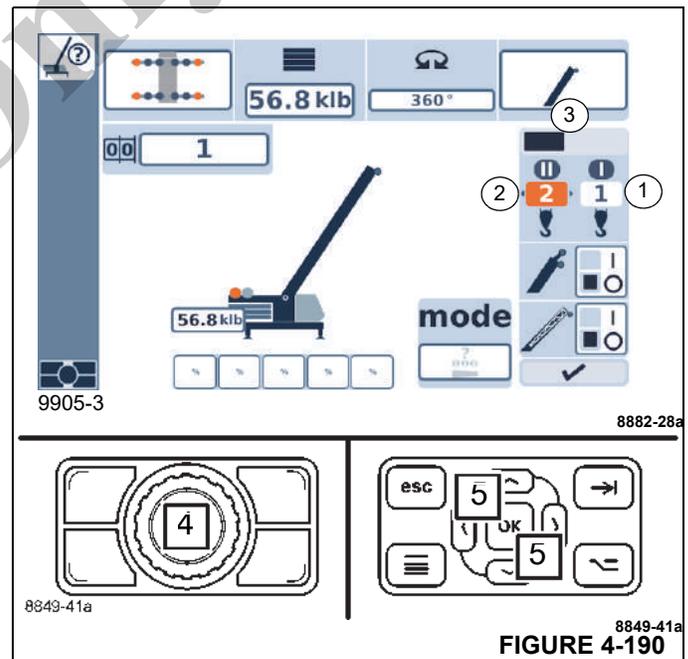


The other displays will show the corresponding rigging mode.

Now you can enter the reeving and accept the rigging mode.

Selecting the Hoist and Entering the Reeving

Entering the reeving does not have an effect on any other component that has already been entered.



- Position the slider bar (3, Figure 4-190) over the top of the hoist that is to be used. Example screenshot in Figure 4-190 shows the Auxiliary Hoist is selected.

1	Symbol for main hoist
2	Symbol for auxiliary hoist

- Confirm the selection.
- Use the buttons (4, Figure 4-190) or (5) to select the rigged reeving.
- Confirm the selection.

Accepting the Rigging Code

Prior to crane operation, you must confirm and accept the newly entered rigging code.

Confirming and Applying the Rigging Code

- Select the symbol (1, Figure 4-191).
- Confirm the selection.

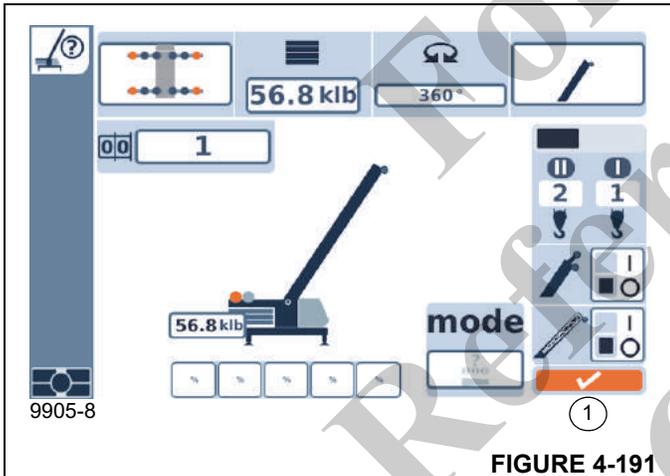


FIGURE 4-191

The Monitoring menu is opened and the rigging code is applied.

If the rigging code is not permissible, symbol 1 cannot be selected.



WARNING

Overload/Tipover Hazard!

The RCL is an operator aid. If it is programmed incorrectly, the system may not warn the operator of impending overload and may not activate function lockouts.

Ensure the RCL is properly programmed to correspond to the actual crane configuration being used.

Entering the Telescoping Mode Number

After the RCL has been initialized, and the rigging mode screen is re-entered, and the telescoping function has been enabled, and the boom is fully retracted and locked, then a Telescoping Mode Number may be selected (1, Figure 4-192). Entering this option allows the up/down or jog dial to be used to select from an available list of these mode numbers. After this selection and using the check-mark again on the rigging screen, the telescoping function will commence for the requested telescoping status based on the mode number.

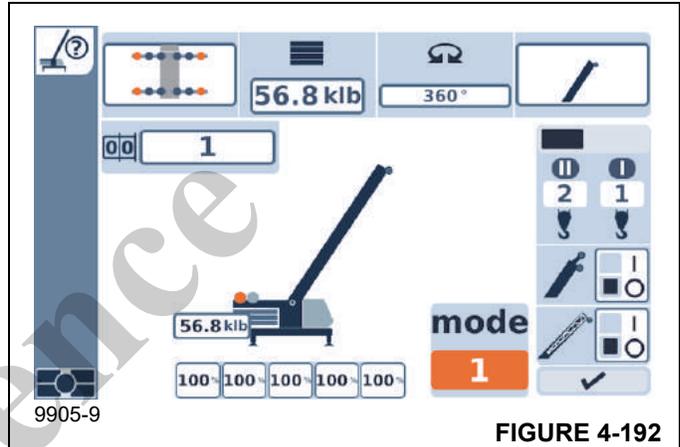


FIGURE 4-192

Checks Before Operating the Crane

Open the Menu

Crane operation is only enabled when the Monitoring menu is open. The Monitoring menu opens automatically after the rigging code is configured and confirmed.

Checks

- Check whether the current rigging mode of the crane corresponds to the displayed rigging mode.



WARNING

Overload/Tipover Hazard!

The RCL is an operator aid. If it is programmed incorrectly, the system may not warn the operator of impending overload and may not activate function lockouts.

Ensure the RCL is properly programmed to correspond to the actual crane configuration being used.

- Check Figure 4-193:

1	Lattice extension angle where necessary
2	Boom length
3	Boom tip/boom extension tip height
4	Rigged counterweight
5	Hoist that is switched on
6	Number of reeved hoist rope lines
7	Rigged outrigger span

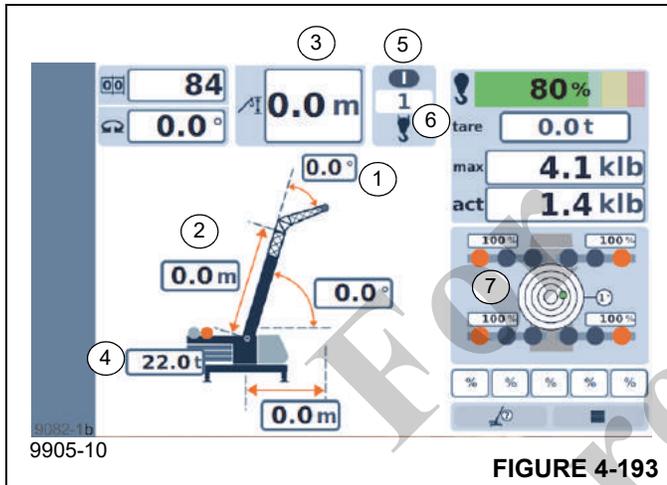


FIGURE 4-193

Hoists Display

The symbol bar symbol (1, Figure 4-194) must appear over top of the hoist with which the load is to be lifted.

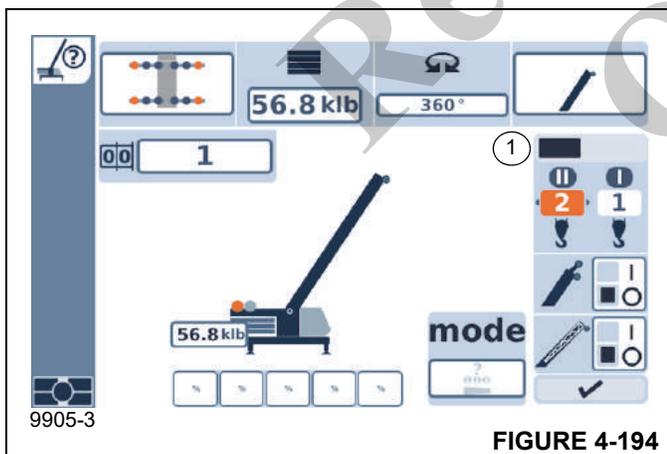
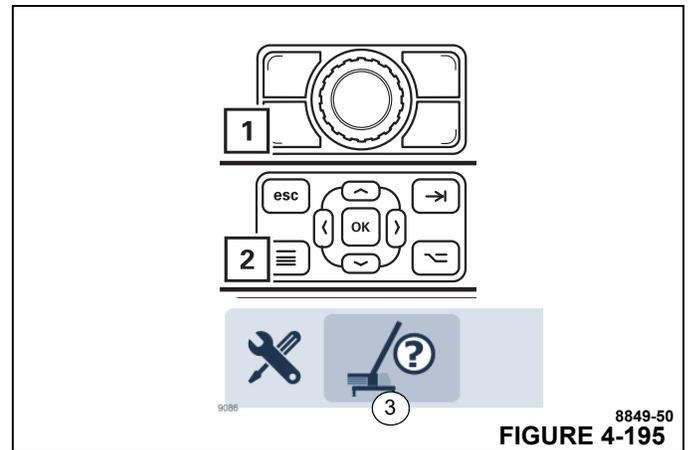


FIGURE 4-194

To switch between main hoist or auxiliary hoist, refer to *Example of how to Switch over the Hoists*, page 4-165.

If you need to correct values, press the button (1, Figure 4-195) or (2) and open the Enter rigging mode (3) menu.

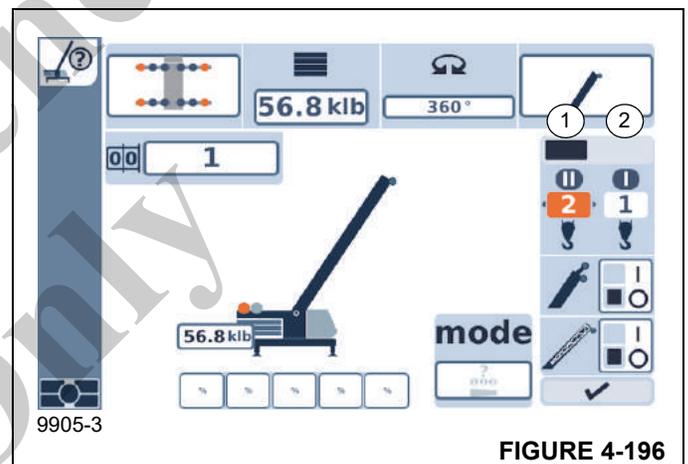
You can start working with the crane if the correct rigging mode of the crane is displayed.



8849-50
FIGURE 4-195

Example of how to Switch over the Hoists

The load is planned to be raised with the main hoist, for example. However, the hoist indicator (1, Figure 4-196) for the auxiliary hoist is on and the indicator (2) for the main hoist is off.



9905-3
FIGURE 4-196

Switch over the hoists as follows:

- Switch off both hoists by selecting no hoist indicator.

Switch on the auxiliary hoist indicator.

The hoist indicator will now be displayed above the auxiliary hoist icon.

WARNING
Overload Hazard!

When operating the crane with two hoists reeved, ensure that the hoist in use is identified in the RCL configuration. Failure to do so may result in overload of the hoist line or crane. Death or Serious Injury could occur.

Displays During Crane Operation

The following information is constantly displayed in addition to the displays of the rigging mode:

Current Overall Height

Overall height is the approximate vertical distance between the lower edge of the outrigger pad and the highest point of the main boom or lattice extension. The displayed value (1, Figure 4-197) applies to fully extended outrigger cylinders on the largest outrigger span.

The value is displayed either in meters (m) or in feet (ft), depending on the setting.

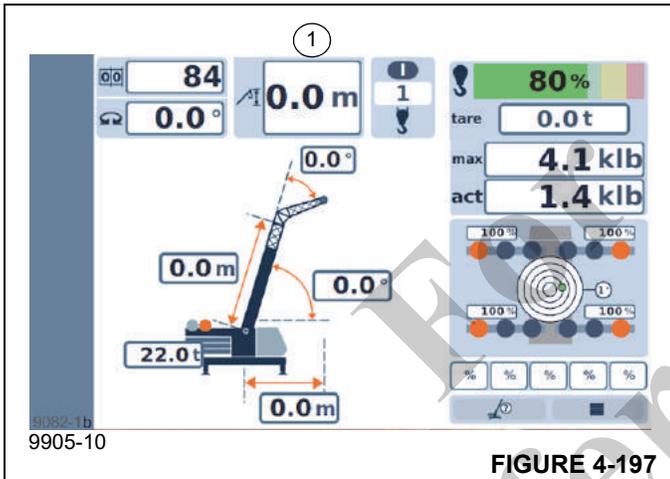


FIGURE 4-197

Current Lattice Extension Angle

- **Lifting/lowering lattice extension:** Shows the current lattice extension angle (1, Figure 4-198) in relation to the main boom in degrees.
- **Lattice extension, can be angled:** Shows the angle of the lattice extension corresponding to the RCL code in degrees (1, Figure 4-198).

If the displayed RCL code does not apply to a lattice extension, nothing will be displayed.

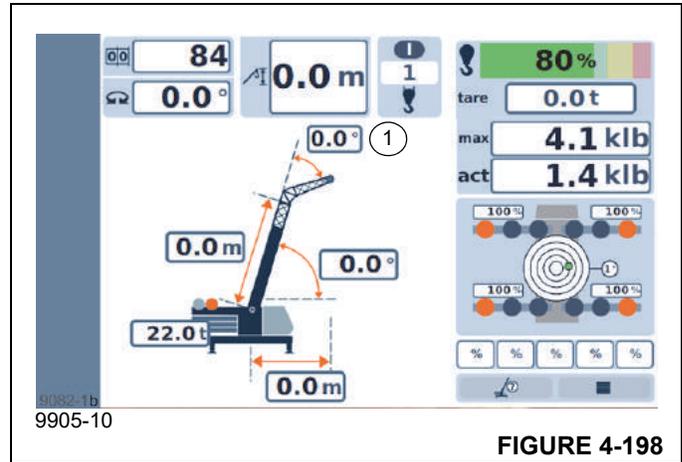


FIGURE 4-198

Counterweight Installed

Shows the counterweight (1, Figure 4-199) in tons (t).

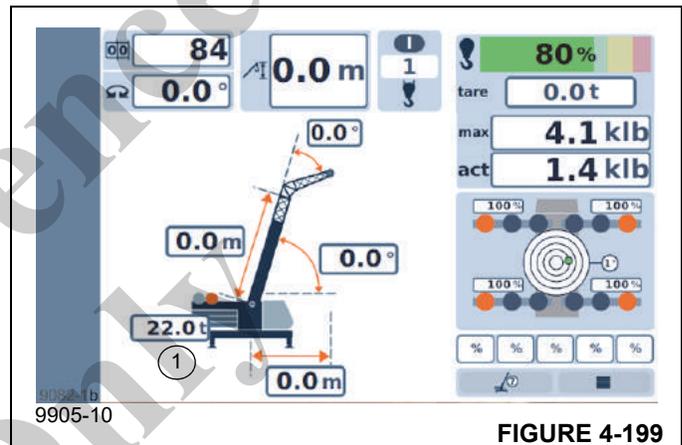


FIGURE 4-199

The Current Swing Angle

Shows the swing angle (1, Figure 4-200) of the current superstructure position.

0° means that the superstructure is positioned over the front.

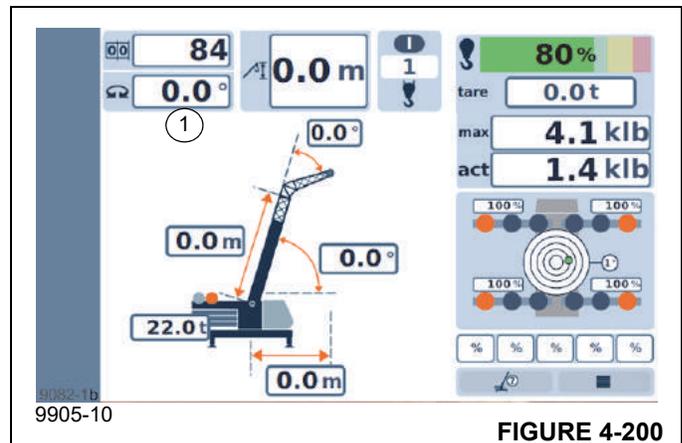
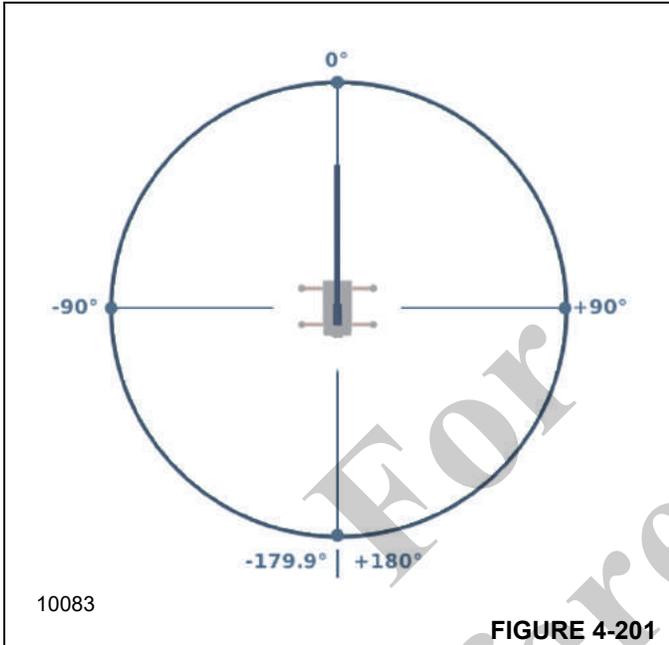


FIGURE 4-200

A full turn from this working position is divided into two semi-circles (Figure 4-201).

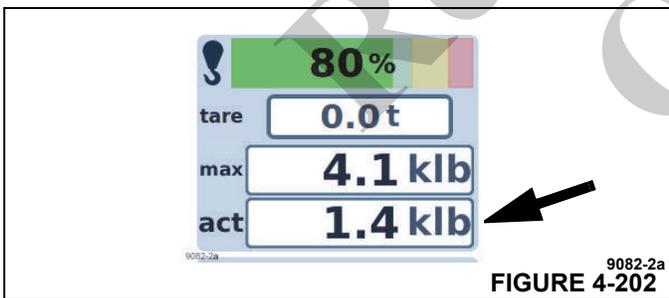
Angles in the left semi-circle are displayed as negative values (0° to -179.9°),

Angles in the right semicircle will be shown as positive (0° to 180°).



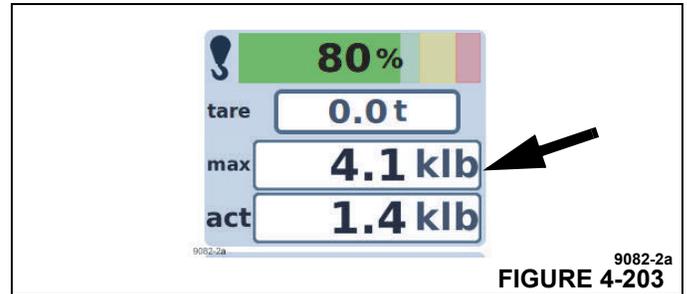
Currently Raised Load

The display (Figure 4-202) shows the sum of the payload + lifting gear + hook block.



Maximum Load

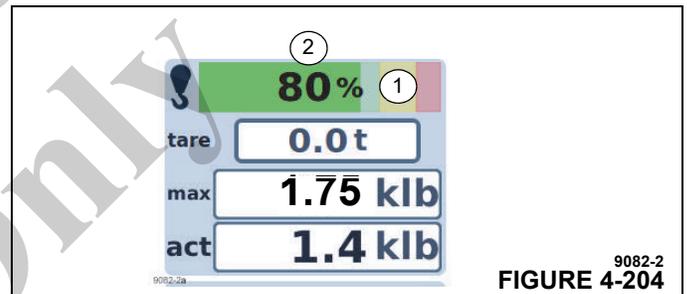
The display (Figure 4-203) shows the maximum load that can be lifted in the current rigging mode with the current working radius.



Degree of Utilization

The degree of utilization shows the weight of the current load as a percentage of the maximum possible load. Display (2, Figure 4-204) shows the percentage value. Display (1) shows the ranges in different colors:

Green:	0 – 90%
Yellow:	approx. 90 – 100%
Red:	greater than 100%



RCL Early Warning

If approximately 90% of the maximum permissible load is exceeded, an RCL early warning will be issued.

- An intermittent buzzer tone will sound. After five seconds, you can switch off the buzzer tone using button (2, Figure 4-205).
- The lamp (3) lights up.
- Display (1) shows the current degree of utilization, e.g. 80%; the bar is green.

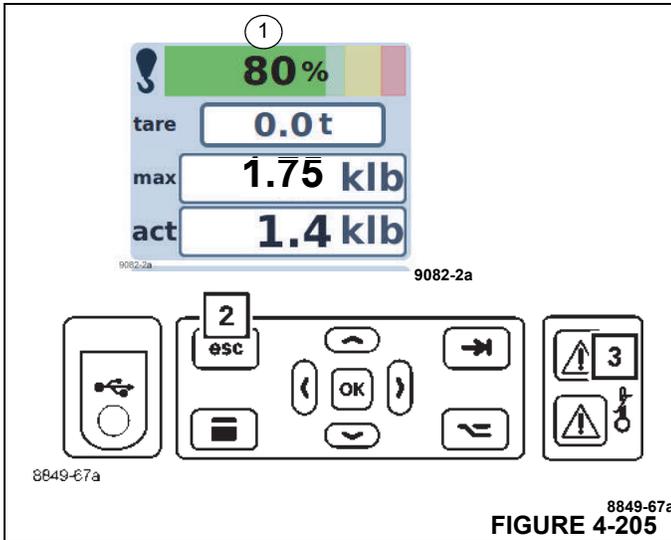


FIGURE 4-205

NOTE: If the capacity continues to increase, the RCL will reach an overload state and a RCL shutdown will occur.

RCL Shutdown

There are different types of RCL shutdowns:

- shutdown due to overload,
- shutdown due to an error.

Shutdown due to Overload

If the maximum permissible load is exceeded, shutdown will occur due to overload.

- All crane movements which increase the load moment will be switched off.
- A continuous buzzer tone will sound.
- After five seconds, you can switch off the buzzer tone using button (4, Figure 4-206).
- Greater than 100%, indicator 5 will illuminate solid
- Lamp (6) will illuminate.
- Display (3) shows the current degree of utilization, e.g. 100%; the bar is red.
- The value on display (1) is equal to or greater than the value on display (2).

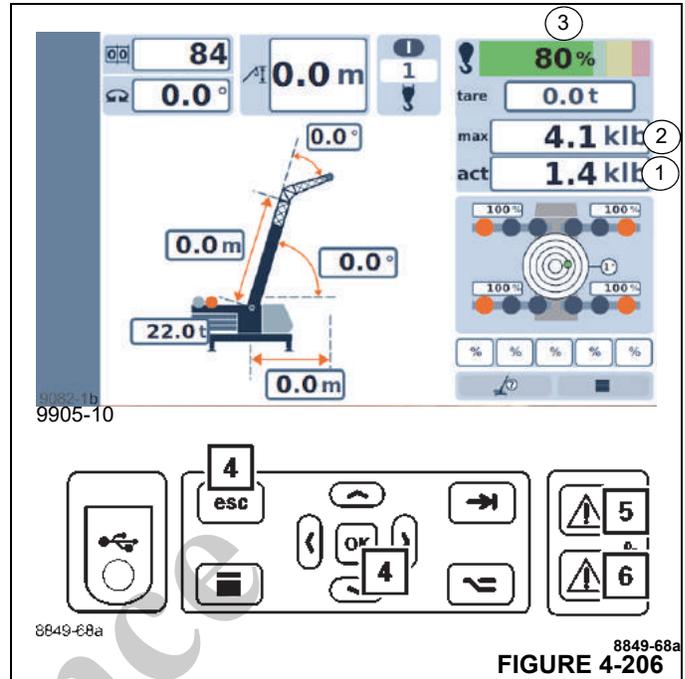


FIGURE 4-206

Canceling a Shutdown

- Turn off the buzzer tone if necessary.
- Leave the shutdown range by moving the crane according to the following table.

Switched off crane movements	Permitted crane movements
Lift loads	Lower loads
Lower the main boom	Raising the main boom ¹⁾
Extend the main boom	Retracting the main boom
Swing to the left	Swing to the right
Swing to the right	Swing to the left
Lower the lattice extension	Raise the lattice extension

¹⁾In some cases, the RCL will also switch off these movements. In this case, leave the shutdown range through other enabled movements. If this is not possible, set down the load.

When booming down the load limit decreases and can eventually lock out crane motions including boom up. Using the boom up bypass key to boom up then causes the load limit to increase again, and quickly eliminates the lockout condition.

The crane movements are reactivated when you have returned to a normal operating state below the maximum permissible load capacity – lamps (1, Figure 4-207) and (2) go out.

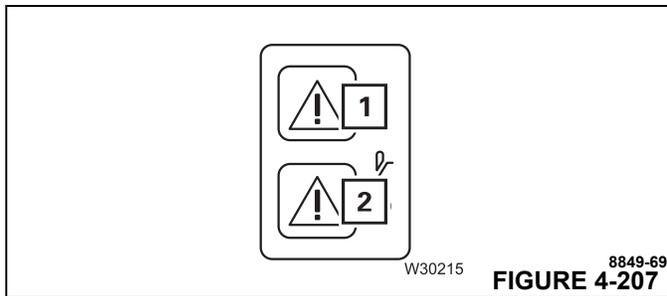


FIGURE 4-207

Limit Bypass Alert Indicators

In an emergency situation only, the Limit Bypass Switch located in the cab on the right overhead control panel can be used to bypass the different limiter systems on the crane. Refer to the following pages for information regarding the switch's operation:

1. *Momentary Limit Bypass Switch (Non-CE Certified Cranes)*, page 3-13
2. *Limit Bypass Set-Up Switch (CE Certified Cranes)*, page 3-13

A Limit Bypass Switch is also located in the cab behind the operator's seat on non-CE certified cranes and on the outside rear of the cab on CE certified cranes:

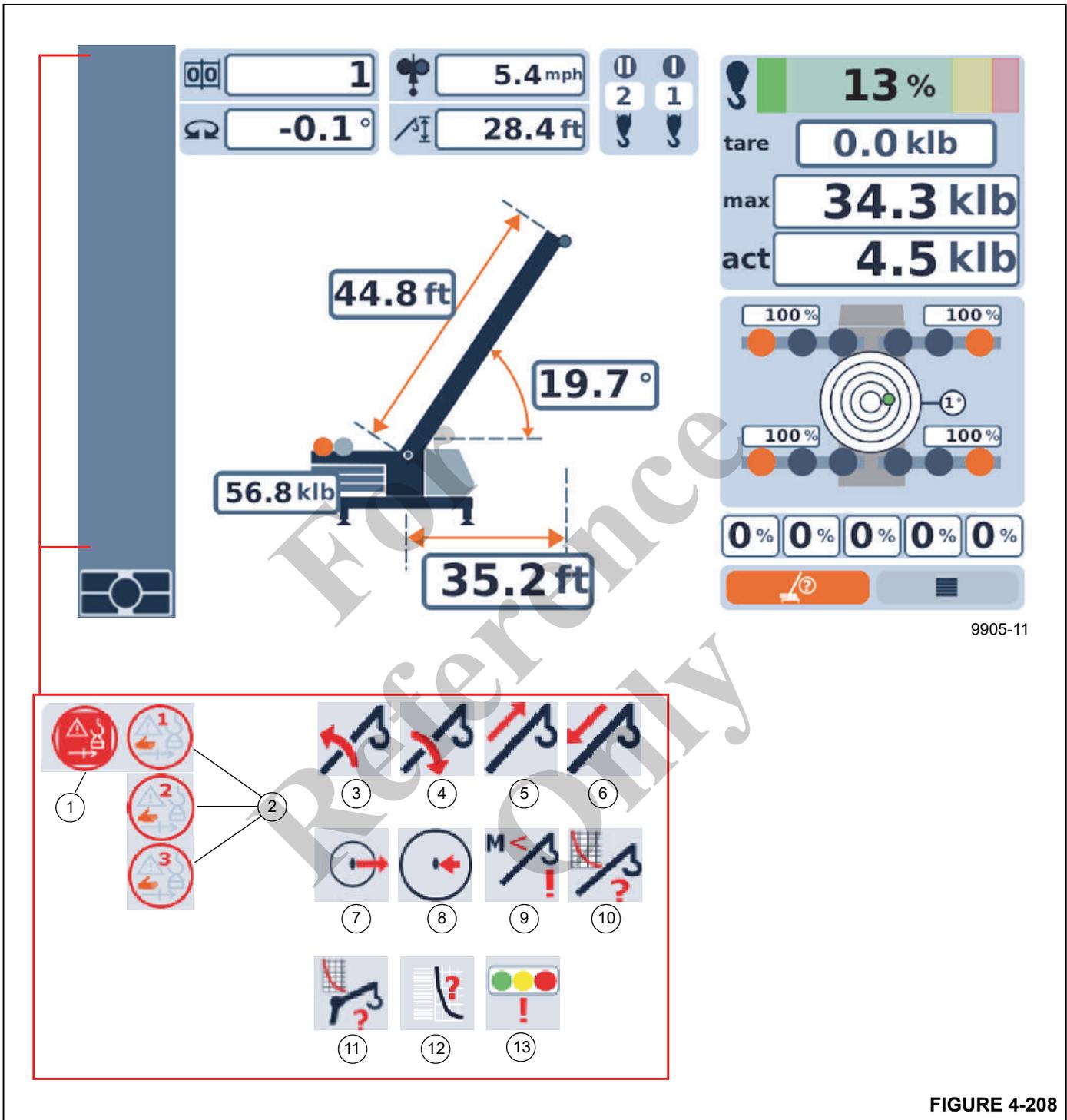
3. *Maintained Limit Bypass Switch (Non-CE Certified Cranes)*, page 3-44
4. *Bridging Switch (CE Certified Cranes)*, page 3-47

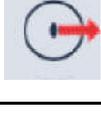
When a Limit Bypass Switch is actuated, the following indicators on the Rated Capacity Limiter Display Module (RDM) come on to confirm that the limiters are bypassed (1 and 2, Figure 4-208).

Load Chart and Miscellaneous Alerts

Refer to Figure 4-208 for a list of alerts and their definitions that can appear at the bottom of the Main Screen of the RDM.

For Reference Only



Item	Description	Graphic	Explanation
1	RCL Bypass Active Indicator (Red - Constant On)		Indicates the RCL system is bypassed
2	Bypass 1 Pressed Indicator (Constant On)		Indicates that limiter systems have been bypassed by way of the Limit Bypass Switch located on the right overhead control panel. Refer to <i>Momentary Limit Bypass Switch (Non-CE Certified Cranes)</i> , page 3-13 or <i>Limit Bypass Set-Up Switch (CE Certified Cranes)</i> , page 3-13 for more information on the switch's operation.
	Bypass 2 Pressed Indicator (Constant On)		Indicates that the limiter systems have been bypassed by way of the Boom Up Bypass Switch located on the right armrest. Refer to <i>Boom Up Bypass Switch</i> , page 3-14 for more information on the switch's operation.
	Bypass 3 Pressed Indicator (Constant On)		Indicates that limiter systems have been bypassed by way of the Limit Bypass Switch located behind the operator's seat on non-CE certified cranes or inside a key-locked single-door enclosure attached to the outside rear of the operator's cab on CE certified cranes. Refer to <i>Maintained Limit Bypass Switch (Non-CE Certified Cranes)</i> , page 3-44 or <i>Bridging Switch (CE Certified Cranes)</i> , page 3-47 for more information on the switch's operation.
3	Boom Angle Too High Indicator		Indicates the boom angle is greater than the maximum angle limit allowed by the selected load chart or the boom angle is greater than 78°.
4	Boom Angle Too Low Indicator		Indicates the boom angle is less than the minimum angle limit allowed by the selected load chart or the boom angle is less than -1°.
5	Boom Length Too Long Indicator		Indicates the boom length is longer than the last length of the selected load chart.
6	Boom Length Too Short Indicator		Indicates the boom length is shorter than the first length of the selected load chart.
7	Radius Too Long Indicator		Indicates the radius is greater than the maximum radius in the selected load chart.

Item	Description	Graphic	Explanation
8	Radius Too Short Indicator		Indicates the radius is smaller than the minimum radius in the selected load chart.
9	Load Too Small Indicator		Indicates the load is smaller than the minimum load in the selected load chart
10	Boom - No Load Chart Indicator		Indicates the main boom load chart is not available for the given crane configuration.
11	Boom Extension - No Load Chart Indicator		Indicates there is no load chart available for the boom extension, but the boom extension has been chosen in the RCL.
12	Curve Chart Point Error Indicator		Indicates there is no load chart found for the given crane configuration (off chart).
13	Status Light Bar Indicator (CE cranes)		Indicates the system setting for CE cranes is disabled but the system setting for the outside light bar is enabled. Accessing the system requires the CAN-link service software and connection cable, which are available through Crane Care to those service technicians who have attended the Grove New Technology training course.

PRELOAD CHECK

After crane has been readied for service, an operational check of all crane functions (with no load applied) should be performed. Refer to *Craning Functions*, page 4-20 for details as to how to operate the different crane functions.

Preload check is as follows:

CAUTION

Run engine at or near governed RPM during operation of all crane functions.

1. Extend and set outriggers and level crane.
2. Raise, lower, and swing boom right and left at least 45°.
3. Fully telescope boom out and back in at a 75° boom angle, ensuring all sections extend and retract properly.
4. With boom fully retracted and at maximum boom angle, lower the hook block/overhaul ball to near ground level.

Fully extend the boom while keeping the block/ball at near ground level.



CAUTION

Hoist Rope Damage Hazard!

Hoist rope that is not properly tensioned can cause rope diving, which could result in rope damage.

Always properly tension the hoist rope by spooling as much of the rope onto the hoist with as much load available and allowable as indicated by the *Load Chart*.

5. With a load applied, fully retract the boom while keeping the hook block/overhaul ball at near ground level.

Once boom is fully retracted, raise block/ball up to boom tip.

If block/ball rotates more than 90° during this procedure, turn dead-end bucket one revolution opposite the direction that the block/ball rotates as the fall length increases. Repeat as necessary until block/ball rotates no more than 90°.

Using the Load Chart

NOTE: One of the most important tools of every Grove crane is the *Load Chart Manual* in the crane operator's cab.

NOTE: Refer to Figure 4-209 for terms to know in determining lifting capacities.

The *Load Chart Manual* contains crane lifting capacities in all allowable lifting configurations and must be thoroughly understood by the operator.

The left column is the load radius, which is the distance from axis of crane rotation to load center of gravity. The top row lists various boom lengths from fully retracted to fully extended (with swingaway boom extension). The number at the intersection of the left column and top row is the total load limit for that load radius and boom length.

Another important section is the range diagram. The range diagram shows operating radius and tip height that can be achieved at a given boom length and angle. If the operator knows radius and tip height required for a specific lift, the angle and boom length can quickly be determined from the range diagram. Or, if an operator knows boom length and angle, they can quickly determine tip height and operating radius.

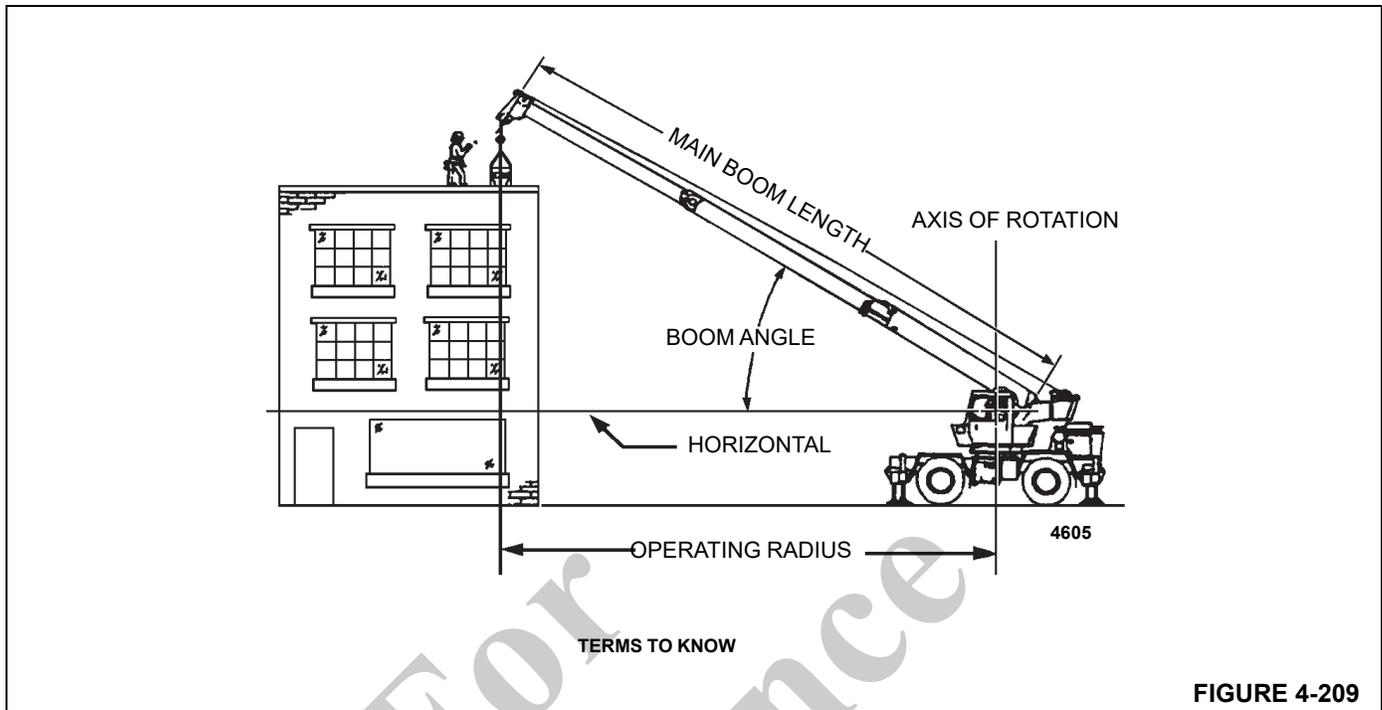


FIGURE 4-209

A lifting diagram is included for over-side, over-rear, and over-front lifting areas. The lifting area diagram shows locations of the outrigger jack cylinders in full extended position are used to mark lifting area boundaries.

Another section contains notes for lifting capacities. Be sure to read and understand all notes concerning lifting capacities.

Capacity reductions for wind speed are also included in the load chart book.

The load chart also gives weight reductions for Grove load handling devices such as hook blocks, overhaul balls, boom extension sections, etc., which must be considered as part of the load. Weight of any other load handling devices such as chains, slings, or spreader bars must also be added to the weight of the load.

NOTE: Information in the following paragraph is an example only of how to compute a lift. Numbers may not match load chart in the crane cab.

Example: A concrete beam weighing 2268 kg (5000 lb) needs to be lifted to a height of 9.1 m (30 ft) at a radius of 15.2 m (50 ft). The range diagram indicates the

boom must be extended to 18.9 m (62 ft) to reach a height of 9.1 m (30 ft) at a radius of 15.2 m (50 ft).

First check the crane for load handling devices. In our example, the crane is equipped with a auxiliary boom nose (rooster sheave) and a five ton overhaul ball. The rooster sheave is 50 kg (110 lb), and the overhaul ball is 78 kg (172 lb) for a total of 128 kg (282 lb). The lift requires slings and spreader bars weighing 159 kg (350 lb) which makes the total weight for the load handling devices 286 kg (632 lb).

A check of the load chart for a 15.2 m (50 ft) radius and 19.5 m (64 ft) of boom length shows a capacity of 3601 kg (7940 lb) on outriggers over-front and 2254 kg (4970 lb) on outriggers 360 degrees.

Subtract load handling weight of 632 lb from load capacity of 3601 kg (7940 lb) and 2254 kg (4970 lb). The result is a weight capacity of 3315 kg (7308 lb) over-the-front and 1968 kg (4338 lb) for 360 degrees.

We are restricted in making the lift over-front only, with a boom angle of about 29 degrees.

STOWING AND PARKING



DANGER

Tipping Hazard!

Never park crane near holes, on rocky surfaces, or on soft spots. This may cause crane to overturn, resulting in injury or death to personnel.

When parking crane, do the following:

1. Remove load from hook.
2. Fully retract all boom sections.
3. Lower boom to normal travel position.
4. Engage swing brake and swing lock pin.
5. Retract all jack cylinders and outrigger beams.
6. Park crane on a stable surface.

CAUTION

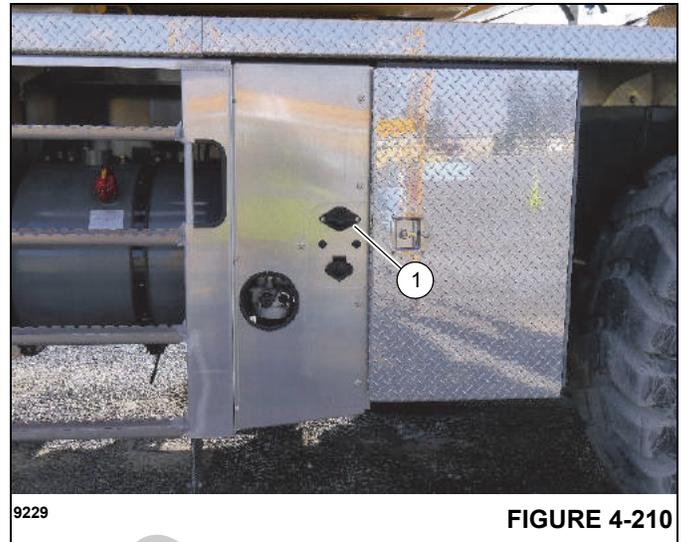
Avoid Crane Damage!

Do not engage the parking brake while the vehicle is moving. Damage to the crane can occur.

Disengage the parking brake before driving. Damage to the crane can occur.

7. Apply parking brakes and if necessary, chock wheels.
8. Make sure all operating controls are in neutral position.
9. Shut down engine following proper procedures specified in this *Operator Manual* and applicable engine manual.
10. Remove keys.
11. Close and lock, if applicable, all windows, covers, and doors.
12. Set battery disconnect switch (1, Figure 4-210) to the OFF position if machine will be inactive for over 24 hours.

To avoid possible engine fault codes and undesirable operation, make sure that the Ignition Switch has been in the OFF (0) position for 2 minutes before disconnecting the batteries from the crane.



9229

FIGURE 4-210

LEAVING CRANE UNATTENDED



WARNING

Tipping Hazard!

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

Failure to comply with these instructions may cause death or serious injury.

The configuration in which the crane should be left while unattended shall be determined by a qualified, designated individual familiar with the job site, configuration, conditions, and limitations.

LONG-TERM STORAGE

Guidelines for tires on cranes parked for long periods:

1. If possible, place the crane on jacks to keep the weight off the tires.

If the crane cannot be placed on jacks, move the crane at least once a month to prevent permanent distortion of tires.
2. Keep the inflation pressure as recommended.

*For
Reference
Only*

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SECTION 5

SET-UP AND INSTALLATION

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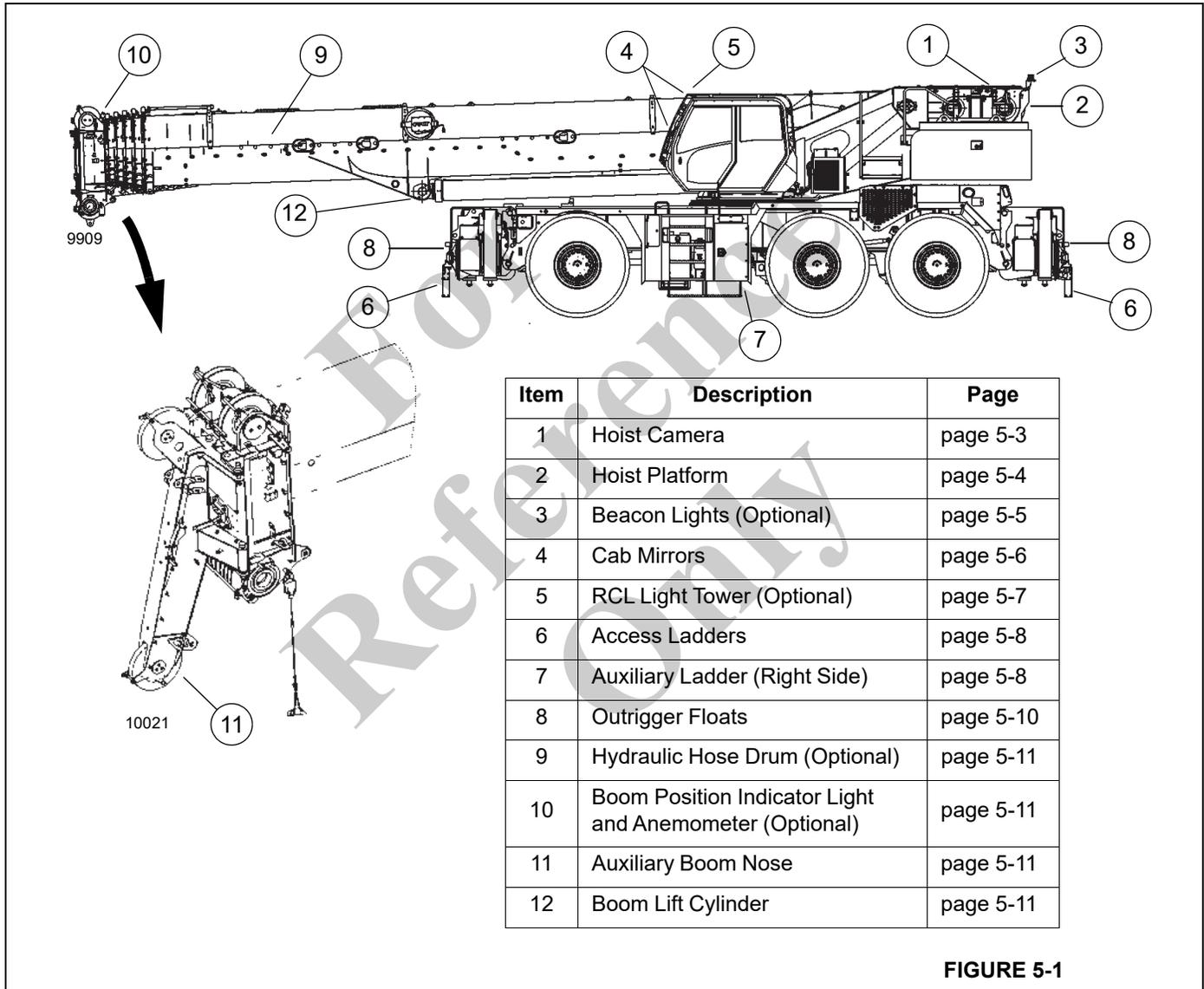


FIGURE 5-1

SETUP OF CRANE BEFORE AND AFTER TRANSPORTING

Figure 5-1 shows the components that must be placed in to their transport positions before transporting the crane.

Securing all valve cover latches with tie-straps is recommended to prevent accidental opening during transportation. After transporting the crane, place these components into their working positions.

Hoist Camera

The hoist camera (1, Figure 5-2) is located at the rear of the superstructure. The camera should be raised for operation and lowered for transport.

Lowering the Hoist Camera for Transport

1. Pull the retractable lock (2). Lower the hoist camera (1).
2. Push the retractable lock (2) in the locked position to secure the hoist camera in the transport position.

3. Lower the rear and side hoist platform railings. For more information, see *Hoist Platform*, page 5-4.

Raising the Hoist Camera for Operation

1. Raise the side and rear hoist platform railings. For more information, see *Hoist Platform*, page 5-4.
2. Pull the retractable lock (2). Raise the hoist camera (1).
3. Push the retractable lock (2) in to the locked position to secure the hoist camera (2) in the working position.

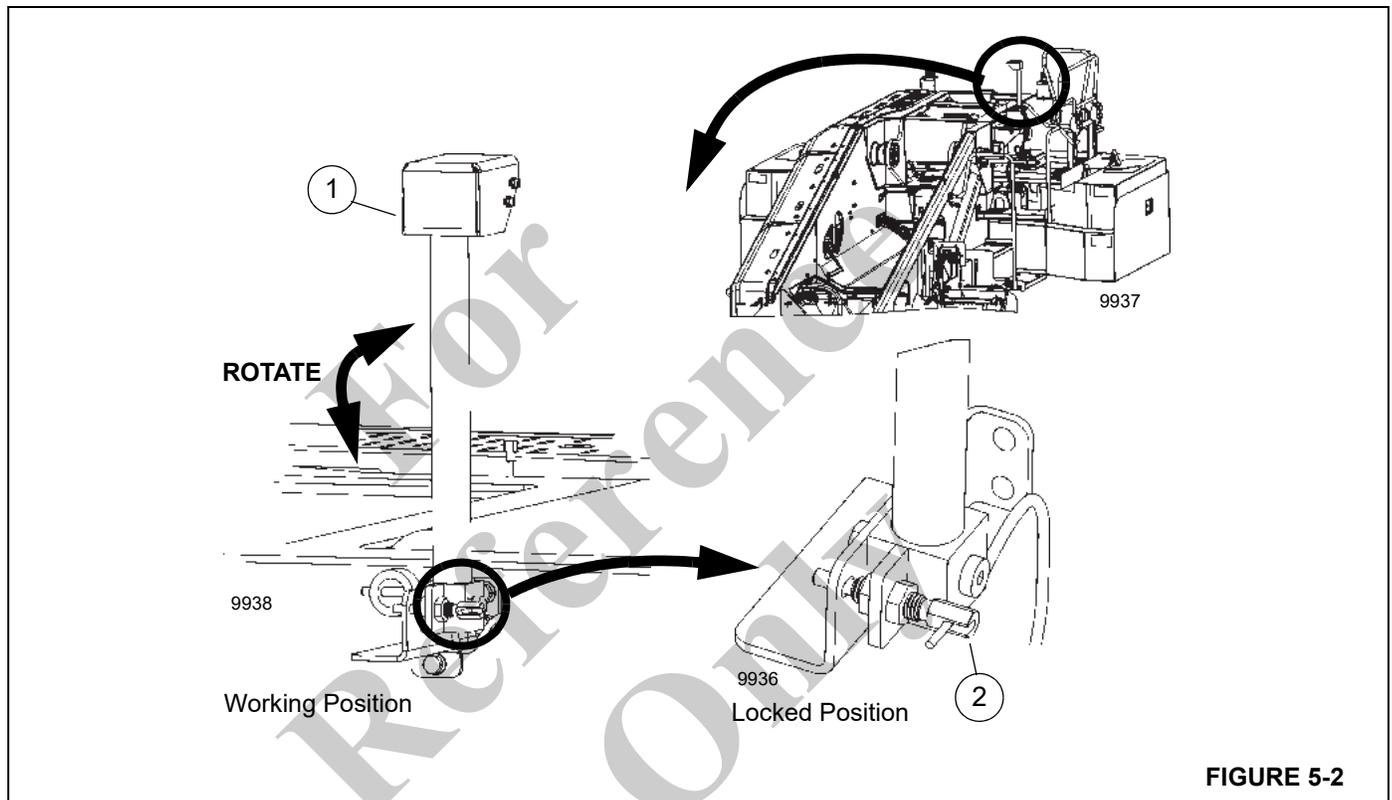


FIGURE 5-2

Hoist Platform



! DANGER

Do not use platform for hauling passengers. Death or serious injury could occur.
 No storage of components is allowed on the platform.
 Only one person at a time is allowed on the platform.

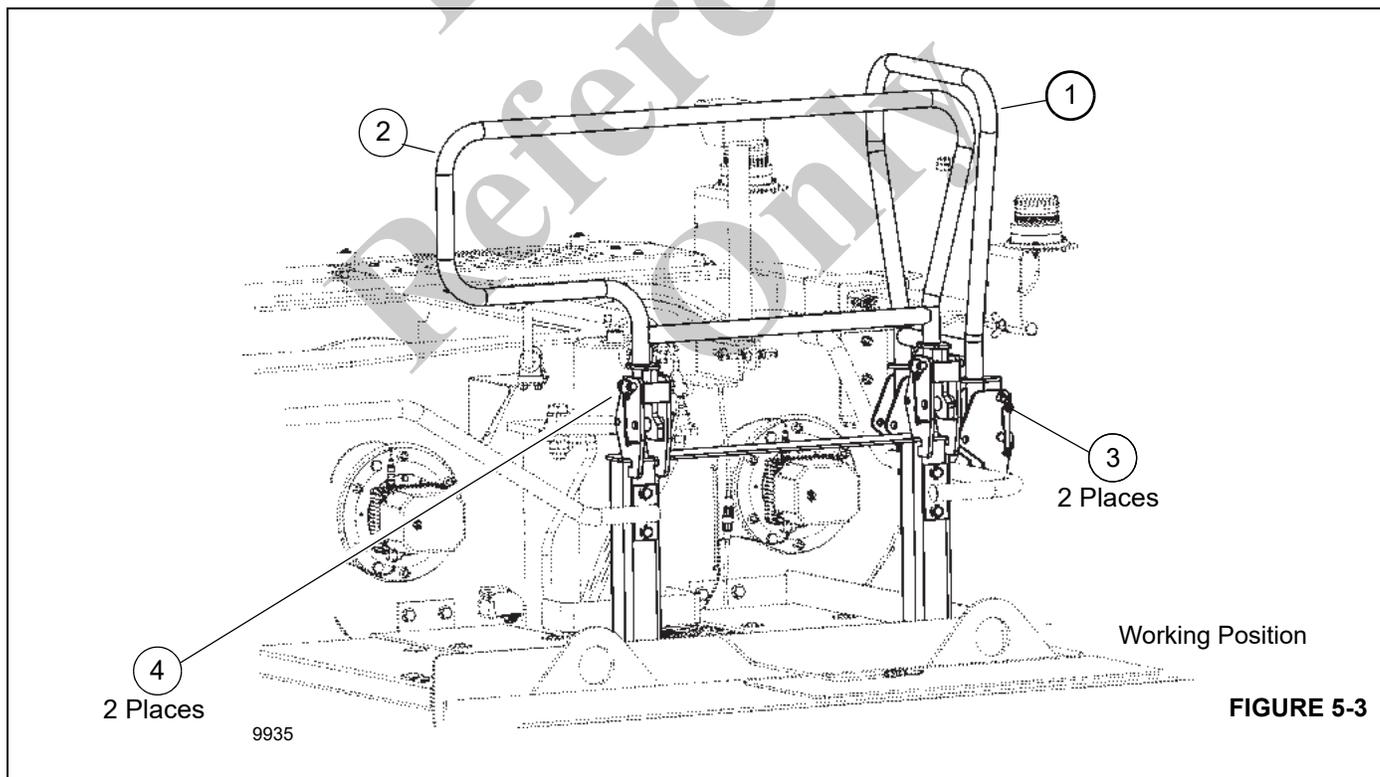
The hoist platform is located at the rear of the superstructure near the main and auxiliary hoists. Raise the hoist platform railings (1 and 2, Figure 5-3) when maintaining the hoists. The platform railings must be lowered prior to transport.

Lowering the Hoist Platform Railings for Transport

4. Lower the hoist camera. For more information, see *Hoist Camera*, page 5-3.
5. Remove pins (3) and lower the rear railing (1). Use pins (3) to secure the railing in the lowered position.
6. Remove pins (4) and lower the side railing (2). Use pins to secure the railing in the lowered position.

Raising the Hoist Access Railings for Operation

1. Remove pins (4) and raise the side railing (2). Use pins (4) to secure the railing in the raised position.
2. Remove pins (3) and raise the rear railing (1). Use pins (3) to secure the railing in the working position.
3. Raise the hoist camera. For more information, see *Hoist Camera*, page 5-3.



Beacon Lights (Optional)

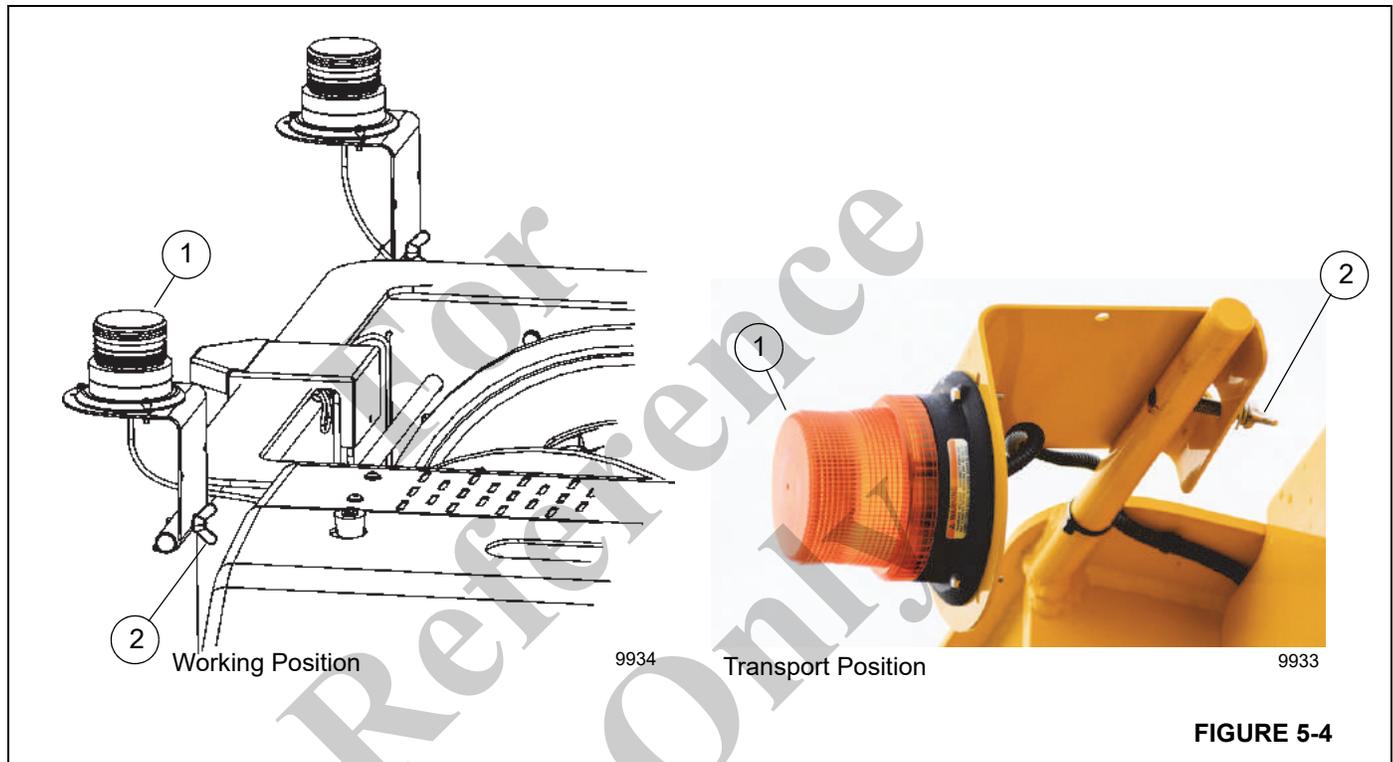
The optional beacon lights (1, Figure 5-4) can be installed as part of the optional Auxiliary Lighting and Convenience Package. When installed, the beacons are located on the rear of the superstructure. The beacons must be lowered for transport and raised for operation.

Lowering the Beacon Light for Transport

1. Loosen the wing nut (2). Lower the beacon light (1).
2. Tighten the wing nut (2) to secure the beacon light (1) in the transport position.

Raising the Beacon Light for Operation

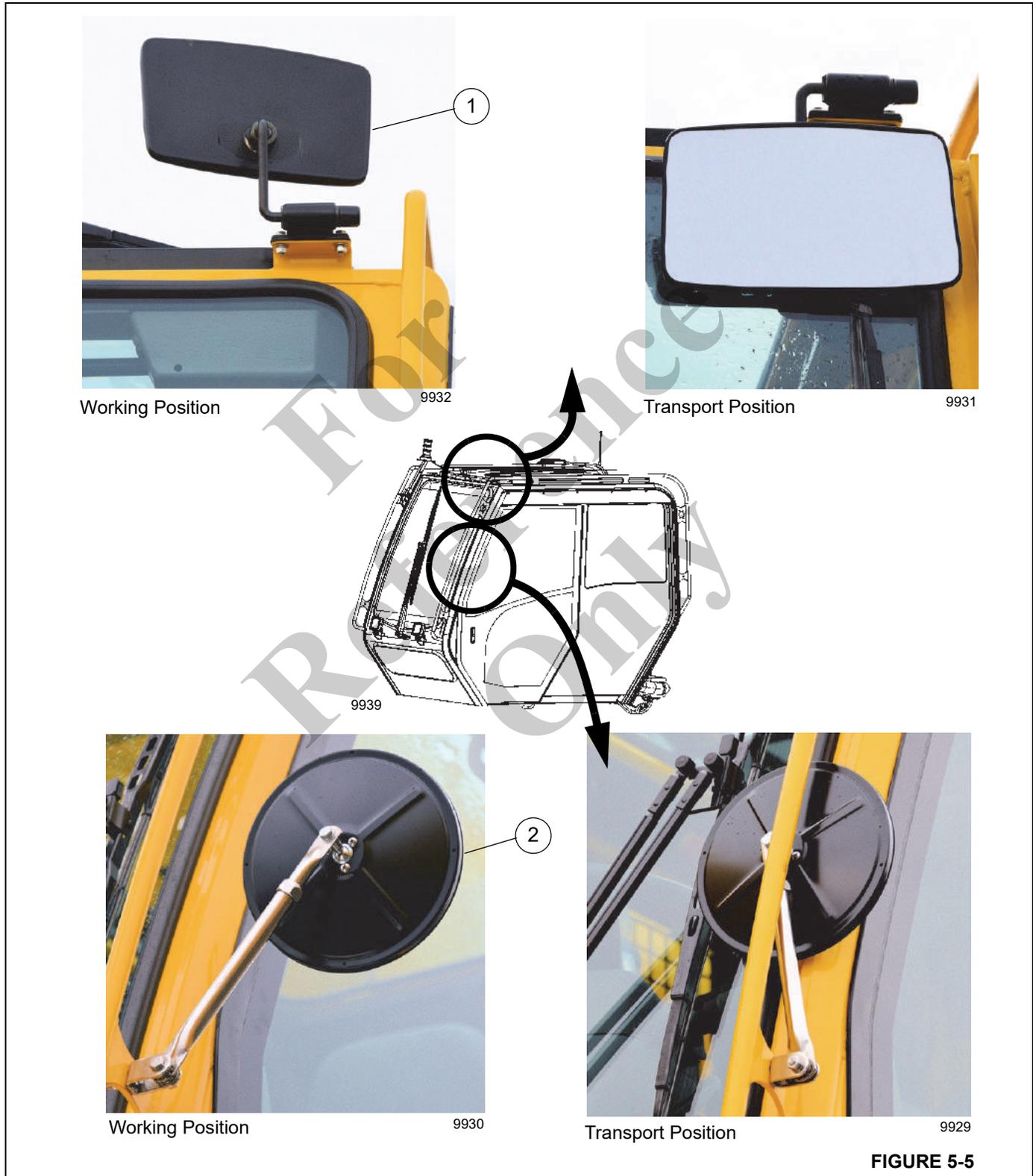
1. Loosen the wing nut (2). Raise the beacon light (1).
2. Tighten the wing nut (2) to secure the beacon light (1) in the working position.



Cab Mirrors

Figure 5-5 shows the working and transport positions for the top (1) and side (2) cab mirrors. The operator can use the top cab mirror to view the hoists and the side mirror to view

behind the left side of the cab. The cab mirrors must be retracted for stowed and moved to working position for operation.



RCL Light Tower (Optional)

The RCL Light Tower (1, Figure 5-6) is an optional feature located on the front right of the crane cab. It must be retracted for transport and extended for operation.

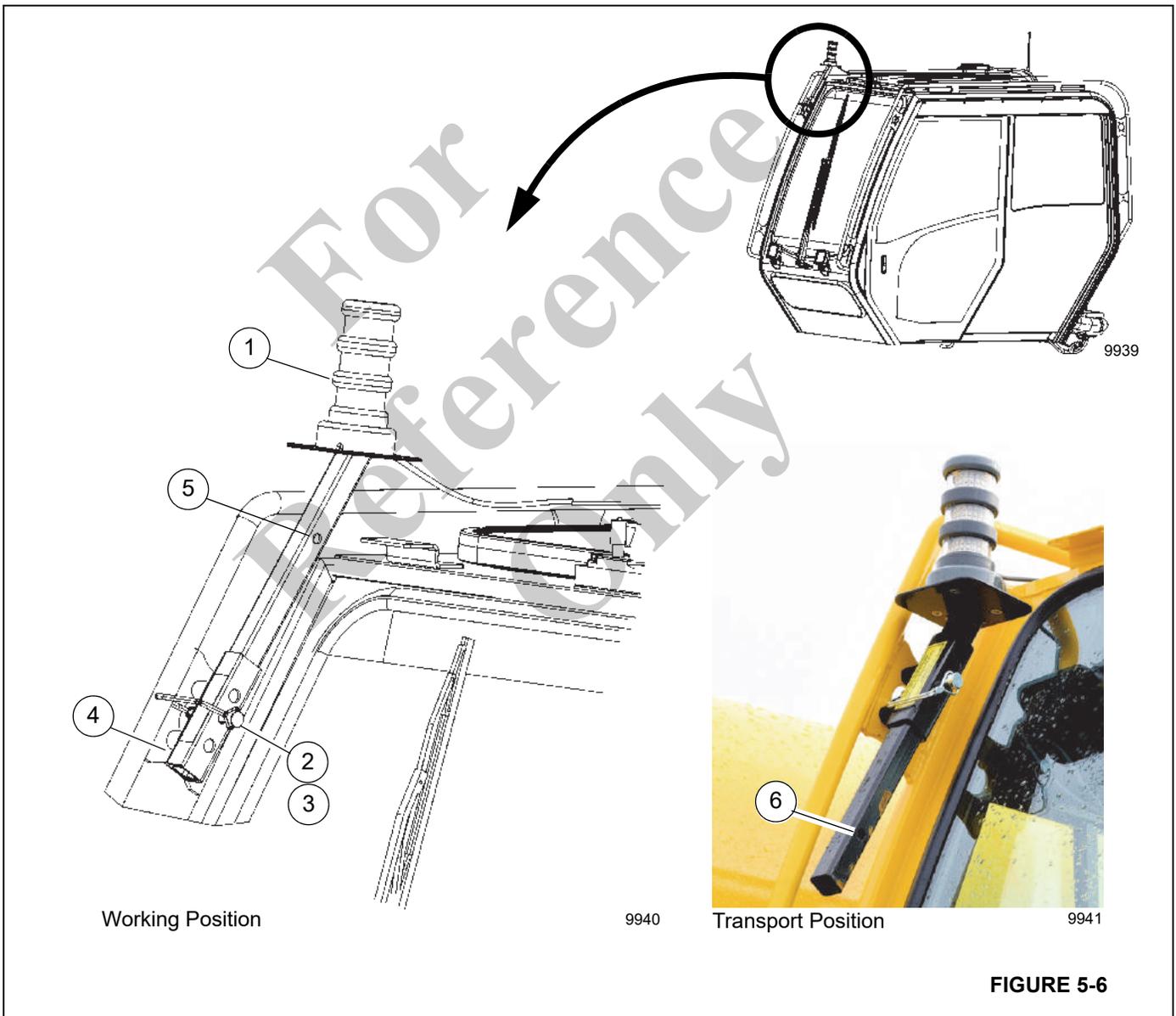
Retracting the RCL Light Tower for Transport

1. Remove retaining clip (2) and pin (3) from the mounting bracket (4).
2. Slide the RCL light tower down to the retracted position. Align the retract position hole (5) in the tower post with the hole in the mounting bracket.

3. Install the pin (3) in the mounting bracket (4) and tower post. Secure the pin with the retaining clip (2).

Extending the RCL Light Tower for Operation

1. Remove the retaining clip (2) and pin (3) from the mounting bracket (4).
2. Slide the RCL light tower (1) up to the extended position. Align the extend position hole (6) in the tower post with the hole in the mounting bracket (4).
3. Install the pin (3) in the mounting bracket (4) and tower post. Secure the pin (3) with the retaining clip (2).



Access Ladders

The access ladders (1, Figure 5-7) are located on the front and rear outrigger boxes. The access ladders must be raised for transport and must be lowered during operation.

Raising the Access Ladder for Transport

1. Remove retaining clips (3) and pins (2).
2. Raise the ladder (1) in to transport position.

3. Install pins (2). Install retaining clips (3) to secure the pins.

Lowering the Access Ladder

1. Remove retaining clips (3) and pins (2).
2. Lower the ladder (1).
3. Install pins (2). Install retaining clips (3) to secure the pins.

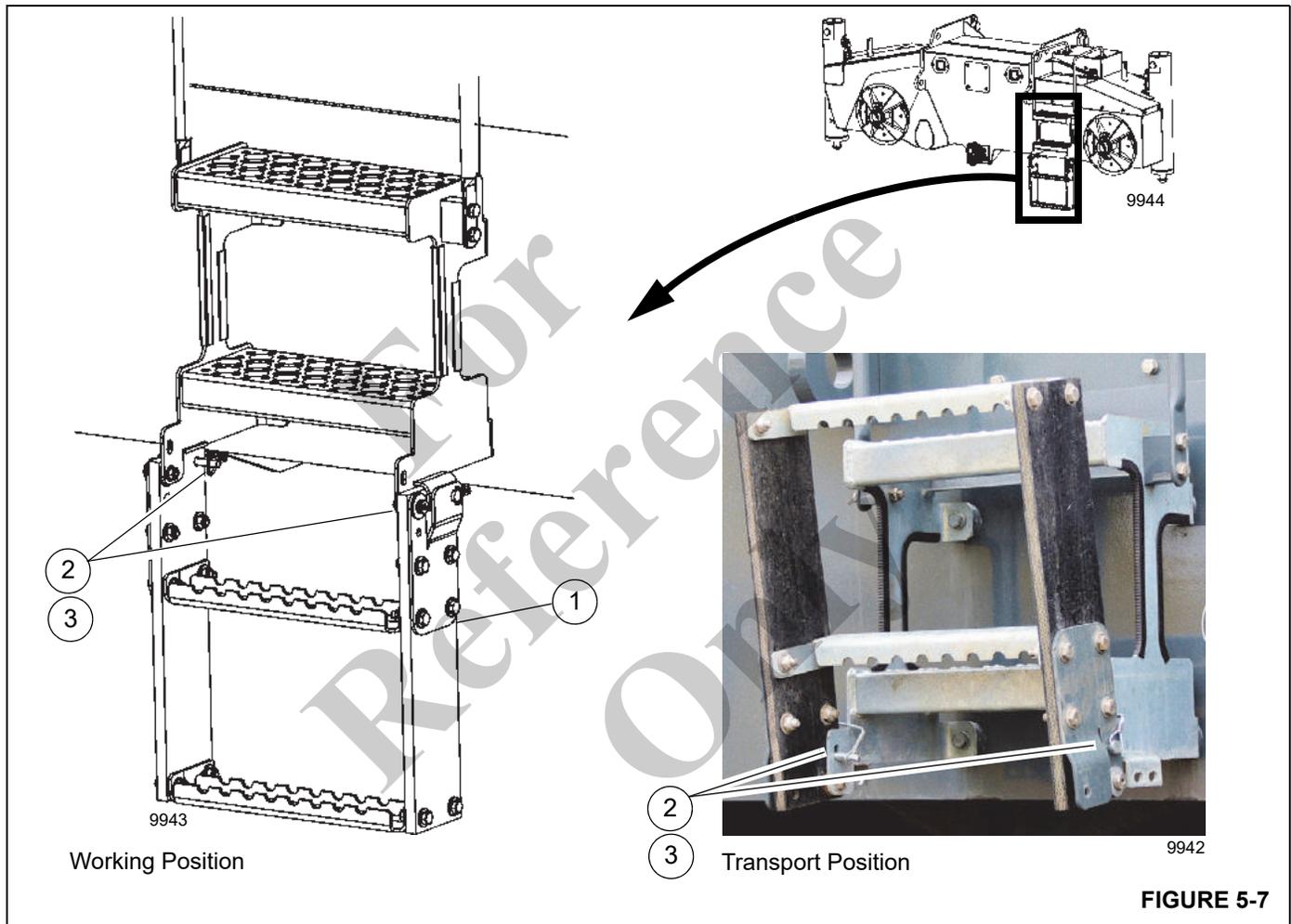


FIGURE 5-7

Auxiliary Ladder

Figure 5-8 shows the stowage and possible installation locations for the auxiliary ladder when the outrigger boxes

are removed. The auxiliary ladder is stowed under the hydraulic tank on the lower right side of the carrier. The auxiliary ladder must be stowed for transport.

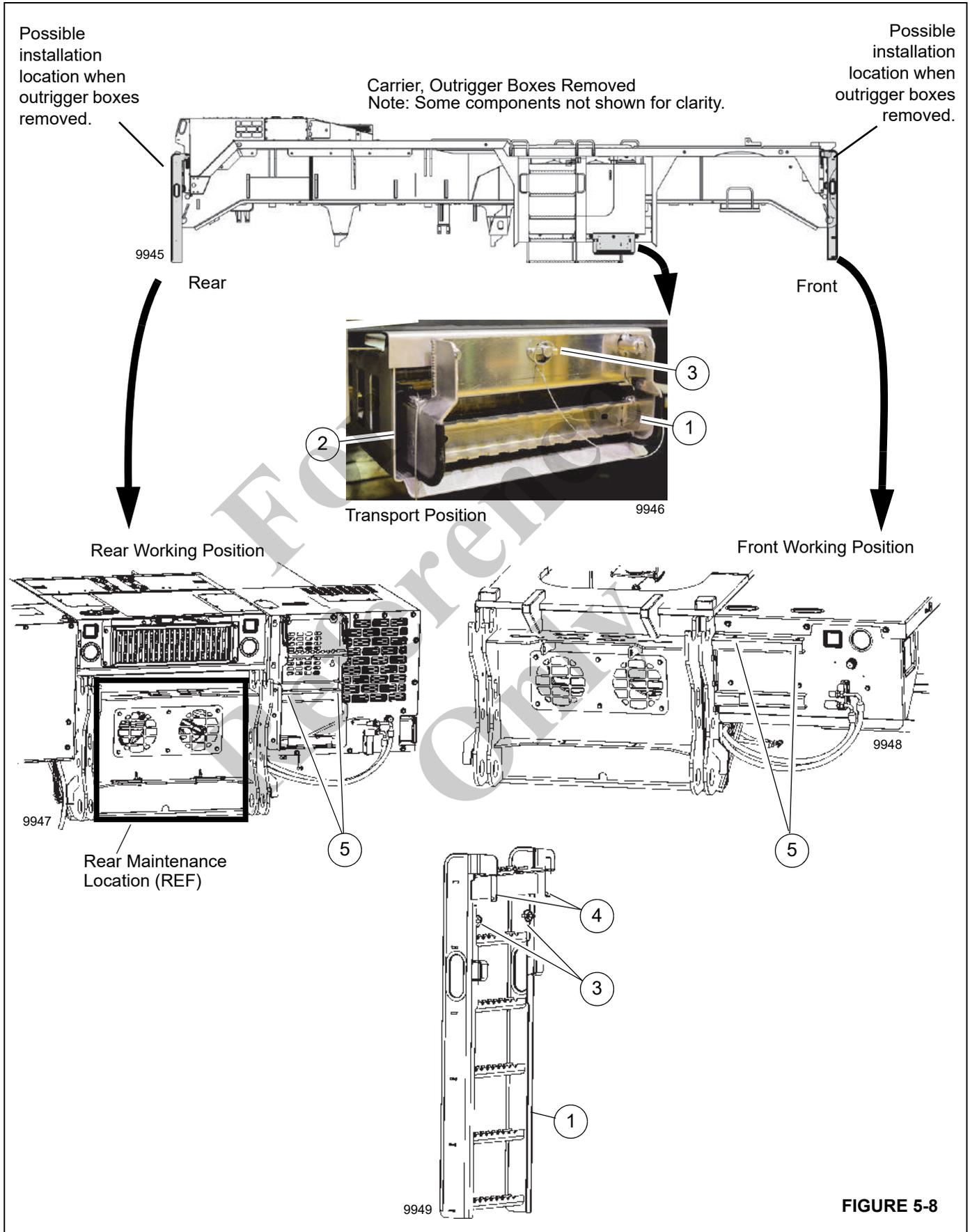


FIGURE 5-8

Stowing the Auxiliary Ladder for Transport

NOTE: The auxiliary ladder weighs approximately 11.5 kg (25.0 lb).

1. Remove the auxiliary ladder (1, Figure 5-8) from the installed position.
2. Slide the auxiliary ladder (1) in to the stowage bracket (2).
3. Secure the auxiliary ladder (1) to the bracket with the ladder quick pin (3). Secure the other ladder quick pin as necessary.

Installing the Auxiliary Ladder

Use this procedure to install the auxiliary ladder (1, Figure 5-8) in the front and rear locations. Use the front and rear ladder locations to access the crane decking.

NOTE: The auxiliary ladder weighs approximately 11.5 kg (25.0 lb).

1. Remove the quick pin (3, Figure 5-8). Remove the auxiliary ladder (1) from the stowage bracket (2).
2. Insert ladder installation pins (4) in holes (5) at the front or rear ladder location.
3. Secure the ladder (1) with pins (3).

Auxiliary Ladder Rear Maintenance Location

Use the following procedures to install and remove the auxiliary ladder in the rear maintenance location. Install the auxiliary ladder in the rear maintenance location to check and add engine fluids, such as the engine coolant.

Installation

1. Pull the pins (1, Figure 5-9) and rotate the ladder support plates (2) into position.

NOTE: The auxiliary ladder weighs approximately 11.5 kg (25.0 lb).

2. Remove the quick pin (3, Figure 5-8). Remove the auxiliary ladder from the stowage bracket (2).
3. Insert ladder quick pins (3, Figure 5-9) in holes (4) at the rear maintenance location.
4. Secure the ladder (5) with pins (6).

Removal

1. Remove pins (6, Figure 5-9) and ladder from the rear maintenance position.
2. Stow the ladder for transport. For more information, see *Stowing the Auxiliary Ladder for Transport*, page 5-10.
3. Pull the pins (1, Figure 5-9) and rotate the ladder support plates (2) to the stowed position.

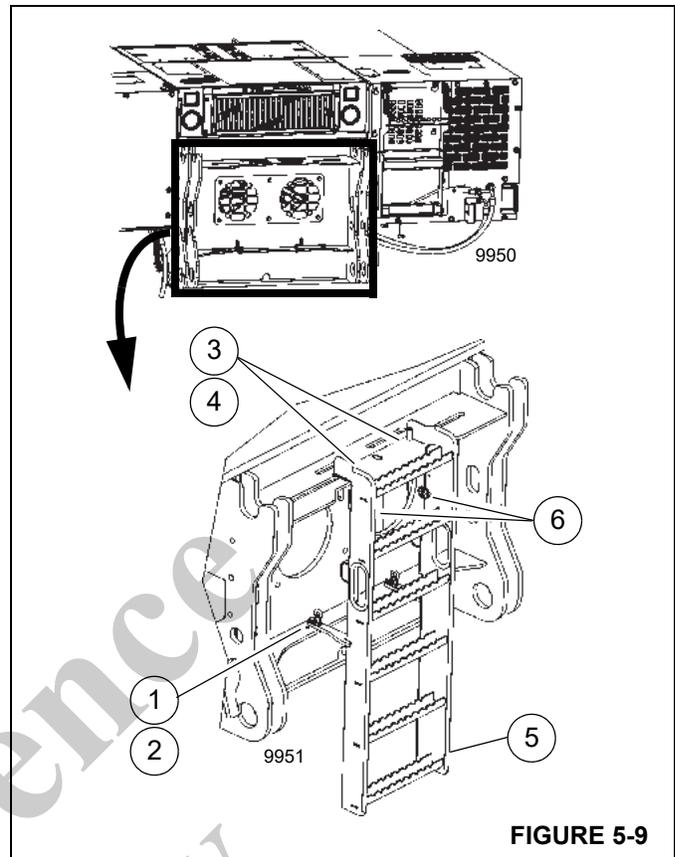


FIGURE 5-9

Outrigger Floats

The outrigger floats (1, Figure 5-10) are stowed on the outrigger boxes. The outrigger floats must be stowed prior to transport.

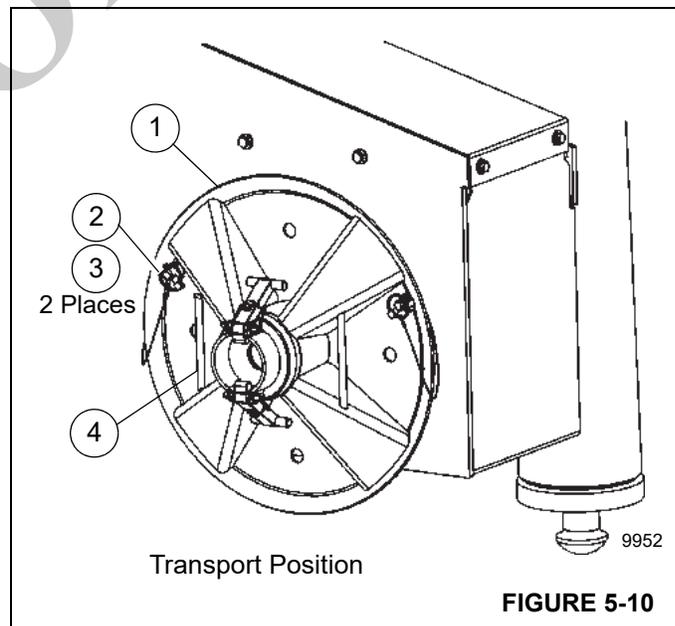


FIGURE 5-10

Stowing an Outrigger Float for Transport

NOTE: An outrigger float weighs approximately 30 kg (65.0 lbs).

1. Remove pins (3) from stowage posts (2).
2. Lift outrigger float into position using handles (4).
3. Install outrigger float (1) on stowage posts (2) on the outrigger box.
4. Install pins (3) in posts (2) to secure the outrigger float.

Removing an Outrigger Float from Stowage

NOTE: An outrigger float weighs approximately 30 kg (65.0 lbs).

1. Hold the handle (4) and remove pins (3) from posts (2).
2. Remove the outrigger float (1) from stowage posts (2) on the outrigger box.
3. Install pins (3) in stowage posts (2).

Hydraulic Hose Drum (Optional)

If installed on the boom, the hydraulic hose drum must be secured before transport. For more information, see *Checking the Locking Device on the Hose Drum*, page 5-74.

Boom Position Indicator Light and Anemometer (Optional)

The boom position light and anemometer assembly must be removed and stowed for transport. For more information, see *Anemometer/Boom Position Light (Optional)*, page 5-94.

Auxiliary Single-Sheave Boom Nose

The auxiliary single-sheave boom nose must be secured for transport. For more information, see *Rigging the Auxiliary Single-Sheave Boom Nose for Transport*, page 5-94.

Boom Lift Cylinder

If the boom is removed for transport, properly secure the lift cylinder. For information about removing the boom, see the *Service Manual*.

INSTALLING CABLE ON THE HOIST

Refer to Figure 5-11.



DANGER

Do not use platform for hauling passengers. Death or serious injury could occur.

No storage of components is allowed on the platform.

Only one person at a time is allowed on the platform.

CAUTION

If cable is wound from storage drum, rotate reel in same direction as hoist.

NOTE: Straighten cable before installing on hoist drum.

1. Place cable (1) over boom nose sheave and route to hoist drum (2).
2. Rotate hoist drum so cable slot located on left side of drum is easily accessible.
3. Insert cable through slot (3) and wedge block (4). Loop around anchor wedge (6) and route back through wedge block to clamp (5). Ensure the cable is routed over the guide inside of drum. End of cable should extend approximately 50 mm (2 in) beyond clamp. Tighten clamp.
4. Adjust cable so clamp side is snug against guide. Position anchor wedge in wedge block. Pull firmly on inside hoist side of cable to secure the wedge.
5. If wedge does not seat securely in slot, carefully tap cable and top of wedge (7) with a mallet.

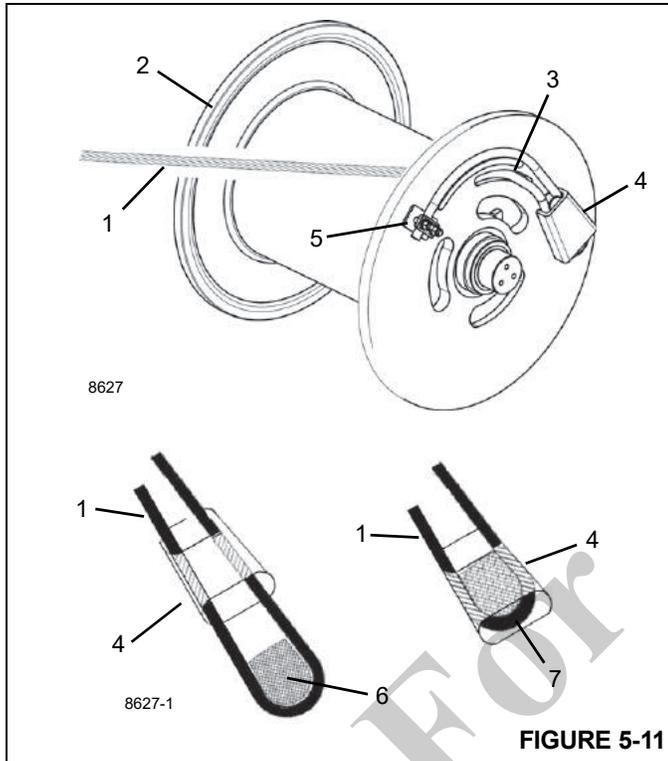


FIGURE 5-11



6. Slowly rotate drum and evenly wind first layer of cable.
7. Install remainder of cable as required.

COUNTERWEIGHT REMOVAL AND INSTALLATION

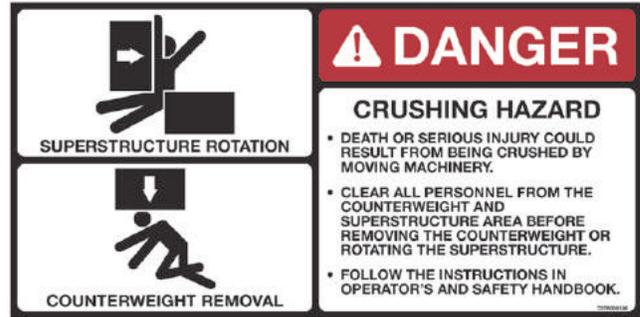
The GRT9165 features a 25764 kg (56800 lb) counterweight.

Figure 5-12 shows the assembled counterweight and component sections. The counterweight can be removed from the crane and disassembled for transport. The counterweight must be assembled and installed on the superstructure for lifting operations. The counterweight is not required when installing and removing the counterweight and outrigger boxes from the crane.

The GRT9165 boom can be used to install and remove the counterweight and sections. The appropriate RCL load code for the rigging mode must be selected and confirmed before

installing the counterweight with the GRT9165 boom. For more information, see *Enter Rigging Code*, page 4-159.

General Warnings



DANGER

Read and understand the following when removing and installing the counterweight to avoid serious injury or death.

- Outriggers must be fully extended and set and crane level before installation or removal of counterweight.
- Lifting operations are not permitted with the counterweight on the carrier deck except for the removal or installation of the counterweight.
- Boom is not permitted over carrier deck when the boom angle is less than 30° and the counterweight is positioned on deck.
- Hookblock is not permitted to come in contact with counterweight during removal or installation.
- Travel is not permitted with the counterweight on carrier deck.

DANGER

Crushing Hazard!

Death or serious injury could result from being crushed by falling counterweight.

Follow instructions in Operator and safety handbook for counterweight installation and removal procedure.

Counterweight Sections Lifting Points

Figure 5-12 shows the lift points for the counterweight and sections. Attach the slings to the points identified when lifting the counterweight and sections.

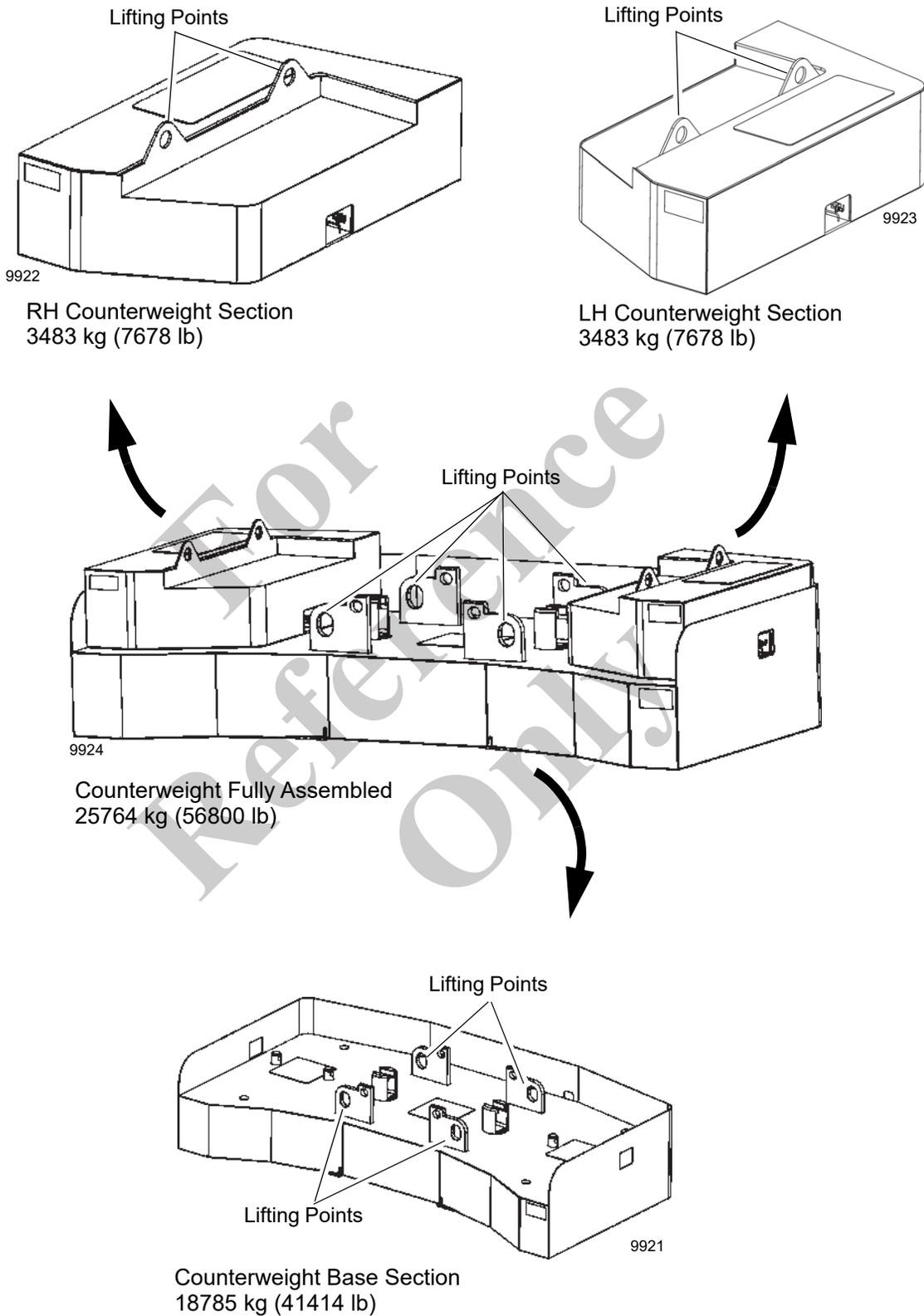


FIGURE 5-12

Assembling the Counterweight for Operation

Use this procedure to assemble the 25764 kg (56800 lb) counterweight for operation. The base counterweight section must be on a stable supporting surface prior to assembly.



DANGER

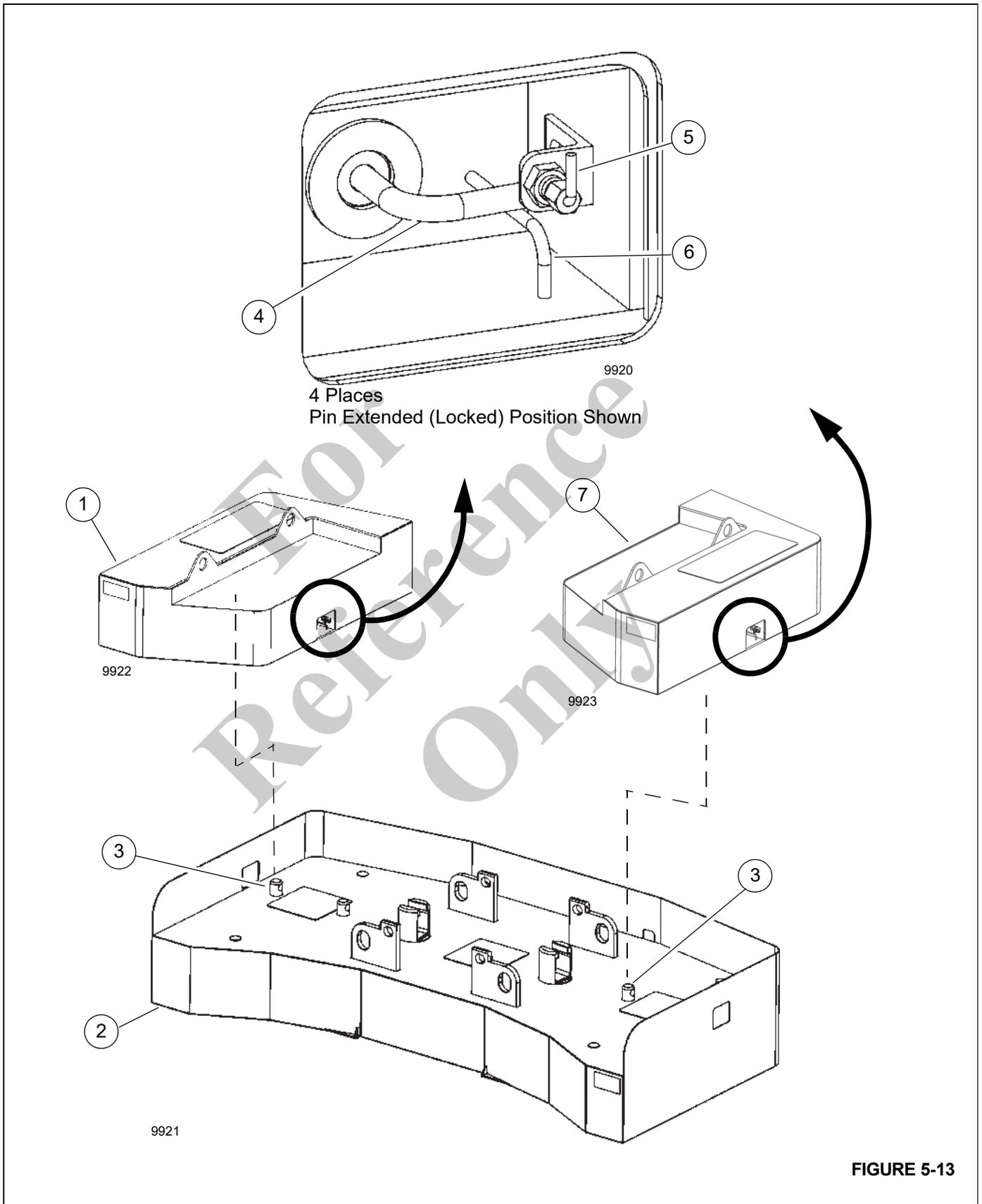
Prior to installing counterweight on the crane, outrigger boxes must be installed and outrigger beams must be fully extended and set.

1. Attach lift slings to the lifting points on the Right Hand (RH) counterweight section (Figure 5-12).
2. Install the RH counterweight section (1, Figure 5-13) on to the base counterweight section (2). Make sure the RH section is seated on the base section mounting posts (3).
3. To secure the RH counterweight section (1) on the base section (2), extend the counterweight section locking pins (4) in to the mounting posts (3) in two places as follows:
 - a. Turn and pull the spring-loaded pin (5) to unlock the pin (4) handle.
 - b. Rotate the pin (4) handle clockwise so it rests on the rod (6). This extends the locking pin (4) in to the mounting post (3).
 - c. Release the spring-loaded pin (5) to secure the pin (4) handle.
4. Attach lift slings to the lifting points on the Left Hand (LH) counterweight section (Figure 5-12).
5. Install the Left Hand (LH) counterweight section (7) on to the base section (2). Make sure the LH section (7) is seated on the base section mounting posts (3).
6. To secure the LH counterweight section (7) on the base section (2), extend the counterweight section locking pins (4) in to the mounting posts (3) in two places as described in step 3.
7. Install the assembled counterweight on the carrier counterweight platform. For more information, see *Installing the Counterweight on the Carrier Platform*, page 5-16.

Disassembling the Counterweight for Transport

Use the following procedure to disassemble the counterweight for transport.

1. Remove the assembled counterweight from the carrier counterweight platform. For more information, see *Removing the Counterweight from the Carrier Platform*, page 5-17.
2. Retract the LH counterweight section (7, Figure 5-13) locking pins (4) in two places as follows:
 - a. Turn and pull the spring-loaded pin (5) to unlock the pin (4) handle.
 - b. Rotate the pin (4) handle counterclockwise to retract the pin from the mounting posts (3).
 - c. Release the spring-loaded pin (5).
3. Attach a suitable lifting device to the LH counterweight lifting points (Figure 5-12) and remove the section (7, Figure 5-13) from the base section (2).
4. Retract the locking pins (4) from the RH counterweight section (1) in two places as described in step 2.
5. Attach a suitable lifting device to the RH counterweight lifting points (Figure 5-12). Remove the section (1, Figure 5-13) from the base section (2).



Installing the Counterweight on the Carrier Platform

Use this procedure to install the assembled counterweight on the platform on the carrier.

! DANGER
Crushing Hazard!

Death or serious injury could result from being crushed by falling counterweight.

Follow instructions in Operator and safety handbook for counterweight installation and removal procedure.

! DANGER

Read and understand the following when removing and installing the counterweight, to avoid serious injury or death.

- Outriggers must be fully extended and set and crane level before installation or removal of counterweight.
- Lifting operations are not permitted with the counterweight on the carrier deck except for the removal or installation of the counterweight.
- Boom is not permitted over carrier deck when the boom angle is less than 30° and the counterweight is positioned on deck.
- Hookblock is not permitted to come in contact with counterweight during removal or installation.
- Travel is not permitted with the counterweight on carrier deck.

CAUTION

Locking Pin Damage!

When lifting the 56,800 lb counterweight, ensure ALL locking pins (4, Figure 5-13) are completely installed in the lock position before lifting the counterweight on and off of the crane. DO NOT leave the locking pins in the unlocked position while lifting the counterweight on and off of the crane. This ensures the counterweight sections are properly locked together.

1. Program the RCL/Load Chart code for *Main Boom on O/R Extended, No Cwt* (Code 0801). For more information, see *Enter Rigging Code*, page 4-159.
2. Make sure counterweight section locking pins (4, Figure 5-13) are securely locked. For more information,

see *Assembling the Counterweight for Operation*, page 5-14.

3. Fully extend the outriggers. For more information, see *Using the Outriggers*, page 4-21.
4. Raise the boom as necessary so the lift cylinder is not resting on the lift cylinder support.

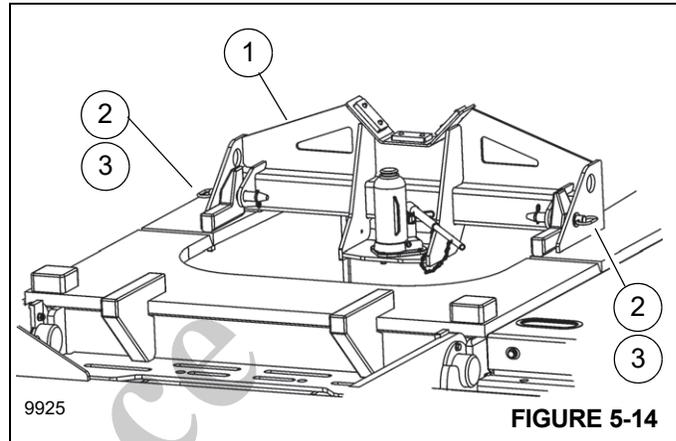


FIGURE 5-14

5. Remove the lift cylinder support (1, Figure 5-14) from the counterweight platform as follows:



NOTE: The lift cylinder support weighs approximately 59 kg (129 lb).

- a. Remove retaining clips (2) and pins (3).
- b. Using a suitable lifting device, remove the lift cylinder support (1) from the counterweight platform.
- c. Install pins (3) and retaining clips (2) on lift cylinder support (1).
6. Attach a suitable lifting device to the sling points on the assembled counterweight.

! DANGER

The counterweight must be installed flush against counterweight stops on the carrier deck. The counterweight could tip off of the deck if there is a gap between the counterweight and counterweight stops.

7. Lift the counterweight (1, Figure 5-15) and place it on the counterweight platform on the carrier. Align the

counterweight guides (2) located on the front of the counterweight with the counterweight stops (3) on the carrier platform. Make sure the counterweight (1) is flush against the counterweight stops (3).

8. Install the counterweight on the superstructure. For more information, see *Installing and Removing the Counterweight on/from the Superstructure*, page 5-19.

Removing the Counterweight from the Carrier Platform

Use this procedure to remove the counterweight from the carrier counterweight platform.



DANGER Crushing Hazard!

Death or serious injury could result from being crushed by falling counterweight.

Follow instructions in Operator and safety handbook for counterweight installation and removal procedure.



DANGER

Read and understand the following when removing and installing the counterweight, to avoid serious injury or death.

- Outriggers must be fully extended and set and crane level before installation or removal of counterweight.
- Lifting operations are not permitted with the counterweight on the carrier deck except for the removal or installation of the counterweight.
- Boom is not permitted over carrier deck when the boom angle is less than 30° and the counterweight is positioned on deck.
- Hookblock is not permitted to come in contact with counterweight during removal or installation.
- Travel is not permitted with the counterweight on carrier deck.

CAUTION

Locking Pin Damage!

When lifting the 56,800 lb counterweight, ensure ALL locking pins (4, Figure 5-13) are completely installed in the lock position before lifting the counterweight on and off of the crane. DO NOT leave the locking pins in the unlocked position while lifting the counterweight on and off of the crane.

1. Program the RCL/Load Chart code for *Main Boom on O/R Extended, No Cwt* (Code 0801). For more information, see *Enter Rigging Code*, page 4-159.
2. Attach lifting sling to lifting points (Figure 5-12).
3. Lift the counterweight from the carrier counterweight platform. Lower the counterweight on to a suitable surface.
4. Disassemble the counterweight as needed for transport. For more information, see *Disassembling the Counterweight for Transport*, page 5-14.

NOTE: The lift cylinder support weighs approximately 59 kg (129 lb).

5. Install the lift cylinder support (1, Figure 5-14) on the carrier as follows:
 - a. Remove retaining clips (2) and pins (3).
 - b. Position the lift cylinder support (1) on the carrier. Align support holes with the holes in the counterweight stops.
 - c. Secure the support (1) to the carrier with pins (3) and retaining clips (2).

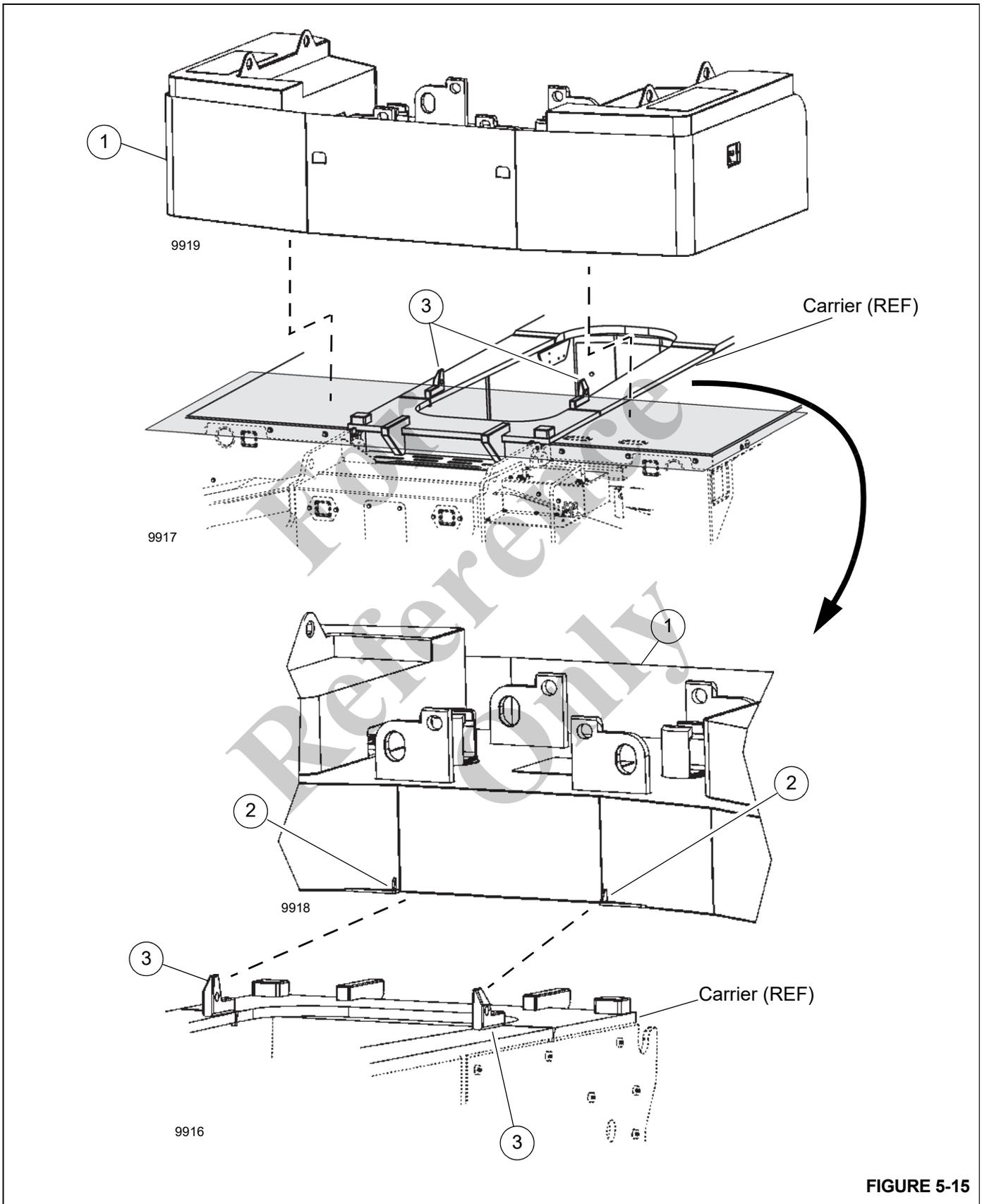


FIGURE 5-15

Installing and Removing the Counterweight on/from the Superstructure



DANGER
Crushing Hazard!

Death or serious injury could result from being crushed by falling counterweight

Follow instructions in Operator and Safety Handbook for counterweight installation and removal procedure.

Use the information in this section to remove and install the counterweight from/on the superstructure using automatic or manual mode.

For more information about controllers and switches, see *Section 3 - Operating Controls and Features*. For more information about the Operator Display Module (ODM), see *Using the Operator Display Module (ODM)*, page 4-72.

Overview of the Counterweight ODM Screen

Figure 5-16 and Table 5-1 describe the elements of the Counterweight screen in the ODM.

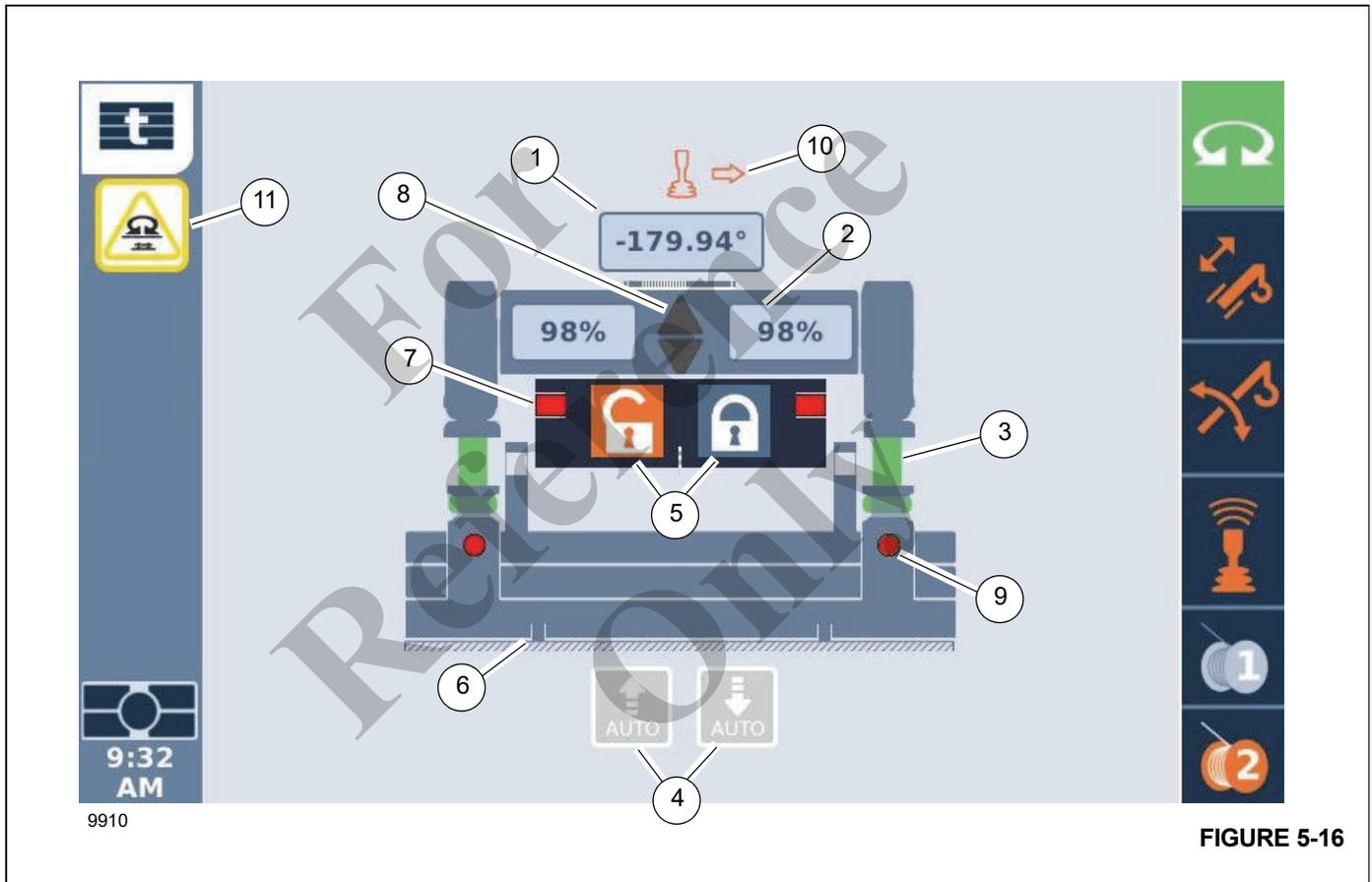


FIGURE 5-16

Table 5-1 ODM Counterweight Overview

Item	Name	Symbol	Description
1	Swing Indicator	-179.09°	Displays the orientation of the superstructure. The range is -180° to 180°.
2	Counterweight Cylinder Length Indicator	100%	Displays the length of the counterweight cylinder in percent. The range is 0% (fully retracted) to 100% (fully extended).

Table 5-1 ODM Counterweight Overview (Continued)

Item	Name	Symbol	Description
3	Counterweight Cylinder Indicator		Green indicates the counterweight cylinders can be raised or lowered.
			Yellow indicates the counterweight cylinders are outside of the range for raising or lowering the counterweight (176.5° to -176.5°).
			Red indicates the counterweight cylinders cannot be raised or lowered.
4	Automatic Mode Icons		Gray indicates that the swing angle is outside of the automatic mode swing angle range (176.5° to -176.5°).
			Blue indicates the swing angle is in the automatic mode swing angle range (176.5° to -176.5°).
			Orange indicates the Automatic Mode icon is highlighted. Use the ODM keypad or jog dial to enter Automatic Mode.
5	Lock and Unlock Icons (Manual Mode Only)		Blue indicates the counterweight pin lock and unlock icon is not highlighted.
			Orange indicates the counterweight pin lock or unlock icon is highlighted.
			Green indicates the lock or unlock icon is selected when removing or retracting Counterweight Pins in manual mode. For more information, see <i>Manual Mode</i> , page 5-26.
6	Carrier Alignment Indicators		Indicates the counterweight alignment relative to the counterweight stops on the carrier deck.
7	Counterweight Pin Indicators		Green indicates the counterweight pin is fully extended.
			Yellow indicates the counterweight pin is partially extended or retracted.
			Red indicates the counterweight pin is fully retracted.

Table 5-1 ODM Counterweight Overview (Continued)

Item	Name	Symbol	Description
8	Counterweight Cylinder Remove/Install Arrows (Manual Mode Only)		Gray indicates the arrows are inactive because the swing angle is outside of the 179.5° to -179.5° range.
			Black indicates the arrows are active. The counterweight cylinder remove and install arrows can be highlighted and selected when the swing angle is in the 179.5° to -179.5° range.
			An orange border indicates the arrow is highlighted. Use the ODM navigation panel or jog dial to highlight the arrow when using manual mode. The Up arrow raises the counterweight cylinders. The down arrow lowers the counterweight cylinders.
			Orange (solid) indicates the remove (down) or install (up) function is selected. When the arrow is highlighted, press and hold the OK button on the ODM navigation control panel or the jog dial to select the function. For more information, see <i>Manual Mode</i> , page 5-26.
9	Counterweight Status Indicators		Green indicates the counterweight is installed on the superstructure.
			Red indicates the counterweight is not installed on the superstructure.
10	Controller Icon		Indicates the Swing Controller should be moved and held to the left to start and progress through automatic mode steps to install or remove the counterweight.
			Indicates the Swing Controller should be moved and held to the right to start and progress through automatic mode steps to install or remove the counterweight.
			Indicates the Swing Controller can be moved and held in either direction to start and progress through automatic mode steps to install or remove the counterweight.
11	Swing Caution Icon		Indicates that the swing speed is reduced because the counterweight not being fully raised. This icon appears when installing the counterweight in automatic or manual mode.

Automatic Mode

The following procedures describe how to remove and install the assembled counterweight using automatic mode. With the counterweight already properly placed on the carrier platform, in automatic mode, move and hold the swing controller so that the superstructure rotates in the direction shown in the ODM counterweight screen. When the swing controller is held, the counterweight is removed from or installed on the superstructure with a minimum of operator intervention.

Entering Automatic Mode

When the swing angle is within the range (-176.5° to 176.5°), use the ODM keypad or jog dial to highlight the Auto Up  or Auto Down  icon (4, Figure 5-16) and click OK on the ODM keypad or press down on the jog dial to enter Automatic mode. For more information, see *Lowering the Counterweight on to the Carrier (Automatic Mode)*, page 5-22 and *Installing the Counterweight on to the Superstructure (Automatic Mode)*, page 5-24.

Pausing Automatic Mode

Release the swing controller to pause automatic mode. To continue automatic mode, move and hold the swing controller so the superstructure rotates in the direction shown in the ODM screen.

Canceling Automatic Mode

CAUTION

Machine Damage!

With the override switch actuated, the functions are always enabled. The counterweight removal or installation procedures must be completed manually before moving the superstructure.

Swing the superstructure only when the lifting cylinders are fully retracted.

Press the Momentary Limit Bypass Switch to cancel automatic mode. When you cancel automatic mode, you must complete the removal or installation operation in manual mode. For more information, see *Manual Mode*, page 5-26.

Lowering the Counterweight on to the Carrier (Automatic Mode)

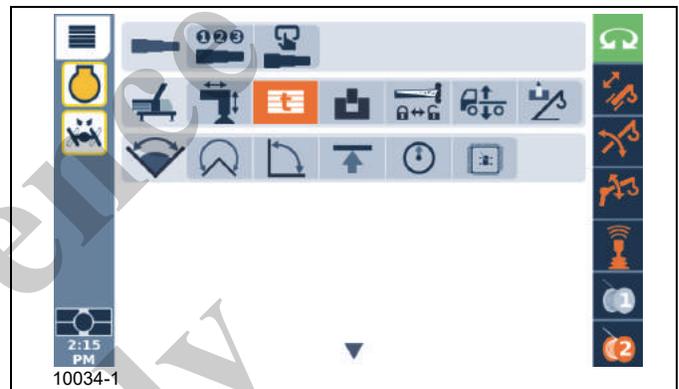
NOTE: When possible, lift and lower the counterweight in automatic mode.

Use the following procedure to lower the fully assembled counterweight on to the carrier platform. The automatic mode can be paused or canceled at any time. For more information, see *Pausing Automatic Mode*, page 5-22 and *Canceling Automatic Mode*, page 5-22.

1. Fully extend the outriggers. For more information, see *Using the Outriggers*, page 4-21.
2. Make sure the Turntable Swing Pin Lock Control is unlocked.
3. Enable the Swing Enable/Disable Switch located on the left armrest.

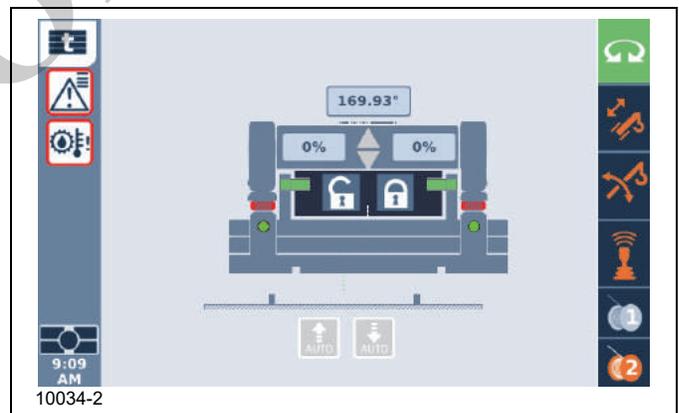
The Swing Enabled Indicator  is enabled (green).

4. In the ODM, use the ODM keypad or jog dial to highlight the counterweight icon .



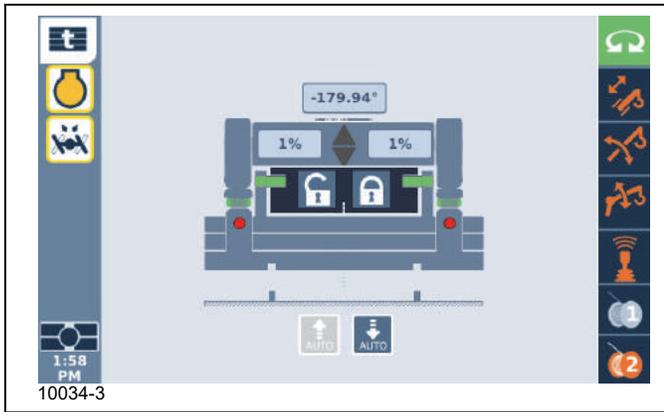
5. Press the OK button on the ODM keypad or press the jog dial.

The Counterweight screen appears.



6. Rotate the superstructure so the rear is over the counterweight platform on the front of the carrier. When within range, the Auto icon becomes active. The valid range to activate Automatic mode is -176.5° to 176.5°.

The Auto icon becomes active (blue) .



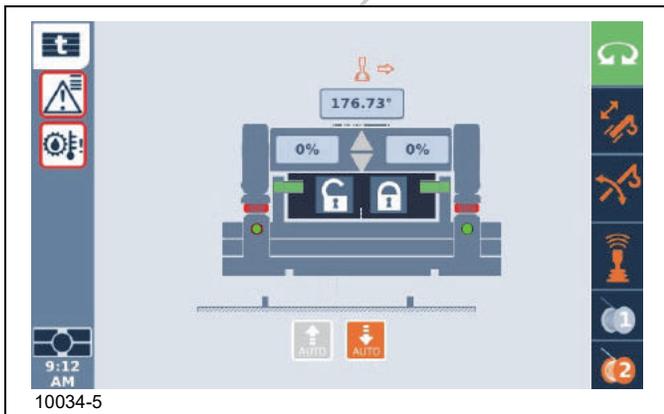
- Use the ODM control pad arrow buttons or jog dial to highlight the Auto icon.

The Auto icon is highlighted (orange) .



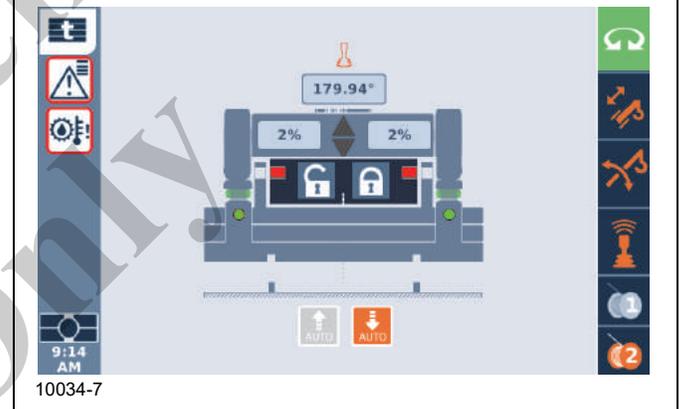
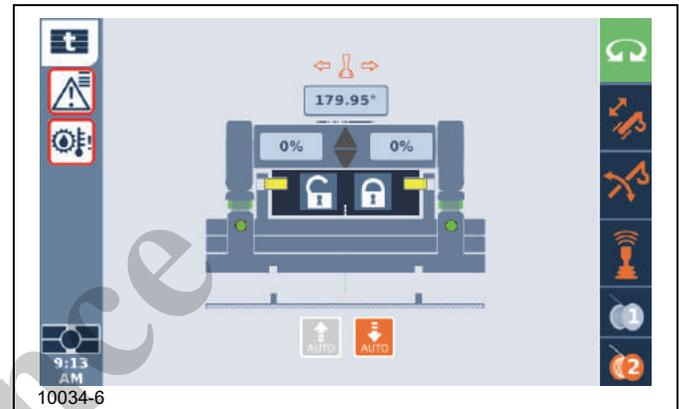
- Press OK on the ODM control pad or press down on the jog dial.

The Swing Controller icon appears.



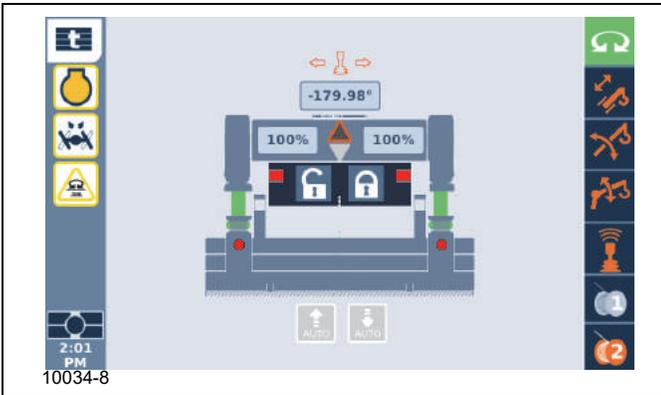
NOTE: If two direction arrows appear, it means the controller can be moved in either direction.

- Move and hold the Swing Controller in the direction displayed. The counterweight is removed as described in the steps below. Hold the controller throughout the steps below.
 - Locking pins are retracted. The locking pin icons turn yellow while being retracted, then red when fully retracted.

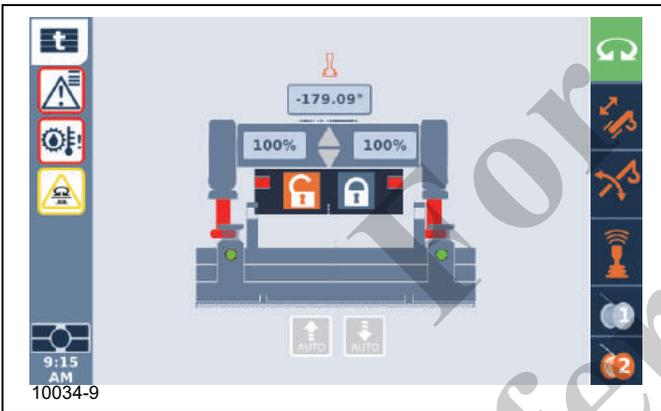


- The lift cylinders lower the counterweight to the carrier platform. The progress of the cylinders is shown in percent. The cylinders are fully retracted when 0% is displayed. The cylinders are fully extended when 100% is displayed.

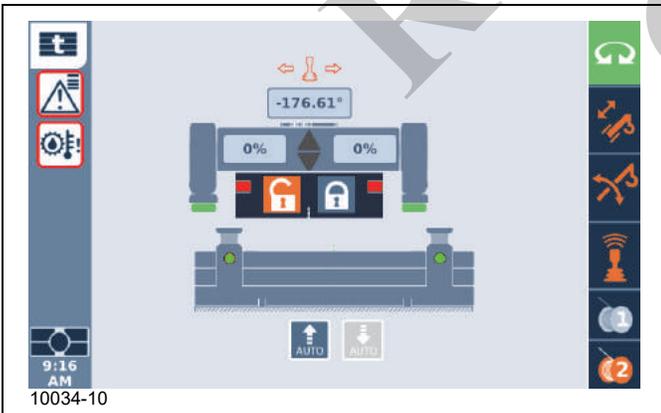
NOTE: The Swing Caution icon (11, Figure 5-16) appears and swing speed is restricted when the counterweight is being removed from the superstructure.



c. The superstructure swings the cylinders out of the counterweight mounting posts.



d. When the lift cylinders are fully retracted (0%), release the controller. When the cylinders are fully retracted, the counterweight is installed on the carrier platform.



10. Update the RCL code to a Load Chart that does not feature a counterweight. For more information, see *Enter Rigging Code*, page 4-159.

11. Remove the counterweight from the carrier platform as needed. For more information, see *Removing the Counterweight from the Carrier Platform*, page 5-17.

12. Disassemble the counterweight for transport as needed. For more information, see *Disassembling the Counterweight for Transport*, page 5-14.

Installing the Counterweight on to the Superstructure (Automatic Mode)

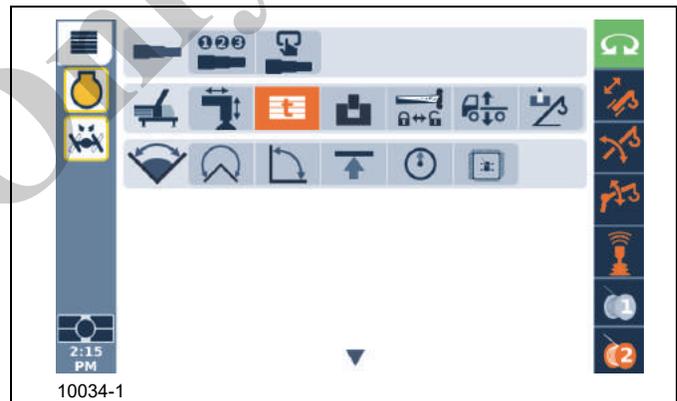
NOTE: When possible, lift and lower the counterweight in automatic mode

Use the following procedure to install the assembled counterweight on the superstructure.

1. Fully extend the outriggers. For more information, see *Using the Outriggers*, page 4-21.
2. Assemble the counterweight. For more information, see *Assembling the Counterweight for Operation*, page 5-14.
3. Install the counterweight on the front of carrier. For more information, see *Installing the Counterweight on the Carrier Platform*, page 5-16.
4. Make sure the Turntable Swing Pin Lock Control is unlocked.
5. Enable the Swing Enable/Disable Switch located on the left armrest.

The Swing Enabled Indicator  is enabled (green).

6. In the ODM, use the ODM keypad or jog dial to highlight the counterweight icon .

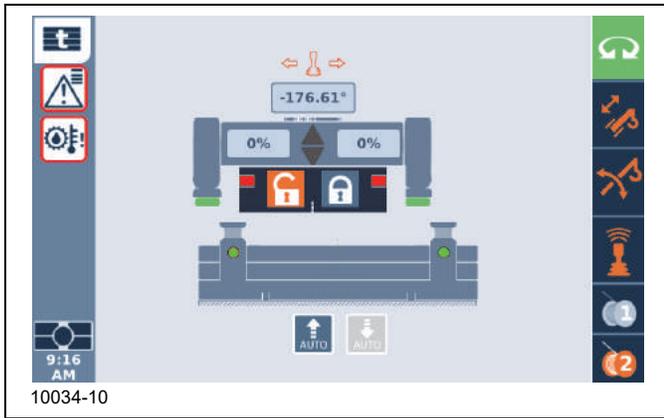


7. Press the OK button on the ODM keypad or press the jog dial.

The Counterweight screen appears.

8. Rotate the superstructure so the rear is over the counterweight platform on the front of the carrier. When within range, the Auto icon becomes active. The valid range to activate Automatic mode is -176.5° to 176.5° .

The Auto icon becomes active (blue) .



9. Use the ODM control pad arrow buttons or jog dial to highlight the Auto icon.

The Auto icon is highlighted (orange) .

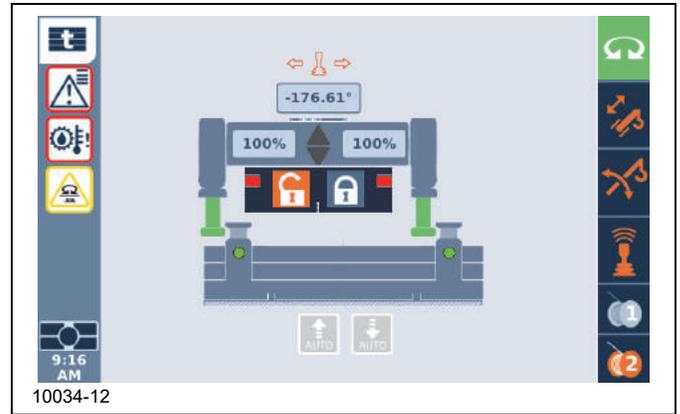
10. Press OK on the ODM control pad or press down on the jog dial.

The controller icon appears.

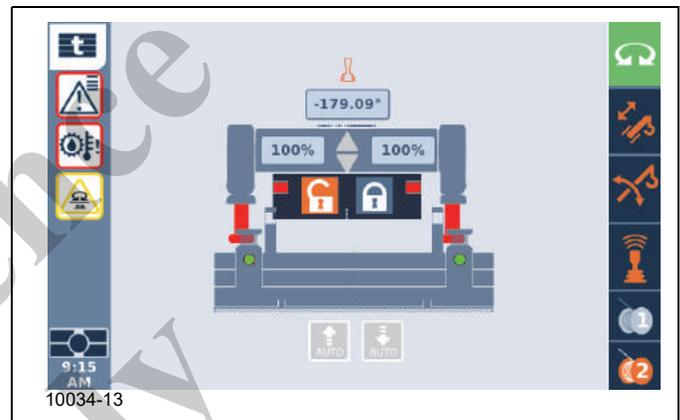


11. Move and hold the Swing Controller in the direction displayed. The counterweight is installed as described in the steps below. Hold the controller throughout the steps below.

- a. The lift cylinders are extended.



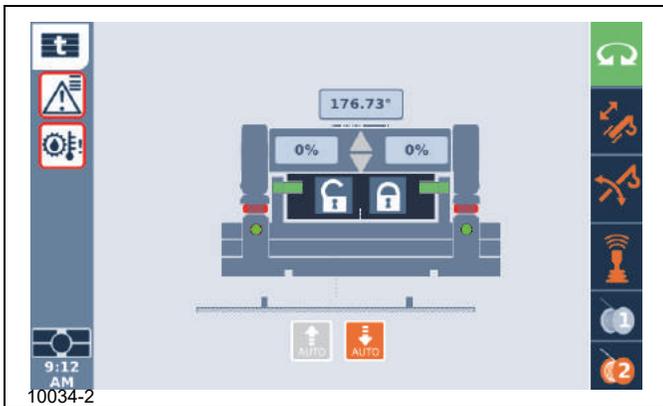
- b. The superstructure swings the cylinders in to the counterweight mounting posts.



- c. The lift cylinders raise the counterweight up to the superstructure. The lift cylinder icons turn green and the percentages show 0% when the cylinders are fully installed.



- d. The locking pins are extended. The locking pin icons turn green when the pins are fully extended.



12. When the counterweight lift cylinders are fully retracted, (0%), release the controller. When the cylinders are fully retracted, the counterweight is installed on the superstructure.
13. Update the RCL code as needed for a configuration that includes the counterweight. For more information, see *Enter Rigging Code*, page 4-159.

Manual Mode

Use the following procedures to remove and install the counterweight using manual mode. In manual mode, you must actuate the locking pins, counterweight cylinders, and swing the superstructure in the ODM in separate operations.

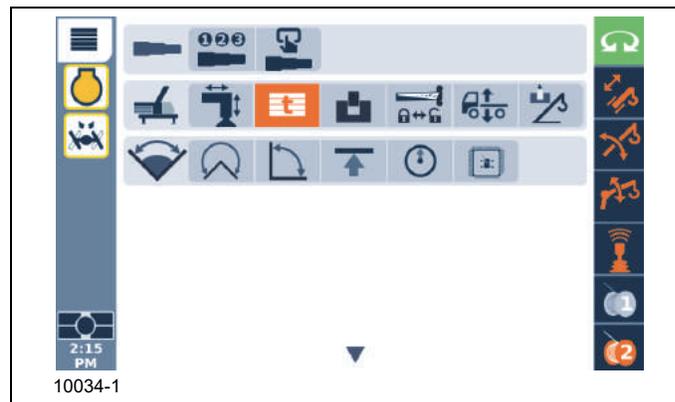
Removing the Counterweight (Manual Mode)

NOTE: When possible, lift and lower the counterweight in automatic mode. For more information, *Removing the Counterweight from the Carrier Platform*, page 5-17

1. Fully extend the outriggers. For more information, see *Using the Outriggers*, page 4-21.
2. Make sure the Turntable Swing Pin Lock Control is unlocked.
3. Assemble the counterweight. For more information, see *Assembling the Counterweight for Operation*, page 5-14.
4. Install the counterweight on the front of carrier. For more information, see *Installing the Counterweight on the Carrier Platform*, page 5-16.
5. Enable the Swing Enable/Disable Switch located on the left armrest.

The Swing Enabled Indicator  is enabled (green).

6. In the ODM, use the ODM keypad or jog dial to highlight the counterweight icon .



7. Press the OK button on the ODM keypad or press the jog dial.

The Counterweight screen appears.



NOTE: The superstructure must be slewed between 179.5° to -179.5° to activate the counterweight cylinder Up and Down arrows (8, Figure 5-16).

8. Rotate the superstructure so the rear is over the counterweight platform on the front of the carrier. The valid range is 179.5° to -179.5°.
9. Using the ODM navigation control pad or jog dial, highlight the counterweight cylinder Up arrow . Press and hold the OK button on the ODM navigation control pad or the jog dial down to make sure the counterweight cylinders are fully retracted (0%).
10. Using the ODM navigation control pad or jog dial, highlight the unlock icon . Press and hold the OK button on the ODM navigation control pad or the jog dial down until the locking pins are retracted (red).



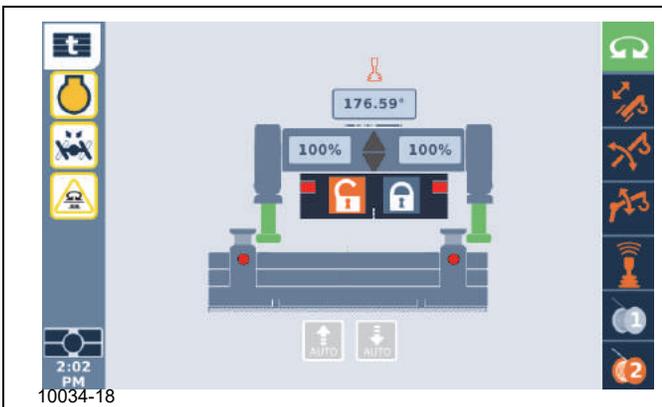
11. Using the ODM keypad or jog dial, highlight the down arrow . Press and hold the OK button on the ODM navigation control pad or the jog dial down until the counterweight cylinders are fully extended.



12. Release the OK button on the ODM navigation control pad or jog dial.

NOTE: The swing speed is restricted during this operation when the counterweight cylinders are extended.

13. Using the Swing Controller (Dual Axis), swing the superstructure to 176.5° or -176.5° to remove the counterweight cylinders from the counterweight posts.



14. Using the ODM keypad or jog dial, highlight the Up arrow . Press and hold the OK button on the ODM navigation control pad or the jog dial down until the counterweight cylinders are fully retracted.



When the counterweight cylinders are fully retracted, the counterweight is removed.

Installing the Counterweight (Manual Mode)

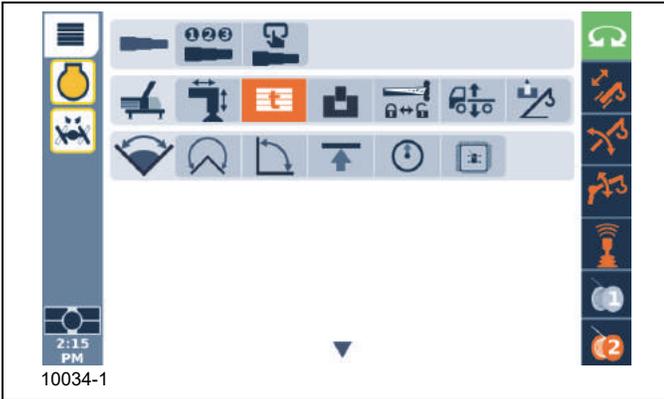
NOTE: When possible, lift and lower the counterweight in automatic mode. For more information, *Installing and Removing the Counterweight on/from the Superstructure*, page 5-19.

Use the following procedure to install the counterweight on the superstructure in manual mode.

1. Fully extend the outriggers. For more information, see *Using the Outriggers*, page 4-21.
2. Make sure the Turntable Swing Pin Lock Control is unlocked.
3. Assemble the counterweight. For more information, see *Assembling the Counterweight for Operation*, page 5-14.
4. Install the counterweight on the front of carrier. For more information, see *Installing the Counterweight on the Carrier Platform*, page 5-16.
5. Enable the Swing Enable/Disable Switch located on the left armrest.

The Swing Enabled Indicator is enabled (green).

6. In the ODM, use the ODM keypad or jog dial to highlight the counterweight icon .



7. Press the OK button on the ODM keypad or press the jog dial.

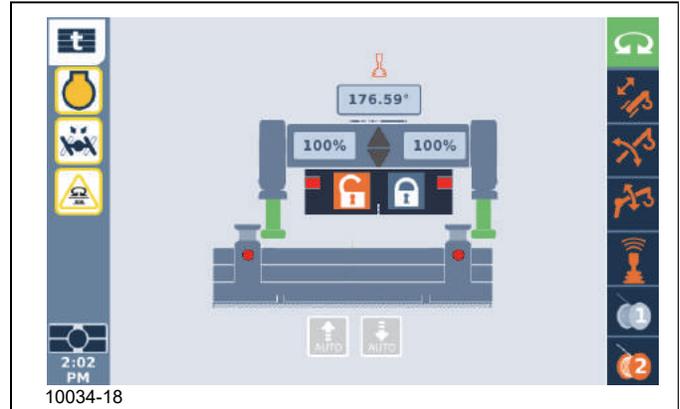
The Counterweight screen appears.



8. If necessary, rotate the superstructure so the rear is over the counterweight platform on the front of the carrier (slew angle 176.5° or -176.5°).
9. Using the ODM keypad or jog dial, highlight the down arrow . Press and hold the OK button on the ODM navigation control pad or the jog dial down until the counterweight cylinders are fully extended.

NOTE: The swing speed is restricted during this operation when the counterweight cylinders are extended.

10. Using the Swing Controller, the swing the superstructure to a slew angle of 176.5° or -176.5° to install the counterweight cylinders in to the counterweight posts.



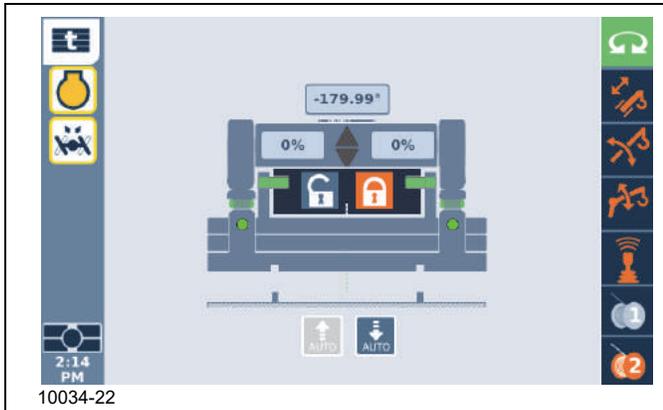
NOTE: The Up and Down counterweight cylinder arrows are active when the superstructure slew angle is between 179.5° to -179.5°.

11. Rotate the superstructure to a slew angle of 179.5° to -179.5°.

12. Using the ODM keypad or jog dial, highlight the Up arrow . Press and hold the OK button on the ODM navigation control pad or the jog dial down until the counterweight cylinders are fully retracted, lifting the counterweight up to the superstructure.



13. Using the ODM navigation control pad or jog dial, highlight the lock icon . Press and hold the OK button on the ODM navigation control pad or the jog dial until the locking pins are locked (green).



When the locking pins are locked, the counterweight is installed.

- Update the RCL code as needed for a configuration that includes the counterweight. For more information, see *Enter Rigging Code*, page 4-159.

OUTRIGGER REMOVAL AND INSTALLATION

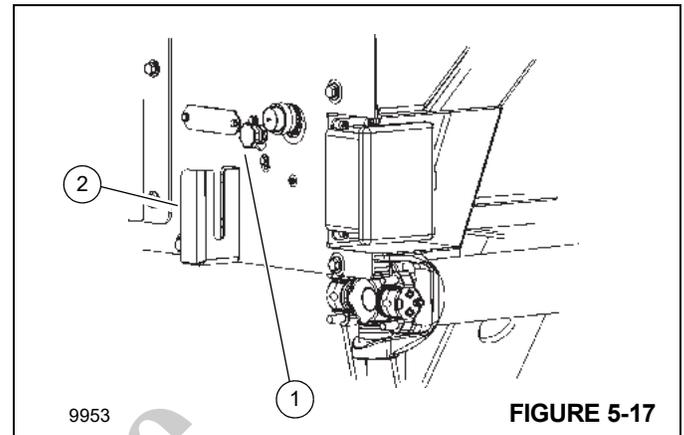
! DANGER! Tipping Hazard

- Lifting the outrigger box must be done sitting on the tires.
- While lifting the outrigger box on rubber, the Crane must be positioned on a firm, level surface.
- When lifting the outrigger box while on rubber, the boom must be limited to 8 m (25 ft) maximum radius.
- No counterweights are to be installed on the superstructure if swinging over the side on rubber.
- With no load, do not exceed a 9 m (30 ft) load radius over sides of machine since a loss of stability could occur, causing a tipping condition. To lower boom into a horizontal position, boom must be swung over the front of the machine and the RCL bypass activated.
- After one outrigger box is installed, do not swing the boom over that end of the machine while installing the other outrigger box.

Bleed Valve Operation

The manual pressure bleed valve (1, Figure 5-17) is located on the back of the right rear fender. The purpose of the valve is to reduce the effort required to separate and connect the hydraulic quick disconnect couplers when removing or installing the front and rear outrigger boxes.

The hydraulic hoses on each outrigger box also feature bleed fittings (9, Figure 5-19). Use these bleed fittings relieve pressure when installing the outrigger box after the box has been sitting in the sun.



- Shut off the engine.
- Turn the handle counterclockwise to open the bleed valve.
- Wait approximately 20 to 30 seconds.
- As necessary, separate or connect the quick disconnects.
- Immediately close the bleed valve.
- Restart the engine if necessary.

Outrigger Box Removal

NOTE: The outrigger box assembly weighs approximately 9427 lb (4276 kg).

- Remove the counterweight. For more information, see *Counterweight Removal and Installation*, page 5-12.
- Program the RCL for the On Rubber, 360° Rotation, No Counterweight (code 9810) load chart.
- Remove the quick release pins (2, Figure 5-19) from the ends of each of the pinning cylinder rod ends (3).
- Using the crane boom for the lifting operation, fasten lifting slings to the lifting lugs (4).
- Lift the outrigger box enough to remove the pressure off of the ends of the pinning cylinder rod ends (3).

! CAUTION!

Do not activate any switches on the control in Figure 5-18 or the remote control until you are thoroughly familiar with the outrigger box installation and removal procedure.

6. Using the appropriate outrigger box removal control (on the left front fender for the front outrigger box, on the right rear fender for the rear outrigger box, or the remote control), hold the Pin Enable switch to the ON position (Figure 5-18) and push the Pin Control switch to DISENGAGE until the pinning cylinder rods are fully retracted.



7556-2 **FIGURE 5-18**

7. Disconnect the carrier external electrical connector from the outrigger electrical connector (7, Figure 5-19).
8. Disconnect the carrier hydraulic quick disconnects from the outrigger hydraulic connectors (8). Stow the carrier hydraulic lines on stowage bracket (2, Figure 5-17).
9. Lift the outrigger box (6) from the carrier.
10. Stow the quick release pins (2) in the stowage clamps (1) on the outrigger box.
11. Stow the electrical connector (7) in the plug provided on the fender.

! DANGER!
Crush Hazard

Make sure the outrigger box is stable before removing the rigging.

12. Lower the outrigger box on to a suitable surface.

Outrigger Box Installation

NOTE: The outrigger box assembly weighs approximately 9427 lb (4276 kg).

NOTE: The outrigger boxes must be installed in the correct locations. The outrigger boxes are marked Front (install on single axle end) and Rear (installed on the tandem axle end).

1. Program the RCL for On Rubber 360° rotation load chart. For more information, see *Enter Rigging Code*, page 4-159.
2. While the outrigger box is on a stable surface, relieve pressure from outrigger box hydraulic hoses using bleed fittings (9, Figure 5-19).
3. Make sure the outrigger pressure bleed valve (1, Figure 5-17) is closed.
4. Apply grease to the upper outrigger box pin saddles on the carrier frame (four places per end). For more information, see the SECTION 6 - Maintenance and Lubrication.
5. Connect sling assembly to the lifting lugs (4, Figure 5-19) provided on the outrigger box.
6. Lift the outrigger box into position using the crane boom, then lower the outrigger box assembly until the upper pins on the outrigger box assembly are seated in the saddles on the carrier frame.
7. Connect the carrier external electrical connector to the outrigger electrical connector (7).
8. Install the carrier hydraulic quick disconnects to the outrigger hydraulic connectors (8).
9. Lower the outrigger box aligning the pinning cylinder pins (3) with the attach points on the carrier frame.

! CAUTION!

Do not activate any switches on the control (Figure 5-18) or remote control until you are thoroughly familiar with the outrigger box installation and removal procedure.

10. Using the appropriate remote mounted pin control box or remote control, hold the Pin Enable switch at the ON position and hold the Pin Control switch to the ENGAGE position (Figure 5-18).
11. After the pinning cylinders have fully engaged the outrigger box, install a quick release pin (2, Figure 5-19) in the end of each of the cylinder rod ends (3).

Item	Description
1	Clamp
2	Quick Release Pin
3	Pin Cylinder
4	Lifting Lug
5	Outrigger Beam Assembly
6	Outrigger Box Assembly
7	Outrigger Electrical Connector
8	Outrigger Hydraulic Connectors
9	Outrigger Bleed Fittings

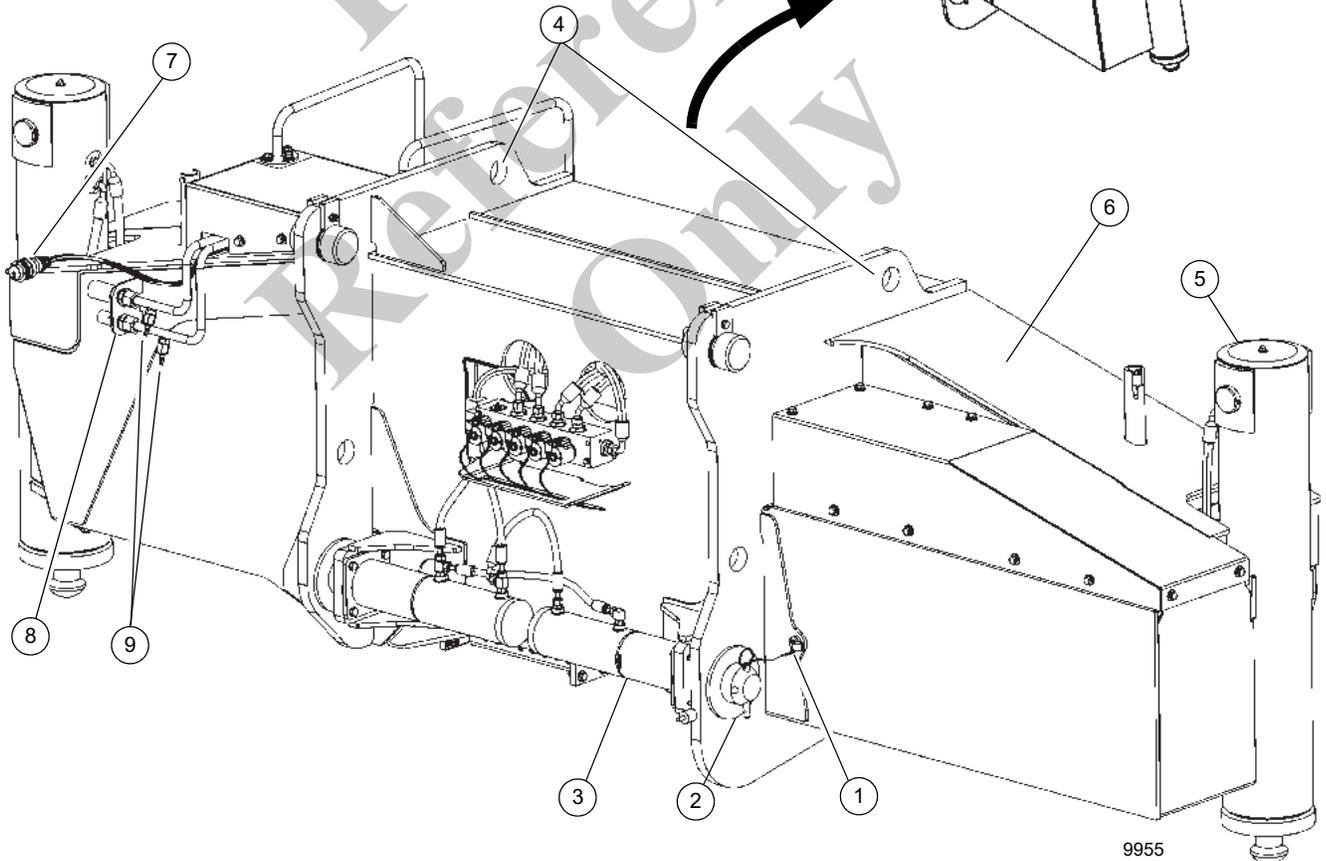
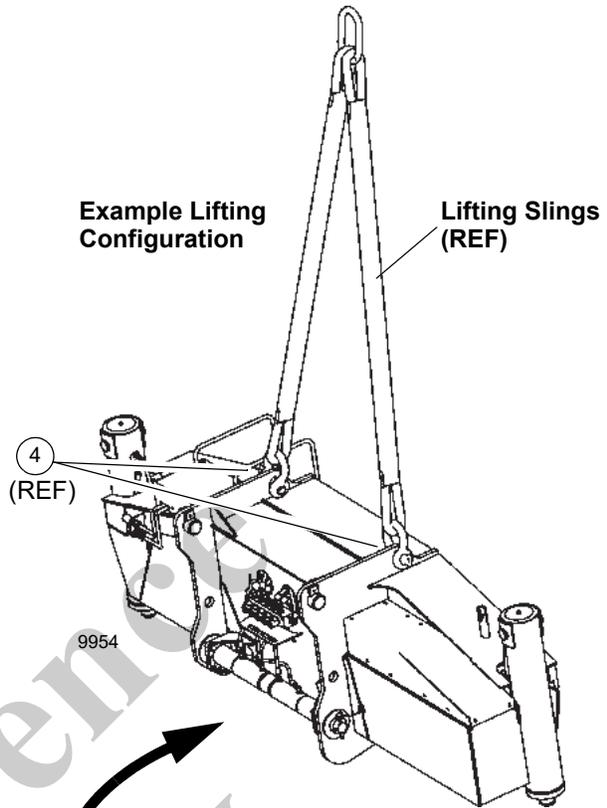


FIGURE 5-19

ANTI-TWO BLOCK (A2B) SWITCH

Two anti-block switches must be installed to allow crane operation. If a single hoist rope has been reeved and two A2B switches are installed, the unused A2B switch must be locked (disabled) with A2B weight removed to allow all crane operations.

Locking

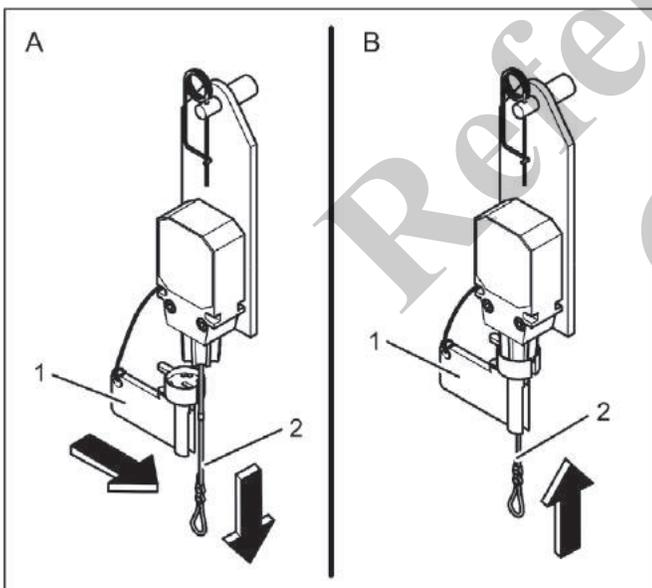
DANGER

Two-Block Hazard!

To avoid death or serious injury, keep load handling devices away from the tip of the boom or boom extension when extending the boom and when hoisting up.

If the A2B switch is locked (disabled), the hook block could hit the main boom head or extension. Never lock an A2B switch when a hoist rope is installed to that attachment.

1. Remove A2B weight.
2. (A) Remove cap (1) from switch.
3. Pull lanyard (2) down.
4. (B) Secure lanyard (2) in this position using cap (1). A2B switch is locked (disabled).



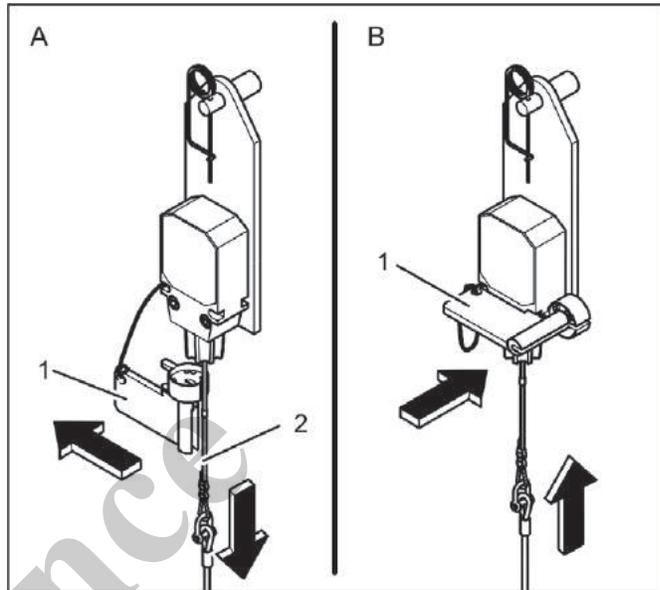
8684-1

FIGURE 5-20

Unlocking

NOTE: Always remove the switch lock (enable) before installing an A2B weight around the hoist rope.

1. (A) Pull down lanyard (2) and remove cap (1). Switch is unlocked (enabled).
2. (B) Install cap (1) on A2B switch.



8684-2

FIGURE 5-21

Checking Before Operation

Check the following electrical connections before operating the crane to make sure the RCL system is properly connected for the crane configuration.

Cranes With Main Hoist Only

If the crane is operated only with the boom and without boom extension or lattice insert, no additional connections are necessary. It must however be ensured that the A2B switch weight is correctly mounted on the main boom hoist rope. With even numbers of rope lines, the lifting limit switch weight shall be attached to the “dead end” of the hoist rope. With odd numbers of rope lines, the lifting limit switch weight shall be attached to the rope line with the lowest operating speed.

If the crane is operated with a main boom extension or lattice insert, the connecting cable must be mounted between the connector on the boom extension or lattice insert and the connector on the main boom. The main boom A2B switch weight must be disconnected and mounted on the extension or fly section A2B switch.

WARNING

Failure to reposition the A2B weight will prevent the A2B system from functioning properly. No weight shall be mounted on the A2B switch of the main boom when working with the boom extension/lattice insert.

Cranes with Main and Auxiliary Hoists

If the main boom extension or fly section is not used, the A2B switch must be plugged into the connector on the main boom and the A2B switch weight must be mounted on the main boom.

If the crane is operated with a main boom extension and the main boom is equipped with a hoist rope, then the connecting cable must be mounted between the connector on the extension or lattice insert and the connector on the main boom. In addition, weights must be fitted to both the A2B switch of the main boom and the extension or fly section.

If the boom extension is in working position and if the main boom is not equipped with a hoist rope, then the A2B switch on the main boom must be placed into its locked position.

After electrical connections have been checked to make sure the system is properly connected for the respective crane configuration, the following checks must be made:

1. Check electrical wiring connecting various parts of the system for physical damage.
2. Check A2B switches and weights for free movement.
3. Inspect RCL cable drum for smooth running, initial drum tension, and correct cable winding.



WARNING

The following tests must be performed with care to prevent personnel injury or crane damage. Proper functioning of the ODM requires successful completion of these tests before starting work.

If the operator cannot see the hook block approaching the boom nose, this task must be assigned to an assistant.

The crane operator must be prepared to stop the crane immediately if the ODM is not working correctly, that is when the warning indicators do not display, the acoustic alarm does not sound, and the crane movements such as raising, extending and luffing are not disabled.

Check A2B warning light and acoustic alarm for both A2B switches as follows:

1. Position boom over front of crane.
2. Manually raise weight fitted on the A2B switch. As soon as weight is raised, the acoustic alarm should sound and the A2B indicator should display.
3. Using the main hoist, pull hook block slowly against the A2B switch weight. As soon as the hook block raises the weight, the acoustic alarm should be triggered, the A2B indicator should display, and the main hoist should switch off. Lower the hook block slightly to eliminate this condition.
4. Slowly lower the boom to bring about a potential two block situation. As soon as the hook block raises the weight, the acoustic alarm should sound, the A2B indicator should display, and boom lower should switch off. Lower the hook block slightly to eliminate this condition.
5. Slowly extend (telescope out) the boom to bring about a potential two block situation. As soon as the hook block raises the weight, the acoustic alarm should sound, the A2B indicator should display, and the telescoping function should switch off. Lower the hook block slightly to eliminate this condition.



WARNING

If warning indicators and audible alarm do not function as described and crane movements are not switched off, the system is not working properly. The malfunction must be corrected before starting work.

6. If crane is equipped with a boom extension, the inspection procedure must be repeated for the A2B switch of the extension.
7. Verify display of main boom length agrees with actual boom length.
8. Verify display of main boom angle agrees with actual boom angles.
9. Verify display of the crane operating radius agrees with the actual radius.
10. Verify load display by lifting a load of known weight. Load display accuracy must be within the tolerance range.

HOIST ROPE REEVING

NOTE: 35 x 7 (rotation resistant) hoist rope is used on this crane.

Within load and range chart limits and permissible line pull, multi-part line reeving allows the operator to raise a greater load than can be raised with a single line part. A qualified rigger should do the reeving using standard rigging procedures. The load lifted must be within the limits contained in the load chart.

Possible Reeving Combinations

The GRT9165 supports reevings up to 16 line parts, depending on the hook block used. Table 5-2 shows possible reevings combinations. Possible components used for reeving include:

- Anti-Two Block. For more information, see *Anti-Two Block (A2B) Switch*, page 5-32.
- Wedge Socket. For more information, see *Installing Wedge and Socket*, page 5-44.

- Overhaul Weight
- Overhaul Ball
- 1-Sheave Hook Block
- 3-Sheave Hook Block
- 5-Sheave Hook Block
- 7-Sheave Hook Block
- 8-Sheave Hook Block

The GRT9165 also features a 1-sheave auxiliary boom nose. Figure 5-22 shows the auxiliary boom nose with an overhaul weight and hook block. The auxiliary boom nose must be used in 15- and 16-part reevings. For more information about the auxiliary boom nose, see *Auxiliary Single Sheave Boom Nose*, page 5-93.

The reeving configuration is entered in the RDM during set up. For more information, see *Selecting the Hoist and Entering the Reeving*, page 4-163.

Table 5-2 Possible Multi-part Line Reeving Combinations

Line Part	Reference Drawing
5 Line Parts. 3 Sheave Hook Block.	<p style="text-align: center;">10043</p>

Table 5-2 Possible Multi-part Line Reeving Combinations (Continued)

Line Part	Reference Drawing
<p>6 Line Parts. 3 Sheave Hook Block.</p>	<p>To main hoist</p> <p>1</p> <p>2</p> <p>Upper Boom Nose Sheaves</p> <p>1 2 3 4 5 6 7</p> <p>Lower Boom Nose Sheaves</p> <p>1 2 3</p> <p>Hook Block Sheaves</p> <p>Boom Nose Dead End</p> <p>10044</p>
<p>7 Line Parts. 3 Sheave Hook Block.</p>	<p>To main hoist</p> <p>1</p> <p>2</p> <p>Upper Boom Nose Sheaves</p> <p>1 2 3 4 5 6 7</p> <p>Lower Boom Nose Sheaves</p> <p>1 2 3</p> <p>Hook Block Sheaves</p> <p>Hook Block Dead End</p> <p>10045</p>

Table 5-2 Possible Multi-part Line Reeving Combinations (Continued)

Line Part	Reference Drawing
<p>8 Line Parts. 5 Sheave Hook Block.</p>	<p>10046</p>
<p>9 Line Parts. 5 Sheave Hook Block.</p>	<p>10047</p>

Table 5-2 Possible Multi-part Line Reeving Combinations (Continued)

Line Part	Reference Drawing
<p>10 Line Parts. 5 Sheave Hook Block.</p>	<p>To main hoist</p> <p>1</p> <p>2</p> <p>Upper Boom Nose Sheaves</p> <p>1 2 3 4 5 6 7</p> <p>Lower Boom Nose Sheaves</p> <p>Boom Nose Dead End</p> <p>1 2 3 4 5</p> <p>Hook Block Sheaves</p> <p>10048</p>
<p>11 Line Parts. 5 Sheave Hook Block.</p>	<p>To main hoist</p> <p>1</p> <p>2</p> <p>Upper Boom Nose Sheaves</p> <p>1 2 3 4 5 6 7</p> <p>Lower Boom Nose Sheaves</p> <p>Hook Block Dead End</p> <p>1 2 3 4 5</p> <p>Hook Block Sheaves</p> <p>10049</p>

Table 5-2 Possible Multi-part Line Reeving Combinations (Continued)

Line Part	Reference Drawing
<p>12 Line Parts. 7 Sheave Hook Block.</p>	<p>The diagram shows a line starting from a main hoist (labeled 'To main hoist') passing through sheave 1 of the Upper Boom Nose Sheaves. It then passes through sheave 2 of the Upper Boom Nose Sheaves. The line then descends to the Lower Boom Nose Sheaves, passing through sheaves 1 through 7. From there, it passes through sheaves 1 through 7 of the Hook Block Sheaves. The line ends at the Boom Nose Dead End. The drawing is labeled 10050.</p>
<p>13 Line Parts. 7 Sheave Hook Block.</p>	<p>The diagram shows a line starting from a main hoist (labeled 'To main hoist') passing through sheave 1 of the Upper Boom Nose Sheaves. It then passes through sheave 2 of the Upper Boom Nose Sheaves. The line then descends to the Lower Boom Nose Sheaves, passing through sheaves 1 through 7. From there, it passes through sheaves 1 through 7 of the Hook Block Sheaves. The line ends at the Hook Block Dead End. The drawing is labeled 10051.</p>

Table 5-2 Possible Multi-part Line Reeving Combinations (Continued)

Line Part	Reference Drawing
<p>14 Line Parts. 7 Sheave Hook Block.</p>	<p>To main hoist</p> <p>1</p> <p>2</p> <p>Upper Boom Nose Sheaves</p> <p>1 2 3 4 5 6 7</p> <p>Lower Boom Nose Sheaves</p> <p>1 2 3 4 5 6 7</p> <p>Boom Nose Dead End</p> <p>Hook Block Sheaves</p> <p>10052</p>
<p>15 Line Part. 7 Sheave Hook Block. Auxiliary Boom Nose.</p>	<p>To main hoist</p> <p>1</p> <p>2</p> <p>Upper Boom Nose Sheaves</p> <p>Auxiliary Nose Boom</p> <p>1 2 3 4 5 6 7</p> <p>Lower Boom Nose Sheaves</p> <p>1 2 3 4 5 6 7</p> <p>Hook Block Dead End</p> <p>Hook Block Sheaves</p> <p>10053</p>

Table 5-2 Possible Multi-part Line Reeving Combinations (Continued)

Line Part	Reference Drawing
<p>16 Line Parts. 8 Sheave Hook Block. Auxiliary Boom Nose.</p>	<p>To main hoist</p> <p>1 2</p> <p>Upper Boom Nose Sheaves</p> <p>Auxiliary Nose Boom</p> <p>1 2 3 4 5 6 7</p> <p>Lower Boom Nose Sheaves</p> <p>Boom Nose Dead End</p> <p>1 2 3 4 5 6 7 8</p> <p>Hook Block Sheaves</p> <p>10054</p>

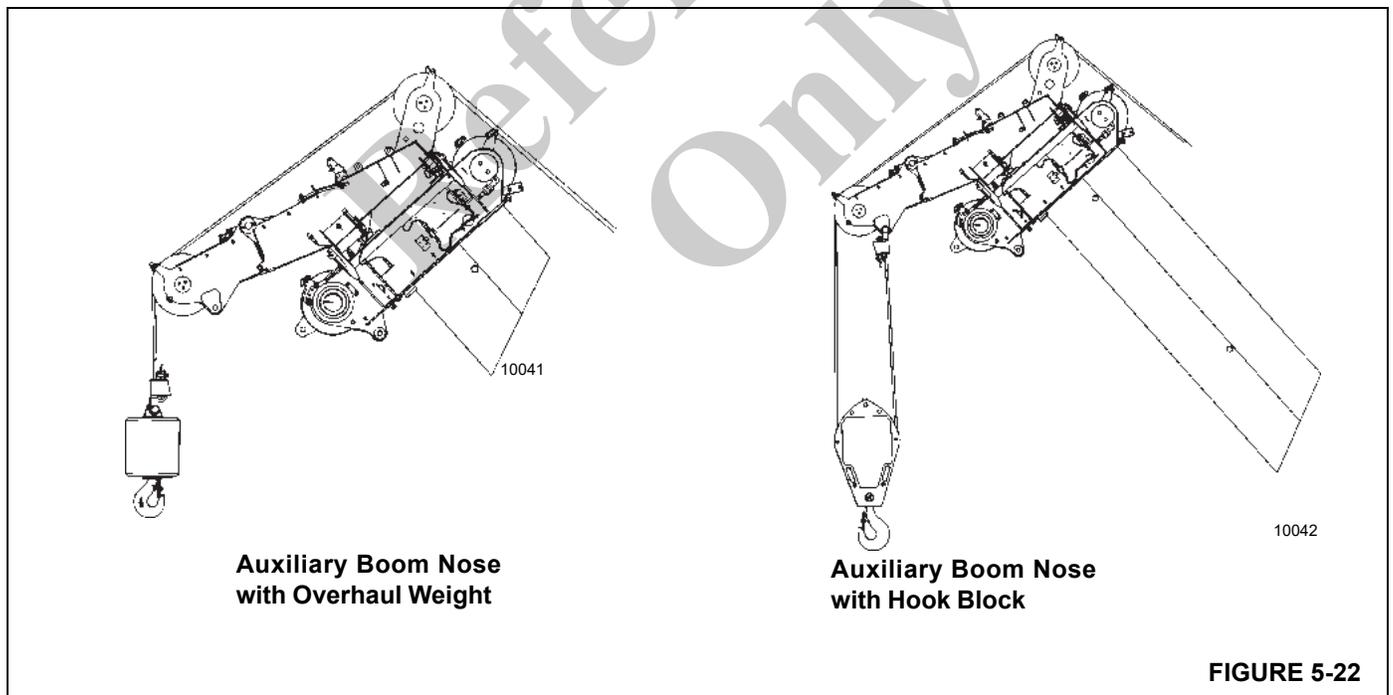
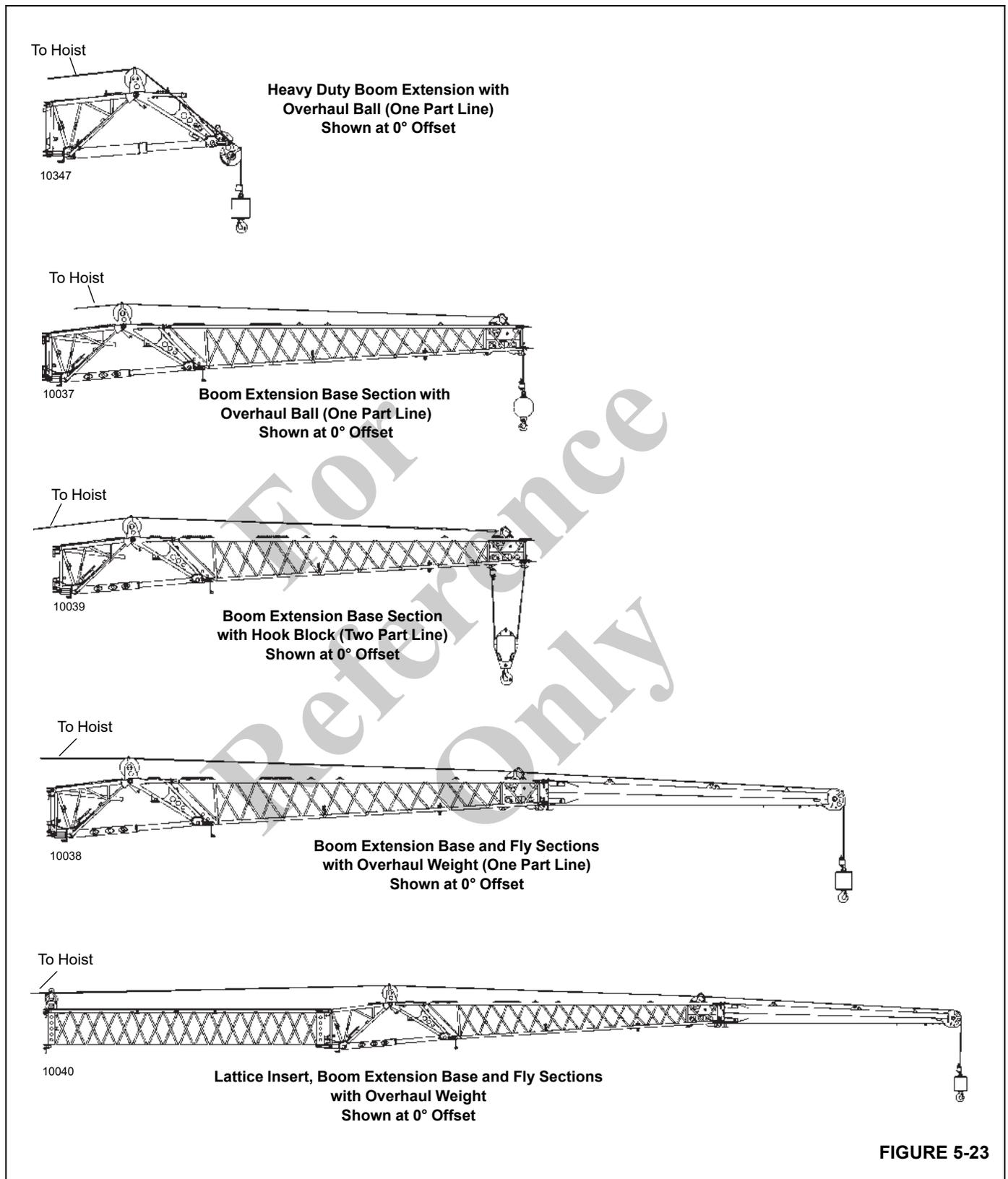
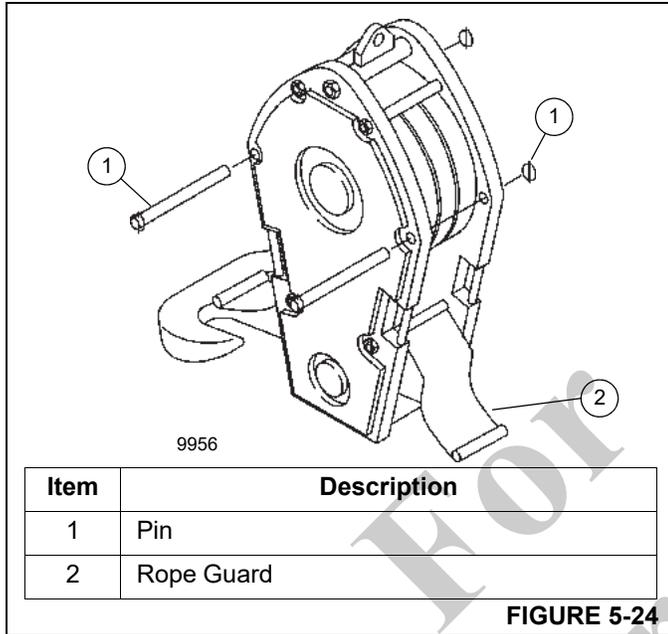


FIGURE 5-22



Quick Reeving the Hook Block

To quick reeve the hook block without removing the wedge socket on end of hoist rope, remove the retaining clips from the two pins (1, Figure 5-24), then lower the two rope guards (2) to their lowered positions.

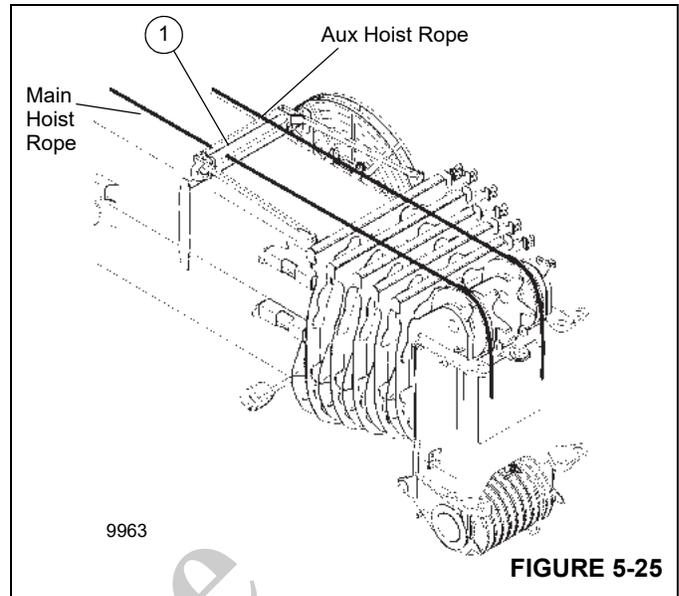


Reeving Hoist Rope Over the Boom

CAUTION

Reeve only the main hoist rope through the rope guide. Do not reeve the auxiliary rope through the rope guide. Never reeve multiple ropes through the rope guide at the same time. Rope damage can occur.

Always reeve main hoist rope through rope guide (1, Figure 5-25). Always reeve auxiliary hoist rope *outside* of the rope guide.



Adjusting the Upper Head Sheave

Use the following procedure to adjust the right head sheave (1, Figure 5-26) on the boom tip. Adjusting the upper head sheave aligns the hoist rope with the second inner sheave on the lower sheave head. The required position of the head sheave depends on the reeving configuration.

NOTE: The left upper sheave head used for the auxiliary hoist rope cannot be adjusted.

1. Remove the retaining clip and rod (2).
2. Turn and remove the lever (3) from the cutout (4 or 5).
3. Push the head sheave (1) into the required position.
4. Turn the lever (3) in to the cutout (4 or 5).
5. Insert the rod (2). Secure the rod with the retaining clip.

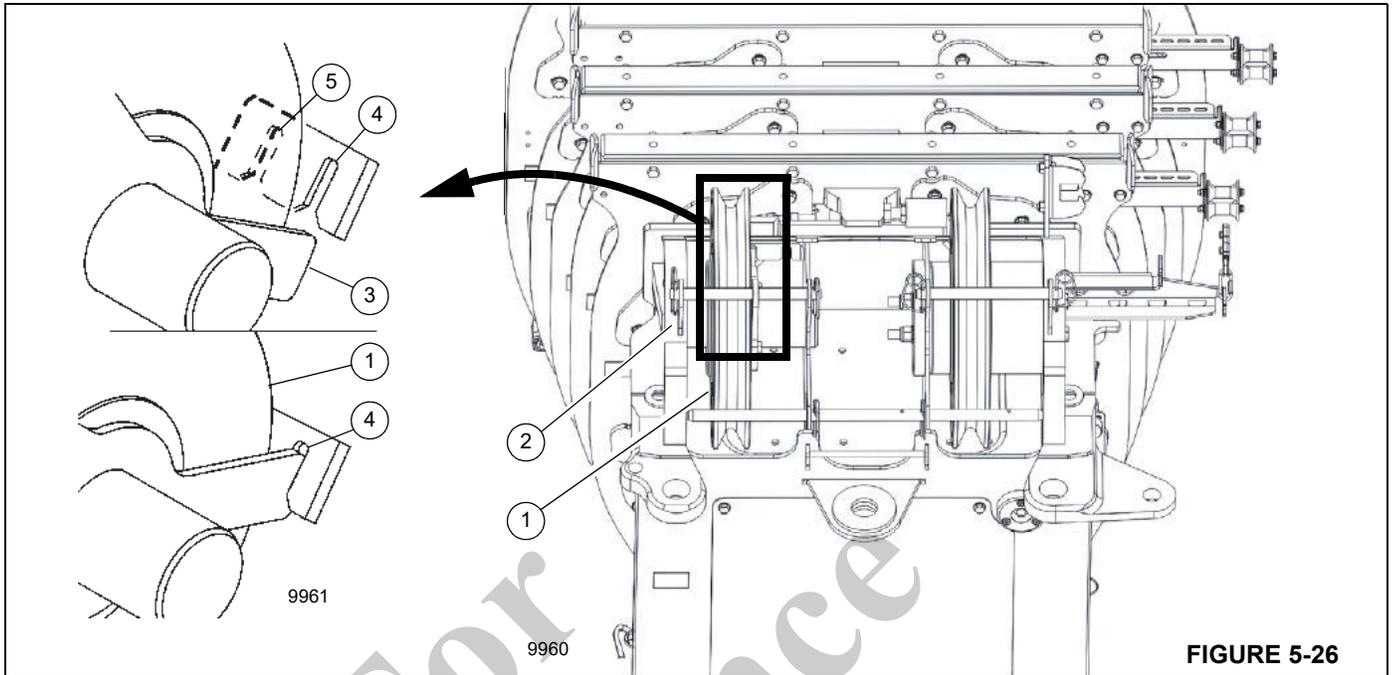


FIGURE 5-26

Reeving/Unreeving the Hoist Rope

Use the following procedures to reeve and unreeve the hoist rope.

Reeving Hoist Rope



CAUTION

Falling Objects Hazard!

Always make sure sheaves and pins that secure the hoist rope are secured with clips. This prevents components from coming loose, falling and causing injury.

1. Make sure the main hoist rope is in the rope guide. If necessary, make sure the auxiliary hoist rope is over the rope guide. For more information, see *Reeving Hoist Rope Over the Boom*, page 5-42.
2. Remove the retaining rods (1, Figure 5-27).
3. Guide the rope over the upper boom nose sheave (2).
4. Guide the rope over the lower boom nose sheave (3).
5. Install the hook tackle or the hook block.
6. Reinstall all the retaining rods (1) and secure with retaining clips.

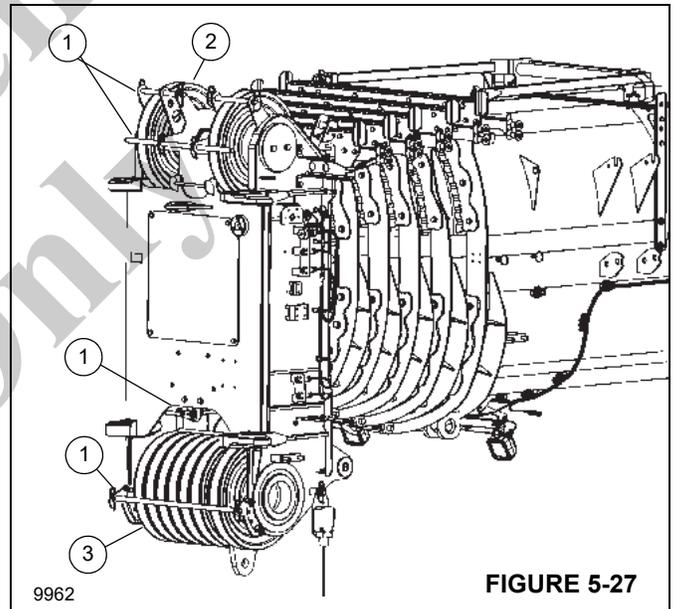


FIGURE 5-27

Unreeving Hoist Cable

1. Remove the retaining rods (1, Figure 5-27).
2. Unreeve the hook block.
3. Take the hoist rope off of the upper boom nose sheave (2) and place it on the ground on the left side. Spool the hoist rope on the hoist drum.
4. Replace all retaining rods and secure them with retaining clips.

Dead-End Rigging/Wedge Sockets

Wedge socket assemblies are popular rigging accessories used for decades to terminate hoist ropes on mobile cranes. A wedge socket assembly is easily installed and dismantled, but must be installed and used correctly. Use only a wedge and socket of the correct size for the rope fitted. Failure to do so may result in rope pulling through fitting.

Since state and local laws may vary, alternate attachment methods may be necessary depending upon work conditions. If alternate methods are selected, the user is responsible and should proceed in compliance with the regulations in force. If there are any questions, contact your local Grove distributor or Manitowoc Crane Care

Do not mix components from different manufacturers. The selection, installation, and use of a wedge socket assembly must be in accordance with requirements of the wedge socket manufacturer and hoist rope manufacturer upon whose hoist rope the wedge socket assembly will be used.

Grove specifies size, type, class, and line pulls for hoist rope; predominately rotation resistant hoist rope, and rigging accessories such as overhaul balls and hook blocks for use with each new crane it manufactures.

Other hoist ropes and rigging accessories are available from various vendors. Different hoist rope manufacturers have differing requirements for construction, handling, cutting, seizing, installation, termination, inspection, and replacement of hoist ropes they produce. Their advice should be sought for each specific type of hoist rope a crane user intends to install on a mobile crane.

When assembly is complete, raise boom to a working position with a load suspended to firmly seat wedge and rope in socket before crane is used operationally.

CAUTION

If socket is not positioned with flat face toward boom sections, structural damage will occur.

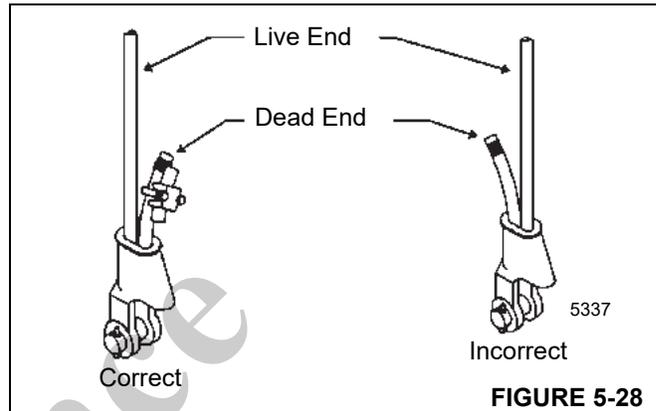
When anchoring socket to the boom, make sure flat face of socket is toward boom sections.

Installing Wedge and Socket

1. Inspect wedge and socket. Remove rough edges and burrs.
2. Seize hoist rope end using soft or annealed wire or strand. If end of rope is welded, welded end should be cut off unless otherwise stated by the rope manufacturer. This allows distortion of the rope strands, caused by the

bend around the wedge, to adjust themselves at the end of the line.

3. Make sure live end side (Figure 5-28) of rope is directly in line with ears of socket and direction of pull to which the rope will be subjected. If rope is loaded into socket incorrectly, under a load the rope will bend as it leaves the socket. The edge of the socket will wear into the rope causing damage and eventual failure.



4. Insert hoist rope end in socket, form a loop in the rope, and route rope back through socket allowing the "dead" end to protrude from the socket. Make sure dead end of the rope is long enough to apply end treatment after wedge is seated.
5. Insert wedge in loop. Pull live end of rope until wedge and rope are snug inside socket. It is recommended wedge be seated inside socket to properly secure the hoist rope using the crane's hoist to first apply a light load to the live line.
6. After final pin connections are made, increase loads gradually until wedge is properly seated.
7. Wire rope and wedge must be properly secured inside socket before placing crane into lifting service. It is the wedge that secures the hoist rope inside the socket. The dead-end treatment is used to keep wedge from becoming dislodged from socket should the rope suddenly become unloaded from the overhaul ball or hook block striking the ground, etc.

Figure 5-29 shows methods for securing dead-ends of hoist ropes in a wedge socket assembly. While the loop-back method (C, D, E) is acceptable, take care to prevent the loop becoming entangled with tree branches and other components during crane transport, or the anti two-block system and other components during crane operation.

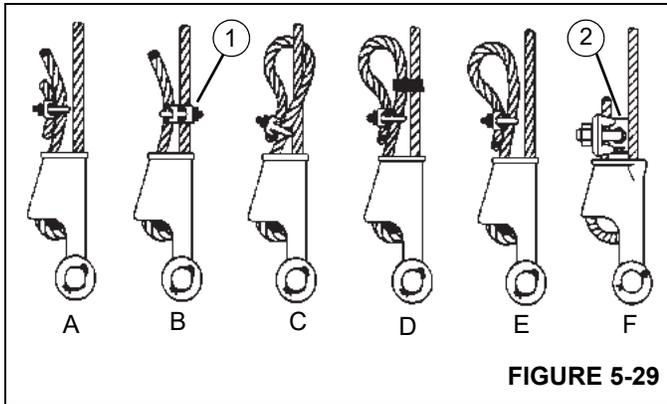


FIGURE 5-29

Of the methods shown, Grove prefers method A or F be used on Grove cranes, i.e., clipping a short piece of hoist rope to the dead-end or using a commercially available specialty clip (1) or wedge (2). It is recommended the dead-end tail length be a minimum of 6 rope diameters, but not less than 15.2 cm (6 in) for standard 6 to 8 strand ropes. For rotation resistant rope, the dead-end tail length must be a minimum of 20 rope diameters, but not less than 15.2 cm (6 in).

When using method A, place a hoist rope clip around the dead end by clamping a short extra piece of rope to the rope dead end. DO NOT CLAMP LIVE END. U-bolt should bear against the dead end. Clip saddle should bear against the short extra piece. Torque U-bolts to values listed in Table 5-3.

NOTE: Use of swivels is not allowed with non-rotation resistant hoist ropes.

Other sources for information with which crane users should be familiar and follow is provided by the American Society of Mechanical Engineers, American National Standard, ASME B30.5, latest revised. ASME (formerly ANSI) B30 applies to cableways, cranes, derricks, hoists, hooks, jacks, and slings.

It states, in section 5-1.7.3, “(c) Swaged, compressed, or wedge socket fittings shall be applied as recommended by the rope, crane or fitting manufacturer.” Wire ropes are addressed in ASME B30.5, section 5-1.7.2, ROPES, It states, in pertinent part, “(a) The ropes shall be of a construction recommended by the rope or crane manufacturer, or person qualified for that service.” Additional information is published by the Wire Rope Technical Board in *Wire Rope Users Manual*, latest revision.

Table 5-3 Wire Rope Clip Torque Values

Clip Size		Torque*	
mm	In	N-m	ft-lb
3.18	1/8	6	4.5
4.76	3/16	10	7.5
6.35	1/4	20	15
7.94	5/16	40	30
13.28	3/8	60	45
11.11	7/16	90	65
12.70	1/2	90	65
14.29	9/16	130	95
15.88	5/8	130	95
19.05	3/4	175	130
22.23	7/8	300	225
25.40	1	300	225
28.58	1-1/8	300	225
31.75	1-1/4	490	360
38.68	1-3/8	490	360
38.10	1-1/2	490	360

*Torque values are based on threads being clean, dry, and free of lubrication.

BOOM EXTENSION

A 10.9 m to 17.8 m (35.8 ft to 58.4 ft) off-settable bi-fold swingaway boom extension is available to provide additional reach. An optional 8 m (26.2 ft) lattice insert can be used with the boom extension to provide additional reach.

The boom extension features manual offset (standard) or hydraulic offset (optional). The standard boom extension can be offset manually to 0°, 15°, 30°, or 50°. The optional hydraulic boom extension can be offset from 0° to 50° and controlled from the operator cab.

Throughout the following instructions, the lattice section portion of the boom extension is referred to as the boom extension base section and the solid steel section is referred to as the boom extension fly section.

General Warnings



DANGER

Make sure the boom is fully retracted during erection and stowage of the boom extension.

If the boom is extended during this process, the pins may not engage properly and/or the boom extension could move in an uncontrolled manner resulting in death or serious injury.



DANGER

To prevent serious injury or death, always wear personal protective equipment, including a hard hat, eye protection, gloves, and metatarsal boots.

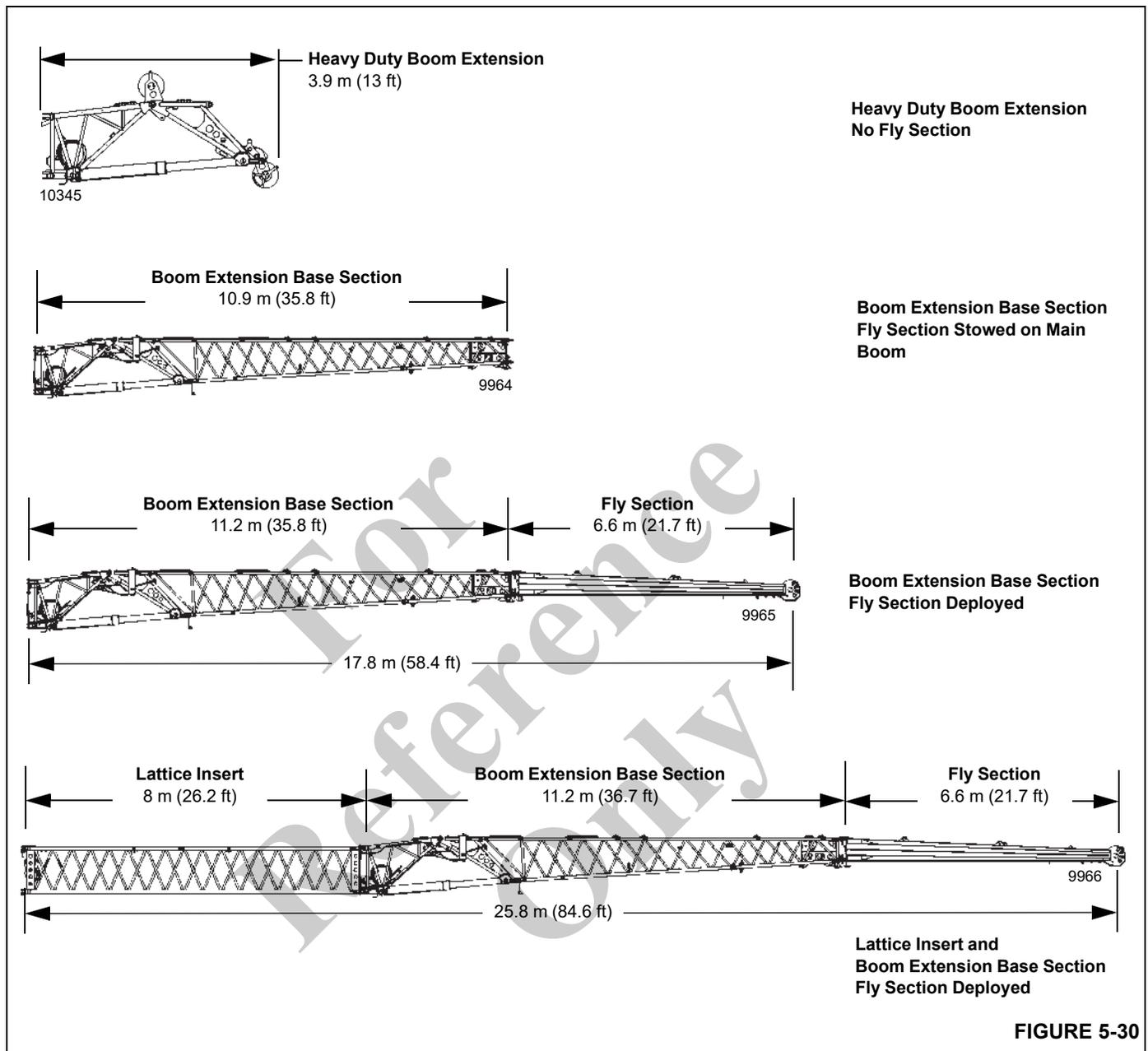
Before attempting to erect or stow the boom extension, read and strictly adhere to all danger decals installed on the boom/boom nose, boom extension, and stowage brackets to prevent serious injury or death.

Controlling the boom extension during erecting and stowing procedures is accomplished by raising or lowering the boom. Failure to control the boom extension could cause serious injury or death.

Boom Extension Configurations

Figure 5-30 shows the sections of the boom extension. The boom extension can be deployed in the following configurations:

- 10.9 m (35.8 ft) manual (standard) or hydraulic (optional) off-settable boom extension base section only. The mechanical boom extension can be manually offset to 0°, 15°, 30°, or 50°. The boom extension can be hydraulically offset from 0° to 50°.
- 17.8 m (58.4 ft) manual (standard) or hydraulic (optional) off-settable boom extension base section with the fly section deployed. The boom extension can be manually offset to 0°, 15°, 30°, or 50°. The boom extension can be hydraulically offset from 0° to 50°.
- 8 m (26.2 ft) Lattice Insert (optional) with the 17.8 m (58.4 ft) boom extension deployed. The boom extension base section can be manually (standard) or hydraulically offset (optional). The boom extension can be manually offset to 0°, 15°, 30°, or 50°. The boom extension can be hydraulically offset from 0° to 50°.
- 3.9 m (13 ft) (optional) hydraulic heavy duty off-settable boom extension. The boom extension can be hydraulically offset from 0° to 50°. For more information, see *Heavy Duty Hydraulic Boom Extension (Optional)*, page 5-83.



Boom Extension Pin Interlock Mechanism

The boom extension pin interlock mechanism (1, Figure 5-31) interlocks the front mounting pin (3) and boom installation pins (4) to ensure that the boom extension is deployed and stowed safely. The front mounting bracket pin (3) is extended and retracted electrically from the ODM in the operator cab. Push/pull cables (2) connect the front mounting bracket pin (3) and boom nose installation pins (4). When the front mounting pin is extended, the cables (2) retract the interlock pins from the boom installation pins (4), unlocking them. When the front mounting pin (3) is retracted, the cables (2) insert the interlock pins in the boom installation pins (4), locking them in the extended position. If the boom installation pins (4) are unlocked, the front mounting pin cannot be retracted.

Front Boom Extension Mounting Pin

The front boom extension mounting pin (3, Figure 5-31) is electrically actuated from the ODM in the operator cab. When the front mounting pin is extended, the boom nose installation pins (4) are unlocked, allowing the installation pins to be extended or retracted. When the mounting pin is extended, the proximity sensor in the front mounting bracket signals the control system that the front mounting pin is properly installed. When the front mounting pin is retracted, no signal is sent to the control system.

Boom Nose Installation Pins

The boom nose installation pins (4, Figure 5-31) are used as a pivot to deploy the boom extension on to the boom nose and stow the boom extension on the side of the boom base section. Mechanical interlock pins lock and unlock the installation pins (4) based on the position of the front mounting pin (3). When the front mounting pin (3) is retracted, the front mounting pin (3) is removed from the front mounting bracket and the boom nose installation pins (4) are locked in the extended position. When the front mounting pin (3) is extended, the installation pins (4) are unlocked, allowing the installation pins to be extended or retracted. An

impact drill is required to extend and retract the boom nose installation pins.

Front Mounting Pin Handle

The front mounting pin handle (5, Figure 5-31) moves in unison with the front mounting pin (3), providing a visual cue for operators outside of the operator cab know status of the front boom extension mounting pin (3):

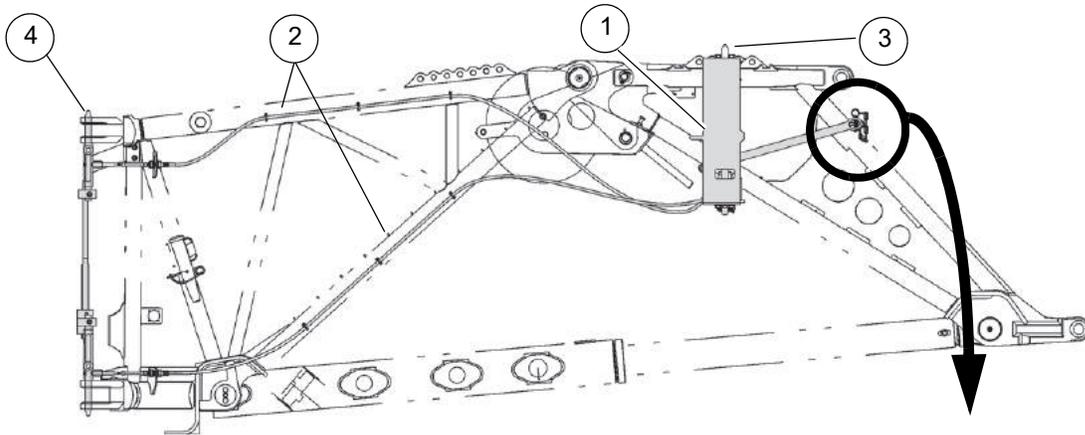
- Handle up—The front mounting pin is extended in the front mounting bracket and the boom extension installation pins are unlocked.
- Handle down—The front mounting pin is retracted and the installation pins are locked.

Boom Extension Mounting Brackets

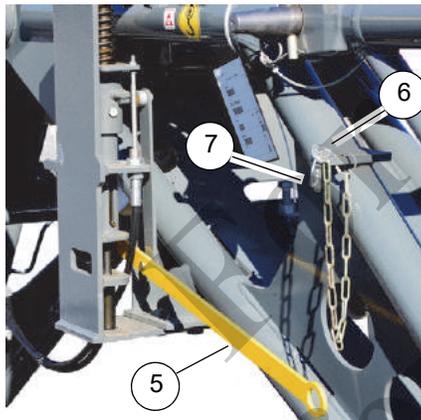
NOTE: The fly section and boom extension base section must be connected with the fly section in the stowed position to secure the boom extension to the side of the boom.

The main boom base section features the following mounting brackets for stowing the fly section and boom extension base section:

- Rear Boom Extension Mounting Bracket—Located nearest to the superstructure cab is the rear boom extension mounting bracket (1, Figure 5-32). The boom extension base section is pinned to the fly section. The fly section is secured to the side of the boom base section with the electrically actuated pin.
- Front Boom Extension Mounting Bracket—Located nearest the boom nose is the front boom extension mounting bracket (6, Figure 5-32). The front mounting bracket pin is actuated with the boom extension actuating mechanism. For more information, see *Boom Extension Pin Interlock Mechanism*, page 5-48.
- Front Fly Section Mounting Bracket—Located near the lift cylinder pin. The front fly section bracket (9, Figure 5-32) secures the fly section the main boom.

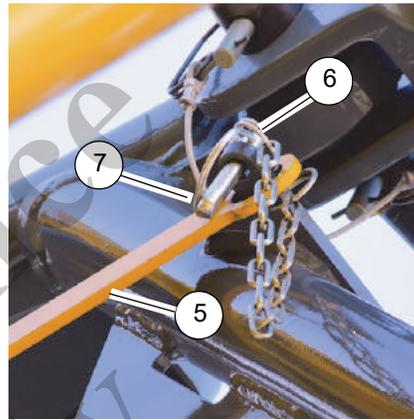


9967



9968

Deploy Boom Extension
Front Boom Extension Pin Retracted
Boom Extension Installation Pins Locked



9969

Stow Boom Extension
Front Boom Extension Pin Extended
Boom Extension Installation Pins Unlocked

FIGURE 5-31

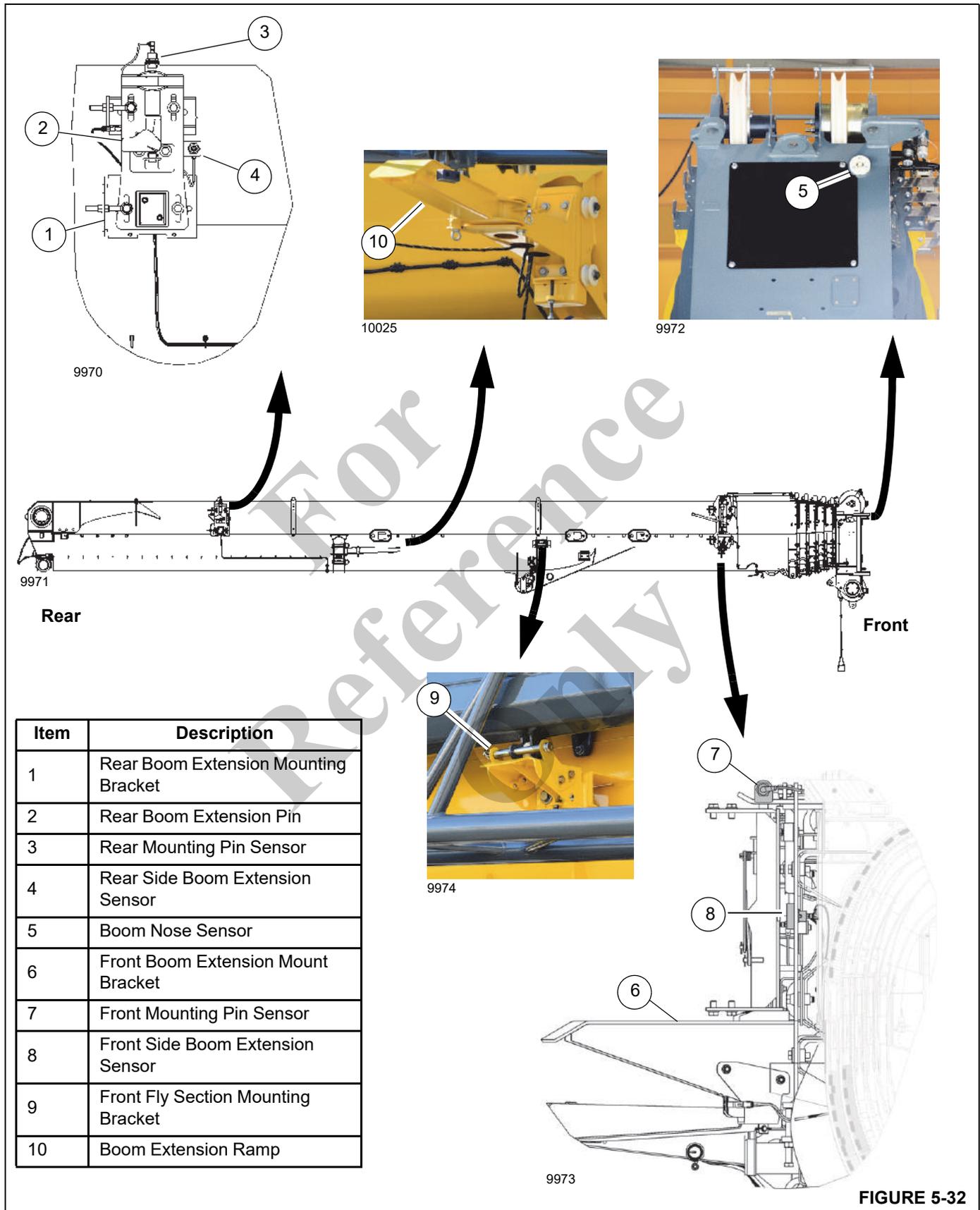


FIGURE 5-32

Boom Extension Sensors

The front and rear boom extension mounting brackets feature the following sensors:

- Rear Mounting Pin Sensor (3, Figure 5-32)—Sends a signal to the control system when the rear boom extension pin is extended in the rear boom extension mounting bracket. The rear mounting pin is electrically controlled from the ODM in the operator cab.
- Rear Side Sensor(4, Figure 5-32)—Sends a signal to the control system when the boom extension fly section is in the stowed position next to the boom base.
- Front Mounting Pin Sensor (7, Figure 5-32)—Sends a signal to the control system when the front boom extension pin is extended in the front boom extension mounting bracket. The front mounting pin is electrically controlled from the ODM in the operator cab. For more information, see *Boom Extension Pin Interlock Mechanism*, page 5-48.
- Front Side Sensor (8, Figure 5-32)—Sends a signal to the control system when the boom extension is in the stowed position next to the boom base.
- Boom Nose Sensor (5, Figure 5-32)—Sends a signal to the control system when the boom extension is in the deployed position.

Signals from the sensors appear in the ODM in the operator cab to inform the operator about the status of the boom extension.

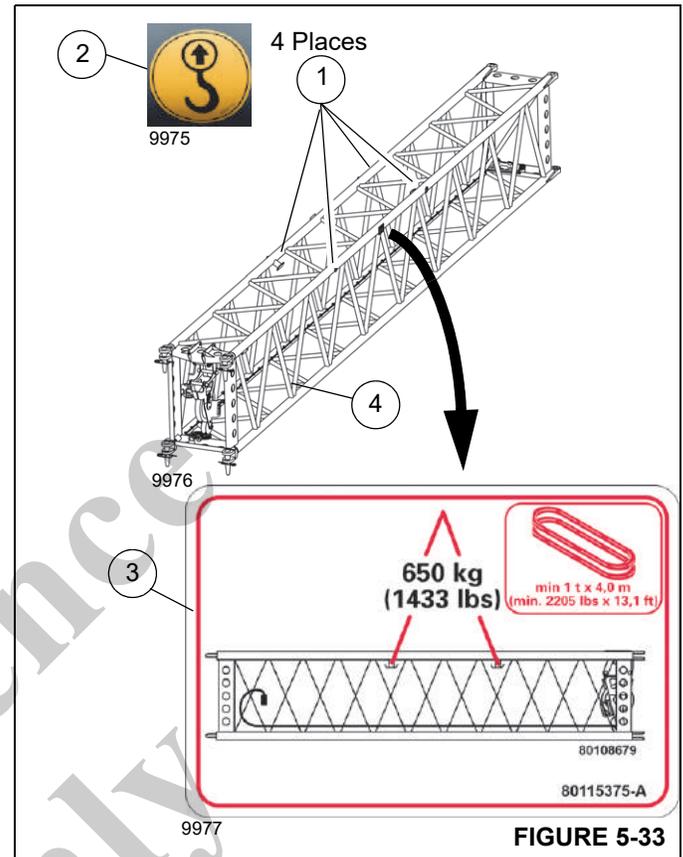
Lifting Points

The following sections describe the sling attaching points for the boom extension sections.

Lattice Insert

The lattice insert features four fixed attaching points (1, Figure 5-33). Decals (2) mark the attaching points. The weight information decal (3) shows information about the

lattice insert weight and necessary lifting gear. Tie a tag line to a lacing (4) as necessary to guide the lattice insert during lifting operations.



Fly Section

The fly section features four fixed attaching points (1, Figure 5-34). Decals (2) mark the attaching points. The weight information decal (3) shows information about the fly section weight and necessary lifting gear. Tie a tag line to the end of fly section (4) as necessary to guide the section during lifting operations.

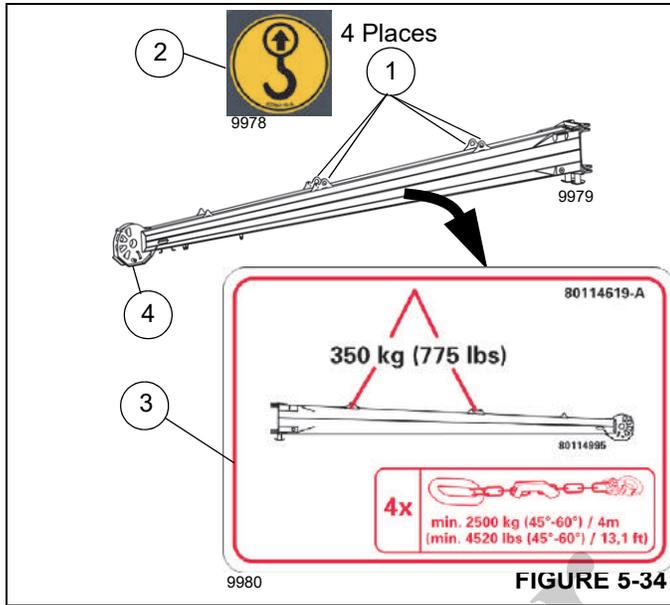


FIGURE 5-34

Boom Extension Base Section

The boom extension base section features eight attaching points on each side (16 total) (1, Figure 5-35). Decals show the attaching points (2). The attaching point decals are numbered 1 through 8 (3). The Transportation and Lifting decal (4) shows the different supported lifting configurations:

- Boom extension base only
- Boom extension base with fly section deployed
- Boom extension base with fly section stowed

Use the Transportation and Lifting decal to determine which attaching points to use. The Transportation and Lifting decal also shows required minimum lifting gear.

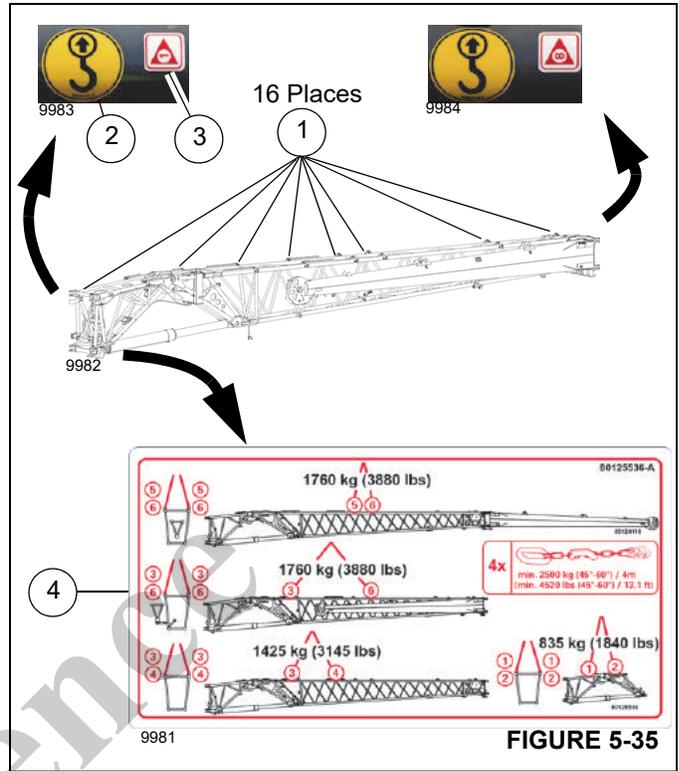


FIGURE 5-35

Heavy Duty Boom Extension

The optional heavy duty boom extension features four attaching points (1, Figure 5-36). Decals mark the attaching points. The weight information decal (2) shows information about the heavy duty boom extension weight and necessary lifting gear. Tie a tag line to the end of heavy duty boom extension (3) as necessary to guide the section during installation and removal operations.

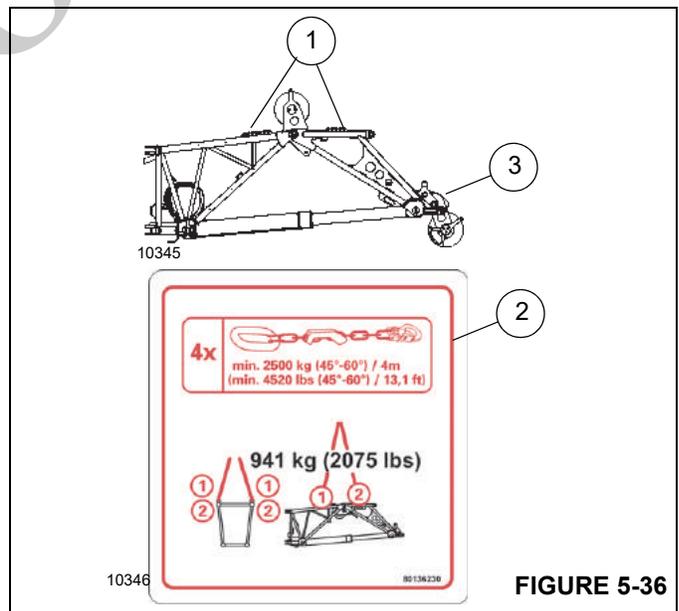


FIGURE 5-36

About the Boom Extension Group in the ODM

screen. For more information about the Alerts Area, Active Screen Indicator Area, and Status Bar, see *Using the Operator Display Module (ODM)*, page 4-72.

Figure 5-37 shows the Boom Extension screen in the ODM. Table 5-4 describes the icons on the Boom Extension

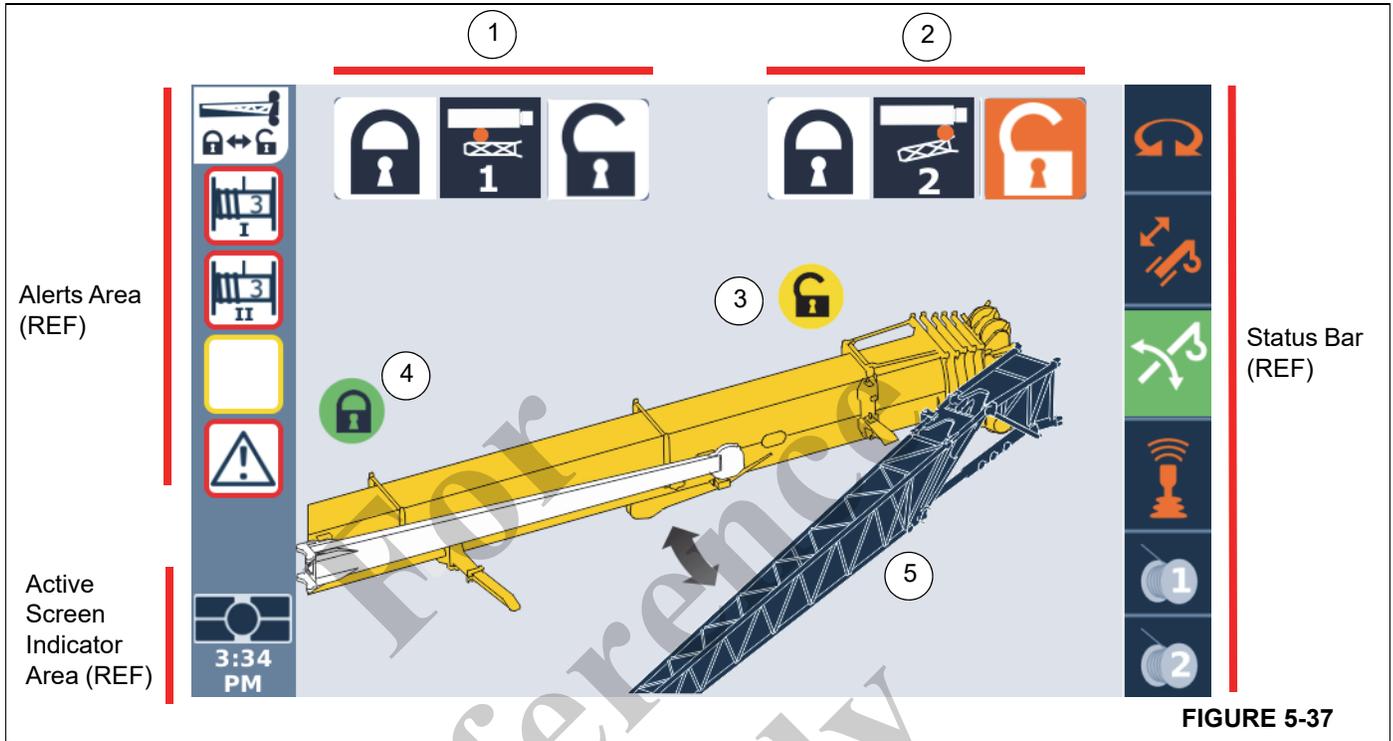
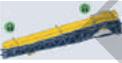


FIGURE 5-37

Table 5-4 Boom Extension Group Icons

Item(s)	Icon	Description
1 and 2		Boom Extension Rear or Front Mounting Pin Locked (Selected).
1 and 2		Boom Extension Rear or Front Mounting Pin Unlocked (Selected)
1 and 2		Boom Extension Rear or Front Mounting Pin Unlocked (Unselected)
1 and 2		Boom Extension Rear or Front Mounting Pin Locked (Unselected)

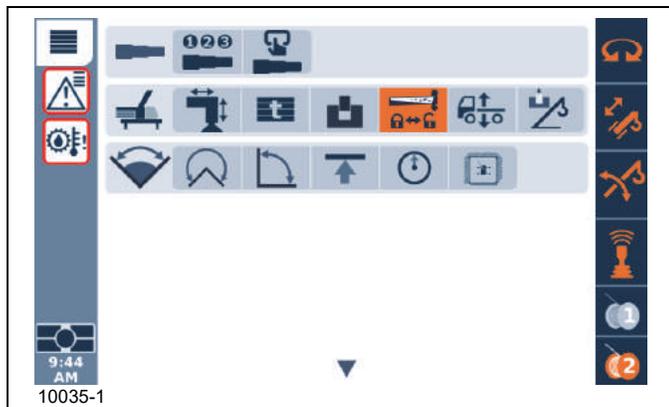
Table 5-4 Boom Extension Group Icons (Continued)

Item(s)	Icon	Description
1		Rear Boom Extension Mounting Pin (pin #1).
2		Front Boom Extension Mounting Pin (pin #2).
3 and 4		Boom Extension Rear or Front Mounting Pin Status: Locked
3 and 4		Boom Extension Rear or Front Mounting Pin Status: Unlocked.
5		Boom Extension status indicator. This icon changes depending on the location of the boom extension.

Accessing the Boom Extension Group in the ODM

Use the following procedure to access the boom extension group in the ODM. For more information about the ODM navigation control pad or jog dial, see *Navigating the Operator Display Module and Rated Capacity Limiter Display Module*, page 4-71.

1. Access the Menu Screen.
2. Use the ODM navigation pad or jog dial to highlight the Boom Extension Deployment/Stowage icon.



3. Press the OK button on the ODM navigation pad or press down on the jog dial to select the Boom Extension Deployment/Stowage icon.

The boom extension group screen appears.

Installing the Boom Extension



DANGER

Boom Extension Hazard!

To avoid death or serious injury, follow procedures and cautions in the Operator and Safety Manuals and decals during erection, stowage and use of boom extension. Install and secure all pins properly and control boom extension movement at all times.

Use this procedure to install the boom extension base section and fly section that are separate from the crane on to the boom nose.

<p>Required Tools</p>	<ul style="list-style-type: none"> • 1/2 in Impact Wrench • 24 in — 1/2 in Drive Impact Extension • 1/2 in Square Drive Socket — 14mm impact rated hex socket
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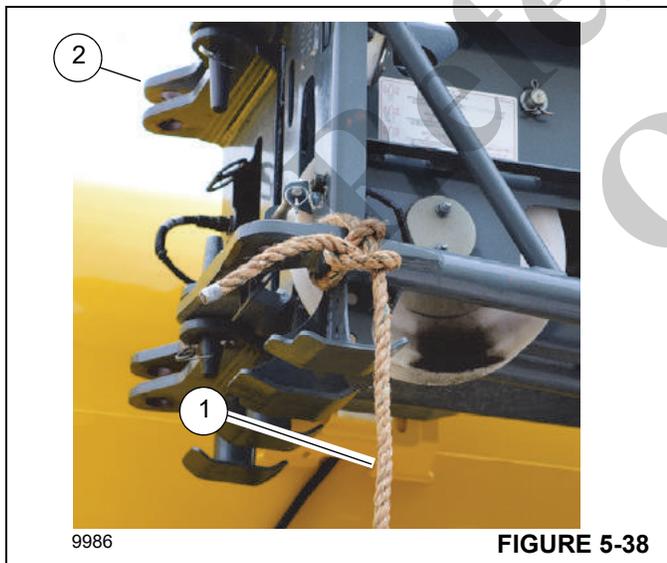
NOTE: This procedure assumes the boom extension is completely removed from the boom nose and the fly section is stowed on the boom extension base.

NOTE: This procedure applies to manual and hydraulic boom extensions unless otherwise noted.

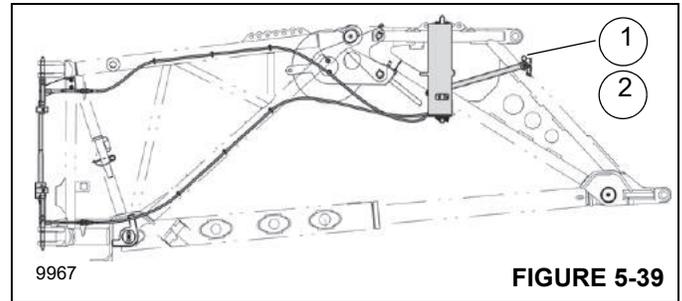
1. Make sure the counterweight is installed. For more information about installing the counterweight, see *Counterweight Removal and Installation*, page 5-12.
2. Make sure the crane is set up on fully-extended outriggers. For more information, see *Using the Outriggers*, page 4-21.

NOTE: An auxiliary crane with sling is required to install the boom extension on the boom nose.

3. Retract and lower the boom to horizontal.
4. Attach a tag line (1, Figure 5-38) to the end of the boom extension (2).



5. If necessary, raise the front mounting pin handle (1, Figure 5-39) to unlock the boom extension installation pins. Lock the handle with pin (2).

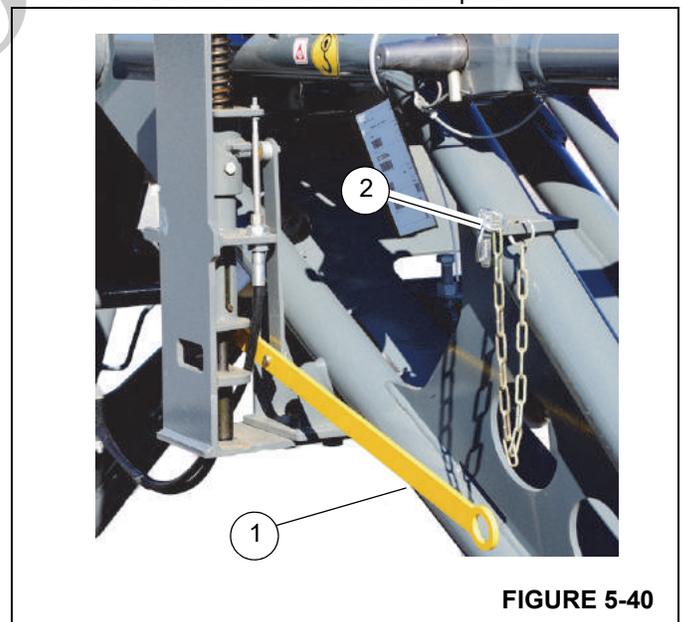


6. If necessary, turn the jack screw (3, Figure 5-41) counterclockwise to retract the boom extension installation pins (4) using an impact wrench, extension, and 14 mm socket.

! DANGER

When installing the boom extension, make sure that all personnel and equipment are kept clear of the swing path.

7. Using a sling attached to an auxiliary crane, lift the boom extension in front of the boom. For more information about attaching points for the sling, see *Lifting Points*, page 5-51.
8. Raise and lower the boom extension as necessary to align the boom extension anchor fittings (1, Figure 5-41) with the boom nose attachment lugs (2). Align and secure the boom extension installation pins (4) in the holes in the boom nose using an impact driver, turning the jack screw (3) counterclockwise.
9. Remove the pin (2, Figure 5-40) and unlock the pin interlock mechanism handle (1). Lower the handle (1) to lock the boom extension installation pins.



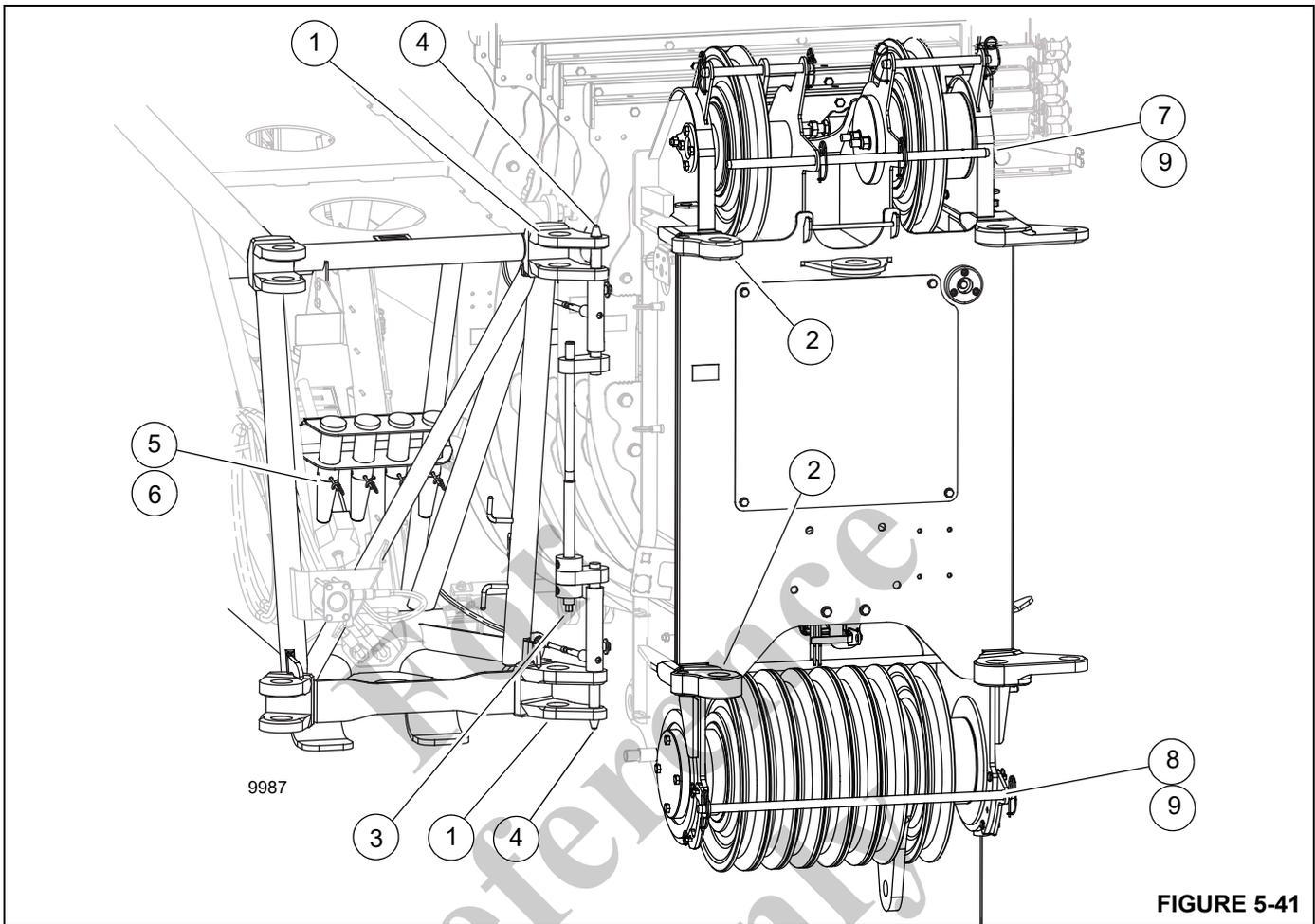


FIGURE 5-41

10. Remove pins (5, Figure 5-41) and retaining clips (6) from the stowage bracket. Secure the boom extension to the boom nose using four pins (5). Secure the pins (5) with retaining clips (6). If necessary, remove the upper (7) and lower (8) hoist rope rods and retaining clips (9) to install the pins (5). Use the jack as necessary to install the fourth pin as necessary as follows:

- a. Install three pins to attach the boom extension to the boom nose.
- b. Operate the jack handle (2) to align the holes on the boom extension with the hole in the boom nose.
- c. Install the fourth pin. Secure the fourth pin with retaining clip.

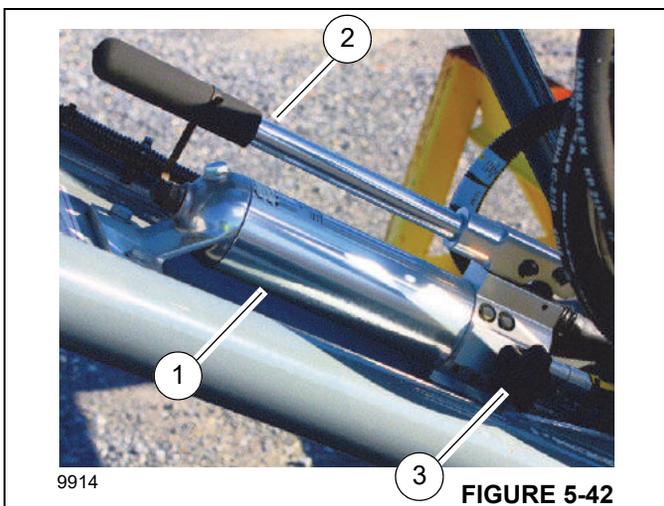


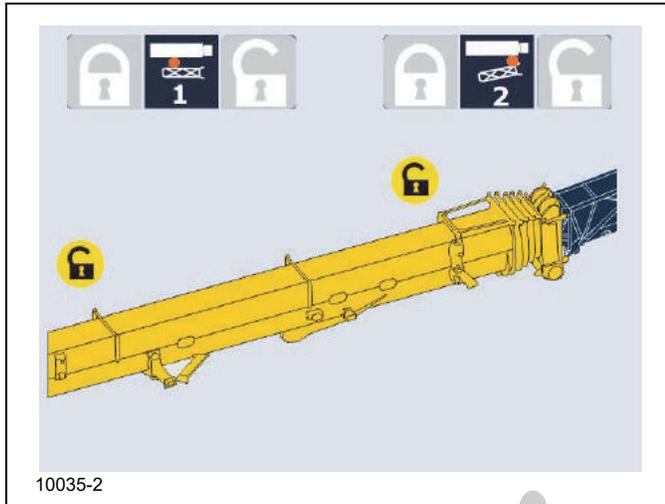
FIGURE 5-42

CAUTION

After installing the fourth pin, turn the pressure relief nob (3) to retract the jack so the jack does not contact the boom nose. Failure to retract the jack could result in damage to the boom extension jack.

- d. Turn the nob (3) to relieve the pressure to retract the jack pin.
11. Connect boom extension electrical connector to the main boom electrical connector. For more information, see *Boom Extension and Lattice Insert Electrical Connections*, page 5-73.

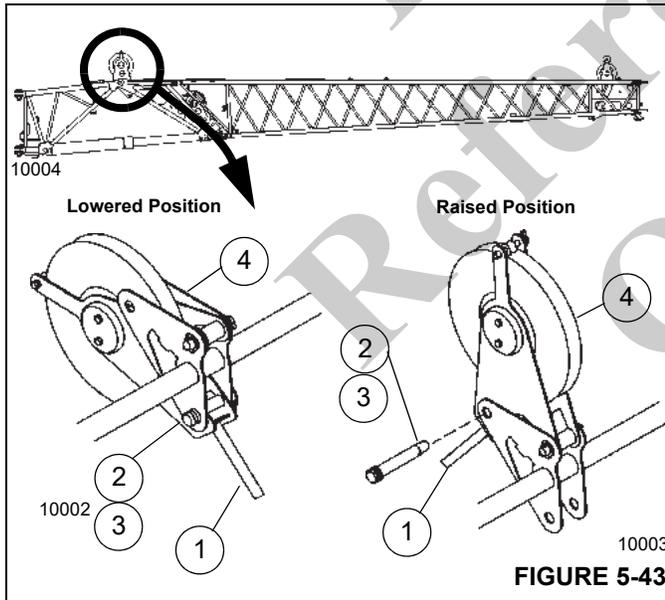
12. Make sure the boom extension is shown as erected in the ODM.



13. If installing the hydraulic boom extension, connect hydraulic hoses. For more information, see *Hydraulic Boom Extension Connections*, page 5-74.

14. Remove the slings from the boom extension.

15. Raise the rear mast sheave assembly as follows:

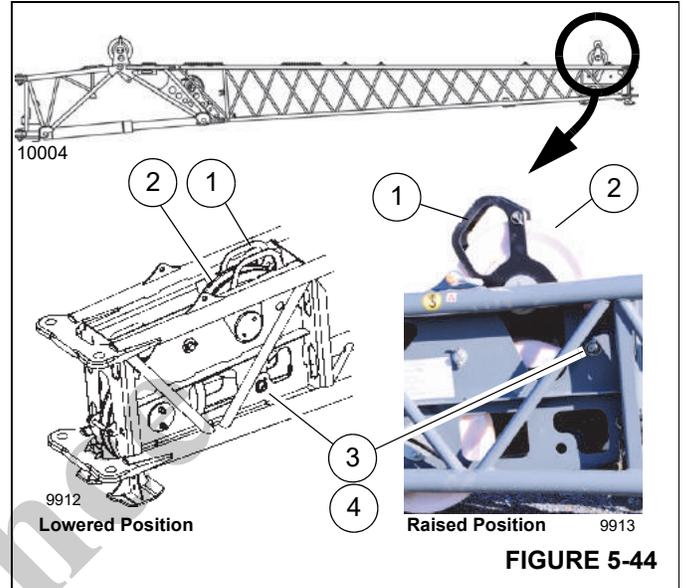


a. Hold the handle (1, Figure 5-43) and remove the retaining clip (2) and pin (3).

b. Raise the mast (4). Make sure the connecting point holes are aligned.

c. Insert pin (3). Secure the pin with retaining clip (2).

16. Raise the front mast assembly as follows:



a. Hold the handle (1, Figure 5-44) of the mast sheave assembly (2). Remove retaining clip (3) and pin (4).

b. Raise the mast assembly (2) until the connecting holes are aligned.

c. Insert pin (4) and secure with retaining clip (3).

17. Reeve the hoist rope. For more information, see *Reeving the Hoist Rope*, page 5-78.

18. Remove the anti-two block switch from the boom nose. For more information, see *Anti-Two Block (A2B) Switch*, page 5-32. Install the anti-two block switch on the boom extension. For more information, see *Anti-Two Block Switch on the Boom Extension*, page 5-80.

Removing the Boom Extension

! DANGER

Boom Extension Hazard!

To avoid death or serious injury, follow procedures and cautions in the Operator and Safety Manuals and decals during erection, stowage and use of boom extension. Install and secure all pins properly and control boom extension movement at all times.

Use the following procedure to remove the boom extension from the boom nose.

NOTE: This procedure assumes the boom extension is erected on the boom nose and fly section is stowed on the boom extension base. If the fly section is erected, stow the fly section. For more information, see *Stowing the Fly Section*, page 5-65.

Required Tools	<ul style="list-style-type: none"> • 1/2 in Impact Wrench • 24 in — 1/2 in Drive Impact Extension • 1/2 in Square Drive Socket — 1/2 in (11mm) drive 6-point Socket
----------------	--

1. Make sure the crane is set up on fully extended outriggers. For more information, see *Using the Outriggers*, page 4-21.

NOTE: An auxiliary crane with sling is required to remove the boom extension from the main boom.

2. Retract and lower the boom to horizontal.
3. If necessary, remove the anemometer and boom position light. For more information, see *Anemometer/ Boom Position Light (Optional)*, page 5-94.
4. Remove the anti-two block switch from the end of the boom extension. For more information, see *Anti-Two Block Switch on the Boom Extension*, page 5-80. Install the anti-two block switch on the main boom nose. For more information, see *Anti-Two Block (A2B) Switch*, page 5-32.
5. Unreeve the hoist rope from the boom extension sheaves. For more information, see *Reeving the Hoist Rope*, page 5-78.
6. Using a sling attached to an auxiliary crane, attach the auxiliary crane to the boom extension attaching points. For more information about attaching points for the sling, see *Lifting Points*, page 5-51.
7. Attach a tag line (1, Figure 5-38) to the end of the boom extension base section (2).
8. Stow the rear mast assembly as follows:
 - a. Hold the handle (1, Figure 5-43) and remove the retaining clip (2) and pin (3).
 - b. Lower the mast (4). Make sure the connecting point holes are aligned.
 - c. Insert pin (3). Secure the pin with retaining clip (2).
9. Stow the front mast assembly as follows:
 - a. Hold the handle (1, Figure 5-44) of the mast sheave assembly. Remove retaining clip (3) and pin (4).

- b. Lower the mast assembly (2) until the connecting holes are aligned.
- c. Insert pin (4) and secure with retaining clip (3).

10. Disconnect and stow the boom extension electrical connections from the main boom. For more information, see *Boom Extension and Lattice Insert Electrical Connections*, page 5-73
11. If removing a hydraulic boom extension, disconnect and stow hydraulic connections. For more information, see *Hydraulic Boom Extension Connections*, page 5-74.
12. Remove four retaining clips (6, Figure 5-41) and pins (5) from the boom extension anchor fittings and main boom attachment fittings. If necessary, remove the upper (7) and lower (8) hoist rope rods and retaining clips (9) to install the pins (5). Secure the pins (5) and retaining clips (6) in the holder on the boom extension.
13. Raise the front mounting pin handle (1, Figure 5-39) to unlock the boom extension installation pins. Lock the handle with pin (2).



DANGER

When removing the boom extension, make sure the boom extension is properly supported by the auxiliary crane and the movement of the boom extension is controlled at all times.

14. Using an impact drill and 24-inch 1/2-inch impact drill extension, retract the boom extension installation pins.
15. Using the auxiliary crane and the tag line, remove the boom extension from the boom nose and move the boom extension to a suitable location.

Erecting the 17.8 m Boom Extension



DANGER

Boom Extension Hazard!

To avoid death or serious injury, follow procedures and cautions in the Operator and Safety Manuals and decals during erection, stowage and use of boom extension. Install and secure all pins properly and control boom extension movement at all times.



DANGER

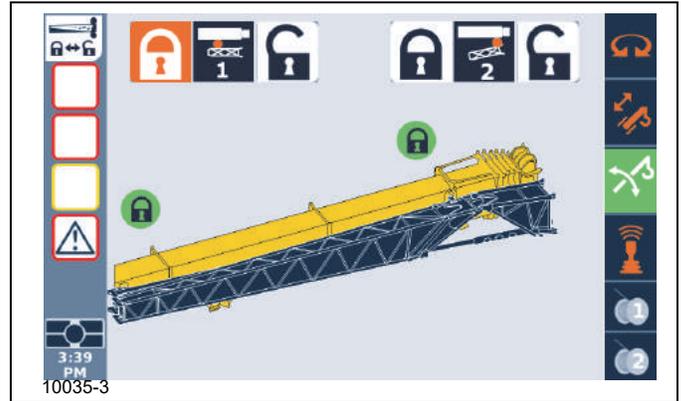
To prevent serious injury or death, do not stand on crane decking unless boom extension is secure.

Use the following procedure to erect the boom extension.

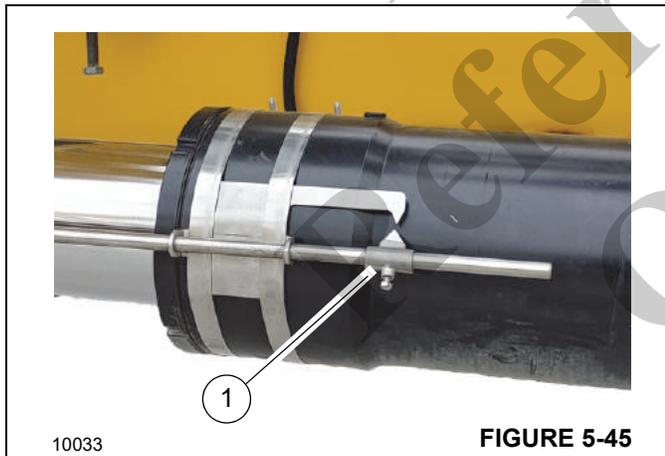
NOTE: This procedure assumes the boom extension base and fly sections are stowed on the side of the main boom.

1. Make sure the counterweight is installed. For more information, see *Counterweight Removal and Installation*, page 5-12.
2. Make sure the crane is set up on fully-extended outriggers. For more information, see *Using the Outriggers*, page 4-21.
3. Retract and lower the boom to horizontal.
4. Connect boom extension electrical connectors. For more information, see *Boom Extension and Lattice Insert Electrical Connections*, page 5-73.
5. If erecting a hydraulic boom extension, connect hydraulic hoses. For more information, see *Hydraulic Boom Extension Connections*, page 5-74.
6. If erecting an optional hydraulic boom extension, make sure the angle indicator (1, Figure 5-45) is aligned. If the arrows are not aligned, adjust the boom extension offset as needed to align the arrows. For more information, see *Setting the (Optional) Hydraulic Boom Extension Offset*, page 5-80.

7. In the ODM, verify that the front and rear mounting pins are securely installed. Visually confirm that the pins are installed.



8. Tie a tag line (1, Figure 5-38) to the end of the boom extension base section (2). The tag line will assist when swinging the boom extension to the boom nose.
9. Retract the captive retaining pin (1, Figure 5-46) from the bracket (2) to release the rear boom extension ramp (3) from the stowed position. Swing the rear boom extension ramp (3) into the deployed position. Retract the captive pin (4) to secure the ramp in the deployed position.



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FIGURE 5-45

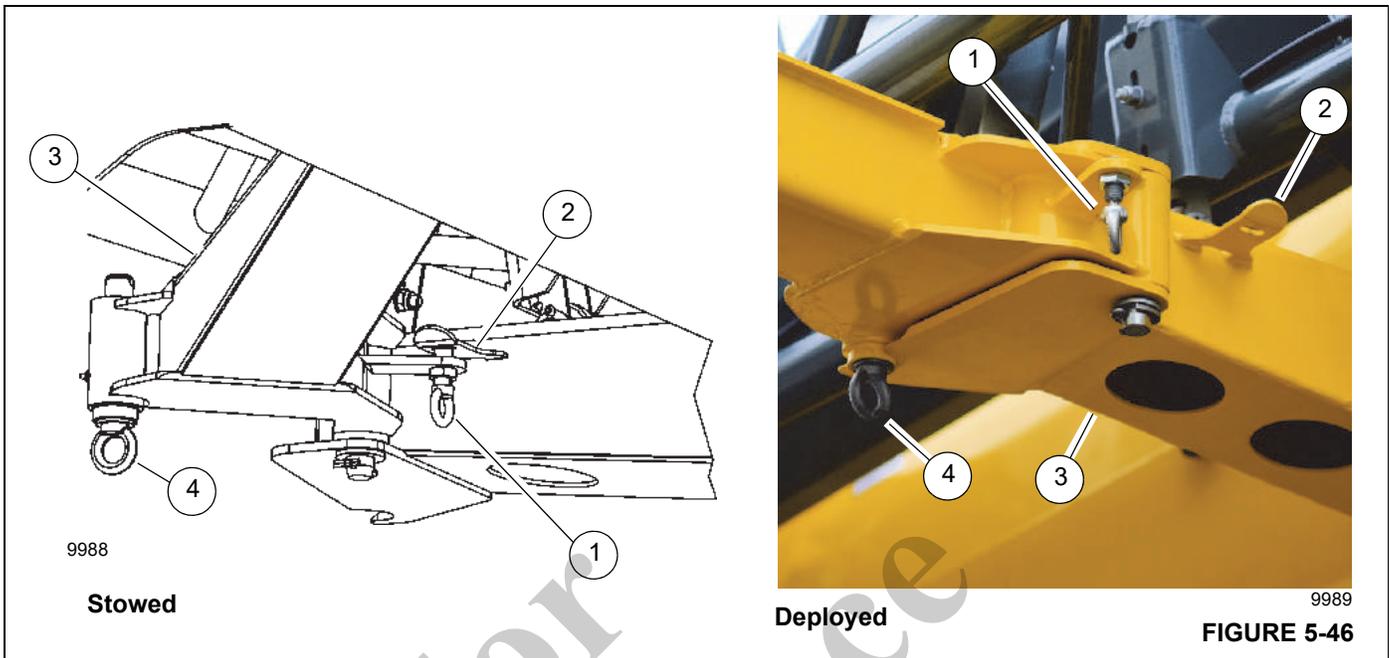


FIGURE 5-46

10. Remove retaining clip and pin (1 and 2, Figure 5-47) from holes in the fly section storage bracket (3). Install the retaining clip and pin in the storage position (4).

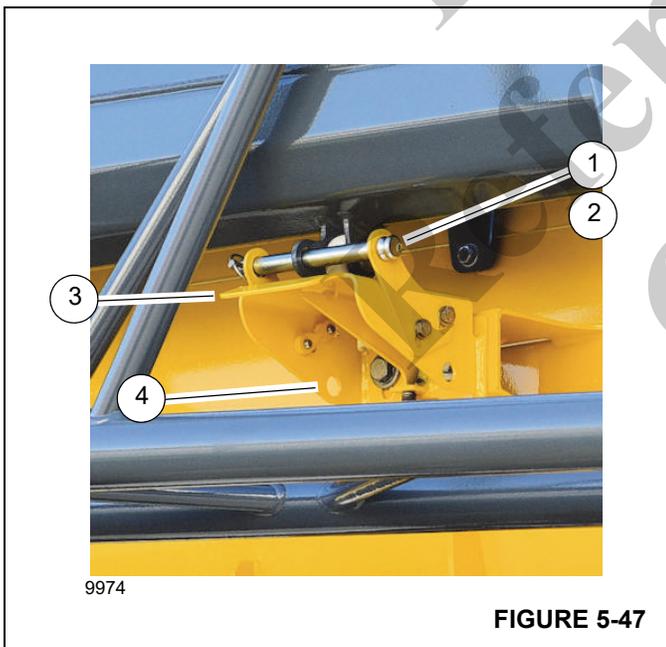


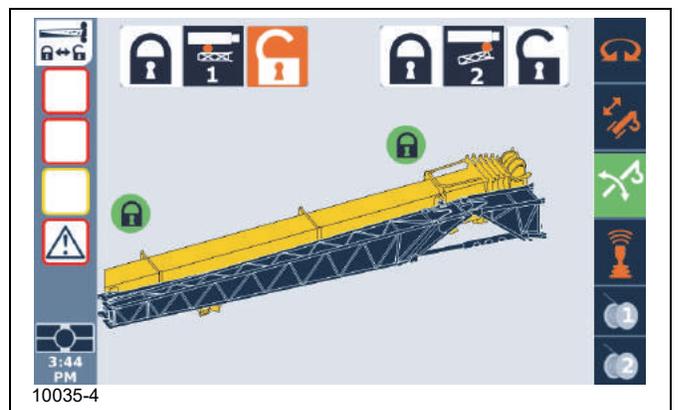
FIGURE 5-47

11. In the ODM, highlight the unlock icon and the retract the rear boom extension pin (Pin #1) as follows:



a. Use the ODM control pad arrow buttons or jog dial to highlight unlock icon.

The unlock icon is highlighted (orange).



b. Press and hold the OK on the ODM control pad or press down on the jog dial.

The lock status icon turns yellow, indicating the pin is retracted.

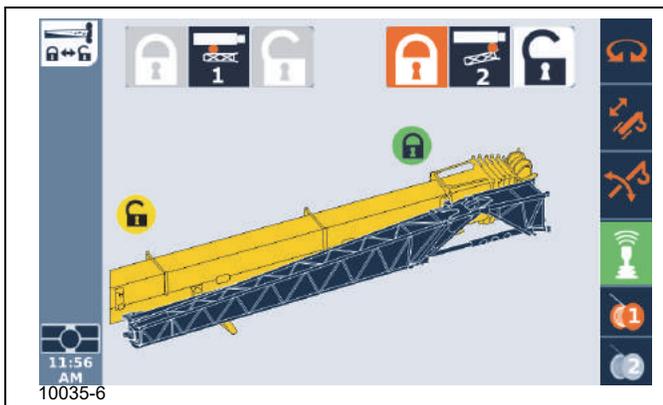


12. Visually confirm that the rear mounting pin (Pin #1 in the ODM) is unlocked.
13. Using the tag line, swing the boom extension on to the rear ramp so the boom extension installation pins (4, Figure 5-41) align with the holes in the main boom attachment fittings (2).
14. With an impact wrench and 14 mm socket extension, turn the jack screw (3, Figure 5-41) counterclockwise to extend the boom extension installation pins (4) into the boom nose attachment fittings (2). The jack screw drive will bottom out when the pins are fully engaged. Verify that the pins (4) are fully engaged and that the bolts and washers are at the end of the slots.

! DANGER
Crush Hazard

To avoid death or serious injury, ensure boom extension installation pins (4, Figure 5-41) are installed prior to retracting the front mounting pin (Pin #2).

15. In the ODM, retract the front mounting pin (Pin #2) as follows:



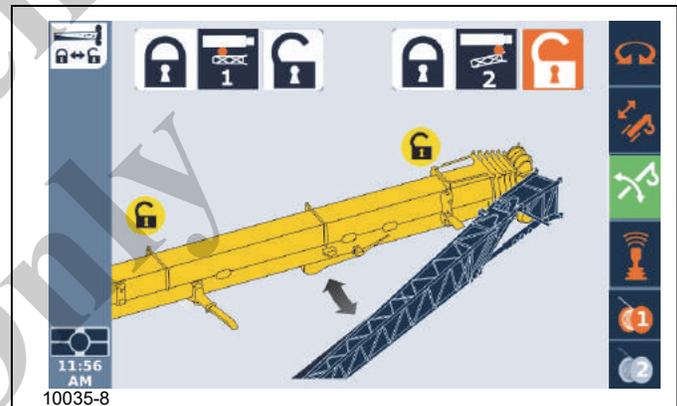
- a. Use the ODM control pad arrow buttons or jog dial to highlight unlock icon.

The unlock icon is highlighted (orange).



- b. Press and hold the OK on the ODM control pad or press down on the jog dial.

The lock status icon turns yellow, indicating the pin is retracted. The boom extension is displayed as detached from the side of the main boom.



16. Visually confirm that the front mounting pin (Pin #2 in the ODM) is unlocked. The handle should be in the down position. When the handle is in the down position, the front mounting pin is retracted and the boom installation pins are locked.

NOTE: The front mounting pin (Pin #2) will not unlock unless the right side boom extension installation pins are fully engaged. If the front boom extension pin (Pin #2) does not unlock, make sure the right side boom extension installation pins are fully engaged and the cable ends are inserted through the pins.

! DANGER

When erecting the boom extension, make sure that all personnel and equipment are kept clear of the swing path.

17. Using the tag line, swing the boom extension to the front of the boom nose. Align the boom extension anchor fittings with the main boom attachment fittings.
18. Install four pins (5, Figure 5-41) and retaining clips (6) to secure the boom extension to the boom nose. If necessary, remove the upper (7) and lower (8) hoist rope rods and retaining clips (9) to install the pins (5). Use the jack (1, Figure 5-48) as necessary to install the fourth pin as necessary as follows:

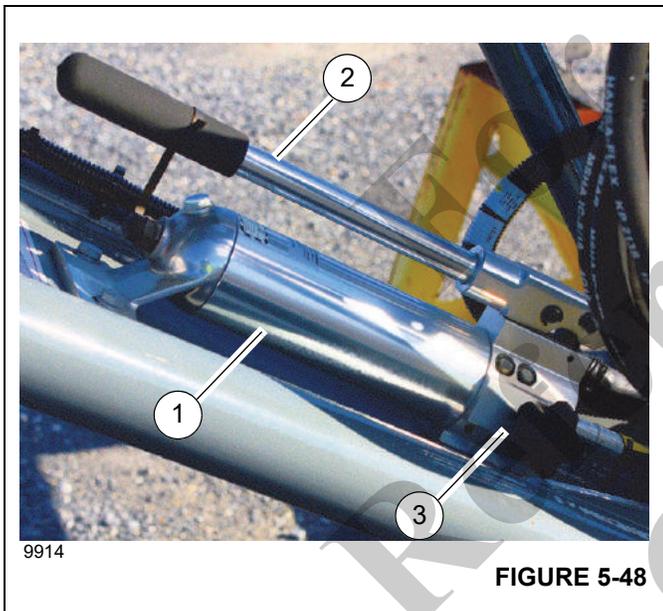


FIGURE 5-48

- a. Install three pins to attach the boom extension to the boom nose.
- b. Operate the jack handle (2) to align the holes on the boom extension with the hole in the boom nose.
- c. Install the fourth pin. Secure the fourth pin with retaining clip.

CAUTION

After installing the fourth pin, turn the pressure relief nob (3) to retract the jack so the jack does not contact the boom nose. Failure to retract the jack could result in damage to the boom extension jack.

- d. Turn the nob (3) to relieve the pressure to retract the jack pin.
19. In the ODM display, make sure that ODM shows that the boom extension is deployed.



20. Remove the tag line.
21. Erect the fly section. For more information, see *Erecting the Fly Section*, page 5-63.
22. Raise the rear mast sheave assembly as follows:

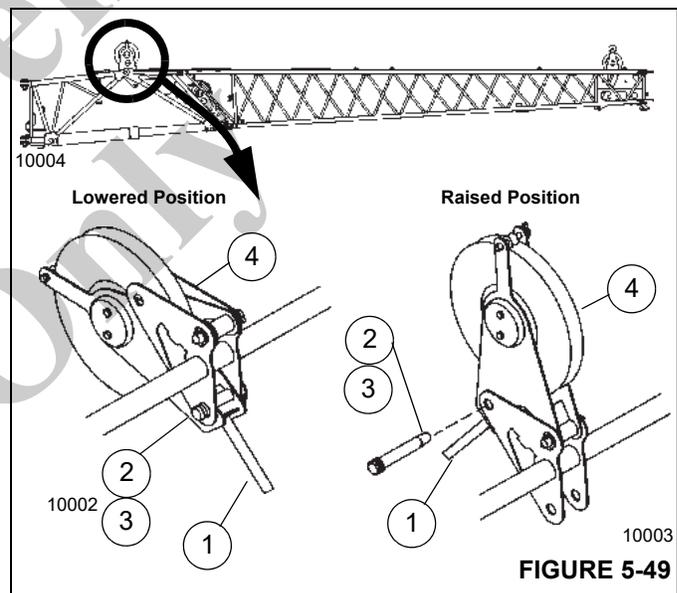


FIGURE 5-49

- a. Hold the handle (1, Figure 5-49) and remove the retaining clip (2) and pin (3).
- b. Raise the mast (4). Make sure the connecting point holes are aligned.
- c. Insert pin (3). Secure the pin with retaining clip (2).

23. Raise the front mast assembly as follows:

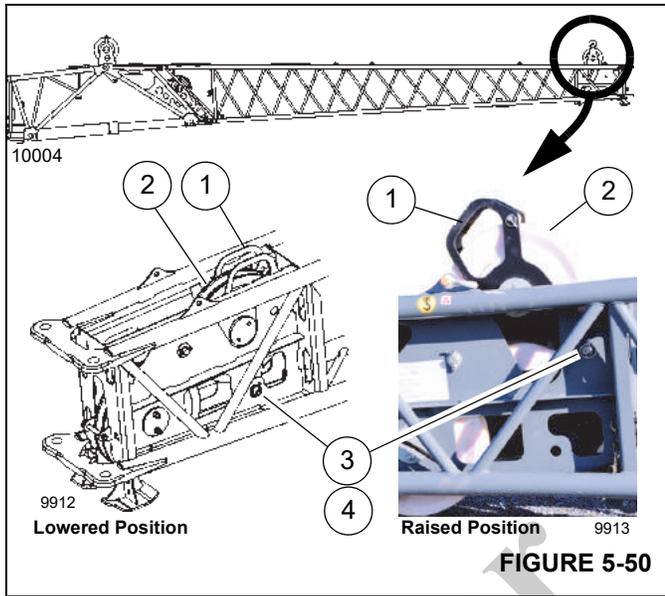


FIGURE 5-50

- a. Hold the handle (1, Figure 5-50) of the mast sheave assembly (2). Remove retaining clip (3) and pin (4).
- b. Raise the mast assembly (2) until the connecting holes are aligned.
- c. Insert pin (4) and secure with retaining clip (3).

24. Reeve the hoist rope. For more information, see *Reeving the Hoist Rope*, page 5-78.
25. Remove the anti-two block switch from the main boom nose. For more information, see *Anti-Two Block (A2B) Switch*, page 5-32. Install the anti-two block switch. For more information, *Anti-Two Block (A2B) Switch*, page 5-32.
26. (Optional) Install the anemometer and boom position light. For more information, see *Anemometer/Boom Position Light (Optional)*, page 5-94.

Erecting the Fly Section

Use this procedure to deploy the boom extension fly section.

NOTE: This procedure assumes the boom extension is erected and fly extension is folded on the boom extension base section.

1. Make sure the locking bar (3, Figure 5-52) and pins can retaining clips (9 and 10, Figure 5-53) are properly installed.
2. Tie a tag line (1, Figure 5-51) to the end of the fly section (2).

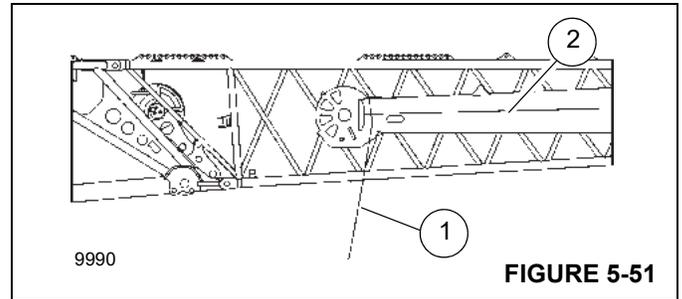


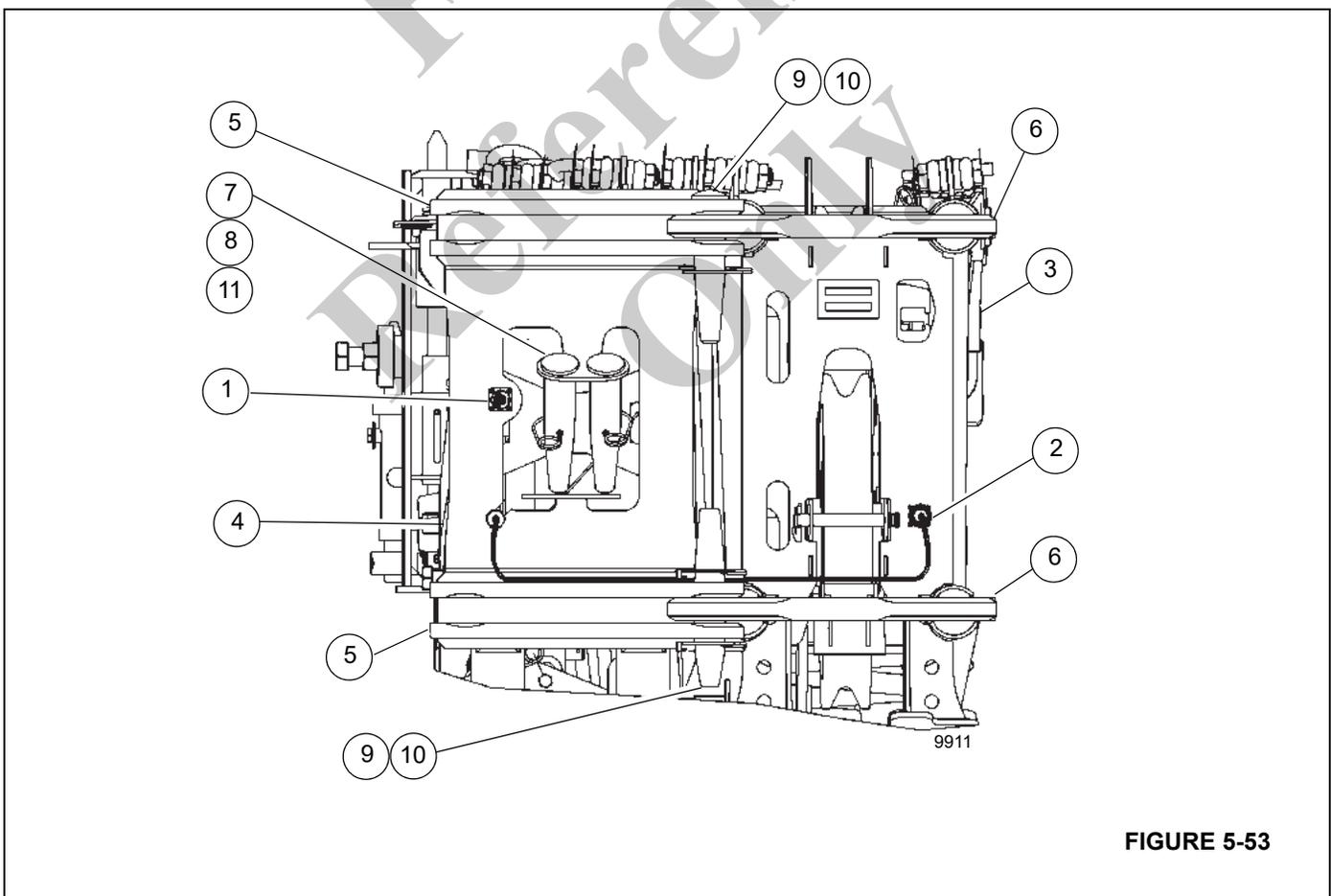
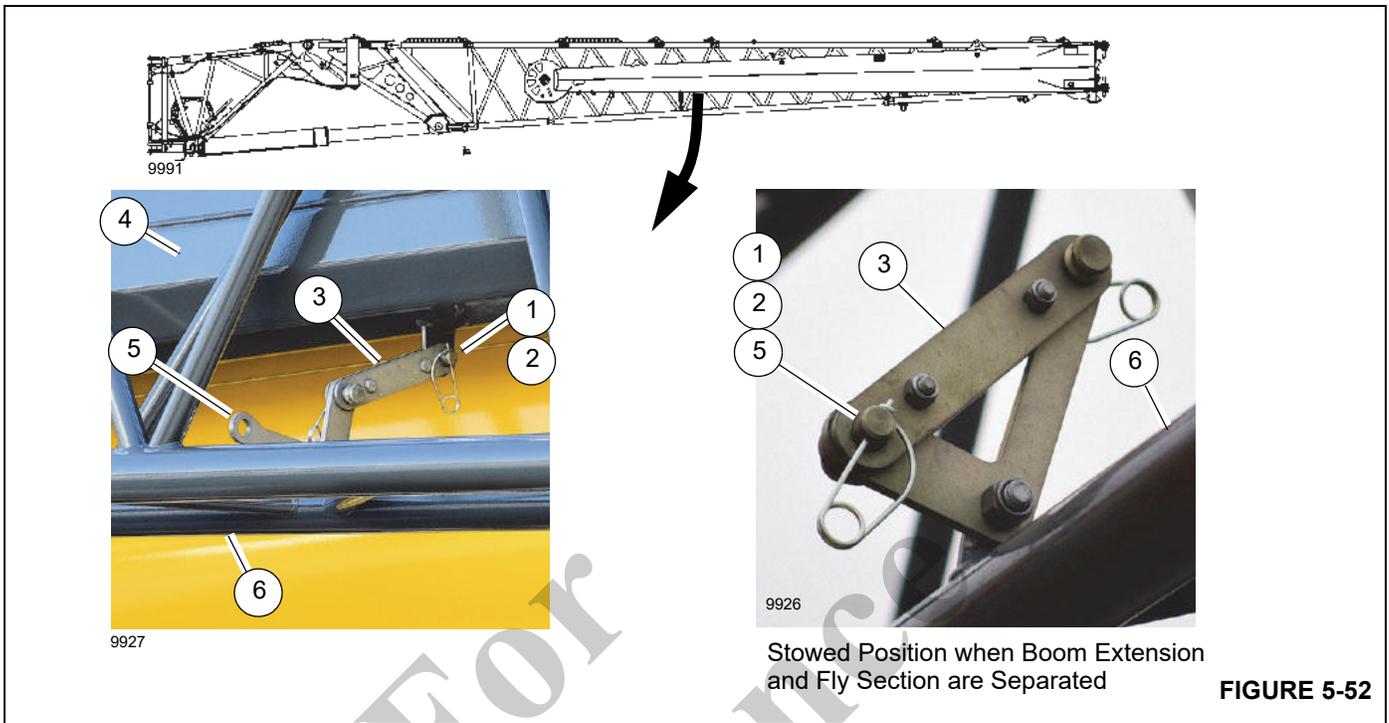
FIGURE 5-51

3. Remove the retaining clip (1, Figure 5-52) and pin (2) from the boom extension fly section (4). Remove the locking bar (3) from the boom extension fly section (4). Rotate the locking bar (3) and store the clip and pin in retaining bracket (5) on the boom extension base section (6).
4. Remove the fly section electrical connection from fly section stowage receptacle (1, Figure 5-53). Connect the fly section electrical connector to the receptacle (2) on the boom extension base section (3).

DANGER

When erecting the fly section, make sure that all personnel and equipment are kept clear of the swing path.

5. Remove the retaining clips (8) and pins (7) from stowage bracket (11) as necessary. Using the tag line, swing the fly section (4) around and engage the fly attachment fittings (5) with the base section anchor fittings (6).
6. Install the pins (7) into the fittings (5 and 6). Secure the pins with retaining clips (8).
7. (Optional) Install and connect the wind speed indicator and boom position light assembly on the end of the fly section. For more information, see *Anemometer/Boom Position Light (Optional)*, page 5-94.
8. Remove the tag line from the end of the fly section.
9. Reeve the hoist rope. For more information, see *Hoist Rope Reeving*, page 5-34.
10. Remove the anti-two block switch from the main boom nose. For more information, see *Anti-Two Block (A2B) Switch*, page 5-32. Install the anti-two block switch on the nose of the fly section. For more information, see *Anti-Two Block Switch on the Boom Extension*, page 5-80.



Stowing the Fly Section

Use the following procedure to stow the fly section on the boom extension base section.

NOTE: This procedure assumes the boom extension base section and fly section are erected.

1. Remove the anti-two block switch from the end of the fly section. For more information, see *Anti-Two Block Switch on the Boom Extension*, page 5-80.
2. Unreeve the hoist rope from the fly section sheave assembly and boom extension mast sheave assemblies. Install the anti-two block switch on the end of the boom extension base section. For more information, see *Anti-Two Block Switch on the Boom Extension*, page 5-80.
3. If installed, disconnect and remove wind speed indicator and boom position light assembly from the end of the fly section. For more information, see *Anemometer/Boom Position Light (Optional)*, page 5-94.
4. Attach a tag line (1, Figure 5-51) to the end of the fly section (2). This tag line will aid in swinging the fly section into position.



DANGER

When stowing the fly section, make sure that all personnel and equipment are kept clear of the swing path.

5. Remove two retaining clips (8, Figure 5-53) and pins (7).
6. Swing and stow the fly section on the boom extension base section.
7. Secure pins (7) and retaining clips (8) in stowage bracket (11).
8. Secure the locking bar (3, Figure 5-52) to the fly section (4) with pin (1) and retaining clip (2).
9. Disconnect the fly section electrical connection from base section receptacle (2, Figure 5-53). Connect the electrical connector to the stowage receptacle (1) on the fly section.
10. Remove the tag line from the end of the fly section.

Stowing the 17.8 m Boom Extension



DANGER

Boom Extension Hazard!

To avoid death or serious injury, follow procedures and cautions in the Operator and Safety Manuals and decals during erection, stowage and use of boom extension. Install and secure all pins properly and control boom extension movement at all times.



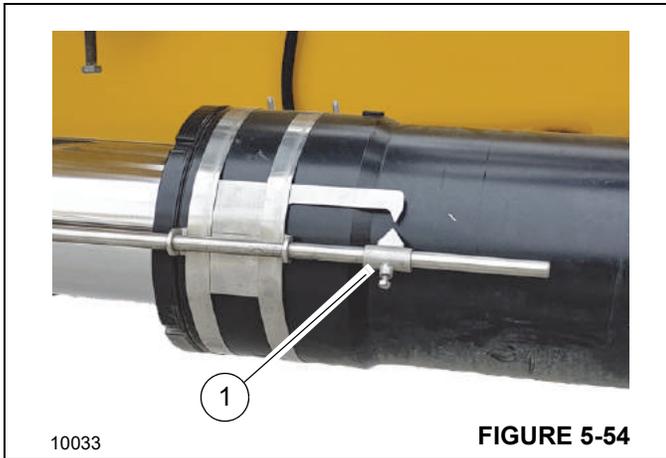
DANGER

To prevent serious injury or death, do not stand on crane decking unless boom extension is secure.

Use this procedure to stow the boom extension to the side of the main boom.

NOTE: This procedure assumes the fly section is stowed on the boom extension base section. For more information about stowing the fly section, see *Stowing the Fly Section*, page 5-65.

1. Make sure the crane is set up on fully extended outriggers. For more information, see *Using the Outriggers*, page 4-21.
2. Make sure the counterweight is installed. For more information about installing the counterweight, see *Counterweight Removal and Installation*, page 5-12.
3. Retract and lower the boom to horizontal.
4. If necessary, adjust the boom extension offset to 0° depending on the type of boom extension:
 - If stowing a mechanical boom extension, make sure the offset is set to 0°. For more information, see *Setting a Manual Offset Angle of 0°, 15°, 30°, or 50°*, page 5-79.
 - or
 - If stowing an optional hydraulic boom extension, make sure the angle indicator (1, Figure 5-54) is aligned. If the arrows are not aligned, adjust the boom extension offset as needed to align the arrows. For more information, see *Setting the (Optional) Hydraulic Boom Extension Offset*, page 5-80.

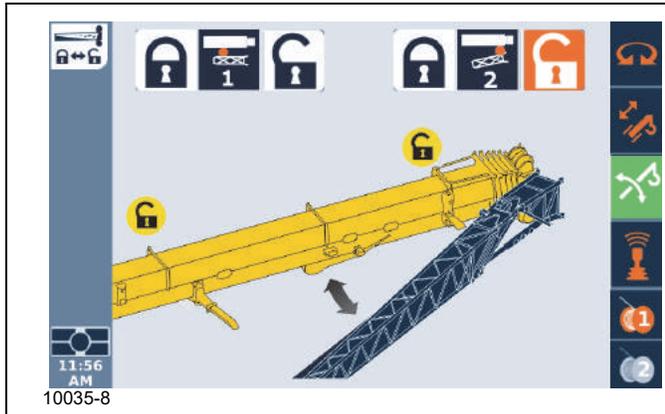


10033

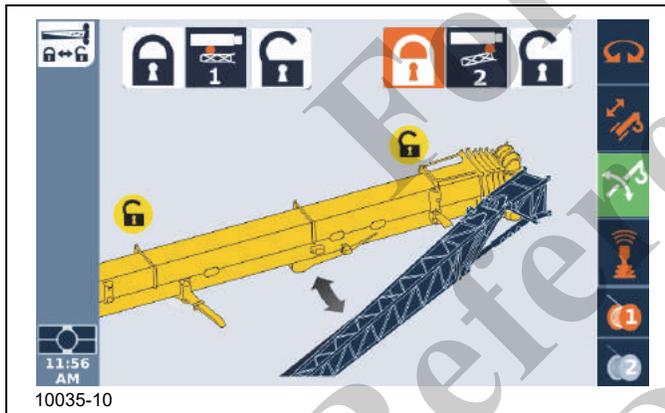
FIGURE 5-54

5. Unreeve the hoist rope as necessary from the boom extension base section mast sheaves. For more information, see *Unreeving Hoist Rope*, page 5-78.
 6. If necessary, stow the fly section. For more information, see *Stowing the Fly Section*, page 5-65.
 7. Remove the anti-two block switch from the end of the boom extension. For more information, see *Anti-Two Block Switch on the Boom Extension*, page 5-80. Install the anti-two block switch on the main boom nose. For more information, see *Anti-Two Block (A2B) Switch*, page 5-32.
 8. Stow the rear mast assembly as follows:
 - a. Hold the handle (1, Figure 5-49) and remove the retaining clip (2) and pin (3).
 - b. Lower the mast (4). Make sure the connecting point holes are aligned.
 - c. Insert Pin (3). Secure the pin with retaining clip (2).
 9. Stow the front mast assembly as follows:
 - a. Hold the handle (1, Figure 5-50) of the mast sheave assembly. Remove retaining clip (3) and pin (4).
 - b. Lower the mast assembly (2) until the connecting holes are aligned.
 - c. Insert pin (4) and secure with retaining clip (3).
 10. Attach a tag line (1, Figure 5-38) to the end of the boom extension base section (2).
-
- 
DANGER
Boom Extension Hazard!
- The boom extension installation pins (4, Figure 5-41) must be extended and engaged before removing the four pins (5, Figure 5-41). If the boom extension installation pins (4, Figure 5-41) are not extended and fully engaged, the boom extension will fall when pins (5, Figure 5-41) are removed, resulting in possible injury or death.
-
11. Make sure the boom extension installation pins (4, Figure 5-41) are engaged.
-
- 
CAUTION
- After removing the four retaining clips and pins, the boom extension is free to swing to the side of the main boom.
-
12. Remove the four pins (5, Figure 5-41) and retaining clips (6) that attach the boom extension base section to the boom nose. If necessary, remove the upper (7) and lower (8) hoist rope rods and retaining clips (9) to install the pins (5). Store the pins (5) and retaining clips (6) on the boom extension stowage bracket.
-
- 
DANGER
- When stowing the boom extension, make sure that all personnel and equipment are kept clear of the swing path.
-
13. Swing the boom extension to the intermediate position on the side of the base section of the boom. Make sure the wheels engage on the front (Figure 5-46) and rear (Figure 5-47) boom extension ramps.
 14. Move the boom extension in the against the main boom so the front boom extension pin (Pin #2) can be secured.

15. From the operator cab or with the remote control, lock the front boom extension pin (Pin #2) as follows:



- a. Use the ODM control pad arrow buttons or jog dial to highlight the Pin #2 lock icon.
The lock icon highlights (orange).



- b. Press and hold the OK on the ODM control pad or press down on the jog dial.
Pin #2 is extended. The pin status indicator icon turns green when the pin is fully extended and the boom extension is displayed in the intermediate installation position.

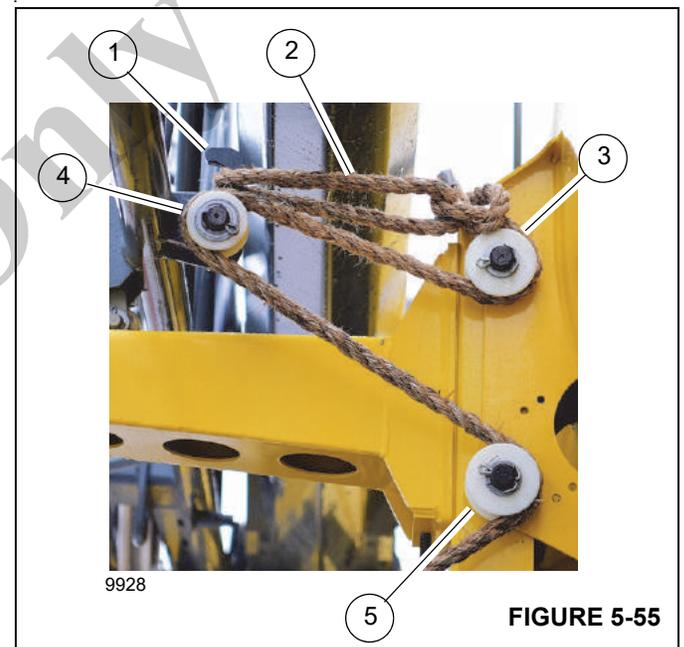


16. Make sure the ODM shows that the front mounting pin (Pin #2) is extended. Visually confirm that the front mounting pin is securely installed. Lock the handle (1, Figure 5-39) with pin (2).

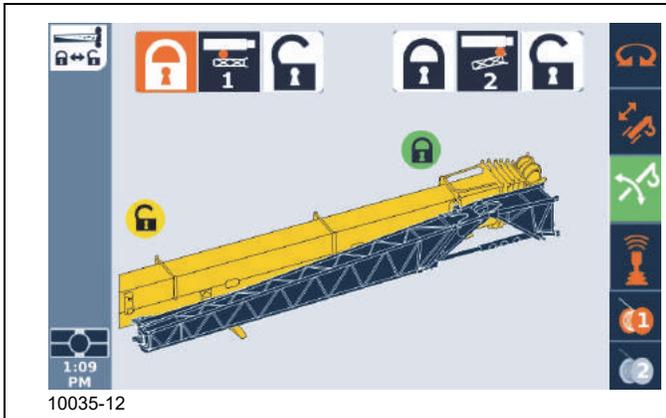
DANGER
Crush Hazard

To avoid death or serious injury, make sure the front mounting pin (Pin #2) is installed and the handle (1, Figure 5-39) is locked prior to retracting the boom extension installation pins (4, Figure 5-41).

17. Turn the jack screw (3, Figure 5-41) clockwise with the impact wrench, extension, and 14 mm impact socket to retract the boom extension installation pins (4) from the boom nose.
18. Secure the boom extension to the side of the main boom using a tag line as follows:
- Loop a tag line rope (2, Figure 5-55) over hook (1).
 - Reeve the tag line on sheaves (3, 4, 5) as shown.
 - Pull the tag line to secure the boom extension in the fully stowed position. Use the tag line as necessary to adjust the position of the boom extension to extend Pin #1.



19. In the ODM, highlight the lock icon and the extend the rear boom extension pin (Pin #1) as follows:



- a. Use the ODM control pad arrow buttons or jog dial to highlight lock icon.

The lock icon highlights (orange).

- b. Press and hold the OK on the ODM control pad or press down on the jog dial.

The lock status indicator icon turns green, indicating the pin is extended. The boom extension is displayed as secured to the main boom.



20. Visually verify that the rear mounting pin is securely installed.
21. Unreeve and remove tag line (2, Figure 5-55).
22. Attach the fly section to the stowage bracket (3, Figure 5-47) with pin (1) and retaining clip (2). Insert pin (4) and secure with retaining clip (3).
23. Disconnect boom extension electrical connections. For more information, see *Boom Extension and Lattice Insert Electrical Connections*, page 5-73.

24. If stowing a hydraulic boom extension, disconnect hydraulic hoses. For more information, see *Hydraulic Boom Extension Connections*, page 5-74.

Erecting the 10.9 m Boom Extension Base Section Only



DANGER

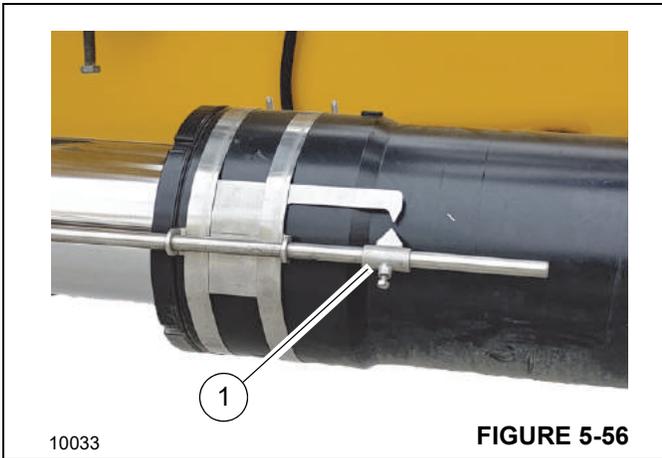
Boom Extension Hazard!

To avoid death or serious injury, follow procedures and cautions in the Operator and Safety Manuals and decals during erection, stowage and use of boom extension. Install and secure all pins properly and control boom extension movement at all times.

Use the following procedure to erect the boom extension base section. During this procedure, the boom extension base section is decoupled from the fly section and attached to the boom nose. The fly section remains attached to the side of the main boom. In the ODM, Pin #1 will be shown as locked.

NOTE: This procedure assumes the boom extension and fly section are installed on the side of the main boom.

1. Make sure the counterweight is installed. For more information about installing the counterweight, see *Counterweight Removal and Installation*, page 5-12.
1. Make sure the crane is set up on fully extended outriggers. For more information, see *Using the Outriggers*, page 4-21.
2. Retract and lower the boom to horizontal.
3. Connect boom extension electrical connectors. For more information, see *Boom Extension and Lattice Insert Electrical Connections*, page 5-73.
4. If erecting a hydraulic boom extension, connect hydraulic hoses. For more information, see *Hydraulic Boom Extension Connections*, page 5-74.
5. If erecting an optional hydraulic boom extension, make sure the angle indicator (1, Figure 5-56) is aligned. If the arrows are not aligned, adjust the boom extension offset as needed to align the arrows. For more information, see *Setting the (Optional) Hydraulic Boom Extension Offset*, page 5-80.



6. In the ODM, verify that the front (Pin #2) and rear (Pin #1) boom extension pins are securely installed. Visually confirm that the pins are installed.



7. Tie a tag line (1, Figure 5-38) to the end of the boom extension base section (2). The tag line will assist when swinging the boom extension to the boom nose.
8. Remove the retaining clip (1, Figure 5-52) and pin (2) from the boom extension fly section (4). Remove the locking bar (3) from the boom extension fly section (4). Rotate the locking bar (3) and store the clip and pin in retaining bracket (5) on the boom extension base section (6).
9. Remove pin (1, Figure 5-46) and retaining clip (2) and deploy the rear boom extension ramp (3). Insert pin and retaining clip to secure the ramp.
10. Visually confirm the rear boom extension pin (Pin #1 in the ODM) (2, Figure 5-32) properly secures the fly section to the main boom. Visually confirm the fly section is securely stowed on the fly section stowage bracket (3, Figure 5-47).

CAUTION

After removing the four retaining clips and pins, the boom extension is free to swing to the side of the main boom.

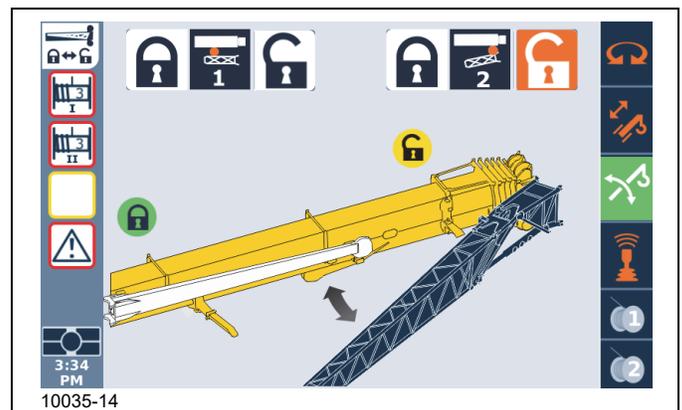
11. Remove retaining clips (9, Figure 5-53) and pins (10) to decouple the boom extension base section from the fly section.
12. Using the tag line, swing the boom extension out on the rear ramp to the intermediate position so the boom extension anchor fittings (1, Figure 5-41) engage with the main boom attachment fittings (2).
13. Align the holes for the boom installation pins. With an impact wrench and extension, turn the jack screw (3) extend the boom installation pins (4) into the boom nose attachment fittings (2). The jack screw drive will bottom out when the pins are fully engaged. Visually confirm that the pins (4) are fully engaged.

DANGER

Crush Hazard

To avoid death or serious injury, make sure boom extension installation pins (4, Figure 5-41) are installed prior to retracting the front mounting pin (Pin #2).

14. In the ODM, highlight the front boom extension pin (Pin #2) unlock icon and retract Pin #2 as follows:
 - a. Use the ODM control pad arrow buttons or jog dial to highlight unlock icon. The unlock icon is highlighted (orange).
 - b. Press and hold the OK on the ODM control pad or press down on the jog dial. The lock status indicator icon turns yellow, indicating Pin #2 is retracted.



15. Visually confirm that the front boom extension pin (Pin #2 in the ODM) is unlocked. The boom extension interlock handle should be in the down position. When the handle is in the down position, the front mounting pin is retracted and the boom installation pins are locked.

NOTE: The front mounting pin (Pin #2) will not unlock unless the right side boom extension installation pins are fully engaged. If the front mounting pin does not unlock, make sure the right side boom extension pins are fully engaged and the cable ends are inserted through the pins.

! DANGER

When erecting the boom extension, make sure that all personnel and equipment are kept clear of the swing path.

16. Using the tag line, swing the boom extension to the front of the main boom. Align the boom extension anchor fittings (1) with the main boom attachment fittings (2).

17. Install four pins (5, Figure 5-41) and retaining clips (6) to secure the boom extension to the boom nose. If necessary, remove the upper (7) and lower (8) hoist rope rods and retaining clips (9) to install the pins (5). Use the jack (1, Figure 5-57) as necessary to install the fourth pin as necessary as follows:

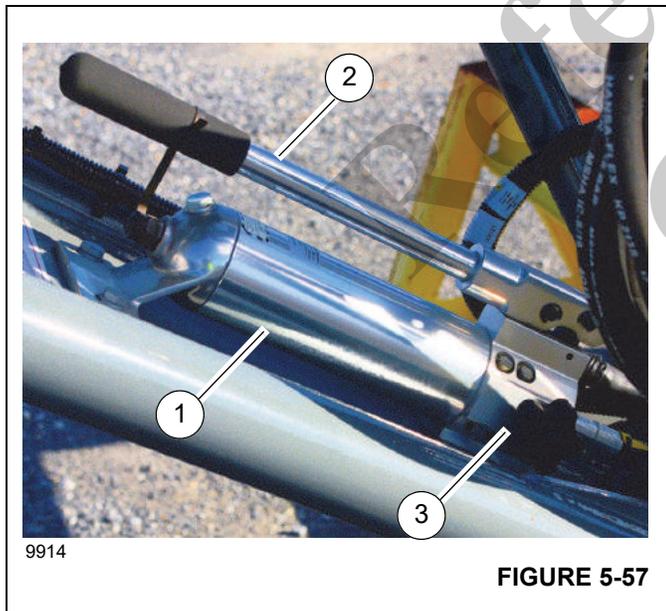


FIGURE 5-57

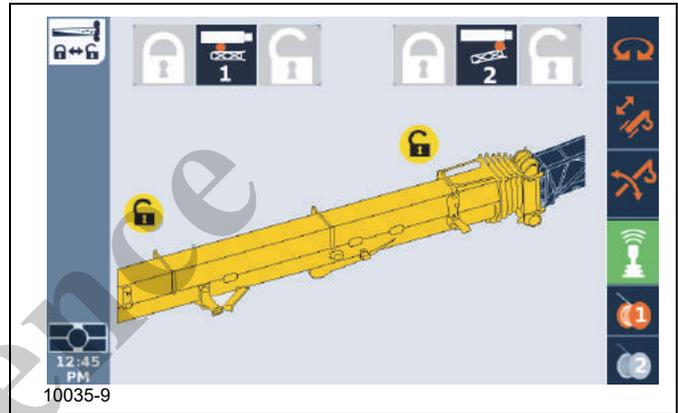
- a. Install three pins to attach the boom extension to the boom nose.
- b. Operate the jack handle (2) to align the holes on the boom extension with the hole in the boom nose.
- c. Install the fourth pin. Secure the fourth pin with retaining clip.

CAUTION

After installing the fourth pin, turn the pressure relief nob (3) to retract the jack so the jack does not contact the boom nose. Failure to retract the jack could result in damage to the boom extension jack.

- d. Turn the nob (3) to relieve the pressure to retract the jack pin.

18. In the ODM, make sure the ODM shows that the boom extension is deployed.



19. Connect boom extension electrical connectors. For more information, see *Boom Extension and Lattice Insert Electrical Connections*, page 5-73.

20. If erecting a hydraulic boom extension, connect hydraulic hoses. For more information, see *Hydraulic Boom Extension Connections*, page 5-74.

21. Raise the rear mast sheave assembly as follows:

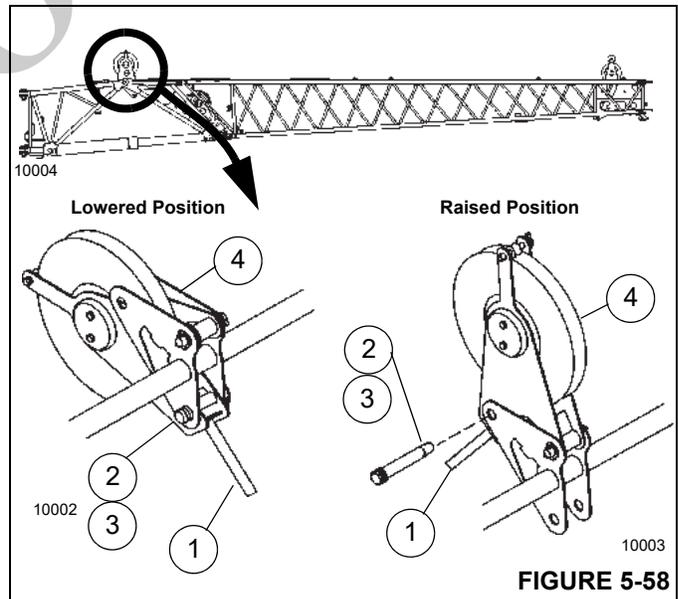
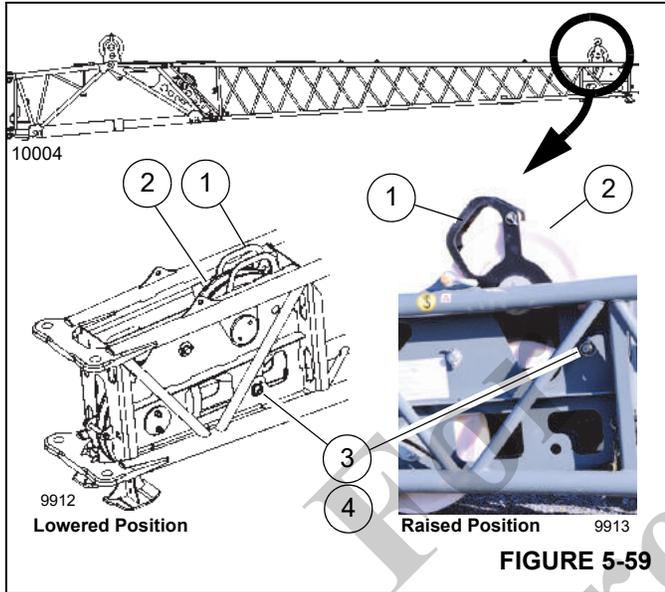


FIGURE 5-58

- a. Hold the handle (1, Figure 5-58) and remove the retaining clip (2) and pin (3).
- b. Raise the mast (4). Make sure the connecting point holes are aligned.
- c. Insert Pin (3). Secure the pin with retaining clip (2).

22. Raise the front mast assembly as follows:



- a. Hold the handle (1, Figure 5-59) of the mast sheave assembly (2). Remove retaining clip (3) and pin (4).
- b. Raise the mast assembly (2) until the connecting holes are aligned.
- c. Insert pin (4) and secure with retaining clip (3).

23. Reeve the hoist rope. For more information, see *Reeving the Hoist Rope*, page 5-78.
24. Remove the anti-two block switch from the main boom nose. For more information, see *Anti-Two Block (A2B) Switch*, page 5-32. Install anti-two block switch on the end of the boom extension. For more information, see *Anti-Two Block Switch on the Boom Extension*, page 5-80.
25. (Optional) Install the anemometer and boom position light assembly. For more information, see *Anemometer/ Boom Position Light (Optional)*, page 5-94.

Stowing the 10.9 m Boom Extension Base Section Only

! DANGER

Boom Extension Hazard!

To avoid death or serious injury, follow procedures and cautions in the Operator and Safety Manuals and decals during erection, stowage and use of boom extension. Install and secure all pins properly and control boom extension movement at all times.

Use the following procedure to stow the boom extension base section to the side of the main boom.

NOTE: This procedure the assumes only the boom extension base section is deployed and the fly section is secured to the side of the main boom.

NOTE: The boom extension base section cannot be stowed if the fly section is not first stowed on the side of the main boom.

1. Make sure the crane is set up on fully extended outriggers. For more information, see *Using the Outriggers*, page 4-21.
2. Make sure the counterweight is installed. For more information about installing the counterweight, see *Counterweight Removal and Installation*, page 5-12.
3. Retract and lower the boom to horizontal.
4. (Optional) Remove the anemometer and boom position light assembly. For more information, see *Anemometer/ Boom Position Light (Optional)*, page 5-94.
5. Remove the anti-two block switch from the end of the boom extension. For more information, see *Anti-Two Block Switch on the Boom Extension*, page 5-80. Install the anti-two block switch on the main boom nose. For more information, see *Anti-Two Block (A2B) Switch*, page 5-32.
6. Remove the hoist rope from the boom extension base section sheaves. For more information, see *Reeving the Hoist Rope*, page 5-78.
7. If necessary, adjust the boom extension offset to 0° depending on the type of boom extension:
 - If stowing a mechanical boom extension, make sure the offset is set to 0°. For more information, see *Setting a Manual Offset Angle of 0°, 15°, 30°, or 50°*, page 5-79.
 - or
 - If stowing an optional hydraulic boom extension, make sure the angle indicator (1, Figure 5-60) is aligned. If the arrows are not aligned, adjust the

boom extension offset as needed to align the arrows. For more information, see *Setting the (Optional) Hydraulic Boom Extension Offset*, page 5-80.

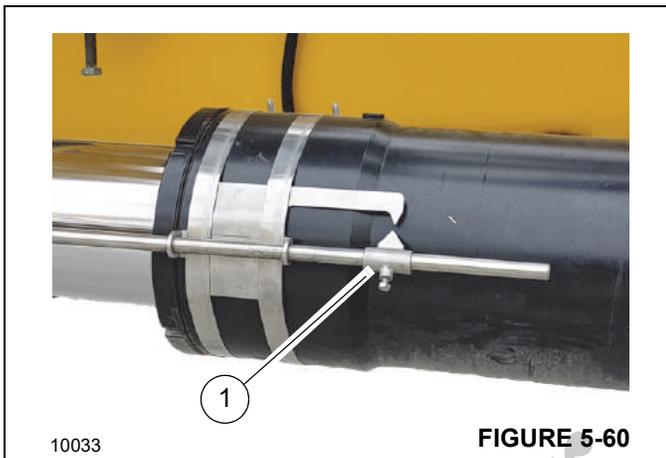


FIGURE 5-60

8. Stow the rear mast assembly as follows:
 - a. Hold the handle (1, Figure 5-58) and remove the retaining clip (2) and pin (3).
 - b. Lower the mast (4). Make sure the connecting point holes are aligned.
 - c. Insert pin (3). Secure the pin with retaining clip (2).
9. Stow the front mast assembly as follows:
 - a. Hold the handle (1, Figure 5-59) of the mast sheave assembly. Remove retaining clip (3) and pin (4).
 - b. Lower the mast assembly (2) until the connecting holes are aligned.
 - c. Insert pin (4) and secure with retaining clip (3).
10. Attach a tag line (1, Figure 5-38) to the end of the boom extension base section (2).

! DANGER

Boom Extension Hazard!

The boom extension installation pins (4, Figure 5-41) must be extended and engaged before removing the four pins (5, Figure 5-41). If the boom extension installation pins (4, Figure 5-41) are not extended and fully engaged, the boom extension will fall when pins (5, Figure 5-41) are removed, resulting in possible injury or death.

11. Make sure the boom extension installation pins (4, Figure 5-41) are engaged.

! CAUTION

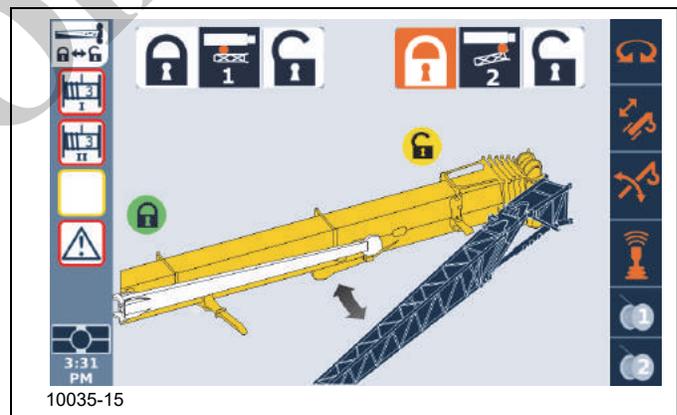
After removing the four retaining clips and pins, the boom extension is free to swing to the side of the main boom.

12. Remove the four pins (5, Figure 5-41) and retaining clips (6) that attach the boom extension base section to the boom nose. If necessary, remove the upper (7) and lower (8) hoist rope rods and retaining clips (9) to install the pins (5). Store the pins (5) and retaining clips (6) on the boom extension stowage bracket.

! DANGER

When erecting the boom extension, make sure that all personnel and equipment are kept clear of the swing path.

13. Swing the boom extension to the intermediate position on the side of the base section of the boom. Make sure the wheels engage on the front and rear boom extension ramps.
14. From the operator cab, lock the front mounting pin (Pin #2 in the ODM) as follows:
 - a. Use the ODM navigation pad arrow buttons or jog dial to highlight the Pin #2 lock icon. The lock icon is highlighted (orange).



- b. Press and hold the OK on the ODM navigation pad or press down on the jog dial.

When front extension pin is locked, the status indicator show a green lock icon.



15. Visually confirm that the front boom extension pin (Pin #2 in the ODM) is locked. The handle should be in the up position. When the handle is in the up position, the front mounting pin is extended and the boom installation pins are unlocked. Lock the handle (1, Figure 5-39) with pin (2).

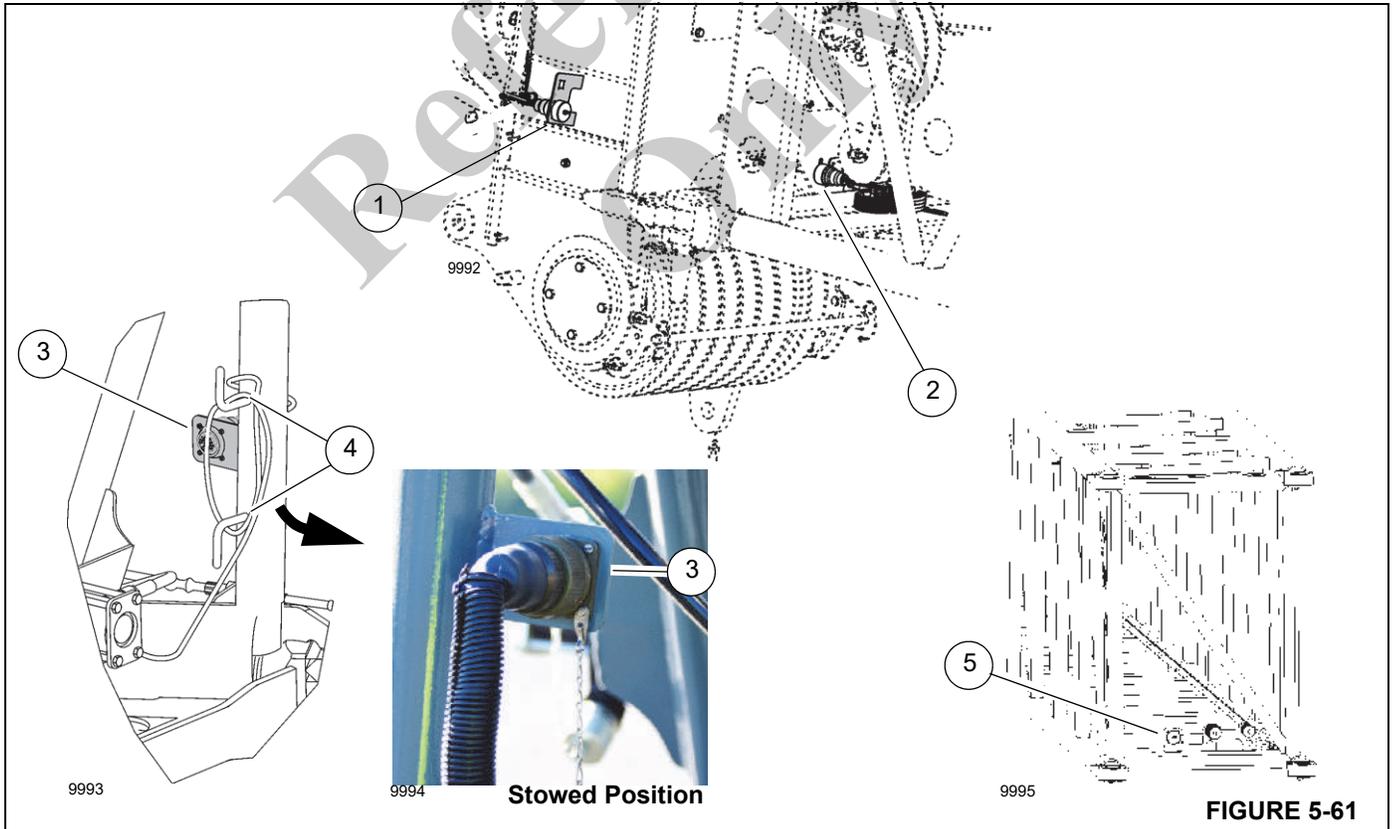
- 16. Turn the jack screw (3, Figure 5-41) with the impact wrench and extension to retract the boom extension installation pins (4) from the boom nose.
- 17. Move the boom extension to the fully stowed position.
- 18. Install pins and retaining clips (9 and 10, Figure 5-53) to attach the boom extension base section to the fly section.
- 19. Secure the locking bar (3, Figure 5-52) to the fly section (4) with pin (1) and retaining clip (2).
- 20. Disconnect electrical connections. For more information, see *Boom Extension and Lattice Insert Electrical Connections*, page 5-73.
- 21. If stowing a hydraulic boom extension, disconnect hydraulic connections. For more information, see *Hydraulic Boom Extension Connections*, page 5-74.

Boom Extension and Lattice Insert Electrical Connections

Figure 5-61 shows the boom extension electrical connector (1) on the main boom. Use the following procedures to disconnect and connect the boom extension, heavy duty boom extension, or lattice insert electrical connections to the main boom.

DANGER Crush Hazard

To avoid death or serious injury, make sure the front mounting pin (Pin #2) is installed and the handle (1, Figure 5-39) is locked prior to retracting the boom extension installation pins (4, Figure 5-41).



Connecting Electrical Connection to Main Boom

Use the following procedure to connect the boom extension, heavy duty boom extension, or lattice insert electrical connector to the main boom.

1. Disconnect the boom extension connector from the stowage bracket (3, Figure 5-61) receptacle.
2. Unwrap excess wire length from the stowage hooks (4) as necessary.
3. Connect the boom extension, heavy duty boom extension, or lattice insert electrical connector (2) to the electrical connector on the main boom (1).

Disconnecting Electrical Connection from Main Boom

Use the following procedure to disconnect the boom extension, heavy duty boom extension, or lattice insert electrical connector (2, Figure 5-61) from the electrical connector on the main boom. Be sure to stow the boom extension, heavy duty boom extension, or lattice insert electrical connector on the stowage bracket (3) to prevent water damage to the connector (2).

1. Disconnect the boom extension, heavy duty boom extension, or lattice insert electrical connector (2) from the electrical connector on the main boom (1).
2. Connect the boom extension connector to the receptacle on the stowage bracket (3).
3. Wrap excess wire length on the stowage hooks (4).
4. Install protective cap on main boom electrical connector (1).

Connecting Electrical Connection to Lattice Insert

Use the following procedure to connect the boom extension electrical connection to the lattice insert. For more information about connecting the boom extension to the lattice insert, see *Installing the Boom Extension on the Lattice Insert*, page 5-89.

1. Install the boom extension on the lattice insert. For more information, see *Installing the Boom Extension on the Lattice Insert*, page 5-89.
2. Remove the boom extension connector from the stowage bracket (3, Figure 5-61) receptacle. Install the protective cap on the receptacle to prevent water damage. Unwrap the wire from the hooks (4) as necessary.
3. Remove protective cap from the lattice insert electrical socket (5).

4. Connect the boom extension electrical connector (3) to the electrical socket (5) on the lattice insert. Route the wire so it does not interfere with crane operation. Store excess wire on the hooks (4) on the boom extension as necessary.

Disconnecting Electrical Connection from Lattice Insert

Use the following procedure to disconnect the boom extension electrical connection from the lattice insert.

1. Disconnect the boom extension electrical connector (2, Figure 5-61) from the lattice insert socket (5).
2. Install protective cap on lattice insert socket (5) to prevent water damage.
3. Remove the protective cap from the stowage bracket (3) on the boom extension.
4. Connect the boom extension electrical connector (2) to the stowage bracket (3).
5. Wrap excess wire on the hooks (4) as necessary.

Hydraulic Boom Extension Connections

Use the following procedures to connect and disconnect the optional hydraulic boom extension to the main boom. Disconnect and retract the hydraulic lines from the boom nose whenever the operation of the crane does not require hydraulic power. This will extend the life of the hose drum, hoses, and associated hardware. For more information, see *Retracting Hydraulic Hoses for Main Boom Operation*, page 5-77.

Checking the Locking Device on the Hose Drum

The hose drum on the side of the main boom provides the hydraulic supply to the boom nose hydraulic boom extension. The hose drum is equipped with a locking device. The drum must be unlocked before operation.

If the hose drum must be removed, the drum must be locked. For more information about removing the hose drum, see the *Service Manual*.

CAUTION

Equipment Damage Hazard!

Always verify the drum is unlocked before using extensions or other equipment that require hydraulic power. Damage to hydraulic hoses or the boom may occur.

**CAUTION****Spring Loaded Equipment Hazard!**

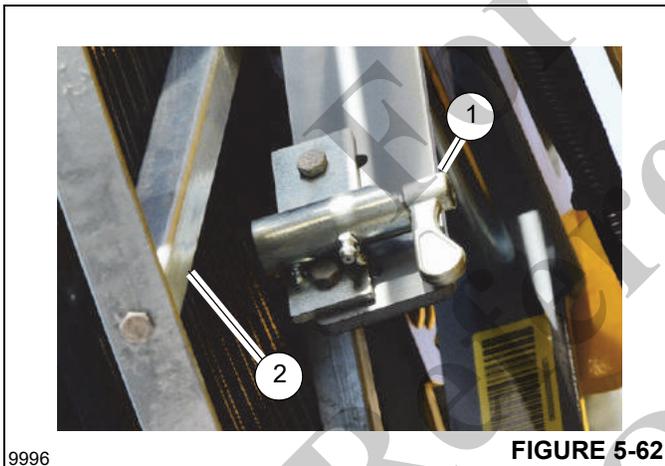
The drum must be locked before removal. The drum is spring loaded and must be locked to prevent damage or injury.

Unlocking the Drum

Rotate the latch (1, Figure 5-62) clockwise to disengage it from hose drum strut (2).

Locking the Drum

1. Turn the hose drum until a strut is near the latch (1).
2. Rotate the latch (1) counterclockwise and then allow the hose drum to slowly rotate until the latch engages the strut (2).



9996

FIGURE 5-62**DANGER****Spring Loaded Equipment Hazard!**

If the strain relief bracket (9, Figure 5-63) is detached after the locking device has been released, do not under any circumstances let go of the strain relief bracket before it has been re-attached. If you let go of the strain relief bracket, the hydraulic hoses will spring back uncontrollably due to the spring force in the hose drum and may injure persons or damage parts of the crane.

Extending Hoses for Hydraulic Boom Extension Operation

Use the following procedure to extend the hydraulic hoses to connect to the (optional) hydraulic boom extension or lattice insert.

NOTE: This procedure assumes the (optional) hydraulic boom extension or lattice insert is installed to the boom nose and the hose end bracket is stowed on the base section.

1. Disengage the latch (1, Figure 5-63) to unlock the hose drum (2).
2. Remove the retaining clips (3) from pins (4) and hose end bracket (5) from the boom base section stowage bracket (6).
3. Remove the pins (7) and fold up the guide sheaves (8).
4. Remove the strain relief bracket (9) from its boom base section mounting bracket (10) and pull the hydraulic hoses (11) towards the boom nose.
5. Hook the strain relief bracket (9) onto the boom nose mounting bracket (12).
6. Install the hose end bracket (5) on the boom nose stowage bracket (13) with retaining clips (3).
7. Fold down the guide sheaves (8) and secure them with the pins (7).

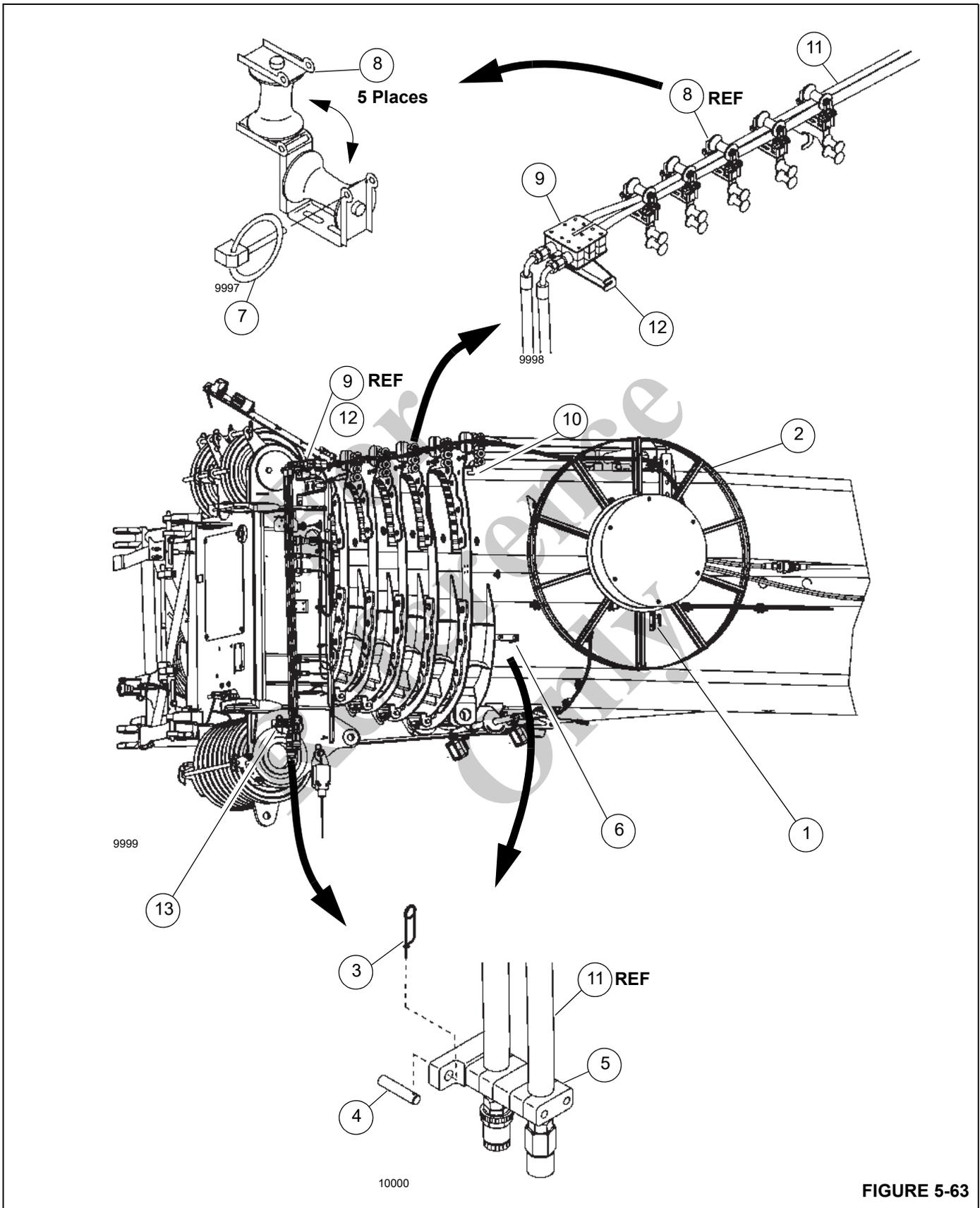


FIGURE 5-63

Retracting Hydraulic Hoses for Main Boom Operation

Use the following procedure to retract the hydraulic hoses on the drum for main boom operation.

NOTE: This procedure assumes the hydraulic hoses are disconnected from the optional hydraulic boom extension or lattice insert.

1. Make sure the locking device is unlocked (1, Figure 5-63) and the hose drum (2) can rotate.
2. Remove pins (7) and fold up the guide sheaves (8).
3. Remove retaining clips (3) from pins (4) and hose end bracket (5) from boom nose stowage bracket (13).
4. Detach the strain relief bracket (9) from the boom nose mounting bracket (12) and attach it to the boom base section mounting bracket (10).
5. Install hose end bracket (5) on boom base section stowage bracket (6). Secure with retaining clips (3).
6. Fold down the guide sheaves (8) and secure them with the pins (7).
7. Lock (1) the hose drum (2).

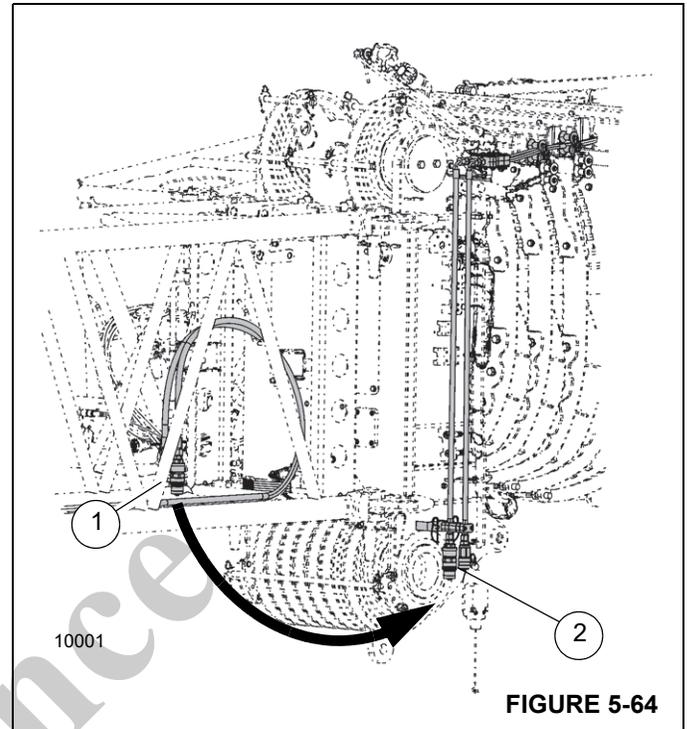


FIGURE 5-64

Connecting the Hydraulic Hoses for Operation

Use this procedure to connect the hydraulic hoses from the (optional) hydraulic boom extension, heavy duty boom extension, or lattice insert to the hose drum hoses located on the boom nose.

1. If necessary, extend the hydraulic hoses on the boom nose. For more information, see *Extending Hoses for Hydraulic Boom Extension Operation*, page 5-75.
2. Remove the caps from the hydraulic hoses (1) on the boom extension or lattice insert.
3. Remove the caps from the hydraulic hoses (2) on the boom nose.
4. Connect the boom extension, heavy duty boom extension, or lattice insert hydraulic hoses (1) to the hose drum hydraulic hoses (2) on the boom nose. Turn the nut to secure the connections. When the couplers are fully connected, the coupler sleeve clicks into place.
5. Secure any excess hose on the hooks on boom extension, heavy duty boom extension, or lattice insert.

CAUTION!

Machine Damage!

Feed the hydraulic hoses under the main boom head in such a way that they hang freely. Take care that the hoses are not torn off when erecting or stowing the lattice insert extension. This prevents damage to the hydraulic hoses.

Disconnecting Hydraulic Hoses

Use this procedure to disconnect the hydraulic hoses on the (optional) hydraulic boom extension, heavy duty boom extension, or lattice insert from the hose drum hoses located on the boom nose.

1. Disconnect the hydraulic hoses (1, Figure 5-64) from the boom extension, heavy duty boom extension, or lattice insert from the hose drum hydraulic hoses (2) on the boom nose.
2. Install the protective caps on the hydraulic hoses (1, 2).
3. Store excess hose length on the hooks (3) on the boom extension, heavy duty boom extension, or lattice insert.

Reeving the Hoist Rope

Use the following to reeve the hoist rope on the mast sheave assemblies.

Reeving the Hoist Rope



CAUTION

Falling Objects Hazard!

Always make sure sheaves and pins that secure the hoist cable are secured with clips. This prevents components from coming loose, falling and causing injury.

1. Remove the retaining pin and roller (1, Figure 5-65).
2. Guide the rope over the mast sheaves (4), (3) and over the nose sheave (2) of the extension.
3. Reinstall all the retaining pin and roller (1) and secure with retaining clips.
4. Install the overhaul ball or the hook block.

Unreeving Hoist Rope

1. Unreeve the hook block or unpin the overhaul ball.
2. Remove the retaining pin and roller (1, Figure 5-65).
3. Take the hoist rope off the head sheave (2) and mast sheaves (4), (3) and place it on the ground on the left side.
4. Replace all retaining sheaves. Secure with retaining clips.

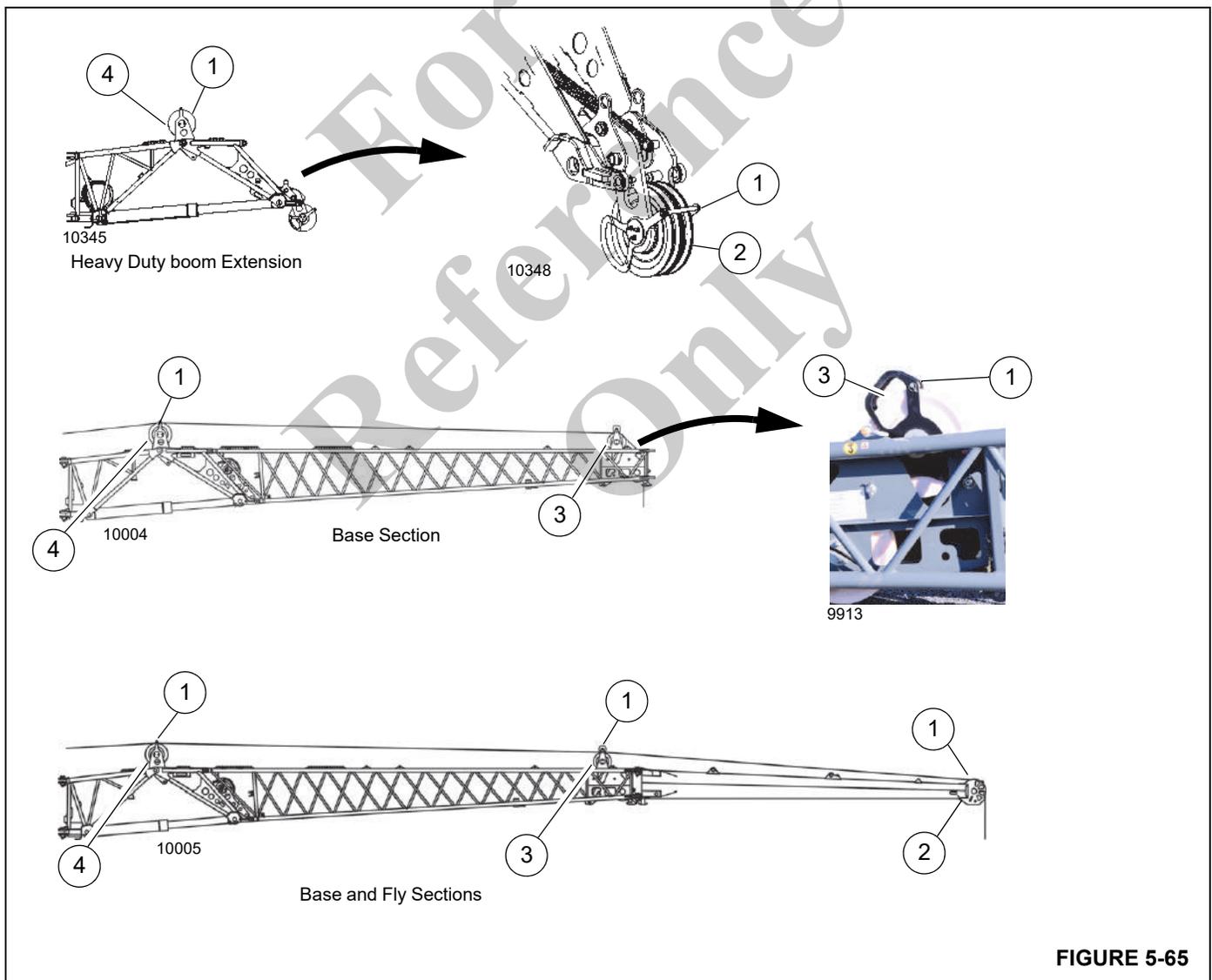


FIGURE 5-65

Offsetting the Boom Extension

The GRT9165 boom extension features manual offset or hydraulic offset. The standard boom extension can be offset manually to 0°, 15°, 30°, or 50°. The hydraulic boom extension can be offset from 0° to 50° and controlled from the operator cab.



WARNING

Crushing Hazard!

Always secure the adjustable boom extension with an auxiliary crane or set the nose of the extension on the ground before you remove the adjusting pins when adjusting the angle of the boom extension.

This prevents the extension from suddenly unfolding and causing serious injury or death.

CAUTION

Risk of Equipment Damage!

Always stow the mast sheave assemblies before adjusting the boom extension offset angle.

This will prevent any interference between the mast sheave assemblies and boom extension.

The boom extension can be set manually to the positions shown in Figure 5-66.

Setting the Offset Angle Mechanically with an Auxiliary Crane

If an auxiliary crane is available, the boom extension can be attached to a sling to set the angle. If an auxiliary crane is not available, refer to *Setting the Offset Angle Mechanically without an Auxiliary Crane*, page 5-79.

1. Lift the boom extension with the auxiliary crane until the pin is relieved of load. For more information about lifting positions, see *Lifting Points*, page 5-51
2. Lift or lower the extension with the auxiliary crane until the adjusting pin (1, Figure 5-66) can be installed into the position for the required angle.

3. Lower the boom extension with the auxiliary crane and remove the lifting gear.

Setting the Offset Angle Mechanically without an Auxiliary Crane

If an auxiliary crane is not available, the extension head must rest on the ground before the angle is changed.



WARNING

Tipping Hazard!

Always enter the RCL rigging code for the current rigging mode of the crane. Only rotate the superstructure into the working position permitted by the RCL rigging code set according to the *Load Chart*.

This prevents the crane from overturning when the main boom is extended.

The telescoping range which is enabled for the rigging code is only permissible for telescoping without a load and without hook block/hook tackle.

CAUTION

Risk of Damage to the Wire Rope!

Unreeve the hook block and lay the hoist rope beside the boom extension before you set the angle of the extension.

This prevents the rope from being damaged when the head of the boom extension is set on the ground.

Setting a Manual Offset Angle of 0°, 15°, 30°, or 50°

This section assumes that the manual offset extension is pinned on front of the main boom, the hook block or downhaul weight are removed, and the unreeved rope is laid beside the boom extension.

NOTE: No pin is required to set the 50° offset angle.

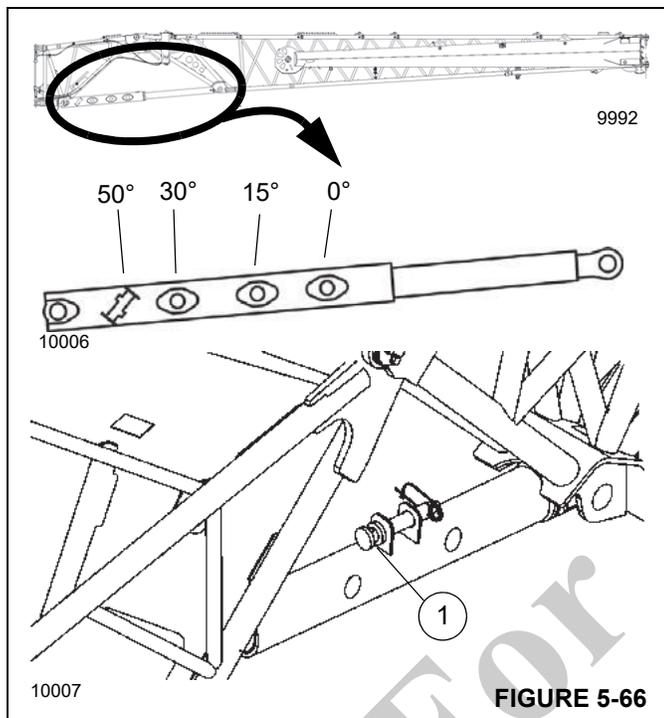


FIGURE 5-66

1. In the ODM, configure the crane for the offset angle to be used. The options are 0°, 15°, 30°, or 50°.
2. Stow the boom extension mast sheave assemblies.
3. Extend the main boom as necessary, or as far as possible given the space available.

! WARNING
Crushing Hazard!

If the extension is lowered onto timbers or some other structure to set the angle, keep in mind that as the extension is raised the extension head will slide towards the crane until the set angle is reached.

The extension could slip off an unsuitable structure, fold down and cause serious injury or death.

4. Set up timbers or other suitable structure for the extended boom nose. The boom extension nose be lowered on the timbers or structure.
5. Lower the main boom until the boom extension nose touches the timbers or structure.
6. Remove the offset pin (1, Figure 5-66). Lower the boom extension head on the timbers or structure as necessary to make it easier to remove the pin.
7. Insert the offset pin in the location of the angle required.
8. Raise the main boom slowly until the extension head no longer touches the timbers or structure.

9. Fully retract the main boom. While doing so, raise the boom as necessary so the head of the boom extension does not touch the ground.
10. Raise the boom extension mast sheave assemblies.
11. Reeve the hoist rope. For more information, see *Hoist Rope Reeving*, page 5-34.

Setting the (Optional) Hydraulic Boom Extension Offset

Use the following procedure to set the offset for the hydraulic boom extension and hydraulic heavy duty boom extension. The hydraulic boom extension offset range is 0° to 50°.

1. In the operator cab, enable the Luffing Boom Extension Enable/Disable Switch. For more information about the Luffing Boom Extension Enable/Disable Switch, see *Operator Seat and Armrest Controls (Dual Axis)*, page 3-24.
2. Using the right controller, raise or lower the hydraulic (luffing) boom extension. For more information about the Boom Lift – Main Hoist – Telescope – Luffing Boom Extension Controller (Dual Axis), see *Operator Seat and Armrest Controls (Dual Axis)*, page 3-24.

Anti-Two Block Switch on the Boom Extension

Use the following procedures to install and remove the anti-two block (A2B) switch from the boom extension base and fly sections.

Boom Extension Base Section

Use the following procedures to install and remove the anti-two block switch from the end of the boom extension base section. The anti-two block switch is installed on the right side of the nose of the boom extension base section. The A2B electrical cable is installed on the left side of the boom extension base section.

Installing the Anti-two Block Switch on the Boom Extension Base

1. Install the anti-two block switch (1, Figure 5-67) on bracket (2) on the right side of the boom extension base section. Secure switch with retaining clip (3).
2. Remove the protective cap from the electrical socket (4). Connect the electrical plug in socket (4) on left side of the boom extension base section.
3. Be sure the anti-two block wire does not interfere with operation. Secure excess wire as necessary.
4. Remove safety pin (5). Install the anti-two block weight (6) around the hoist rope. Secure with safety pin (5).

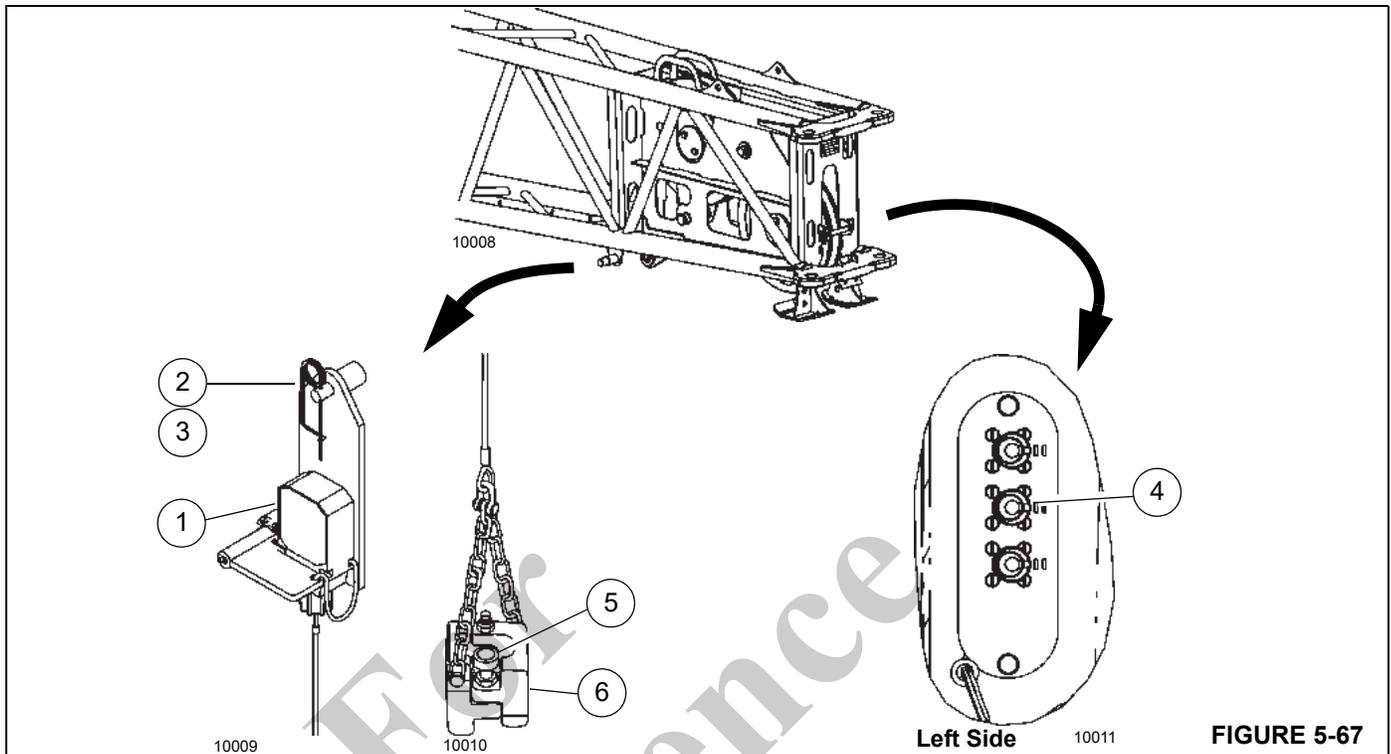


FIGURE 5-67

Removing the Anti-two Block Switch from the Boom Extension Base

1. Remove the safety pin (5) and remove switch weight (6) from the hoist rope.
2. Remove the electrical plug from the socket (4). Install the protective cap on the socket (4).
3. Remove retaining clip (3) and the anti-two block switch (1) from bracket (2).
4. Install the anti-two block switch (1) on the main boom nose.

Boom Extension Fly Section

Use the following procedures to install and remove the anti-two block switch from the end of the boom extension fly

section. The anti-two block switch can be installed on the left or right side of the nose of the fly section.

Installing the Anti-two Block Switch on the Fly Section

1. Install the anti-two block switch (1, Figure 5-68) on the bracket (2) on either side of the fly section nose. Secure with retaining clip (3).
2. Remove protective cap from the socket (4). Connect the switch electrical connector to the socket (4).
3. Secure excess wire on stowage hooks (5) as necessary.
4. Remove safety pin (6) and install anti-two block weight (7) around the hoist rope. Install the safety pin (6).

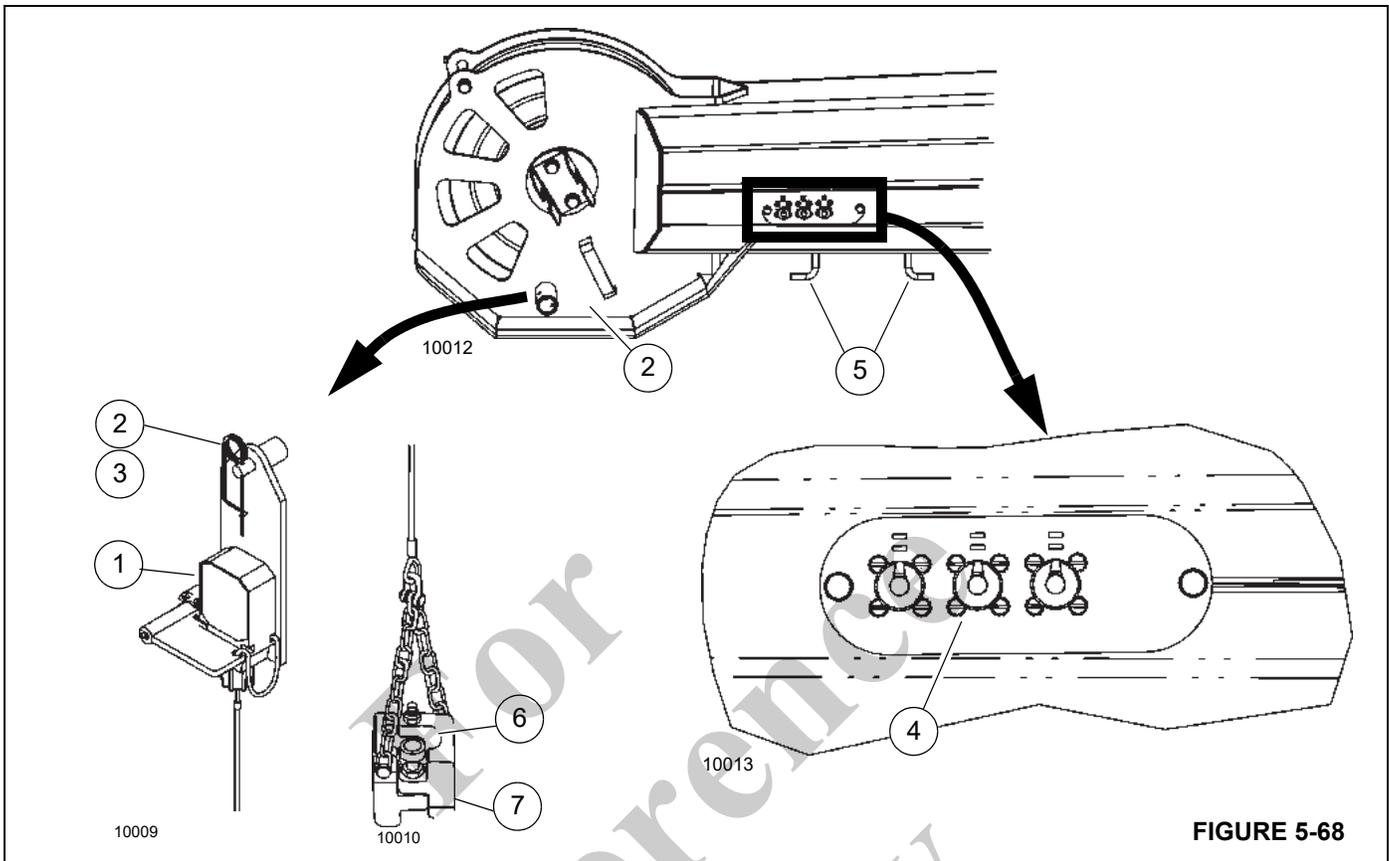


FIGURE 5-68

Removing the Anti-two Block Switch from the Fly Section

1. Remove safety pin (6, Figure 5-68) and switch weight (7) from hoist rope.
2. Remove electrical connector from socket (4).
3. Install protective cap on socket (4).
4. Remove retaining clip (3) and remove anti-two block switch (1) from bracket (2).
5. Install the anti-two block switch (1) on the main boom.

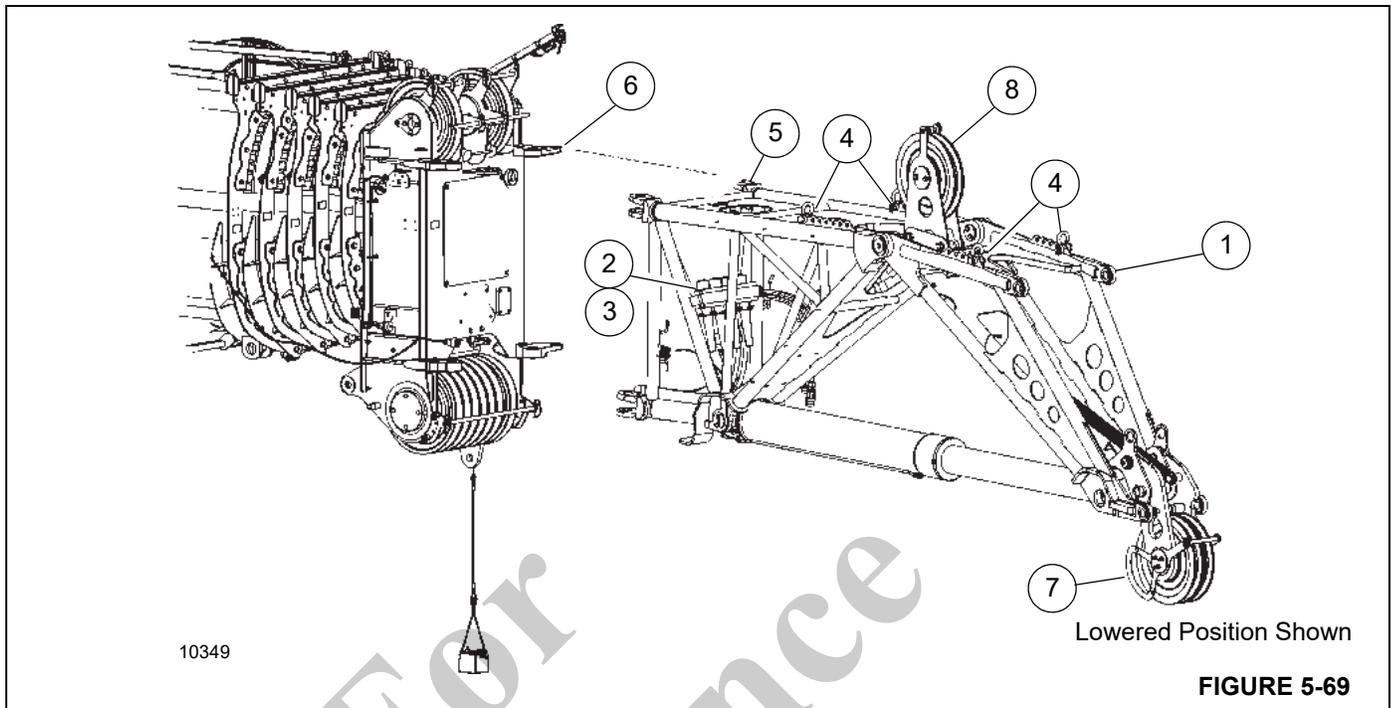


FIGURE 5-69

HEAVY DUTY HYDRAULIC BOOM EXTENSION (OPTIONAL)

A 3.9 m (13 ft) hydraulic off-settable heavy duty boom extension (1, Figure 5-69) provides additional boom reach designed for tilt-up panel operations. The extension weighs approximately 942 kg (2075 lb).

Installing the Heavy Duty Boom Extension



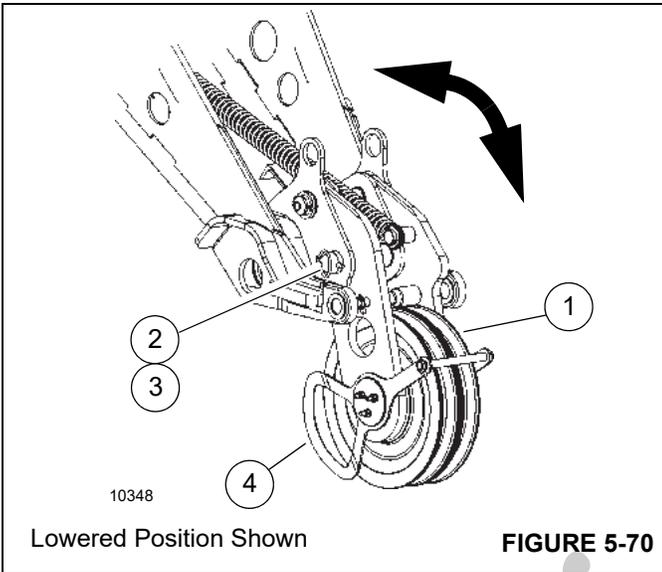
DANGER

Boom Extension Hazard!

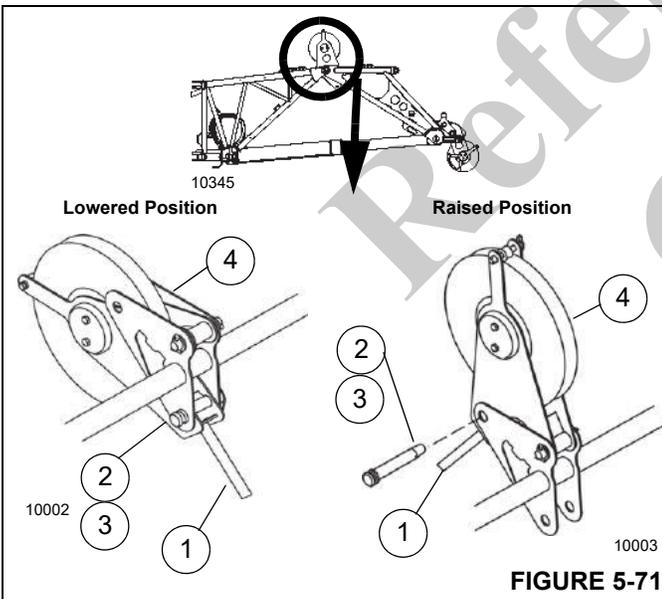
To avoid death or serious injury, follow procedures and cautions in the Operator and Safety Manuals and decals during erection, stowage and use of boom extension. Install and secure all pins properly and control boom extension movement at all times.

NOTE: The heavy duty boom extension cannot stowed on the side of the boom. Use an assist crane to install and remove the heavy duty boom extension on the boom nose.

1. Make sure the counterweight is installed. For more information about installing the counterweight, see *Counterweight Removal and Installation*, page 5-12.
2. Fully extend and set outriggers. For more information, see *Using the Outriggers*, page 4-21.
3. Position boom over front of crane.
4. Fully retract all boom sections.
5. Lower boom to the horizontal position.
6. Attach a tag line to the end of the heavy duty boom extension as necessary.
7. Remove attachment pins (2, Figure 5-69) and retaining clips (3) from the storage bracket on the heavy duty boom extension.
8. Attach a suitable lifting device to the clevises (4) on the heavy duty boom extension. Lift the heavy duty boom extension in front of the boom nose, aligning the boom extension anchor fittings (5) with boom attachment fittings (6).
9. Install attachment pins (2) in anchor fittings (5) and attachment fittings (6) of the boom nose. Install retaining clips (3) in attachment pins.
10. Lower the front sheave assembly (1, Figure 5-70) as follows:

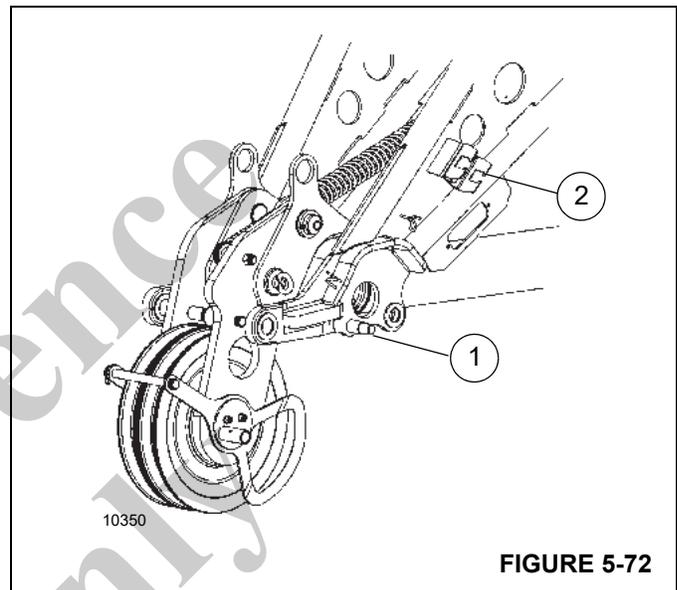


- a. Hold the handle (4) and remove retaining pin (2) and pins (3).
 - b. Swing the front sheave assembly (1) to the lowered position. Align the holes.
 - c. Install pin (3). Secure with retaining pin (2).
11. Raise the mast sheave assembly (4, Figure 5-71) as follows:



- a. Hold the handle (1) and remove the retaining clip (2) and pin (3).
- b. Raise the mast (4). Make sure the connecting point holes are aligned.
- c. Insert Pin (3). Secure the pin with retaining clip (2).

12. As required, reeve the main hoist or optional auxiliary hoist cable for single part through four parts of line. For more information, see *Reeving/Unreeving the Hoist Rope*, page 5-43.
13. Set up and install the boom extension hydraulic connections. For more information, see *Hydraulic Boom Extension Connections*, page 5-74.
14. Install and connect the Anti-two Block switch on the bracket (1, Figure 5-72) on the front of the heavy duty boom extension. For more information about the Anti-Two Block Switch, see *Anti-Two Block Switch on the Boom Extension*, page 5-80.



15. Install the anemometer and boom position light assembly on the bracket (2, Figure 5-72) on the heavy duty boom extension. For more information, see *Installing the Anemometer/Boom Position Light*, page 5-94.
16. Connect the boom extension electrical/RCL cables to the main boom. For more information, see *Boom Extension and Lattice Insert Electrical Connections*, page 5-73.

Possible Reeving Combinations

The heavy duty boom extension supports reevings up to four parts of line. Table 5-5 shows possible reevings combinations. Possible components used for reeving include:

- Anti-Two Block. For more information, see *Anti-Two Block (A2B) Switch*, page 5-32.
- Wedge Socket. For more information, see *Installing Wedge and Socket*, page 5-44.
- Overhaul Weight
- Overhaul Ball

- 1-Sheave Hook Block
- 3-Sheave Hook Block
- 5-Sheave Hook Block

The reeving configuration is entered in the RDM during set up. For more information, see *Selecting the Hoist and Entering the Reeving*, page 4-163.

Table 5-5 Heavy Duty Boom Extension Possible Reeving Combinations

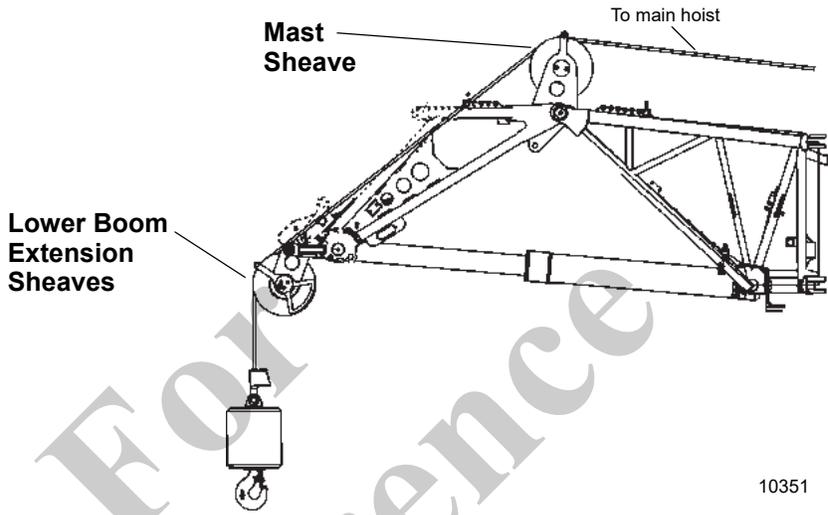
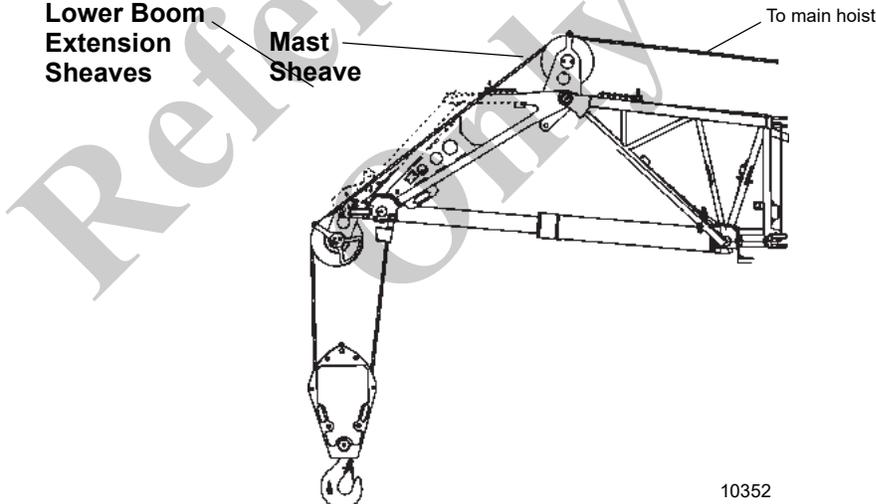
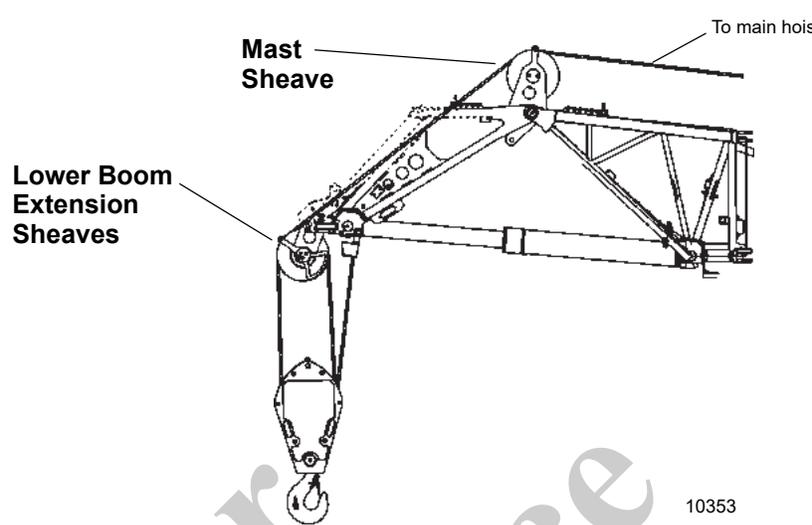
Line Part	Reference Drawing
<p>1 Line Part Overhaul Weight.</p>	 <p style="text-align: right;">10351</p>
<p>2 Line Parts 1-Sheave Hook block</p>	 <p style="text-align: right;">10352</p>

Table 5-5 Heavy Duty Boom Extension Possible Reeving Combinations (Continued)

Line Part	Reference Drawing
4 Line Parts 2- or more Sheave Hook Block	 <p style="text-align: right;">10353</p>

Offsetting the Heavy Duty Boom Extension Hydraulically

For more information about setting the offset of the hydraulic heavy duty boom extension, see *Setting the (Optional) Hydraulic Boom Extension Offset*, page 5-80.

Tilt-Up Panel Procedure Using the Heavy Duty Boom Extension

For more information, see *Tilt-Up Panel Lifting*, page 2-21, in the *Safety Information* section.

! DANGER

Death or serious injury may result if the permissible working loads and RCL programs are not observed.

Only lift loads weighing less than/or equal to the permissible load of the heavy duty boom extension in the appropriate working radius.

When possible, the load's center of gravity should move towards the crane (Figure 5-73, A & B).

Movement of the load during tilting shall be done such that the moment decreases.

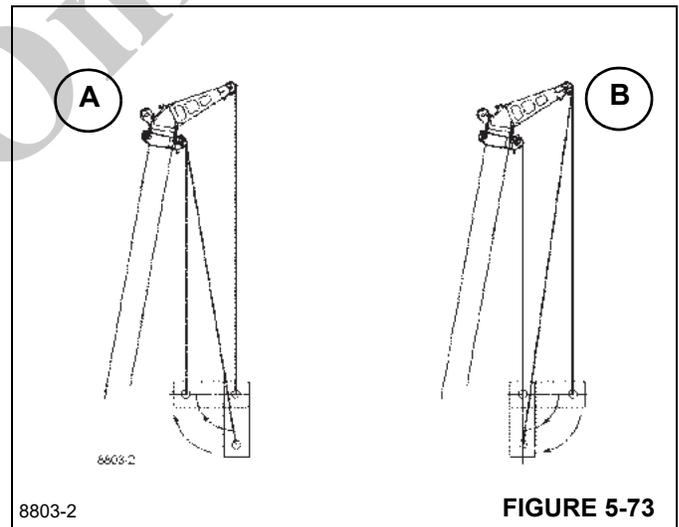
Tilting from Vertical to Horizontal

1. Lift the load on the heavy duty boom extension (Detail A).
2. The hoisting rope on the main boom remains unloaded at first but the rope must not become slack. Then lift the

load via the main boom until the load is horizontal. Then lower the load uniformly using the two hoists.

Tilting from Horizontal to Vertical

1. Lift the load horizontally using the two hoists (Detail B).
2. Slacken the lifting rope of the boom extension until the load is suspended vertically. Lower the load via the main boom and pay-out the lifting rope of the boom extension. Ensure that the rope does not have slack.



Removing the Heavy Duty Boom Extension



DANGER

Boom Extension Hazard!

To avoid death or serious injury, follow procedures and cautions in the Operator and Safety Manuals and decals during erection, stowage and use of boom extension. Install and secure all pins properly and control boom extension movement at all times.

NOTE: The heavy duty boom extension cannot stowed on the side of the boom. Use an assist crane to install and remove the heavy duty boom extension on the boom nose.

1. Fully extend and set outriggers. For more information, see *Using the Outriggers*, page 4-21.
2. Position boom over front of crane.
3. Fully retract all boom sections.
4. Lower boom to the horizontal position.
5. Attach a tag line to the front of the boom extension.
6. Unreeve the hoist ropes as necessary from the heavy duty boom extension. For more information, see *Reeving/Unreeving the Hoist Rope*, page 5-43.
7. Lower the mast (8, Figure 5-69).
8. Remove the anemometer and boom position light from the heavy duty boom extension as needed. *Removing Anemometer/Boom Position Light*, page 5-95.
9. Remove the Anti-Two Block switch from the heavy duty boom extension. For more information, see *Anti-Two Block Switch on the Boom Extension*, page 5-80.
10. Disconnect the heavy duty boom extension electrical connections from the main boom. For more information, see *Boom Extension and Lattice Insert Electrical Connections*, page 5-73.
11. Raise the lower boom extension sheaves (7, Figure 5-69).
12. Disconnect the heavy duty boom extension hydraulic connections from the boom. For more information, see *Hydraulic Boom Extension Connections*, page 5-74.



DANGER

When removing the boom extension, make sure the boom extension is properly supported by the auxiliary crane and the movement of the boom extension is controlled at all times.

13. Attach a suitable lifting device to the clevises (4, Figure 5-69) on the boom extension. Lift the boom extension enough to take the load off of the anchor fittings and attachment fittings. For more information, see *Lifting Points*, page 5-51.
14. Remove retaining clips (3) from attachment pins (2). Remove attachment pins (2) from the boom extension anchor fittings (5) and attachment fittings on the boom nose (6).
15. Remove the boom extension from the front of the boom nose. Using the tag line to guide the boom extension, set the heavy duty boom extension on a level surface.
16. Install the attachment pins (2) in the bracket. Secure the pins with retaining pins (3).

LATTICE INSERT (OPTIONAL)

Use the following procedures to install and remove the optional lattice insert. The lattice insert connects to the boom nose. The lattice insert mast sheave assembly must be raised before installing the lattice insert on the boom nose.

Attaching the Lattice Insert on the Boom Nose

! DANGER
Boom Extension Hazard!

To avoid death or serious injury, follow procedures and cautions in the Operator and Safety Manuals and decals during erection, stowage and use of boom extension. Install and secure all pins properly and control boom extension movement at all times.

NOTE: Use an auxiliary crane or suitable lifting device to install the lattice extension.

1. Make sure the crane is set up on outriggers. For more information, see *Using the Outriggers*, page 4-21.
2. Retract and lower the boom to horizontal.
3. Connect a sling to the lifting lugs on the lattice insert section. For more information, see *Lifting Points*, page 5-51.
4. Raise the mast sheave assembly on the lattice insert as follows:
 - a. Hold the handle (1, Figure 5-74) and remove retaining clips (2) and pins (3).
 - b. Swing the mast sheave assembly (4) to the raised position. Align the holes.

c. Install pins (3). Secure with retaining clips (2).

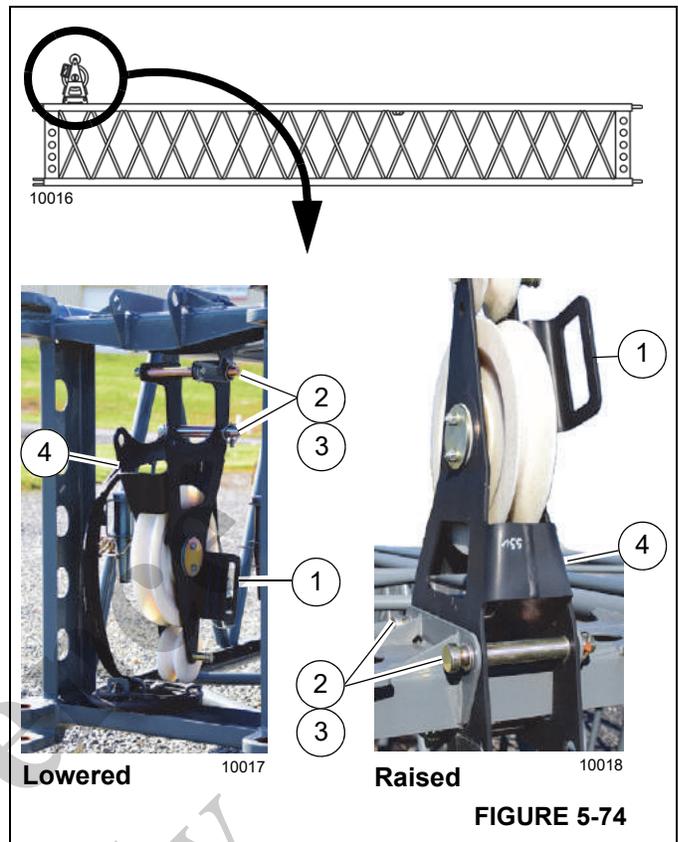


FIGURE 5-74

5. Tie a tag line (1, Figure 5-75) to the end of the lattice insert section (2).
6. Lift the lattice insert in front of the nose of the main boom (3) so the four pin holes align on both sides.
7. Install pins (4) and retaining clips (5).

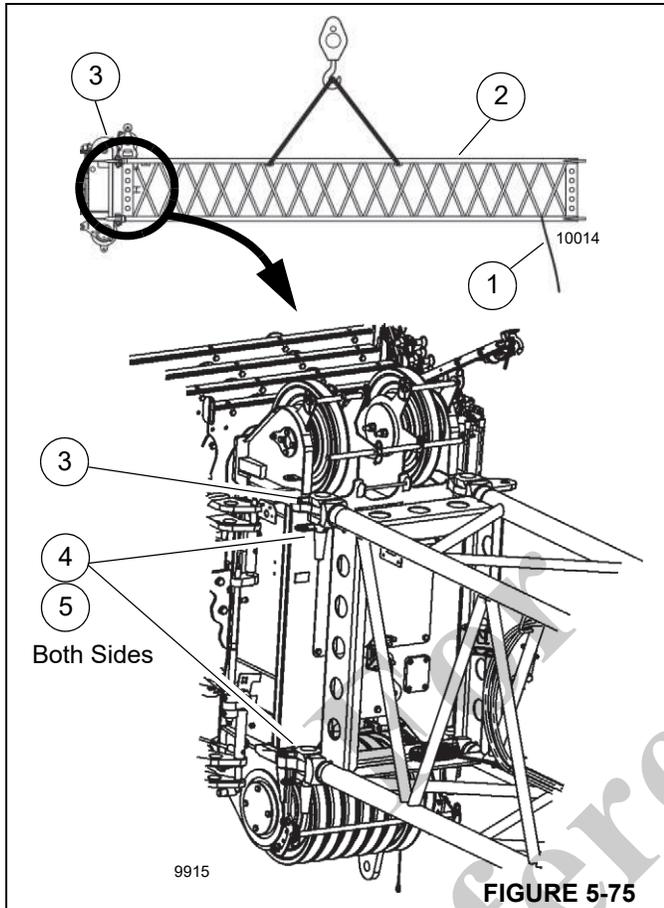


FIGURE 5-75

8. Remove pins (4) from the holders.
9. Insert pins (4) into the connecting points. Secure the pins with retaining clips (5).
10. Connect lattice insert section electrical connector to the main boom electrical connector.
11. If installing a hydraulic boom extension to the lattice insert section, connect the hydraulic connectors and if needed, route the hoses the length of the lattice insert.
12. Install the boom extension. For more information, see *Installing the Boom Extension on the Lattice Insert*, page 5-89.

Installing the Boom Extension on the Lattice Insert



DANGER Boom Extension Hazard!

To avoid death or serious injury, follow procedures and cautions in the Operator and Safety Manuals and decals during erection, stowage and use of boom extension. Install and secure all pins properly and control boom extension movement at all times.

NOTE: This procedure assumes the fly section is stowed on the boom extension base. For information about deploying the fly section, see *Stowing the Fly Section*, page 5-65.

NOTE: This procedure applies to manual and hydraulic boom extensions unless otherwise noted.

1. Make sure the crane is set up on outriggers. For more information, see *Using the Outriggers*, page 4-21.

NOTE: An auxiliary crane with sling is required to install the boom extension on the boom nose.

2. Retract and lower the boom to horizontal.

3. Tie a tag line to the boom extension (1, Figure 5-76).

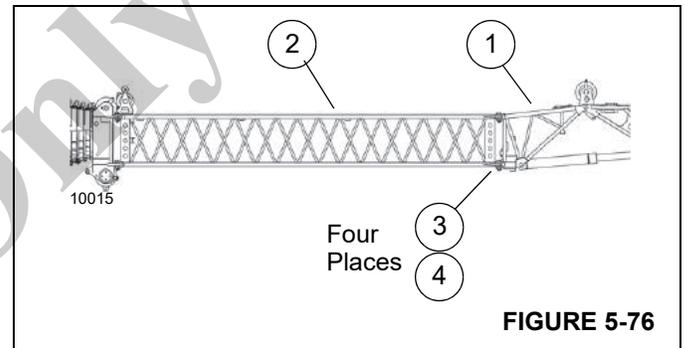


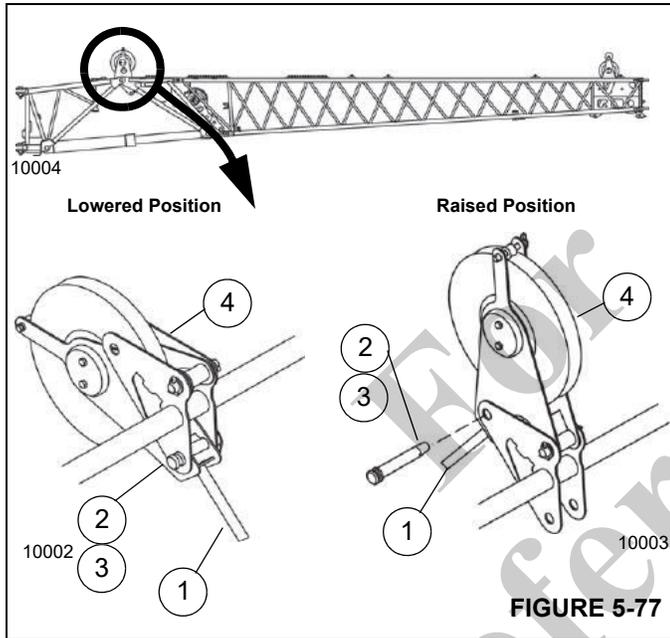
FIGURE 5-76

4. Using a sling attached to an auxiliary crane, lift the boom extension and fly section (1) in front of the lattice insert (2). For more information about attaching points for the sling, see *Lifting Points*, page 5-51.

5. Raise and lower the boom extension (1) as necessary to align the boom extension anchor fittings with the lattice insert attachment lugs. Secure the boom extension and fly section to the lattice insert using pins (3). Secure the pins (3) with retaining clips (4). If necessary, use the jack to install the fourth pin.

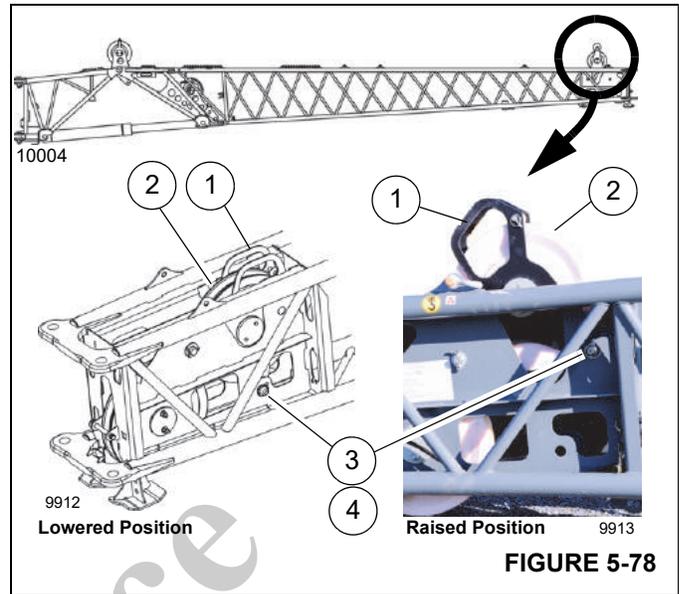
6. Connect boom extension electrical connector to the lattice insert electrical connector. For more information, see *Boom Extension and Lattice Insert Electrical Connections*, page 5-73.

7. Install the anti-two block switch. For more information, see *Anti-Two Block (A2B) Switch*, page 5-32.
8. If installing the hydraulic boom extension, connect hydraulic hoses between the lattice insert and hydraulic boom extension. For more information, see *Boom Extension-to-Lattice Insert Hydraulic Connections*, page 5-92.
9. Remove the sling from the boom extension.
10. Raise the rear mast sheave assembly as follows:



- a. Hold the handle (1, Figure 5-77) and remove the retaining clip (2) and pin (3).
- b. Raise the mast (4). Make sure the connecting point holes are aligned.
- c. Insert Pin (3). Secure the pin with retaining clip (2).

11. Raise the front mast assembly as follows:



- a. Hold the handle (1, Figure 5-78) of the mast sheave assembly (2). Remove retaining clip (3) and pin (4).
 - b. Raise the mast assembly (2) until the connecting holes are aligned.
 - c. Insert pin (4) and secure with retaining clip (3).
12. Deploy the fly section as necessary. For more information, see *Erecting the Fly Section*, page 5-63.

Removing the Boom Extension from the Lattice Insert



DANGER

Boom Extension Hazard!

To avoid death or serious injury, follow procedures and cautions in the Operator and Safety Manuals and decals during erection, stowage and use of boom extension. Install and secure all pins properly and control boom extension movement at all times.

1. Make sure the crane is set up on fully extended outriggers. For more information, see *Using the Outriggers*, page 4-21.
- NOTE:** An auxiliary crane with sling is required to install the boom extension on the boom nose.
2. Retract and lower the boom to horizontal.
 3. Tie a tag line to the boom extension (1, Figure 5-76).
 4. Unreeve the hoist rope. For more information, see *Hoist Rope Reeving*, page 5-34.

5. Stow the rear mast assembly as follows:
 - a. Hold the handle (1, Figure 5-77) and remove the retaining clip (2) and pin (3).
 - b. Lower the mast (4). Make sure the connecting point holes are aligned.
 - c. Insert Pin (3). Secure the pin with retaining clip (2).
6. Stow the front mast assembly as follows:
 - a. Hold the handle (1, Figure 5-78) of the mast sheave assembly. Remove retaining clip (3) and pin (4).
 - b. Lower the mast assembly (2) until the connecting holes are aligned.
 - c. Insert pin (4) and secure with retaining clip (3).
7. Remove the anti-two block switch. For more information, see *Anti-Two Block (A2B) Switch*, page 5-32.
8. Disconnect the boom extension electrical connector from the lattice insert. For more information, see *Boom Extension and Lattice Insert Electrical Connections*, page 5-73.
9. If removing a hydraulic boom extension, disconnect the hydraulic hoses. For more information, see *Boom Extension-to-Lattice Insert Hydraulic Connections*, page 5-92.
10. Stow the fly section as necessary. For more information, see *Stowing the Fly Section*, page 5-65.
11. Attach a sling and auxiliary crane to the boom extension. For more information about attaching points for the sling, see *Lifting Points*, page 5-51.
12. Remove retaining clips (4, Figure 5-76) and pins (3).
13. Lift the boom extension and fly section (1) from the front of the lattice insert (2) with the auxiliary crane. Place the boom extension on a suitable surface.
14. Remove the sling from the boom extension.
15. Remove the lattice insert from the boom nose. For more information, see *Removing the Lattice Insert from the Boom Nose*, page 5-91.

Removing the Lattice Insert from the Boom Nose



DANGER

Boom Extension Hazard!

To avoid death or serious injury, follow procedures and cautions in the Operator and Safety Manuals and decals during erection, stowage and use of boom extension. Install and secure all pins properly and control boom extension movement at all times.

Use the following procedure to remove the lattice insert from the boom nose.

CAUTION

Equipment Damage Hazard!

Before removing an extension, ensure that the electrical and hydraulic connections have been disconnected and properly stowed to prevent damaging the rope and hydraulic hoses.

1. Use another auxiliary crane or suitable lifting device to remove the extension.
2. Connect a sling to the lifting lugs and lift the extension enough to take the load off the connecting pins. For more information about attaching points, see *Lifting Points*, page 5-51.
3. Verify the electrical and hydraulic connections are disconnected. Refer to *Boom Extension and Lattice Insert Electrical Connections*, page 5-73 and *Hydraulic Boom Extension Connections*, page 5-74.
4. Remove the retaining clips and pins (4 and 5, Figure 5-75) from the connecting points.
5. Insert the pins (4) into the holders. Secure pins (4) with retaining clips (5).
6. Remove the lattice insert (2). Lower the lattice insert on to a stable surface.
7. Lower the Lattice Insert mast sheave assembly as follows:

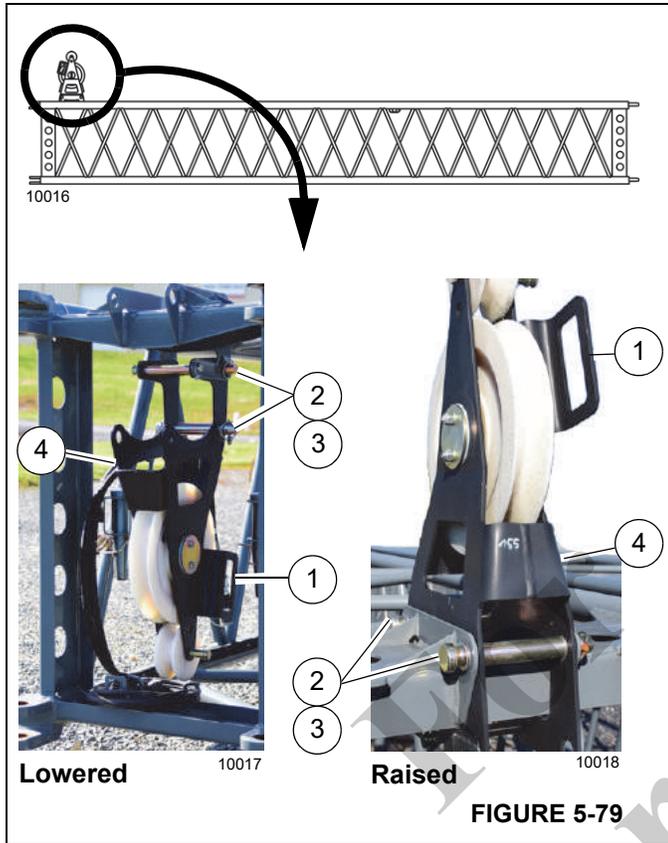


FIGURE 5-79

- a. Hold the handle (1, Figure 5-79) and remove retaining clips (2) and pins (3).
- b. Swing the mast sheave assembly (4) to the lowered position. Align the holes.
- c. Install pins (3). Secure with retaining clips (2).

Boom Extension-to-Lattice Insert Hydraulic Connections

Use the following procedures to connect the optional hydraulic boom extension to the lattice insert.

Connecting the Boom Extension Hydraulics to the Lattice Insert

1. Remove the long hoses (1, Figure 5-80) from the holders (2) on the boom extension (3).

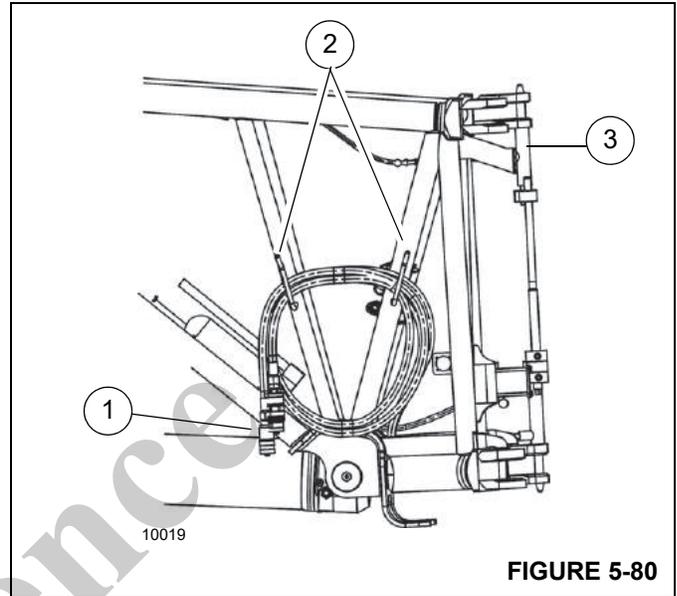


FIGURE 5-80

2. Remove the protective caps from the hoses (1).
3. Route the hoses (1, Figure 5-80) to the front of the lattice insert (1, Figure 5-81).
4. Remove the protective caps from hydraulic hose connectors (2) on the lattice insert (1).
5. Connect the boom extension hoses (1, Figure 5-80) to the hydraulic hoses on the lattice insert (2, Figure 5-81).

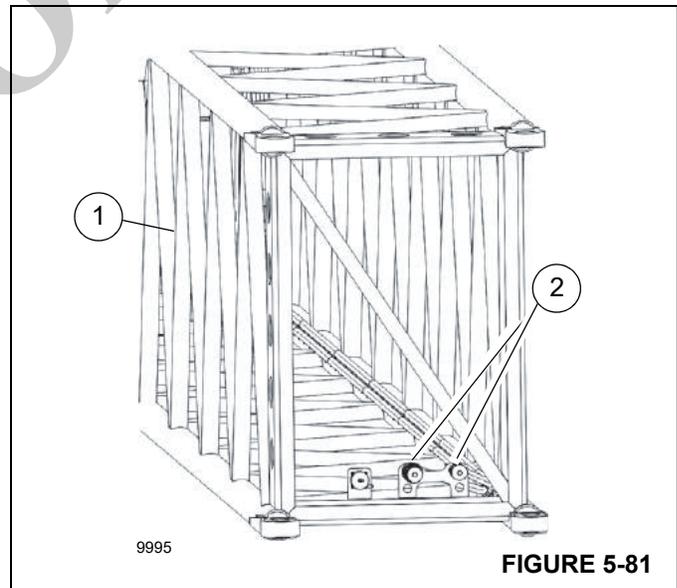


FIGURE 5-81

Disconnecting the Boom Extension Hydraulics from the Lattice Insert

1. Disconnect the boom extension hoses (1, Figure 5-80) from the hydraulic connectors (2, Figure 5-81) on the lattice insert (1).
2. Install protective caps on all hose ends.
3. Secure the boom extension hoses (1, Figure 5-80) to the hooks (2) on the boom extension (3).

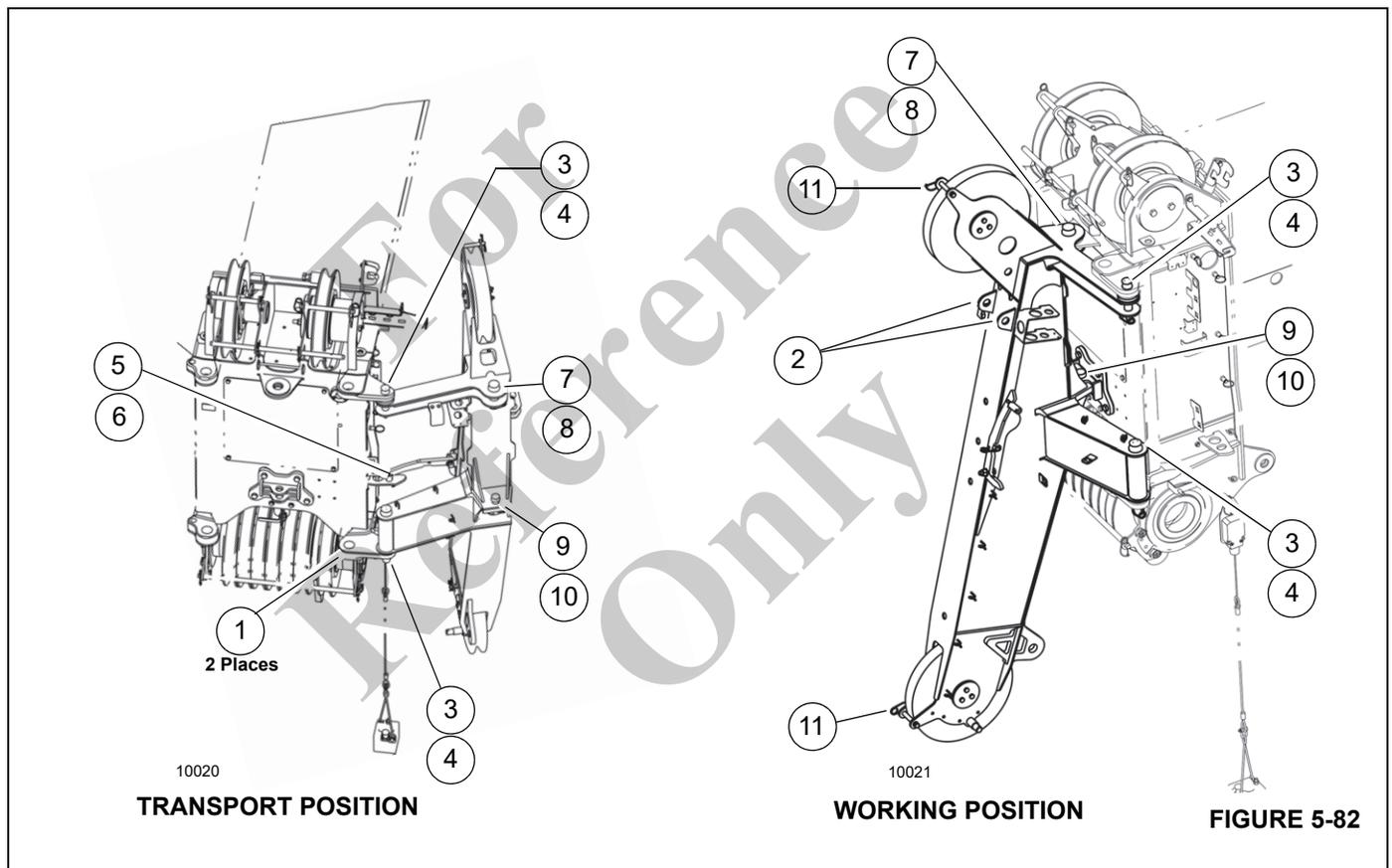
AUXILIARY SINGLE SHEAVE BOOM NOSE

The following sections describe how to install, remove, and rig the auxiliary single sheave boom nose.

NOTE: The auxiliary single-sheave boom nose assembly weighs approximately 185 kg (408 lbs).

! **DANGER**
Crushing Hazard!

During installation and removal, always use the proper equipment with sufficient load bearing capacities.



Installing Auxiliary Single-Sheave Boom Nose

1. If necessary, remove and store the retaining clips from the boom nose attachment lugs (1, Figure 5-82).
2. Use an auxiliary crane attached to the lifting eyes (2) on the auxiliary boom nose and lift it to the front of the main boom head.
3. Align the auxiliary single-sheave boom nose so that the attachment lugs line up to the boom nose attachment lugs (1).
4. Secure the auxiliary single-sheave boom nose to the main boom nose using pins (3).
5. Secure the pins (3) with retaining clips (4).
6. Insert catch hook (5) in to the flange (6) to secure the auxiliary single sheave boom to the main boom for transport.
7. Depending on the application, bring the auxiliary single-sheave boom nose into transport position or working position.

Removing the Auxiliary Single-Sheave Boom Nose

In the working position, the auxiliary single-sheave boom nose is positioned in front of the main boom head and is fastened with four pins (3, 8, and 10, Figure 5-82).

In the transport position, the auxiliary single-sheave boom nose is positioned to the side of the main boom head and is fastened with two pins (2) and catch hook (5).

1. Attach an auxiliary crane to the lifting eyes (2) of the auxiliary boom nose (1).
2. Remove catch hook (5) from flange (6) on the side of the main boom.
3. Remove the retaining clip (7) and remove pin (8).
4. Remove the retaining clip (9) and remove pin (10).
5. Lift the auxiliary single-sheave boom nose from the head of the main boom.

Rigging the Auxiliary Single-Sheave Boom Nose for Transport

Use the following procedures to rig the auxiliary single-sheave boom nose for transport.

Rigging in Transport Position

1. Remove the retaining clip (9, Figure 5-82) and remove pin (10) from the boom nose.
1. Remove the retaining clip (7) and remove pin (8) from the boom nose.
2. Rotate the auxiliary boom nose to the side of the main boom head.
3. Insert catch hook (5) into flange (6) to secure the auxiliary single sheave boom nose to the main boom.
4. Store pins (8 and 10) on auxiliary boom nose. Secure with retaining clips (7 and 9).

Rigging in Working Position

1. Remove and store the catch hook (5, Figure 5-82) from flange (6).
2. Remove clips (7 and 9) and pins (8 and 10) from auxiliary boom nose.
3. Swing the auxiliary single-sheave boom nose to the front of the main boom nose.
4. Install pin (8). Secure with retaining clip (7).
5. Install pin (10). Secure with retaining clip (9).

Reeving the Hoist Rope

1. Remove the hoist rope holding rods from the head of the main boom and from the auxiliary single-sheave boom nose (11, Figure 5-82).
2. Reeve the hoist rope. Guide the hoist rope over the main boom and auxiliary single-sheave boom nose sheaves.
3. Insert the hoist rope holding rods into the appropriate bore holes and secure with the corresponding retaining clips.
4. Fasten the cable end clamp on the overhaul ball or the hook block.

Unreeving the Hoist Cable

1. Release the cable end clamp on the overhaul ball or hook block.
2. Remove the retaining clips and rope holding rods.
3. Remove the hoist rope from the sheaves.
4. Install the hoist rope holding rods on the head of the main boom and auxiliary single sheave boom nose.

ANEMOMETER/BOOM POSITION LIGHT (OPTIONAL)

Use the following procedures to install and remove the anemometer and boom position light from the end of the main boom, boom extension base, and fly sections.

CAUTION

Equipment Damage Hazard!

Always remove the wind speed indicator/boom position light before transporting the crane.

This prevents damage by overhead obstructions and the anemometer from being damaged due to excessive air speeds.

Installing the Anemometer/Boom Position Light

1. Insert the mounting arm (1, Figure 5-83) into the holder (2) and secure it with the retaining clips.
2. Remove the cable from the clamps (2).
3. Remove the protective caps from the anemometer and boom position light electrical connectors (4 and 5).
4. Connect the anemometer cable to the connector (4).
5. Connect the boom position light cable to the connector (5).
6. Arrange the cable so that it will not be damaged during crane operation.

7. Check that the anemometer swings freely so that it hangs vertically at different boom angles.

Removing Anemometer/Boom Position Light

1. Take the plugs out of the connectors (4 and 5, Figure 5-83) and install the protective caps.
2. Wind the cable onto the clamps (3).

3. Remove retaining clips and the mounting arm (1) from the holder (2).
4. For transportation, fasten the retaining clips to the mounting arm (1).

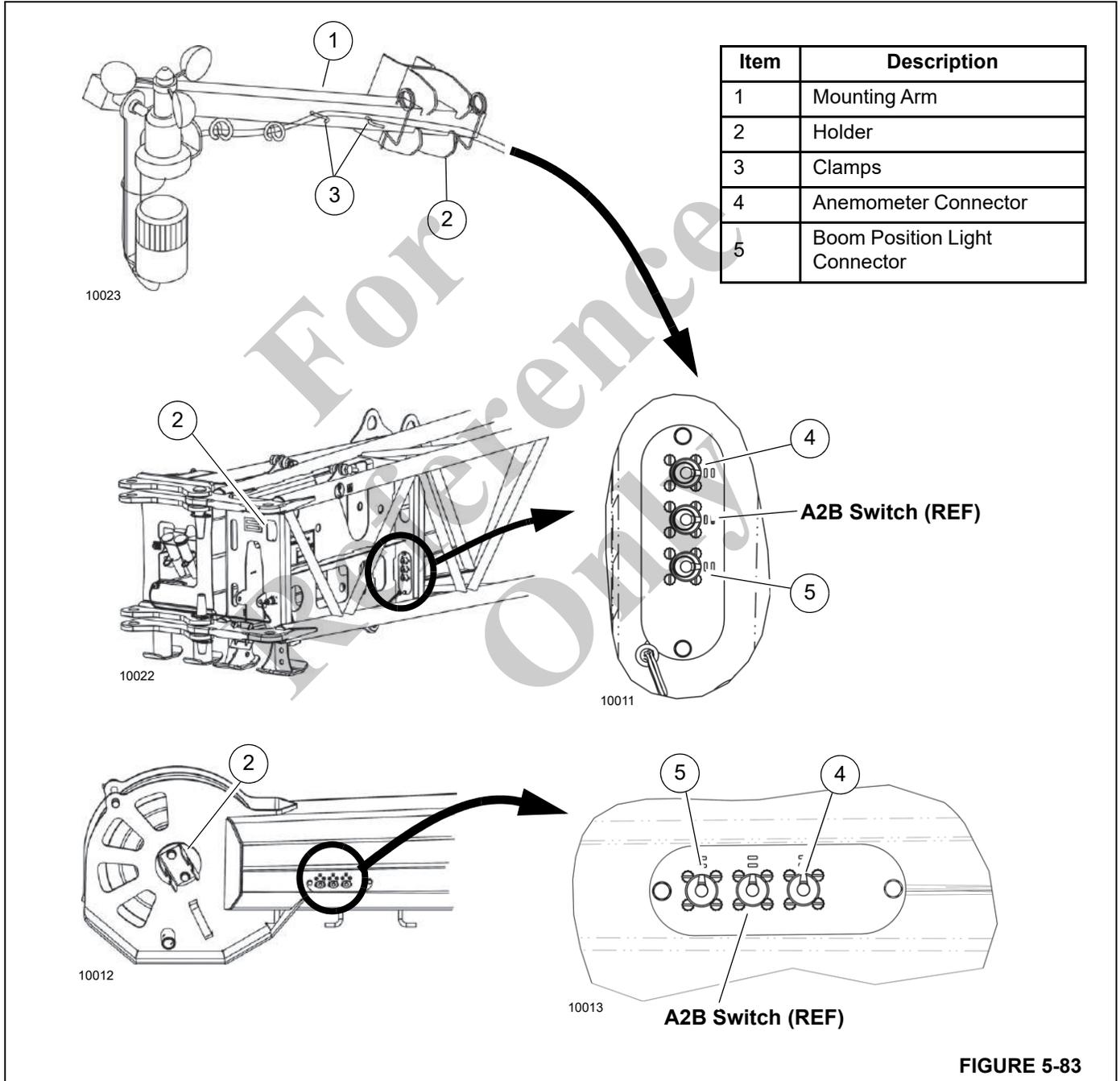


FIGURE 5-83

*For
Reference
Only*

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SECTION 6 MAINTENANCE AND LUBRICATION

SECTION CONTENTS

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For Reference Only

GENERAL

Following the designated lubrication procedures is important to ensure maximum crane lifetime and utilization. Procedures and lubrication charts in this section include information on types of lubricants used, location of the lubrication points, frequency of lubrication, and other information.

Refer to your *Inspection and Lubrication Service Log* for routine checks which will help maintain the safety, dependability, and productivity designed into your crane.

One copy of the *Inspection and Lubrication Service Log* is provided in the original package of manuals shipped with the crane. Additional copies are available through the Grove distributor network or Manitowoc Crane Care.

Refer to your *Service Manual* for specific maintenance and adjustment procedures.

ENVIRONMENTAL PROTECTION

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

Potentially harmful waste used in Grove cranes includes—but is not limited to—oil, fuel, grease, coolant, filters, air conditioning refrigerant, 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, observe the following:

- 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 filling pump.
- Immediately clean up any spills.

LUBRICANTS AND LUBRICATION INTERVALS

Use lubricants as listed in this section of the *Operator Manual*. See also your GRT9165 *Service Manual* for maintenance and lubrication instructions.

CAUTION

Possible Equipment Damage!

The multipurpose grease installed during manufacture of this crane contains a lithium base.

Do not apply chassis grease lubricants with air pressure devices, as chassis contains sealed fittings.

Use of non-approved lubricant may damage components and/or invalidate published lubricant intervals.

Failure to follow this instruction may cause damage to equipment.

Grove recommends the use of Standard lubricants for Grove cranes operating in regions where moderate ambient temperature, humidity, and atmospheric conditions prevail. These Standard lubricants are effective in ambient temperatures down to -9°C (+15°F).

Cold weather temperatures below -9°C (+15°F) are considered arctic. Grove recommends the use of Cold Weather lubricants for Grove cranes operating in arctic conditions.

In regions where Grove cranes are operating with arctic conditions down to -29°C (-20°F), Grove recommends the use of the Cold Weather lubricants found in Table 6-2.

In regions where Grove cranes are operating with arctic conditions down to -40°C (-40°F), Grove recommends the use of the Cold Weather lubricants found in Table 6-3.

NOTE: All fluids and lubricants may be purchased by contacting an authorized Grove distributor or Manitowoc Crane Care Parts Department.

Standard Lubricants

Standard lubricants are used on all Grove cranes. Cranes can also be ordered with Cold Weather lubricants. The Standard lubricants listed in Table 6-1 are effective in ambient temperatures down to -9°C (+15°F).

Table 6-1 : Standard Lubricants [Down to -9°C (+15°F)]

Lubricant/Fluid	Grove Spec.	Recommended Lubricant		
		Type	Grade	Classification
Extended Service Interval Axle Gear Oil	6829012964	Century Unigear Semi-synthetic Texaco Multigear SS Chevron DELO Gear Lubricant	80W-90	GL-5
Engine Oil (SAE) (EO 15W-40)	6829104182	Conoco Fleet Supreme EC Mobil Delvac 1300 Super Mobil Delvac MX ESP	15W-40	CJ-4
Hydraulic/Transmission Oil	6829006444	Phillip 66 PowerTran XP Exxon Mobil 424	ISO 46/68	Must meet John Deere Standard JDM J20C
Extreme Pressure Hoist Gear Oil Swing Drive Oil	6829100213	Mobil Mobilgear 600XP 150 Gear Oil Texaco Meropa 150 Phillips 66 Extra Duty Gear Oil	AGMA EP-4	AGMA No. 4 EP
Extreme Pressure Multipurpose Grease (EP-MPG)	6829003477	Citgo Lithoplex MP# 2 (red) Chevron Starplex EP-2 (red) Phillips 66 Multiplex Red (red) Mobil Mobilgrease XHP 222 (dark blue) IPIFLEX LI-COMP EP2 (red) Renolit Hi-Temp 220 (Ivory)	NLGI 2	GC-LB Certified
Open Gear Lube (EP-OGL)	6829102971	Fuchs Ceplattyn 300 Spray	NLGI 1-2	
Antifreeze Coolant	6829101130	Old World Industries, Inc. Fleet Charge SCA (red) Caterpillar DEAC (magenta) Fleetguard ES Compleat EG (blue)	AFC - 50/50 Mix 50/50	
Liquid Coolant Conditioner (LCC)	6829012858	Fleetguard DCA4 Fleetguard DCA2 Penray Pencil 3000	LCC	
Diesel Exhaust Fluid (DEF)	80019225	Fleetguard StableGuard™ Urea 32 Premix AdBlue® TerraCair Ultrapure® DEF	DEF	

Table 6-1 : Standard Lubricants [Down to -9°C (+15°F)]

Lubricant/Fluid	Grove Spec.	Recommended Lubricant		
		Type	Grade	Classification
Extreme Pressure 3% Moly Grease (EM-3MG)	6829015304	Citgo Lithoplex CM2	NLGI 2	GC-LB Certified GC-LB Certified
		Mobil Mobilgrease CM-P	NLGI 2	
		Phillips 66 Megaplex XD3	NLGI 1	
		Ipiranga IPIFLEX LI-COMP MOLY 2 (Gray)	NLGI 2	
BECHEM PAL1	01373458			
BECHEM High-Lub LM 2 EP (400g)	03313195		NLGI 2	

For Reference Only

ARCTIC LUBRICANTS AND CONDITIONS

Arctic Conditions Below -9°C (+15°F)

Regions with ambient temperatures below -9°C (+15°F) are considered arctic. In general, petroleum based fluids developed especially for low temperature service may be used with satisfactory results. However, certain fluids, such as halogenated hydrocarbons, nitro hydrocarbons, and phosphate ester hydraulic fluids, might not be compatible with hydraulic system seals and wear bands. If you are in doubt about the suitability of a specific fluid or lubricant, check with an authorized Grove distributor or Manitowoc Crane Care.

NOTE: All fluids and lubricants may be purchased by contacting your local Grove distributor or Manitowoc Crane Care.

Regardless of temperature and oil viscosity, always follow the cold weather start-up and operating procedures, as described in *Section 4 - Operating Procedures*, to ensure

adequate lubrication during system warm-up and proper operation of all crane functions.

Cold Weather Package and Lubricants

Grove recommends specific Cold Weather lubricants for use in ambient temperatures down to -29°C (-20°F). Refer to Table 6-2 for a list of these recommended Cold Weather lubricants.

Additionally, Grove recommends specific Cold Weather lubricants for use in ambient temperatures down to -40°C (-40°F). Refer to Table 6-3 for a list of these recommended Cold Weather lubricants.

These recommended Cold Weather lubricants alone are not sufficient to operate the crane in extreme low temperatures (arctic conditions). Therefore, Grove recommends that the crane be equipped with specific cold weather accessories, as listed under the section *Crane Warm-up Procedures*, page 4-11.

For Reference Only

Table 6-2 : Cold Weather Lubricants in Arctic Conditions [Down to -29°C (-20°F)]

Lubricant/Fluid	Grove Spec.	Recommended Lubricant		
		Type	Grade	Classification
Synthetic Axle Gear Oil	6829014058	CITGO Synthetic Gear Lube Eaton Roadranger EP Mobil Mobilube SHC Mobil Delvac Synthetic Gear Shell Spirax S6 Sunoco Duragear EP Petro-Canada Traxon E Synthetic Phillips 66 Triton Syngear FE	75W-90	OEM Meritor 076N (GL-5)
Engine Oil (SAE)	80056036	Shell Rotella® T6 Mobil Delvac 1 ESP Caterpillar Cat DE0-ULS Cold Weather	0W-40	CJ-4
Hydraulic/Transmission Oil	6829101559	Petro-Canada Duratran Synthetic THF Chevron All Weather THF Texaco TDH Oil SS		Must Meet John Deere Std. JDM J20C & J20D
Hoist Gear Oil Swing Drive Oil	6829103636	Petro-Canada ENDURATEX Synthetic EP 150 Mobil SHC629 Phillips 66 Syncon EP Plus	ISO 150	AGMA No. 4 EP
Extreme Pressure Multipurpose Grease (Cold Weather) (EP-MPG)	6829104275	Mobil Mobilith SHC 220 (red) Petro-Canada Precision Synthetic EP1 Phillips 66: Triton 220 (replaced by Multiplex FS 220 (purple) Phillips 66: Multiples FS220 (purple)	NLGI 2	GC-LB Certified
Open Gear Lube	6829102971	Fuchs: Ceplattyn 300 Spray	NLGI 1-2	
Antifreeze Coolant	6829101130	Old World Industries, Inc. Fleet Charge SCA Caterpillar DEAC Fleetguard Compleat EG	Mix 50/50	
Liquid Coolant Conditioner	6829012858	Fleetguard DCA4 Fleetguard DCA2 Penray Pencool 3000		

Table 6-2 : Cold Weather Lubricants in Arctic Conditions [Down to -29°C (-20°F)]

Lubricant/Fluid	Grove Spec.	Recommended Lubricant		
		Type	Grade	Classification
Diesel Exhaust Fluid (DEF)	80019225	Fleetguard StableGuard™ Urea 32 Premix AdBlue® TerraCair Ultrapure® DEF		
Extreme Pressure 3% Moly Grease	6829104275	Mobil Mobilith SHC 220 Petro-Canada Precision Synthetic EP1	NLGI 2	
Windshield Washer fluid	90037773	Splash De-icer		
Diesel Fuel	80069407	NOCO Kerosene, 3, UN1223, III Product #1	#1	NLOCK08
BECHEM PAL1	01373458			
BECHEM High-Lub LM 2 EP (400g)	03313195		NLGI 2	

Table 6-3 : Cold Weather Lubricants in Arctic Conditions [Down to -40°C (-40°F)]

Lubricant/Fluid	Grove Spec.	Recommended Lubricant		
		Type	Grade	Classification
Axle Gear Oil Hoist Gear Oil	6829014058	Petro-Canada Traxon E Synthetic CITGO Synthetic Gear Lube Eaton Roadranger EP Mobil Mobilube SCH Shell Spirax S Sunoco Duragear EP	75W-90	GL-5
Engine Oil (SAE)	80056036	Shell Rotella® T6 Mobil Delvac 1 ESP Caterpillar Cat DE0-ULS Cold Weather	0W-40	CJ-4
Hydraulic/Transmission Oil	6829101559	Petro-Canada Duratran Synthetic THF Chevron All Weather THF Texaco TDH Oil SS		Must Meet John Deere Std. JDM J20C & J20D
Swing Drive Oil	6829103636	Petro-Canada ENDURATEX Synthetic EP 150 Mobil SHC629		AGMA No. 4 EP
Grease, Extreme Pressure Multipurpose	6829104275	Petro-Canada Precision Synthetic EP1 Mobil, Mobilith SHC 220	NLGI 2	
Open Gear Lube	6829102971	Fuchs Ceplattyn 300 Spray	NLGI 1-2	

Table 6-3 : Cold Weather Lubricants in Arctic Conditions [Down to -40°C (-40°F)]

Lubricant/Fluid	Grove Spec.	Recommended Lubricant		
		Type	Grade	Classification
Antifreeze Coolant	6829104212	Old World Industries, Inc. Fleet Charge SCA Pre-charged Fleetguard Compleat EG Petro-Canada	Mix 60/40	
Liquid Coolant Conditioner	6829012858	Fleetguard DCA4 Fleetguard DCA2 Penray Pencool 3000		
Diesel Exhaust Fluid (DEF)	80019225	Fleetguard StableGuard™ Urea 32 Premix AdBlue® TerraCair Ultrapure® DEF		
Extreme Pressure 3% Moly Grease	6829104275	Mobil Mobilith SHC 220 Petro-Canada Precision Synthetic EP1	NLGI 2	
Windshield Washer fluid	90037773	Splash De-icer		
Diesel Fuel	80069407	NOCO Kerosene, 3, UN1223, III	#1	NLOCK08
BECHEM PAL1	01373458			
BECHEM High-Lub LM 2 EP (400g)	03313195		NLGI 2	

Reference Only

CYLINDER ROD SURFACE PROTECTION

Steel cylinder rods include a thin layer of chrome plating on their surfaces to protect them from corroding. However, chrome plating inherently has cracks in its structure which can allow moisture to corrode the underlying steel. At typical ambient temperatures, hydraulic oil is too thick to penetrate these cracks. Normal crane operating temperatures will allow hydraulic oil to warm sufficiently to penetrate these cracks and if cranes are operated daily, protect the rods. Cranes that are stored, transported, or used in a corrosive environment (high moisture, rain, snow, or coastline conditions) need to have the exposed rods protected more frequently by applying a protectant. Unless the crane is operated daily, exposed rod surfaces will corrode. Some cylinders will have rods exposed even when completely retracted. Assume all cylinders have exposed rods, as corrosion on the end of the rod can ruin the cylinder.

It is recommended that all exposed cylinder rods be protected using Boeshield® T-9 Premium Metal Protectant. Manitowoc Crane Care has Boeshield® T-9 Premium Metal Protectant available in 12 oz. aerosol cans by ordering part number 9999101803 through the Parts Department.

Cylinder operation and inclement weather will remove the Boeshield® protectant; therefore, inspect cranes once a week and reapply Boeshield® to unprotected rods.

WIRE ROPE LUBRICATION

Wire rope is lubricated during manufacturing so that the strands, and individual wires in strands, may move as the rope moves and bends. A wire rope cannot be lubricated sufficiently during manufacture to last its entire life. Therefore, new lubricant must be added periodically throughout the life of a rope to replace factory lubricant which is used or lost. For more detailed information concerning the lubrication and inspection of wire rope, refer to *Wire Rope* in *Section 1 - Introduction* of the *Service Manual*.

LUBRICATION POINTS

A regular frequency of lubrication must be established for all lubrication points. Normally, this is based on component operating time. The most efficient method of keeping track of lube requirements is to maintain a job log indicating crane usage. The log must use the engine hourmeter to ensure coverage of lube points that will receive attention based on their readings. Other lubrication requirements must be made on a time basis, for example, weekly, monthly, etc.

Check all oil levels with crane parked on a level surface in transport position, while oil is cold, unless otherwise specified.

On plug type check points, oil levels are to be at the bottom edge of the check port.

All grease fittings are SAE STANDARD unless otherwise indicated. Grease non-sealed fittings until grease is seen extruding from the fitting. One pump on a standard 0.45 kg (1 lb) grease gun equals 28 grams (1 oz) of EP-MPG.

Over-lubrication on non-sealed fittings will not harm fittings or components, but under-lubrication will definitely lead to a shorter lifetime.

Unless otherwise indicated, items not equipped with grease fittings, such as linkages, pins, levers, etc., should be lubricated with oil once a week. Motor oil, applied sparingly, will provide the necessary lubrication and help prevent the formation of rust. An Anti-Seize compound may be used if rust has not formed, otherwise the component must be cleaned first.

Grease fittings that are worn and will not hold the grease gun, or those that have a stuck check ball, must be replaced.

Where wear pads are used, cycle the components and lubricate again to make sure that the entire wear area is fully lubricated.

CraneLUBE

Grove highly recommends use of Manitowoc CraneLUBE lubricants to increase crane reliability and performance. Contact your Grove distributor for information about the Manitowoc CraneLUBE lubrication program.

Cummins Oil Registration List

Cummins has a program that lists engine oils that have been tested and meet the requirements of Cummins Engineering Specifications. A listing of recommended oils is on QuickServe® Online. Log on to quickservice.cummins.com and login with a current username and password. Or create a new account by selecting "Create an Account" under information, then choose Limited Owners Plan, and register. Once logged in, click on the "Service" Tab in the top red bar, "Service Tools" mini-tab and "Oil Registration Lists" link within the Service Tools list. This will load a list of the different Cummins Engineering Specification numbers. Select the one that applies to your engine, and view the registered oils.

Safety



WARNING

Crushing Hazard!

Movement of the superstructure the boom, and outriggers may create a crushing and/or pinching hazard.

Make sure that personnel maintain an adequate clearance from moving parts when these parts are operated during lubrication of the crane.

Failure to follow this instruction may cause serious injury or death to personnel.

To lubricate many of the locations on the crane, the engine must be started. Parts of the crane, to include the boom, superstructure, outriggers, and the like, must be retracted or extended, or swung left or right, which movement may cause pinching and crushing hazards.

After positioning areas of the crane for lubrication, turn off the engine and make sure that the moving parts of the crane are stopped before approaching.

For Reference Only

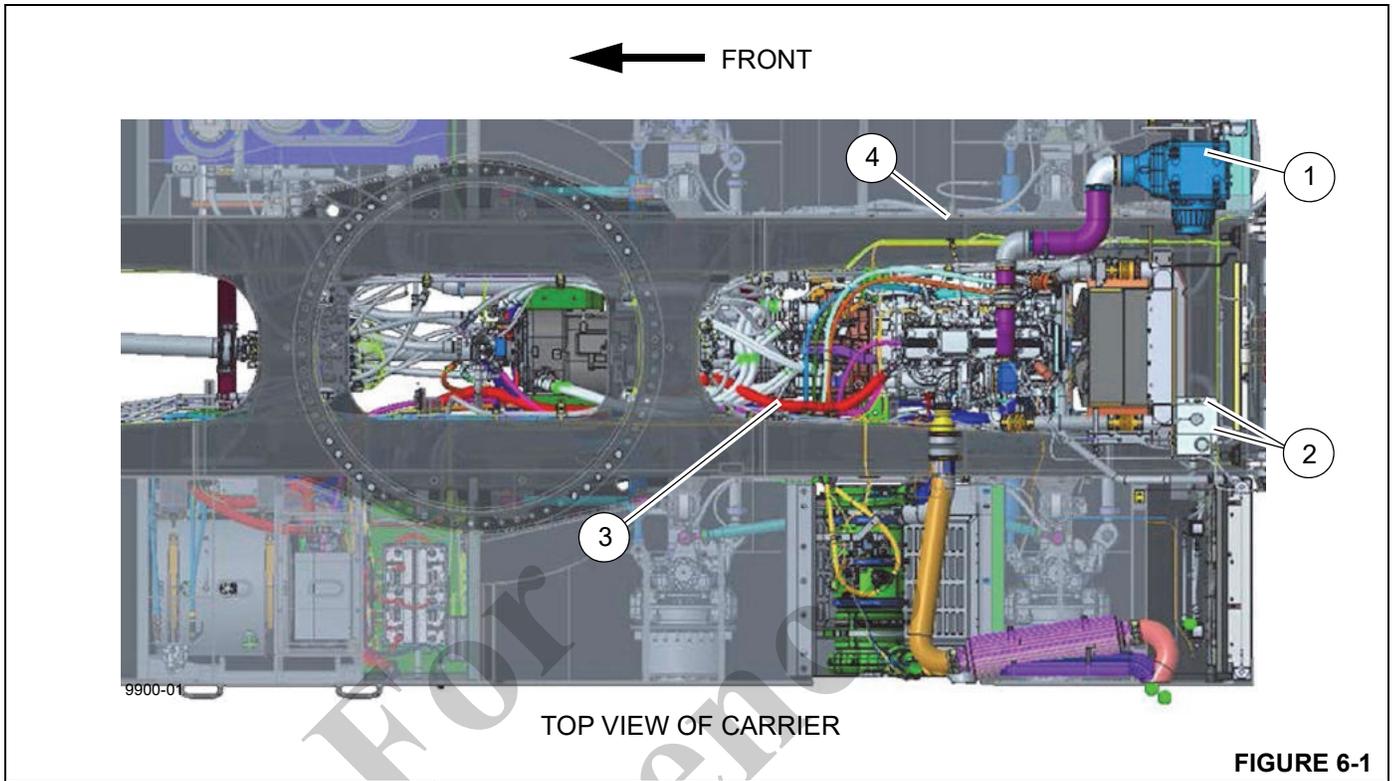
Table 6-4 : Approved Lubricant Reference Table

Ref.	Approved Lubricant	Lube Specification Down To -9°C (+15°F)	Lube Specification Down To -29°C (-20°F)	Lube Specification Down To -40°C (-40°F)
A	Extreme Pressure Multipurpose Grease	6829003477	6829104275	6829104275
B	Gear Lube (GL-5)	6829012964	6829014058	6829014058
C	Fully Formulated Anti-Freeze Coolant	6829101130	6829101130	6829104212
D	Liquid Coolant Conditioner (LCC)	6829012858	6829012858	6829012858
E	Tractor Hydraulic Fluid	6829006444	6829101559	6829101559
F	Engine Oil (SAE)	6829104182 (15W-40)	80056036 (0W-40)	80056036 (0W-40)
G	Open Gear Lube	6829102971	6829102971	6829102971
H	Extreme Pressure Gear Lube	6829100213	6829103636	6829103636
J	Hydraulic Oil	6829006444	6829101559	6829101559
K	Diesel Exhaust Fluid (DEF)	80019225	80019225	80019225
L	Extreme Pressure 3% MOLY Grease	6829015304	6829104275	6829104275
M	BECHEM PAL1	01373458	01373458	01373458
N	BECHEM High-Lub LM 2 EP (400g)	03313195	03313195	03313195

For
Reference
Only

Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Drive Train						
1	Engine Air Cleaner Filter Element	Figure 6-1	—	—	When indicator shows red (25" H ₂ O)	REPLACE engine air cleaner filter See NOTE 1.
2	Engine Cooling System	Figure 6-1	C	42 L (11.1 gal) See NOTE 2.	Every 10 hours/daily	CHECK coolant level in sight glass (rear of crane) See NOTE 3.
					LIFETIME See Service Manual.	DRAIN and FILL See NOTE 4.
	Liquid Cooling Conditioner (LCC)	Figure 6-1	D	As necessary	See Service Manual	TEST and ADD See NOTE 5.
3	Coolant Strainer (Cab Heater)	Figure 6-1	—	—	After first 100 hours of service	CLEAN strainer See NOTE 6.
					Then, every 2000 hr, or 1 year, whichever interval comes first	REPLACE strainer See NOTE 6.
4	Engine Crankcase Cummins B6.7L Stage V, with Engine Oil Filter	Figure 6-1	F	—	Every 10 hours/daily	CHECK oil level ADD oil through crankcase fill cap to FULL on DIPSTICK
						DRAIN engine crankcase REPLACE oil filter See NOTE 7.
			F	15 L (4 gal)	Every 500 hours	FILL engine crankcase through fill cap to FULL on DIPSTICK See NOTE 7.

- NOTE 1:** If installed, ladder must be removed to access the Engine Air Cleaner Filter element.
- NOTE 2:** Engine Anti-Freeze Coolant capacities indicated are for a fully formulated mixture of 50% AFC and 50% water.
- NOTE 3:** If coolant LEVEL in the large surge tank, with 15 PSI cap, is LOW, then FILL the large surge tank to COLD on sight glass (MAX FILL RATE 11.2 L/min (3 gal/min), and ADD 0.95 L (1 qt) above it. Resume normal operation.
- NOTE 4:** See your GRT9165 *Service Manual* for specified coolant fill instructions.
- NOTE 5:** See your GRT9165 *Service Manual* for information about Liquid Cooling Conditioner (LCC) levels.
- NOTE 6:** The Coolant Strainer should be CLEANED after the first 100 hours of service, and then REPLACED at 2000 hours or 1 year of service thereafter, whichever interval comes first.
- NOTE 7:** Engine Oil Fill is located on top of the Engine Crankcase. Engine Oil Dipstick is located on the right side nearby the Engine Oil Fill. Engine Oil Filter is located on lower inside left side of the frame adjacent to the torque converter.



For Reference Only

Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Drive Train (Continued)						
5a	Transmission and Torque Converter Locations	Figure 6-2	J	44.5 L (11.75 gal)	Every 10 hours/daily	CHECK fluid level See NOTE 8. See NOTE 9. See NOTE 10. FILL transmission sump to FULL on DIPSTICK See NOTE 12.
					PERFORM after first 50 hours of service, and REPEAT after another 50 hours for a total of 100 hours of service	DRAIN transmission sump See NOTE 11. REPLACE transmission and torque converter filter See NOTE 11. CLEAN magnetic drain plug INSTALL magnetic plug in drain port FILL transmission sump to FULL on DIPSTICK
					Then every 1000 hours, or 6 months, thereafter, whichever interval comes first	DRAIN transmission sump See NOTE 11. REPLACE transmission and torque converter filter See NOTE 11. FILL transmission sump to FULL on DIPSTICK See NOTE 12.
<p>NOTE 8: Check Transmission Fluid level using the transmission oil dipstick located on the side of carrier adjacent to the hydraulic tank. Check fluid level with boom fully retracted and lowered, and all outrigger cylinders retracted.</p> <p>NOTE 9: Only check the fluid level when transmission is at operating temperature.</p> <p>NOTE 10: Level should be checked with engine running at 850 rpm idle and torque converter fluid temp at 65°C to 90°C (150°F to 200°F). To bring fluid temperature to this range, it is necessary to work the crane or stall the converter.</p>						

Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
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CAUTION

Possible Equipment Damage!

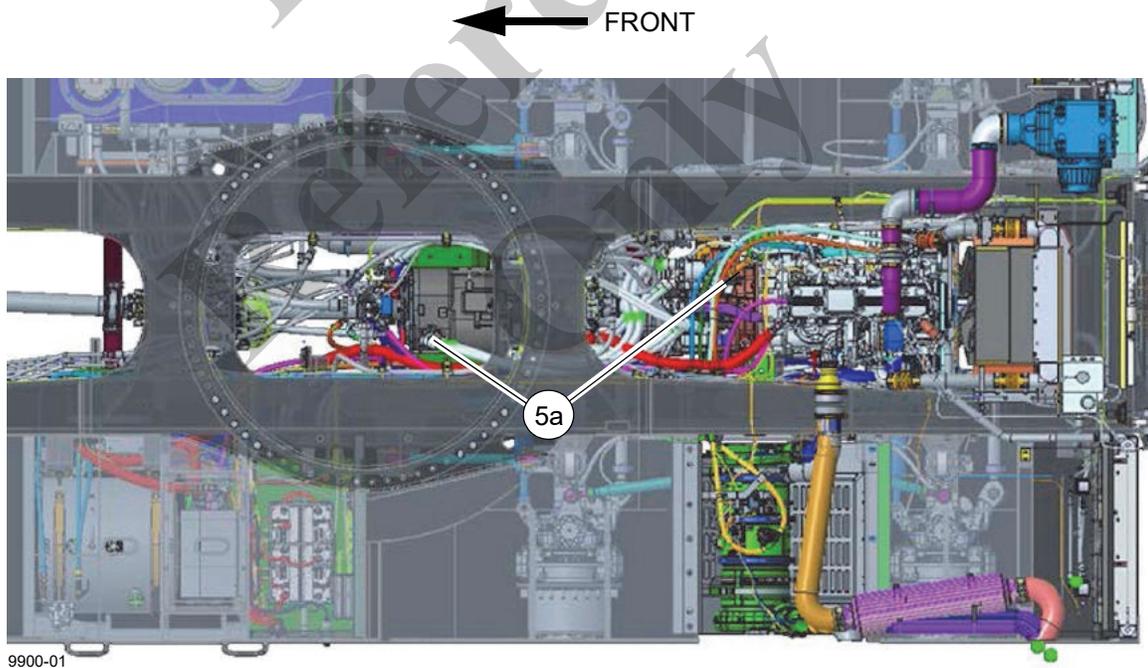
Do not operate torque converter at stall condition for longer than 30 seconds at one time. Shift to neutral for 15 seconds, and repeat procedure until desired fluid temperature is reached.

Excessive fluid temperature [120°C (250°F) maximum] will damage transmission clutches, transmission fluid, torque converter, and seals.

Failure to follow this instruction may cause damage to equipment.

NOTE 11: Drain Transmission Fluid at a temperature of 65°C to 90°C (150°F to 200°F). Clean magnetic drain plug when changing lubricant. Transmission and Torque Converter filter is located on the inside left side of the frame behind the battery box.

- NOTE 12:** Follow these specified transmission fluid fill instructions:
- a. Fill to FULL on DIPSTICK. Dipstick is located on the side of the carrier, adjacent to the hydraulic tank.
 - b. Run engine at 850 rpm to prime torque converter and lines.
 - c. Check fluid level with engine running at 850 rpm and torque converter fluid at 65°C to 90°C (150°F to 200°F).
 - d. Add transmission fluid, as necessary. FILL to FULL on DIPSTICK.

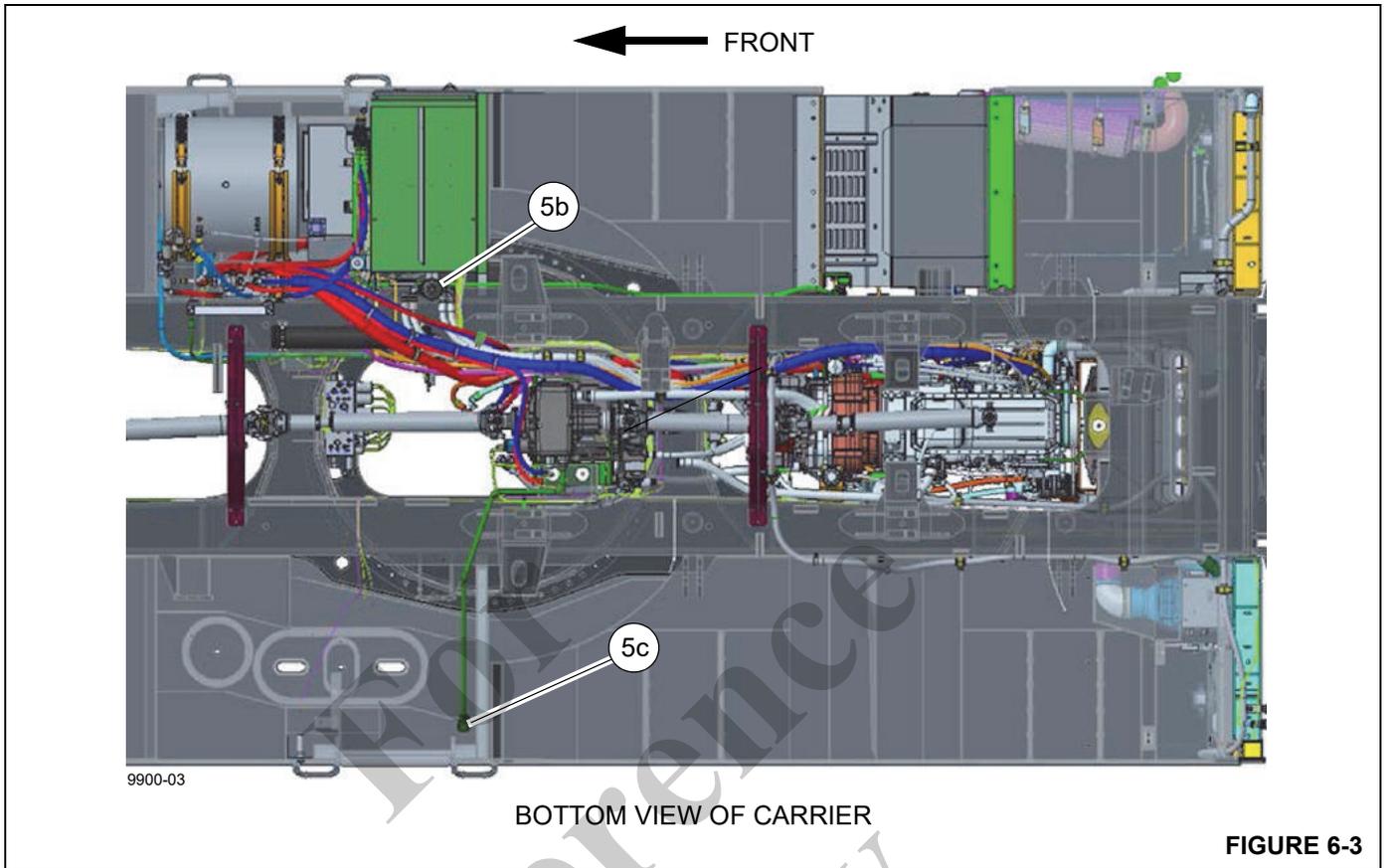


TOP VIEW OF CARRIER

FIGURE 6-2

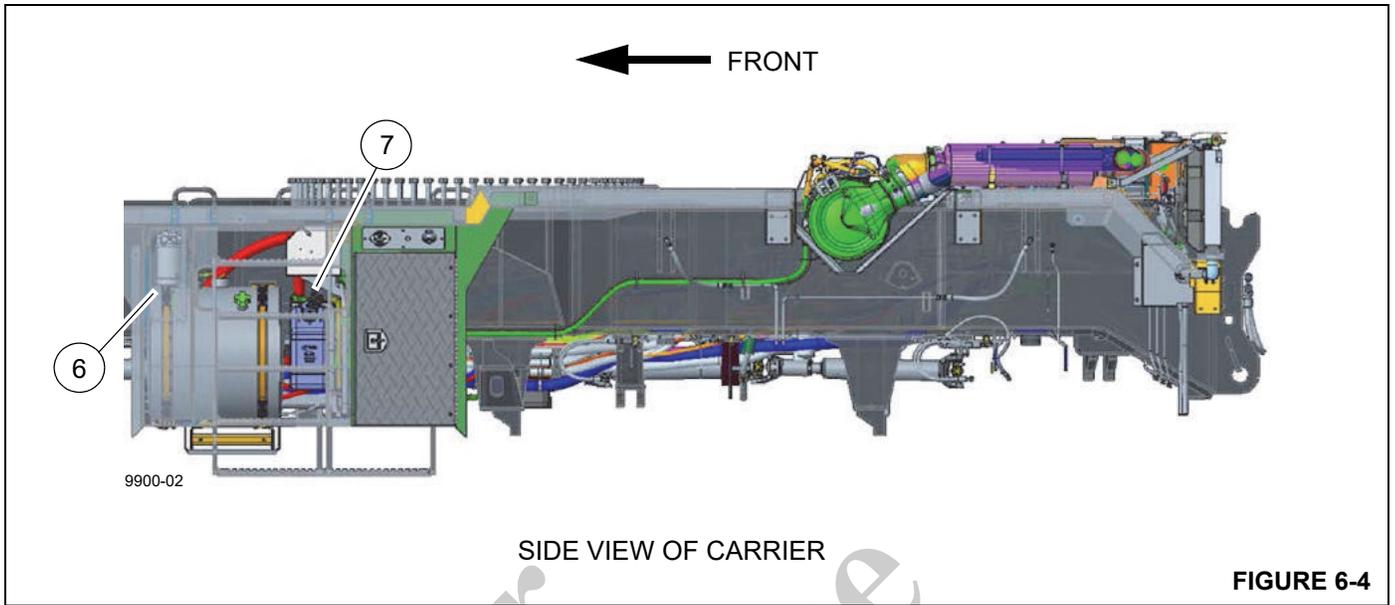
Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Drive Train (Continued)						
5b	Transmission and Torque Converter Filter	Figure 6-3	—	—	PERFORM after first 50 hours of service, and	REPLACE transmission and torque converter filter See NOTE 11.
					REPEAT after another 50 hours for a total of 100 hours of service	REPLACE transmission and torque converter filter
					THEN every 1000 hours, or 6 months, thereafter whichever interval comes first	REPLACE transmission and torque converter filter
5c	Transmission Fluid FILL and DIPSTICK	Figure 6-3	J	44.5 L (11.75 gal)	As necessary, in DRAIN and FILL routines	FILL transmission sump to FULL on DIPSTICK See NOTE 13.
NOTE 13: The Transmission Fluid FILL and DIPSTICK is in a remote location for ease of servicing the transmission.						

For Reference Only



Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Drive Train (Continued)						
6	Fuel Filter/ Water Separator (showing Side View)	Figure 6-4	—	—	Every 10 hours/daily	DRAIN water trap
7	Diesel Exhaust Fluid (DEF) Tank	Figure 6-4	K	37.9 L (10 gal)	Every 10 hours/daily	CHECK DEF level and FILL Indicator in cab comes on when DEF level is low See NOTE 14.
	DEF Tank Filter	Figure 6-4	—	—	Every 2000 hours, or 1 year, whichever interval comes first	CHECK DEF tank filter
NOTE 14: The Diesel Exhaust Fluid (DEF) Level Indicator in the Crane Vitals Area of the Operator Display Module (ODM) comes on YELLOW when the DEF tank is 5%–10% FULL, and RED when the tank is <5% FULL.						

For Reference Only



For Reference Only

Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Drive Train (Continued)						
8	DEF Supply Module Filter	Figure 6-5	—	—	Every 4500 hours of service, or 3 years, whichever interval comes first	CHECK DEF Supply Module filter
9	Engine Oil Filter	Figure 6-5	—	—	Every 500 hours	REPLACE engine oil filter See NOTE 15.
10	Driveline – Slip Joints	Figure 6-5	A	Until grease extrudes	Every 500 hours of service, or 3 months, whichever interval comes first	LUBRICATE 3 grease fittings See NOTE 17.
11	Fuel Filter	Figure 6-5	—	—	Every 500 hours of service, or 6 months, whichever interval comes first	REPLACE fuel filter See NOTE 16.

NOTE 15: The Engine Oil Filter is located on the lower inside left side of the frame adjacent to the torque converter.

NOTE 16: The Fuel Filter is located on the lower inside right side of the frame adjacent to the torque converter.

CAUTION

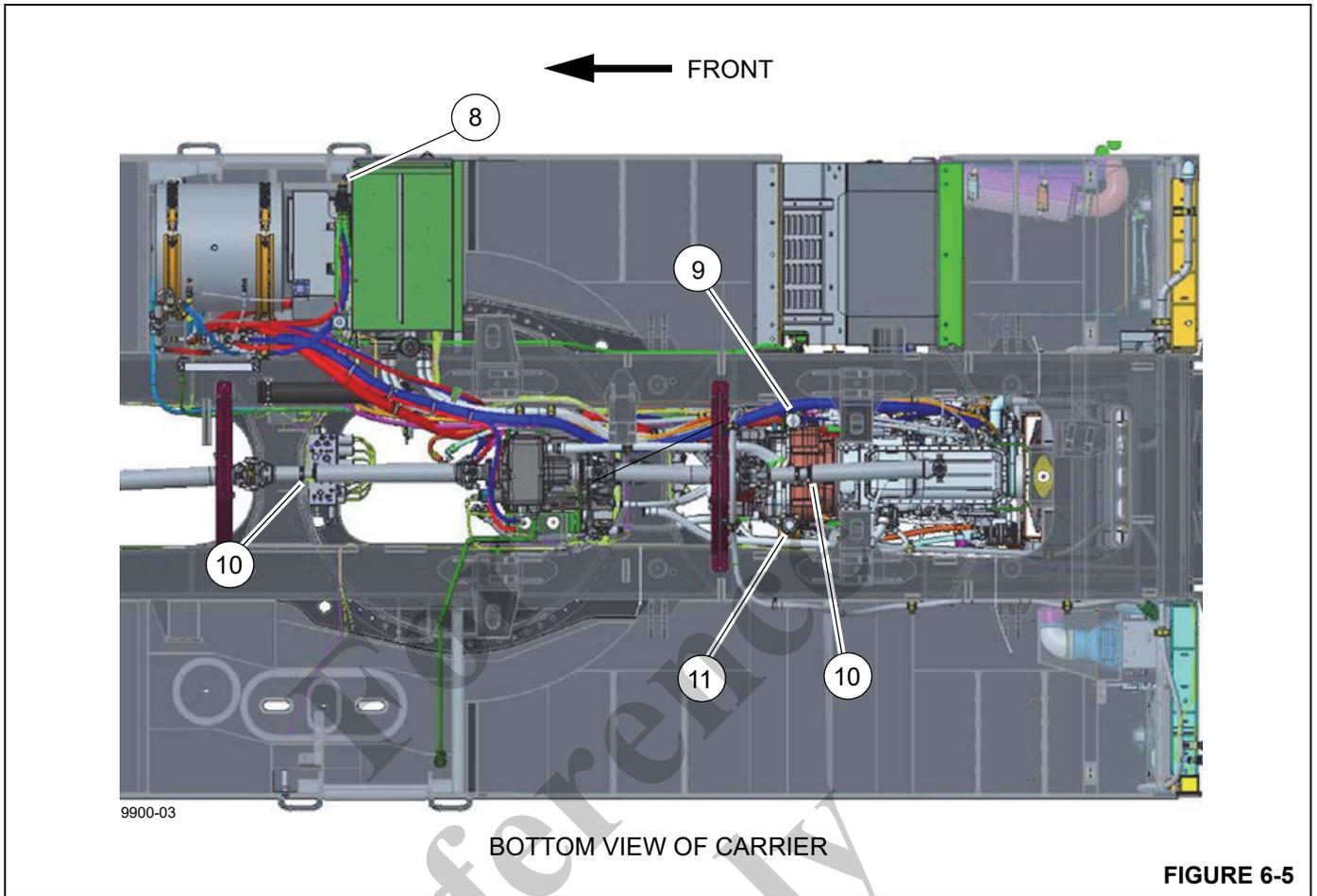
Possible Equipment Damage!

Use semi-synthetic or synthetic lubricants as listed in Section 6 of this *Operator Manual*. See also your GRT9165 *Service Manual* for maintenance and lubrication instructions.

Use of non-approved lubricant may damage components and/or invalidate published lubricant intervals.

Failure to follow this instruction may cause damage to equipment.

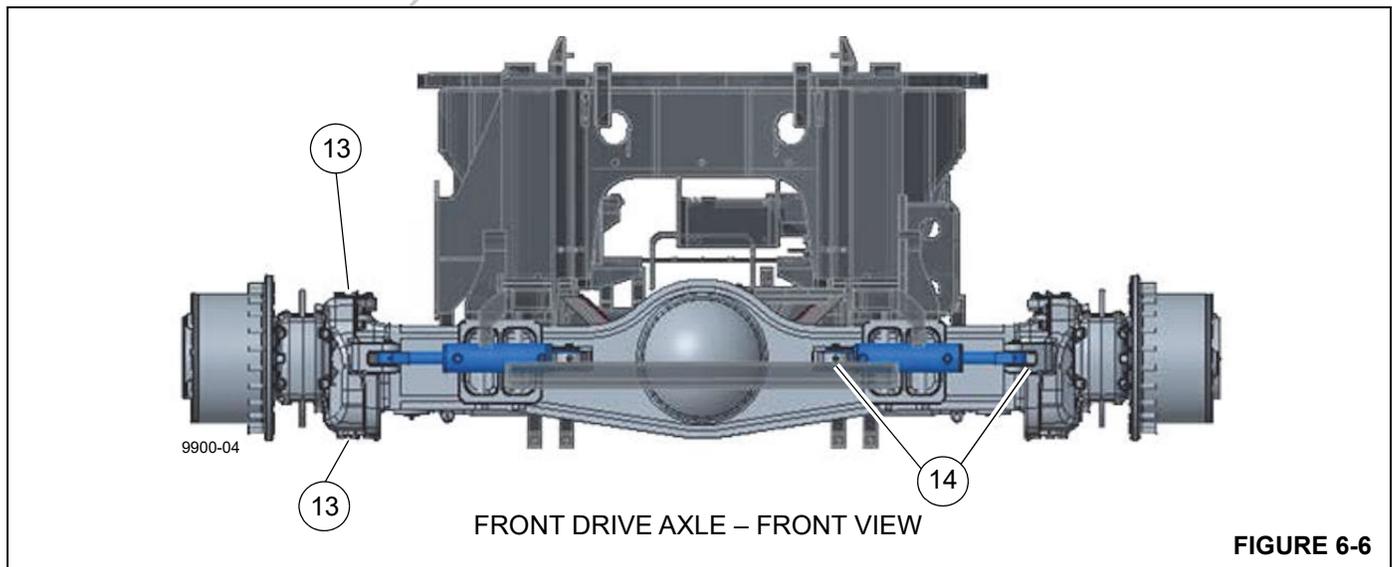
NOTE 17: DO NOT USE non semi-synthetic lubricant. Use of non-approved lubricant may damage components.



Reference Only

Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Steering and Suspension						
13	Upper and Lower King Pins See NOTE 18.	Figure 6-6	A	Until grease extrudes	Every 500 hours, or 3 months, whichever interval comes first	LUBRICATE 4 grease fittings per axle, 3 axles 12 service points
14	Steering Cylinder Pivot Pins See NOTE 18.	Figure 6-6	A	Until grease extrudes	Every 500 hours, or 3 months, whichever interval comes first	LUBRICATE 4 grease fittings per axle, 3 axles 12 service points
16	Tie Rod Pivots See NOTE 18.	Figure 6-7	A	Until grease extrudes	Every 500 hours, or 3 months, whichever interval comes first	LUBRICATE 2 grease fittings per axle, 3 axles 6 service points
17	Panhard Rod Pivots See NOTE 18.	Figure 6-7	A	Until grease extrudes	Every 500 hours, or 3 months, whichever interval comes first	LUBRICATE 2 grease fittings per rod pivot, 2 axles 1 rod pivot Axle 2, 1 rod pivot Axle 3 4 service points
18	Drag Link Pivots See NOTE 18.	Figure 6-8	A	Until grease extrudes	Every 500 hours, or 3 months, whichever interval comes first	LUBRICATE 2 grease fittings per drag link, 2 drag links 4 service points
19	Trailing Rod Pivots See NOTE 18.	Figure 6-8	A	Until grease extrudes	Every 500 hours, or 3 months, whichever interval comes first	LUBRICATE 2 grease fittings per rod pivot, 2 axles 4 rod pivots Axle 2, 4 rod pivots Axle 3 16 service points

NOTE 18: Use grease fittings provided.



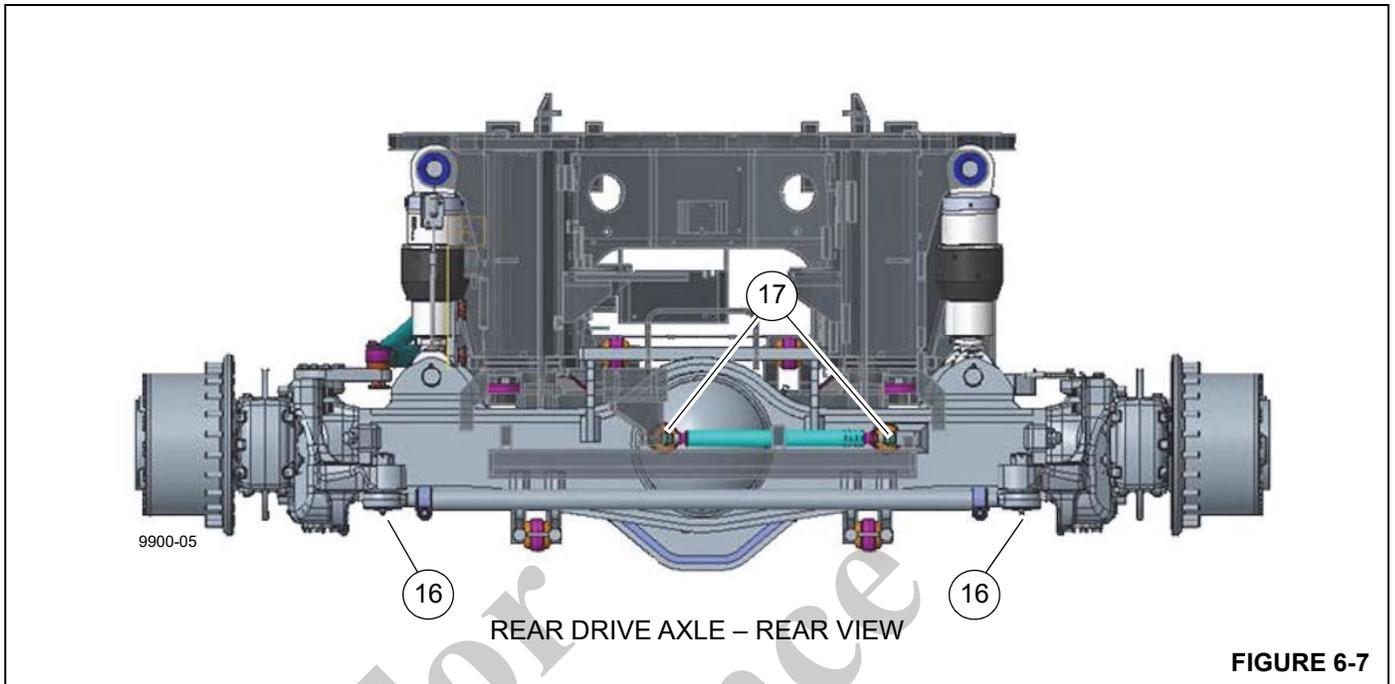


FIGURE 6-7

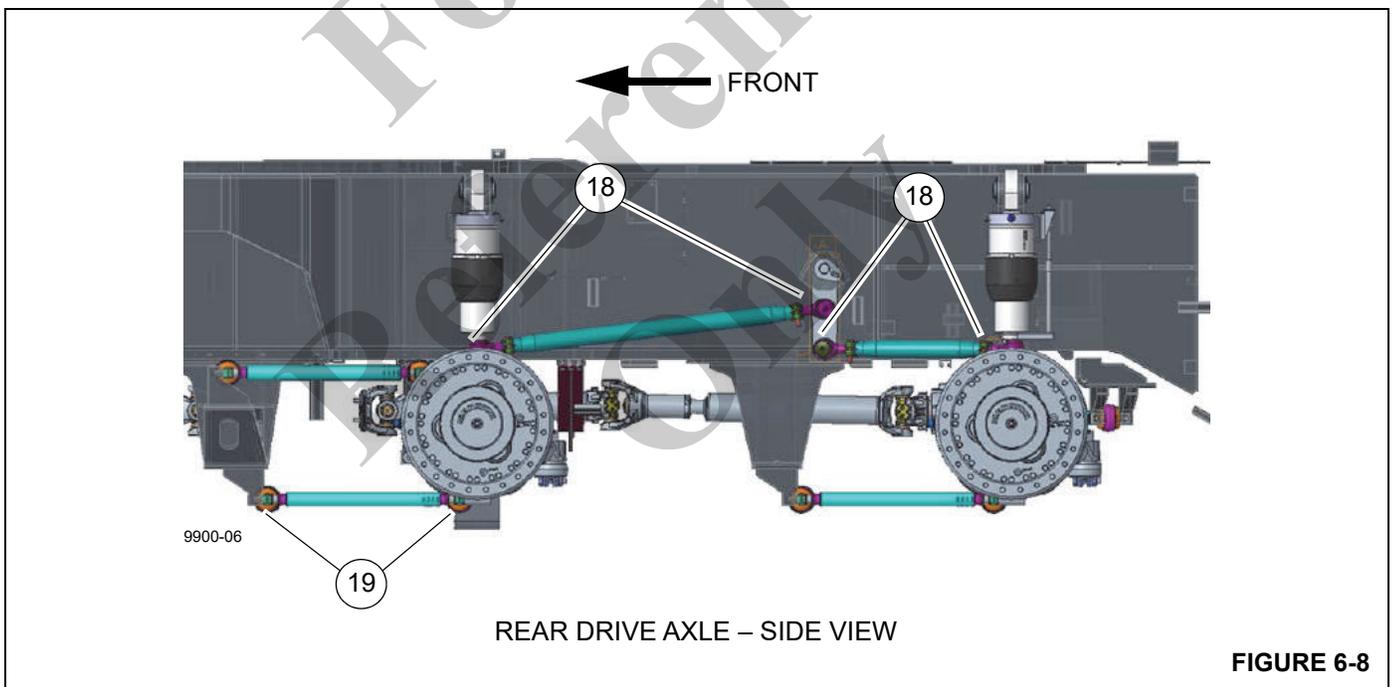


FIGURE 6-8

Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Axle Lubrication						
20	Differentials	Figure 6-9	B	44.8 L (11.8 gal) ea NOTE 21. NOTE 22.	Every 250 hours, or 1 month, whichever interval comes first	CHECK and FILL 2 service points
					Every 3000 hours, or 2 years, whichever interval comes first	DRAIN and FILL 2 service points CLEAN magnetic drain plug INSTALL magnetic plug in drain port
21	Planetary Hubs & Wheel Bearings	Figure 6-10	B	9.8 L (10.4 qt) ea Wheel End NOTE 21. NOTE 22.	Every 250 hours, or 1 month, whichever interval comes first	CHECK and FILL 6 service points See NOTE 19.
	Side View, Planetary DRAIN and FILL ports	Figure 6-11			Every 3000 hours, or 2 years, whichever interval comes first	DRAIN and FILL 6 service points See NOTE 19. See NOTE 20.

NOTE 19: Planetary Hubs and Wheel Bearings must be filled to oil fill level indicated on axle hub. To provide sufficient lubrication, final fluid level **MUST BE LEVEL** with the filler plug hole at the Wheel End, with fluid even slightly dripping from the hole. CLEAN magnetic plug, then INSTALL magnetic plug in drain port.

NOTE 20: Before operating crane in cold weather (arctic) ambient temperatures below -9°C (+15°F), Standard bearing lubricant must be fully purged and replaced with Cold Weather lubricant meeting Grove U.S. L.L.C. specifications as shown in Table 6-4: *Approved Lubricant Reference Table*, page 6-11 in this *Operator Manual*. See also your GRT9165 *Service Manual* for maintenance and lubrication instructions.

NOTE 21: If the makeup amount of fluid is substantially more than 0.23 L (0.5 pt), CHECK for leaks.

CAUTION

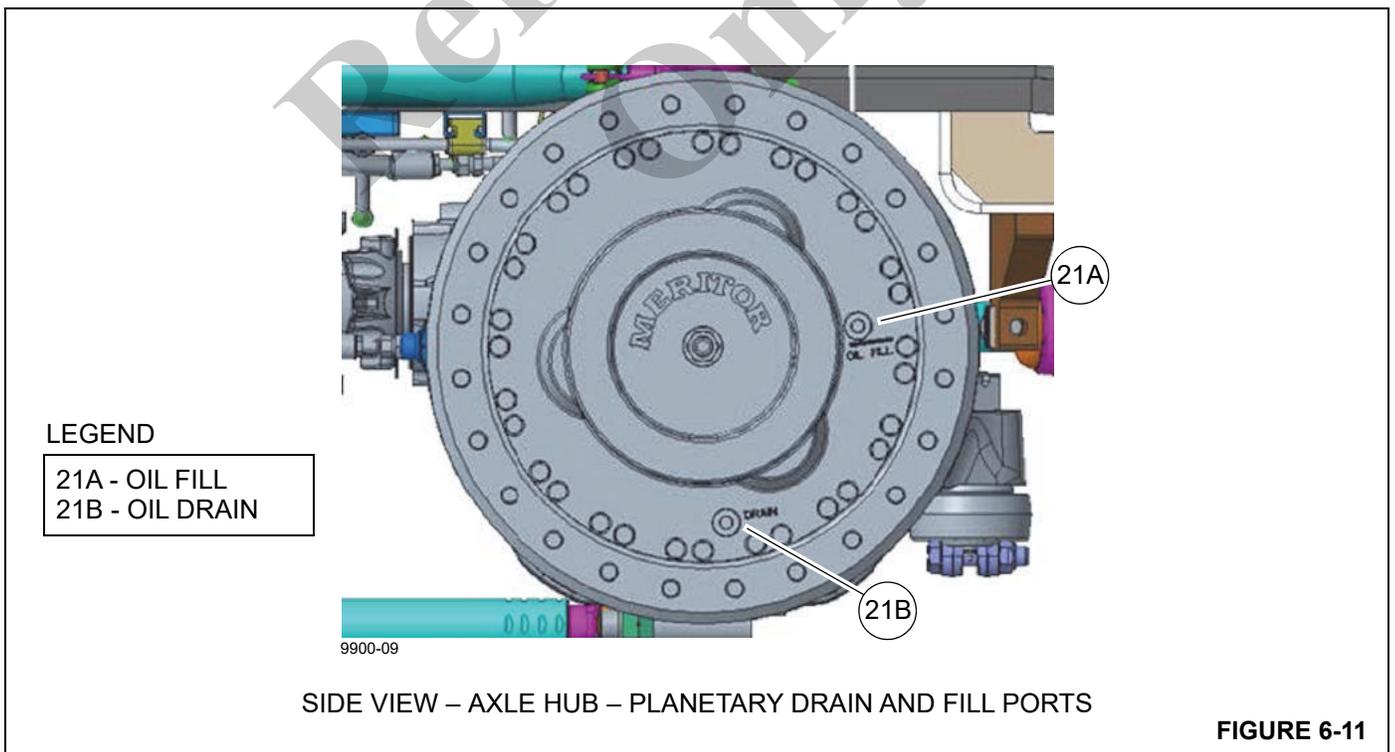
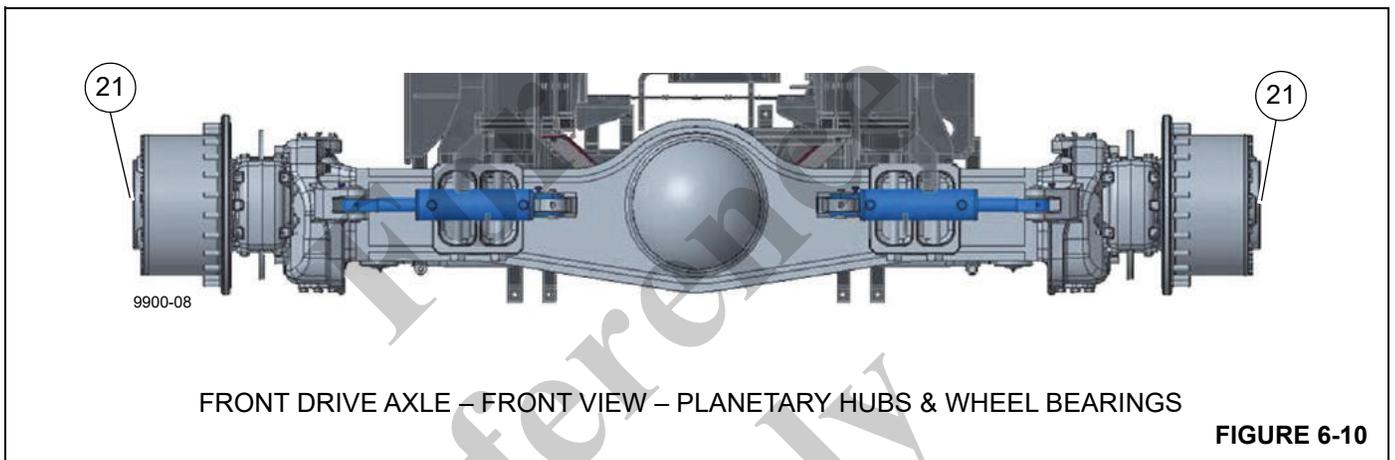
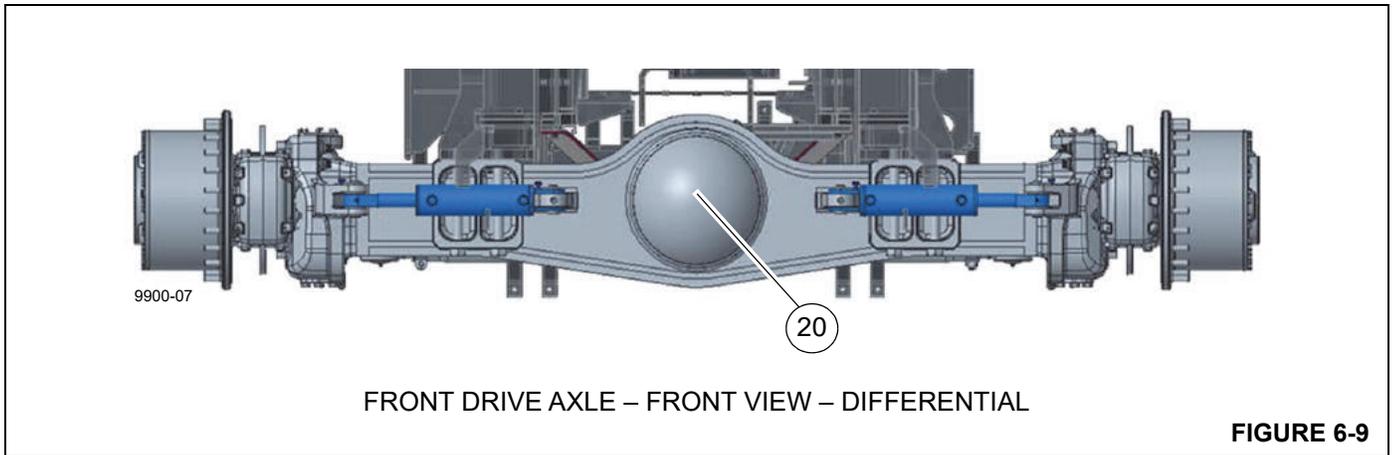
Possible Equipment Damage!

Use semi-synthetic or synthetic lubricants as listed in Section 6 of this *Operator Manual*. See also your GRT9165 *Service Manual* for maintenance and lubrication instructions.

Use of non-approved, non semi-synthetic lubricant may damage components and/or invalidate published lubricant intervals.

Failure to follow this instruction may cause damage to equipment.

NOTE 22: **DO NOT USE non semi-synthetic lubricant.** Use of non-approved lubricant may damage components.



Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Superstructure Lubrication						
22	Swing Drive Bearing	Figure 6-12	A	ROTATE the S/S 90° then grease again REPEAT until the S/S has made one full rotation	Every 500 hours, or 6 months, whichever interval comes first	LUBRICATE 4 grease fittings at front of superstructure (S/S) 4 service points See NOTE 23. See NOTE 24. See NOTE 25.
<p>NOTE 23: Apply grease to four (4) fittings at front of superstructure. Then rotate superstructure 90° and apply grease to fittings once more. Repeat rotating the superstructure in 90° increments and applying grease to the fittings until the entire superstructure has made a full rotation.</p> <p>NOTE 24: The swing drive bearing in this crane is supplied with <i>Cold Weather</i> (arctic) bearing grease capable of ambient temperatures between -40°C and +49°C (-40°F to +120°F), If operating the crane in regions expecting sustained winter/cold season temperatures below 15°F, top off bearing grease using Table 6-2, Cold Weather Lubricants in Arctic Conditions [Down to -29°C (-20°F)]. If temperatures below -9°C (15°F) are rare and intermittent, then greases from Table 6-1, Standard Lubricants [Down to -9°C (+15°F)], are acceptable.</p>						
<p>CAUTION</p> <p>Possible Equipment Damage!</p> <p>Use semi-synthetic or synthetic lubricants as listed in Section 6 of this <i>Operator Manual</i>. See also your GRT9165 <i>Service Manual</i> for maintenance and lubrication instructions.</p> <p>Use of non-approved, non semi-synthetic lubricant may damage components and/or invalidate published lubricant intervals.</p> <p>Failure to follow this instruction may cause damage to equipment.</p>						
<p>NOTE 25: DO NOT USE non semi-synthetic lubricant. Use of non-approved lubricant may damage components.</p>						

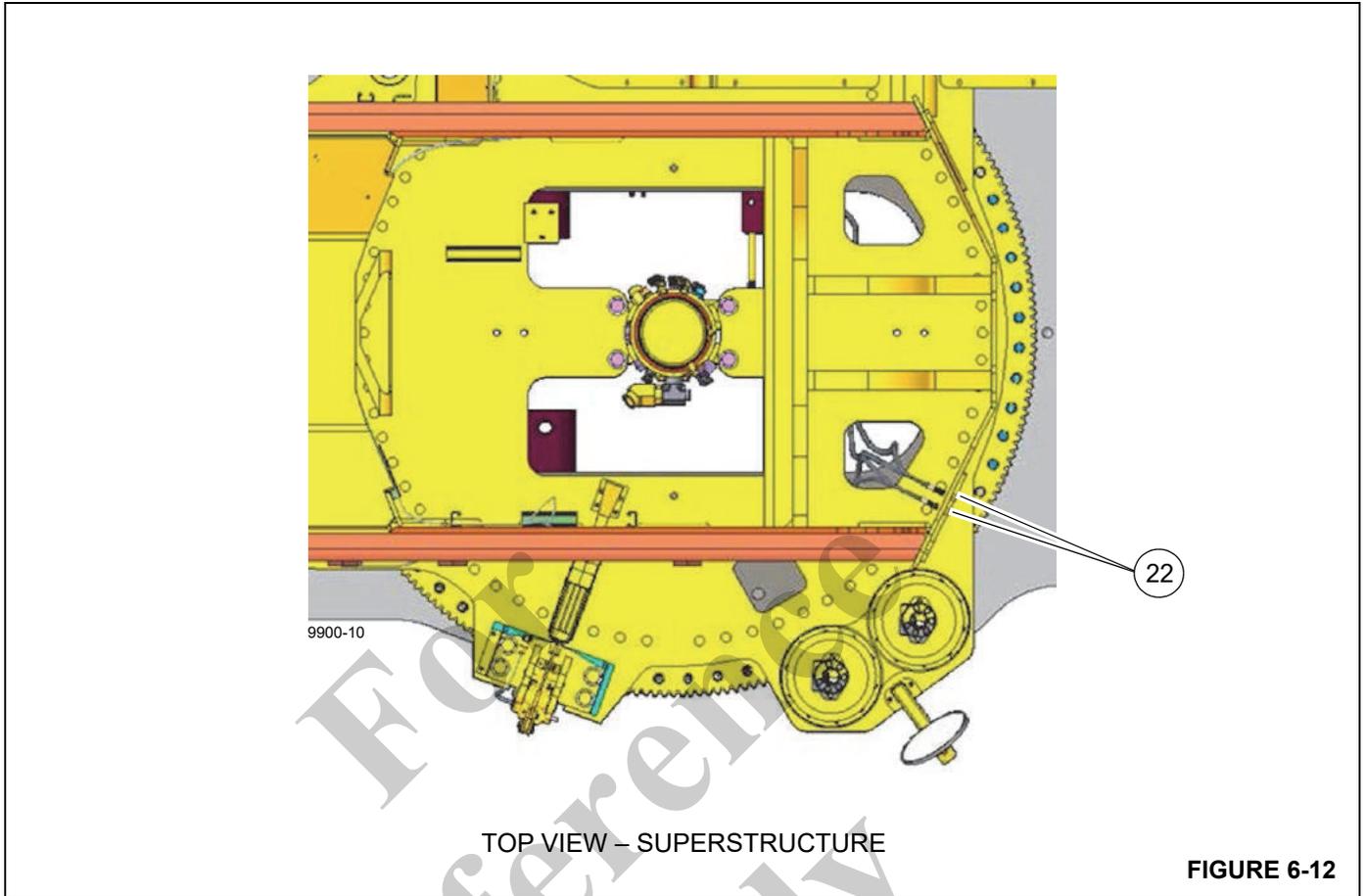
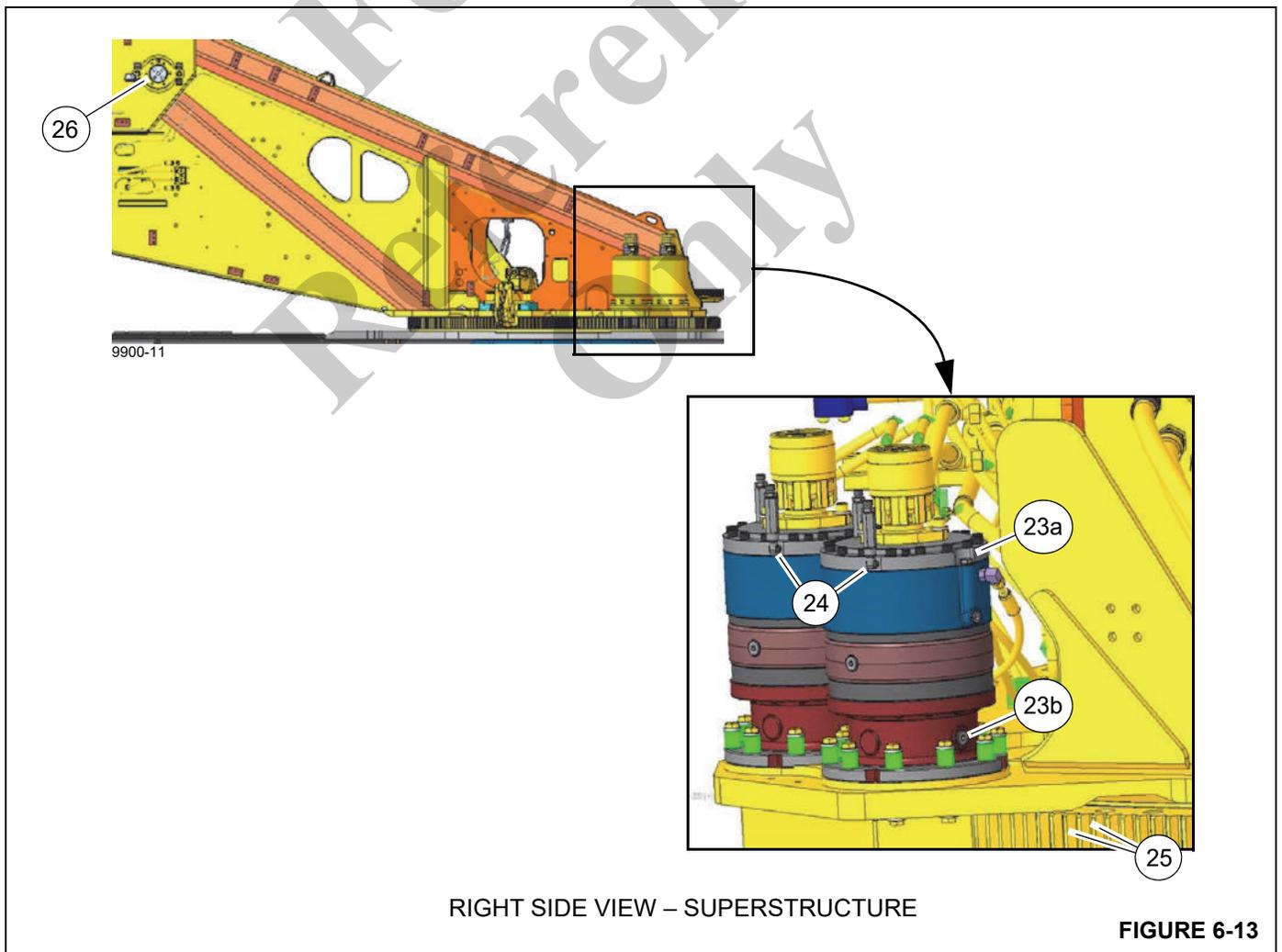


FIGURE 6-12

For Reference Only

Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Superstructure Lubrication						
23	Swing Drive Gearbox See NOTE 29. See NOTE 30.	Figure 6-13	B	4 L (4.23 qt) each gearbox	Every 50 hours of service	CHECK oil level FILL swing drive gearbox to LEVEL on DIPSTICK (23a) 2 service points See NOTE 26.
					Every 1000 hours, or 12 months of service, whichever interval comes first	DRAIN swing drive gearbox at (23b) FILL swing drive gearbox to LEVEL on DIPSTICK (23a) 2 service points See NOTE 26.
24	Swing Drive Gearbox – Brake Assembly See NOTE 29. See NOTE 30.	Figure 6-13	H	0.3 L (0.63 pt) each gearbox	After first 50 hours of service	REMOVE Breather at (24) and DRAIN swing drive brake assembly FILL swing drive brake assembly at (24) to top of elbow See NOTE 27.
					Then, every 50 hours of service, thereafter	CHECK oil level FILL swing drive brake assembly at (24) to top of elbow See NOTE 27.
					Every 1000 hours, or 6 months of service, whichever interval comes first	REMOVE Breather at (24) and DRAIN swing drive brake assembly FILL swing drive brake assembly at (24) to top of elbow See NOTE 27.
25	Swing Drive Gearbox – Drive Pinion See NOTE 29. See NOTE 30.	Figure 6-13	G	SPRAY ON	Every 500 hours, or 6 months of service, whichever interval comes first	SPRAY ON swing drive pinions COAT ALL TEETH
26	Boom Pivot Pins See NOTE 29. See NOTE 30.	Figure 6-13	L	Until grease extrudes	Every 300 hours, or 3 months of service, whichever interval comes first	LUBRICATE 2 grease fittings See NOTE 28.

Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
NOTE 26:	CHECK fluid level in each of two (2) Swing Drive Gearboxes, and FILL to MAX LEVEL on DIPSTICK.					
NOTE 27:	CHECK level in each of two (2) Swing Drive Gearbox Brake Assemblies, and FILL to TOP of ELBOW.					
NOTE 28:	Perform same service for each of two (2) Boom Pivot Pins.					
<p>CAUTION</p> <p>Possible Equipment Damage!</p> <p>Use semi-synthetic or synthetic lubricants as listed in Section 6 of this <i>Operator Manual</i>. See also your <i>Service Manual</i> for maintenance and lubrication instructions.</p> <p>Use of non-approved, non semi-synthetic lubricant may damage components and/or invalidate published lubricant intervals.</p> <p>Failure to follow this instruction may cause damage to equipment.</p>						
NOTE 29:	DO NOT USE non semi-synthetic lubricant. Use of non-approved lubricant may damage components.					
NOTE 30:	Before operating crane in cold weather (arctic) ambient temperatures below -9°C (+15°F), Standard lubricant must be fully purged and replaced with Cold Weather lubricant meeting Grove U.S. L.L.C. specifications as shown in Table 6-4: <i>Approved Lubricant Reference Table</i> , page 6-11 in this <i>Operator Manual</i> . See also your <i>Service Manual</i> for maintenance and lubrication instructions.					



RIGHT SIDE VIEW – SUPERSTRUCTURE

FIGURE 6-13

Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Superstructure and Cab Tilt Lubrication						
27	Pillow Block Bearings See NOTE 34.	Figure 6-14	A	Until grease extrudes from entire bearing circumference	Every 500 hours, or 3 months of service, whichever interval comes first	LUBRICATE 2 grease fittings per pillow block bearing, 2 bearings 4 service points See NOTE 31. See NOTE 33.
28	Turntable Swivel Lock Pin	Figure 6-14	G	Spray on	Every 500 hours, or 6 months of service, whichever interval comes first	SPRAY ON 1 service point
29	Swing Angle Sensor	Figure 6-14	A	Apply grease to fitting See NOTE 32	Every 5000 hours, or 60 months of service, whichever interval comes first	REMOVE M16x1.5 plug from housing LUBRICATE fitting on bottom of swing angle sensor See NOTE 32. See NOTE 33. INSTALL M16x1.5 plug TORQUE plug to 25 N·m (18.45 lbf-ft)
30	Cab Tilt Cylinder Pivot Pins	Figure 6-14	A	Until grease extrudes	Every 500 hours, or 3 months of service, whichever interval comes first	LUBRICATE 2 service points See NOTE 31. See NOTE 33. See NOTE 35.
31	Cab Door Tracks and Rollers	Figure 6-15	Light Oil	—	Every 6 months	LUBRICATE 2 service points See NOTE 36.
32	Air Conditioner Condenser Filter	Figure 6-15	—	—	Every 1000 hours, or 6 months of service, whichever interval comes first	CHECK/CLEAN air conditioner condenser filter 1 service point

NOTE 31: Use grease fittings provided.

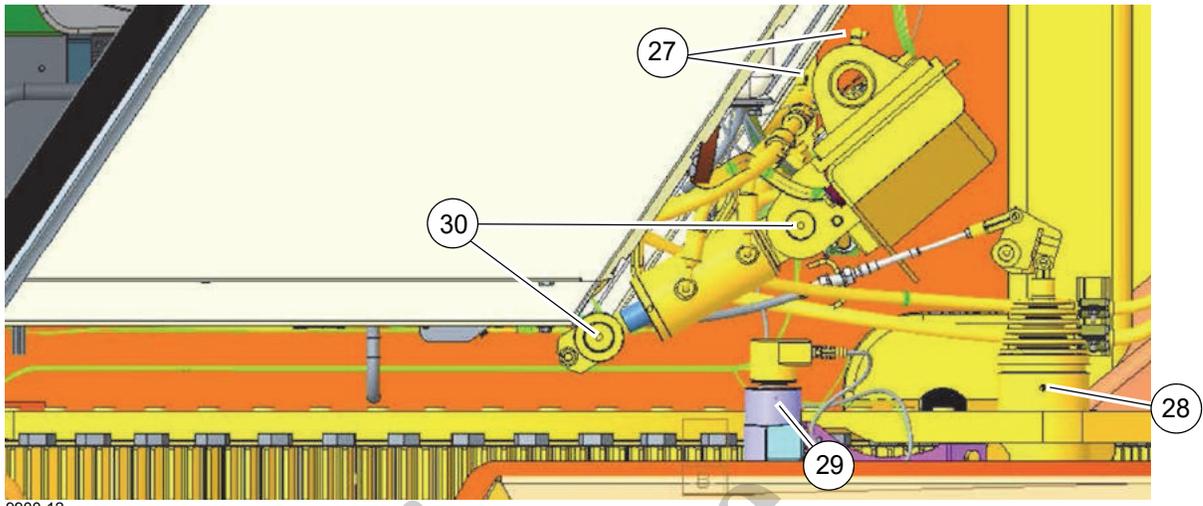
NOTE 32: Remove plug (M16x1.5) from housing. Apply grease to fitting on bottom of sensor. Install plug again and torque plug to 25 N·m (18.45 lb-ft).

NOTE 33: Before operating crane in cold weather (arctic) ambient temperatures below -9°C (+15°F), Standard bearing grease must be fully purged and replaced with Cold Weather grease meeting Grove U.S. L.L.C. specifications as shown in Table 6-4: *Approved Lubricant Reference Table*, page 6-11 in this *Operator Manual*. See also your *GRT9165 Service Manual* for maintenance and lubrication instructions.

NOTE 34: Perform same service for each of two (2) Pillow Block Bearings.

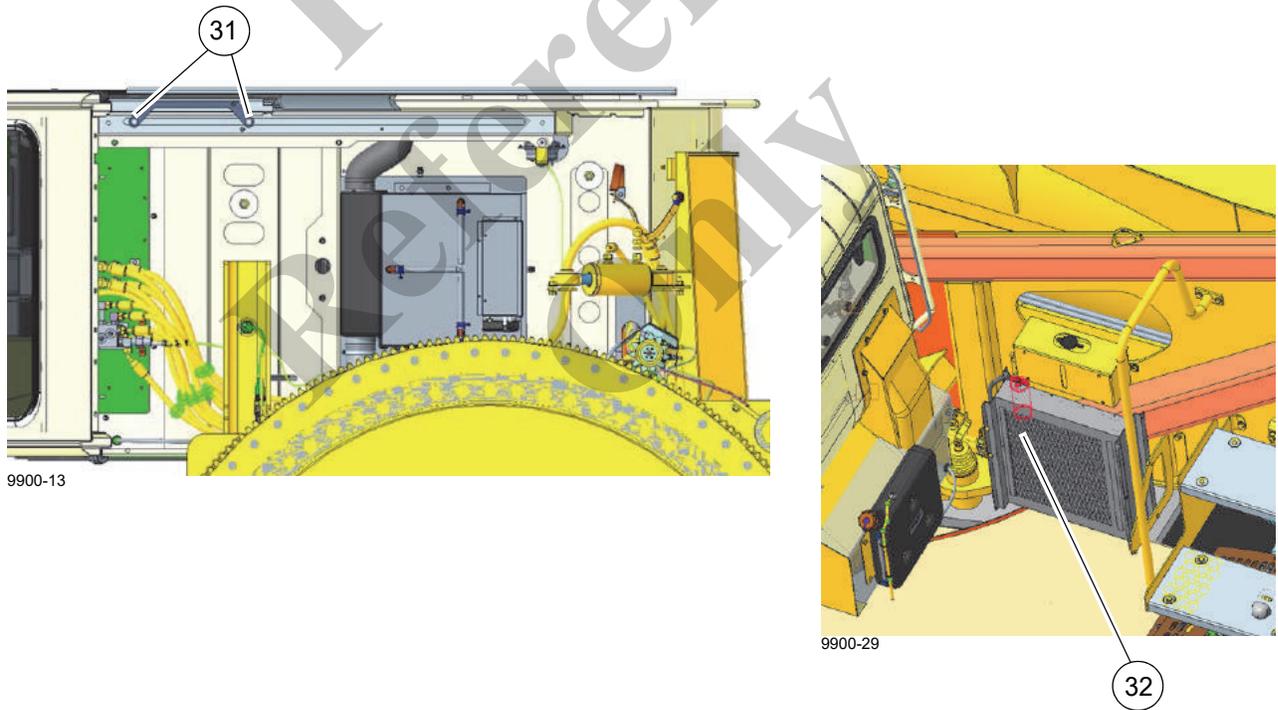
NOTE 35: Perform lubrication service for each grease fitting on two (2) Cab Tilt Cylinder Pivot Pins.

NOTE 36: Perform lubrication service for each of two (2) Cab Door Tracks and Rollers.



LEFT SIDE – SUPERSTRUCTURE

FIGURE 6-14



UNDERSIDE OPERATOR CAB – SUPERSTRUCTURE

FIGURE 6-15

Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Outrigger Lubrication						
33	Jack Cylinder Support Tubes	Figure 6-16	L	Brush on I.D. of each cylinder support tube and wear bands	Every 50 hours, or 1 week of service, whichever interval comes first	BRUSH ON I.D. of 4 service points See NOTE 37. See NOTE 38. See NOTE 42.
34	Outrigger Box Pins See NOTE 42.	Figure 6-16	L	Brush on	Every 50 hours, or 1 week of service, whichever interval comes first	BRUSH ON 8 service points at assembly and/or tear down. See NOTE 37.
35	Outrigger Beams –Top Plates	Figure 6-16	L	Brush on	Every 50 hours, or 1 week of service, whichever interval comes first	BRUSH ON beam top plate as beam is fully extended. See NOTE 37. See NOTE 39. See NOTE 40. See NOTE 41. See NOTE 42.
	Outrigger Beams –Bump-outs	Figure 6-16	L	Brush on	Every 50 hours, or 1 week of service, whichever interval comes first	BRUSH ON 3 TOP, and 3 BOTTOM bump-outs on each side of outrigger beam 12 service points each beam. See NOTE 37. See NOTE 39. See NOTE 40. See NOTE 41. See NOTE 42.
36	Wear Pads	Figure 6-16	L	Brush on	Every 50 hours, or 1 week of service, whichever interval comes first	BRUSH ON 2 TOP wear pads (rectangular–rear), and 2 BOTTOM wear pads (circular–front) of ea outrigger beam 4 service points each beam See NOTE 37. See NOTE 39. See NOTE 42.
37	Jack Cylinder Barrels See NOTE 42.	Figure 6-16	L	Brush on	Every 50 hours, or 1 week of service, whichever interval comes first	BRUSH ON 4 service points See NOTE 37. See NOTE 38.

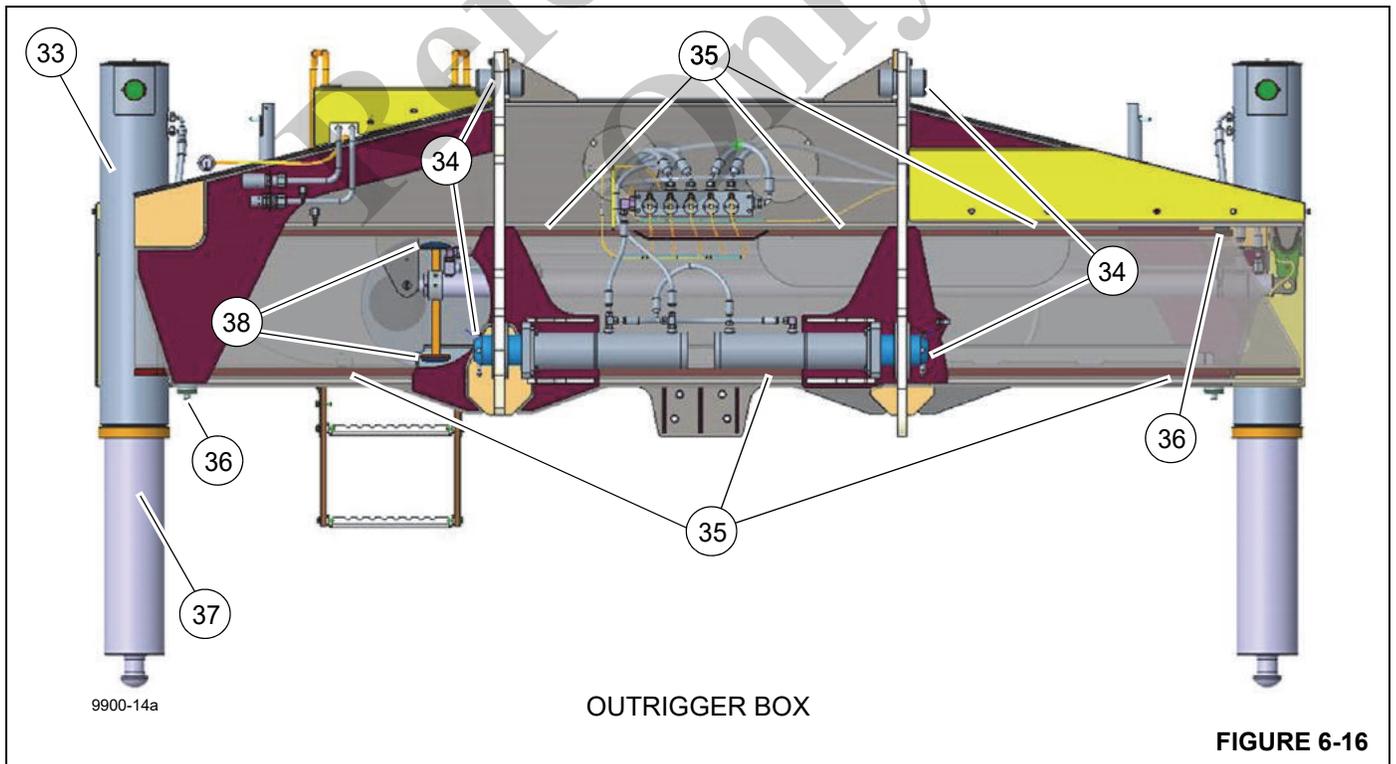
Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
38	Extend Cylinder Supports See NOTE 40. See NOTE 42.	Figure 6-16	L	BRUSH ON	Every 50 hours, or 1 week of service, whichever interval comes first	BRUSH ON 8 service points See NOTE 37. See NOTE 39.

CAUTION

Possible Equipment Damage!

Use semi-synthetic or synthetic lubricants as listed in Section 6 of this *Operator Manual*. See also your *Service Manual* for maintenance and lubrication instructions. Use of non-approved, non semi-synthetic lubricant may damage components and/or invalidate published lubricant intervals. Failure to follow this instruction may cause damage to equipment.

- NOTE 37:** DO NOT USE non semi-synthetic lubricant. Use of non-approved lubricant may damage components.
- NOTE 38:** Brush lubricant in I.D. of Jack Cylinder Support Tubes and Wear Bands before installing Jack Cylinders.
- NOTE 39:** Brush lubricant on TOP wear pads (rectangular–rear), and BOTTOM wear pads (circular–front) of Outrigger Beams and Extend Cylinder Supports.
- NOTE 40:** Brush lubricant on three (3) TOP and three (3) BOTTOM bump-outs found on each side of the outrigger beam where top and bottom plates contact the sides of the outrigger box. Lubricate 6 points each side, per outrigger, when the beam is fully extended.
- NOTE 41:** Perform same service for each of four (4) Outrigger Beams, for a total of 48 service points.
- NOTE 42:** Before operating crane in cold weather (arctic) ambient temperatures below -9°C (+15°F), Standard grease must be fully purged and replaced with Cold Weather grease meeting Grove U.S. L.L.C. specifications as shown in Table 6-4: *Approved Lubricant Reference Table*, page 6-11 in this *Operator Manual*. See also your GRT9165 *Service Manual* for maintenance and lubrication instructions.



Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Lift Cylinder Lubrication						
39	Lower Lift Cylinder Pivot Pin	Figure 6-17	L	Until grease extrudes	Every 100 hours, or 1 month, whichever interval comes first	LUBRICATE 1 grease fitting, 1 service point See NOTE 43. See NOTE 44.

CAUTION

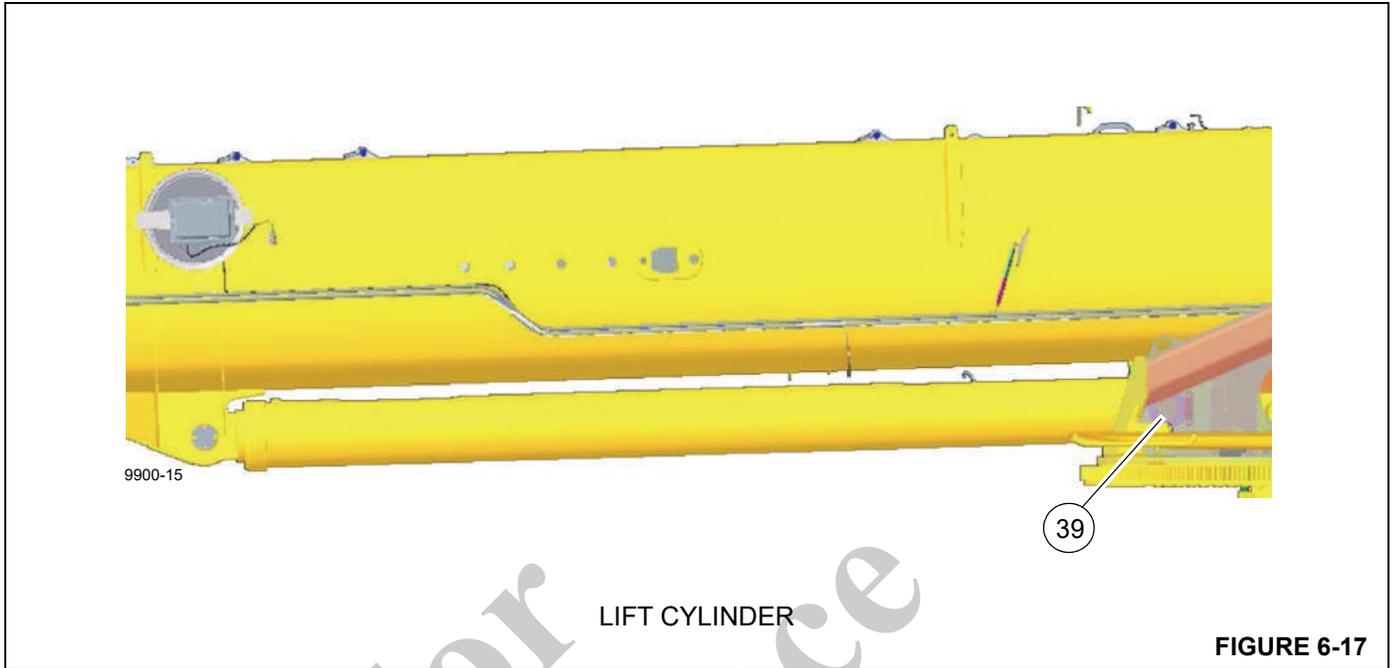
Possible Equipment Damage!

Use semi-synthetic or synthetic lubricants as listed in Section 6 of this *Operator Manual*. See also your *Service Manual* for maintenance and lubrication instructions. Use of non-approved, non semi-synthetic lubricant may damage components and/or invalidate published lubricant intervals. Failure to follow this instruction may cause damage to equipment.

NOTE 43: **DO NOT USE non semi-synthetic lubricant.** Use of non-approved lubricant may damage components.

NOTE 44: Before operating crane in cold weather (arctic) ambient temperatures below -9°C (+15°F), Standard grease must be fully purged and replaced with Cold Weather grease meeting Grove U.S. L.L.C. specifications as shown in Table 6-4: *Approved Lubricant Reference Table*, page 6-11 in this *Operator Manual*. See also your *GRT9165 Service Manual* for specified maintenance and lubrication instructions.

Reference Only



For Reference Only

FIGURE 6-17

Boom Lubrication

READ FIRST! IMPORTANT CRANE SET-UP INFORMATION!

1. With crane set on a firm level surface and counterweight installed, fully extend the outriggers, and level the crane.
2. Center the boom over the front of the crane, engage the turntable swing lock pin, and disable the swing function.
3. Fully retract the boom and set boom angle to 70°.
4. Limit rigging to an overhaul ball or a hook block of no more than 2000 lb.
5. Program the RCL to Rigging Code 0001. Do Not Override the RCL with the Limit Bypass Switch to service the boom.
6. Use the Manual Telescope Mode in the ODM to extend and retract the Tele Sections in the sequences given.
7. To grease rear upper wear pads, front wear pads, and locking pins **on each Tele Section**, extend boom to the sequence given in the following chart.
8. Start with Tele Section 5 (Tele 5).

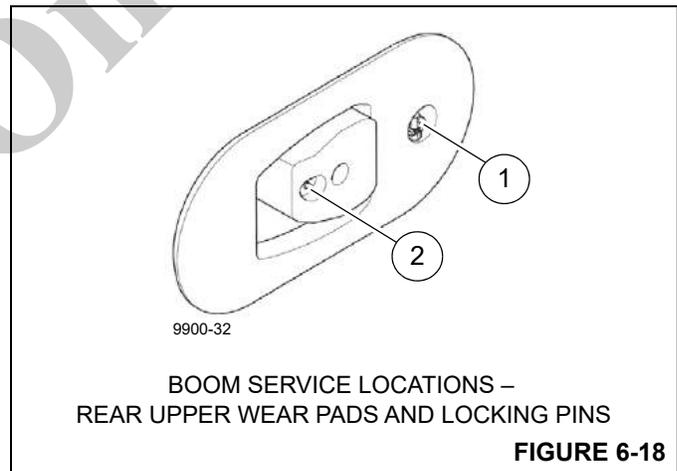
	To Grease Tele 5	To Grease Tele 4	To Grease Tele 3	To Grease Tele 2	To Grease Tele 1
Position Tele 1	0	0	0	55	100
Position Tele 2	0	0	55	100	0
Position Tele 3	0	50	100	0	0
Position Tele 4	50	100	0	0	0
Position Tele 5	100	0	0	0	0

If necessary, refer to the following detailed procedures to lubricate the boom in Manual Telescope Mode.

Telescope Section 5 (Tele 5)

1. Select the Manual Telescope Mode function icon  in the Operator Display Module (ODM) to enter Manual Telescope Mode.
2. Make sure that the tele cylinder is locked to Tele 5.
3. Extend and lock Tele 5 to the 100% pinning location.
4. Extend and lock Tele 4 to the 50% pinning location.
5. Lower the boom to 0° and perform the following greasing in this position:
 - a. Grease outer sides of Tele 5 in the areas that touch the front wear pads of Tele 4.
 - b. Grease the rear upper wear pads of Tele 5 on both sides, at the grease fittings (1, Figure 6-18), through the openings in Tele 4.
 - c. Grease locking pins on both sides (2, Figure 6-18).

NOTE: To grease the rear upper wear pads of Tele 5 at the 50% or 89% pinning locations, extend and lock Tele 5 to these pinning locations and repeat **Step 5b** greasing.



6. While in the horizontal position, first retract Tele 4, and then retract and extend Tele 5 several times to make sure that grease is properly distributed.
7. When Tele 5 greasing is complete, retract and lock Tele 5 to the 0% pinning location.
8. Raise boom to 70°.

Telescope Section 4 (Tele 4)

1. Make sure that the tele cylinder is locked to Tele 4.
2. Extend and lock Tele 4 to the 100% pinning location.
3. Extend and lock Tele 3 to the 50% pinning location.
4. Lower the boom to 0° and perform the following greasing in this position:
 - a. Grease outer sides of Tele 4 in the areas that touch the front wear pads of Tele 3.
 - b. Grease the rear upper wear pads of Tele 4 on both sides, at the grease fittings (1, Figure 6-18), through the openings in Tele 3.
 - c. Grease locking pins on both sides (2, Figure 6-18).

NOTE: To grease the rear upper wear pads of Tele 4 at the 50% or 89% pinning locations, extend and lock Tele 4 to these pinning locations and repeat **Step 4b** greasing.

5. While in the horizontal position, first retract Tele 3, and then retract and extend Tele 4 several times to make sure that grease is properly distributed.
6. When Tele 4 greasing is complete, retract and lock Tele 4 to the 0% pinning location.
7. Raise boom to 70°.

Telescope Section 3 (Tele 3)

1. Make sure that the tele cylinder is locked to Tele 3.
2. Extend and lock Tele 3 to the 100% pinning location.
3. Extend and lock Tele 2 to the 55% pinning location.
4. Lower the boom to 0° and perform the following greasing in this position:
 - a. Grease outer sides of Tele 3 in the areas that touch the front wear pads of Tele 2.
 - b. Grease the rear upper wear pads of Tele 3 on both sides, at the grease fittings (1, Figure 6-18), through the openings in Tele 2.
 - c. Grease locking pins on both sides (2, Figure 6-18).

NOTE: To grease the rear upper wear pads of Tele 3 at the 50% or 89% pinning locations, extend and lock Tele 3 to these pinning locations and repeat **Step 4b** greasing.

5. While in the horizontal position, first retract Tele 2, and then retract and extend Tele 3 several times to make sure that grease is properly distributed.
6. When Tele 3 greasing is complete, retract and lock Tele 3 to the 0% pinning locations.
7. Raise boom to 70°.

Telescope Section 2 (Tele 2)

1. Make sure that the tele cylinder is locked to Tele 2.
2. Extend and lock Tele 2 to the 100% pinning location.
3. Extend and lock Tele 1 to the 55% pinning location.
4. Lower the boom to 0° and perform the following greasing in this position:
 - a. Grease outer sides of Tele 2 in the areas that touch the front wear pads of Tele 1.
 - b. Grease the rear upper wear pads of Tele 2 on both sides, at the grease fittings (1, Figure 6-18), through the openings in Tele 1.
 - c. Grease locking pins on both sides (2, Figure 6-18).

NOTE: To grease the rear upper wear pads of Tele 2 at the 55% or 89% pinning locations, extend and lock Tele 2 to these pinning locations and repeat **Step 4b** greasing.

5. While in the horizontal position, first retract Tele 1, and then retract and extend Tele 2 several times to make sure that grease is properly distributed.
6. When Tele 2 greasing is complete, retract and lock Tele 2 to the 0% pinning location.
7. Raise boom to 70°.

Telescope Section 1 (Tele 1)

1. Make sure that the tele cylinder is locked to Tele 1.
2. Extend and lock Tele 1 to the 100% pinning location.
3. Lower the boom to 0° and perform the following greasing in this position:
 - a. Grease outer sides of Tele 1 in the areas that touch the front wear pads of the base section.
 - b. Grease the rear upper wear pads of Tele 1 on both sides, at the grease fittings (1, Figure 6-18), through the openings in the base section.
 - c. Grease locking pins on both sides (2, Figure 6-18).

NOTE: To grease the rear upper wear pads of Tele 1 at the 55% or 89% pinning locations, extend and lock Tele 1 to these pinning locations and repeat **Step 3b** greasing.

4. While in the horizontal position, extend and retract Tele 1 several times to make sure that grease is properly distributed.
5. When Tele 1 greasing is complete, retract and lock Tele 1 to the 0% pinning location.

Boom Tele Section Lubrication procedures are complete.

Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Boom Lubrication (Continued)						
41	Telescopic Slide Faces See NOTE 45.	Figure 6-19	N	BRUSH ON	Every 500 hours, or 6 months, whichever interval comes first	BRUSH ON front faces in a thin line See NOTE 46.

CAUTION

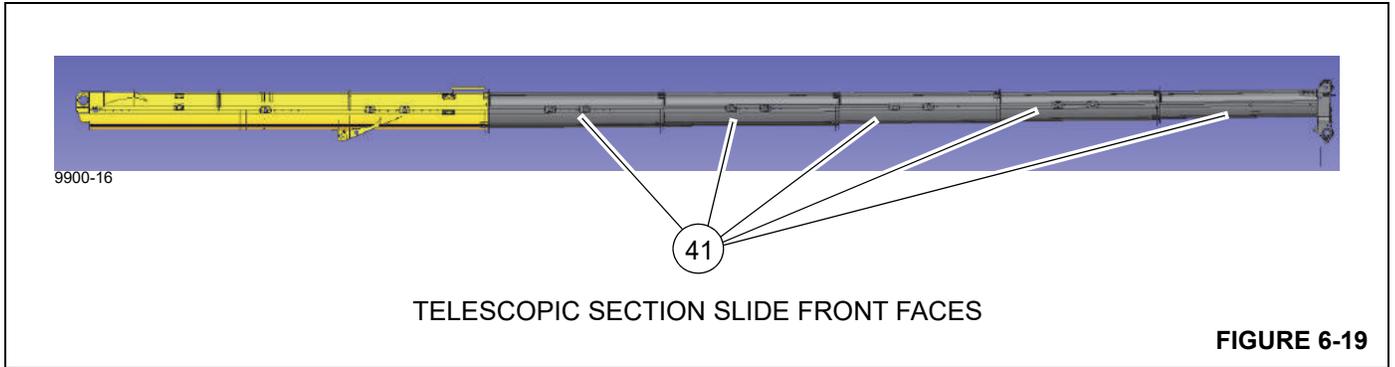
Possible Equipment Damage!

Use semi-synthetic or synthetic lubricants as listed in Section 6 of this *Operator Manual*. See also your *Service Manual* for maintenance and lubrication instructions. Use of non-approved, non semi-synthetic lubricant may damage components and/or invalidate published lubricant intervals. Failure to follow this instruction may cause damage to equipment.

NOTE 45: DO NOT USE non semi-synthetic lubricant. Use of non-approved lubricant may damage components.

NOTE 46: Extend boom for **access to telescopic slide front faces** that contact wear pads inside the boom. Follow the boom Tele Section positioning and lubrication instruction given in the section titled *READ FIRST! IMPORTANT CRANE SET-UP INFORMATION!*, page 6-36. If the weather is very bad or operating conditions are poor, then more frequent intervals are necessary. Monitor the service points and adjust lubrication intervals, as necessary.

For Reference Only

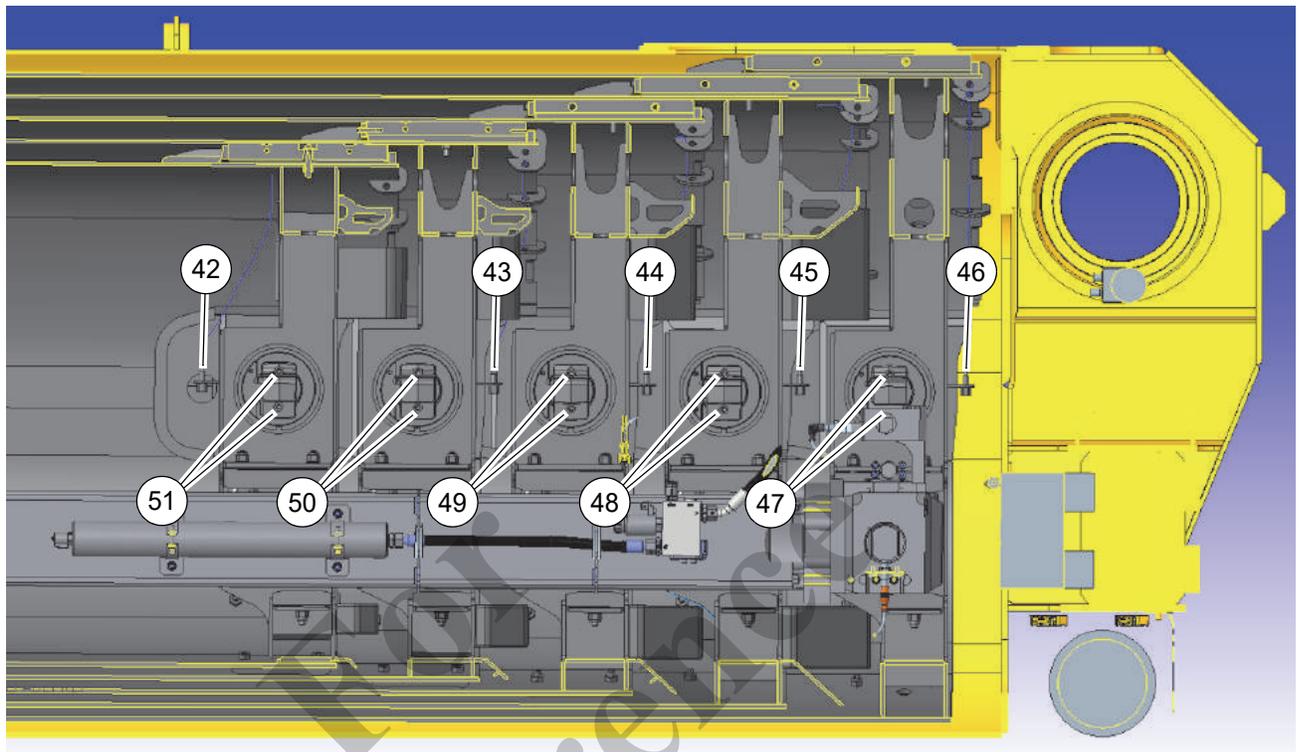


For Reference Only

Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Boom Lubrication (Continued)						
42	Tele 5 Rear Upper Wear Pad	Figure 6-20	N	Only until resistance is felt	Every 500 hours, or 6 months, whichever interval comes first	LUBRICATE 2 service points See NOTE 47.
43	Tele 4 Rear Upper Wear Pad	Figure 6-20	N	Only until resistance is felt	Every 500 hours, or 6 months, whichever interval comes first	LUBRICATE 2 service points See NOTE 47.
44	Tele 3 Rear Upper Wear Pad	Figure 6-20	N	Only until resistance is felt	Every 500 hours, or 6 months, whichever interval comes first	LUBRICATE 2 service points See NOTE 47.
45	Tele 2 Rear Upper Wear Pad	Figure 6-20	N	Only until resistance is felt	Every 500 hours, or 6 months, whichever interval comes first	LUBRICATE 2 service points See NOTE 47.
46	Tele 1 Rear Upper Wear Pad	Figure 6-20	N	Only until resistance is felt	Every 500 hours, or 6 months, whichever interval comes first	LUBRICATE 2 service points See NOTE 47.
47	Tele 1 Lock Pin	Figure 6-20	P	1 or 2 pumps each fitting	Every 250 hours, or 3 months, whichever interval comes first	LUBRICATE 2 service points See NOTE 48.
48	Tele 2 Lock Pin	Figure 6-20	P	1 or 2 pumps each fitting	Every 250 hours, or 3 months, whichever interval comes first	LUBRICATE 2 service points See NOTE 48.
49	Tele 3 Lock Pin	Figure 6-20	P	1 or 2 pumps each fitting	Every 250 hours, or 3 months, whichever interval comes first	LUBRICATE 2 service points See NOTE 48.
50	Tele 4 Lock Pin	Figure 6-20	P	1 or 2 pumps each fitting	Every 250 hours, or 3 months, whichever interval comes first	LUBRICATE 2 service points See NOTE 48.
51	Tele 5 Lock Pin	Figure 6-20	P	1 or 2 pumps each fitting	Every 250 hours, or 3 months, whichever interval comes first	LUBRICATE 2 service points See NOTE 48.

NOTE 47: DO NOT apply excessive pressure or force when greasing wear pads. Applying excessive pressure or force can cause grease fitting to separate from wear pad. Apply grease only until resistance is felt.

NOTE 48: To grease rear upper-wear pads, front wear pads, and locking pins on each Tele Section, follow the boom Tele Section positioning and lubrication instruction given in the section titled *READ FIRST! IMPORTANT CRANE SET-UP INFORMATION!*, page 6-36. Start with Tele Section 5 (Tele 5). See also your GRT9165 Service Manual for detailed service interval and specified boom lubrication instructions.



9900-20

LEFT SIDE BOOM – REAR UPPER WEAR PADS AND LOCK PINS

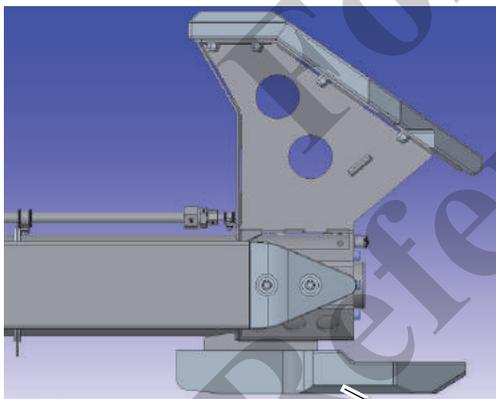
FIGURE 6-20

Reference Only

Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Boom Lubrication (Continued)						
52	Tele Cylinder Wear Pad	Figure 6-21	N	Coat areas that the wear pads move on	Every 500 hours, or 6 months of service, whichever interval comes first	BRUSH ON 5 service points
53	Boom Extension Pivot Pin	Figure 6-21	A	Until grease extrudes	Every 100 hours, or 1 month of service, whichever interval comes first	LUBRICATE 2 service points
54	Mast Sheave	Figure 6-21	—	—	Every 250 hours, or 3 months of service, whichever interval comes first	CHECK 1 service point CHECK sheave for dry points of operation CHECK sheave for grease leaks See NOTE 49.
55	Boom Nose Sheave	Figure 6-21	—	—	Every 250 hours, or 3 months of service, whichever interval comes first	CHECK 7 service points CHECK sheave for dry points of operation CHECK sheave for grease leaks See NOTE 49.
56	Auxiliary Boom Nose Sheave	Figure 6-21	—	—	Every 250 hours, or 3 months of service, whichever interval comes first	CHECK 1 service point CHECK sheave for dry points of operation CHECK sheave for grease leaks See NOTE 49.
57	Boom Extension Offset Cylinder Pivot Pin	Figure 6-21	A	Until grease extrudes	Every 100 hours, or 1 month of service, whichever interval comes first	LUBRICATE 2 service points

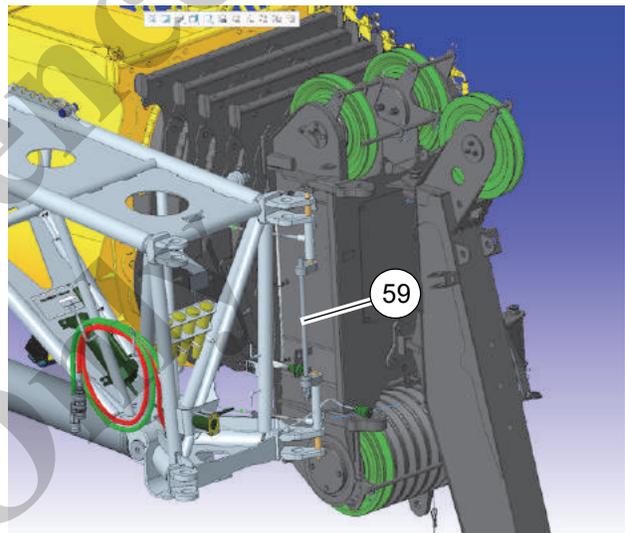
Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Boom Lubrication (Continued)						
58	Boom Extension Sheaves	Figure 6-21	—	—	Every 250 hours, or 3 months of service, whichever interval comes first	CHECK 3 service points CHECK sheaves for dry points of operation CHECK sheaves for grease leaks See NOTE 49.
59	Boom Extension Screw	Figure 6-21	A	Brush on entire screw	BRUSH ON, as necessary	BRUSH ON 1 service point

NOTE 49: Slowly turn the sheave, and **examine it for rough or dry points** of operation and **grease leaks**. If rough or dry points of operation are found, then **replace the sheave**. If grease leaks are found, then **replace the sheave**.



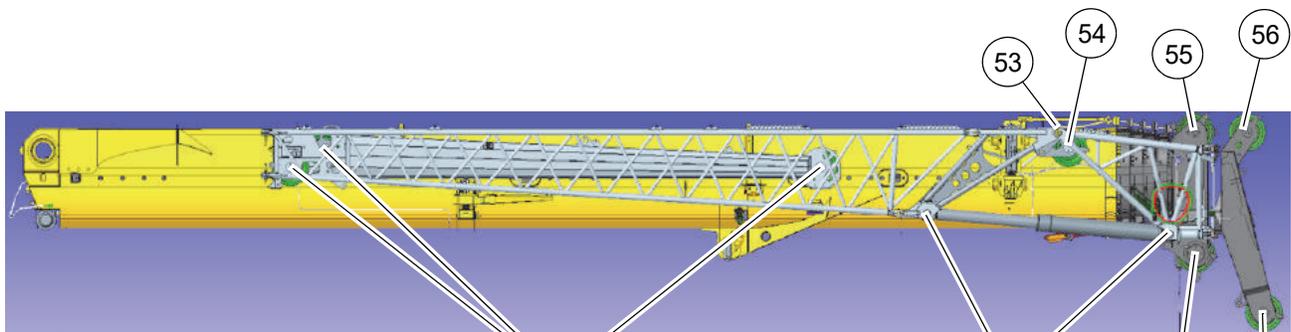
9900-19

TELE CYLINDER WEAR PAD (52)



9900-18

BOOM EXTENSION SCREW (59)



9900-17

BOOM EXTENSION (58)

FIGURE 6-21

Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Boom Lubrication (Continued)						
60	Hook Block Swivel Bearing	Figure 6-22	A	Until grease extrudes	Every 250 hours, or 3 months of service, whichever interval comes first	LUBRICATE 1 to 2 service points See NOTE 50. See NOTE 51. See NOTE 53.
61A	Hook Block Sheaves – 100MT	Figure 6-22	—	—	Every 250 hours, or 3 months of service, whichever interval comes first	CHECK sheaves on each of five (5) hook blocks listed. 1 service point ea as defined below: CHECK sheaves for dry points of operation CHECK sheaves for grease leaks See NOTE 52.
61B	Hook Block Sheaves – 120MT					
61C	Hook Block Sheaves – 26MT					
61D	Hook Block Sheaves – 45MT					
61E	Hook Block Sheaves – 75MT					
62	Swivel Rope	Figure 6-22	A	Until grease extrudes	Every 250 hours, or 3 months of service, whichever interval comes first	LUBRICATE 1 service point on each of three (3) items listed See NOTE 50. See NOTE 51. See NOTE 53.
63	Overhaul Weight					
64	Overhaul Ball					

CAUTION

Possible Equipment Damage!

Use semi-synthetic or synthetic lubricants as listed in Section 6 of this *Operator Manual*. See also your GRT9165 *Service Manual* for maintenance and lubrication instructions.

Use of non-approved, non semi-synthetic lubricant may damage components and/or invalidate published lubricant intervals.

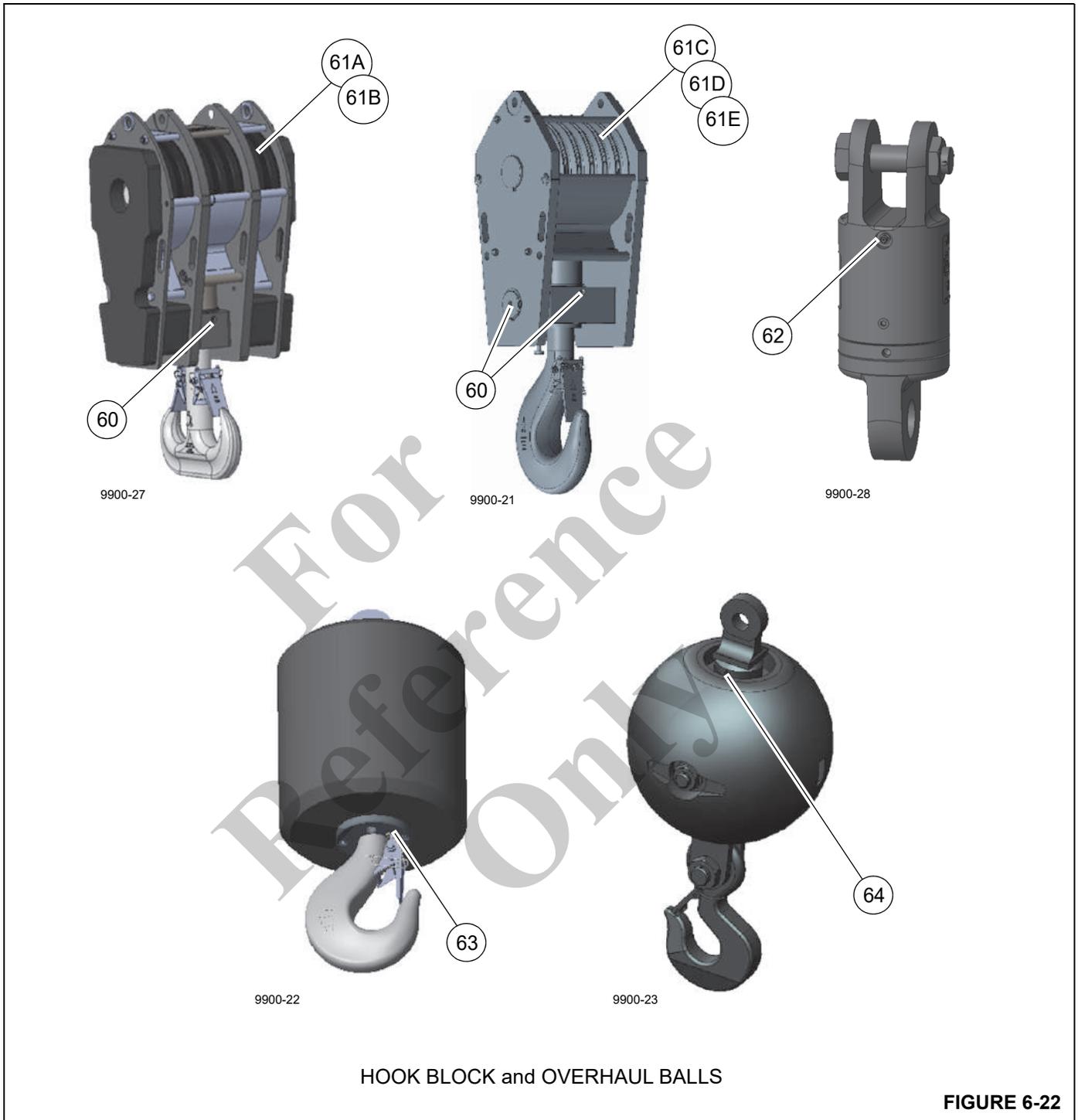
Failure to follow this instruction may cause damage to equipment.

NOTE 50: **DO NOT USE non semi-synthetic lubricant.** Use of non-approved lubricant may damage components.

NOTE 51: Before operating crane in cold weather (arctic) ambient temperatures below -9°C (+15°F), Standard grease must be fully purged and replaced with Cold Weather grease meeting Grove U.S. L.L.C. specifications as shown in Table 6-4: *Approved Lubricant Reference Table*, page 6-11 in this *Operator Manual*. See also your GRT9165 *Service Manual* for maintenance and lubrication instructions.

NOTE 52: Slowly turn the sheave, and **examine it for rough or dry points** of operation and **grease leaks**. If rough or dry points of operation are found, then replace the sheave. If grease leaks are found, then replace the sheave.

NOTE 53: If the weather is very bad or operating conditions are poor, then more frequent intervals are necessary. Monitor the service points and adjust lubrication intervals, as necessary.



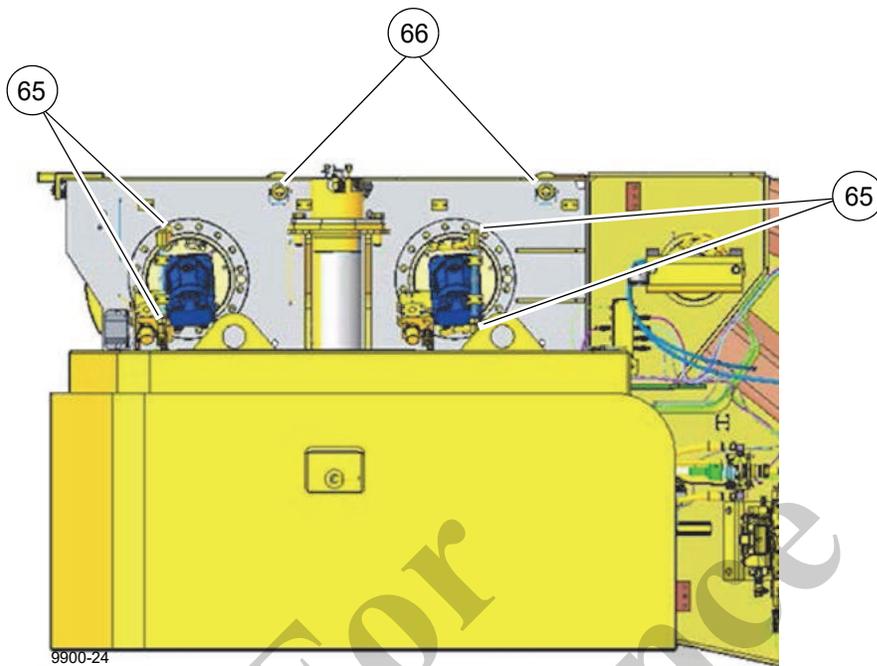
Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Hoist Lubrication						
65	Hoist Drums (Main & Auxiliary)	Figure 6-23	H	4 L (1.05 gal)	Every 50 hours of service, or weekly, whichever interval comes first	CHECK oil level 2 service points REMOVE vent or hose from top of the sight glass to FILL FILL hoist drums to LEVEL visible in sight glass 2 service points See NOTE 54. See NOTE 55. See NOTE 57.
						CHECK and CLEAN breather as needed
					Every 1000 hours, or 12 months of service, whichever interval comes first	REMOVE plug or hose from bottom of sight glass to DRAIN oil DRAIN hoist drums 2 service points FILL hoist drums to LEVEL visible in sight glass See NOTE 54. See NOTE 55. See NOTE 57.
						CHECK and CLEAN breather as needed
66	Hoist Rope Rollers	Figure 6-23	A	Brush on outer surface of roller	Every 250 hours, or 3 months of service, whichever interval comes first	BRUSH ON 2 service points See NOTE 54. See NOTE 56.
67	Hoist Bearings	Figure 6-23	A	Until grease extrudes from entire bearing circumference	Every 250 hours, or 3 months of service, whichever interval comes first	LUBRICATE 2 service points See NOTE 54. See NOTE 57.

NOTE 54: DO NOT USE non semi-synthetic lubricant. Use of non-approved lubricant may damage components.

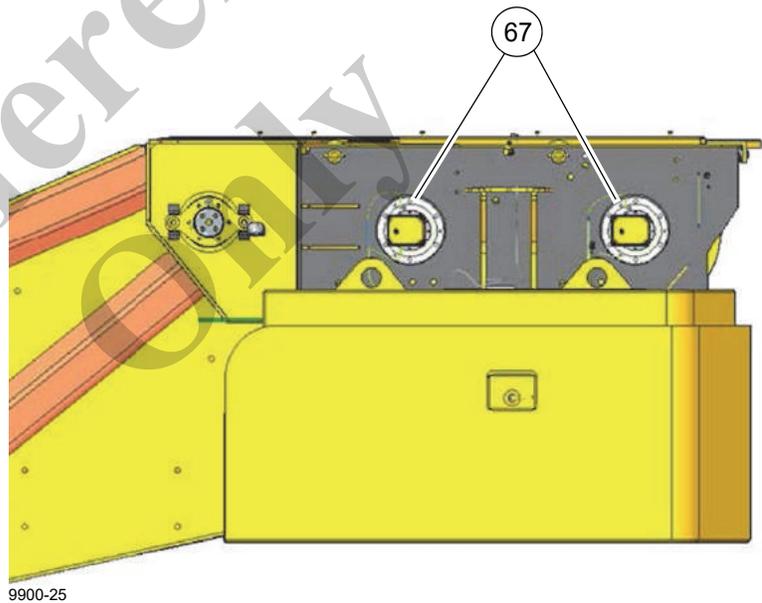
NOTE 55: Check oil level in hoist drum sight glass. Hoist oil level MUST be between the high and low marks on sight glass. If oil is not visible, hoist may be underfilled. If oil is escaping from the vent plug, hoist may be overfilled.

NOTE 56: If the weather is very bad or operating conditions are poor, then more frequent intervals are necessary. Monitor the service points and adjust lubrication intervals, as necessary.

NOTE 57: Before operating crane in cold weather (arctic) ambient temperatures below -9°C (+15°F), Standard bearing grease must be fully purged and replaced with Cold Weather bearing grease meeting Grove U.S. L.L.C. specifications as shown in Table 6-4: *Approved Lubricant Reference Table*, page 6-11 in this *Operator Manual*. See also your GRT9165 *Service Manual* for maintenance and lubrication instructions.



HOIST DRUM – RIGHT SIDE



HOIST DRUM – LEFT SIDE

HOIST DRUMS – (MAIN and AUXILIARY)

FIGURE 6-23

Item	Lube Point Description	Figure No.	Approved Lubricant	Lube Capacity	Lube Interval	Application
Hydraulics Lubrication						
68	Hydraulic Tank SIGHT GLASS	Figure 6-24	J	729 L (192.6 gal)	Every 10 hours of service, or daily, whichever interval comes first	CHECK oil level FILL hydraulic tank to LEVEL in SIGHT GLASS See NOTE 58. See NOTE 61.
69	Hydraulic Tank BREATHER				PERFORM SERVICE INSPECTION every 3 to 6 months	PERFORM SERVICE INSPECTION of oil, filters, and breathers See NOTE 59. See NOTE 60. See NOTE 61.
		SAMPLE hydraulic oil every 3 to 6 months	SAMPLE hydraulic oil			
70	Hydraulic Filter	Figure 6-24	—	—	REPLACE hydraulic filter when restriction indicator gauge on the filter head shows red	REPLACE hydraulic filter element See NOTE 59. See NOTE 61.

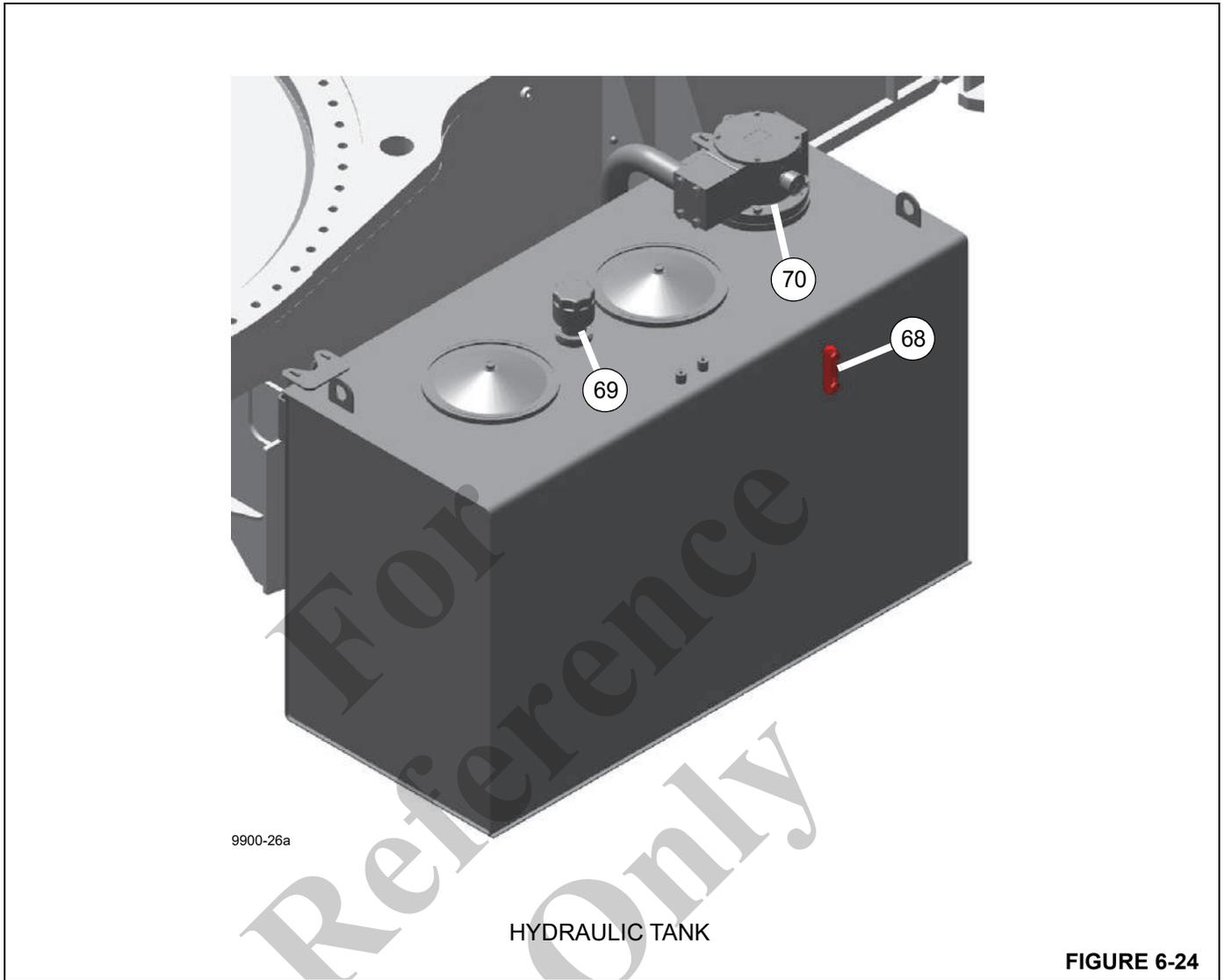
NOTE 58: Check Hydraulic oil level using sight glass on tank with boom fully retracted and lowered, and all outrigger cylinders retracted.

NOTE 59: REPLACE hydraulic filters at **first 50-hours of service** and **repeat after another 50-hours**, for a total of **100 hours of service**, thereafter, at normal intervals. **Hydraulic oil MUST BE at operating temperature** at hydraulic filter and tank inspection and service.

NOTE 60: Hydraulic oil should be drained at a temperature of 65°C to 90°C (150°F to 200°F).

NOTE 61: **Hydraulic oil SHALL MEET or EXCEED ISO 4406 class 17/14 cleanliness level** (reference SAE J1165).

- Working in harsh environmental conditions can dramatically affect the performance and condition of hydraulic oil, filters, and breathers. Therefore, specific intervals for servicing/changing hydraulic oil, filters, and hydraulic tank breathers cannot be set. Thus, it is imperative for the continued satisfactory performance of Grove cranes, that service inspections be performed on the basis of how and where each crane is used. Airborne and ingested contaminants can significantly reduce the life of oil, and condition of hydraulic oil filters and tank breathers.
- Under normal operating conditions, Grove recommends that **hydraulic oil, filters, and breathers** be serviced, and **hydraulic oil sampled** at least every 3 to 6 months. Service inspections should be for airborne or ingested particles and water that deteriorates and contaminates the hydraulic oil. Contaminated hydraulic oil appears “milky” or no longer has a transparent clear to amber color. The return filter by-pass indicator should be observed daily to determine if the contaminant content is high. If the filter by-pass indicator reaches the red zone or indicates a by-pass condition, the hydraulic oil must be sampled. Perform service to **make sure that the hydraulic oil tank breather does not restrict air flow IN, or air flow OUT of the reservoir.**
- FILL procedure for Hydraulic Tank operation below -9°C (+15°F):
 - a. DRAIN existing oil.
 - b. FILL tank with oil per 6829101559 and cycle all cylinders.
 - c. DRAIN oil.
 - d. FILL tank with oil per 6829101559.
- See also your GRT9165 *Service Manual* for further details on Hydraulic Oil Sampling Test. Should you have any questions, please contact your local authorized Grove distributor.



Item	Lube Point Description	Figure No.	Approved Lubricant	Lube Capacity	Lube Interval	Application
HVAC System						
80	HVAC Filter	---	---	---	Replace HVAC filter yearly. If used in dirty conditions, check filter monthly or as needed and replace if necessary.	HVAC filter is located behind access panel on bottom side of cab.

For Reference Only

RUST PROTECTION

Protecting Cranes From Rusting

Grove cranes are manufactured to high quality standards, including the type of paint finish demanded by today's industry. In partnership with our paint supplier, we are also doing our part to help prevent premature corrosion of cranes.

Grove cranes are treated with Carwell[®] T32 (CP-90) rust inhibitor. While a rust inhibitor cannot guarantee that a crane will never rust, this product helps protect against corrosion on Grove cranes.

Carwell[®] is a treatment, not a coating. It contains no silicones, solvents, chlorofluorocarbons (CFC), or anything that would be classified as hazardous under OSHA Regulation 29CFR 1910.1200. The product is a liquid blend of petroleum derivatives, rust inhibitors, and water-repelling/water-displacing agents.

Special equipment is used to spray a light film on the entire undercarriage and various other areas of each new crane before shipment. When applied, the product has a red tint to allow applicators to view coverage. This red tint turns clear within approximately 24 hours after application.

Once applied, treatment can appear to leave a slightly "oily" residue on painted surfaces, and until the red tinting fades, could be mistaken for a hydraulic oil leak. While the product is not harmful to painted surfaces, glass, plastic or rubber, it must be removed using standard steam-cleaning techniques.

This treatment works in various ways: (1) it eliminates the moisture containing salt, dirt, and other pollutants by lifting and removing them from the metal surface; (2) the film creates a barrier to repel further moisture from coming in contact with the metal; and (3) it penetrates crevices.

In addition to the factory-applied treatment, owners of Grove cranes must provide proper maintenance and care to help ensure long-term protection of their crane against corrosion. This procedure provides information and guidelines to help maintain the paint finish on Grove cranes.

The most common causes of corrosion include the following:

- Road salts, chemicals, dirt, and moisture trapped in the hard-to-reach areas;
- Chipping or wear of paint, caused by minor incidents or moving components;
- Damage caused by personal abuse, such as using the decks to transport rigging gear, tools, or cribbing; and
- Exposure to harsh environmental hazards such as alkaline, acids, or other chemicals that can attack the crane's paint finish.

While crane surfaces that are easily seen have the biggest impact on appearance, particular attention should be given to the undercarriage to minimize harmful effects of corrosion.

Exercise special care and increase frequency of cleaning if crane is operated:

- on roads where large quantities of salt or calcium are applied to treat icy and snowy road surfaces;
- in areas that use dust control chemicals;
- anywhere there are increased levels of wetness, especially near salt water;
- during prolonged periods of exposure to damp conditions (for example, moisture held in mud), where certain crane parts may become corroded even though other parts remain dry; or
- in high humidity, or when temperatures are just above the freezing point.

Cleaning Procedures

To help protect against corrosion of Grove cranes, Manitowoc Crane Care recommends washing the crane at least monthly to remove all foreign matter. More frequent cleaning may be needed when operating in harsh environmental conditions. To clean the crane, follow these guidelines:

- High pressure water or steam is effective for cleaning the crane undercarriage and wheel housings. Keeping these areas clean will decrease the rate of corrosion, and improve the ability to identify possible issues before they grow into larger problems.

CAUTION

High pressure water can be forced into spaces and infiltrate beyond seals. Avoid pressure washing near electrical controls, panels, wiring, sensors, hydraulic hoses and fittings, or anything that can be damaged by high pressure cleaning/spraying.

- Rinse dirt and dust off before washing the crane. Dirt can scratch the crane's finish during washing/cleaning.
- Hard to clean spots caused by road tar or bugs should be treated and cleaned after rinsing and before washing. Do not use solvents or gasoline.
- Wash the crane only with soaps and detergents recommended for automotive paint finishes.
- Rinse all surfaces thoroughly to prevent streaking caused by soap residue.
- Allow crane to dry thoroughly. You can increase the speed of evaporation by using compressed air to remove excess water.

NOTE: Polishing and waxing (using automotive-type wax) is recommended to maintain original paint finish.

Inspection and Repair

- Immediately following cleaning of the Grove crane, Manitowoc Crane Care recommends an inspection to detect areas that may have become damaged by stone chips or minor mishaps. A minor scratch (one that has not penetrated to the substrate surface) can be buffed with an automotive-type scratch remover. It is recommended that a good coat of automotive wax be applied to this area afterwards.
- Any area scratched through to bare metal should be touched up and repaired as soon as possible to prevent flash rusting. To repair a major scratch (down to bare metal) or minor damage, follow these procedures:

NOTE: Manitowoc Crane Care recommends a qualified body repair technician prepare, prime, and paint any major scratch(es) or minor damage.



CAUTION

To the extent any damage is structural in nature, Grove crane must be contacted and consulted as to what repairs may be required.

For scratches and marks in highly visible areas:

1. Sand to remove scratch. Feather outward from the mark to blend repair into the original surface. Apply body putty as necessary to hide the defect, then sand smooth.
2. Cover all bare metal with a primer compatible with the original paint finish, and allow to dry thoroughly.
3. Prepare surface before applying finish coat of paint.
4. Apply a finish coat using accepted blending techniques. Use of original paint colors is recommended to ensure the best color match possible.

For scratches and marks in areas of low visibility:

- Consider touching up the spots with a brush technique to cover the bare metal. This will decrease the rate of corrosion, and enable you to do the repair later during a normal maintenance interval.

Spots should be touched up with quality paint. Primers tend to be porous. Only using a single coat of primer will allow air and water to penetrate the repair over time.

Application

Depending on the environment in which a crane is used and/or stored, initial factory application of Carwell® T32 (CP-90) should help inhibit corrosion for approximately 12 months.

It is recommended the treatment be periodically reapplied by the crane owner, after that time, to help continue protection against corrosion of the crane and its components.

However, if a crane is used and/or stored in harsh environments (such as islands, coastal regions, industrial areas, areas where winter road salt is regularly used, etc.), reapplication of treatment is recommended sooner than 12 months, for example, repeat treatment in 6 to 9 months.

- Do not apply to recently primed and painted areas for at least 48 hours after paint is properly dried and cured. For minor touch up areas a 24-hour period is needed for cure time before applying treatment.

NOTE: The crane must be completely dry before applying treatment.

- Do not allow product to puddle or build-up on weather stripping, rubber gaskets, etc. The crane should not have puddles or runs evident anywhere.
- To ensure proper coverage, product needs to be fogged on the crane.
- Use of pressure pots to apply treatment is recommended.
- Carwell® treatment is available in 16-ounce spray bottles from Manitowoc Crane Care (order part number 8898904099).
- After treatment application is complete, wash or clean film residue from lights, windshield, grab handles, ladders/steps and all crane access areas, as necessary.

Contact your local Grove distributor or Manitowoc Crane Care should you have any questions.

Areas of Application

Refer to Figure 6-25 and Figure 6-26 for location of crane components that need periodic application of Carwell® T32 (CP-90) for continued protection against corrosion.

- Underside of crane will have full coverage of the rust inhibitor. These are the only areas that a full coat of rust inhibitor is acceptable on painted surfaces. These areas include; valves, hose end and fittings, swivel, pumps, axles, drive lines, transmission, slew ring fasteners and all interior surfaces of the frame.
- Frame application areas are; hose ends and fittings, all unpainted fasteners and hardware, all bare metal surfaces, outrigger pads, and back up alarm hardware.
- Superstructure applications are; hose end and fittings, wire rope on hoist roller tensioning springs on hoists, all unpainted fasteners and hardware, valves, slew ring fasteners, and all bare metal surfaces.
- Boom applications areas are; pivot pins, hose end and fittings, boom extension pins and shafts, all bare metal surfaces, overhaul ball pins, hook block pins, and fasteners.
- All hardware, clips, pins, and hose connections that are not painted will have treatment applied.

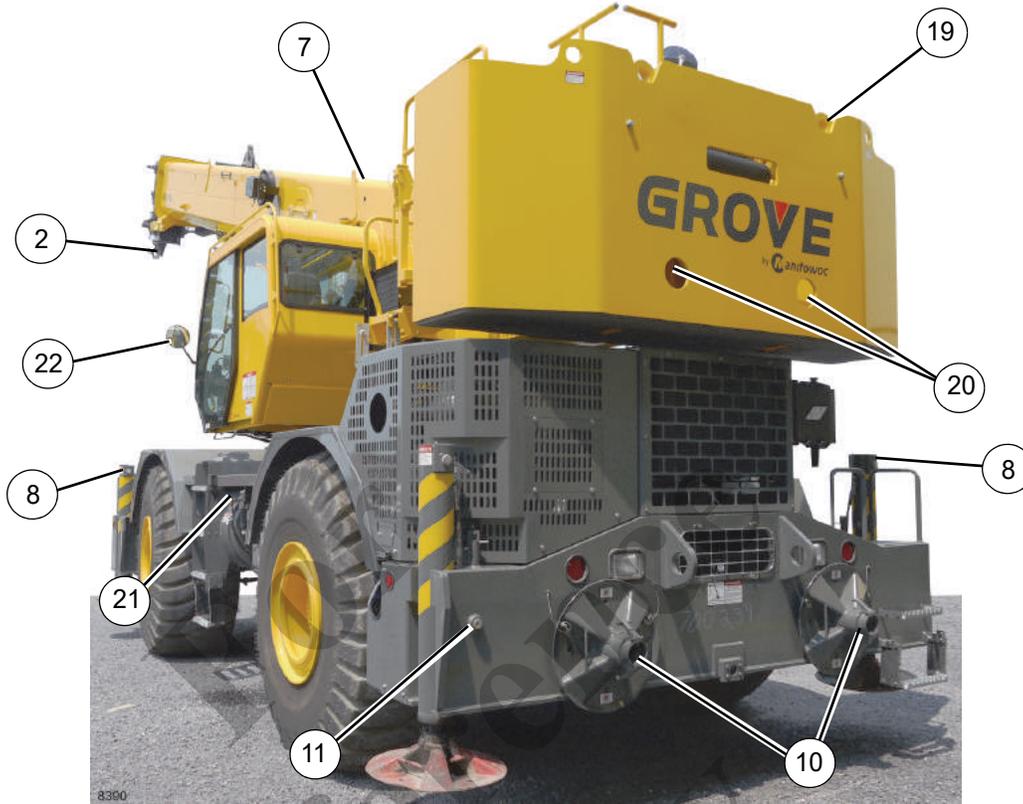
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Picture may not be same model as your crane, it is for reference only.

Figure 6-25



Picture may not be same model as your crane, it is for reference only.

Figure 6-26

Table 6-1 Rust Inhibitor Application Locations

1	Boom Extension Pins, Clips	12	Entire underside of crane
2	Boom Nose Pins, Clips	13	Turntable Bearing Fasteners
3	Hook Block/Overhaul Ball	14	Powertrain Hardware Inside Compartment
4	Boom Extension Hanger Hardware	15	Valve Bank
5	Pivot Shaft	16	Hoist Hose Connections
6	Hose Connections Inside Turntable	17	Tension Spring
7	All Hardware, Clips, Pins, Hose Connections not painted Outrigger Pins, Clips	18	Wire Rope
8	Outrigger Hose Connections	19	Counterweight Mounting Hardware
9	Hook Block Tiedown Cable	20	Counterweight Pins
10	Outrigger Pins, Clips	21	Hose Connections
11	O/R Beam Wear Pad Adjustment Hardware	22	Mirror Mounting Hardware

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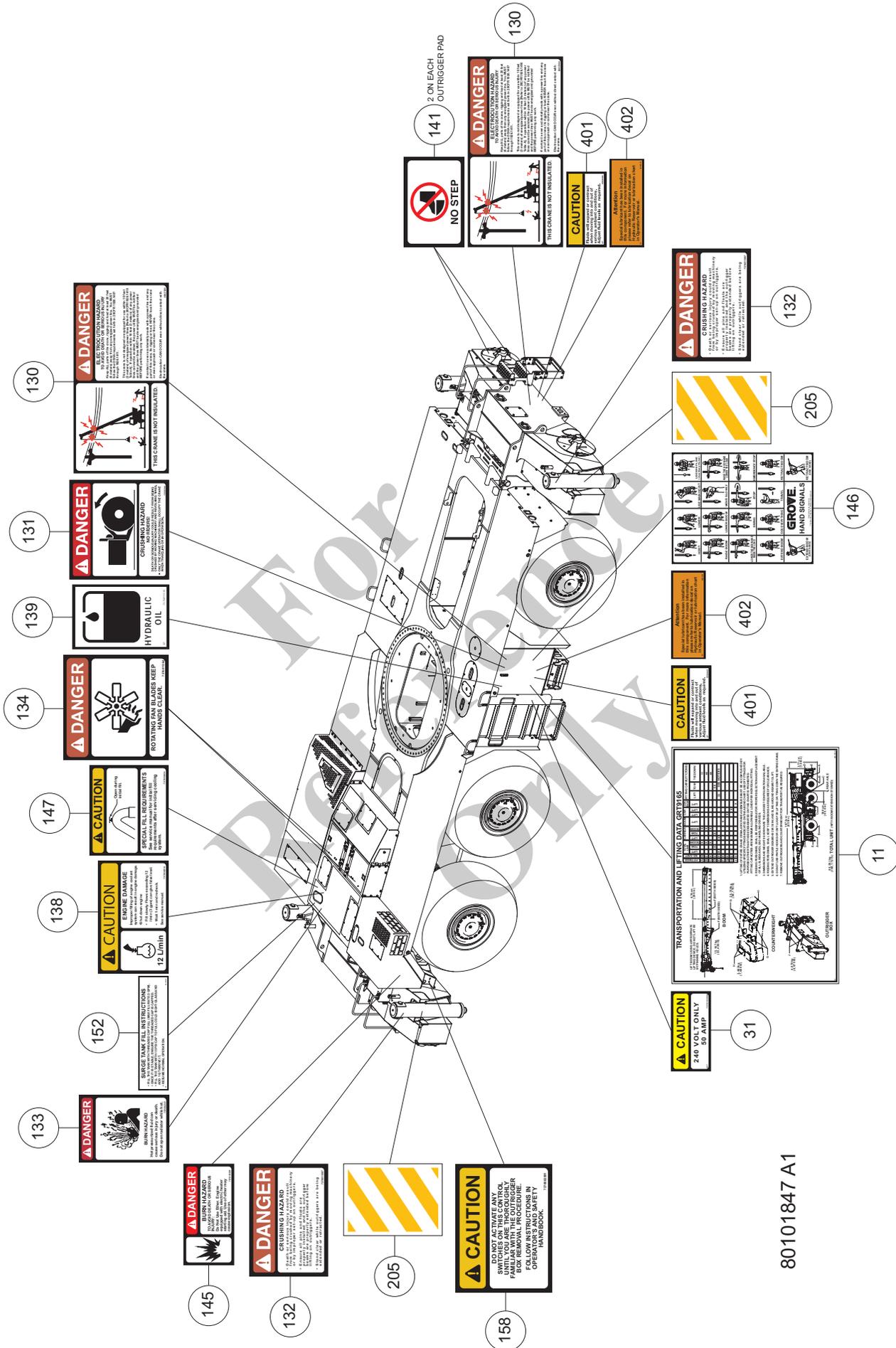
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APPENDIX 1 DECALS

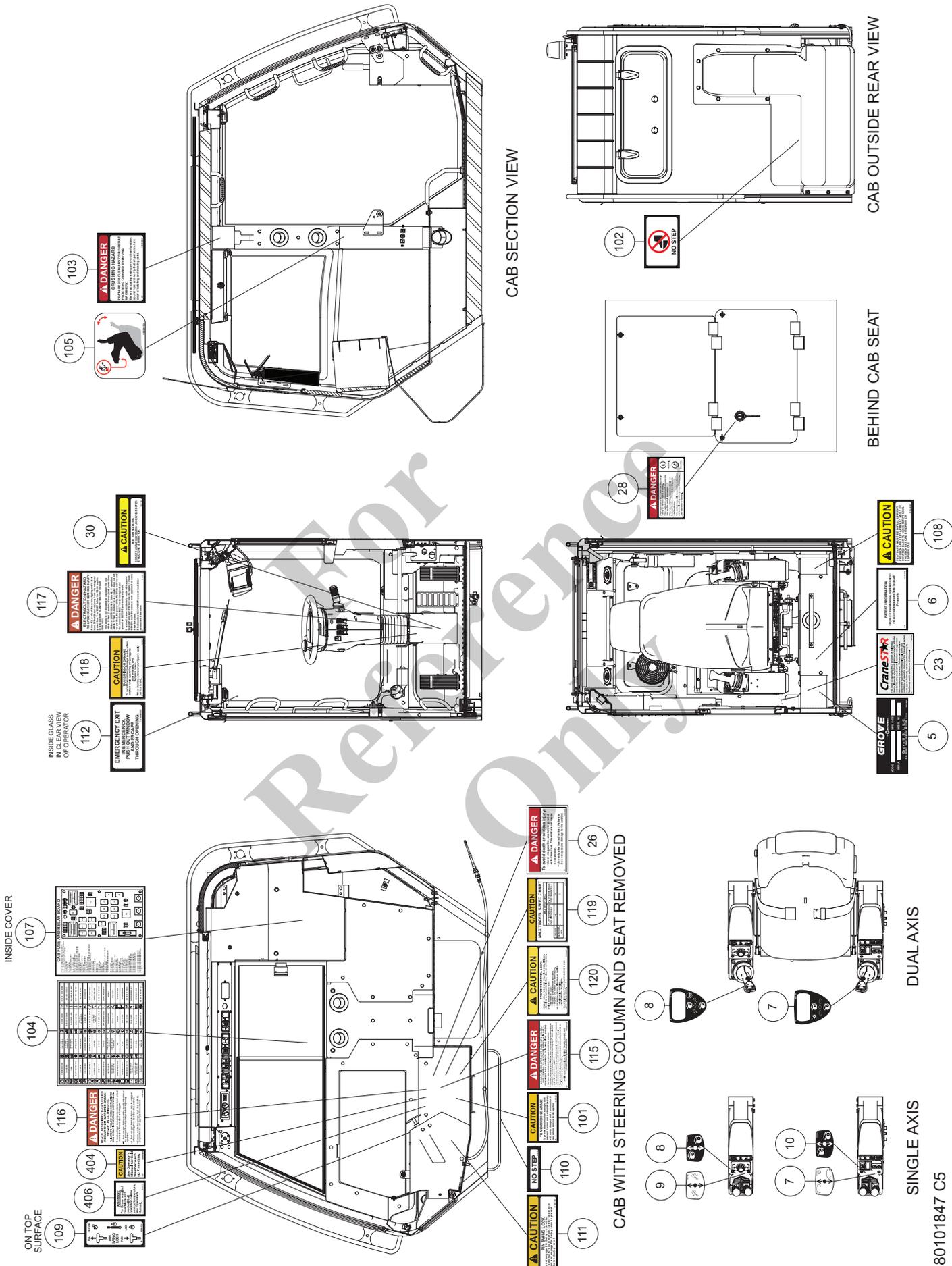
Figure A-1 shows the locations of the decals on the GRT9165.

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FIGURE A-1

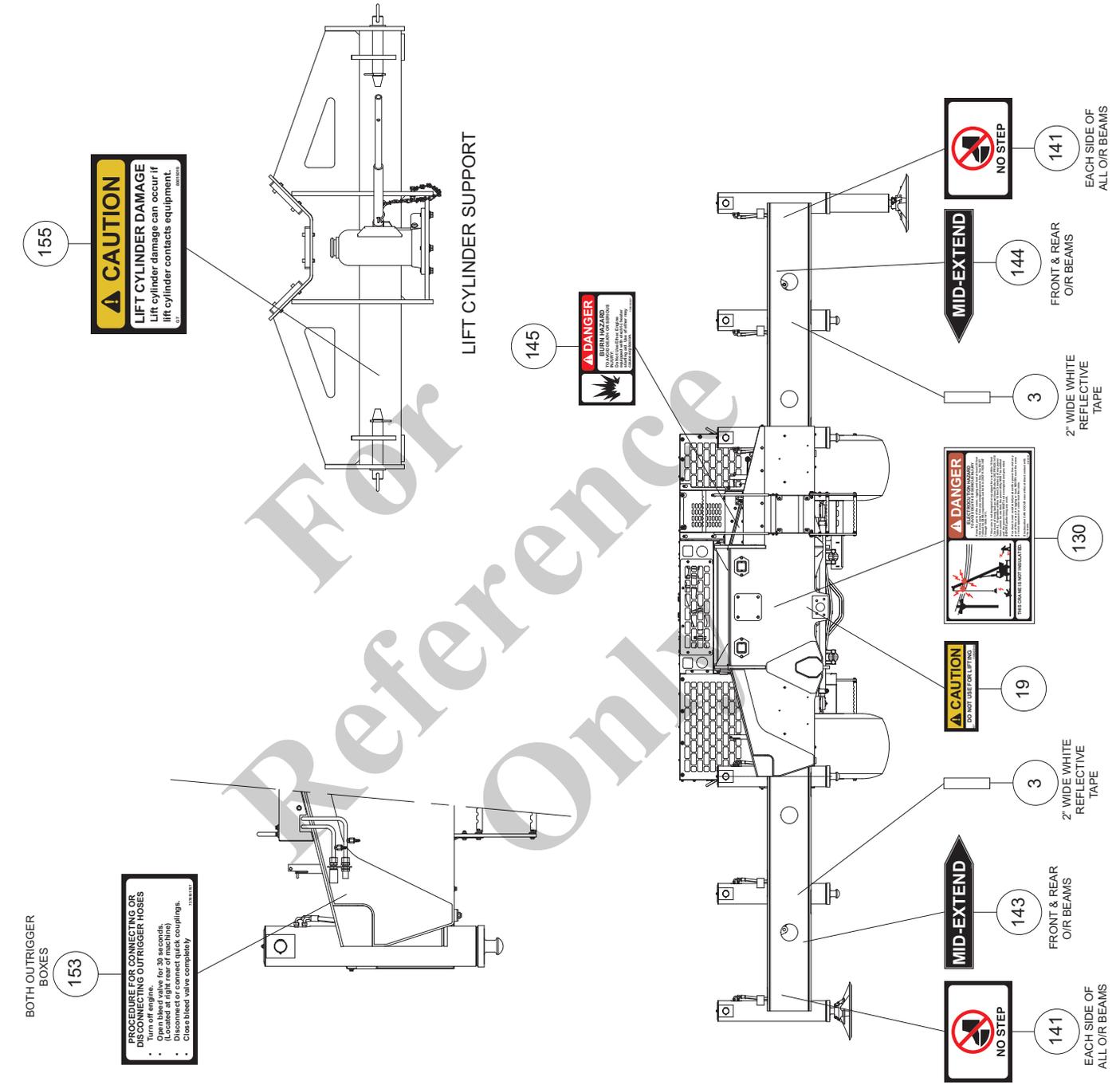


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FIGURE A-1 continued



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FIGURE A-1 continued

Table A-1 —Legend for Figure A-1

Item	Description
3	Reflective Striping
5	Nameplate, Crane
6	Patent
7	Swing (Single Axis)
	Swing/Auxiliary Hoist (Dual Axis)
8	Main Hoist (Single Axis)
	Boom/Main Hoist (Dual Axis)
9	Boom Lift/Telescope
10	Auxiliary Hoist
11	Transportation and Lift, GRT9165
12	CraneSTAR Logo
13	Grove 7-inch White
14	DANGER—Boom Extension Hazard
19	CAUTION—Do not use for lifting
21	Synthetic Gear Oil, Cold Weather
22	Synthetic Grease, Cold Weather
23	CraneSTAR Monitoring
24	CAUTION—Hot Surface and Gases
25	Diesel
26	DANGER—Mixing Fuel
27	E-Stop
28	DANGER—RCL Override Key Switch
30	CAUTION—360° Swing Lock
31	CAUTION—240 Volt Only 50 Amp
32	Diesel Exhaust Fluid (DEF) Quality
33	Engine Block Heater Inlet —120V or 240V
100	DANGER—Tipping/Two-Blocking Hazard
101	CAUTION—Transmission Damage
102	No Step
103	DANGER—Superstructure Swing Hazard
104	Symbol ID
105	Arm Rest Adjustment
107	Cab Fuse and Relay Board
108	CAUTION—Seat and Arm Rest Positions
109	Pin Swing Lock
110	No Step
111	CAUTION—Pin Swing Lock
112	Emergency Exit
114	WARNING—California Proposition 65
115	DANGER—Untrained Operator
116	DANGER—Outrigger Mid Extend
117	DANGER—Electrocution Hazard

Table A-1 —Legend for Figure A-1 (Continued)

Item	Description
118	CAUTION—Transmission Damage
119	CAUTION—Travel Speed
120	CAUTION—4-Wheel Drive/Differential Lock
121	Seat Control
130	DANGER—Electrocution Hazard
131	DANGER—Revolving Tires
132	DANGER—Outrigger Crush Hazard
133	DANGER—Pressurized Fluid
134	DANGER—Rotating Blades Hazard
135	CAUTION—Electronics Damage
136	Battery Connection
137	CAUTION—Battery Disconnection
138	CAUTION—Engine Coolant Fill
139	Hydraulic Oil
140	Carrier Fuse and Relay Box 1
141	No Step
142	Locking Pin Operation
143	Mid Extend Outrigger (Driver Side)
144	Mid Extend Outrigger (Passenger Side)
145	DANGER—Burn Hazard
146	Hand Signals
147	CAUTION—Special Fill Requirements
148	DANGER—Fire Hazard
149	DANGER—Battery Explosion
150	Fuse and Relay Box
151	Battery Disconnect
152	Fill Surge Tank
153	Outrigger Hoses Disconnect Instructions
154	Bleed Off Valve
155	CAUTION—Lift Cylinder Damage
158	Outrigger Box Removal
159	Carrier Fuse and Relay Box
160	DANGER—Counterweight Crushing Hazard
161	DANGER—Counterweight Lifting Hazard
162	DANGER—Cable Wedge
163	No Step
164	Wear Body Harness

Table A-1 —Legend for Figure A-1 (Continued)

Item	Description
165	DANGER—Falling Hazard
166	DANGER—Hoist Entanglement
167	DANGER—Pressurized Oil Leaks
168	Lift Point Prohibition
169	DANGER—Counterweight Removal Instructions
170	DANGER—Counterweight Crush Hazard
180	DANGER—Boom Not Walk Way
183	CAUTION—Dead End Lug
184	CAUTION—Disconnect A2B
185	DANGER—Auxiliary Nose Anti-Two-Block Hazard
186	Boom Extension Wiring Connections
187	Boom Extension Wiring Connections
188	Boom Extension Wiring Connections
189	Boom Extension Wiring Connections
190	Boom Stinger (Fly Section) Electrical Connections
200	GRT9165 Logo
201	Grove 3-inch Gray
202	Grove 6.5-inch Gray
203	Grove 10.1-inch Gray
204	Grove 5-inch White
205	Chevron, Outrigger Jack
206	Manitowoc Gray/Red 3-inch
207	Grove 4.5-inch Gray
401	CAUTION—Fluids
402	ATTENTION—Special Lube
403	ATTENTION—Diesel Fuel Requirements
404	CAUTION—Cold Weather
405	ATTENTION—Hookblock Operation
406	ATTENTION—Hookblock Operation
407	Air Diverter
411	Coolant Fill Instructions

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