

Grove GRT8100-1

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.

CHANGE OF OWNERSHIP REGISTRATION

Manitowoc Crane Care strives to maintain up-to-date contact information for crane owners so that we can readily communicate information about improvements and/or engineering developments for cranes that have been in the field for several years.

Manitowoc Crane Care is pleased to announce that we have developed a QR code to allow the customer to register their crane remotely or re-register their crane if it was purchased used.

To register your crane scan the QR code below or visit <https://www.manitowoc.com/warranty-registration-form> to register your crane.





Manitowoc Cranes

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CHANGE OF OWNERSHIP FORM

Constant improvements, engineering progress or manufacturing information may arise after this crane has been in the field for several years that will make it necessary for us to contact future owners of this machine. It is important to you that Manitowoc Crane have up-to-date records of the current owners of the crane should the need arise for us to contact you. Manitowoc Crane is interested in safe efficient operation of its cranes for their lifetime. Therefore, if you are the second, third, or subsequent owner of this crane, please fill out the form below relating the new owner, model of crane and crane serial number information and e-mail or send to the below address.

PREVIOUS COMPANY NAME: _____

CURRENT COMPANY NAME: _____

CONTACT NAME: _____

ADDRESS: _____

CITY/STATE: _____ POSTAL CODE: _____

TELEPHONE NUMBER: _____

EMAIL ADDRESS: _____

DATE PURCHASED _____ CRANE MODEL _____ CRANE SERIAL NUMBER _____

Please e-mail to: warranty.team@manitowoc.com or visit
<https://www.manitowoc.com/support/change-ownership>

OPERATOR MANUAL

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

GRT8100-1

Crane Model Number

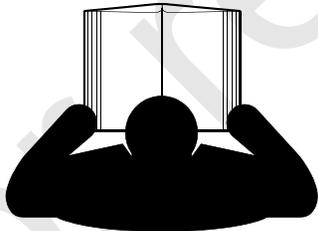
This Manual is divided into the following sections:

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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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 GRT8100-1 Grove Crane.

The GRT8100-1 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 four-wheel steering:

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

The GRT8100-1 Grove crane is driven with the boom centered over the front axle. All-wheel steer enables easy crane positioning, and precise maneuvering on the job site.

The GRT8100-1 introduces new carrier design including:

- flat aluminum decking for easy rigging and access
- multiple, lockable storage compartments
- carrier electrical box, centrally located and accessible to store batteries, modules, relays, and fuses
- full LED-lighting package including side-mounted carrier work lights for improved jobsite visibility

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 GRT8100-1 *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
- 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 to which the rear axle is mounted. This integral fifth wheel provides axle oscillation during travel, when the boom and superstructure are centered over the carrier. Axle oscillation lockout occurs automatically when the superstructure rotates from the travel position.

The superstructure is capable of 360° continuous 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 five-section, full power, sequenced and synchronized boom. Additional reach is obtained by utilizing an optional swingaway boom extension. Lifting is provided by a main hoist and an optional 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 Grove Product Support 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 1-1.

When contacting your local Grove distributor or Grove Product Support, have the crane serial number available.

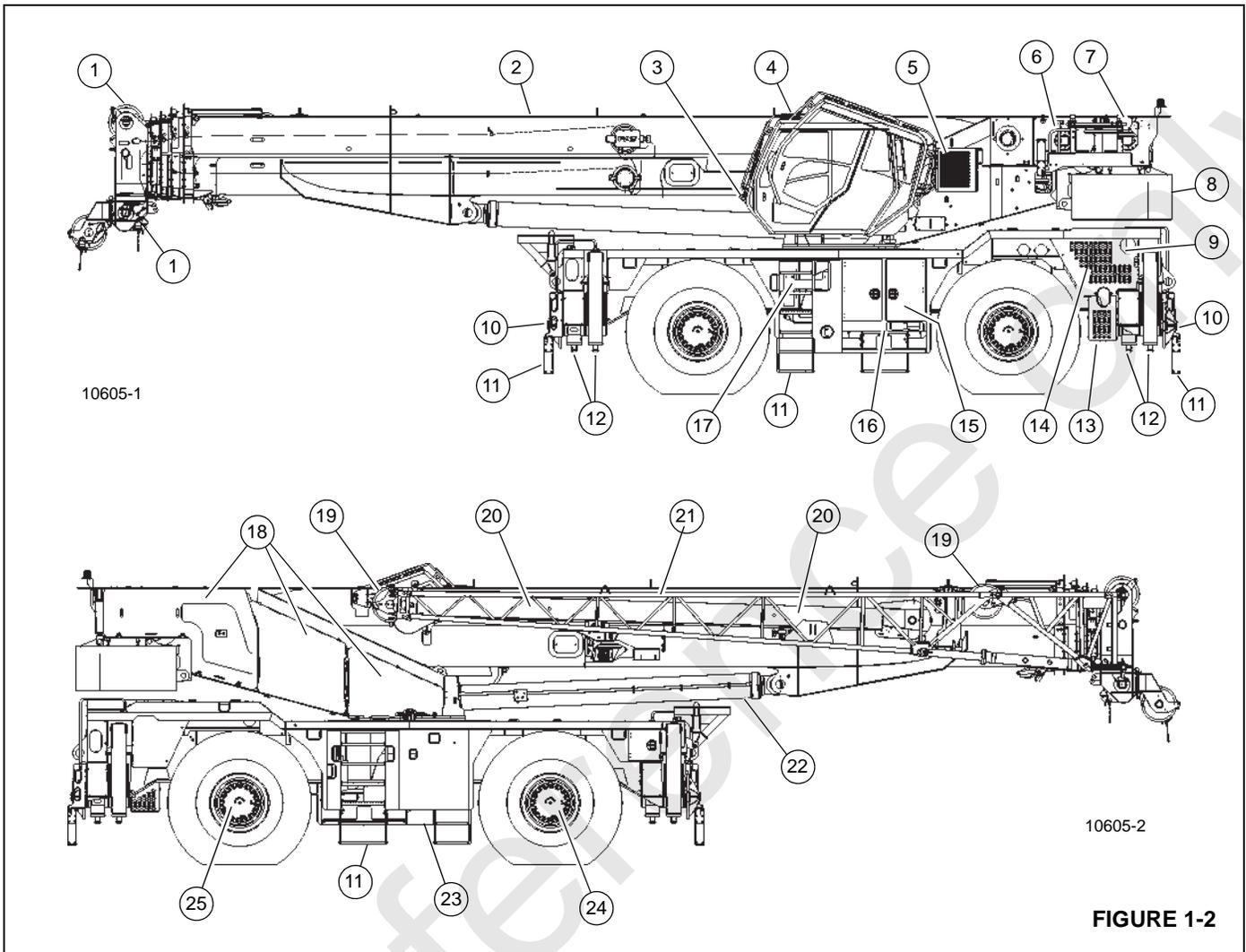
Serial numbers are located at these places on the crane:

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*.



GRT8100-1 CRANE COMPONENTS



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

LIST OF SPECIFICATIONS

General

Model	GRT8100-1
Full Vision Cab	20° cab tilt
Rated Capacity	See <i>Load Chart Manual</i> in cab
Drive	4 x 4
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	4216 mm (166 in)
Length (Frame)	8632 mm (340 in)
Length (Overall)	13919 mm (548 in)
Width	3339 mm (131 in)
Height	3748 mm (147 in)
Weight	59296 kg (130725 lb)
Outside Turning Radius (with Boom Extension Installed)	
2 Wheel Steer	17.5 m (57 ft 6 in)
4 Wheel Steer	11.9 m (39 ft 2 in)
Outside Turning Radius (without Boom Extension Installed)	
2 Wheel Steer	16.7 m (54 ft 10 in)
4 Wheel Steer	11.2 m (36 ft 10 in)
Outside Curb Clearance	
2 Wheel Steer	14 m (45 ft 10 in)
4 Wheel Steer	7.8 m (25 ft 7 in)

Capacities

Fuel Tank (Usable)	271 L (72 gal)
Engine Cooling System	52 L (13.7 gal)
Engine Cooling System (Liquid Coolant Conditioner)	(test and add, as necessary)
Engine Crankcase with filter	20 L (5.3 gal)
Hydraulic Tank (Reservoir Capacity)	
Total	1029.4 L (271.9 gal)
Full Level	926.5 L (244.8 gal)
Hoist Drums (each)	4.9 L (1.3 gal)
Swing Drive	
Gearbox	3.6 L (3.9 qt)
Brake Assembly	.35 L (0.75 pt)
Axle Planetary Hubs and Wheel Bearings (each wheel end)	
Meritor	9.8 L (10.4 qt)
Kessler	2.8 L (2.9 qt)
Axle Differentials (each)	
Meritor	40 L (10.6 gal)
Kessler	37 L (9.8 gal)
Transmission (includes Torque Converter)	41.6 L (44 qt)
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
Maximum Drive Speed	24.1 km/h (15 mph) with counterweight installed

Torque Converter

Stall Ratio	1.806:1
Charge Pump	
Capacity	106 L/min (28 gal/min) @ 2000 rpm

Engine

Cummins QSB 6.7L - Stage V / Tier 4F

Type	4-cycle, Diesel with single module exhaust 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

Cummins QSB 6.7L - Tier 3

Type	4-cycle, Diesel
6-cylinder Turbocharged	After-Cooled Engine
Horse Power Rating	205kW (275 hp) @ 2500 rpm
Maximum Speed, No Load	2750 rpm
Max. Torque	990 N·m (730 lbf-ft) at 1500 rpm
24 Volt Electrical System	two 12 Volt Batteries
Fuel	Maximum 5000 ppm Sulfur Diesel

Axles

Total Axle Ratio	24.54:1
Carrier Ratio	4.09:1
Planetary Ratio	6:1

Steering

Type	Independent Hydraulic Power Steering
Front axle	controlled via steering wheel
Rear axle	provides infinite variations controlled via momentary switch in cab
Coordinated Turning Radius	
Outside 4 Wheel Steer	7.5 m (24 ft 7 in)
Inside 4 Wheel Steer	4.8 m (15 ft 10 in)

Brakes

Type	4 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	618 to 682 N·m (455 to 500 lbf-ft)
Tire Size	29.5 x 25, 34 bias ply rating

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

Boom

Length	11.8 to 46.9 m (39 to 154 ft)
Power	5 Tele Section, Full Power
Elevation	-3 to +80 degrees
Extensions (Optional)	
Manual Bi-Fold	10 to 17 m (33 to 56 ft)
Offset 0°, 20°, or 40°	
Hydraulic Bi-Fold	10 to 17 m (33 to 56 ft)
Offset 0° - 40°	
Lattice Insert	6.0 m (20 ft)
(Installs between boom nose and extension)	

Outriggers

Outrigger Spread	
Retracted	3150 mm (124 in)
Mid Extend	5233 mm (206 in)
Fully Extended	7316 mm (288 in)
Outrigger Pad Diameters	
Polymer	600 mm (23.6 in)
Aluminum (Optional)	600 mm (23.6 in)
Max Individual Outrigger	
Pad Load	556 kN (125,000 lbf or 125 kip)

Swivel Assembly

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

Swing Gearbox

Reduction Ratio	35.2:1
Continuous Torque	8191 N·m (6042 lbf-ft)
Max Pinion Torque	16382 N·m (12083 lbf-ft)

Hydraulic Pumps

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

Pump #1

Type	Piston
Sections	1
Output - @ loaded engine speed	
Section 1 flow rate	204.4 L/min (54 gal/min)

Pump #2

Type	Piston
Sections	1
Output - @ loaded engine speed	
Section 1 flow rate	204.4 L/min (54 gal/min)

Pump #3

Type	Gear
Sections	1
Output - @ loaded engine speed	
Section 1 flow rate	86.7 L/min (22.9 gal/min)

Pump #4

Type	Gear
Sections	1
Output - @ loaded engine speed	
Section 1 flow rate	50.7 L/min (13.4 gal/min)

Hoists MTW 19-71-238

Drum Dimensions	
Diameter	378 mm (14.8 in)
Length	541 mm (21.3 in)
Cable, Main, 35x7 Steel	
Diameter	19 mm (0.75 in)
Length	250 m (820 ft)
Max Permissible	
Single Line Pull	7784 kg (17,160 lb)
Cable, Aux., 35x7 Steel	
Diameter	19 mm (0.75 in)
Length	185 m (607 ft)
Max. Permissible	
Single Line Pull	7784 kg (17,160 lb)

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For reference only

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 Grove Product Support.

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

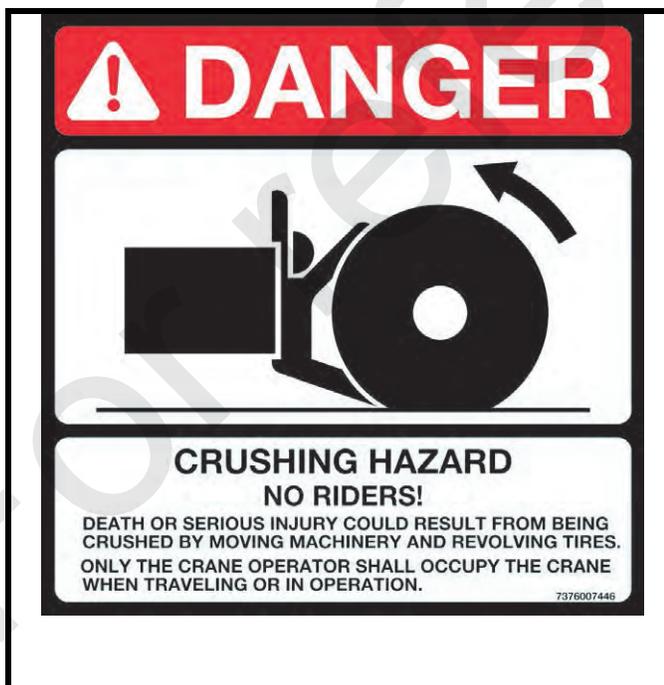
OPERATOR INFORMATION

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.

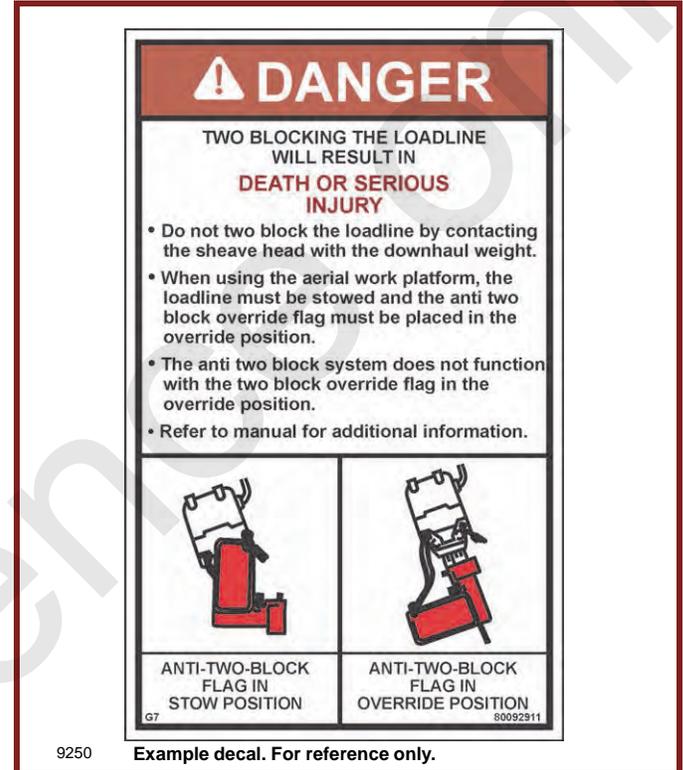
Two-blocking occurs when the load block (hook block, overhaul ball, rigging, etc.) comes into physical contact with the boom (boom nose, sheaves, boom extension, etc.). Two-blocking can cause hoist rope (wire rope or synthetic rope), rigging, reeving, and other components to become highly stressed and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

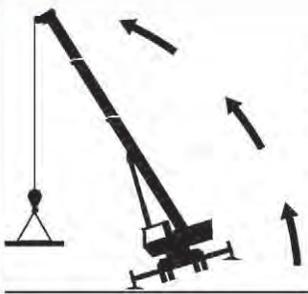


Working Area Limiter (If Equipped)

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

	<p style="text-align: center;">TIPPING HAZARD</p> <p>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.</p> <p>This crane should have a functional load moment indicator and control lock-out system. Test daily for proper operation.</p> <p style="text-align: center;">POSITION CRANE ON FIRM SURFACE. EXTEND OUTRIGGERS AND LEVEL CRANE.</p>	<p>TO AVOID DEATH OR SERIOUS INJURY:</p> <p>NEVER handle personnel with this machine unless the requirements of the applicable national, state and local regulations and safety codes are met.</p> <p>NEVER use this crane for bungee jumping or any form of amusement or sport.</p> <p>NEVER permit anyone to ride loads, hooks, slings or other rigging for any reason.</p> <p>NEVER get on or off a moving crane.</p> <p>NEVER allow anyone other than the operator to be on this crane while it is operating or traveling.</p>	
	<p style="text-align: center;">TWO-BLOCKING HAZARD</p> <p>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.</p> <p>This crane should have a functional anti-two-block and control lock-out system. Test daily for proper operation.</p> <p style="text-align: center;">DO NOT PASS LOADS OR BOOM OVER GROUND PERSONNEL.</p>	<p>ELECTRONIC EQUIPMENT on this crane is intended as an aid to the operator.</p> <p>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.</p> <p>Do not remove any decal, the load chart, or the Operator's and Safety Handbook from this crane.</p>	

7340
FOLLOW INSTRUCTIONS IN OPERATOR'S AND SAFETY HANDBOOK.
7376100175

7340

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.

NOTE: Not all crane models allow lifting operations in all configurations or speeds of 20.1 m/s (45 mph). Refer to load chart notes for allowable configurations and maximum permissible wind speed.

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".

NOTE: Not all crane models allow lifting operations in all configurations or speeds of 20.1 m/s (45 mph). Refer to load chart notes for allowable configurations and maximum permissible wind speed.

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).

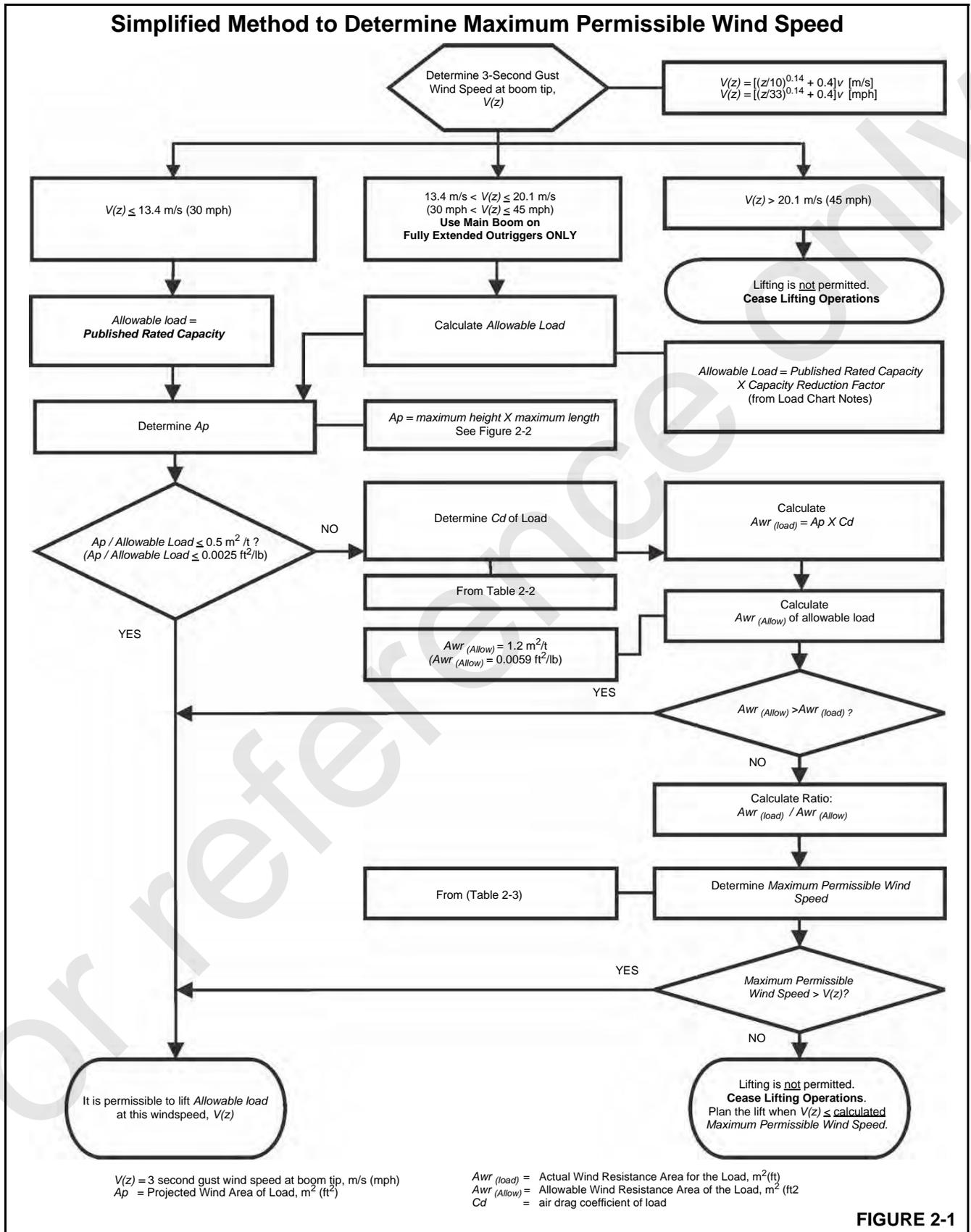
NOTE: This condition is limited to operation with the main boom on fully extended outriggers only.

- 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 **Ap** and by the wind drag coefficient **Cd**: 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.

NOTE: Not all crane models allow lifting operations in all configurations or speeds of 20.1 m/s (45 mph). Refer to load chart notes for allowable configurations and maximum 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 (33 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.**

NOTE: Not all crane models allow lifting operations in all configurations or speeds of 20.1 m/s (45 mph). Refer to load chart notes for allowable configurations and maximum permissible wind speed.

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 of the load with the allowable wind resistance area.

$$Awr_{(load)} = A_p \times C_d \quad (2.3)$$

where:

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

A_p [m²] [ft²] - projected wind area,

C_d - wind drag coefficient.

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

For C_d , refer to Table 2-2. If the C_d 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

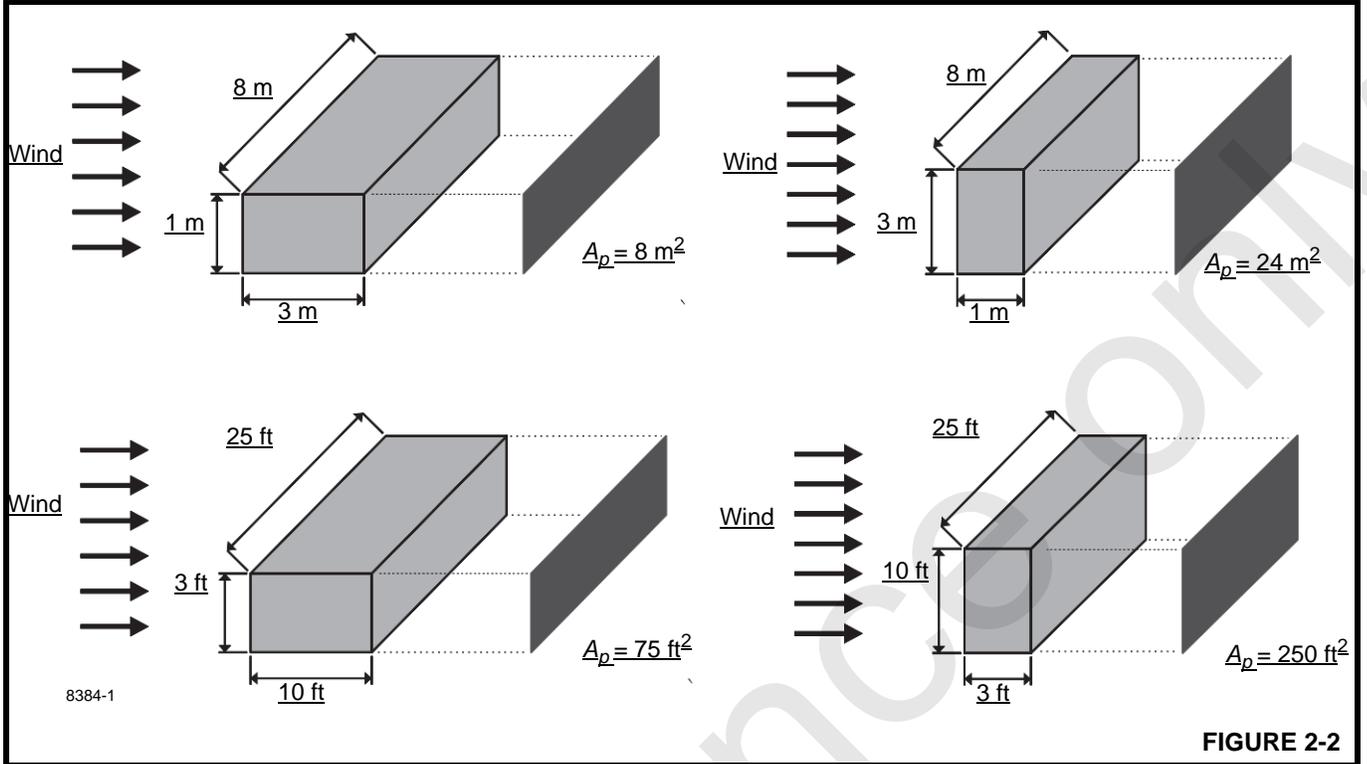
$$Awr_{(allow)} = 0.0012 \times m_{(load)} \quad (2.4)$$

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):



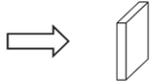
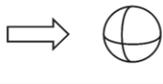
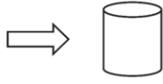
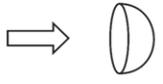
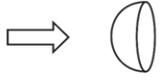
Determining Wind Drag Coefficient (C_d)

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	Turbine Blade or Complete Rotor
	Approximately 1.6	

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Maximum Permissible Wind Speed

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

Table 2-3 Awr 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
NOTE: Not all crane models allow lifting operations in all configurations or speeds of 20.1 m/s (45 mph). Refer to load chart notes for allowable configurations and maximum permissible wind speed.					

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)	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)	7,475 (47)	7,920 (53)	7,980 (57.5)	7,470 (61.5)
18					5,775 (27)	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 (48.5)
24								3,435 (23.5)	3,780 (43.5)
26									2,975 (28)
28									2,400 (16)
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.

FIGURE 2-3

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 $Ap \times$ 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.

NOTE: Not all crane models allow lifting operations in all configurations or speeds of 20.1 m/s (45 mph). Refer to load chart notes for allowable configurations and maximum permissible wind speed.

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

NOTE: Not all crane models allow lifting operations in all configurations or speeds of 20.1 m/s (45 mph). Refer to load chart notes for allowable configurations and maximum permissible wind speed.

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 $V(z)$** .

NOTE: Not all crane models allow lifting operations above 13.4 m/s (30 mph). Refer to load chart notes for maximum permissible wind speed.

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 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 $V(z) > 13.4 \text{ m/s}$ and $\leq 20.1 \text{ m/s}$** . Comparing the load and wind resistant area to the allowable:

- Is the load to be lifted less than allowable load?
11,200 kg \leq 12,040 kg YES
- Is **Awr_(load)** less than **Awr_(allow)**?
13.8 m² \leq 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 $V(z) > 13.4 \text{ m/s}$ and $\leq 20.1 \text{ m/s}$** . Comparing the load and wind resistant area to the allowable:

- Is the load to be lifted less than allowable load?
10,000 kg \leq 12,040 kg YES
- Is **Awr_(load)** less than **Awr_(allow)**?
13.08 m² \leq 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 $V(z) > 13.4 \text{ m/s}$ and $\leq 20.1 \text{ m/s}$** . Comparing the load to the allowable:

- Is the load to be lifted less than allowable load?
14,000 kg \leq 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 $V(z) < 13.4 \text{ m/s}$** . Comparing the load to the allowable:

- Is the load to be lifted less than allowable load?
14,000 kg \leq 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 \leq 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 ≤ 12,040 kg YES
- Is **Awr_(load)** less than **Awr_(allow)**?
19.83 m² ≤ 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:

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

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.

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 (36.5)	56,600 (45)	56,350 (56)	53,650 (63)	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)	33,550 (66)	26,400 (69)	24,700 (71.5)
40			25,800 (28)	26,150 (44.5)	26,300 (52.5)	27,300 (53.5)	25,200 (62.5)	23,300 (66)	21,800 (68.5)
45				20,300 (36.5)	20,450 (47)	22,300 (54)	22,400 (59)	20,700 (62.5)	19,400 (65.5)
50				15,500 (5)	17,400 (41)	18,200 (49.5)	19,100 (55)	18,550 (59.5)	17,350 (62.5)
55					14,300 (33.5)	14,300 (44)	16,000 (51)	16,400 (56)	15,600 (60)
60					11,500 (23.5)	12,700 (38.5)	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 (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 $Awr_{(allow)} = 0.0059 \times$ calculated reduced capacity in lb.									
Wind resistance area of load, $Awr_{(load)} =$ projected wind area $Ap \times$ 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.									
NOTE: Not all crane models allow lifting operations in all configurations or speeds of 20.1 m/s (45 mph). Refer to load chart notes for allowable configurations and maximum permissible wind speed.									

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
NOTE: Not all crane models allow lifting operations in all configurations or speeds of 20.1 m/s (45 mph). Refer to load chart notes for allowable configurations and maximum permissible wind speed.					

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 $V(z)$** .

NOTE: Not all crane models allow lifting operations in all configurations or speeds of 20.1 m/s (45 mph). Refer to load chart notes for allowable configurations and maximum permissible wind speed.

Example 2:

A crane is configured with:

- boom length = 90 ft,
- load radius = 40 ft, and
- wind speed is measured at $V(z) \leq 45$ 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:

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

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

Lifting Limits at wind speed $V(z) < 30 \text{ mph}$ at this configuration:

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

For the allowable wind speed $> 30 \text{ mph}$ and $\leq 45 \text{ mph}$, 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 $V(z) > 30 \text{ mph}$ and $\leq 45 \text{ mph}$ 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 $V(z) > 30 \text{ mph}$ and $\leq 45 \text{ mph}$** . Comparing the load and wind resistant area to the allowable:

- Is the load to be lifted less than allowable load?
19,500 lb \leq 20,160 lb YES
- Is **Awr_(load)** less than **Awr_(allow)**?
105 ft² \leq 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 $V(z) > 30 \text{ mph}$ and $\leq 45 \text{ mph}$** . Comparing the load and wind resistant area to the allowable:

- Is the load to be lifted less than allowable load?
18,000 lb \leq 20,160 lb YES
- Is **Awr_(load)** less than **Awr_(allow)**?
108 ft² \leq 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 $V(z) > 30 \text{ mph}$ and $\leq 45 \text{ mph}$** . Comparing the load to the allowable:

- Is the load to be lifted less than allowable load?
22,000 lb \leq 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 \leq 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 \leq 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 $Ap = 125 \text{ ft}^2$,
- 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 $V(z) > 30 \text{ mph}$ and $\leq 45 \text{ mph}$** . 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

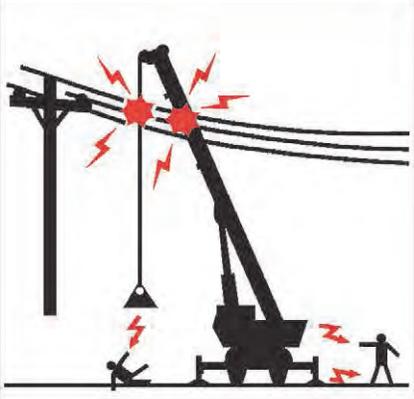
Electrocution Hazard!

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.

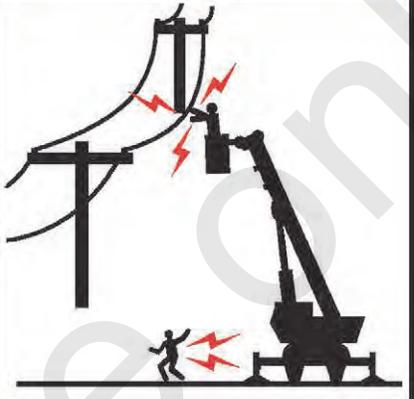
Electrocution **can occur** even without direct contact with the crane.

! DANGER



ELECTROCUTION HAZARD

This equipment may be energized during operation. Contact with energized vehicle will result in death or serious injury.



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80090318

THIS EQUIPMENT IS NOT INSULATED. KEEP CLEAR OF ENERGIZED POWERLINES AND EQUIPMENT.

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.

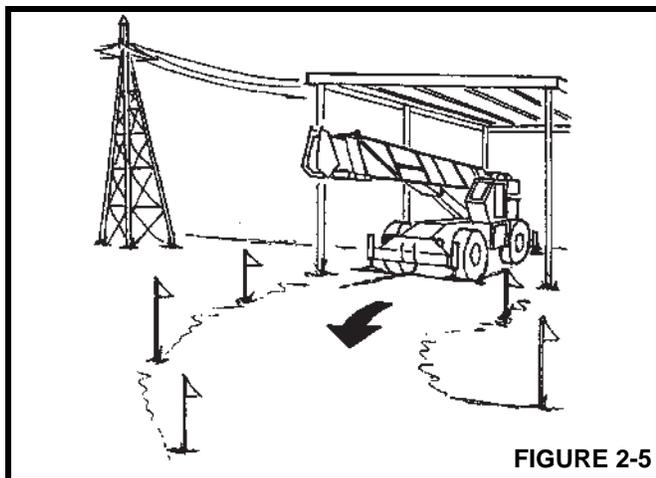


FIGURE 2-5

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 Grove Product Support. 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 Grove Product Support.

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

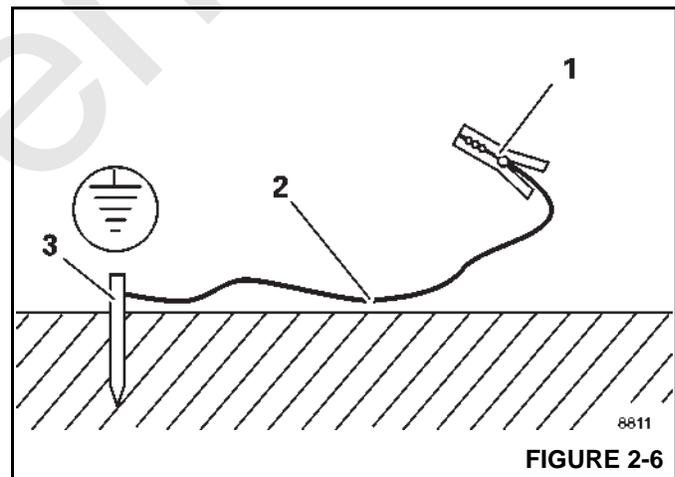
Risk of accidents due to electric shock!

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.



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 Grove Product Support 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 Grove Product Support.

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*.

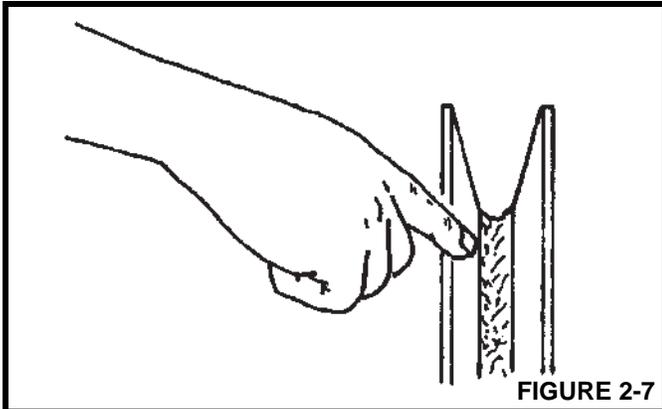
- ***When a rope has been removed from service because it is no longer suitable for use, it must not be reused on another application.***

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

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.

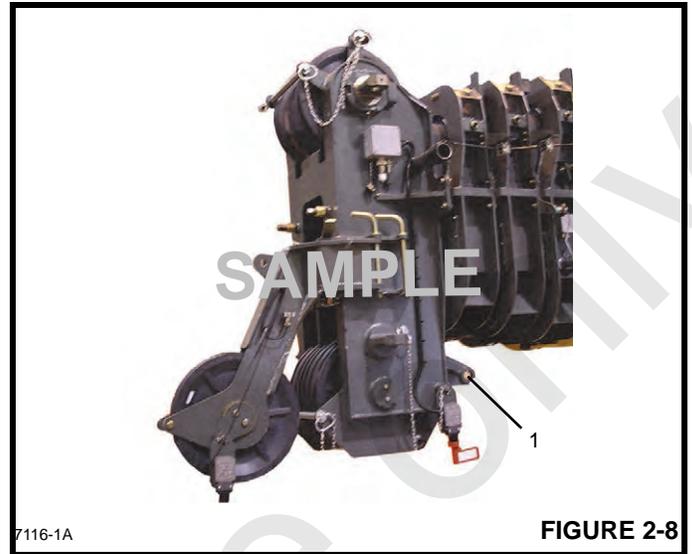


FIGURE 2-8

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.

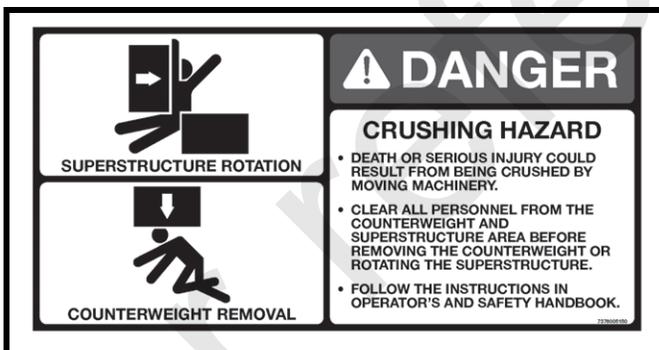
Carbon monoxide fumes from the engine exhaust can cause suffocation in an enclosed area. Good ventilation is very important when operating the crane.

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.

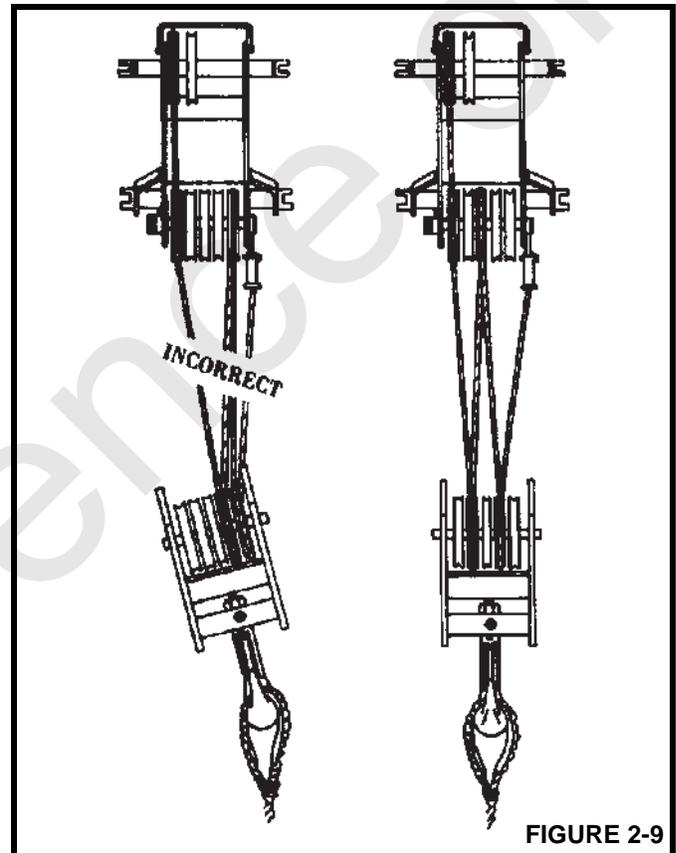
You must always be aware of everything around the crane while lifting or traveling. If you are unable to clearly see in the direction of motion, you must post a look out or signal person before moving the crane or making a lift. Sound the horn to warn personnel

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.



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.

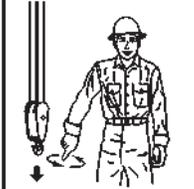
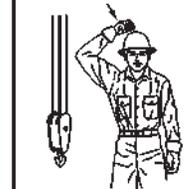
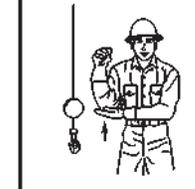
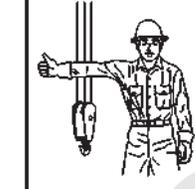
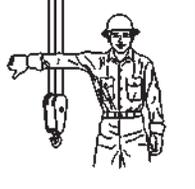
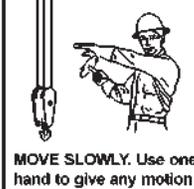
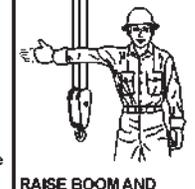
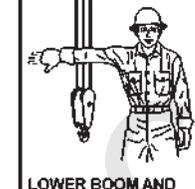
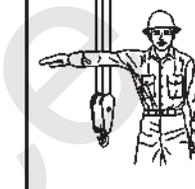
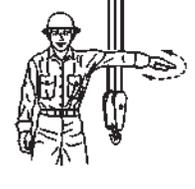
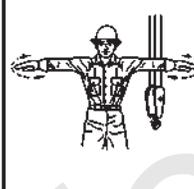
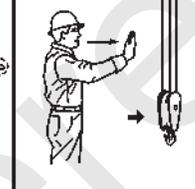
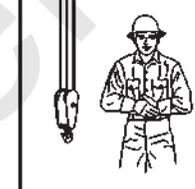
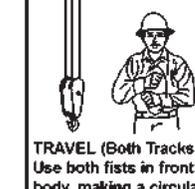
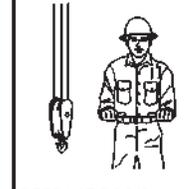
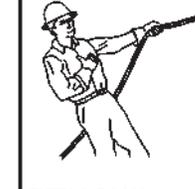
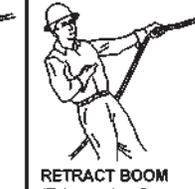
STANDARD HAND SIGNALS FOR CONTROLLING CRANE OPERATIONS				
Complies with ASME B30.5-2014				
				
HOIST. With forearm vertical, forefinger pointing up, move hand in small horizontal circle.	LOWER. With arm extended downward, forefinger pointing down, move hand in small horizontal circle.	USE MAIN HOIST. 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).

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.

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

CRANE STABILITY

When operating on Rubber, the GRT8100-1 360 degree load chart has a minimum published radius of 6 m (19.7 ft). When operating without a load, a radius of less than 4 m (13.1 ft) must be avoided to prevent tipping backwards.



DANGER Backward Stability Hazard!

Do not position the boom at a radius of less than 4 m (13.1 ft) when operating on Rubber. This could result in the crane tipping over backwards causing death, serious injury or property damage.

Always ensure the Rated Capacity Limiter is programmed for the appropriate capacity chart based upon crane configuration.

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 Grove Product Support 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!

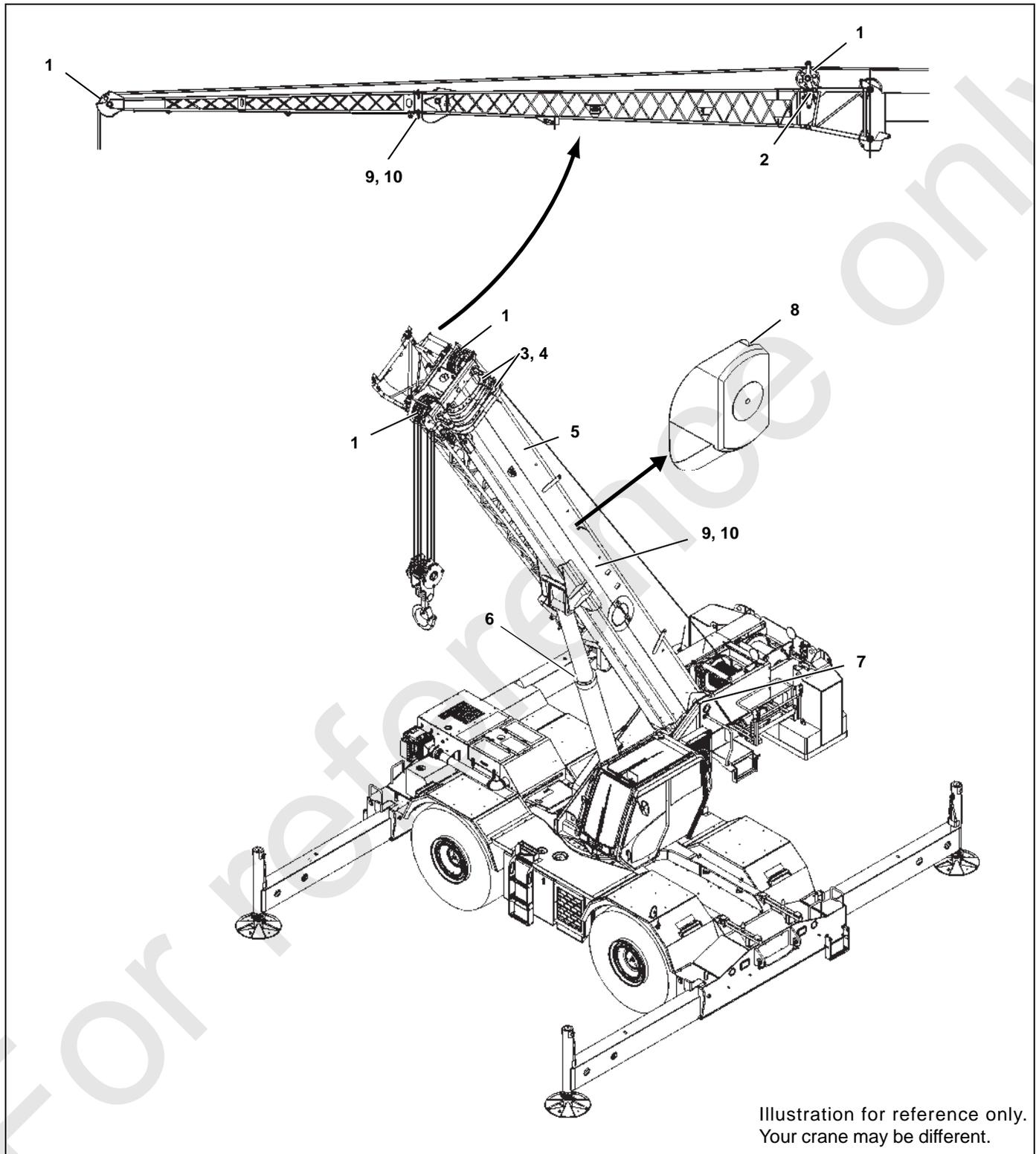
To avoid an accident caused by overload damage to your crane:

- Perform the inspections outlined in this publication for overloads up to 50%.
- Stop operating the crane and contact Grove Product Support 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.

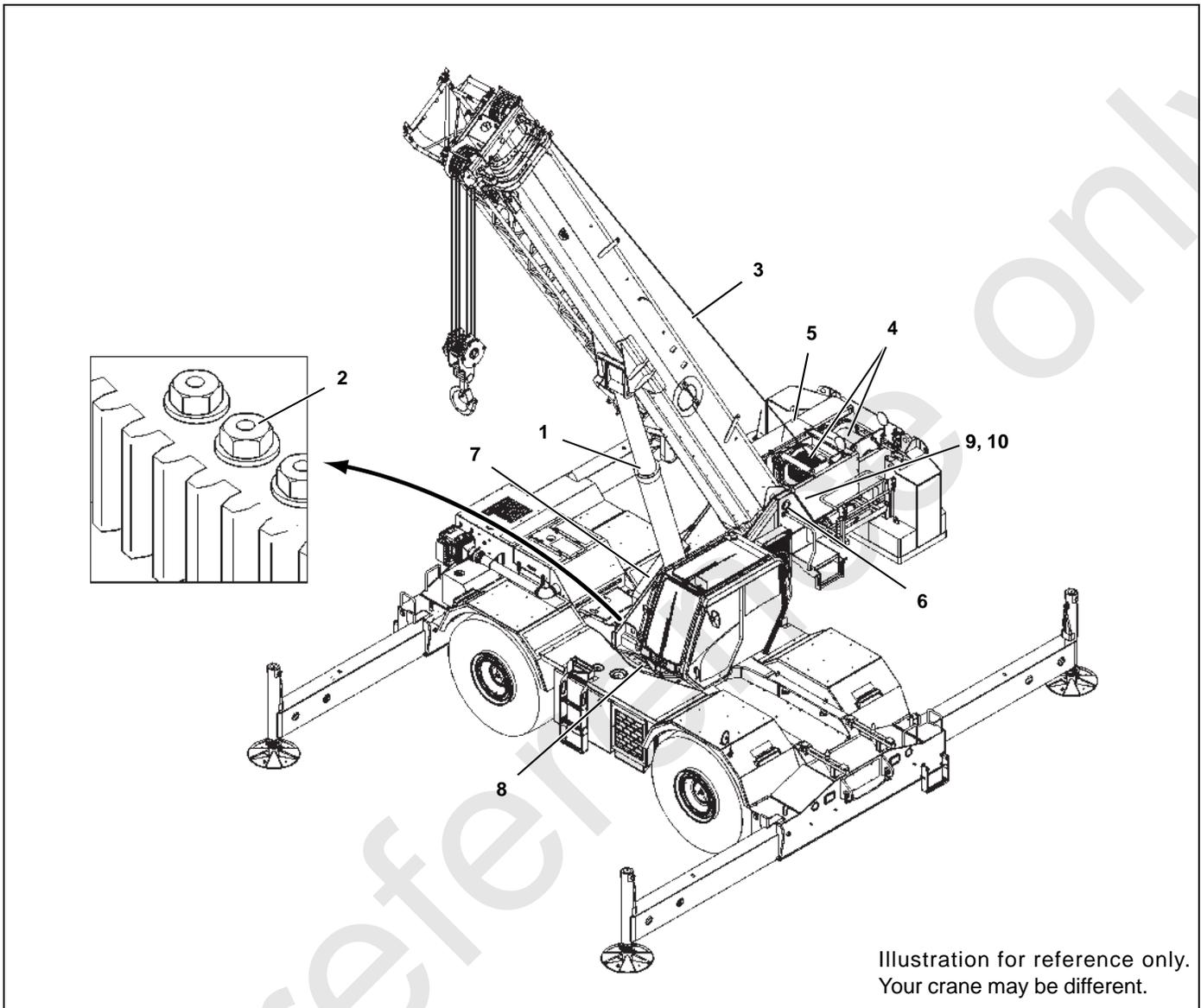
Boom Inspection



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	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.	

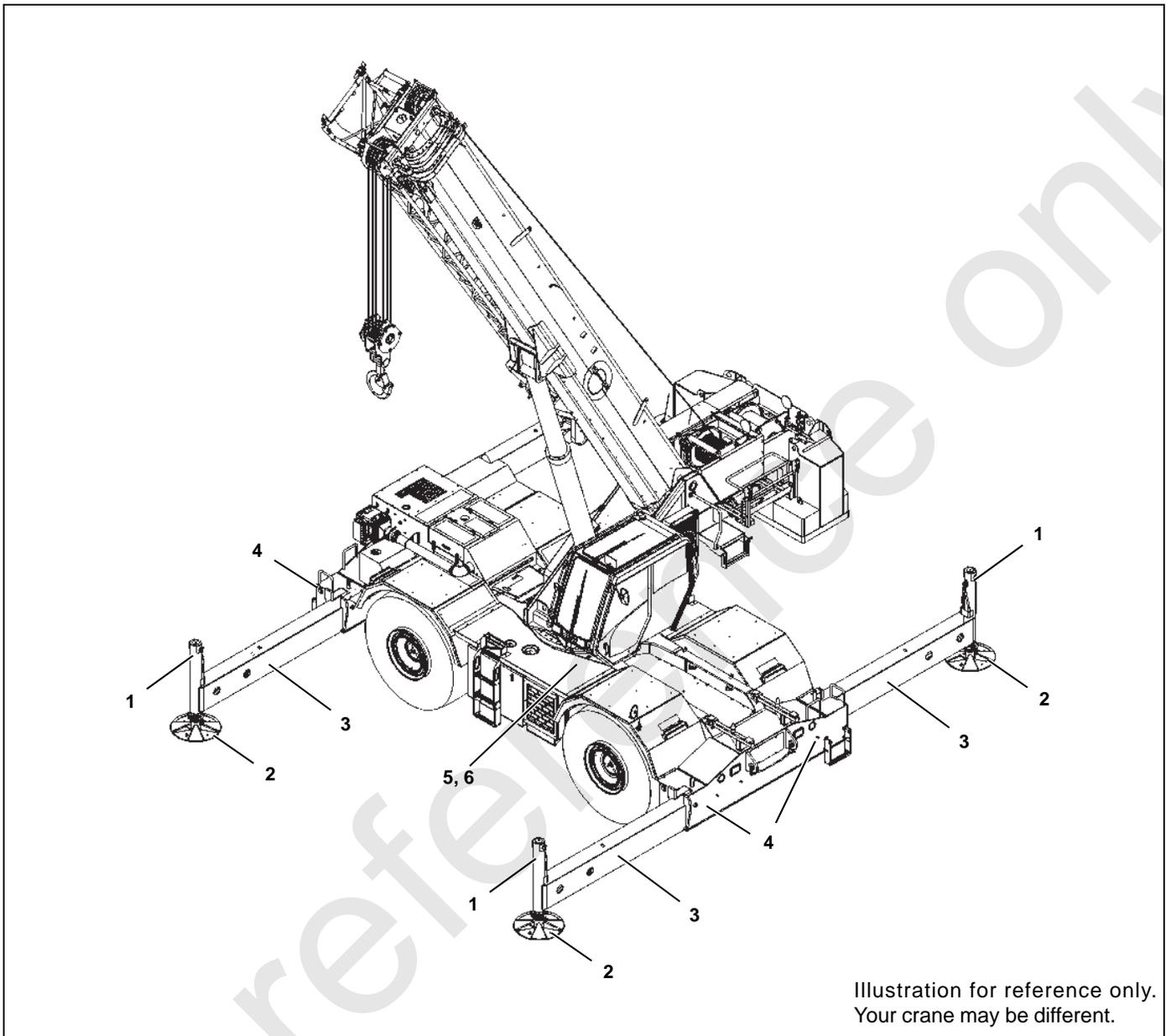
Superstructure Inspection



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



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.	

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For reference only

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).



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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 operating the crane (Figure 3-2).



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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 axle.

With the boom centered over the front axle, turning the steering wheel counterclockwise turns the wheels on the front axle to the left, which causes the crane to turn left.

Turning the steering wheel clockwise turns the wheels on the front axle to the right, which causes the crane to turn right.

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.

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

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.

NOTE: The Transmission Shift Lever must be in Neutral (center) position before applying the Parking Brake.

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

The Parking Brake Indicator in the Alerts Area (Figure 4-12) and Crane Status Area (Figure 4-15) 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 instrument lights and 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).

CAUTION

Transmission Damage!

To prevent transmission damage, shift between two-wheel and four-wheel drive only when crane is stopped, transmission is in Neutral (center) position, and Service Brake Pedal is pushed.

NOTE: The drive axle can only be changed when the Transmission Shift Lever (7, Figure 3-2) is in the Neutral (center) position and the Service Brake Pedal (3, Figure 3-14) is pushed.

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

The Four-Wheel Drive Indicator in the Crane Status Area (Figure 4-15) 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 (Figure 4-12) of the ODM comes on when the operator attempts to shift between drive modes without first shifting the Transmission Shift Lever to Neutral (center), 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

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 Neutral (center) 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 (3, Figure 3-14). Thus, crane must be stopped, and the 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

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. The transmission must be in Neutral (center) position in order to shift to four-wheel drive low-range. 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.

NOTE: The transmission will not shift into forward or reverse gear without first pushing and holding the Service Brake Pedal. Refer to *Traveling — Forward*, page 4-15 and *Traveling — Reverse*, page 4-16 for more detailed information on shifting the transmission.

The Direction/Gear Indicator in the Crane Information Area (Figure 4-14) of the Operating Display Module (ODM) shows the direction of travel and the gear to which the transmission is shifted.

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 6 seconds.

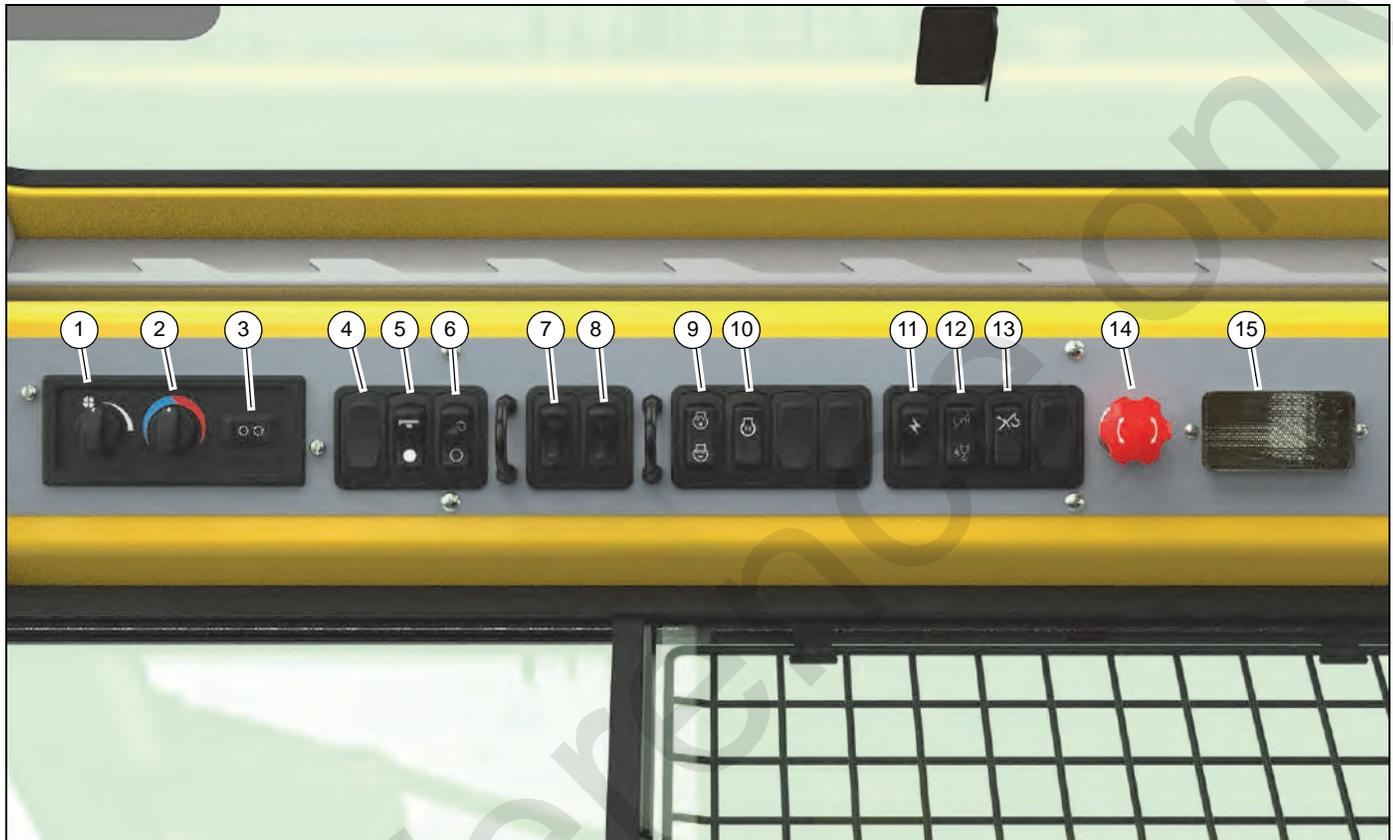
Steering Column Tilt and Telescope Lock Lever

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.

RIGHT OVERHEAD CONTROL PANEL

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



3

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Item	Description	Page	Item	Description	Page
1	Heater/Air Conditioner Fan Speed Switch	3-8	9	Increment/Decrement – Start/Stop Switch	3-8
2	Heater/Air Conditioner Temperature Control Switch	3-8	10	Engine Wait-To-Start Indicator	3-9
3	Fresh Air/Recirculation Air Switch	3-8	12	Crane Function Enable/Disable Switch	3-9
4	Boom-Mounted Lights Motor Switch (Optional)	3-8	13	Momentary Limit Bypass Switch (Non-CE Certified Cranes)	3-9
5	Boom-Mounted Lights Switch (Optional)	3-8	14	Limit Bypass Set-up Switch (CE Certified Cranes)	3-10
6	Cab-Mounted Lights Switch (Optional)	3-8	15	Boom Up Bypass Switch	3-11
7	Front Window Wiper and Washer Switch	3-8	16	Emergency Stop Button (E-Stop)	3-12
8	Skylight Wiper and Washer Switch	3-8	17	Cab Dome Light	3-12

FIGURE 3-3

Heater/Air Conditioner Fan Speed Switch

The Heater/Air Conditioner Fan Speed Switch (1, Figure 3-3) 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 3-3) 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 3-3) 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 3-3) 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 3-3) 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 3-3) 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 3-3) 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 3-3) 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 3-3) 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 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 4-97 for details of its operation.

Engine Wait-To-Start Indicator

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

When the Ignition Switch (8, Figure 3-2) is turned to the RUN (I) position, the Engine Wait-To-Start indicator comes 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 4-7).

Crane Function Enable/Disable Switch

The Crane Function Enable/Disable Switch (12, Figure 3-3) 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.

When the crane is not equipped with the optional auxiliary hoist, the default crane functions include the following:

Left Controller

- Swing
- Telescope

Right Controller

- Boom Lift
- Main Hoist

When the crane is equipped with the optional auxiliary hoist, the default crane functions include the following:

Left Controller

- Swing
- Auxiliary Hoist

Right Controller

- Boom Lift
- Main Hoist

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 loading.

Enabling craning functions with the Crane Function Enable/Disable Switch will cause the engine speed to increase to 1050 rpm. Disabling craning functions with the Crane Function Enable/Disable Switch will cause the engine speed to decrease to 800 rpm.

Momentary Limit Bypass Switch (Non-CE Certified Cranes)



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 (13, Figure 3-3) 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 3-6)
- 3rd Wrap Alert is flashing (Figure 4-12)

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 (Figure 4-110)
- RCL Bypass Active Indicator is on (Figure 4-110)
- RCL Shutdown Warning Indicator is flashing (5, Figure 3-6)
- Anti-Two-Block Indicator is flashing (7, Figure 3-6)
- 3rd Wrap Alert is flashing (Figure 4-12)
- Working Range Limiter (WRL) indicator is flashing (Figure 4-15)
- Low Boom Angle Alert is flashing (Figure 4-12)
- -29°C Temperature Limiter Alert is flashing (Figure 4-12)

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 (13, Figure 3-3) 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 3-6) is flashing
- 3rd Wrap Alert (Figure 4-12) 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 (Figure 4-110) is on
- RCL Bypass Active Indicator (Figure 4-110) is on
- RCL Shutdown Warning Indicator (5, Figure 3-6) is flashing
- Working Range Limiter (WRL) Indicator (Figure 4-15) is on
- Low Boom Angle Alert (Figure 4-12) 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 (Figure 4-110) is on RCL Bypass Active Indicator (Figure 4-110) is on
- RCL Shutdown Warning Indicator (5, Figure 3-6) is flashing
- Working Range Limiter (WRL) Indicator (Figure 4-15) is on
- Low Boom Angle Alert (Figure 4-12) 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 (14, Figure 3-3) 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 (Figure 4-110) is on constant (only when switch is pushed)
- RCL Bypass Active Indicator (Figure 4-110) is on constant
- RCL Shutdown Warning Indicator (5, Figure 3-6) 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

Emergency Stop Button

The Emergency Stop Button (15, Figure 3-3) 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 Alert in the Alerts Area (Figure 4-12) of the Operator Display Module (ODM) comes on (red).

Rotate and pull out Emergency Stop Button to allow engine to be re-started and resume normal operation.

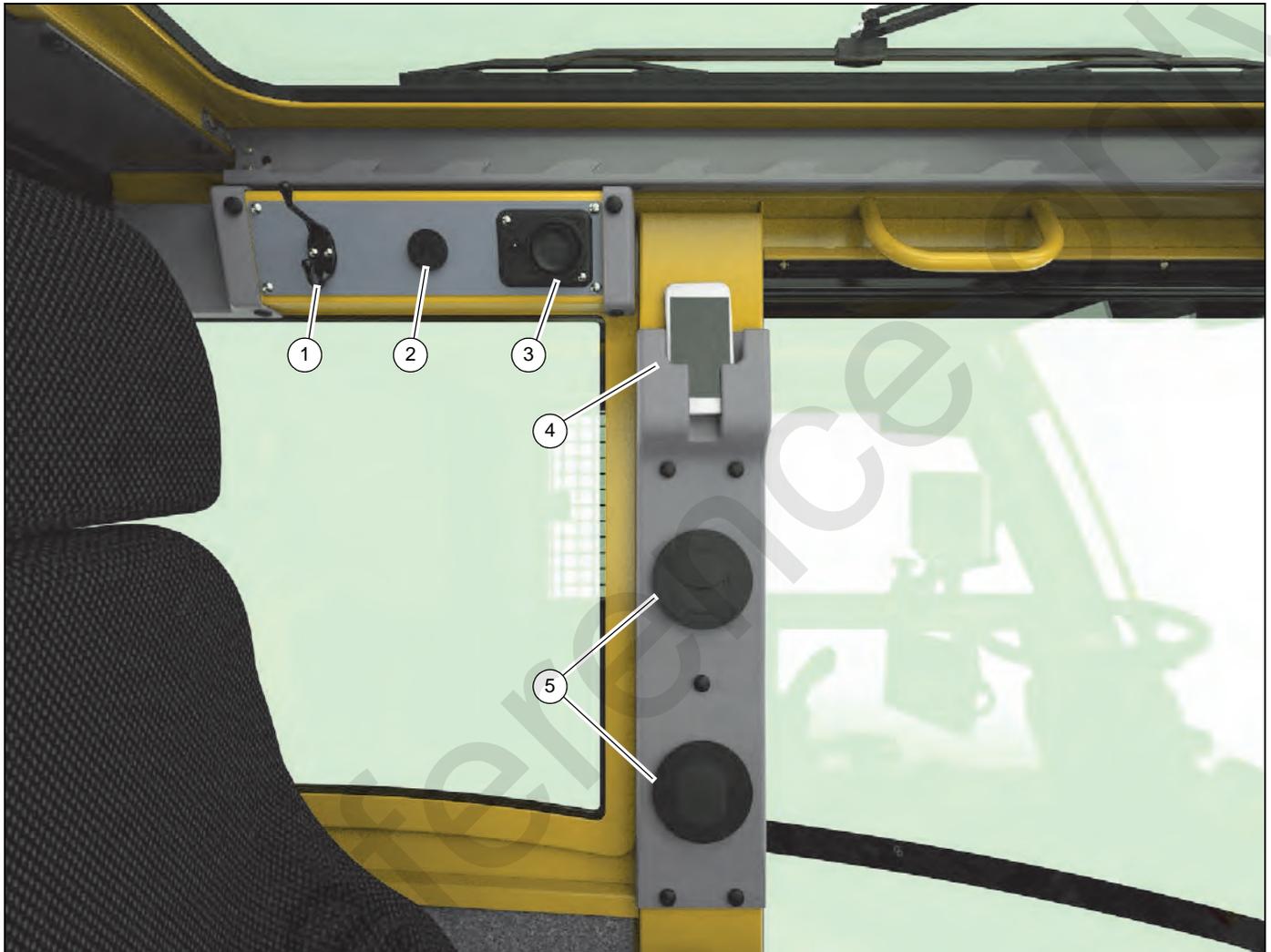
Cab Dome Light

The Cab Dome Light (16, Figure 3-3) 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 3-4) 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	3-14
2	USB Charging Ports	3-14
3	Auxiliary Light and Switch	3-14
4	Mobile Phone Holder	3-14
5	Heater/Air Conditioner Vents	3-14

FIGURE 3-4

Coat Hook

A Coat Hook (1, Figure 3-4) is located on the left overhead and side panel, near the rear of the cab.

USB Charging Ports

Two USB Charging Ports (2, Figure 3-4) are located on the left overhead and side panel.

The ports can be used to charge small electronic devices, such as a mobile phone.

Auxiliary Light and Switch

An Auxiliary Light and Switch (3, Figure 3-4) is located on the left overhead and side panel.

The auxiliary light switch is a two-position switch.

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

The auxiliary light can be adjusted by hand if necessary.

Mobile Phone Holder

A Mobile Phone Holder (4, Figure 3-4) is located on the left overhead and side panel.

Heater/Air Conditioner Vents

Two Heater/Air Conditioner Vents (5, Figure 3-4) 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.

RIGHT LOWER CONTROL PANEL

The right lower control panel (Figure 3-5) includes the turntable swing lock pin control handle, 12-volt outlet, and on-board diagnostic (OBD) connector.



9838-9

Item	Description	Page
1	Turntable Swing Lock Pin Control Handle	3-16
2	12-Volt Outlet	3-16
3	Engine On-Board Diagnostic (OBD) Connector	3-16

FIGURE 3-5

Turntable Swing Lock Pin Control Handle

The Turntable Swing Lock Pin Control Handle (1, Figure 3-5) is located on the right lower control panel.

To lock the superstructure in position, perform the following steps:

1. Center the 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 the swing lock in position.

To unlock the superstructure, perform the following steps:

1. Turn control handle counterclockwise to unlock the swing lock.
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 the 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 3-5) is located on the right lower control panel.

The 12-volt Outlet can power and charge electronic devices having a maximum current of 15 amps or less.

Engine On-Board Diagnostic (OBD) Connector

The Engine On-Board Diagnostic (OBD) Connector (3, Figure 3-5) is located on the right lower control panel.

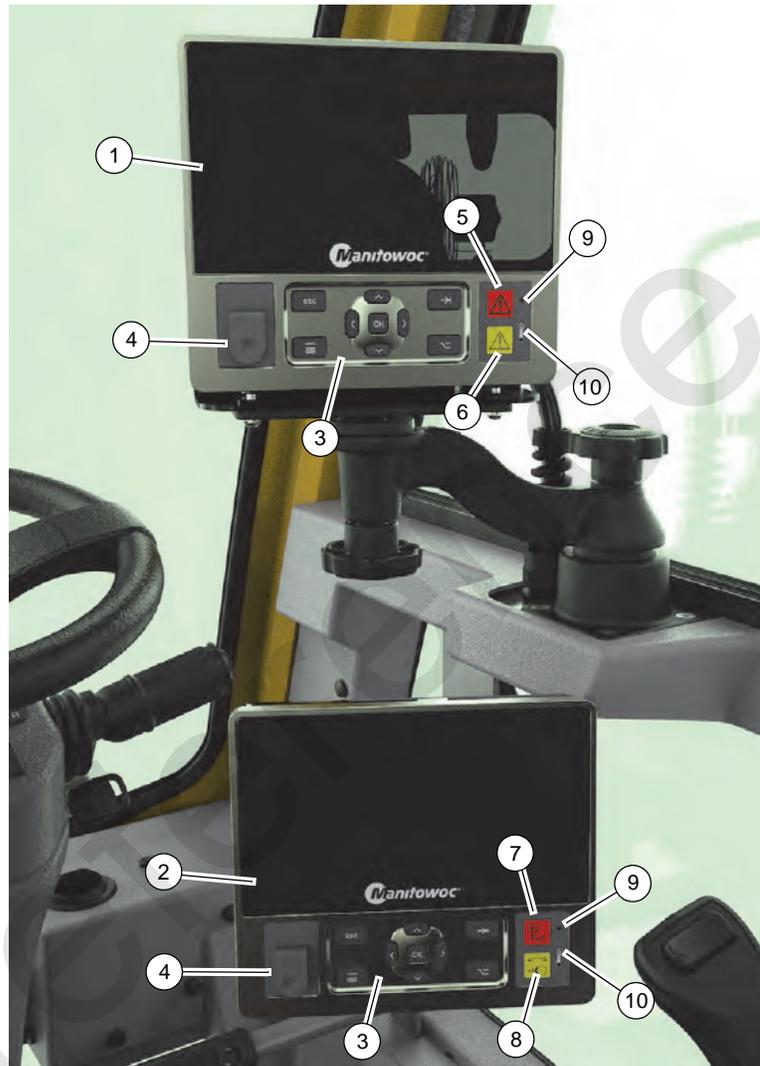
The connector allows the Cummins service software tool to be connected to the engine electronic control unit (ECU) for diagnosing issues that may occur.

A second Engine OBD Connector is located in the battery box.

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 3-6) are located to the right of the steering column.



9838-10

3

Item	Description	Page	Item	Description	Page
1	Rated Capacity Limiter Display Module (RDM)	3-18	6	RCL Early Warning Indicator	3-19
2	Operator Display Module (ODM)	3-18	7	Anti-Two-Block (A2B) Indicator	3-19
3	Navigation Control Pad	3-18	8	Swing Brake Engaged Indicator	3-19
4	USB Diagnostic Connector	3-19	9	Brightness Sensor	3-19
5	RCL Shutdown Warning Indicator (Non-CE Certified Cranes)	3-19	10	Internal Temperature Warning Indicator	3-19
5	RCL Shutdown Warning Indicator (CE Certified Cranes)	3-19			

FIGURE 3-6

Rated Capacity Limiter Display Module (RDM)

The Rated Capacity Limiter Display Module (RDM) (1, Figure 3-6) allows the operator to easily program the RCL by entering a code number from the *Load Chart Manual* or by using the RCL setup screen.

Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-104 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 3-6) allows the operator to do the following actions:

- Monitor performance of crane systems
- Select the camera views displayed on the ODM
- Telescope the boom (semi-automatic and manual modes)
- Extend/retract the outriggers
- Operate the 360° superstructure lock mechanism
- Operate the boom extension stowage pins
- Set the working range limits (WRL)
- View engine, transmission, and crane fault codes
- View software versions 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 4-28 for more information regarding the use of the module in the operation of the crane.

Navigation Control Pad

The Navigation Control Pads (3, Figure 3-6) 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 3-7) on the Navigation Control Pad of the ODM and RDM can be pushed to temporarily silence active audible alarms.

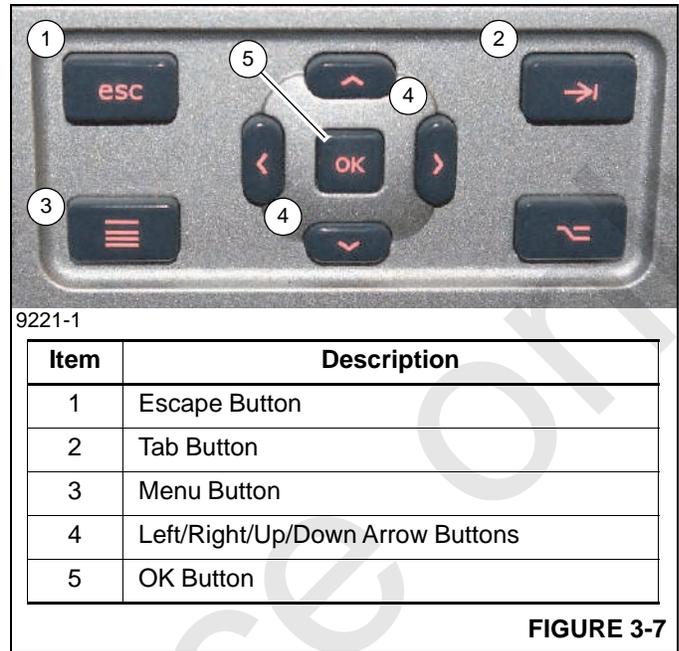


FIGURE 3-7

The Jog Dial (Figure 3-8), mounted on the right armrest (see *Jog Dial*, page 3-22), can be used to navigate the two modules in a similar manner as the Navigation Control Pads.

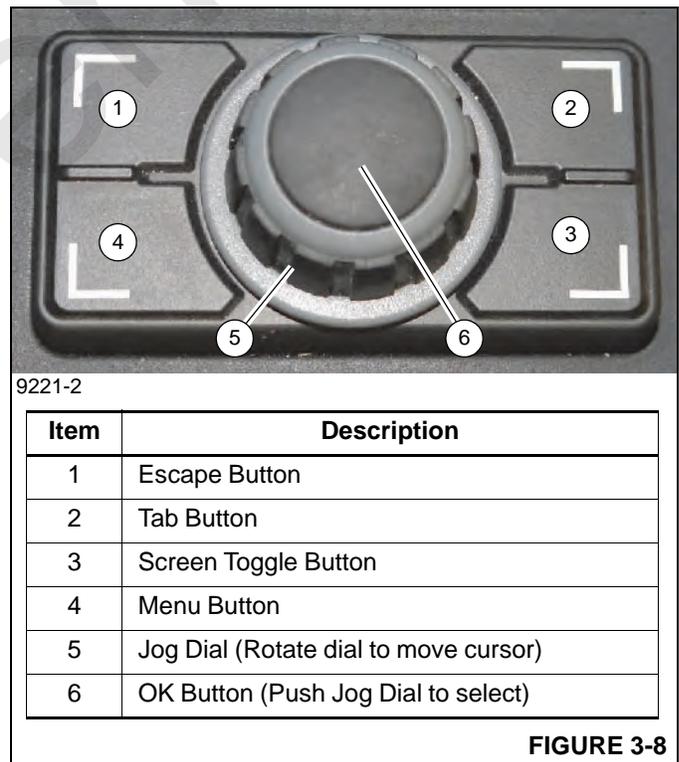


FIGURE 3-8

Refer to *Navigating the Operator Display Module and Rated Capacity Limiter Display Module*, page 4-27 for information on how the Navigational Controls Pads and Jog Dial are used in the operation of the crane.

USB Diagnostic Connector

The RDM and ODM each have a USB Diagnostic Connector (4, Figure 3-6) located immediately below and to the left of its related display module screen.

The USB Diagnostic 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 Diagnostic 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 3-6) 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 3-6) 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 3-6) 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 3-6) 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 3-6) 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 3-6) 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 3-6) is located immediately below and to the right of the RDM screen and ODM screen.

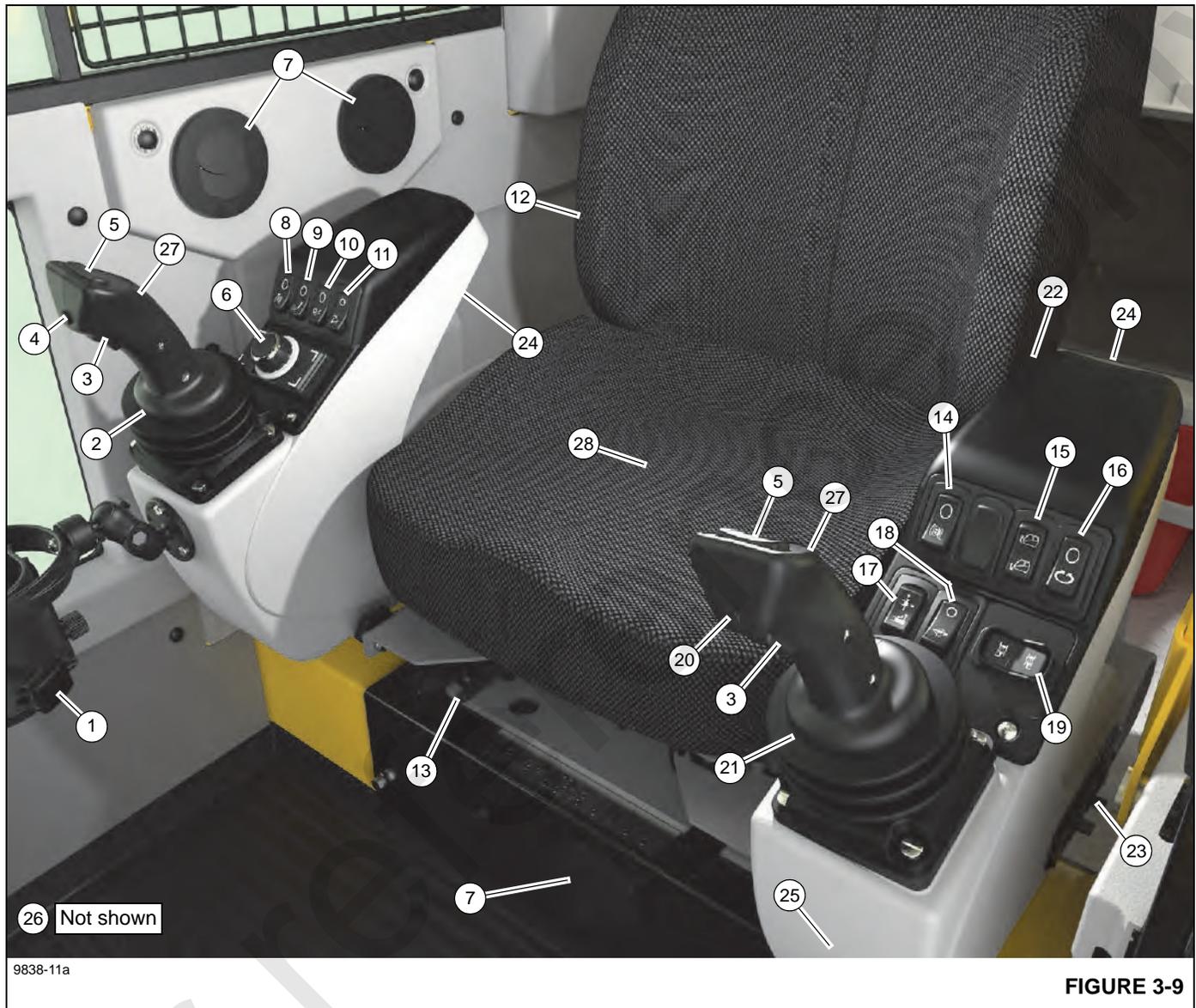
When the Ignition Switch is turned to the RUN (I) position and the internal temperature of either the RDM or the ODM is below -30°C (-22°F), the related module Internal Temperature Warning Indicator will come on (blue) and the module screen will remain blank.

When the Ignition Switch is turned to the RUN (I) 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).

OPERATOR SEAT AND ARMREST CONTROLS (DUAL AXIS)

The operator seat and armrest controls (Figure 3-9) include most of the controls for performing craning operations.



Item	Description	Page	Item	Description	Page
1	Cup Holder	3-22	15	Cab Tilt Switch	3-23
2	Boom Lift - Main Hoist - Luffing Jib Controller (Dual Axis)	3-22	16	Swing Enable/Disable Switch	3-23
3	Deadman Switches (Optional) (Dual Axis)	3-22	17	Outrigger Extend/Retract Switch	3-24
4	Horn Button	3-22	18	Differential Lock Switch (Optional)	3-24
5	Hoist Speed Toggle Switches	3-22	19	Rear Steer Switch	3-24
6	Jog Dial	3-22	20	Swing Brake Release Button	3-25
7	Heater/Air Conditioner Vents	3-22	21	Swing/Telescope or Swing/Auxiliary Hoist Controller (Dual Axis)	3-25
8	Main Hoist Enable/Disable Switch	3-22	22	Seat Backrest Adjustment Lever	3-25
9	Luffing Jib Enable/Disable Switch (Optional)	3-22	23	Seat Adjustment Control Panel	3-25
10	Boom Telescope Enable/Disable Switch	3-23	24	Armrest Adjustment Button	3-26
11	Boom Lift Enable/Disable Switch	3-23	25	Seat Heat Switch (Optional)	3-26
12	Seat Lumbar Support Adjustment Lever	3-23	26	Seat Headrest (Not shown)	3-26
13	Seat Slide Lever	3-23	27	Hoist Rotation Indicators	3-26
14	Auxiliary Hoist Enable/Disable Switch	3-23	28	Seat Switch	3-26

Cup Holder

The adjustable Cup Holder (1, Figure 3-9) 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.

Boom Lift – Main Hoist – Luffing Jib Controller (Dual Axis)

The Boom Lift - Main Hoist Controller (2, Figure 3-9) is located on the right armrest.

Push controller to the right to lower the boom. Push controller to the left to raise the boom.

When used for the main hoist, push controller forward to lower the hoist rope. Pull controller rearward to raise the hoist rope.

Move controller in a diagonal direction to operate the two functions at the same time.

When crane is equipped with an optional luffing jib, the luffing jib function is also operated by this controller. Operator must enable the boom lift or luffing jib function using the related Enable/Disable Switch for the function to operate. Only one of these functions can be enabled at a time.

When used for the luffing jib function, push controller to the right to lower the jib. Push controller to the left to raise the jib.

Deadman Switches (Optional) (Dual Axis)

Deadman Switches (3, Figure 3-9) (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 3-26.

Horn Button

The Horn Button (4, Figure 3-9) 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 3-9) are thumb operated three-position center spring return switches located on top of each controller.

Push and release switch closest to the operator to change hoist speed to high – push and release switch again to return hoist speed to normal.

Push and hold switch farthest from the operator to change hoist speed to high – release switch 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 3-9) 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 4-27 for more information on jog dial operation).

Heater/Air Conditioner Vents

Two Heater/Air Conditioner Vents (7, Figure 3-9) 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 3-9) 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 shows green in the Status Bar (Figure 4-17) of the Operator Display Module (ODM) 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 (Figure 4-17) 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 1050 rpm. Disabling all craning functions will cause the engine speed to decrease to 800 rpm.

Luffing Jib Enable/Disable Switch (Optional)

The Luffing Jib Enable/Disable Switch (9, Figure 3-9) (Optional) is a two-position momentary switch that is located on the right armrest.

Push switch one time to enable the luffing jib function. Push switch again to disable the luffing jib function.

The Luffing Jib Enable/Disable Indicator shows green in the Status Bar (Figure 4-17) of the Operator Display Module (ODM) when the luffing jib function is enabled. The indicator goes off when the luffing jib function is disabled.

Boom Telescope Enable/Disable Switch

The Boom Telescope Enable/Disable Switch (10, Figure 3-9) 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 shows green in the Status Bar (Figure 4-17) of the Operator Display Module (ODM) 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 1050 rpm. Disabling all craning functions will cause the engine speed to decrease to 800 rpm.

Boom Lift Enable/Disable Switch

The Boom Lift Enable/Disable Switch (11, Figure 3-9) 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 shows green in the Status Bar (Figure 4-17) of the Operator Display Module (ODM) when the boom lift function is enabled. The indicator goes off when the 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 1050 rpm. Disabling all craning functions will cause the engine speed to decrease to 800 rpm.

Seat Lumbar Support Adjustment Lever

The Seat Lumbar Support Adjustment Lever (12, Figure 3-9) 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 3-9) 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 3-9) 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 shows green in the Status Bar (Figure 4-17) of the Operator Display Module (ODM) 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 (Figure 4-17) 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 1050 rpm. Disabling all craning functions will cause the engine speed to decrease to 800 rpm.

Cab Tilt Switch

The Cab Tilt Switch (15, Figure 3-9) 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 rear of switch to tilt the cab up. Push and hold front 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 Alert in the Alerts Area (Figure 4-12) of the Operating Display Module (ODM) comes on (amber).

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 3-9) is a momentary switch that is located on the left armrest.

Push switch one time to enable the swing function. Push switch another time to disable the swing function.

The Swing Enable/Disable Indicator shows green in the Status Bar (Figure 4-17) of the Operator Display Module (ODM) 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 1050 rpm. Disabling all craning functions will cause the engine speed to decrease to 800 rpm.

Outrigger Extend/Retract Switch

The Outrigger Extend/Retract Switch (17, Figure 3-9) is a three-position momentary switch that is located on 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 4-57 for complete procedures on extending and retracting the outriggers.

NOTE: Push and hold the Outrigger Extend/Retract Switch to change the ODM screen display to the Outrigger Extend/Retract Function Screen.

Differential Lock Switch (Optional)

The optional Differential Lock Switch (18, Figure 3-9) 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 30 seconds at a time.

NOTE: Crane must be in Four-Wheel-Drive to engage the Differential Lock (refer to *Drive Axle Selector Switch*, page 3-5).

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 4-17 for more information on how and when to engage the differential lock.

The Differential Lock Alert in the Alerts Area (Figure 4-12) of the Operating Display Module (ODM) comes on (amber) when the differential lock is engaged.

Rear Steer Switch

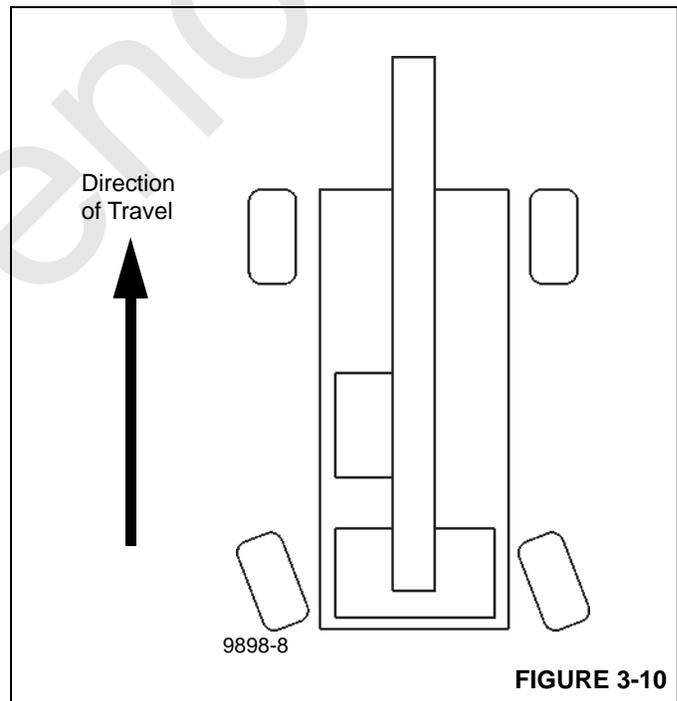
The Rear Steer Switch (19, Figure 3-9) is a three-position, spring centered to off, rocker switch located on the left armrest.

Use the Rear Steer Switch to turn the wheels on the rear axle.

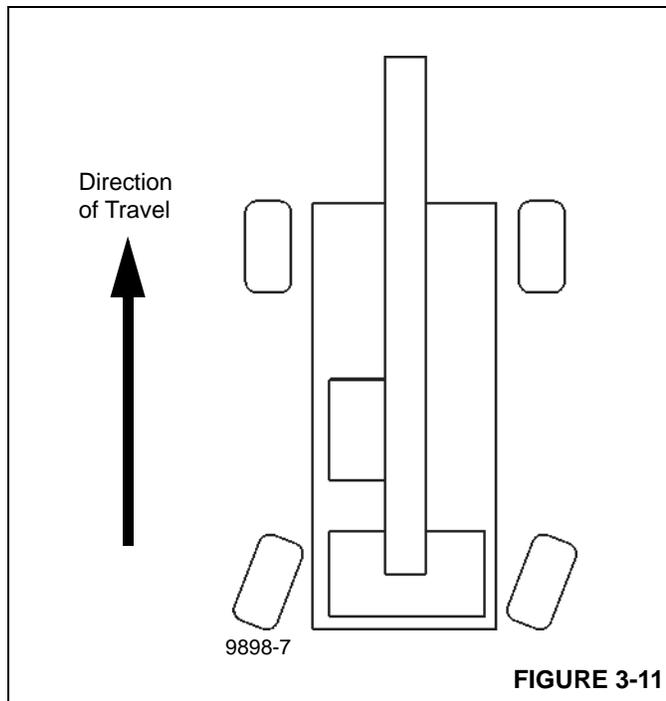
NOTE: The rear steer function will only operate when the crane speed is less than 8 km/h (5 mph) as shown on the Speedometer (7, Figure 4-14) on the Operator Display Module (ODM).

If crane speed is greater than 8 km/h (5 mph) and the rear steer switch is operated, the rear steer function will not operate and the Speedometer will flash.

Push and hold the right side of the Rear Steer Switch to cause the wheels on the rear axle to turn left, causing the crane to turn right as shown in Figure 3-10. 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 axle to turn right, causing the crane to turn left as shown in Figure 3-11. Release the switch when the rear wheels are pointed in the desired direction.



When rear wheels are not centered, the Rear Wheels Not Centered Alert in the Alerts Area (Figure 4-12) of the Operating Display Module (ODM) comes on (amber).

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 Alert goes off.

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 Alert goes off.

Swing Brake Release Button

The Swing Brake Release Button (20, Figure 3-9) is located on the upper front of the left controller.

The swing brake release function is used to align the boom over the center of the load.

Push and hold Swing Brake Release 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.

NOTE: Swing Brake Release Button is disabled when a MAXbase Load Chart or a Pick-and-Carry (On-Rubber, Over-the-Front) Load Chart is programmed in to the Rated Capacity Limiter (RCL).

Swing/Telescope or Swing/Auxiliary Hoist Controller (Dual Axis)

The Swing/Telescope or Swing/Auxiliary Hoist Controller (21, Figure 3-9) is located on the left armrest.

The controller operates the swing and telescope functions when crane is not equipped with an auxiliary hoist.

When equipped with an auxiliary hoist, the controller operates the swing and auxiliary hoist functions. Telescope function moves to the Telescope Control Pedal on the floor.

If not equipped with an auxiliary hoist, push controller left or right for 360 degree continuous rotation of the superstructure in the desired direction. Push controller forward to extend the boom. Pull controller rearward to retract the boom.

If equipped with an auxiliary hoist, push controller forward to lower the auxiliary hoist rope. Pull controller rearward to raise the hoist rope.

Move controller in a diagonal direction to operate the two functions at the same time.

Seat Backrest Adjustment Lever

The Seat Backrest Adjustment Lever (22, Figure 3-9) 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 3-9) is located at the bottom, left side of the seat.

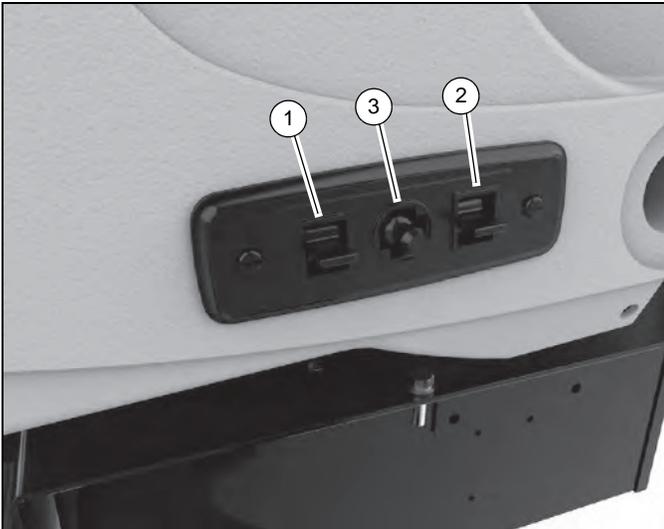
The panel has three electric switches which are used to adjust the position of the seat and armrest assembly.

The Seat Front Adjustment Switch (1, Figure 3-12) 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 Seat Rear Adjustment Switch (2, Figure 3-12) 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 Seat 4-Way Adjustment Switch (3, Figure 3-12) 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 3-23).



9838-12

Item	Description
1	Seat Front Adjustment Switch
2	Seat Rear Adjustment Switch
3	Seat 4-Way Adjustment Switch

FIGURE 3-12

Armrest Adjustment Buttons

The Armrest Adjustment Buttons (24, Figure 3-9) are located under 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 3-9) 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 cause seat heater to go off.

Seat Headrest (Not Shown)

The Seat Headrest (26, Figure 3-9) 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 3-9) for auxiliary and main hoists are located at mid-stick, facing the operator on each dual-axis hoist controller (2, 21, Figure 3-9).

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.

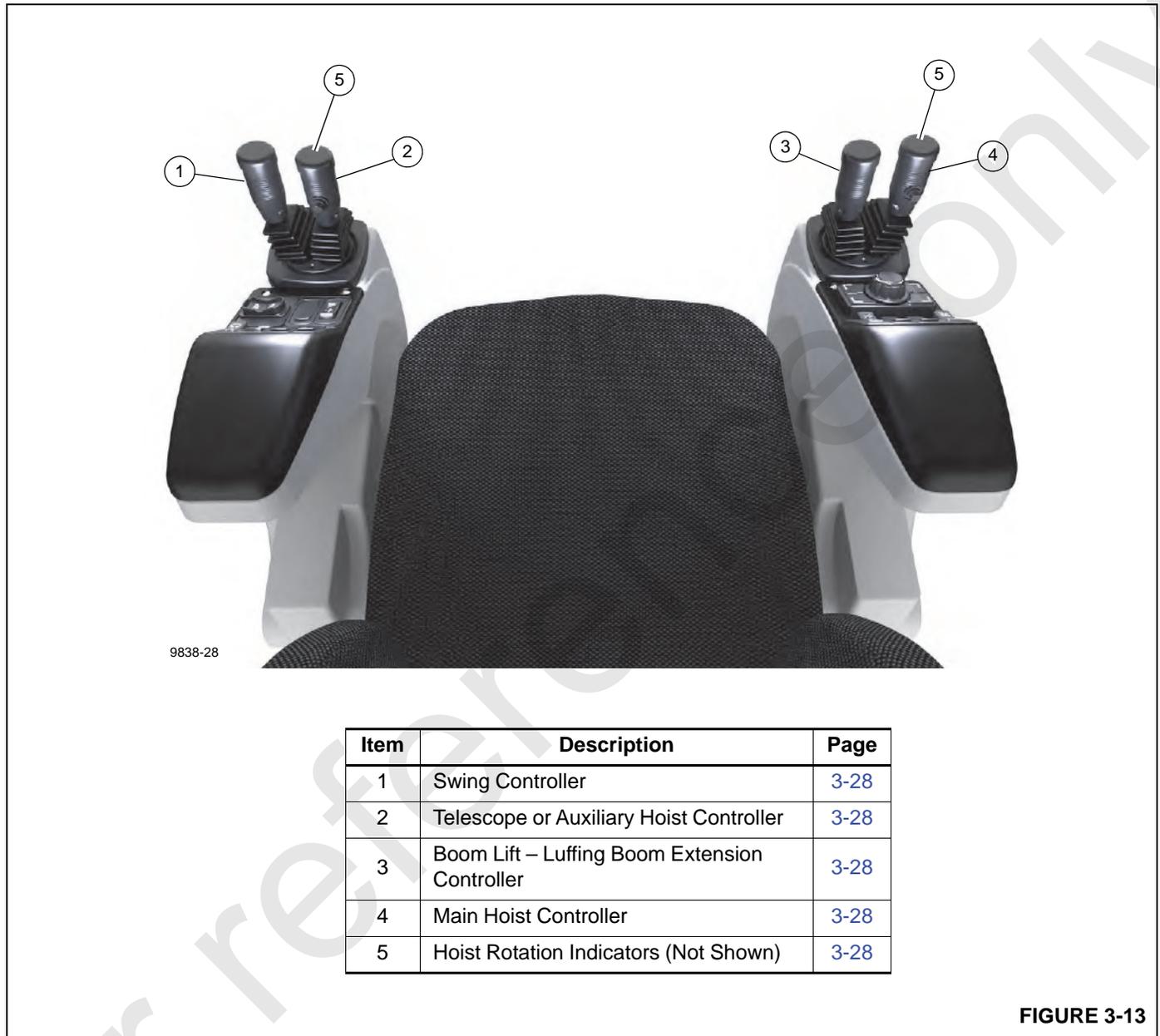
Seat Switch

The Seat Switch (28, Figure 3-9) is located within the seat.

The operator must be sitting in the seat, enabling the switch, before any crane functions can be operated.

OPTIONAL SINGLE AXIS CONTROLLERS

The following single axis controllers (Figure 3-13) are available as an option on the GRT8100-1 crane.



Swing Controller

The Swing Controller (1, Figure 3-13) 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.

Telescope or Auxiliary Hoist Controller

The Telescope Controller (2, Figure 3-13) is located on the left armrest.

Push controller forward to extend the boom. Pull controller rearward to retract the boom.

When the crane is equipped with the optional Auxiliary Hoist, this controller is used to raise and lower the auxiliary hoist rope. The telescope function moves to the Telescope Control Pedal on the floor of the cab.

When used for the auxiliary hoist function, push controller forward to lower the auxiliary hoist rope. Pull controller rearward to raise the hoist rope.

Boom Lift – Luffing Boom Extension Controller

The Boom Lift – Luffing Boom Extension (optional) Controller (3, Figure 3-13) is located on the right armrest.

Operator must enable the boom lift or luffing boom extension 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 crane is equipped with an optional luffing boom extension, the luffing boom extension function is also operated by this 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 3-13) 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 3-13) for auxiliary and main hoists are located on top of each single-axis hoist controller (1, 3, Figure 3-13).

The Hoist Rotation Indicator pulses on the auxiliary or main hoist controller (1, 3) when its related hoist is operating.

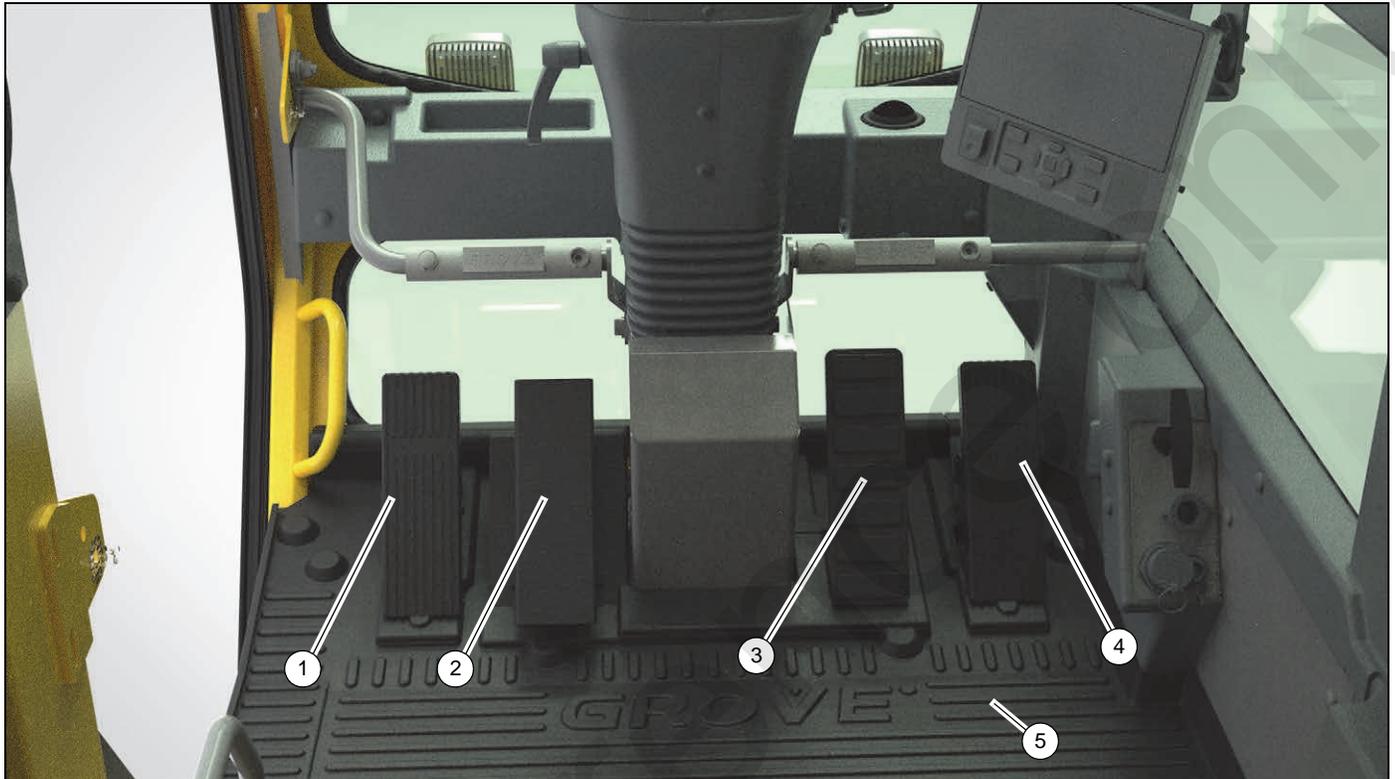
The pulsing, felt by the operator's hand, indicates to the operator that the hoist is operating.

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 AND FLOOR MAT

The foot pedal controls (Figure 3-14) include the swing brake pedal, telescope control pedal, service brake pedal, and throttle pedal.



3

9838-13a

Item	Description	Page
1	Swing Brake Pedal	3-30
2	Telescope Control Pedal	3-30
3	Service Brake Pedal	3-30
4	Throttle Pedal	3-30
5	Floor Mat	3-30

FIGURE 3-14

Swing Brake Pedal

The Swing Brake Pedal (1, Figure 3-14) 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.

Telescope Control Pedal (Optional)

The Telescope Control Pedal (2, Figure 3-14) is the second pedal from the left on the cab floor.

When crane is equipped with an optional auxiliary hoist, the telescope control function moves from the Controller on the armrest to the Telescope Control Pedal.

Push top of Telescope Control Pedal to extend the boom.
Push bottom of pedal to retract the boom.

The speed at which the boom extends or retracts is proportionate with the amount of foot pressure applied to the pedal.

Service Brake Pedal

The Service Brake Pedal (3, Figure 3-14) 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.

Throttle Pedal

The Throttle Pedal (4, Figure 3-14) is located on the right side of the floor.

Push Throttle Pedal to increase engine speed.

Engine speed increases or decreases proportionately with the amount of foot pressure applied to the pedal.

Floor Mat

A Floor Mat (5, Figure 3-14) 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.

INTERNAL RATED CAPACITY LIMITER LIGHT BAR

The Rated Capacity Limiter (RCL) Internal Light Bar (Figure 3-15) 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.



CONTROLS AND FEATURES AT FRONT OF CAB

Controls and features located at the front of the cab (Figure 3-16) include the front windshield/emergency exit, sun visor, grab handles, and foot rests.



9838-31

Item	Description	Page
1	Front Windshield/Emergency Exit	3-33
2	Sun Visor	3-33
3	Grab Handles	3-33
4	Foot Rests	3-33

FIGURE 3-16

Front Windshield/Emergency Exit

The Front Windshield is the Emergency Exit (1, Figure 3-16).

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 3-16) 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.

Grab Handles

Grab Handles (3, Figure 3-16) 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 3-16) 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.

CONTROLS AND FEATURES AT REAR OF CAB

Controls and features located at rear of the cab (Figure 3-17) include the radio, fan, fire extinguisher, user manual holder, fuse and relay panel, and limit bypass switch for non-CE certified cranes.



9838-16a

Item	Description	Page	Item	Description	Page
1	Radio (Optional)	3-35	6	User Manual Holder	3-35
2	Speakers (Optional)	3-35	7	Fuse and Relay Panel	3-36
3	Rear Window	3-35	8	Buzzer (Not Shown)	3-37
4	Fan	3-35	9	Maintained Limit Bypass Switch (Non-CE Certified Cranes)	3-37
5	Fire Extinguisher	3-35			

FIGURE 3-17

Radio (Optional)

An AM/FM Radio (1, Figure 3-17), optional equipment, is located at the upper left rear (as seated in the operator seat) corner of the cab.

Speakers (Optional)

Two Speakers (2, Figure 3-17), optional equipment, are located at the upper rear corners of the cab.

Rear Window

The Rear Window (3, Figure 3-17) 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 3-17) is located at the right rear side of the cab.

The fan is situated 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 3-17) is located at the left rear (as seated in the operator seat) corner of the cab.

User Manual Holder

A User Manual Holder (6, Figure 3-17) 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*.

Fuse and Relay Panel – Cab

The Fuse and Relay Panel (7, Figure 3-17) is located behind the operator seat in the right side upper compartment.

The cab fuse and relay panel contains the fuses and relays listed in Figure 3-18.



9904

FIGURE 3-18

Buzzer

The buzzer (8, Figure 3-17) comes on when one or more of the following conditions exist:

- Park brake not released when transmission is in F or R
- 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)



WARNING

Overload Hazard!

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 3-17) 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 (Figure 4-110)
- RCL Bypass Active Indicator is on (Figure 4-110)
- RCL Shutdown Warning Indicator is flashing (5, Figure 3-6)
- Anti-two-block Indicator is flashing (7, Figure 3-6)
- 3rd Wrap Alert is flashing (Figure 4-12)
- Working Range Limiter (WRL) Indicator is flashing (Figure 4-15)
- Low Boom Angle Alert is flashing (Figure 4-12)
- -29°C Temperature Limiter Alert is flashing (Figure 4-12)

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 3-19) can be opened for ventilation. The skylight sun shade can be adjusted to multiple positions to allow varying amounts of light into the cab.



9838-17

Item	Description	Page
1	Skylight Window Latch (If Equipped)	3-39
2	Skylight Sun Shade	3-39
3	Right Side Window Latch	3-39

FIGURE 3-19

Skylight Window Latch (If Equipped)

The Skylight Window Latch (1, Figure 3-19) 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 3-19) 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.

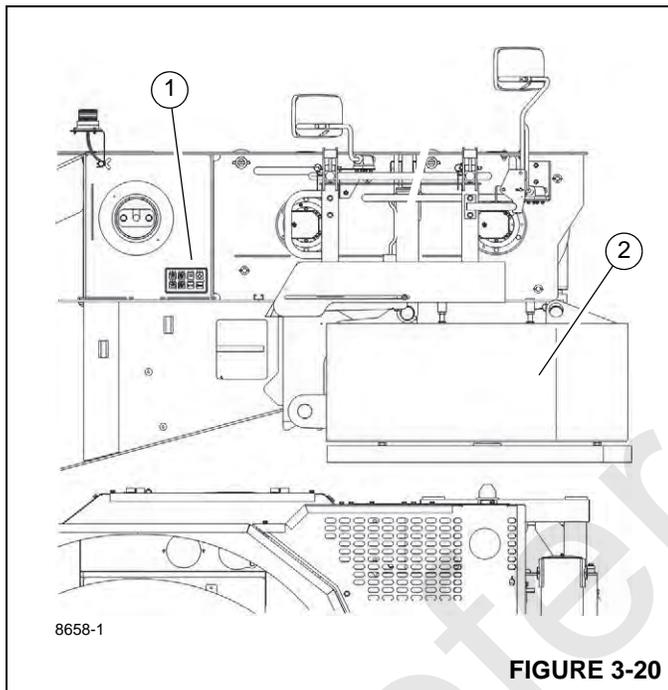
Squeeze latch (3, Figure 3-19) to release and slide the window forward. To close, slide window rearward until the latch engages.

CONTROLS AND FEATURES EXTERNAL TO THE CAB

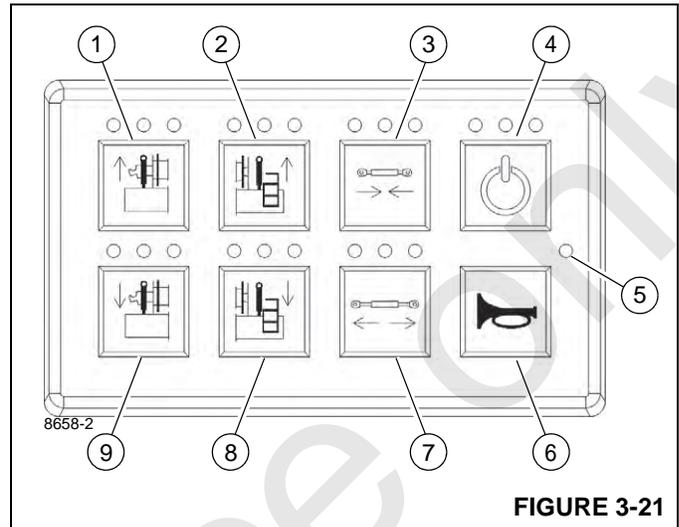
Counterweight Removal Control Pads

The Counterweight (2, Figure 3-20) is removed and installed using hydraulic cylinders controlled by a counterweight control panel located on each side of the superstructure. The counterweight assembly is held in place by a hydraulic cylinder and locking pins with pin clips.

There are two identical Counterweight Removal Control Pads (1, Figure 3-20) located on each side of the superstructure near the counterweight. Only one control pad can be used at a time.



- Red LED (right position) indicates the requested function is not available or the counterweight removal system is not enabled



Item	Description
1	Right Counterweight Cylinder Raise Button
2	Left Counterweight Cylinder Raise Button
3	Lock Cylinder Retract Button
4	Function Enable Button
5	Main Power LED Indicator
6	Horn Button
7	Lock Cylinder Extend Button
8	Left Counterweight Cylinder Lower Button
9	Right Counterweight Cylinder Lower Button

The following section provides a description of the LEDs and buttons which make up the Counterweight Removal Control Pad. For complete procedures and precautions for how to remove and install the counterweight, refer to *Counterweight Removal and Installation*, page 5-46.

The Counterweight Removal Control Pads contain function buttons and LED indicators.

Use the LED indicators to monitor power of the control panel and performance of the counterweight removal system.

The Main Power LED (5, Figure 3-21) flashes green when Main Power is on. Three other LED indicators, located above each function button, indicate the status of the buttons.

- Green LED (left position) indicates function is enabled
- Yellow LED (middle position) indicates an error condition

The crane engine must be running with the parking brake in the ON position, and no other crane functions enabled, for the system to be fully operational.

Use the function buttons on the control pads to operate the hydraulic cylinders of the counterweight removal system.

Right Counterweight Cylinder Raise Button

The Right Counterweight Cylinder Raise Button (1, Figure 3-21) must be pushed and held to raise the right cylinder holding the right side of the counterweight. The operator must release the button when right side of the cylinder is at desired position.

Left Counterweight Cylinder Raise Button

The Left Counterweight Cylinder Raise Button (2, Figure 3-21) must be pushed and held to raise the left cylinder holding the left side of the counterweight. The operator must release the button when left side of the cylinder is at desired position.

Lock Cylinder Retract Button

The Lock Cylinder Retract Button (3, Figure 3-21) must be pushed and held to retract the lock cylinder holding the counterweight. The operator must release the button when lock cylinder is at desired position.

Function Enable Button

The Function Enable Button (4, Figure 3-21) is used to enable the other function buttons on the keypad. Thus, to operate the counterweight removal system, the enable button must first be pushed and released to activate all function buttons.

If a function button is not pushed within 5 seconds of pushing the Enable button, a system time-out will occur.

If the red LED comes on indicating a system time-out, the operator must again quickly push and release the Enable button, to re-activate the function buttons.

If the Enable button is pushed and held for more than 2 seconds without releasing, then the red LED will come on and no functions can be operated. The operator must first release the Enable button, and then quickly push and release it again to re-activate the function buttons.

Main Power LED Indicator

The Main Power LED Indicator (5, Figure 3-21) flashes green to indicate that Main Power is on.

Horn Button

The Horn Button (6, Figure 3-21) is always active and can be pushed at any time without first pushing the Keypad Enable button (4).

Lock Cylinder Extend Button

The Lock Cylinder Extend Button (7, Figure 3-21) must be pushed and held to extend the cylinder holding the counterweight. The operator must release the button when lock cylinder is at desired position.

Left Counterweight Cylinder Lower Button

The Left Counterweight Cylinder Lower Button (8, Figure 3-21) must be pushed and held to lower the left cylinder holding the left side of the counterweight. The operator must release the button when left side of the cylinder is at desired position.

Right Counterweight Cylinder Lower Button

The Right Counterweight Cylinder Lower Button (9, Figure 3-21) must be pushed and held to lower the right cylinder holding the right side of the counterweight. The operator must release the button when right side of the cylinder is at desired position.

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 3-22) 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) (Figure 4-110)

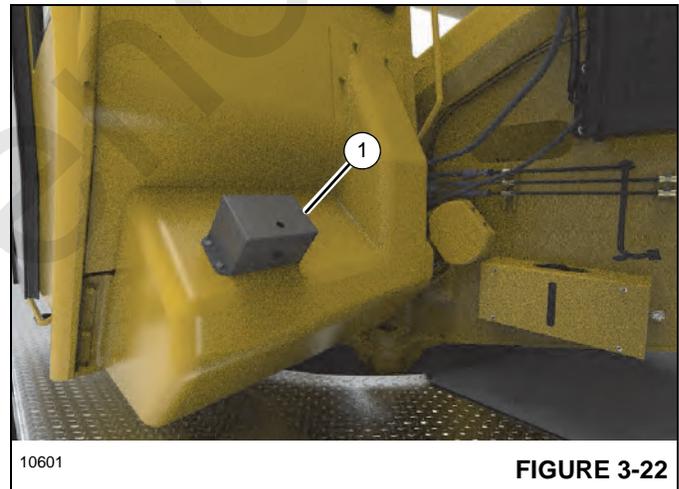
- RCL Bypass Active Indicator is on (Figure 4-110)
- Working Range Limiter (WRL) Indicator is on (Figure 4-15)
- Low Boom Angle Indicator is flashing (Figure 4-12)

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.



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FIGURE 3-22

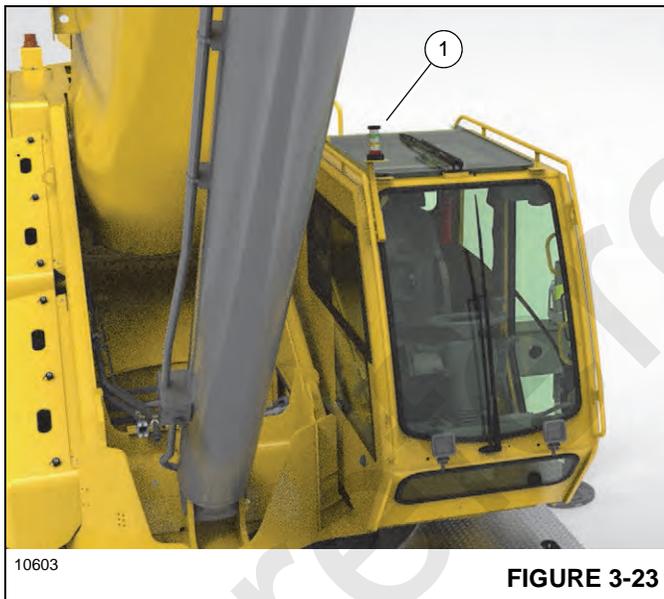
External RCL Light Tower (Optional)

The optional External Rated Capacity Limiter (RCL) Light Tower (1, Figure 3-23) is located on the outside upper right corner of the crane cab.

The External RCL 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.

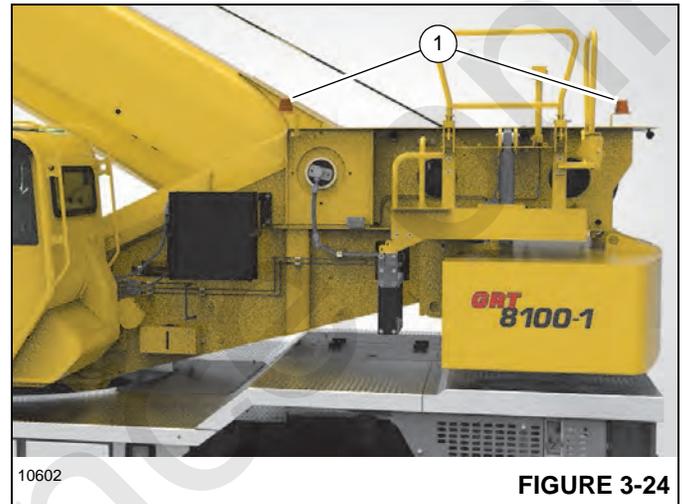


Strobe Light or Beacon

The standard Strobe Light or Beacon (1, Figure 3-24) is located at the right side of the superstructure.

The Beacon is on when the Ignition Switch is in the RUN (I) position.

Two Beacons are available as an option.



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.

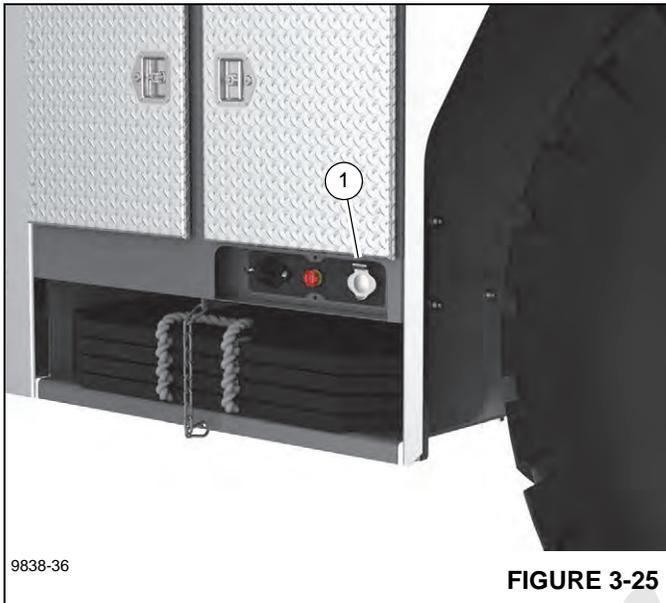
The Backup Alarm is installed on the rear of the carrier.

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 3-25) 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.



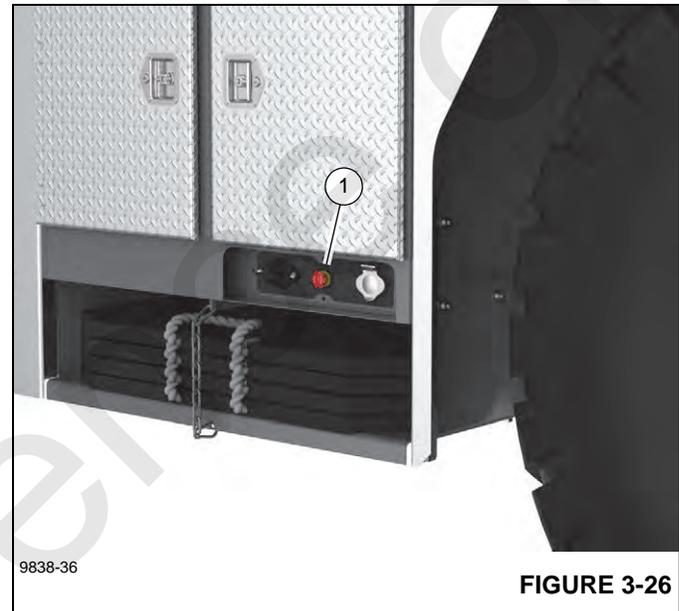
Emergency Stop Buttons (Optional)

The optional Emergency Stop Buttons (1, Figure 3-26) 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 Active Alert in the Alerts Area (Figure 4-12) of the Operator Display Module (ODM) comes on (red).

Rotate and pull out button to allow the engine to be re-started and resume normal operation.



Battery Disconnect Switch

The Battery Disconnect Switch (1, Figure 3-27) 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 and connect the batteries. Turn switch counterclockwise to the OFF position and disconnect the batteries.

Always disconnect batteries using the Battery Disconnect Switch if crane is scheduled to 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 3-6), has been in the

OFF (0) position for 2 minutes before disconnecting the batteries to the crane.



Fuse Box – Carrier

The Fuse Box is located on the left side of the carrier in the battery box and includes fuses listed in Figure 3-28.

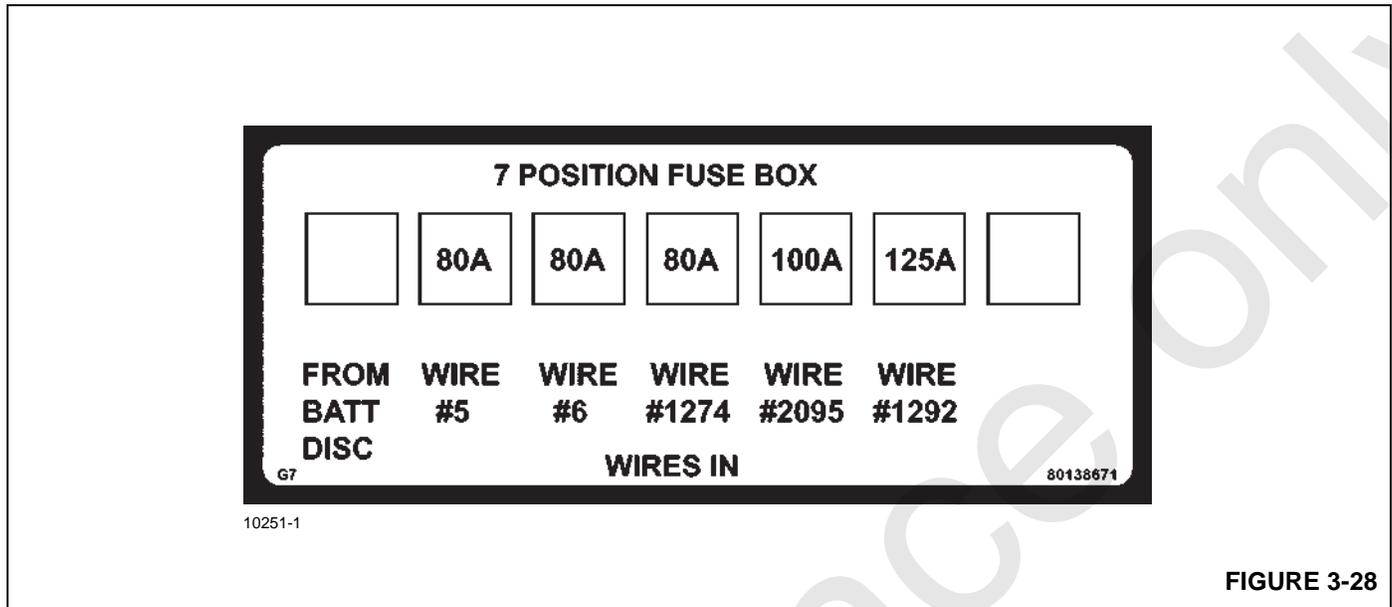
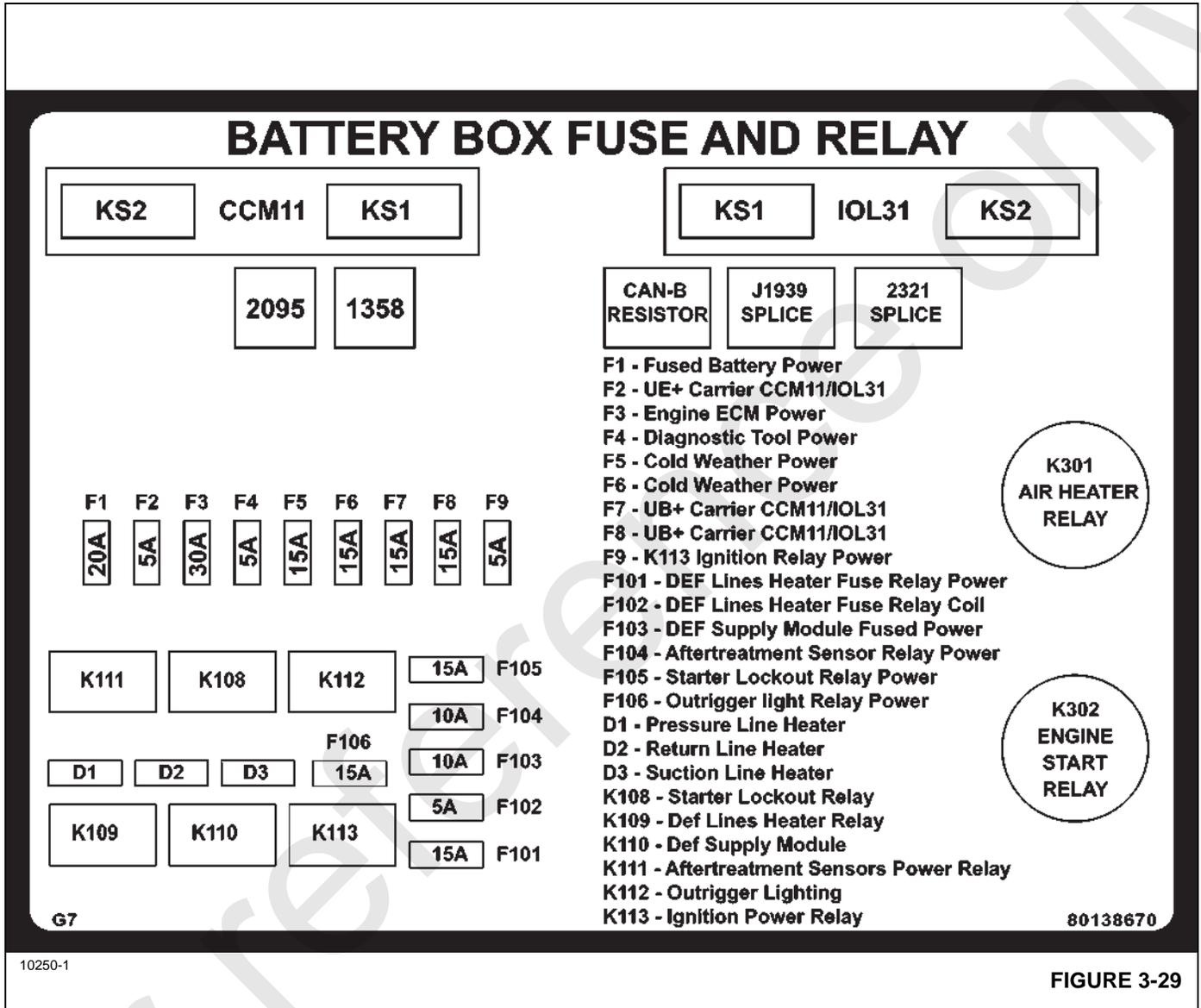


FIGURE 3-28

Fuse and Relay Box – Carrier

The Fuse and Relay Box is located on the left side of the carrier in the battery box and includes fuses and relays listed in Figure 3-29.



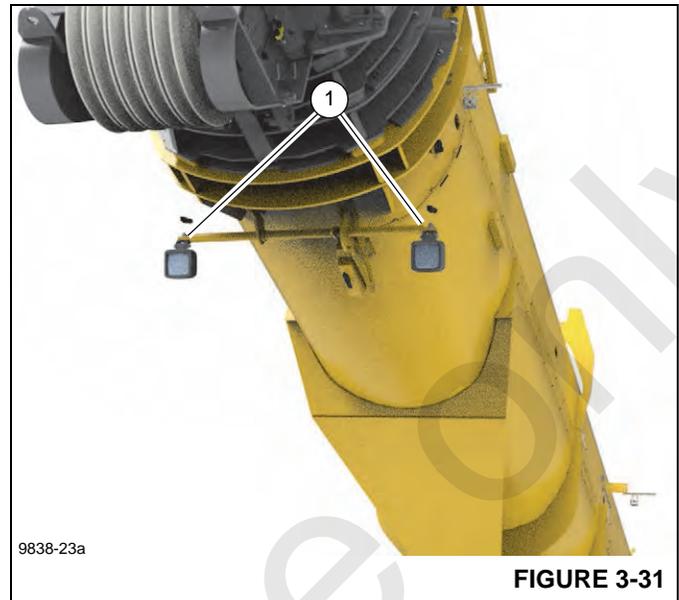
10250-1

FIGURE 3-29

Cab Mounted Work Lights

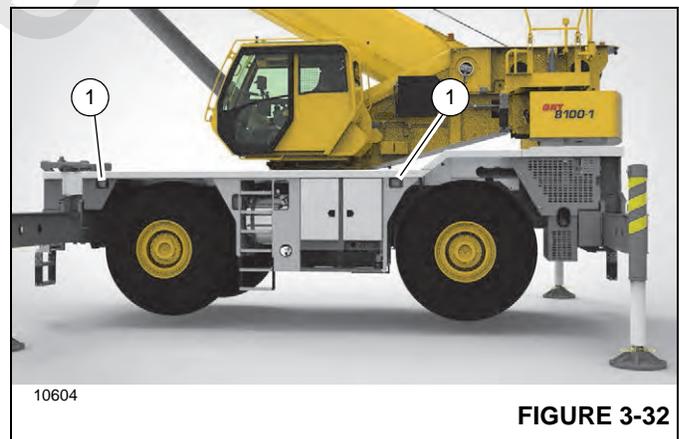
Adjustable Cab Mounted Work Lights (1, Figure 3-30) are located on the front of the cab.

The lights are controlled by the *Cab-Mounted Lights Switch*, page 3-8.



Side Mounted Carrier Work Lights

Two carrier work lights (1, Figure 3-32) are located on each side of the carrier. These four lights can be adjusted by hand to illuminate the desired area around the crane during low light or nighttime ground work. The four lights are toggled on and off in the Outrigger Extend/Retract function screen of the Operator Display Module (ODM) (refer to *Operating the Side Mounted Carrier Work Lights*, page 4-63).



Boom Mounted Work Lights (Optional)

Boom-Mounted Work Lights (1, Figure 3-31) are optional crane equipment and mounted to the bottom of the boom.

The Boom-Mounted Work Lights are controlled by the *Boom-Mounted Lights Switch (Optional)*, page 3-8.

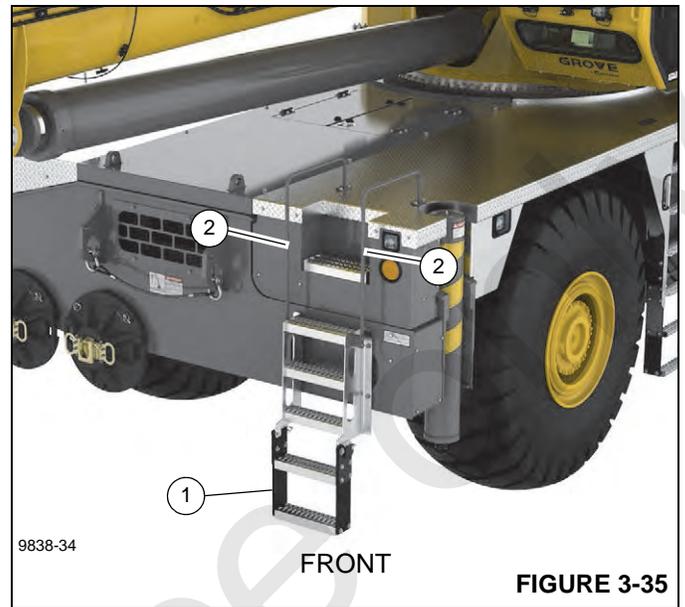
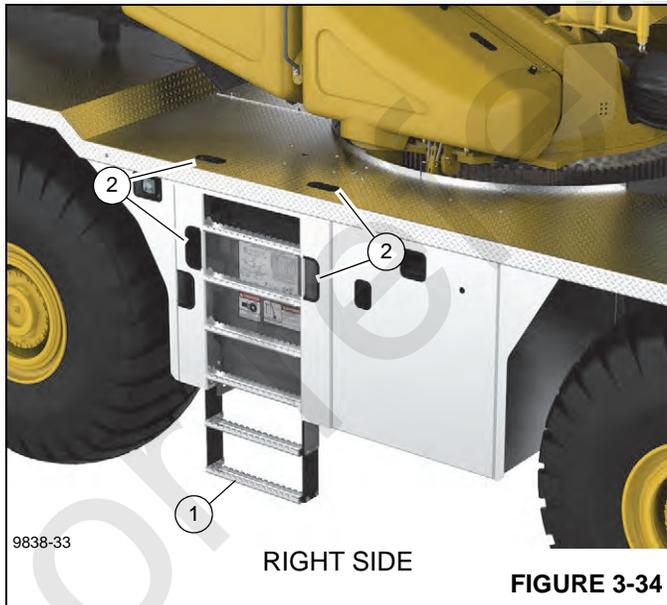
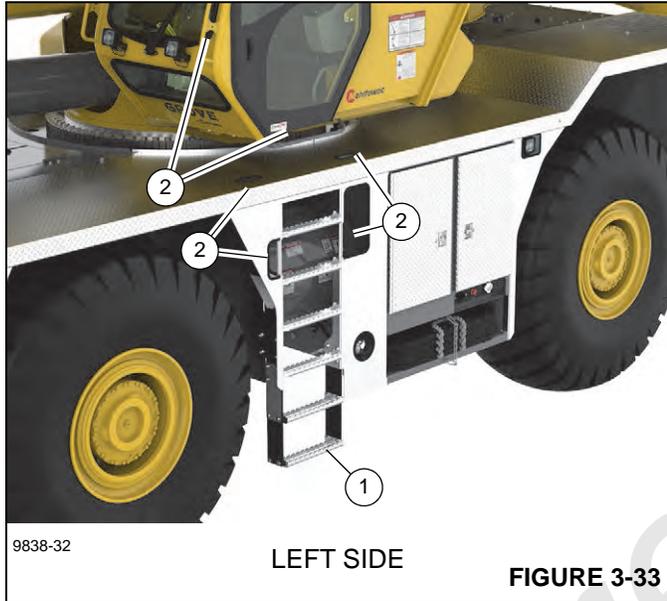
Optional motorized Boom-Mounted Work Lights are adjusted by the *Boom-Mounted Lights Motor Switch (Optional)*, page 3-8.

Ladders and Grab Handles

Ladders (1, Figure 3-33 to Figure 3-36) 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.



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For reference only

SECTION 4 OPERATING PROCEDURES

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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.

Cameras

Make sure hoist, rear view, and side view cameras function properly and are properly adjusted. Make sure cameras are kept clean.

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.
3. Center the rear wheels.
4. With hook unloaded, boom fully retracted and centered over the front at no more than a 10° to 15° boom angle, position the left or right side rear tire on blocks so that the rear tires approximately 15 to 30 cm (6 to 12 in) above the level of the opposite tire.
5. 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 (3, Figure 4-15) to confirm the suspension is locked. Do not swing beyond tire track.
6. Slowly drive off of blocks and stop. Rear tire should be touching the road surface and the opposite front tire should be light or slightly off road surface.
7. 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 4-11) 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 4-89).

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 4-10. 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 Grove Product Support. 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 4-10.

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 Grove Product Support 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 – Maxwell

The super capacitor provides additional cranking 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.

Super Capacitor – Ioxus

The super capacitor is connected in parallel with the two batteries to provide additional cranking power during cold weather startup. 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 super capacitor does not have enough energy to crank the engine, the batteries and super capacitor must be simultaneously charged using a 24V charger (refer to *Charging the Batteries*, page 4-7). Never jump-start the crane using another vehicle (refer to *Jump Starting Hazard*, page 4-7).

If the crane batteries must be removed for charging or replaced with new batteries, follow the procedures in the *Service Manual* for how to properly and safely connect the super capacitor and batteries together. The super capacitor and batteries must be charged to within one volt of each other before being connected to avoid a surge of energy that can result in equipment damage, severe injury, or death.

When performing any maintenance on the crane that requires the batteries to be disconnected (such as welding), always disconnect the battery cables as instructed while making sure the super capacitor remains connected in parallel with the batteries.

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/ampere 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 4-7.

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 4-11) 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 4-11) 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 4-10.

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 4-8.

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 4-30).

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 4-99 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.

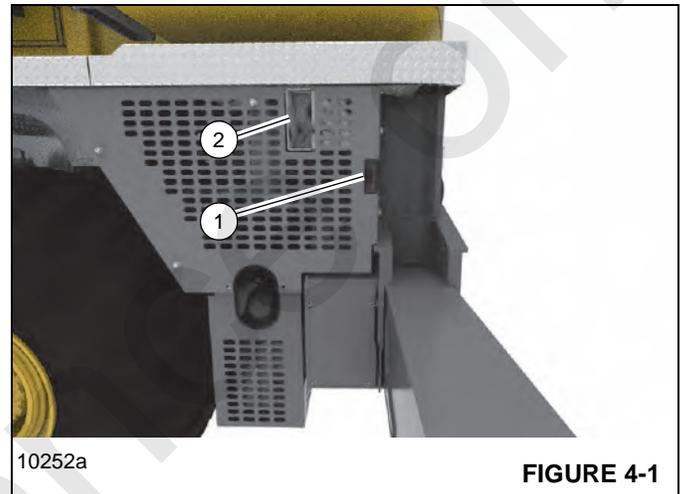


FIGURE 4-1

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.

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 Grove Product Support 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 4-11).
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

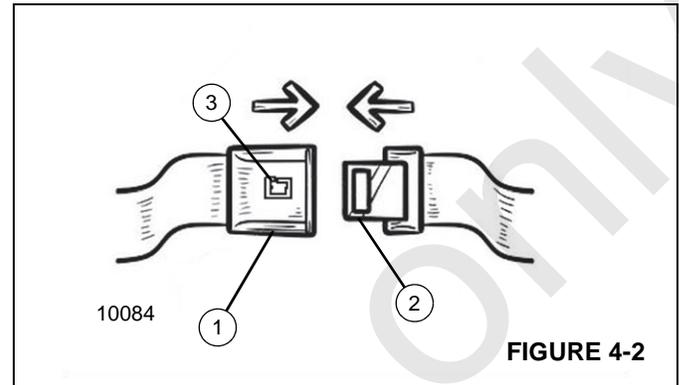


FIGURE 4-2

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, 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.

- Use four-wheel drive only when greater traction is necessary or as instructed in the following sections. (Refer to *Four-Wheel Drive Operation*, page 4-17 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) 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) 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 4-17 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) or evenly attaching to the tie-down lugs 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.
- Do not exceed a speed of 1.6 km/h (1 mph).

- Limit travel to a forward direction only.
- 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 4-14).
- Lower boom to horizontal and position over front of crane. 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°), shift transmission to four-wheel drive and limit travel speed to 1.6 km/h (1 mph). 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 4-15 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

- On a side slope, do not exceed 15% (8.5°) and 1.6 km/h (1 mph).

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 4-13).
- 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 a speed of 16 kph (15 mph).

- 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 4-14 if boom extension is in the erected position.
- Position boom over front 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

- Main Boom shall be fully retracted.
- 34.5 ft/57.6 ft boom extension shall be erected at minimum (0°) offset.

NOTE: While traveling with 34.5 ft extension, fly section must remain stowed on main boom base section.

- Jobsite travel shall be only on firm, level surface (if traveling on slopes, follow the requirements under the section *Traveling on Slopes*, page 4-13).
- Maximum travel speed: 2.5 mph.
- Counterweight shall be installed.
- Boom shall be directly over front. Swing lock shall be engaged.
- Tires shall be properly inflated (refer to *Load Chart Manual*).
- 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.

Traveling with 34.5 ft boom extension erected:

- Fly section must remain stowed on the main boom base section.
- Main boom angle shall be between 0° and 40°.

Traveling with 57.6 ft boom extension erected:

- Main boom angle shall be between 20° and 40°.

Extended Traveling

Depending upon the tire manufacturer, the higher inflation pressures normally specified for lifting on rubber are not recommended for site to site traveling over extended distances. The higher static/creep 8 kph (5 mph) inflation pressures may remain in the tire while operating the crane on site within a distance of less than 6.4 km (4 mi).

CAUTION

Tire Damage Hazard!

For extended travel, check cold tire pressure before start (refer to tire inflation chart in *Load Chart Manual*). After every one hour of travel time, regardless of ambient temperature, stop and allow tires to cool for at least 30 minutes. At destination, tires must be allowed to cool to ambient temperature before crane lifting on rubber.

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 4-11) of the Operator Display Module (ODM) is on.

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.

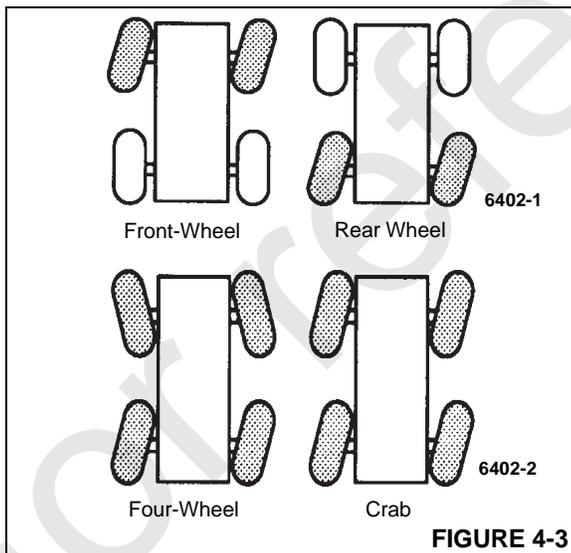
NOTE: Cab must be in the fully lowered position for the drive functions to operate. If cab is not in the fully lowered position, the Cab Not Fully Lowered Indicator is on.

Traveling in reverse is similar to traveling forward, except for shifting Transmission Shift Lever to reverse (R). Refer to *Traveling — Forward*, page 4-15

Steering

Steering is accomplished by the Steering Wheel (1, Figure 3-2) and the Rear Steer Switch (19, Figure 3-9).

These two controls, used individually or together, provide front wheel steering, rear wheel steering, four wheel steering, and crab steering (Figure 4-3).



The Rear Steer Switch can only be operated when the speed of the crane is less than 8 km/h (5 mph).

If operator attempts to use the rear steer switch while driving the crane at a speed greater than 8 km/h (5 mph), the rear steer function will not operate and the Speedometer (7, Figure 4-14) on the Operator Display Module (ODM) will flash.

Front Wheel Steering

Conventional front wheel 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 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.

Four Wheel Steering

Four wheel steering is accomplished with the steering wheel and Rear Steer Switch. With the boom over the front of the crane, turn steering wheel to the left and push Rear Steer Switch to the left to turn crane to the left. Turn steering wheel to the right and push Rear Steer Switch to the right to turn crane to the right.

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. With the boom over the front of the crane, turn steering wheel to the left and push Rear Steer Switch to the right to crab steer the crane to the left. Turn steering wheel to the right and push Rear Steer Switch to the left to crab steer the crane to the right.

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 4-15.
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 4-11) 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 4-18.

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 4-18.

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 4-28].



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, mid-extend, or fully extended position before beginning operation.



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 (50%) or fully extended (100%) position using the Outrigger Extend/Retract Switch and the Operator Display Module (ODM) (Refer to *Extending/Retracting the Outriggers Beams*, page 4-59).

Each outrigger beam is equipped with a length sensor that shows the extended length of an outrigger beam as a percentage on the Outrigger Extend/Retract function screen of the Operator Display Module (ODM) (Figure 4-33) in the ODM.

If outriggers are to be extended and set at the mid-extend (50%) position, operator shall do a visual check to ensure that all four outrigger beams are extended to the mid-extend stripe (decal) shown on the side of each beam.

! DANGER
Tipping Hazard!

Unless crane is equipped with the MAXbase option and a MAXbase load chart is selected in the Rated Capacity Limiter (RCL), 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.

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 4-60 to operate individual outrigger jacks.

Refer to *Extending/Retracting the Outrigger Jacks x4*, page 4-61 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 4-33).

! DANGER
Tipping Hazard!

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

The Auto-level icon (1, Figure 4-4) shows to the right of the O/R Beams icon (2) on the Outrigger Extend/Retract function screen of the Operator Display Module (ODM).

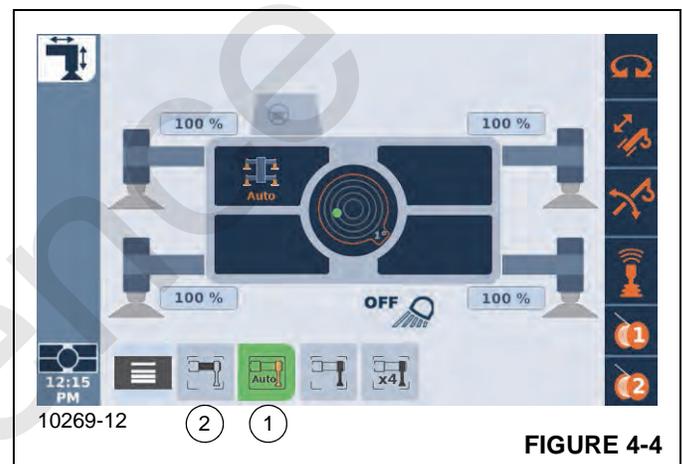


FIGURE 4-4

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. Set the outrigger pads on the ground directly out from each outrigger to where the outriggers will be properly extended (fully retracted, mid-extend, or fully 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 4-59).

**DANGER****Tipping Hazard!**

Unless crane is equipped with MAXbase and a MAXbase load chart is selected in the Rated Capacity Limiter (RCL), 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.

4. Extend the outrigger jacks using the Outrigger Extend/Retract Switch and the Operator Display Module (refer to *Extending/Retracting Individual Outrigger Jacks*, page 4-60 or *Extending/Retracting the Outrigger Jacks x4*, page 4-61).

Extend each outrigger jack until the locking levers of the pad engage the jack cylinder barrel.

5. 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 4-62).

The crane will react in the following manner:

- a. Extend all four outrigger jacks until ground contact is detected.
- b. Briefly extend the two front jacks.
- c. Briefly extend the two rear jacks.
- d. Adjust the two left side or two right side jacks until a level position is reached.

There may be several long pauses after the crane makes a jack height adjustment for the inclination sensor to stabilize – keep holding the buttons through each pause.

Auto-level process is complete when crane is out-of-level by less than 0.1 degrees and the Auto-level Indicator (1, Figure 4-40) flashes.

Outrigger Monitoring System (OMS) (Optional—Standard in North America and European Union Countries)

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 (0%), mid-extend (50%), and fully extended (100%).

Outrigger setup is the same for cranes equipped with OMS; refer to *Setting the Outriggers Manually*, page 4-18.

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 4-108). 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.

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 4-60 to operate individual outrigger jacks.

Refer to *Extending/Retracting the Outrigger Jacks x4*, page 4-61 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**

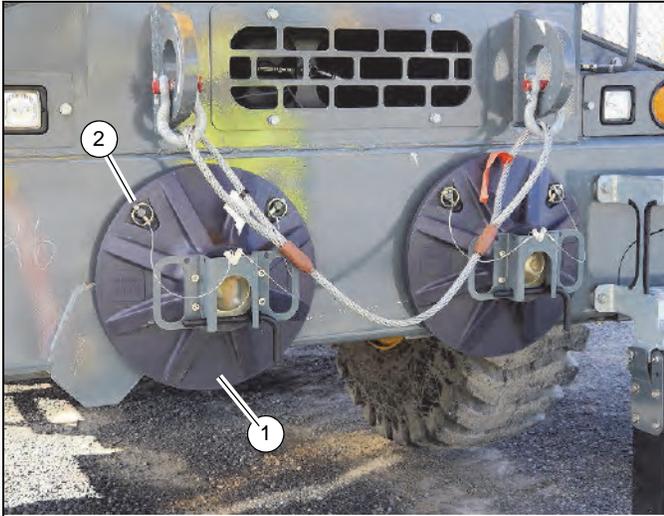
Keep feet and hands clear of outrigger pads when unlocking the pads from the jacks.

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.

- If required, fully retract the outrigger beams using the Outrigger Extend/Retract Switch and the Operator Display Module.

NOTE: More than one outrigger beam may be retracted at a time.

- Stow outrigger pads (Figure 4-5).



9230

FIGURE 4-5

Item	Description
1	Outrigger Pad Assembly
2	Quick Pin with Lanyard

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 3-6) 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: The Crane Control System (CCS) automatically applies counter pressure to the swing motor to slow swing speed if the superstructure is rotating faster than the controller is commanding. The operator may increase the counter pressure by pushing the controller toward the opposite direction of swing motion.

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

- Push the Swing Enable/Disable Switch on left armrest to enable the swing function.

The Swing Enable Indicator in the Status Bar area (Figure 4-17) of the Operator Display Module (ODM) will come on (green).

- 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).

- To stop swinging, let swing controller return to the center (neutral) position and apply the swing brake using the Swing Brake Pedal (refer to *Swing Brake Pedal*, page 3-30).

Single Axis Controller (Optional)

- Push the Swing Enable/Disable Switch on left armrest to enable the swing function.

The Swing Enable Indicator will come on (green).

- 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).

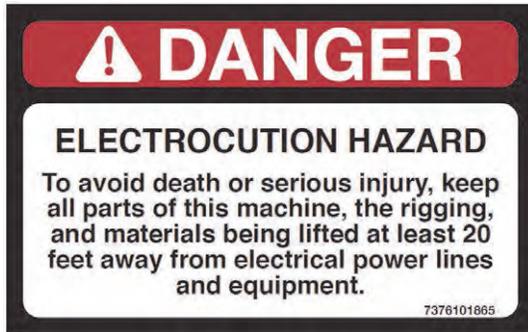
- To stop swinging, let swing controller return to the center (neutral) position and apply the swing brake using the Swing Brake Pedal.

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. Push 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 4-17) 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. Push 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



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. Do not lower the boom below the minimum boom angle shown on load chart.

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. Push 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 4-17) 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. Push 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 GRT8100-1 is equipped with a five-section, full power, sequenced and synchronized boom. The operator must use the telescope controller (standard) or telescope foot pedal (cranes with auxiliary hoist) in combination with the automatic and manual telescope modes selected in the Operator Display Module (ODM) to telescope the boom.

The boom telescope system has three automatic telescope modes and a manual mode, as described in the following table.

Mode	Description
A	T1 remains retracted until T2-4 are fully extended. Control system manages telescoping sequence.
X	T2-4 remain retracted until T1 is extended to 50%. Then T2-4 extend to 100%. Then T1 extends to 100% Control system manages telescoping sequence.
B	T2-4 remain retracted until T1 is fully extended. Control system manages telescoping sequence.
M	T1 and T2-4 have no defined extend or retract order. Operator controls telescoping sequence. Charted capacities strictly based on boom length, not percentage extension. No "out of sequence" possible.

The operator selects the desired telescope mode in the RCL Setup Screen of the RDM. Refer to the section titled *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-104 for more information.

When extending the boom with either the telescope foot pedal or the telescope controller, be aware of the following.

 **DANGER**
Crushing Hazard!

Check *Load Chart* for maximum load at a given radius, boom angle, and length before extending boom with a load.

CAUTION

Before extending boom, ensure large access cover on top of boom base section is installed.

When extending boom, simultaneously let out hoist cable to prevent two-blocking boom nose and hook block.

When retracting the boom, be aware of the following.

 **DANGER**
Crushing Hazard!

When retracting the boom, the load will lower unless the hoist cable is taken in at the same time

Telescope Controller

Dual-Axis

1. Push the Telescope Enable/Disable Switch on the right armrest to enable the telescope function.

The Telescope Indicator in the Status Bar area (Figure 4-17) of the Operator Display Module (ODM) will come on green.

2. Push controller on left armrest forward and hold to extend the boom.

Pull controller rearward and hold to retract the boom.

3. When boom has extended or retracted to the desired length, let controller return to neutral position to stop boom movement.

Single-Axis

1. Push the Telescope Enable/Disable Switch on the right armrest to enable the telescope function.

The Telescope Indicator in the Status Bar area (Figure 4-17) of the Operator Display Module (ODM) will come on green.

2. Push inner controller on left armrest forward and hold to extend the boom.

3. Pull controller rearward and hold to retract the boom.

4. When boom has extended or retracted to the desired length, let controller return to neutral position to stop boom movement.

Telescope Pedal

1. Push the Telescope Enable/Disable Switch on the right armrest to enable the telescope function.

The Telescope Indicator in the Status Bar area (Figure 4-17) of the Operator Display Module (ODM) will come on green.

2. Push on top of pedal and hold to extend the boom.

Push on bottom of pedal and hold to retract the boom.

3. When boom has extended or retracted to the desired length, let pedal return to neutral position to stop boom movement.

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. Push 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 4-17) 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 3-9) pulses and the Main Hoist Lower Indicator (Figure 4-17) comes on to indicate to the operator that the main hoist is operating.

Single Axis Controller (Optional)

1. Push 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 4-17) 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 3-13) pulses and the Main Hoist Lower Indicator (Figure 4-17) 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. Push 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 4-17) 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 3-9) pulses and the Main Hoist Raise Indicator (Figure 4-17) comes on to indicate to the operator that the main hoist is operating.

Single Axis Controller (Optional)

1. Push 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 4-17) 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 3-13) pulses and the Main Hoist Raise Indicator (Figure 4-17) 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 Rope

Dual Axis Controllers

1. Push 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 4-17) 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 3-9) pulses and the Auxiliary Hoist Lower Indicator (Figure 4-17) 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. Push the Auxiliary Hoist Enable/Disable Switch on the left armrest to enable the auxiliary hoist function.

The Auxiliary Hoist Enable Indicator in the Status Bar area (6, Figure 4-11) 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 3-13) pulses and the Auxiliary Hoist Lower Indicator (Figure 4-17) 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. Push 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 4-17) 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 3-9) pulses and the Auxiliary Hoist Raise Indicator (Figure 4-17) 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. Push 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 4-17) 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 3-13) pulses and the Auxiliary Hoist Raise Indicator (Figure 4-17) 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 4-17) of the ODM will come on.

On dual axis controllers only (2, 21, Figure 3-9), press and hold the inside (closest to operator) of the respective Hoist Speed Toggle Switch (5, Figure 3-9) 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).

NAVIGATING THE OPERATOR DISPLAY MODULE AND RATED CAPACITY LIMITER DISPLAY MODULE

For a description of 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 3-17

The ODM and RDM each have an integral Navigation Control Pad (Figure 4-6) 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 within each module.



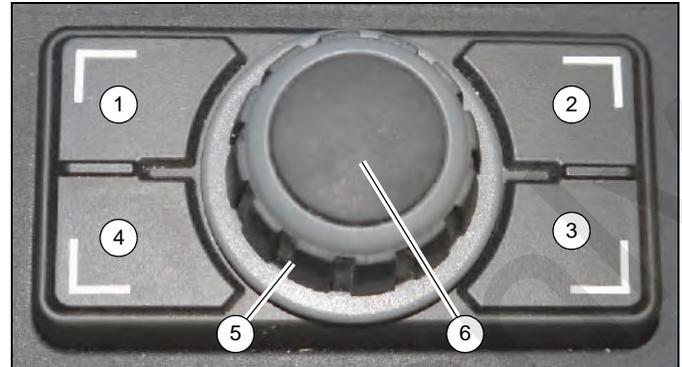
9221-1

Item	Description
1	Escape Button
2	Tab Button
3	Menu Button
4	Left/Right/Up/Down Arrow Buttons
5	OK Button
6	Additional Information Button

FIGURE 4-6

The Jog Dial (Figure 4-7), 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	Active Screen Toggle Button
4	Menu Button
5	Jog Dial (Rotate dial to move cursor)
6	OK Button (Press Jog Dial to select)

FIGURE 4-7

The Jog Dial can control one display module at a time. A Jog Dial Status Indicator (2, Figure 4-11) 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 Active Screen Toggle Button (3, Figure 4-7) 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 4-6 and Figure 4-7) or return to the Menu Screen by pressing the Menu Button (3, Figure 4-6 and 4, Figure 4-7).

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 4-6 and Figure 4-7) or return to the Menu Screen by pressing the Menu Button (3, Figure 4-6 and 4, Figure 4-7).

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 4-57).

Rotating the Jog Dial or pressing the Arrow Buttons allow the operator to select the different function icons that are found on the different screens of the ODM and RDM. When a function icon is selected, the icon will turn orange in color.

To enter a number or letter, press the jog dial button and then spin the jog dial until the desired number or letter is shown. Simultaneously pressing down on the jog dial and rotating

will increase the speed at which the numbers change. Once the desired number or letter is shown, press the jog dial again to confirm the selection.

The Tab Button (2, Figure 4-6) on the ODM and RDM Navigation Control Pads can be pressed to temporarily silence active audible alarms.

The Additional Information Button (6, Figure 4-6) on the ODM Navigation Control Pad is used to get more information about a crane control system (CCS) fault code.

USING THE OPERATOR DISPLAY MODULE (ODM)

NOTE: Refer to *Operator Display Module (ODM)*, page 3-18 for additional information.

The Operator Display Module (ODM) has two primary screens:

1. Main Screen



For detailed information on the Main Screen of the ODM, refer to the section titled *Main Screen*, page 4-29.

2. Menu Screen



For detailed information on the Menu Screen of the ODM, refer to the section titled *Menu Screen*, page 4-50.

Main Screen

The Main Screen (Figure 4-11) 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 4-10) at the Jog Dial to select the ODM screen control, then press the Escape Button (2).

- or -

- Press the Escape Button (3, Figure 4-10) on the Navigation Control Pad at the ODM.

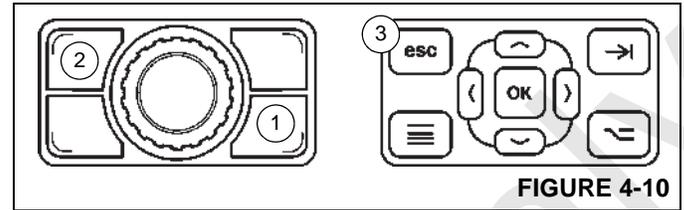


FIGURE 4-10

The Main Screen is separated into seven areas as shown in Figure 4-11.

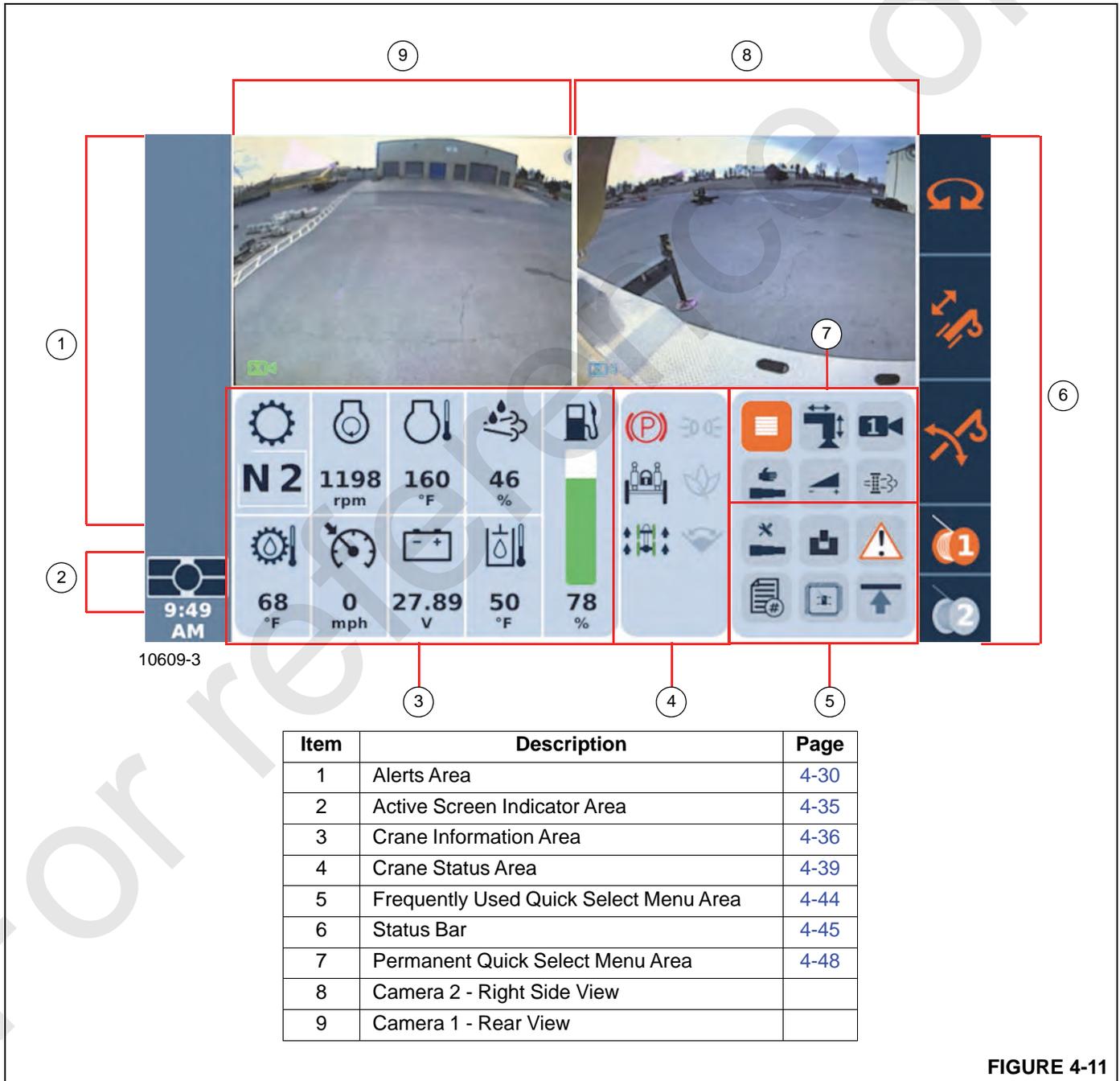


FIGURE 4-11

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 4-12).

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 4-12

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</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. <p>Operator must first shift the transmission to neutral, then try the operation again.</p>
<p>Range Shift Not Completed Alert</p>		<p>Indicates the transmission has not completed its shift between two-wheel drive (high range) and four-wheel drive (low range), or vice-versa.</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
Low Boom Angle Alert		<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>
Engine Stop Alert		<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>
Engine Warning Alert		<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>
Parking Brake Alert		<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.
Auto-level Sensor Warning Alert		<p>Indicates the operator is trying to auto-level the crane and there is a malfunction with sensor.</p>
Controller Speed/Curve Not Set To Factory Default Alert		<p>Indicates one or more of the controller functions are not set to the factory default setting.</p>
Free Swing Active Alert		<p>Indicates the swing brake is released and the boom is free to swing.</p>
Rear Wheels Not Centered Alert		<p>Indicates the rear wheels are not centered.</p>
Service Brake Pedal Not Pushed Alert		<p>Indicates the service brake pedal is not pushed while doing one of 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). - Shifting the transmission from neutral to forward or reverse. -

Name	Symbol	Description
<p>Four-Wheel Drive Alert</p>		<p>Indicates one of the following conditions has occurred:</p> <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.
<p>Differential Lock Alert</p>		<p>Constant On – Indicates the differential lock is engaged.</p> <p>Flashing – Indicates one of the following conditions has occurred:</p> <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.
<p>High Exhaust System Temperature Alert</p>		<p>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).</p> <p>Indicator also is on constant during the manual exhaust system cleaning process.</p>
<p>Exhaust System Clogged Alert</p>		<p>Constant On – Indicates the exhaust system requires cleaning. When possible, stop and perform a manual exhaust system cleaning.</p> <p>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.</p> <p>Flashing – Indicates the manual exhaust system cleaning is active or there is a communication loss with the engine ECM.</p>
<p>Inhibit Exhaust System Cleaning Alert</p>		<p>Constant On – Indicates the Exhaust System Cleaning Switch is set to the Inhibit Cleaning position, which prevents the exhaust cleaning process from automatically occurring.</p> <p>Flashing – Indicates there is a communication loss with the engine ECM.</p>
<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>Low Steering System Pressure Alert</p>		<p>Indicates the hydraulic pressure in the steering system is below normal operating requirements. When the indicator comes on (red), the warning buzzer will sound.</p> <p>Do not drive crane until steering pressure malfunction is corrected.</p>

Active Screen Indicator Area

The following indicator can appear in the Active Screen Indicator Area (1, Figure 4-13) of the ODM Main Screen:

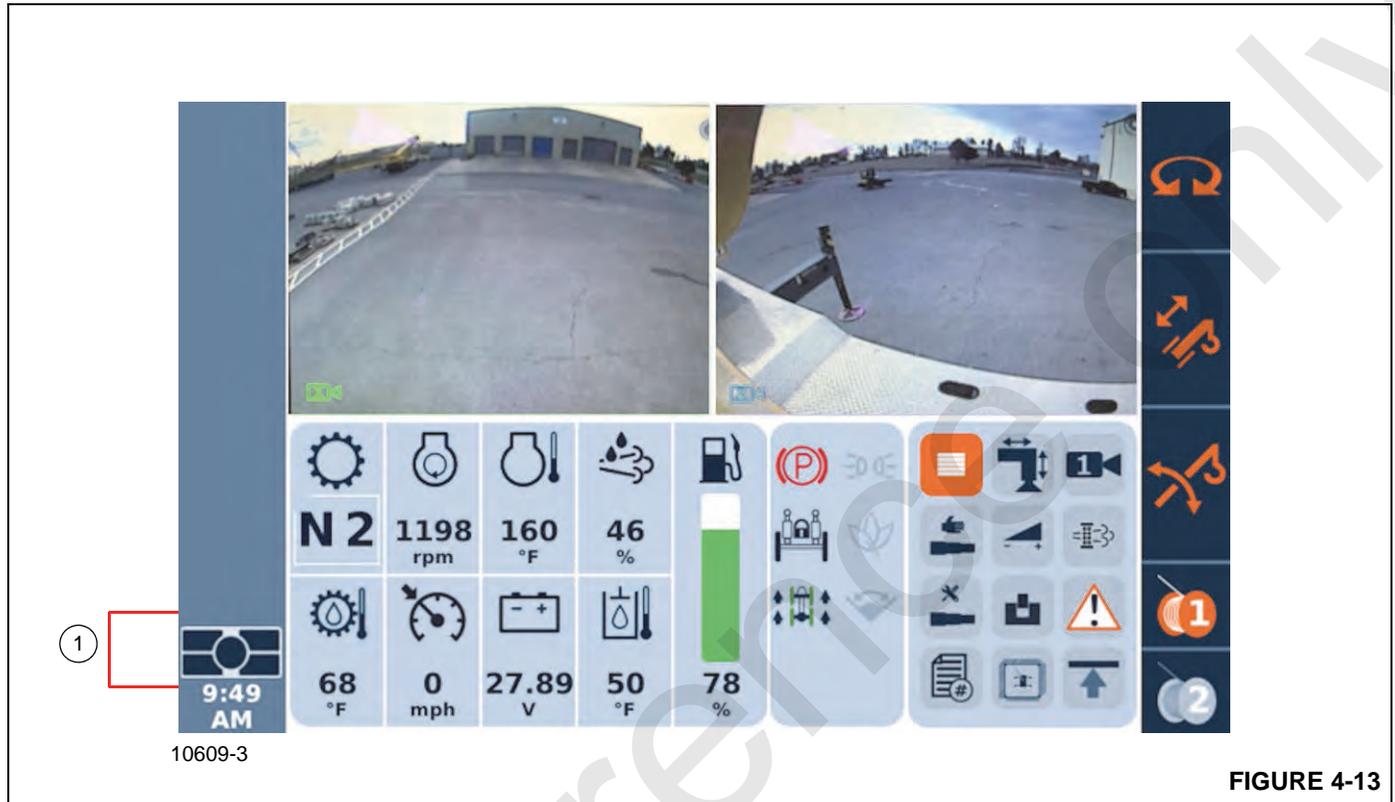


FIGURE 4-13

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 4-27.

Crane Information Area

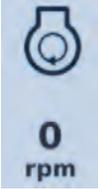
The following indicators make up the Crane Information Area (Figure 4-14) of the ODM Main Screen.

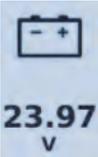


10609-3

Item	Description	Item	Description
1	Direction/Gear Indicator	6	Transmission Oil Temperature Indicator
2	Engine Speed Indicator	7	Speedometer
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 4-14

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 11% to 21% full. Red Bar - Indicates the fuel tank is 10% or less full. Do not overfill the fuel tank. The tank may not always read 100% when 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's travel speed in the selected unit of measure (km/h - 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.

Crane Status Area

The following indicators make up the Crane Status Area (Figure 4-15) of the ODM Main Screen.



10609-3

Item	Description
1	Parking Brake Indicator
2	Marker Light/Headlight Indicator
3	Suspension Control Indicator
4	Economy (ECO) Mode Indicator
5	Two-Wheel Drive/Four-Wheel Drive Indicator
6	Working Range Limiter (WRL) Indicator

FIGURE 4-15

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 3-5).
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 3-5).
3	Suspension Control Indicator		Indicates the suspension is unlocked and the rear axle is free to oscillate from side to side.
			Indicates the suspension is locked and axle oscillation is prevented.
4	Economy (ECO) Mode Indicator		Indicates ECO mode is disabled.
			Indicates ECO mode is enabled (refer to <i>ECO Mode</i> , page 4-97) 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 idle (800 rpm).
5	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

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.

Frequently Used Quick Select Menu Area

The Frequently Used Quick Select Menu Area (1, Figure 4-16) 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 4-16.

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 4-17) 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 4-17) include the following:

1. Swing (1)
2. Telescope (2)
3. Boom Lift (3)
4. Main Hoist (4)
5. Auxiliary Hoist (5)

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 3-26).

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 3-22].

- 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.

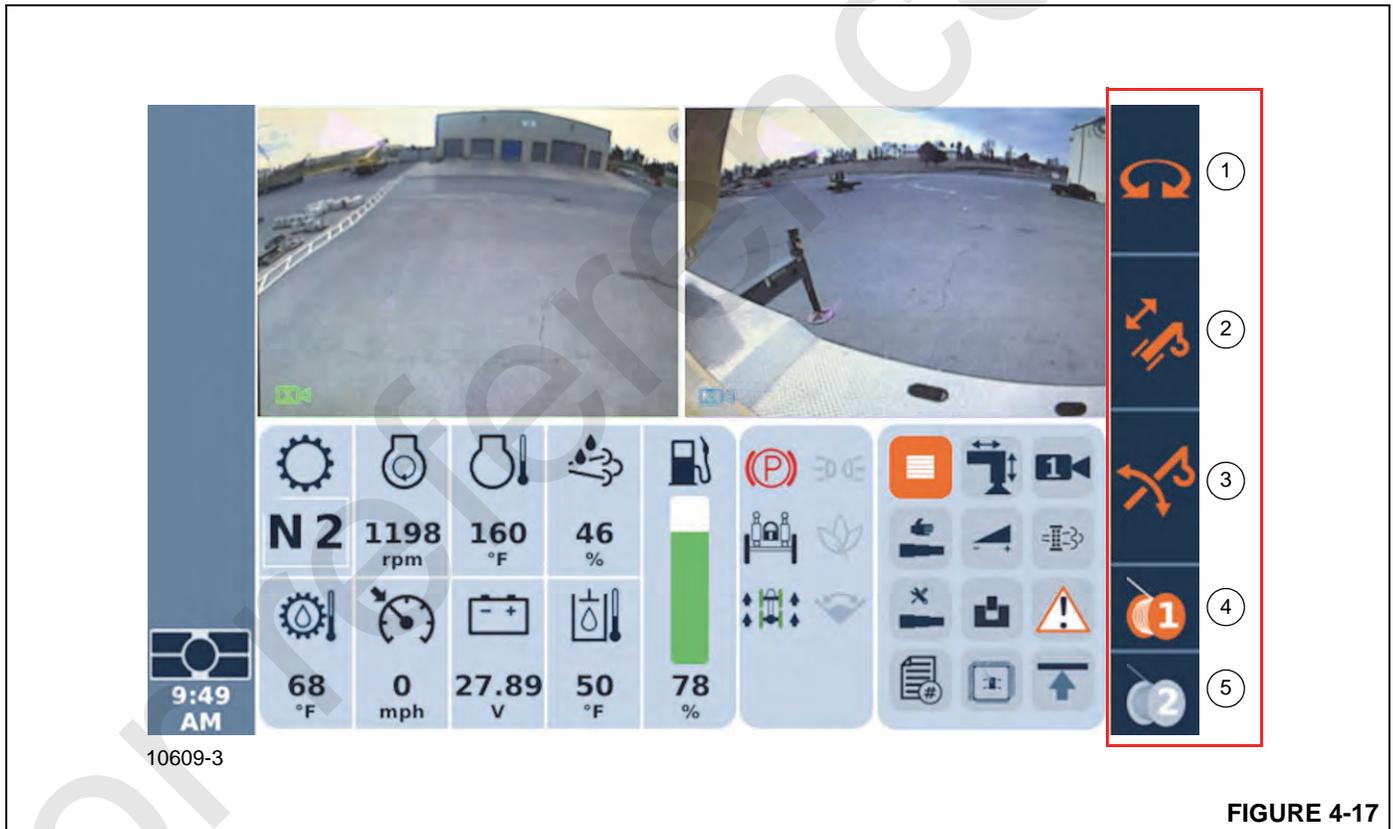


FIGURE 4-17

The telescope indicator can have the following status:

Name	Symbol	Description
T1 Telescope Indicator		Mode M: active telescoping section T1 or T2-4 Indicator always shown in the status bar.
T2-4 Telescope Indicator		Mode A, X, B: T1 or T2-4 Indicator only shown when telescoping function is active. Refer to the section titled <i>Telescoping the Boom</i> , page 4-23 for information on Mode A, X, B, and M.

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.

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Permanent Quick Select Menu Area

The Permanent Quick Select Menu Area (Figure 4-18) 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.

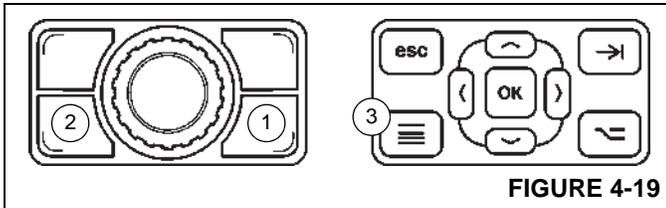


Item	Name	Symbol	Description
1	Menu Screen Icon		Opens the Menu Screen (page 4-50)
2	Outrigger Function Icon		Opens the Outrigger Extend/Retract function screen (page 4-57)
3	Camera 1 Function Icon		Opens the Right Side Camera View function screen (page 4-54)
4	Manual Telescope Function Icon		Opens the Manual Telescope function screen (page 4-55)
5	Controller Speed Function Icon		Opens the Controller Speed function screen (page 4-95)
6	Exhaust System Cleaning Icon		Opens the Exhaust System Cleaning function screen (page 4-99)

Menu Screen

The Menu Screen (Figure 4-20) of the ODM is accessed by doing one of the following:

- Press the Screen Toggle Button (1, Figure 4-19) at the Jog Dial to select the ODM screen control, then press the Menu Button (2).
- or -
- Press the Menu Button (3, Figure 4-19) on the Navigation Control Pad at the ODM.



The ODM Menu Screen (Figure 4-20) has the following menu items for operating the crane:

- **Camera Menu Group (1)**
 - Camera 1 - Right Side View (2)
 - Camera 2 - Rear View (3)
 - Camera 1/2 - Right Side View / Rear View (4)
- **Telescope Menu Group (5)**
 - ManualTelescope(6)
 - Telescope Configuration (7)
- **Crane Function Menu Group (8)**
 - Outrigger Extend/Retract (9)
 - 360° Superstructure Lock/Unlock (10)
- **Working Range Limiter Menu Group (11)**
 - Swing Angle Limitation (12)
 - Boom Angle Limitation (13)
 - Boom Height Limitation (14)
 - Radius Limitation (15)
 - Virtual Walls (16)
- **Faults Menu Group (17)**
 - Crane Faults (18)
 - Engine Faults (19)
- **Information Menu Group (20)**
 - Operating Hours (21)
 - Software Versions (22)
- **User Settings Menu Group (23)**
 - Controller Curve (24)
 - Controller Speed (25)
 - ECO Mode (26)
 - Exhaust System Cleaning (27)
 - Service Menu (28)
- **Screen Settings Menu Group (29)**
 - Units of Measure (Metric/Imperial) (30)
 - Display Screen Brightness (31)
 - Time Set (32)

For reference only

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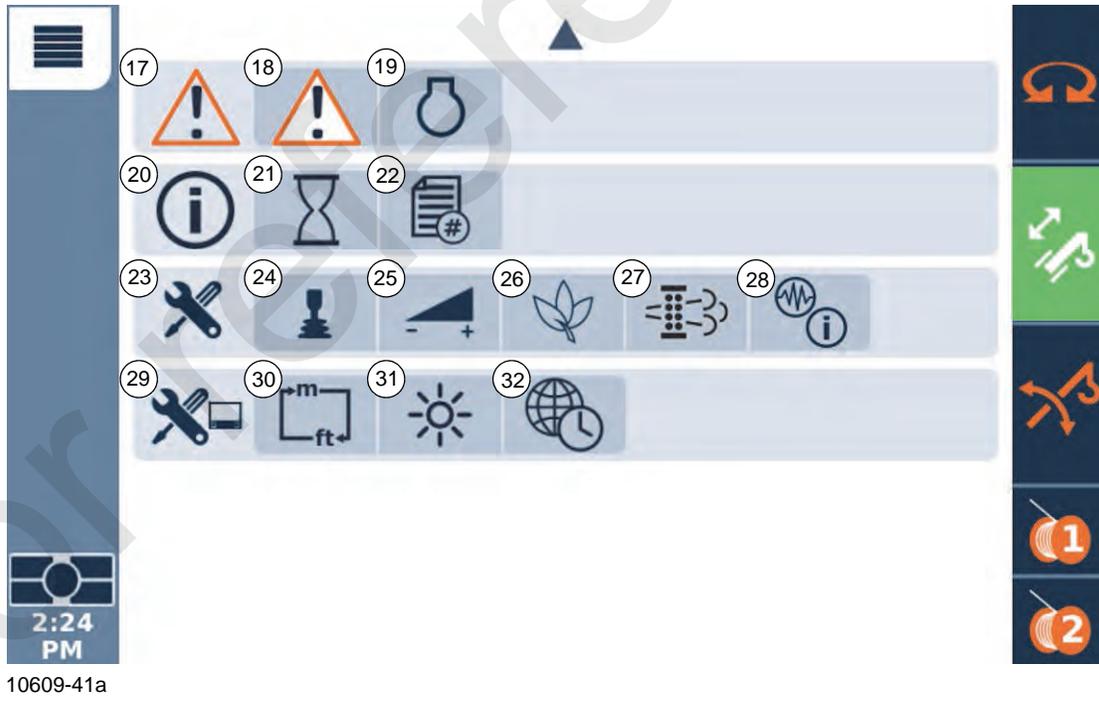
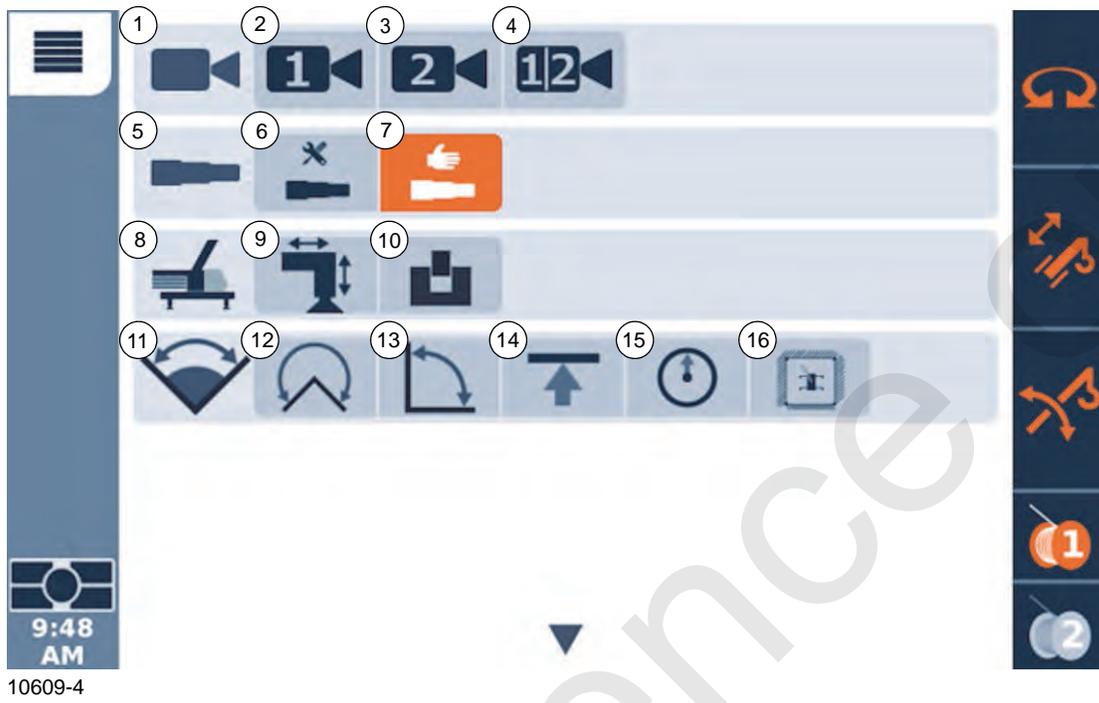


FIGURE 4-20

Item	Description	Page	Item	Description	Page
1	Camera Menu Group Icon	4-54	17	Faults Menu Group Icon	4-86
2	Camera View 1 Icon	4-54	18	Crane Faults Icon	4-86
3	Camera View 2 Icon	4-54	19	Engine Faults Icon	4-87
4	Camera View 1/2 Icon	4-54	20	Information Menu Group Icon	4-89
5	Telescope Menu Group	4-55	21	Operating Hours Icon	4-89
6	Manual Telescope Icon	4-55	22	Software Versions Icon	4-91
7	Telescope Configuration Icon	4-56	23	User Settings Menu Group Icon	4-92
8	Crane Function Menu Group Icon	4-57	24	Controller Curve Icon	4-92
9	Outrigger Extend/Retract Icon	4-57	25	Controller Speed Icon	4-95
10	360° Superstructure Lock/Unlock Icon	4-63	26	ECO Mode Icon	4-97
11	WRL Menu Group Icon	4-65	27	Exhaust System Cleaning Icon	4-99
12	Swing Angle Limitation Icon	4-79	28	Service Menu Icon	4-100
13	Boom Angle Limitation Icon	4-74	29	Screen Settings Menu Group Icon	4-101
14	Boom Height Limitation Icon	4-72	30	Units of Measure (Metric/Imperial) Icon	4-102
15	Radius Limitation Icon	4-77	31	Display Screen Brightness Icon	4-102
16	Virtual Walls Icon	4-82	32	Time Set Icon	4-103

Camera Menu Group

The Camera Menu Group (1, Figure 4-21) includes the following camera view function icons:

- Camera View 1 – Rear View (2)
- Camera View 2 – Right Side View (3)
- Camera Views 1/2 – Rear / Right Side Views (4)

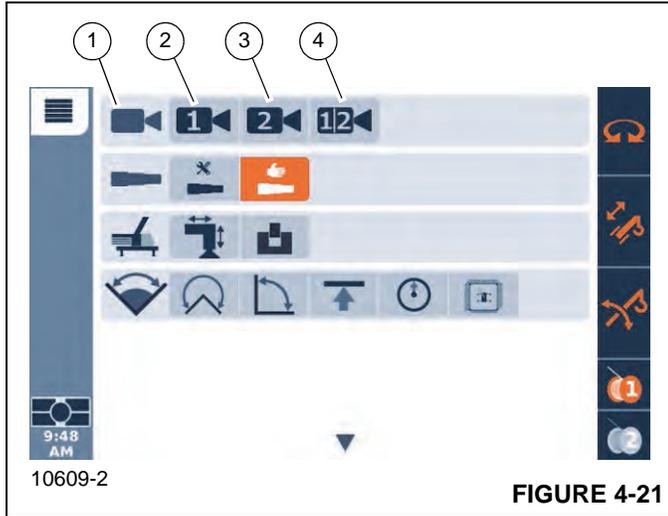


FIGURE 4-21

These camera view function icons are used to select which camera view is displayed on the Camera View Screen (Figure 4-23).

Use the Jog Dial or Arrow Buttons on the Navigation Control Pad to select the desired camera view icon. Press the Jog Dial or the OK Button to show the Camera View Screen.

To exit the Camera View Screen, press the Main Screen Button (1, Figure 4-22) or Menu Screen Button (2).

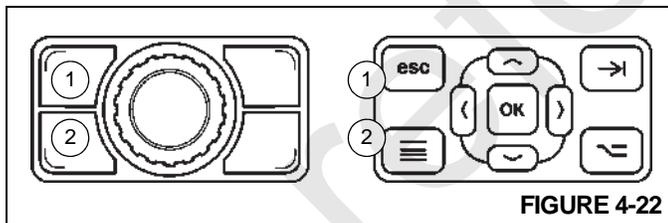
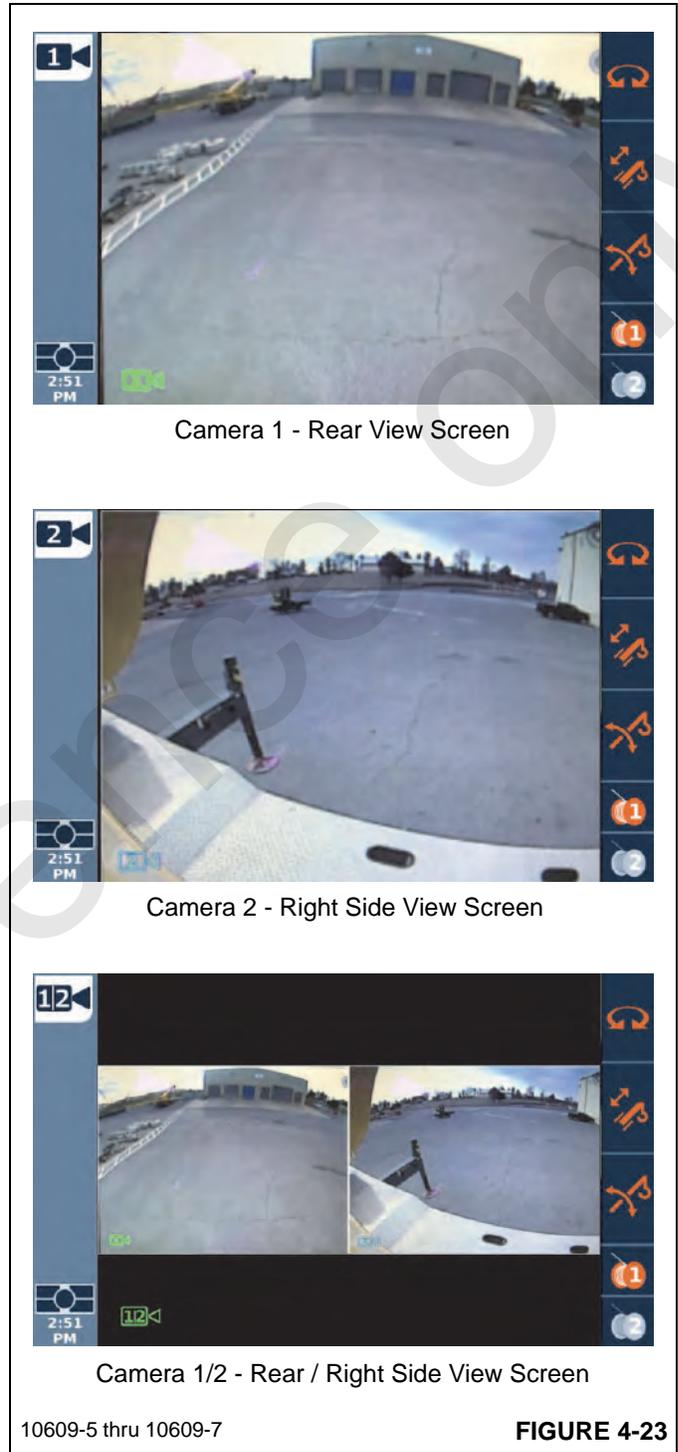


FIGURE 4-22



10609-5 thru 10609-7

FIGURE 4-23

Telescope Menu Group

The Telescope Menu Group (1, Figure 4-24) includes the following telescope function icons:

- Manual Telescope (2) (page 4-55)
- Telescope Configuration (3) (page 4-56)

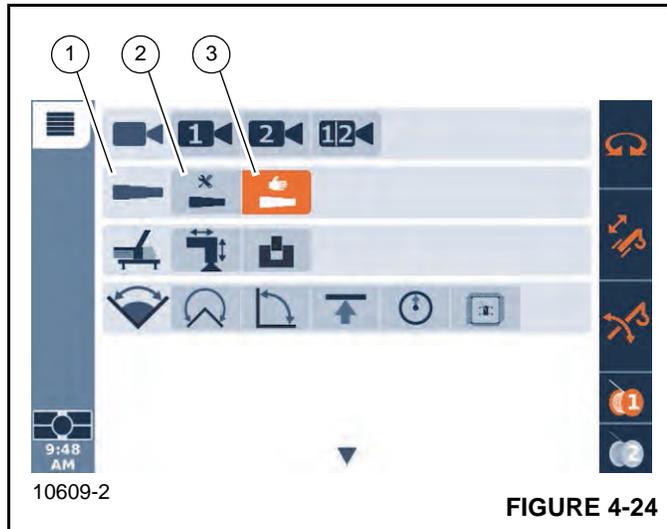


FIGURE 4-24

Manual Telescope

Select the Manual Telescope icon (1, Figure 4-25) under the Telescope Group to show the Manual Telescope function screen.

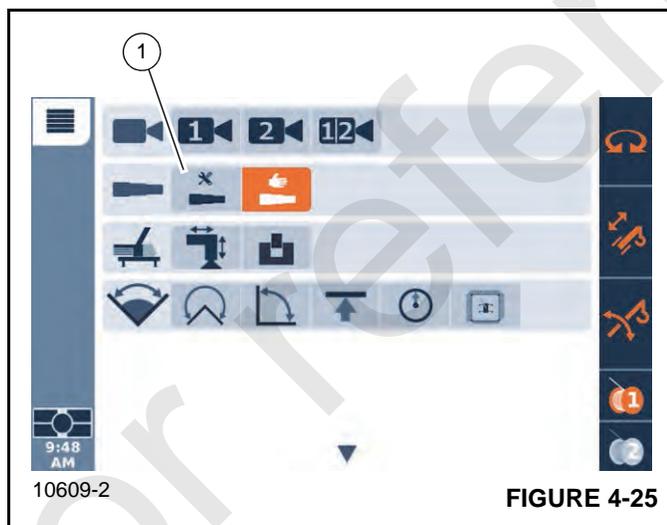


FIGURE 4-25

The Manual Telescope function screen (Figure 4-26) allows the operator to manually control which boom telescope

sections are telescoped. This manual control allows the operator to reset the telescope system if an “out-of-sequence” error occurs while operating in an automatic telescope mode (A, X, or B).

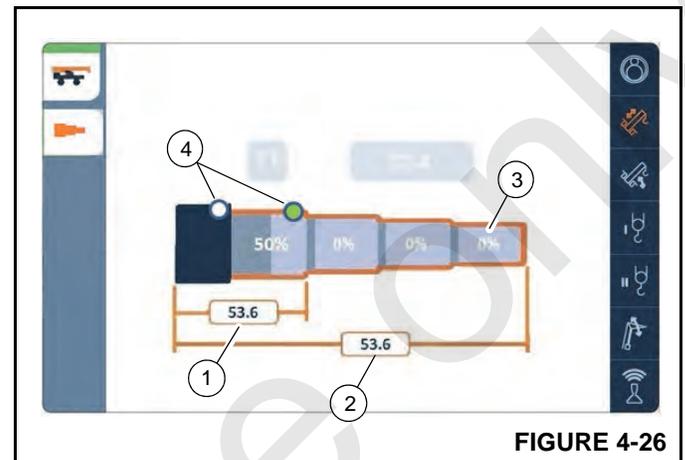


FIGURE 4-26

The Manual Telescope function screen shows an image that represents the boom (base section and the four telescope sections)

The T1 boom section length (1) and the overall boom length (2) are shown in the unit of measure selected by the operator.

The function screen also shows the telescope section lengths as percentages (3). If an “out-of-sequence” error occurs, the percentage values of the out-of-sequence sections will flash.

Two proximity switches, internal to the boom, are used in the telescope system. The status of these proximity switches (4) are shown on the function screen. Each proximity switch can have the following status:

●	On
○	Off
●	Error

If an “out-of-sequence” error occurs due to a proximity switch, the related proximity switch status will flash.

The boom image represented on the Manual Telescope function screen is static. The telescope section percentage values, section fill, boom lengths, and proximity switches status are dynamic and will update as the boom is extended and retracted.

The T1 (1, Figure 4-27) and T2-4 (2) buttons on the function screen are grayed out and unaccessible when the telescope system is in-sequence and the crane is set to an automatic telescope mode (A, X, or B). If the telescope system becomes out-of-sequence, the operator can select Mode M to recover the boom. When Mode M is selected, the T1 and T2-4 buttons become accessible.

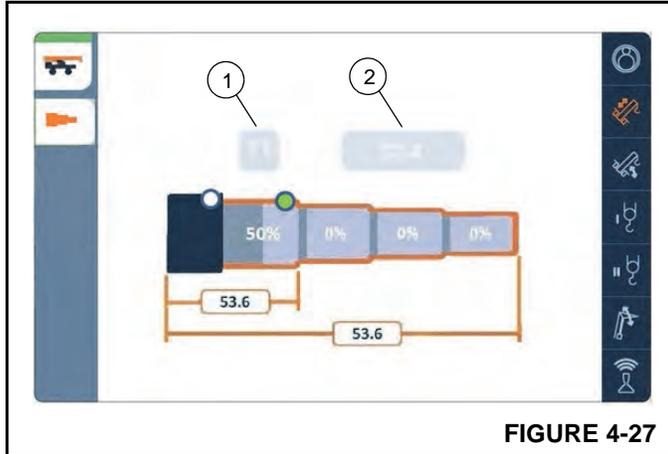


FIGURE 4-27

To manually recover a boom that has become out-of-sequence, do the following:

1. Set telescope Mode to M in the RCL.
2. Review the Manual Telescope function screen (Figure 4-28) to determine which component(s) of the telescope system is out-of-sequence.
3. Use the Jog Dial or Arrow Buttons on the Navigation Control Pad to highlight the button (T1 or T2-4) of the related telescope section that you wish to manually controlled.

Press the Jog Dial or OK Button on the Navigation Control Pad to enable the manual control of the selected telescope section(s) (button is highlighted orange with green letters).

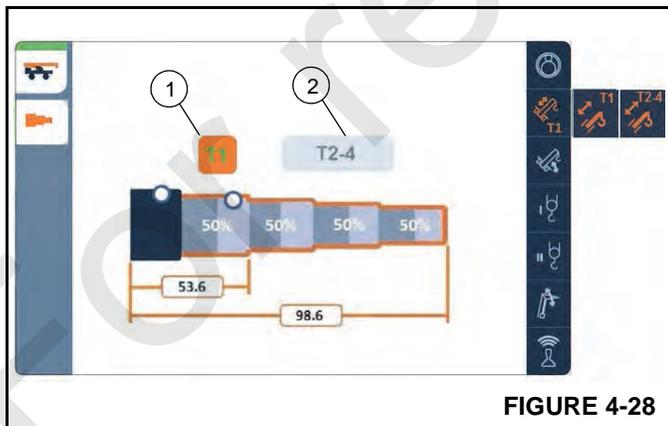


FIGURE 4-28

4. Use the left control lever (standard) or the telescope foot pedal (cranes with optional auxiliary hoist) to fully retract the telescope sections that are out-of-sequence.

When telescope system is reset to in-sequence, the related percentage values and/or the proximity switches status will stop flashing and the Out-of-Sequence Alert on the RCL screen will go off.

Telescoping Configuration

Select the Telescope Configuration icon (1, Figure 4-29) under the Telescope Group to show the Telescope Configuration function screen.

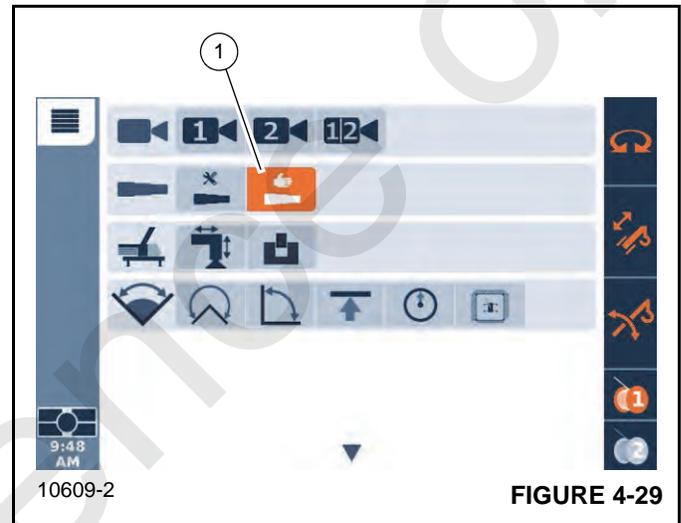


FIGURE 4-29

The Telescope Configuration function screen (Figure 4-30) allows the operator to enable and disable the three automatic telescope modes, to include A, X, and B. The manual mode, Mode M, cannot be disabled.

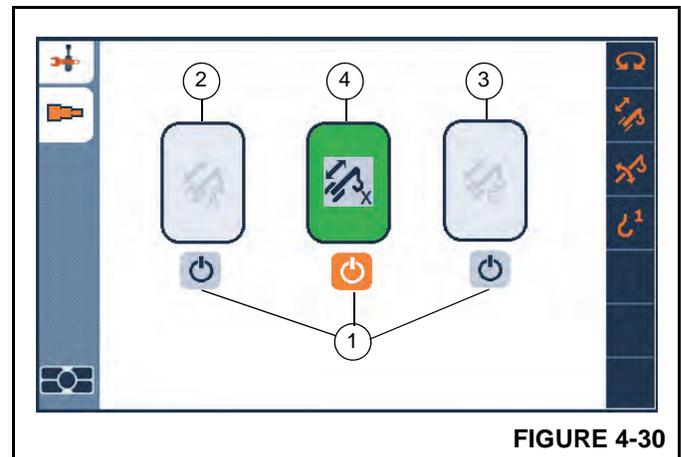


FIGURE 4-30

NOTE: For a description of the A, X, B, and M telescope modes, see *Telescoping the Boom*, page 4-23.

When a telescope mode is enabled, it can be selected on the RCL Setup Screen. Disabled telescope modes cannot be selected.

In Figure 4-30, Modes A (2) and B (3) are disabled and grayed out. Mode X (4) is enabled.

To enable/disable telescope modes, do the following:

1. Use the Jog Dial or Arrow Buttons on the Navigation Control Pad to highlight the button (1, Figure 4-30) under the related Mode icon (2, 3, and 4) you wish to enable (button is orange).
2. Press the Jog Dial or OK Button on the Navigation Control Pad to enable the Mode (Mode icon is green).
3. To disable a Mode, highlight the desired button (1) and Press the Jog Dial or OK Button on the Navigation Control Pad to disable the related the Mode (Mode icon is grayed out).

Crane Function Menu Group

The Crane Function Menu Group (1, Figure 4-31) includes the following function icons:

- Outrigger Extend/Retract (page 4-57)
- 360° Superstructure Lock/Unlock (page 4-63)
-

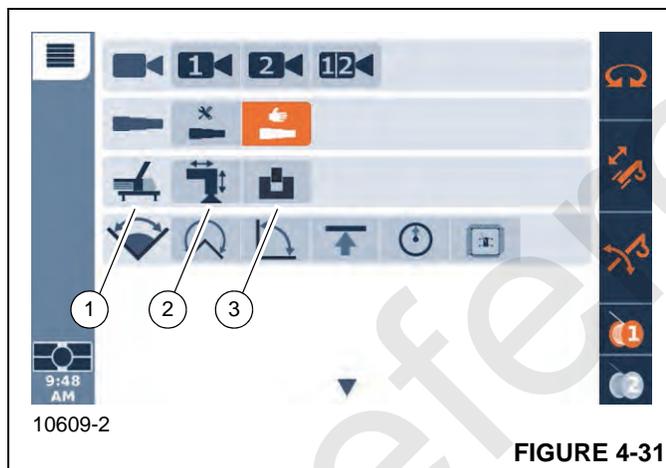


FIGURE 4-31

Outrigger Extend/Retract

Select the Outrigger Extend/Retract icon (1, Figure 4-32) under the Crane Function Group to show the Outrigger Extend/Retract function screen.

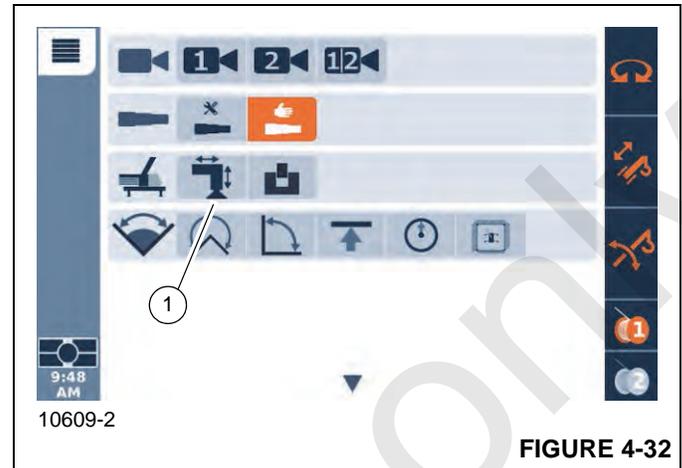


FIGURE 4-32

The Outrigger Extend/Retract function screen (Figure 4-33) allows the operator to set the outriggers and level the crane using either a manual or semi-automatic mode. The Outrigger Extend/Retract function screen is also used to retract and stow the outriggers as well as operate the side mounted carrier work lights.

NOTE: The outriggers are to be deployed with the boom centered over the front axle. In this configuration, the direction the operator is facing is considered the front of the crane.

The steering wheel symbol (6, Figure 4-33) 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 (axle) of the crane.

NOTE: Refer to *Using the Outriggers*, page 4-18 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, the transmission is shifted to neutral, and four-wheel low is selected.

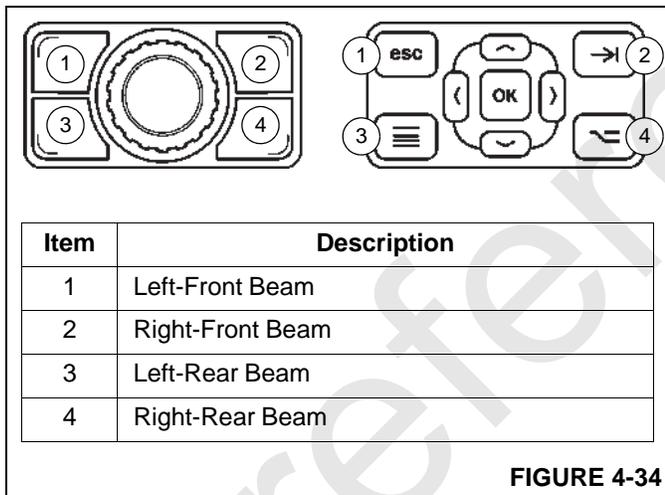
Extending/Retracting the Outriggers Beams

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 4-35) (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 3-9) on the left armrest to the extend position, then push and hold one or more of the four buttons at the Jog Dial or the Navigation Control Pad (Figure 4-34).

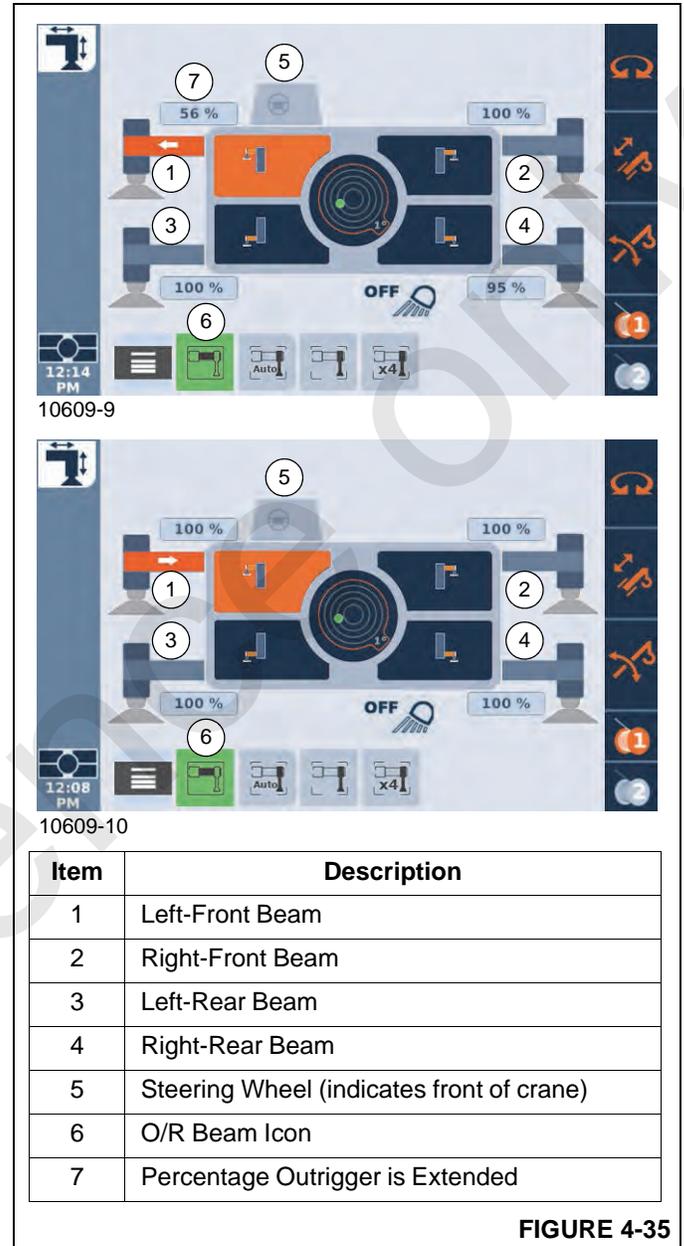
To retract the O/R beams, position the Outrigger Extend/Retract Switch to the retract position, then push and hold one or more of the four buttons at the Jog Dial or the Navigation Control Pad.

NOTE: The O/R beam positions correspond to the four buttons at the Jog Dial and the ODM Navigation Control Pad (Figure 4-34 and Figure 4-35).



When a button at the Jog Dial or Navigation Control Pad is pushed 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 4-35), 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.

NOTE: The OMS requires the measured length of the outrigger beam position to be within $\pm 3\%$ of the target outrigger position to be recognized as a valid setup.



If operating the crane with the outrigger beams in the mid-extended position (50%), use the Percentage Outrigger is Extended field (7, Figure 4-35) to achieve the desired position. When programming the RCL, if the outrigger beam position does not match the RCL rigging code, the Outrigger Beam Over-ride Warning Screen (Figure 4-109) will show on the RDM. Operator must visually inspect to confirm the position of the outrigger beam using the markings on each outrigger beam (see also to *Overriding the Outrigger Monitoring System*, page 4-110).

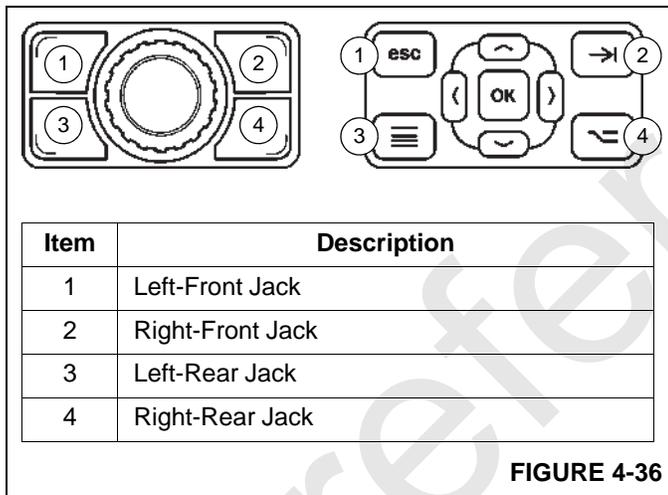
Extending/Retracting Individual Outrigger Jacks

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 4-37) (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 3-9) 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.

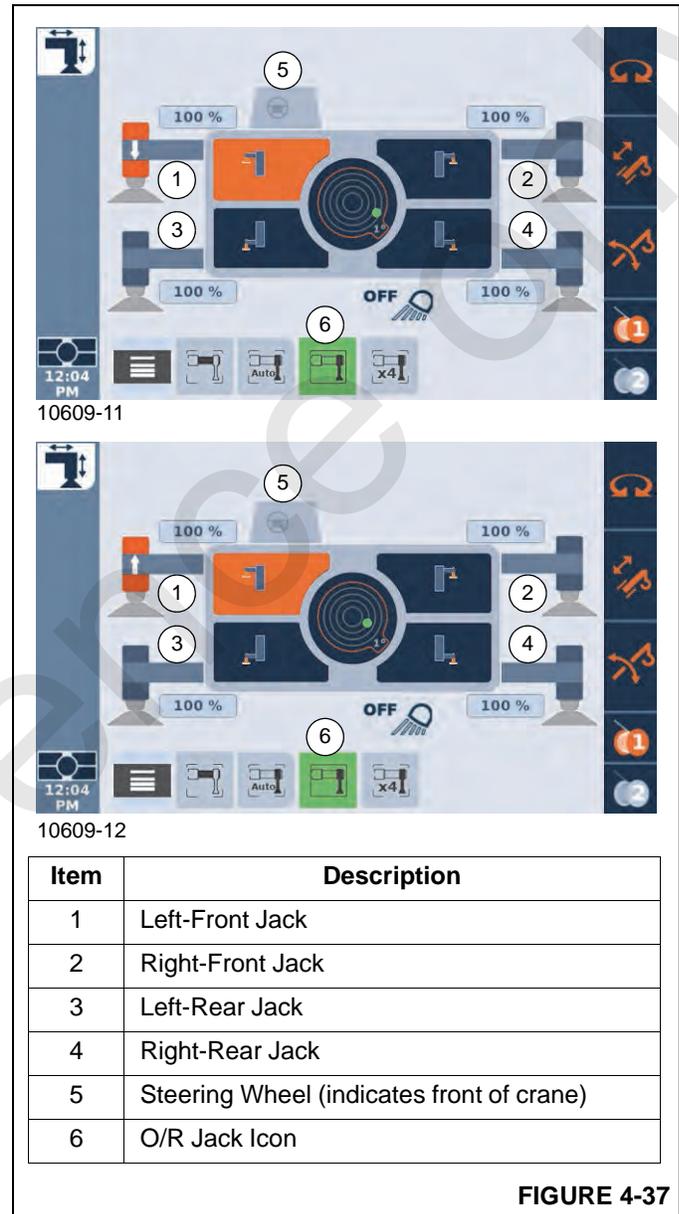
To retract the O/R jacks, position the Outrigger Extend/Retract Switch to the retract position, then press and one or more of the four buttons at the Jog Dial or Navigation Control Pad.

NOTE: The O/R jack positions correspond to the four buttons at the Jog Dial and the ODM Navigation Control Pad (Figure 4-36 and Figure 4-37).



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 will

appear to indicate whether the jack is extending or retracting. In the following example (Figure 4-37), 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 4-39) (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 3-9) 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 4-38).

The O/R jack positions correspond to the four buttons at the Jog Dial and the ODM Navigation Control Pad.

Item	Description
1	Left-Front Jack
2	Right-Front Jack
3	Left-Rear Jack
4	Right-Rear Jack

FIGURE 4-38

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 will show to indicate whether the jacks are extending or retracting. In the following example (Figure 4-39), the top image shows all four outrigger jacks are extending and the bottom image shows all four outrigger jacks are retracting:

Item	Description
1	Left-Front Jack
2	Right-Front Jack
3	Left-Rear Jack
4	Right-Rear Jack
5	Steering Wheel (indicates front of crane)
6	O/R Jack x4 Icon

FIGURE 4-39

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 4-40) (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 4-40).

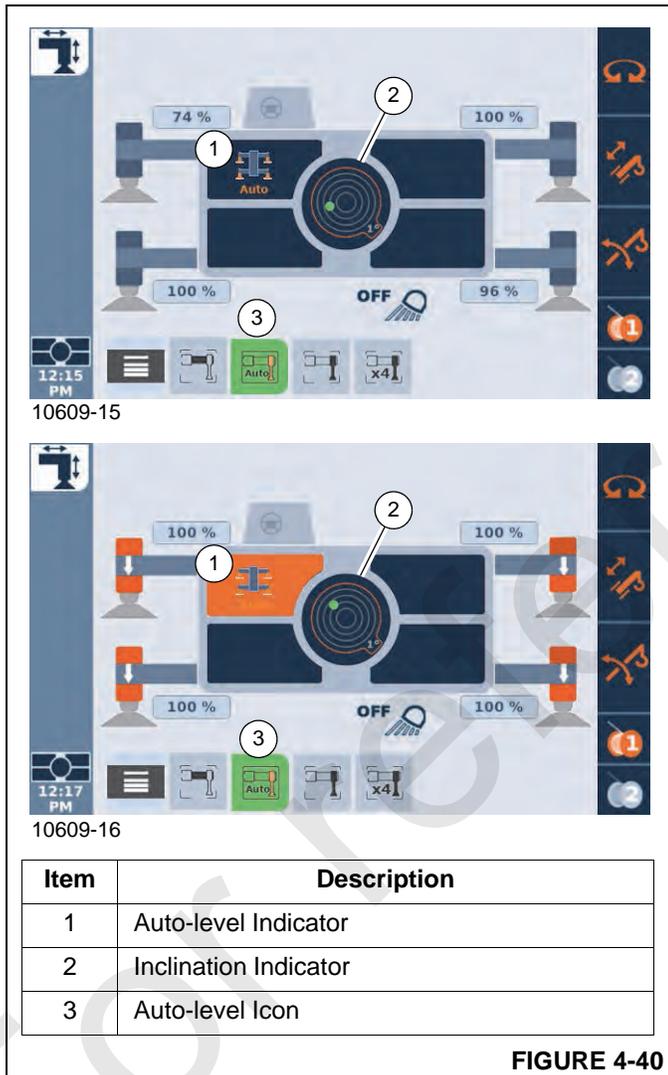


FIGURE 4-40

4. To begin the auto-level function, position the Outrigger Extend/Retract Switch (17, Figure 3-9) on the left armrest to the extend or retract position, then press and hold the button (1, Figure 4-41) at the Jog Dial or Navigation Control Pad that corresponds to the Auto-level Button on the screen.

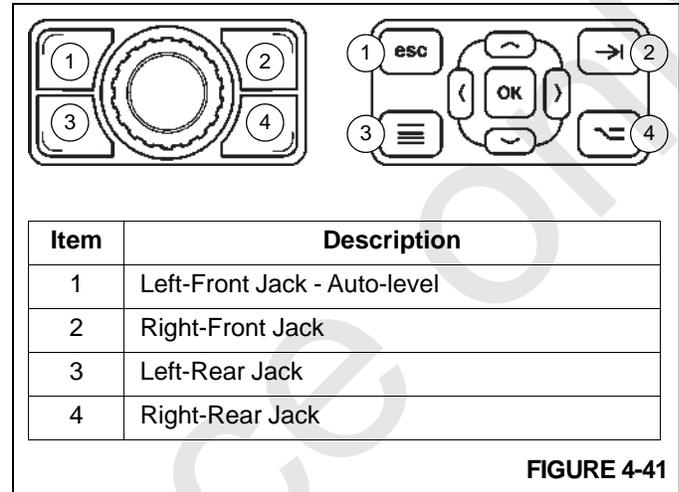


FIGURE 4-41

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 4-40).

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 0.10°, the Auto-level Indicator (1, Figure 4-40) 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 4-41) at the Jog Dial or Navigation Control Pad.

Operating the Side Mounted Carrier Work Lights

The carrier has four side lights which can be used to illuminate the area around the crane (refer to *Side Mounted Carrier Work Lights*, page 3-48 for more information).

Switch the carrier side lights on and off by doing the following:

1. Using the Jog Dial or Arrow Buttons on the Navigation Control Pad, select the Carrier Side Lights On/Off Icon (1, Figure 4-42) (icon background will turn orange when selected).
2. Press the Jog Dial or OK Button on the Navigation Control Pad once to toggle the lights on (icon will turn green). Press the Jog Dial or OK Button again to toggle the lights off.

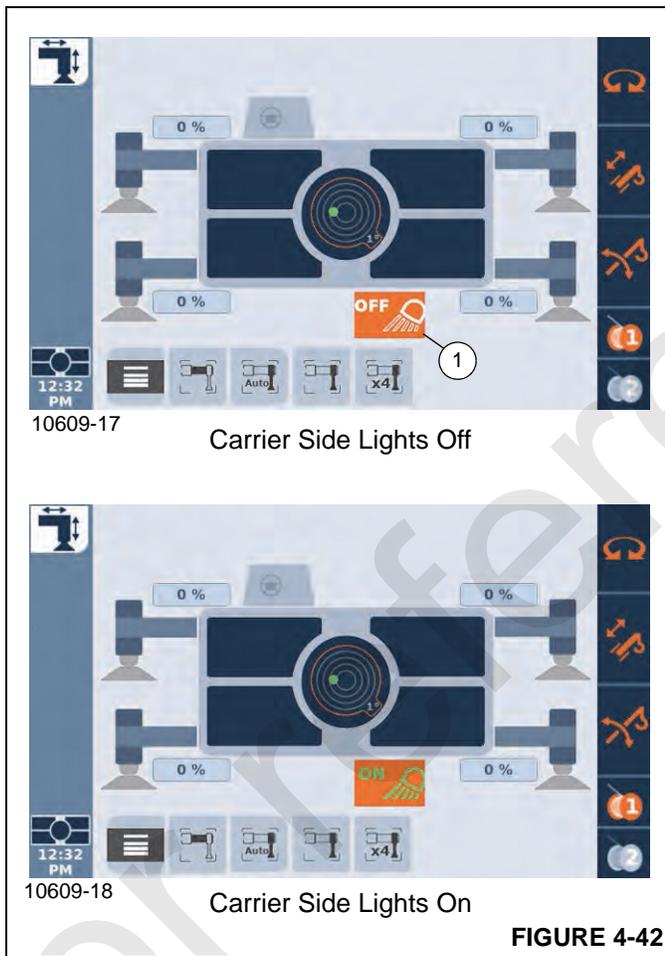


FIGURE 4-42

360° Swing Lock (Optional)

Select the 360° Swing Lock icon (1, Figure 4-43) under the Crane Function Group to show the 360° Superstructure Lock/Unlock function screen.

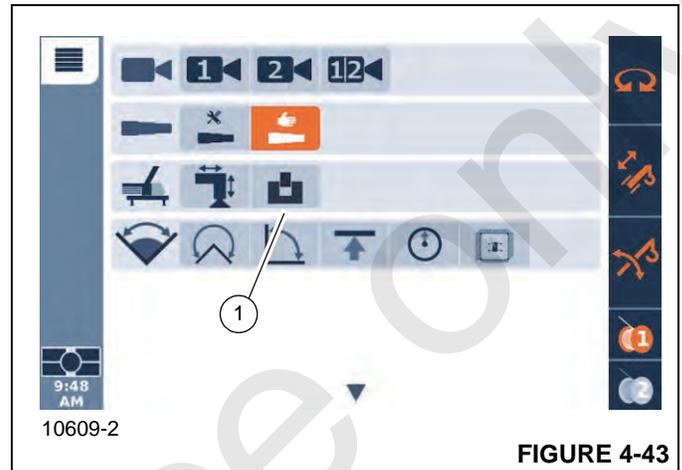
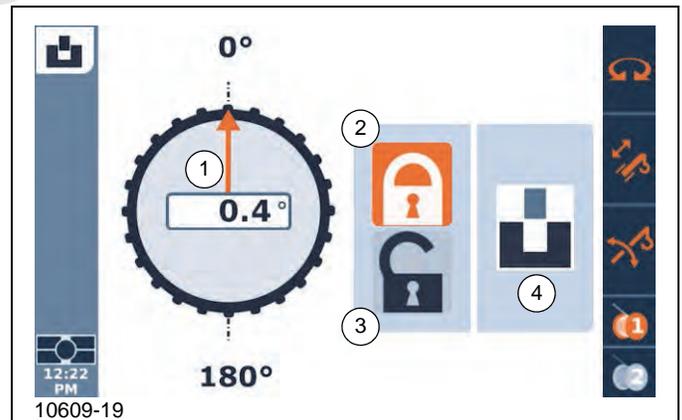


FIGURE 4-43

The 360° Superstructure Lock/Unlock function screen (Figure 4-44) is used to lock the superstructure in position anywhere throughout its 360° rotation.

The function screen (Figure 4-44) 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 4-44, the Swing Lock Status Indicator (4) shows the swing lock is in the unlocked position.



Item	Description
1	Swing Angle
2	Lock Icon
3	Unlock Icon
4	Swing Lock Status Indicator (shown in the unlocked position)

FIGURE 4-44

In Figure 4-45, the Swing Lock Status Indicator (4) shows the swing lock is in the locked position.

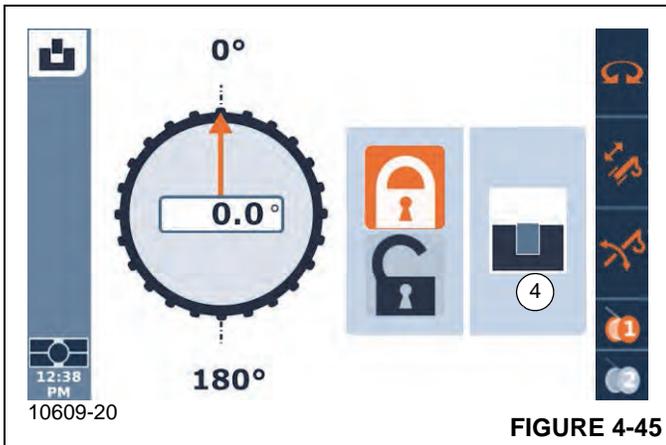


FIGURE 4-45

Locking the Superstructure

1. Swing the superstructure to the desired position.
2. Maintain superstructure position by pushing 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 4-44).

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 4-45) 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 4-44).
3. Press the Jog Dial or the OK Button to start the unlocking process.

When the lock is disengaged, the Unlock Status Indicator (4, Figure 4-44) will appear.

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 4-1 – 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 4-1 – 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 4-46) and sub-menu (2 thru 6) allows the operator to set limits on the location of the boom.

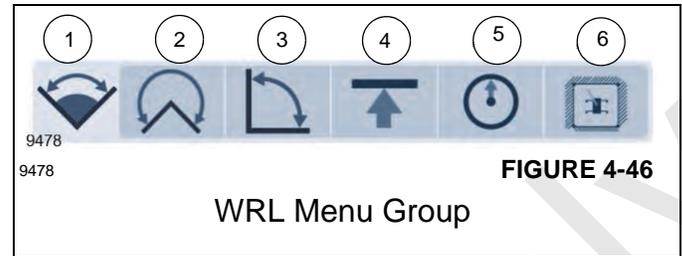


FIGURE 4-46

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 4-46) as noted below. The number next to the limitation indicates the Menu Limitation Icon reflective of that group as shown in Figure 4-46.

- 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 4-50, 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 4-46 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 4-14) 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 4-1.

Table 4-1 – 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 4-6). 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.

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 4-46).

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 4-46).

Table 4-2 – WRL Limitation Screen Symbols

Symbol	Description
	<p>Symbol represents the Working Range Limitation (WRL) Menu Group.</p>
	<p>Symbol represents the Swing Angle Limitation.</p>
	<p>Symbol represents the Boom Angle Limitation.</p>
	<p>Symbol represents the Boom Height Limitation.</p>
	<p>Symbol represents the Working Radius Limitation.</p>
	<p>Symbol represents the Virtual Walls Limitation Menu.</p>
	<p>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).</p>
	<p>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).</p>

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 4-1 – 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.

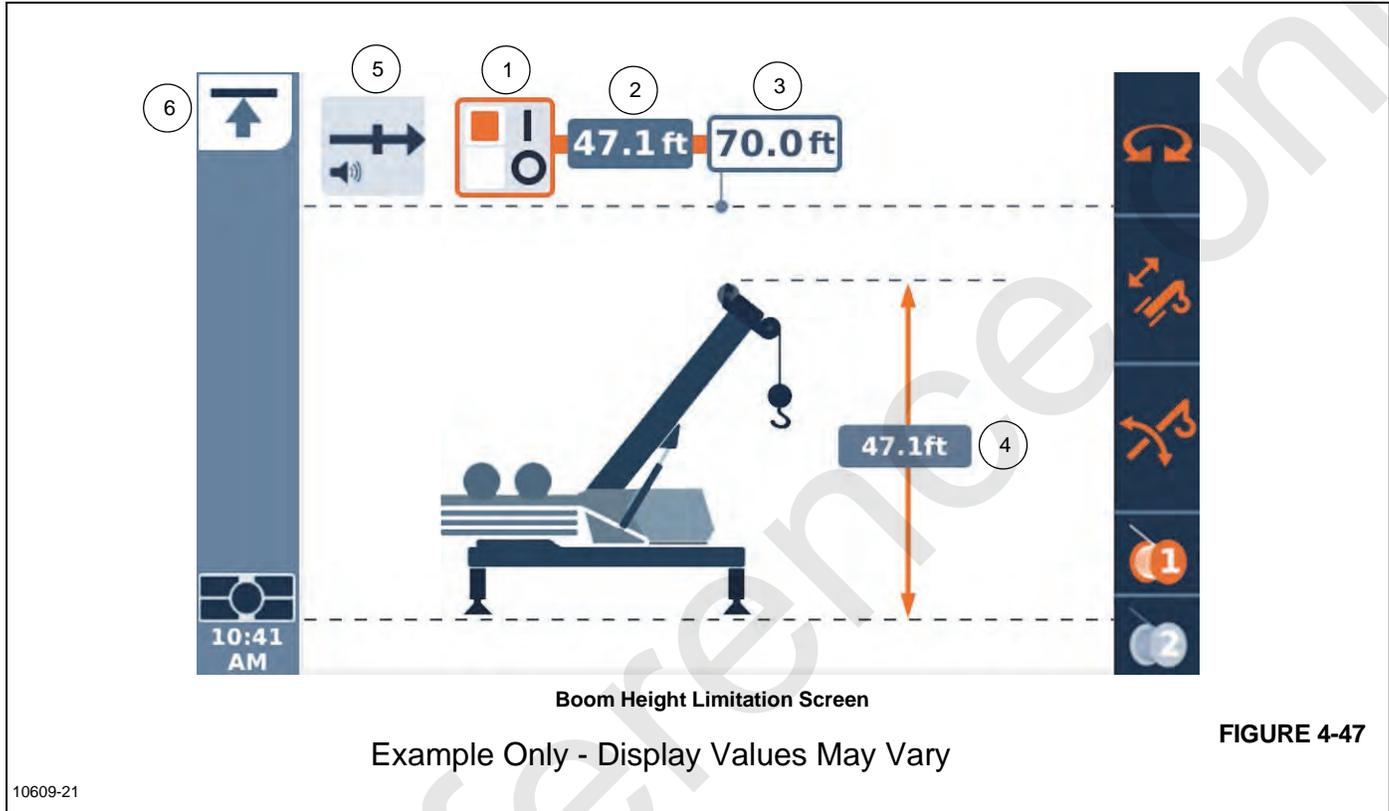
Symbol	Description
	<p>Working Range Limiter (WRL) Wall Icon - Stop.</p>
	<p>This is the inner or Minimum Radius Limitation Indicator.</p>
	<p>This is the outer or Maximum Radius Limitation Indicator.</p>
	<p>Virtual Wall Number - this is used to indicate the virtual wall that is being defined or altered (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 (Figure 4-47).

Using the Left Arrow and Right Arrow Function keys (4, Figure 4-6) on the display or the Jog Dial (5, Figure 4-7)

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 4-47, Item 1 is highlighted in orange.



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 4-47) shows the Boom Height Limitation Icon. Table 4-2 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 4-47
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 4-104.
2. Using the Jog Dial (5, Figure 4-7), go to the ODM Main Menu Screen (Figure 4-20). Go to the Working Range Limiter (WRL) Group Menu Icon (4, Figure 4-46) by using the Arrow keys (4, Figure 4-6) or the Jog Dial (5, Figure 4-7).
3. Select the Boom Height Limitation Menu (4, Figure 4-46). **NOTE:** The Boom Height Limitation Icon (6, Figure 4-47) 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 4-7), or the Arrow Keys (4, Figure 4-6) to move and select the Enable/Disable Switch Symbol ON/Off (1, Figure 4-47). **NOTE:** The Switch (1, Figure 4-47) is a toggle switch. Click OK (5, Figure 4-6), or the Jog Dial (5, Figure 4-7) 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 4-104.
2. Using the Jog Dial (5, Figure 4-7), go to the ODM Main Menu Screen. Then choose the Working Range Limiter (WRL) Group Menu Icon (4, Figure 4-46).
3. Select the Boom Height Limitation Menu Screen (4, Figure 4-46). **NOTE:** The Boom Height Limitation Icon (6, Figure 4-47) is shown on the top left side of the ODM screen.
4. Enable the limitation by using the Jog Dial (5, Figure 4-7) or the Arrow Keys (4, Figure 4-6) and

move to the Enable/Disable Switch (1, Figure 4-47). **NOTE:** The Switch (1, Figure 4-47) is the Enable/Disable Switch and is a toggle switch. Click OK (5, Figure 4-6), or the Jog Dial (5, Figure 4-7) 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 4-47). Use the OK Button (5, Figure 4-6) to begin entering the value. Use the Up Arrow or the Down Arrow or Jog Dial (5, Figure 4-7) to change the value (in tenths) to the desired tip height value.
6. Use the OK Button (5, Figure 4-6) 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 Boom Height Menu (4, Figure 4-46) screen on the Main Menu Screen.
2. Use the Left Arrow and/or Right Arrow Function keys (4, Figure 4-6) to highlight the Switch Enable/Disable Symbol (3, Figure 4-47). Enable is “I” and Disable is “O”.
3. Use the OK Button (5, Figure 4-6), or the Jog Dial (5, Figure 4-7) 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 4-46), then the Boom Angle Limitation Screen will be shown (Figure 4-48).

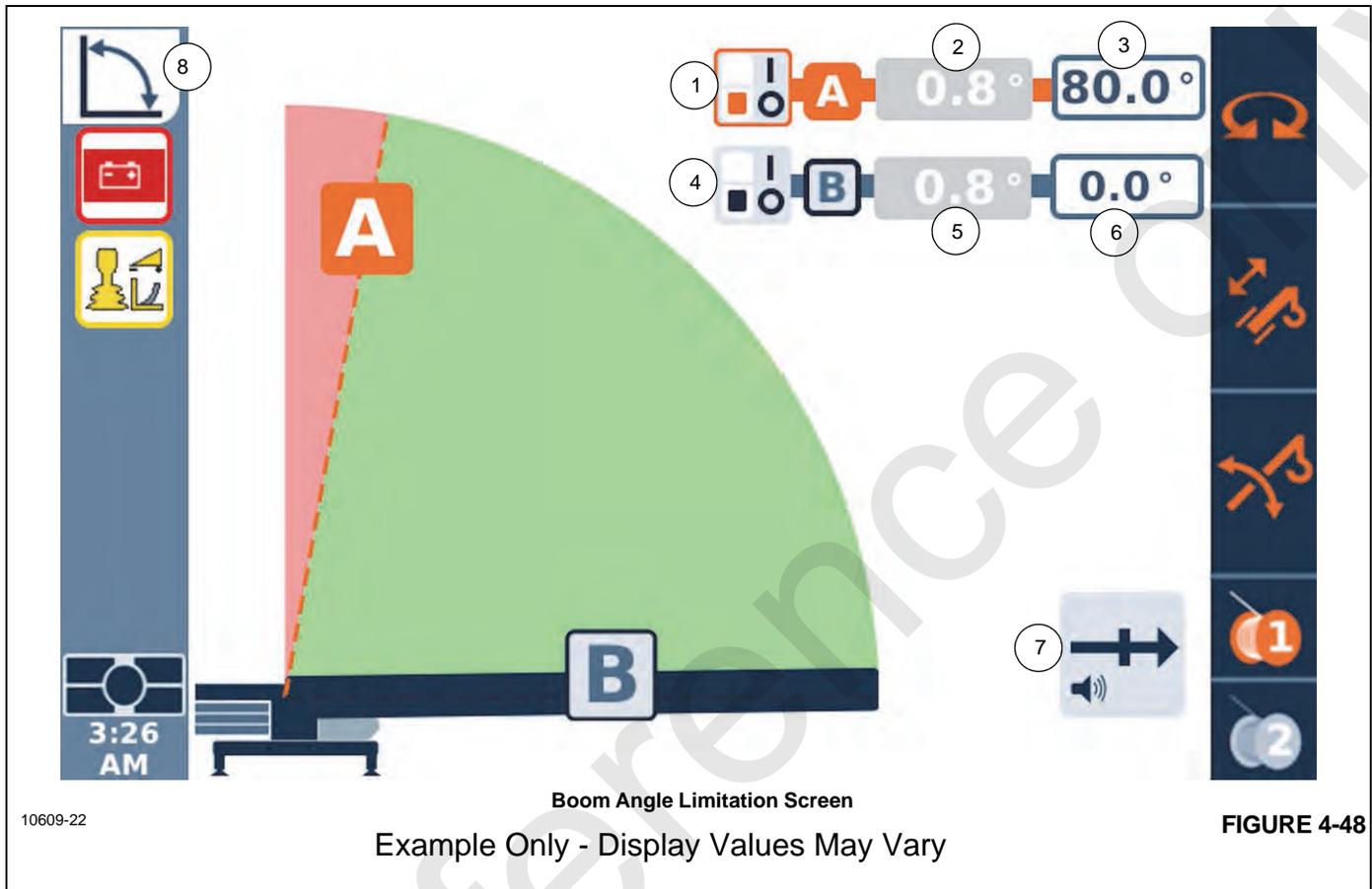


FIGURE 4-48

Using the Left Arrow and Right Arrow Function keys on the Navigation Control Pad (4, Figure 4-6) or the Jog Dial (5, Figure 4-7) 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 4-48, 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 4-2 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 4-48
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 4-104.
2. Using the Jog Dial (5, Figure 4-7), go to the ODM Main Menu Screen (Figure 4-20). Go to the Working Range Limiter (WRL) Group Menu Icon (3, Figure 4-46) by using the Arrow keys (4, Figure 4-6) or the Jog Dial (5, Figure 4-7).
3. Select the Boom Angle Limitation Menu Screen (3, Figure 4-46). **NOTE:** The Boom Up Limitation Screen (8, Figure 4-48) 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 4-7), or the Arrow Keys (4, Figure 4-6) to move and select the Enable/Disable Switch Symbol ON/Off (1, Figure 4-48). **NOTE:** The Switch (1, Figure 4-48) is a toggle switch. Click OK (5, Figure 4-6), or the Jog Dial (5, Figure 4-7) to enable the switch.
6. Use the Jog Dial (5, Figure 4-7) or the Arrow Keys (4, Figure 4-6) and move to the Limitation Value (2, Figure 4-48). Click OK to set the current value Limitation A (2, Figure 4-48) 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 4-104.
2. Using the Jog Dial (5, Figure 4-7), go to the ODM Main Menu Screen (Figure 4-20). Go to the Working Range Limiter (WRL) Group Menu Icon (3, Figure 4-46) by using the Arrow keys (4, Figure 4-6) or the Jog Dial (5, Figure 4-7).
3. Select the Boom Angle Limitation Menu (3, Figure 4-46). **NOTE:** The Boom Angle Limitation Icon (8, Figure 4-48) 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 4-7), or the Arrow Keys (4, Figure 4-6) to move and select the Enable/Disable Switch Symbol ON/Off (4, Figure 4-48). **NOTE:** The Switch (4, Figure 4-48) is a toggle switch. Click OK (5, Figure 4-6), or the Jog Dial (5, Figure 4-7) to enable the switch.
6. Use the Jog Dial (5, Figure 4-7), or the Arrow Keys (4, Figure 4-6) and move to the Limitation Value (5, Figure 4-48). Click OK to set the current value Lower Boom Angle Limitation B (5, Figure 4-48) position.

NOTE: The current lower boom angle Limitation B (5) will automatically populate in the value for Limitation B (6).

7. 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:

1. Set the RDM screen parameters first. Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-104.
2. Using the Jog Dial (5, Figure 4-7), go to the ODM Main Menu Screen. Then choose the Working Range Limiter (WRL) Group Menu Icon (11, Figure 4-20).
3. Select the Boom Angle Limitation Menu Screen (3, Figure 4-46). **NOTE:** The Boom Angle Limitation Icon (8, Figure 4-48) is shown on the top left side of the ODM screen.
4. Enable the limitation by using the Jog Dial (5, Figure 4-7) or the Arrow Keys (4, Figure 4-6) and move to the Enable/Disable Switch (1, Figure 4-48). **NOTE:** The Switch (1, Figure 4-48) is the Enable/Disable Switch and is a toggle switch. Click OK (5, Figure 4-6), or the Jog Dial (5, Figure 4-7) to set the switch.
5. Use the Jog Dial (5, Figure 4-7), or the Right Arrow Key (4, Figure 4-6) to move and select the Maximum Boom Angle (3, Figure 4-48), Limitation A. Enable the value entry by clicking on OK (5, Figure 4-6). Enter a value by using the Jog Dial (5, Figure 4-7) or the upper and lower arrow keys (4, Figure 4-6) to change the value (in tenths) to the desired boom angle value (3, Figure 4-48).

NOTE: The Limitation is dependent on the accuracy of the Boom Angle Sensor, which can be ± 1 degrees.

6. Use the OK Button (5, Figure 4-6) 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.

7. 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:

1. Set the RDM screen parameters first. Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-104.
2. Using the Jog Dial (5, Figure 4-7), go to the ODM Main Menu Screen. Then choose the Working Range Limiter (WRL) Group Menu Icon (11, Figure 4-20).
3. Select the Boom Angle Limitation Menu Screen (3, Figure 4-46). **NOTE:** The Boom Angle Limitation Icon (8, Figure 4-48) is shown on the top left side of the ODM screen.
4. Enable the limitation by using the Jog Dial (5, Figure 4-7) or the Arrow Keys (4, Figure 4-6) and move to the Enable/Disable Switch (4, Figure 4-48). **NOTE:** The Switch (4, Figure 4-48) is the Enable/Disable Switch and is a toggle switch. Click OK (5, Figure 4-6), or the Jog Dial (5, Figure 4-7) to set the switch.
5. Use the Jog Dial (5, Figure 4-7), or the Right Arrow Key (4, Figure 4-6) to move and select the Minimum Boom

Angle Symbol (6, Figure 4-48), Limitation B. Enable the value entry by clicking on OK (5, Figure 4-6). Enter a value by using the Jog Dial (5, Figure 4-7) or the upper and lower arrow keys (4, Figure 4-6) to change the value (in tenths) to the desired boom angle value (6, Figure 4-48).

NOTE: The Limitation is dependent on the accuracy of the Boom Angle Sensor, which can be ± 1 degrees.

6. Use the OK Button (5, Figure 4-6) 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.

7. The Boom Down Limit is now defined and set.

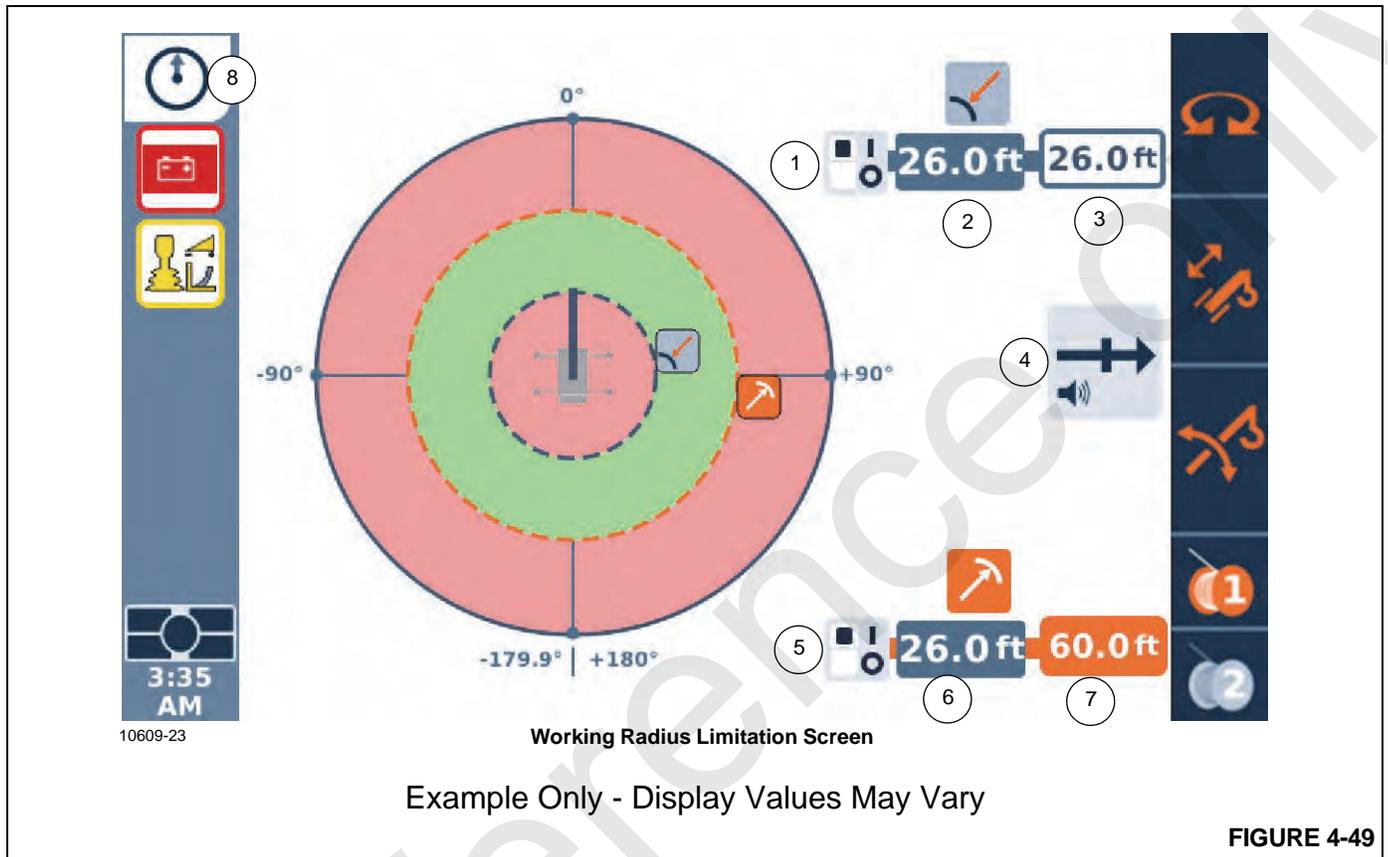
Boom Up/Down Limitation Disable Procedure

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):

1. Select the Boom Up or Boom Down Limitation Menu (3, Figure 4-46) Screen.
2. Use the Left Arrow and/or Right Arrow Function keys (4), (Figure 4-6) to highlight the Switch Enable/Disable Symbol (1, 4, Figure 4-48). Enable is “I” and Disable is “O”.
3. Use the OK Button (5, Figure 4-6), or the Jog Dial (5, Figure 4-7) 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 (Figure 4-49).



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.

Table 4-2 lists the WRL Limitation Screen Symbols.

NOTE: The Working Radius can be “typed in” or set by boom position.

WRL - Working Radius Limit Menu

The Working Radius Menu allows the operator to set minimum and maximum working radii limits.

Item	Description	Refer to
1	Minimum Radius Enable/Disable Switch	Figure 4-49
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 4-104.
2. Using the Jog Dial (5, Figure 4-7), go to the ODM Main Menu Screen. Then choose the Working Range Limiter (WRL) Group Menu Icon (5, Figure 4-46) by using the Arrow keys (4, Figure 4-6) or the Jog Dial (5, Figure 4-7).
3. Select the Working Radius Limitation Menu Screen (5, Figure 4-46). **NOTE:** The Working Radius Limitation Icon (8, Figure 4-49) 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 4-49) position.
5. Enable the limitation by using the Jog Dial (5, Figure 4-7) or the Arrow Keys (4, Figure 4-6) and move to the Enable/Disable Switch (1, Figure 4-49). **NOTE:** The Switch (1, Figure 4-49) is the Enable/Disable Switch and is a toggle switch. Toggle to "I" and click OK (5, Figure 4-6), or the Jog Dial (5, Figure 4-7) to enable the switch.
6. Use the Jog Dial (5, Figure 4-7) or the Arrow Keys (4, Figure 4-6) and move to the Limitation Value (2, Figure 4-49). Click OK to set the current value Limitation (2, Figure 4-49) 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 4-49) 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 4-104.
2. Using the Jog Dial (5, Figure 4-7), go to the ODM Main Menu Screen. Then choose the Working Range Limiter (WRL) Group Menu Icon (5, Figure 4-46).
3. Select the Working Radius Limitation Menu Screen (5, Figure 4-46). **NOTE:** The Working Radius Limitation Icon (8, Figure 4-49) is shown on the top left side of the ODM screen.
4. Enable the limitation by using the Jog Dial (5, Figure 4-7) or the Arrow Keys (4, Figure 4-6) and move to the Enable/Disable Switch (1, Figure 4-49). **NOTE:** The Switch (1, Figure 4-49) is the Enable/Disable Switch and is a toggle switch. Toggle to "I" and click OK (5, Figure 4-6), or the Jog Dial (5, Figure 4-7) to set the switch. Click OK.
5. Use the Jog Dial (5, Figure 4-7), to move and select the Limitation (3, Figure 4-49) to set the Inner or Minimum Radius Limitation value. Enter a value by using the Jog Dial (5, Figure 4-7) or the upper and lower arrow keys (4, Figure 4-6) to change the value (in tenths) to the desired radius value. Use the OK Button (5, Figure 4-6) 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 4-49) 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 4-49) on the Main Menu Screen.
2. Use the Left Arrow and/or Right Arrow Function keys (4, Figure 4-6) to highlight the Switch Enable/Disable Symbol (3, Figure 4-50). Enable is "I" and Disable is "O".
3. Use the OK Button (5, Figure 4-6), or the Jog Dial (5, Figure 4-7) 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 (Figure 4-50).

Using the Left Arrow and Right Arrow Function keys (4, Figure 4-6) on the Navigation Control Pad or the Jog Dial (5, Figure 4-7) 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 4-50, the orange Icon (Item 3)

symbol is selected since it has the orange color highlighting. Table 4-2 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 4-46 for the WRL Menu and sub-menu. Table 4-2 lists the WRL Limitation Screen Symbols.

The Swing Angle can be “typed in” or set by a boom position.

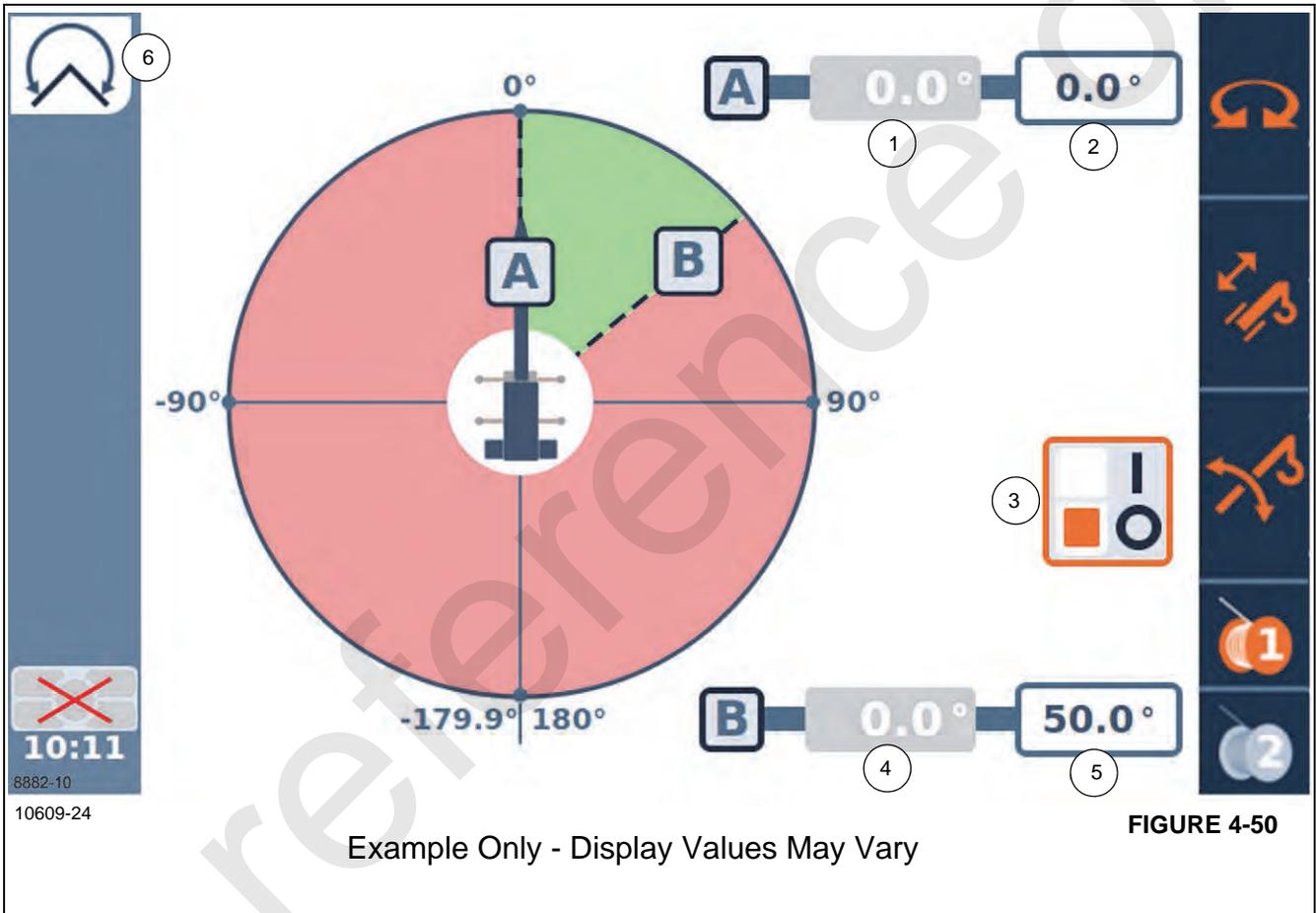


FIGURE 4-50

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 4-50
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 4-104*.
2. Using the Jog Dial (5, Figure 4-7), go to the ODM Main Menu Screen (Figure 4-20). Then choose the Working Range Limiter (WRL) Group Menu Icon (1, Figure 4-46) by using the Arrow keys (4, Figure 4-6) or the Jog Dial (5, Figure 4-7).
3. Select the Swing Angle Menu Screen (2, Figure 4-46). **NOTE:** The Swing Angle Screen (6, Figure 4-50) Icon is shown on the top left side of the ODM screen.
4. Enable the limitation by using the Jog Dial (5, Figure 4-7) or the Arrow Keys (4, Figure 4-6) and move to the Enable/Disable Switch ON/OFF (3, Figure 4-50). **NOTE:** The Switch (3, Figure 4-50) is the Swing Enable/Disable Switch ON/OFF and is a toggle switch. Click OK (5, Figure 4-6), or the Jog Dial (5, Figure 4-7) 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 4-7) or the Arrow Keys (4, Figure 4-6) and move to the Limitation Value (1, Figure 4-50). Click OK to set the current value Limitation A (1, Figure 4-50) 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 4-50) 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 4-104*.
2. Using the Jog Dial (5, Figure 4-7), go to the ODM Main Menu Screen. Then choose the Working Range Limiter (WRL) Group Menu Icon (11, Figure 4-20).
3. Select the Swing Angle Menu Screen (12, Figure 4-20). **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 4-50) at the top of the screen should show the Swing Angle Limitation Icon.
4. Enable the limitation by using the Jog Dial (5, Figure 4-7) or the Arrow Keys (4, Figure 4-6) and move to the Enable/Disable Switch ON/OFF (3, Figure 4-50). **NOTE:** The Switch (3, Figure 4-50) is the Enable/Disable Switch ON/OFF and is a toggle switch. Click OK (5, Figure 4-6), or the Jog Dial (5, Figure 4-7) to toggle the switch.
5. Use the Jog Dial (5, Figure 4-7) to move and select the Swing Angle Left Limitation A (2, Figure 4-50) 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 4-7) or the upper and lower arrow keys (4, Figure 4-6) to change the value (in tenths) to the desired swing angle value. Use the OK Button (5, Figure 4-6) 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 4-50) 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 4-50).

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 4-46).
NOTE: The Swing Angle Screen (6, Figure 4-50) 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 4-6) to highlight the Switch Enable/Disable Symbol (3, Figure 4-50). Enable is "I" and Disable is "O".
3. Use the OK Button (5, Figure 4-6) or the Jog Dial (5, Figure 4-7) 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.

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 4-51).

Using the Left Arrow and Right Arrow (4, Figure 4-6) Function Keys on the Display or the Jog Dial (5, Figure 4-7) 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 4-51, one can see that the wall Point "A" symbol is selected since it has the orange color highlighting.

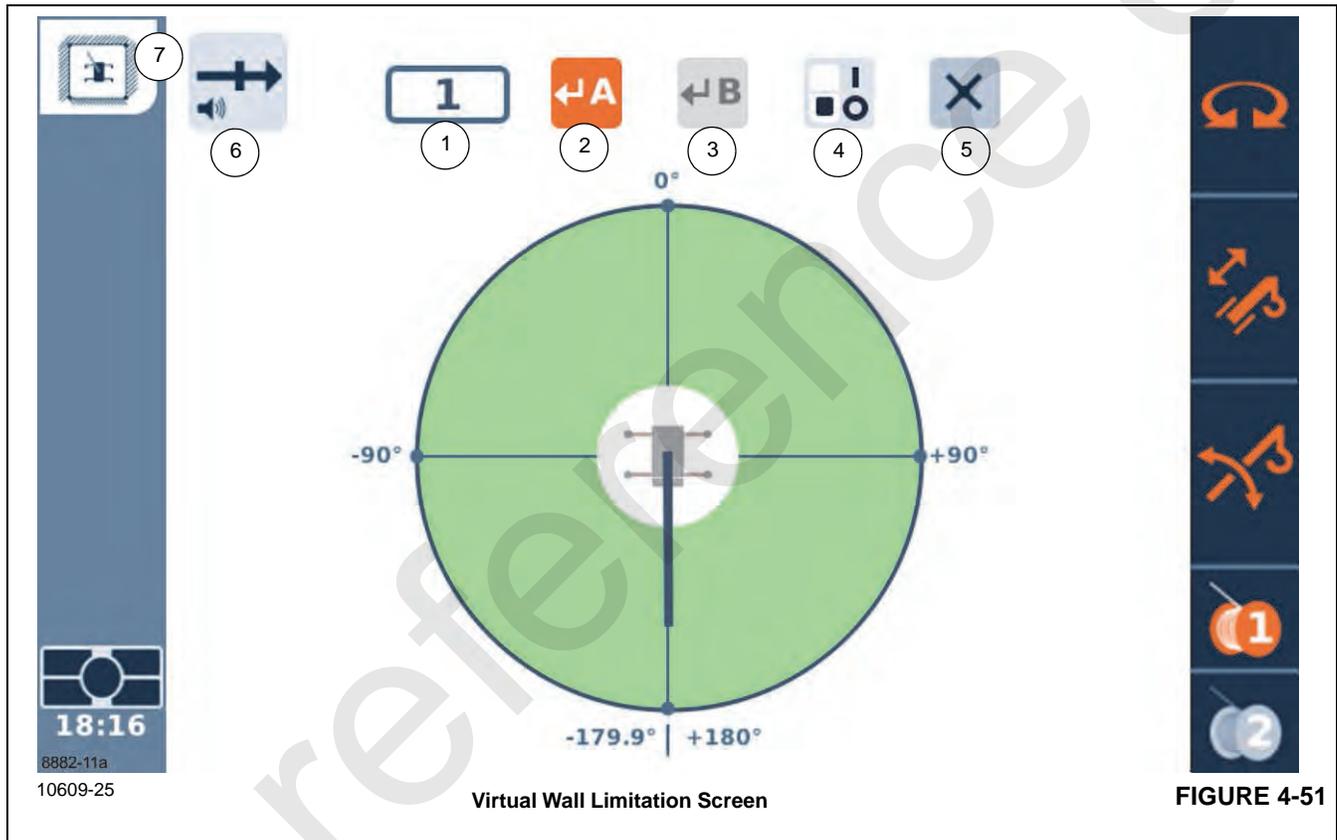


FIGURE 4-51

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 4-2 lists the WRL Limitation Screen Symbols.

Item	Description	Refer to
1	Virtual Wall Number (up to 5)	Figure 4-51
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 4-46) 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 4-51). (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 4-6) Function key to highlight the Accept Crane Position Point A Symbol (2), Figure 4-51.

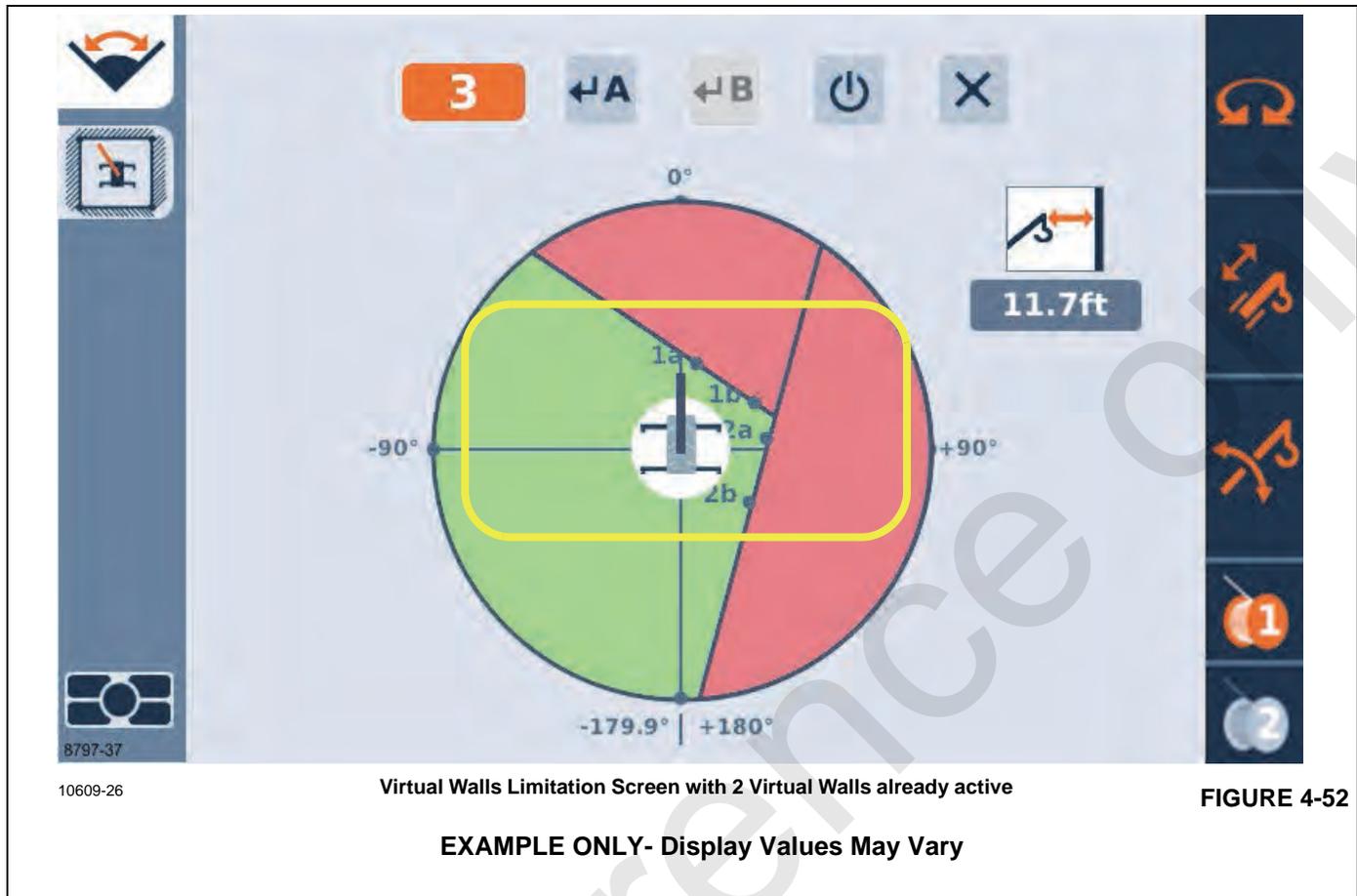
4. Use an OK Button (5, Figure 4-6) to accept the current crane position to be Point A (2). The location of the point should now be shown on the screen with a label of '1a' as indicated in the yellow box in the sample in Figure 4-52.
5. Position the crane so that the hook is located at the position to define the second point of the Virtual Wall (Point B), or Item 3 (Figure 4-51). **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 4-6) Function key to highlight the Accept Crane Position Point B Symbol (3, Figure 4-51).
7. Use an OK Button (5, Figure 4-6) 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 4-52.

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 4-52, 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 4-51).
2. Use the Right Arrow (4, Figure 4-6) function key to highlight the Virtual Wall Number Item (1, Figure 4-51).
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 4-6) to allow modifying the value. Use the Up/Down Arrow Keys (4, Figure 4-6) to alter the Virtual Wall number to the desired value. Use an OK Button (5, Figure 4-6) 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 4-51.
5. Use the Right Arrow (4, Figure 4-6) Function key to highlight the Accept Crane Position Point A Symbol (2, Figure 4-51).
6. Use an OK Button (5, Figure 4-6) to accept the current crane position to be Point A as shown in Figure 4-51.

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 4-52.

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 4-51).

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 4-6) Function key, if needed, to highlight the Accept Crane Position Point B Item (3, Figure 4-51).
9. Use an OK (5, Figure 4-6) Button to accept the current crane position to be Point B (3, Figure 4-51). The location of the point should now be shown on the screen with a label (1b) as shown in yellow highlight in Figure 4-52.

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 4-7) go to the Working Range Limiter (WRL) Group Menu (1), (Figure 4-46). Then choose the Virtual Walls Limitation Menu (6), (Figure 4-46).
2. Use the Right Arrow (4), (Figure 4-6) key and to highlight the Virtual Wall Number (1), (Figure 4-51).
3. If the wall number shown is not the correct number for wall to be disabled, use an OK Button (5, Figure 4-6) 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 4-51).
4. Use the Up/Down Arrows (4, Figure 4-6) to alter the Virtual Walls number to the desired value. Use an OK Button (5, Figure 4-6) to finish entering the value.

5. Use the Left Arrow and/or Right Arrow (4, Figure 4-6) keys or the Jog Dial (5, Figure 4-7) to highlight the Enable/Disable Switch Symbol (4, Figure 4-51).
6. Use an OK Button (5, Figure 4-6) 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 4-46) on the WRL Menu Group Screen (Figure 4-46).
2. Use the Right Arrow (4, Figure 4-6) Function to highlight the Virtual Wall Number (1, Figure 4-51).
3. If the wall number shown is not the correct number for wall to be disabled, use an OK Button (5, Figure 4-6) 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 4-51).
4. Use the Left Arrow and/or Right Arrow (4, Figure 4-6) key to highlight the "X" or the Remove Virtual Walls Symbol (5, Figure 4-51). Use an OK Button (5, Figure 4-6) or the Jog Dial (5, Figure 4-7) to delete the wall.

Faults Menu Group

The Fault Menu Group (1, Figure 4-53) includes the following function icons:

- Crane Faults (2) (page 4-86)
- Engine Faults (3) (page 4-87)

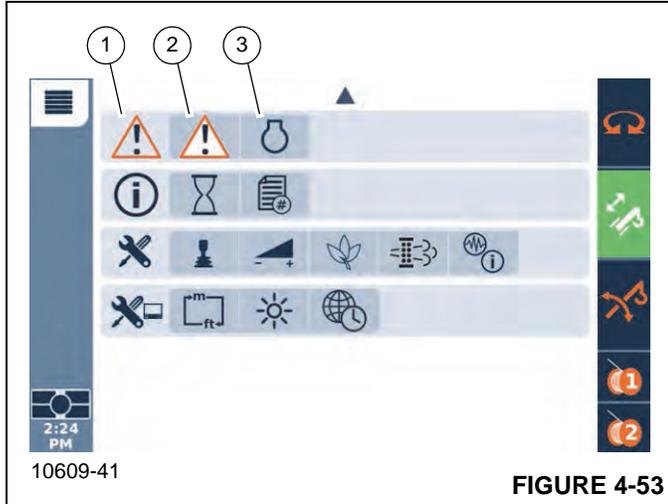


FIGURE 4-53

Crane Faults

Select the Crane Faults icon (1, Figure 4-54) under the Faults Menu Group to view active crane fault codes.

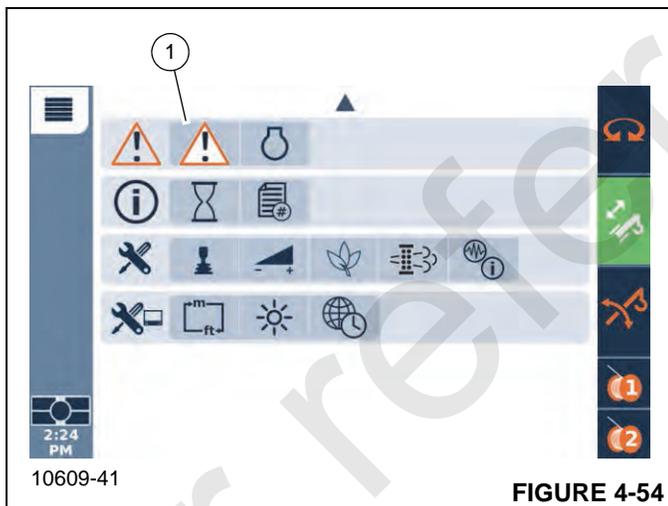


FIGURE 4-54

The Crane Fault Code function screen (Figure 4-55) 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

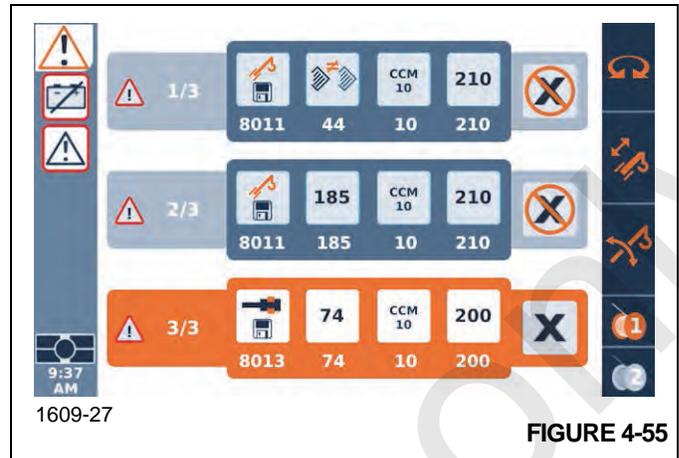


FIGURE 4-55

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 Additional Information Button (1, Figure 4-56) at the ODM Navigation Control Pad.

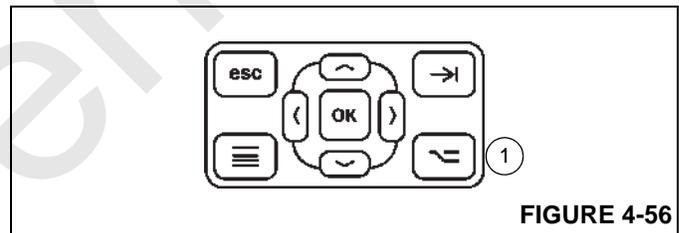


FIGURE 4-56

The Additional Information screen (Figure 4-57) gives the operator details about the location of the system that is at fault, along with an explanation.

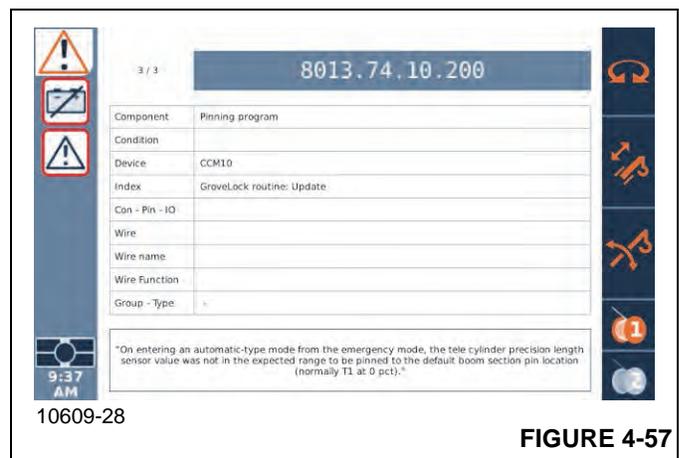


FIGURE 4-57

A list of all fault codes and their definitions are available through the Manitowoc Diagnostic Code application. For more information, refer to the section titled *A list of all fault codes and their definitions are available through the*

*Manitowoc Diagnostic Code application. For more information, refer to the section titled .Manitowoc Diagnostic Code Mobile Application, page 4-87.***Manitowoc Diagnostic Code Mobile Application**

The Manitowoc Diagnostic Code Mobile Application is a free mobile application that enables the user to enter and retrieve information about specific crane fault codes on a mobile device. The application is available from the Google and Apple stores and compatible with most Android and Apple mobile devices.

To look up a fault code with the Manitowoc Diagnostic Code mobile application:

1. Find the fault code you want to research in the Fault Code function screen of the Operator Display Module (ODM).
2. Open the Manitowoc Diagnostics Code Application on your mobile device.

The Diagnostic Code Application splash screen appears.



3. Click CCS.

The CCS screen appears.

10157

FIGURE 4-59

4. Complete the following using information from the error code displayed on the ODM:

- **Select Crane Type**—Select the crane model from the drop down list.
- **Component**—Enter the component information from the fault code.
- **Condition**—Enter the condition information from the fault code.
- **Device**—Enter the device number from the fault code.
- **Index**—Enter the index number information from the fault code.

5. Click Continue.

The Fault code information is displayed.

10158

FIGURE 4-60

6. Click OK to return to the main screen.

Engine Faults

Select the Engine Faults icon (1, Figure 4-61) under the Faults Menu Group to view active engine fault codes.

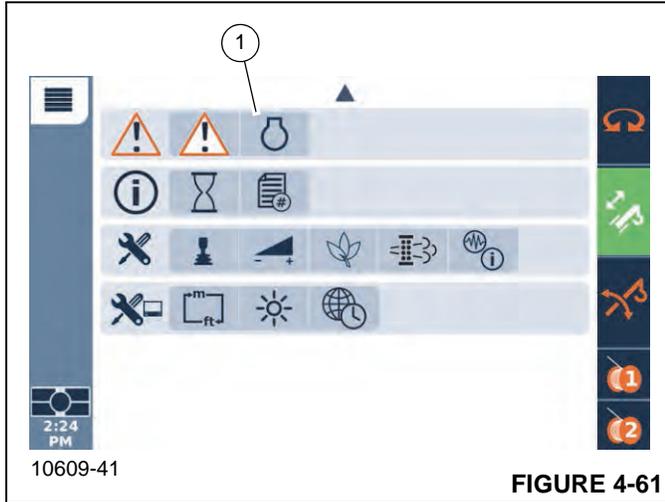


FIGURE 4-61

The Engine Fault Code function screen (Figure 4-62) displays active engine fault codes.

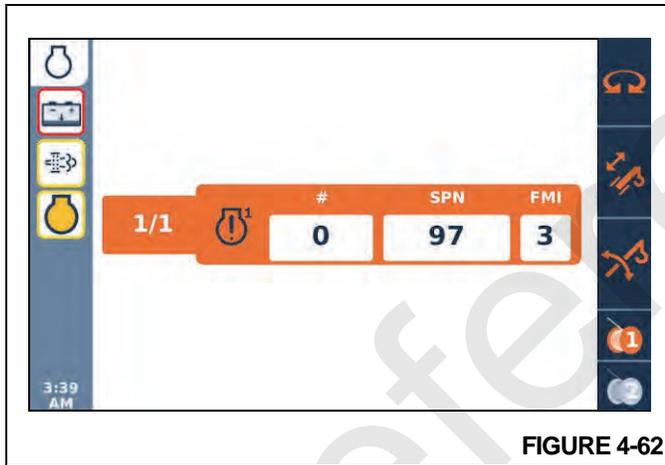


FIGURE 4-62

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.

Information Menu Group

The Information Menu Group (1, Figure 4-63) includes the following function icons:

- Operating Hours (2) (page 4-89)
- Software Versions (3) (page 4-91)

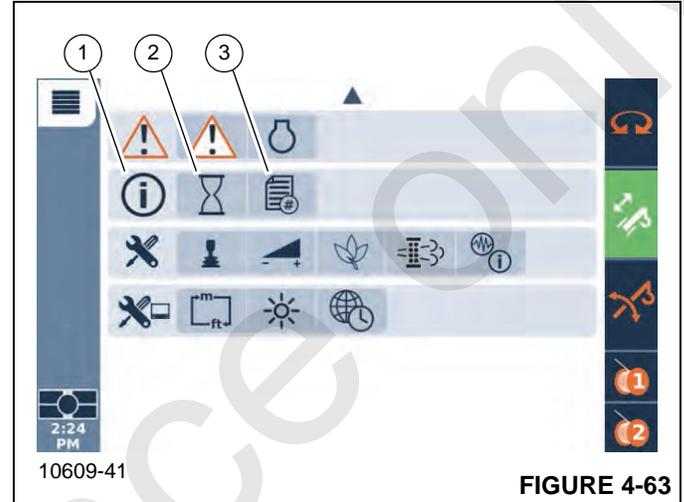


FIGURE 4-63

Operating Hours

Select the Operating Hours icon (1, Figure 4-64) under the Information Menu Group to show the Operating Hours function screen.

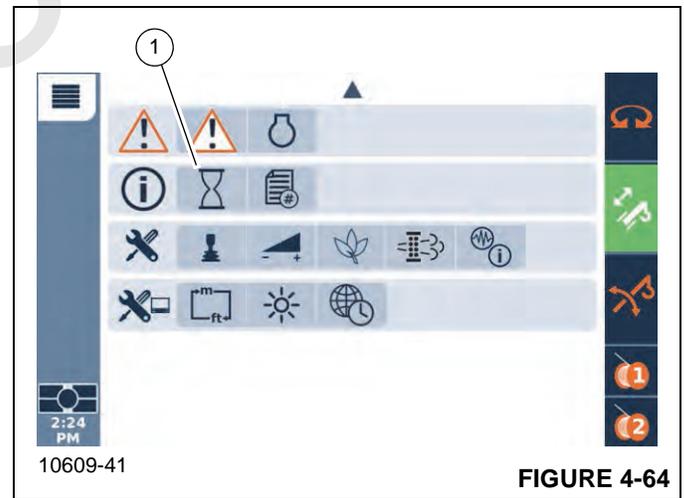
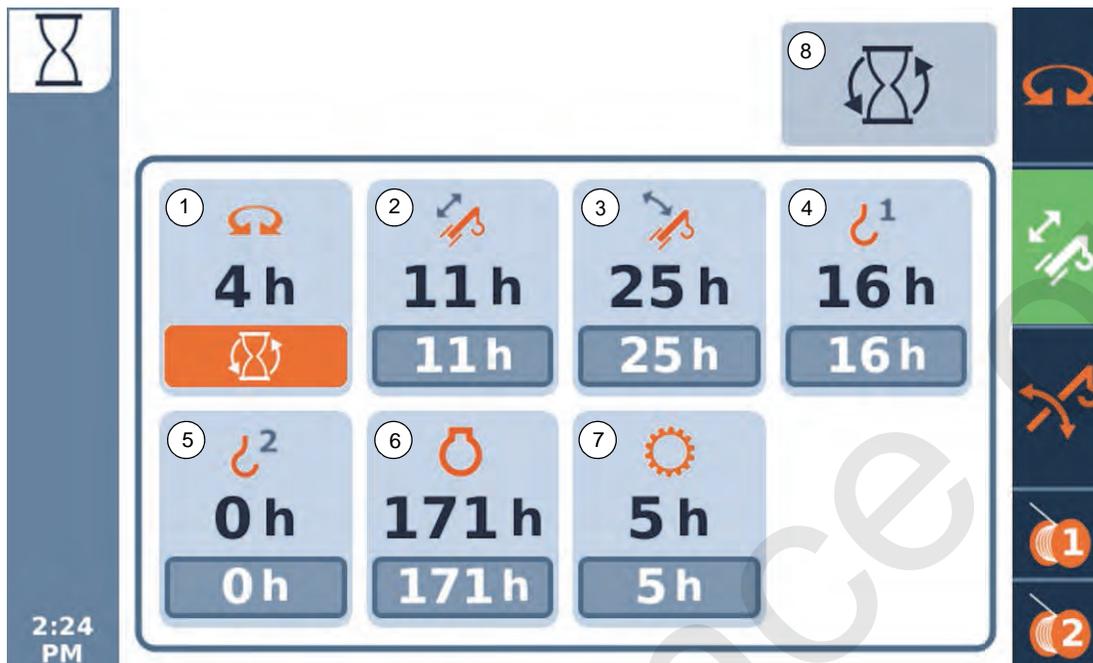


FIGURE 4-64

The Operating Hours function screen (Figure 4-65) shows the total accumulated operating hours for the different crane functions as well as offers a resettable trip meter for each crane function.



10609-42a

Item	Description	Item	Description
1	Swing Operating Hours	5	Auxiliary Hoist Operating Hours
2	Boom Telescope Operating Hours	6	Engine Operating Hours
3	Boom Lift Operating Hours	7	Transmission Operating Hours
4	Main Hoist Operating Hours	8	Reset All Icon

FIGURE 4-65

The top number for each crane function shows the total accumulated hours (1, Figure 4-66). The bottom number is a trip meter and shows total hours since the last reset (2).



FIGURE 4-66

The Boom Pinning Count (7, Figure 4-65) 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:

1. 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).
2. 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 (11, Figure 4-65) (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 4-67) under the Information Menu Group to view the Software Versions function screen.

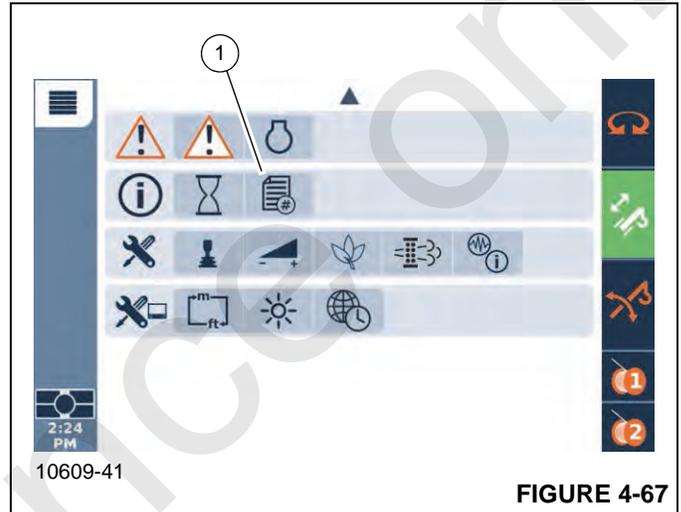


FIGURE 4-67

The Software Versions function screen shows the current software versions for all of the software installed on the crane.

User Settings Menu Group

The User Settings Menu Group (1, Figure 4-68) includes the following function icons:

- Controller Curve (2) (page 4-92)
- Controller Speed (3) (page 4-95)
- ECO Mode (4) (page 4-97)
- Exhaust System Cleaning (5) (page 4-99)
- Service Menu (6) (page 4-100)

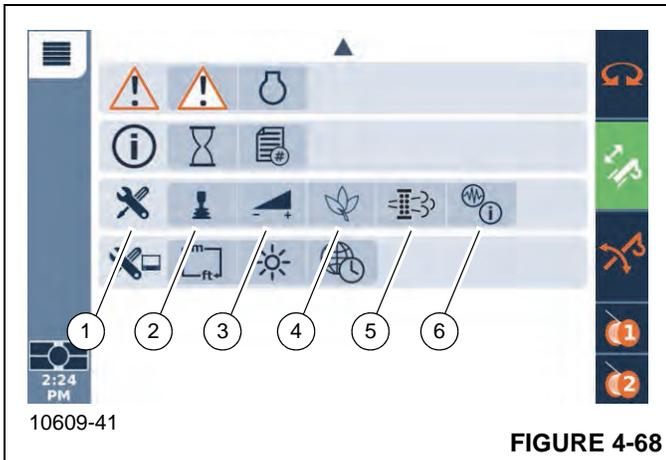


FIGURE 4-68

Controller Curve

Select the Controller Curve icon (1, Figure 4-69) under the User Settings Menu Group to show the Controller Sensitivity function screen.

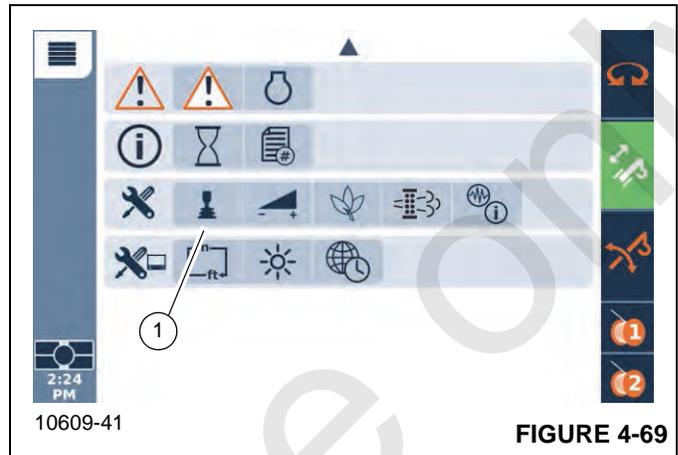


FIGURE 4-69

The Controller Sensitivity function screen (Figure 4-70) allows the operator to adjust the sensitivity of the controllers.

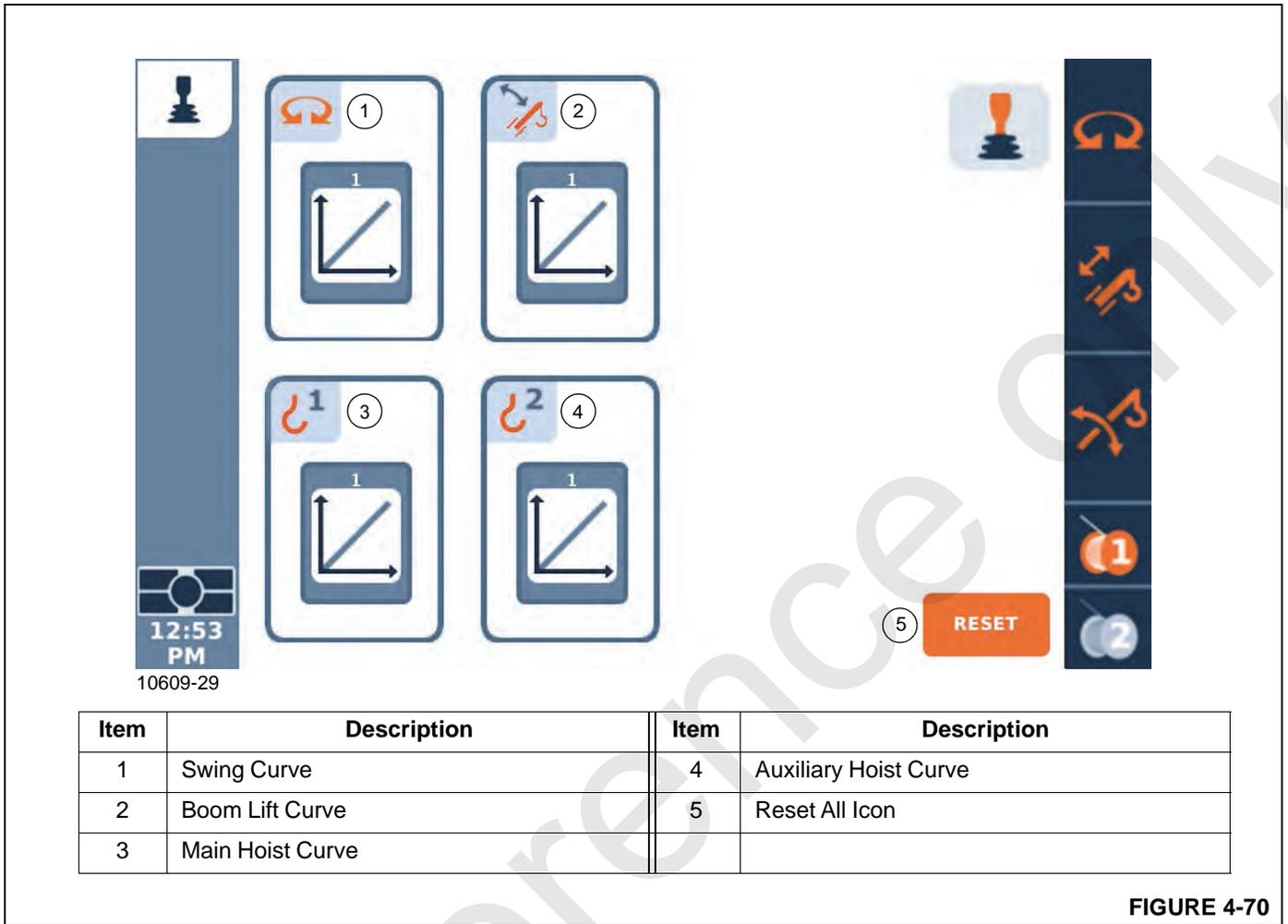


FIGURE 4-70

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 4-71).

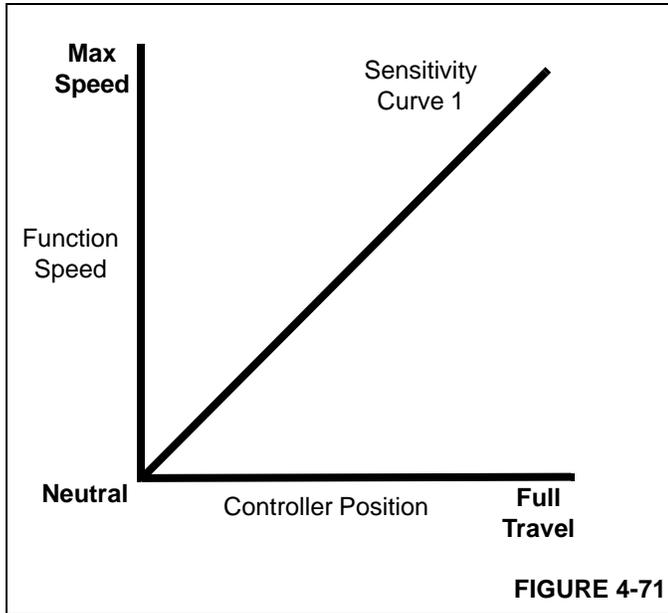


FIGURE 4-71

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 4-72).

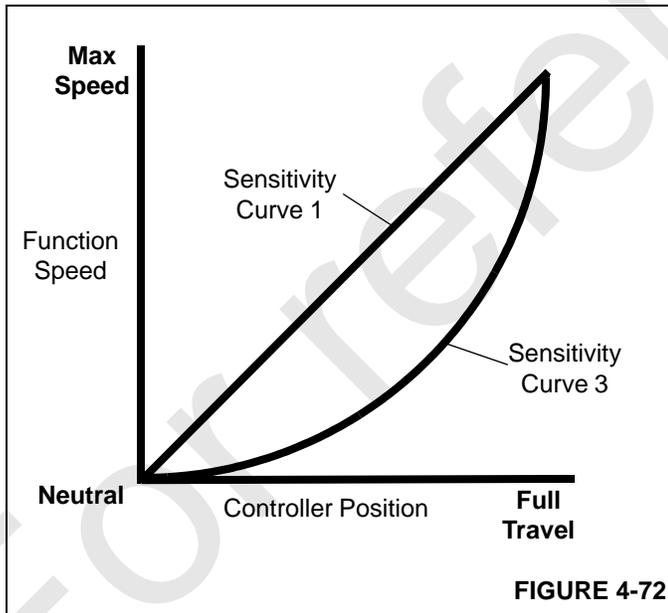


FIGURE 4-72

Sensitivity curve 1 (default) is the most sensitive and sensitivity curve 5 is the least sensitive (Figure 4-73).

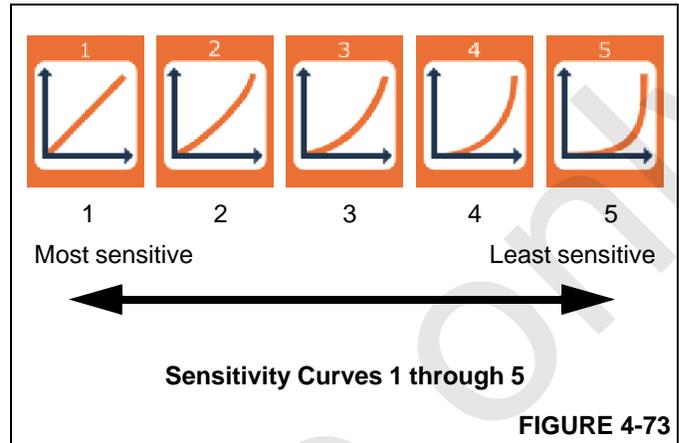


FIGURE 4-73

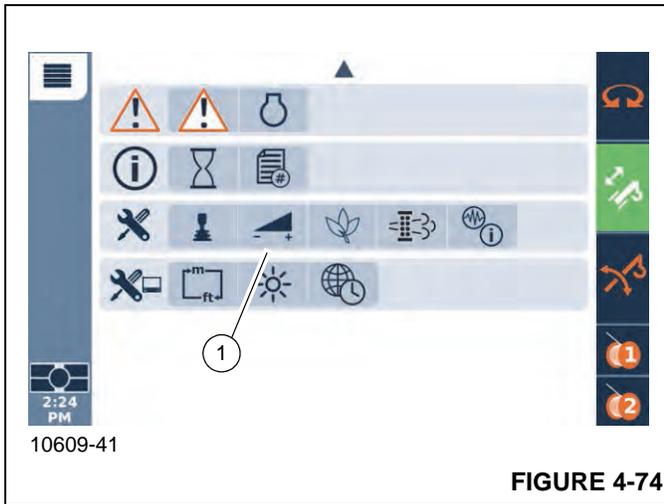
Adjust the sensitivity of a controller function by doing the following:

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 4-73).
4. Press the Jog Dial or OK Button to accept the new setting.

Select the Reset All icon (5, Figure 4-70) 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 4-74) under the User Settings Menu Group to show the Controller Speed function screen.



The Controller Speed function screen (Figure 4-75) allows the operator to adjust the crane function speeds relative to the position of the controllers. Adjustment is made as a percentage of full rated speed.

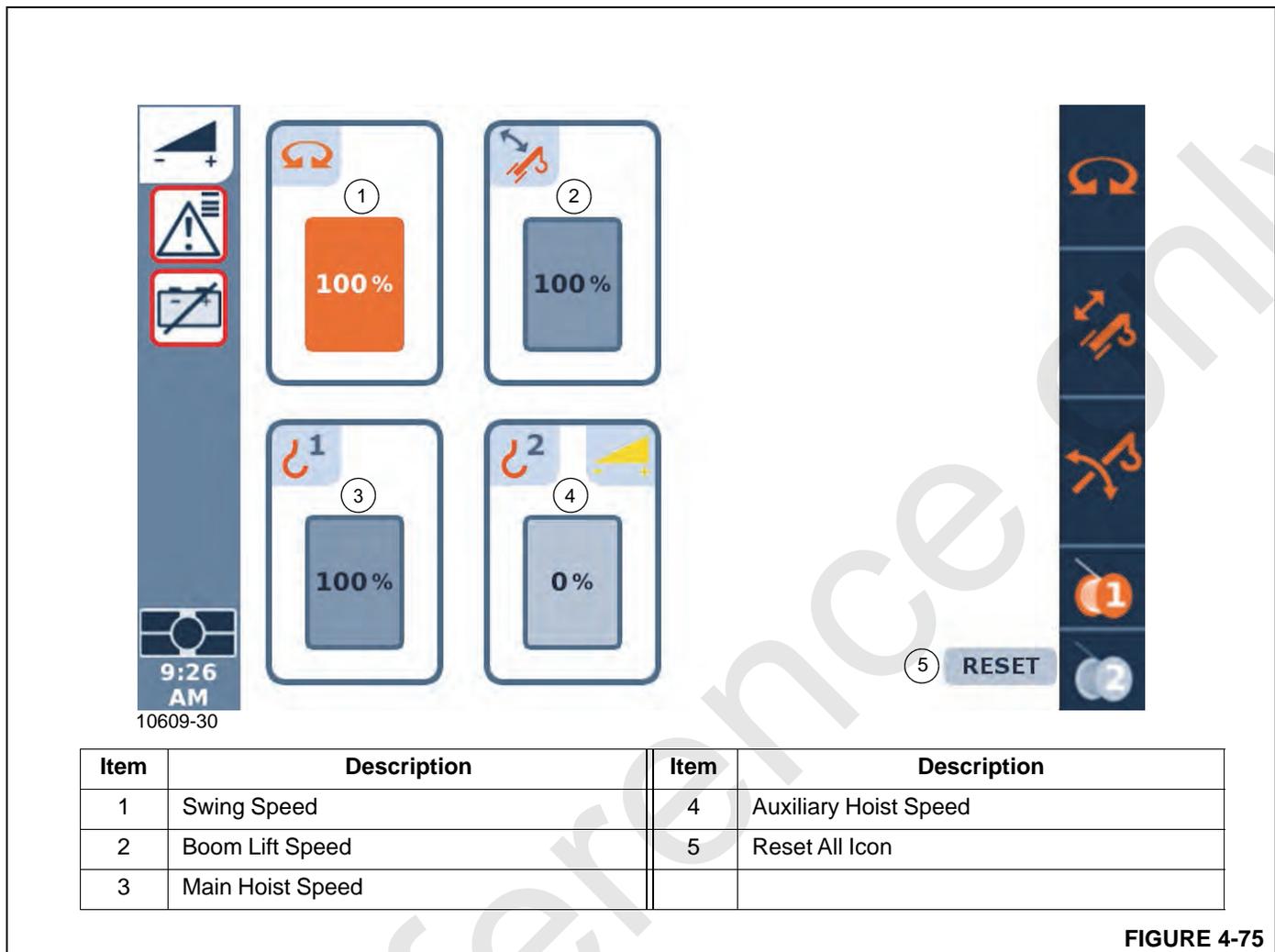


FIGURE 4-75

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:

- 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).
- Press the Jog Dial or OK Button to make the controller function icon active (icon background will turn gray).
- 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.

- Press the Jog Dial or OK Button to accept the new setting.

Select the Reset All icon (5, Figure 4-75) 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 4-76) under the User Settings Menu Group to show the ECO Mode function screen.

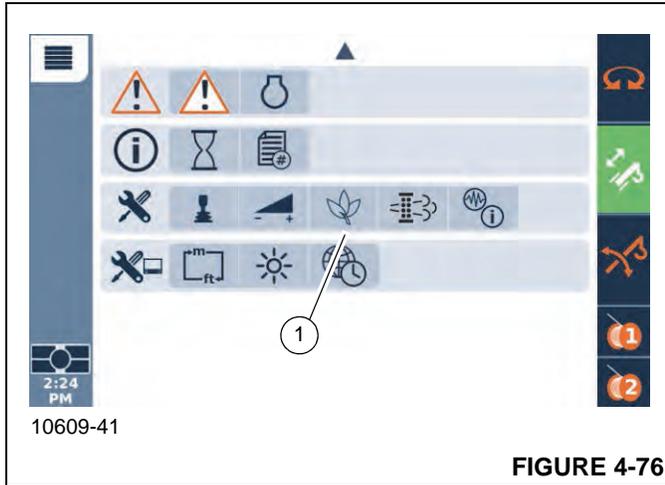


FIGURE 4-76

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 4-77) 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.

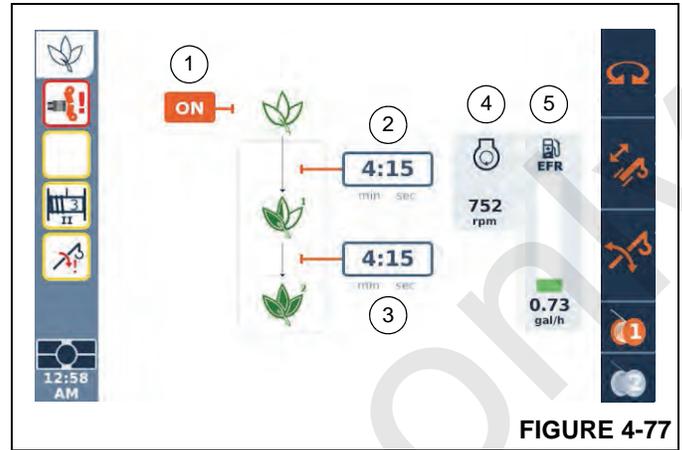


FIGURE 4-77

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 4-77) 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 950 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 800 rpm. If the hydraulic oil cooling fan is operating, the crane will reduce the fan speed when the Time Delay Setting (3) has been met. This reduces fuel consumption and does not affect cooling performance.

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 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 3-8).

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 800 rpm when no craning functions are enabled.
- Engine speed will increase and idle at 950 rpm when a craning function is enabled.
- Engine speed will return to 800 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 800 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 950 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 4-77) has past.
- Engine speed will automatically decrease to the idle speed of 800 rpm after all craning functions are disabled and the time period that was specified in the Idle Speed 2 Time Delay Setting (3, Figure 4-77) 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 4-78) at the Jog Dial to select the ODM screen control. Using the Jog Dial (2, Figure 4-78), select one of the time delay number fields (box around number will turn orange, Figure 4-77), then press the Jog Dial (2) (number will turn white with orange background).

- or -

Using the Arrow Buttons (3, Figure 4-78) on the Navigation Control Pad at the ODM, select one of the time delay number fields (box around number will turn orange, Figure 4-77), then press the OK Button (4) (number will turn white with orange background).

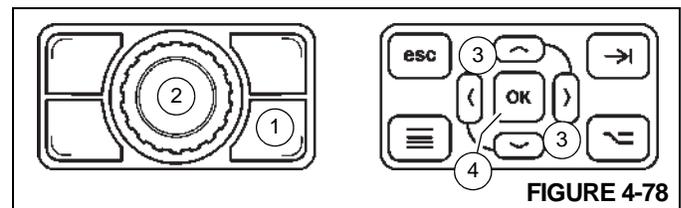


FIGURE 4-78

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 4-79) under the User Settings Menu Group to show the Exhaust System Cleaning function screen.

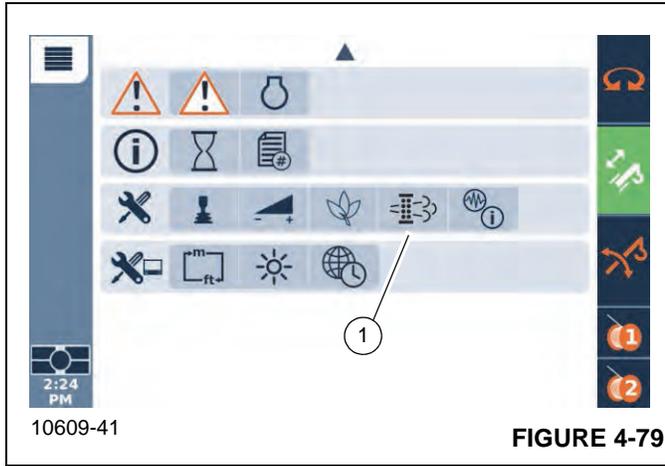


FIGURE 4-79

The Exhaust System Cleaning function screen (Figure 4-80) allows the operator to initiate or inhibit the exhaust system cleaning process.

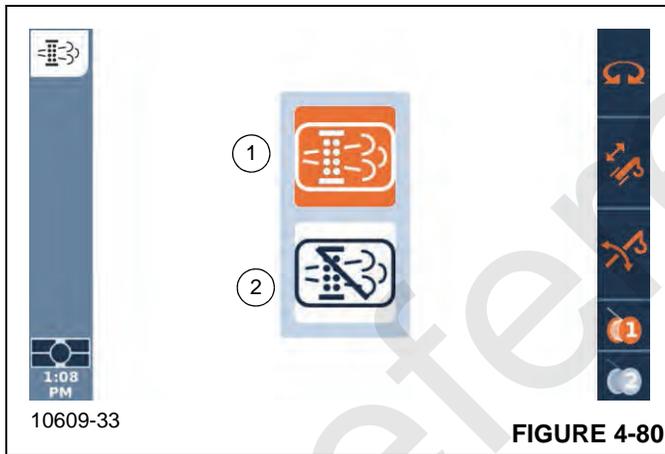


FIGURE 4-80

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 in to 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 4-80) (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 4-81) near the exhaust pipe (2) will flash during exhaust system cleaning.

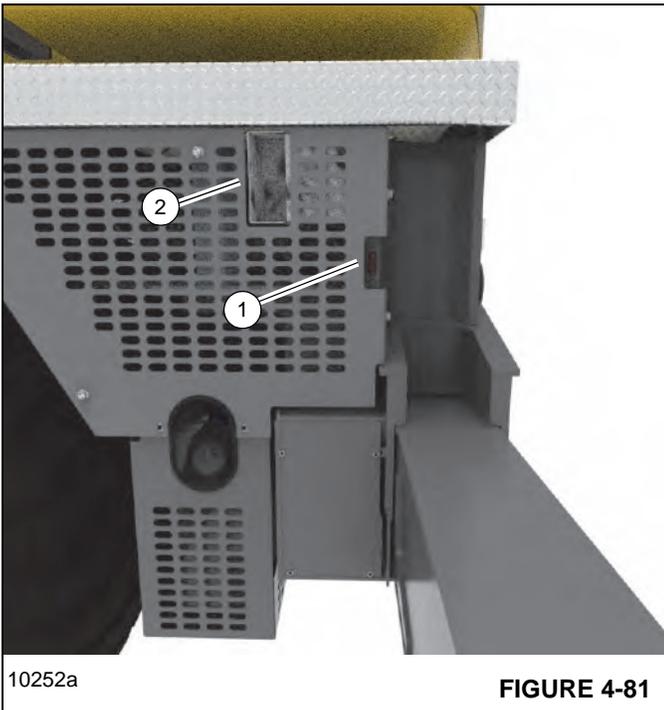


FIGURE 4-81

Pressing the service brake pedal or throttle pedal during cleaning or selecting the Inhibit Cleaning Process Icon (2, Figure 4-80) 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 4-82) (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.

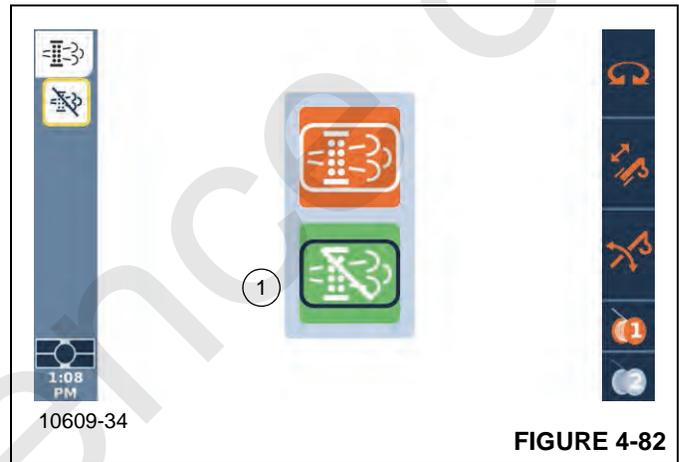


FIGURE 4-82

Service Menu

Select the Service Menu icon (1, Figure 4-83) under the User Settings Menu Group to show the Service Menu function screen.

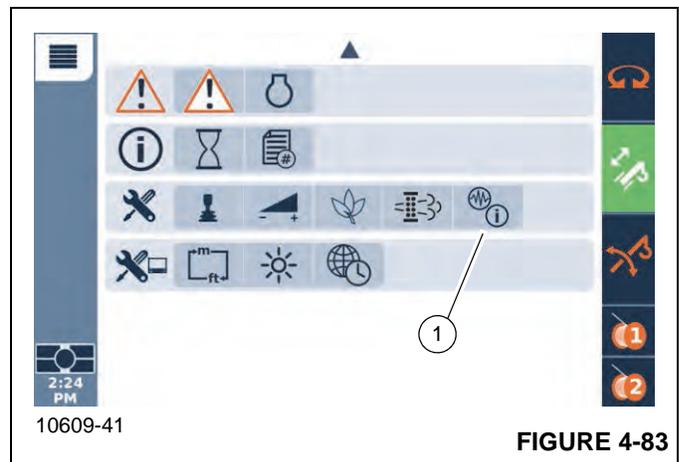
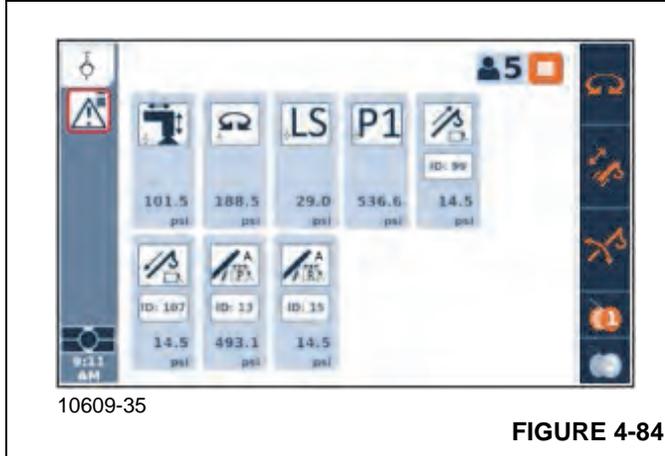


FIGURE 4-83

The Service Menu function screen is accessible to those service technicians who have attended the Grove New Technology training course.

On-Crane Service Interface (oCSI)

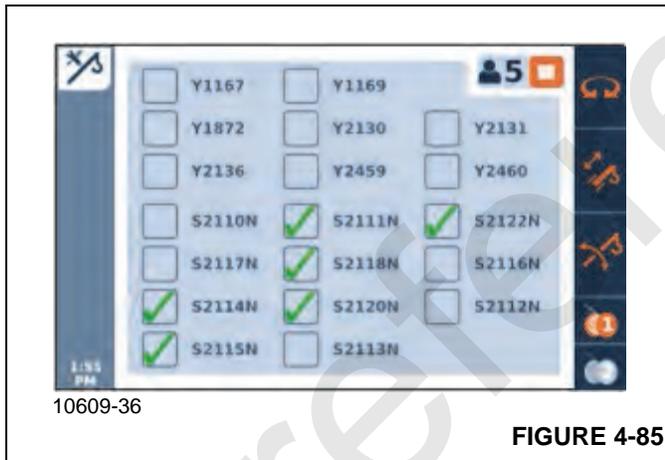
The oCSI screens provide on-board live monitoring of hydraulic pressure sensors (Figure 4-84) from inside the cab, as well as other crane info in real time. These screens can be accessed by anyone inside the cab without the need for specific training.



10609-35

FIGURE 4-84

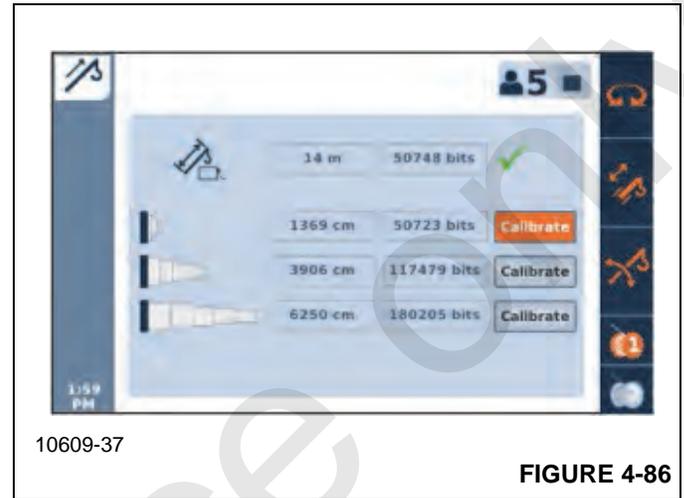
The oCSI screen can also provide quick visibility of the solenoid valves and proximity switches for the boom telescoping system. (Figure 4-85)



10609-36

FIGURE 4-85

The oCSI screen can be used for calibration of sensors (angle, length, slew, level, pedals, OMS, RCS, luffing jib) (Figure 4-86). A day code provided by Grove Product Support is needed for calibration.



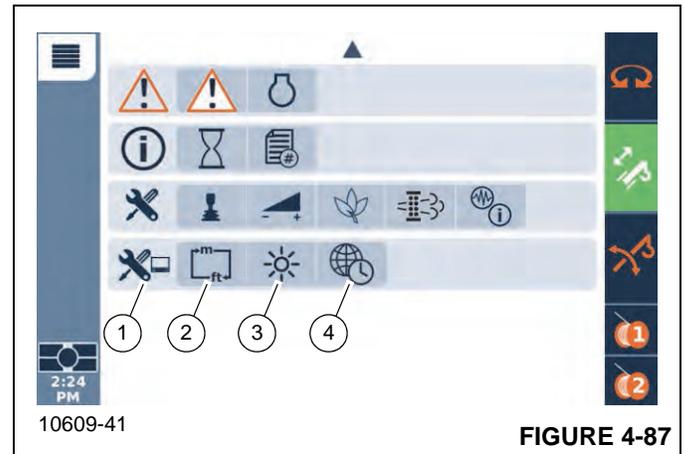
10609-37

FIGURE 4-86

Display Settings Menu Group

The Display Settings Menu Group (1, Figure 4-87) includes the following function icons:

- Units of Measure (2) (page 4-102)
- Display Screen Brightness (3) (page 4-102)
- Time Set (4) (page 4-103)



10609-41

FIGURE 4-87

4

Units of Measure

Select the Units of Measure icon (1, Figure 4-88) under the Display Settings Menu Group to show the Units of Measure function screen.

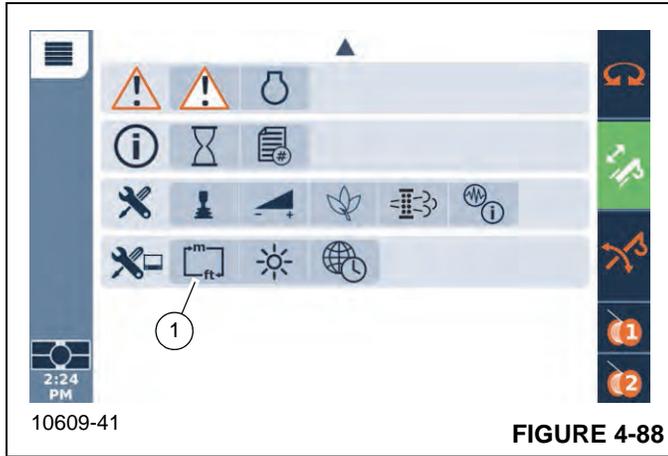


FIGURE 4-88

Display Screen Brightness

Select the Display Screen Brightness icon (1, Figure 4-90) under the Display Settings Menu Group to show the Display Screen Brightness function screen.

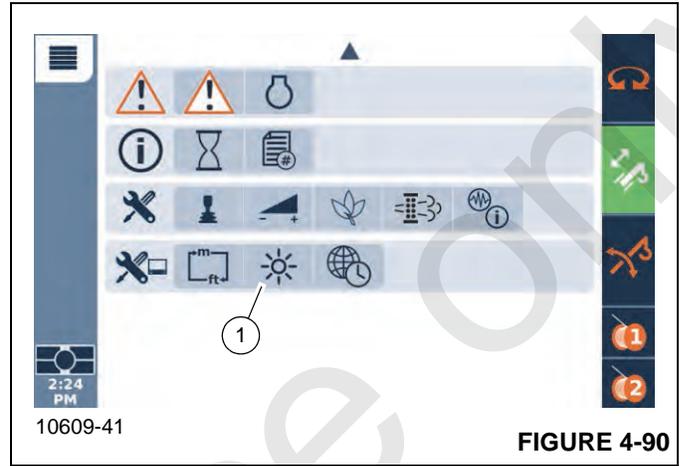


FIGURE 4-90

The Units of Measure function screen (Figure 4-89) allows the operator to change the units of measure (metric/imperial) that are used throughout the ODM and RDM.

The Display Screen Brightness function screen (Figure 4-91) allows the operator to adjust the brightness of the ODM and RDM display screens.

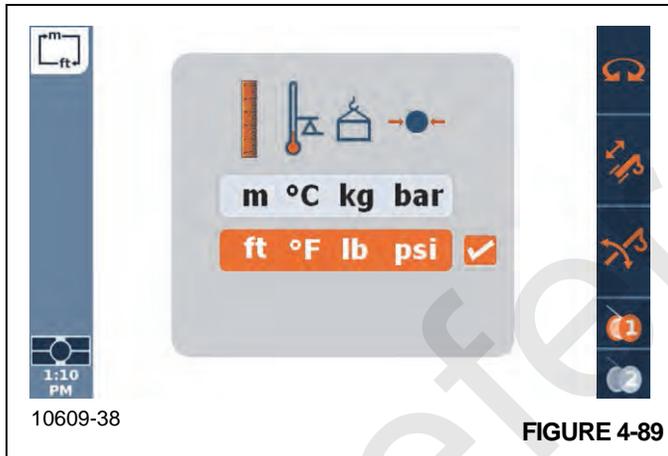


FIGURE 4-89

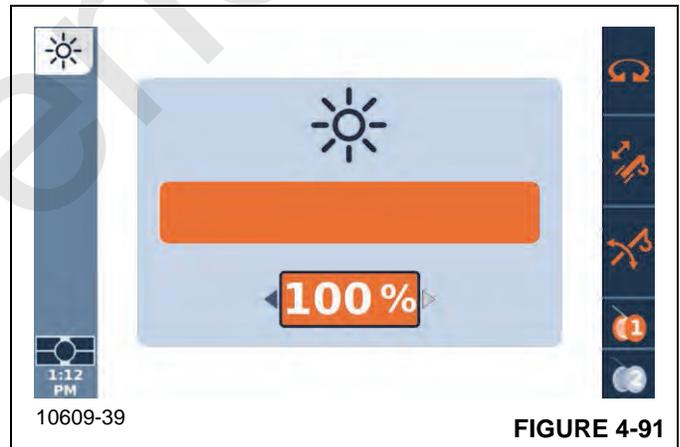


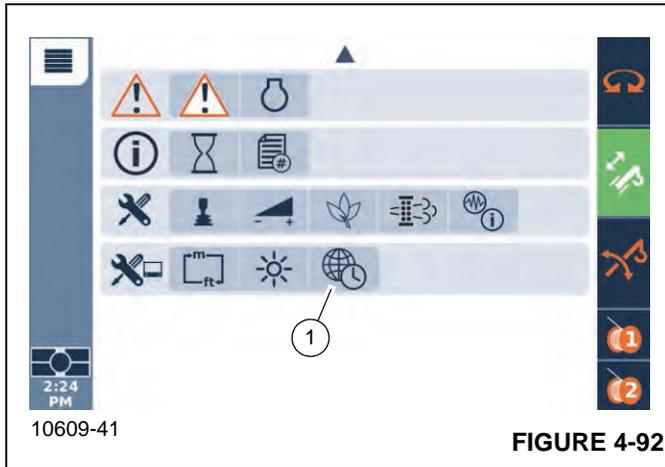
FIGURE 4-91

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.

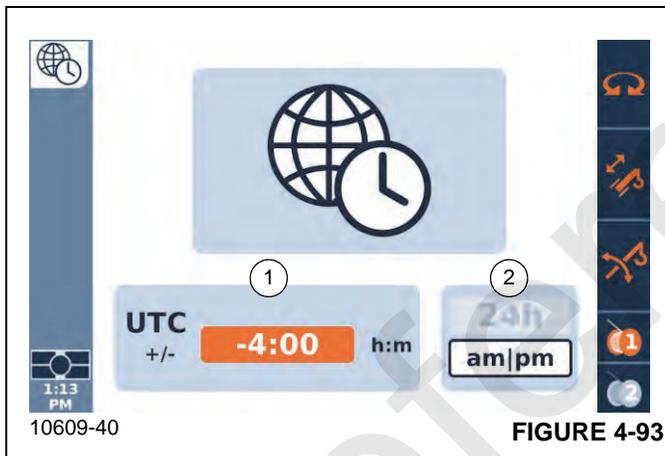
Press the Jog Dial or OK Button on the Navigation Control Pad, then use the Jog Dial or Arrow Buttons to increase or decrease the screen brightness. Once the desired value is selected, press the Jog Dial or OK Button to accept the value.

Time Set

Select the Set Time icon (1, Figure 4-92) under the Display Settings Menu Group to show the Time Set function screen.



The Time Set function screen (Figure 4-93) allows the operator to set the time and the time format that is displayed on the ODM and RDM screens.



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:

1. Using the Jog Dial or Arrow Buttons on the Navigation Control Pad, select the UTC Offset field (1, Figure 4-93).
2. Press the Jog Dial or the OK Button.
3. Turn the Jog Dial or press the Up/Down Arrow Buttons until the correct UTC Offset is shown.
4. Press the Jog Dial or OK Button to accept the value.
5. Using the Jog Dial or Arrow Buttons, select the Time Format field (2, Figure 4-93).
6. Press the Jog Dial or the OK Button.
7. Using the Jog Dial or Arrow Buttons, select the desired time format, either 24 hour or AM/PM.
8. Press the Jog Dial or OK Button to accept the value.

USING THE RATED CAPACITY LIMITER DISPLAY MODULE (RDM)

Operators must completely read and understand this section before operating the crane.

NOTE: A description of the RDM can be found under *Rated Capacity Limiter Display Module (RDM)*, page 3-18.

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 visual and audible warnings, and locks out the controller functions to prevent raising and lowering the boom, extending the boom, swinging left or right, or raising the main or optional auxiliary 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 4-94) appears on the RDM when the ignition key is set to the On position.

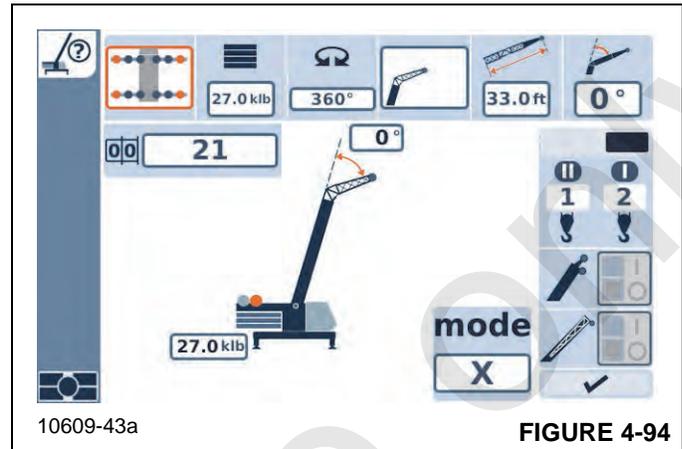


FIGURE 4-94

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. The setup screen is also used to select the telescope mode, to include A, X, B, and M. Refer to the section titled *Telescoping the Boom*, page 4-23 for a description of the telescope modes.

Programming the RCL using the RCL Setup Screen

For a complete rigging code input, operator must enter, confirm and accept the rigging code and the reeving.

There are two methods of entering the current rigging mode.

- Either enter the individual components (1 to 8, Figure 4-95) one after the other.

- Or enter the rigging code (9) and the reeving (8).

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 rigging code, refer to *Entering the Rigging Code using the Direct Entry Method*, page 4-109.

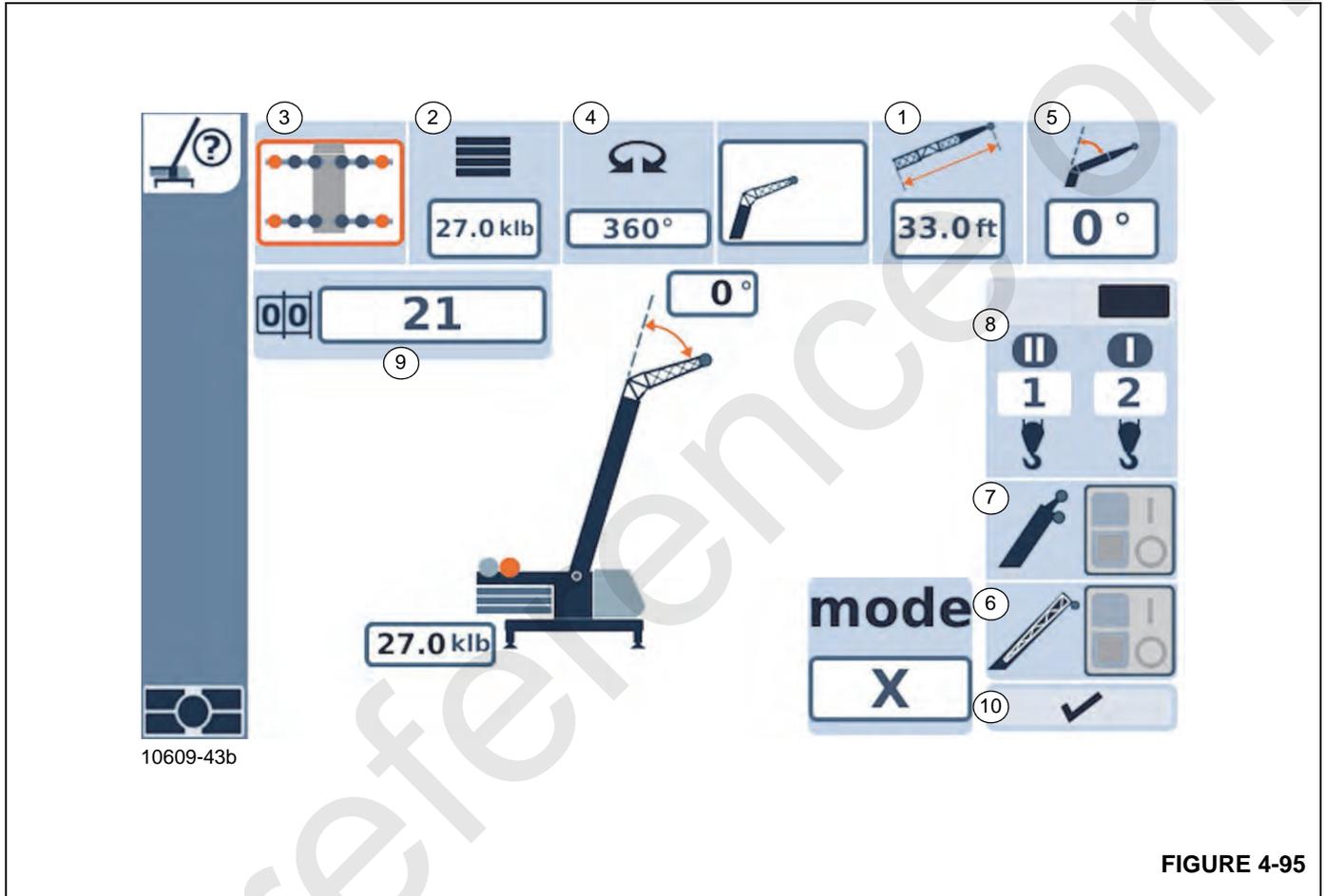


FIGURE 4-95

Entering Individual Components using the Setup Wizard

With this type of input, the operator selects all of 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 4-96)
- Boom system (1)
- Outrigger span (3)

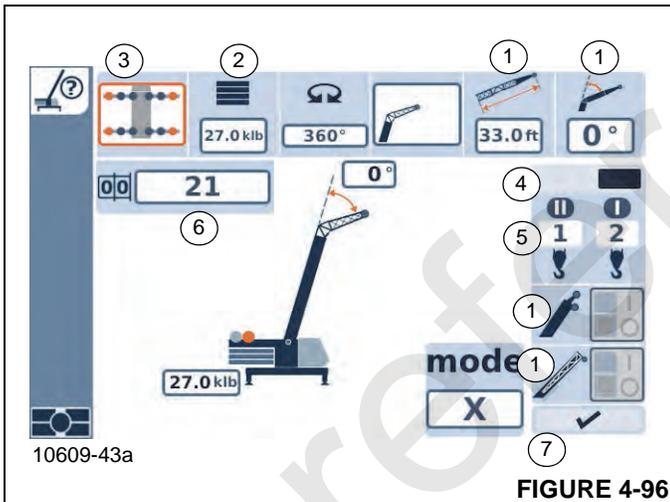


FIGURE 4-96

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 rigging 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 and Selecting Values

- A configuration component is selected when its symbol is orange.

Rotate the Jog dial (1, Figure 4-97) or push the arrow buttons (2) at the RDM Navigation Control Pad until the desired configuration component is selected (becomes orange) (1 to 8, Figure 4-98).

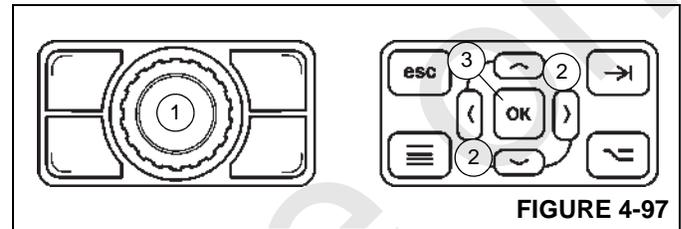


FIGURE 4-97

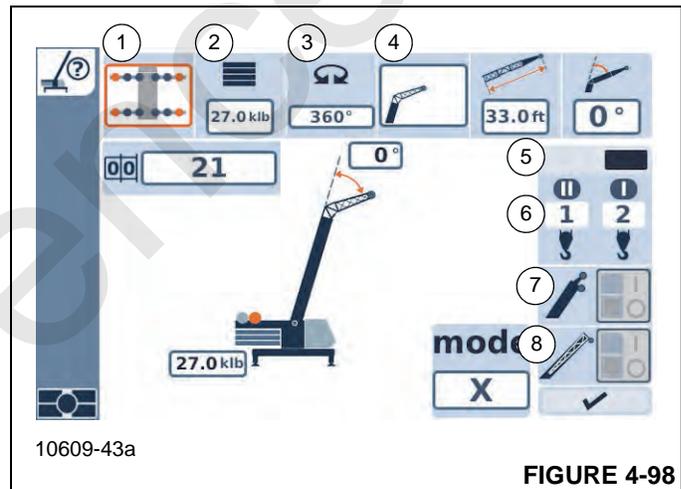


FIGURE 4-98

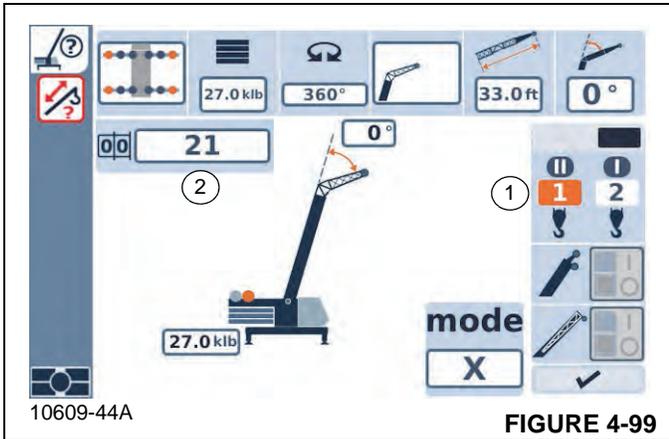
- Once selected, go in to the Input Mode by pressing the Jog Dial (1, Figure 4-97) or the OK button (3) at the RDM Navigation Control Pad.

Direction arrows will appear around the configuration component symbol to confirm that it is in the Input Mode.

With the Input Mode switched on, the operator can select values that are permissible according to the *Load Chart Manual*.

The selection process is described using reeving as an example.

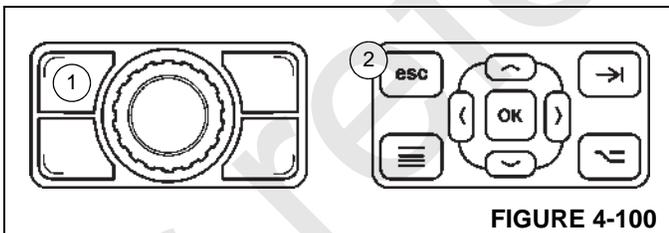
- Using the procedures above, select the Auxiliary Hoist Reeving configuration component (1, Figure 4-99), then go in to the Input Mode.



- Rotate the Jog dial (1, Figure 4-97) or press the arrow buttons (2) at the RDM Navigation Control Pad until the desired reeving value is selected.
- Confirm the selection by pressing the Jog Dial (1, Figure 4-97) or the OK button (3) at the RDM Navigation Control Pad.

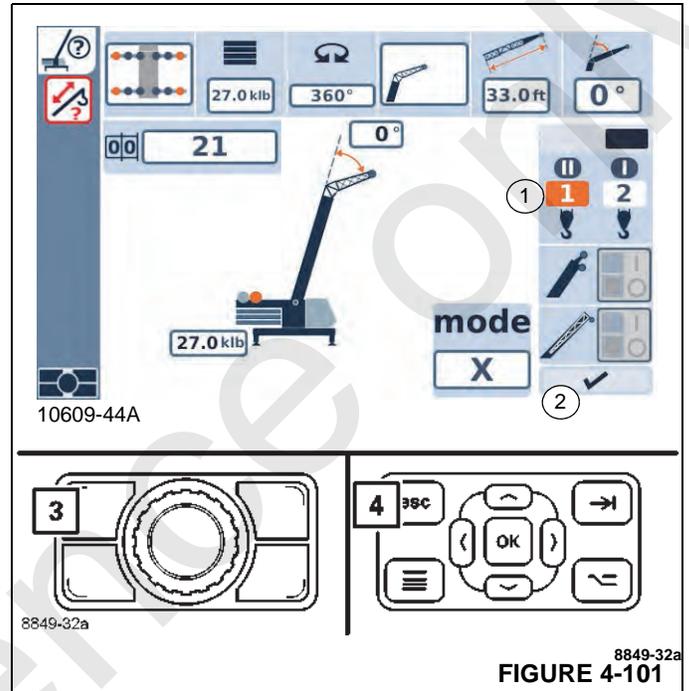
The display shows the corresponding RCL code (2, Figure 4-99).

NOTE: While in the Input Mode, the operator can cancel the input at any time by pressing the ESC button at the Jog Dial (1, Figure 4-100) or at the RDM Navigation Control Pad (2).



After the selection procedure, there are three options:

- Cancel input mode:
 - Press the button (3, Figure 4-101) or (4) once – the Setup Screen is opened.

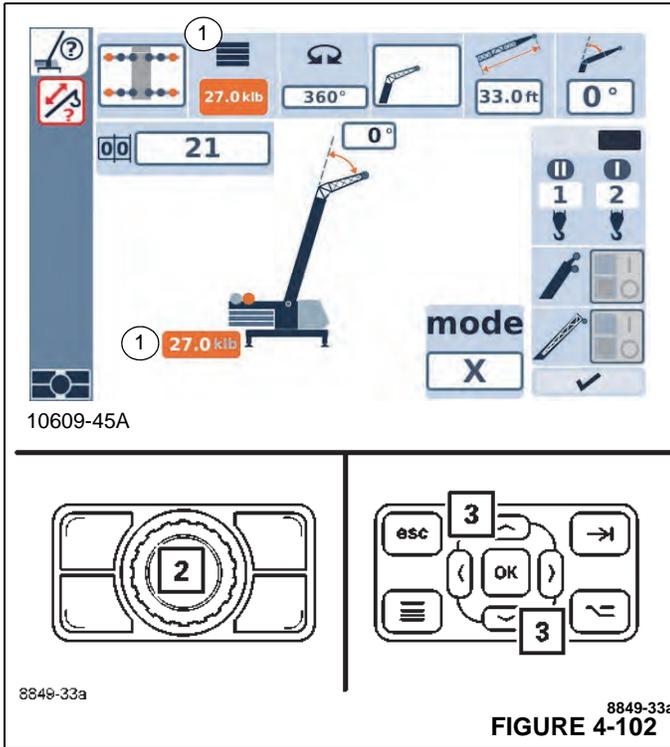


- Switching over the input mode:
 - Select and confirm a symbol (1) for the next component – symbol orange.
- Accept the displayed rigging mode:
 - Select and confirm the symbol (2), refer to *Accepting the Rigging Code, page 4-110.*

Enter the other components of the current rigging mode in the same way.

Counterweight

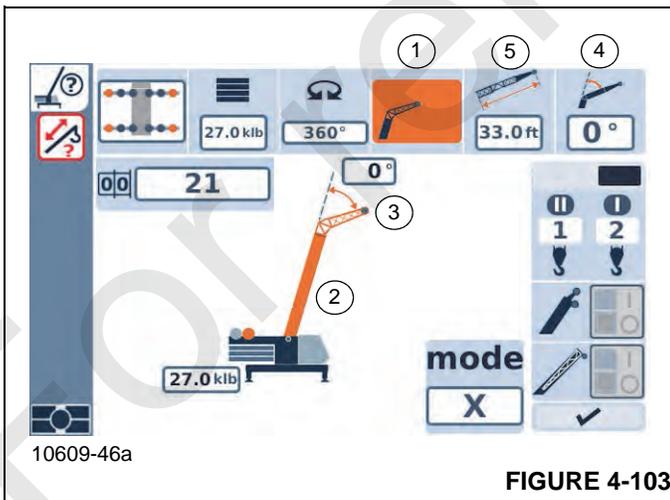
- Select and confirm the symbol (1, Figure 4-102).



- Use the buttons (2) or (3) to select the required counterweight combination, e.g. 27.0 klb.
- Confirm the selection.

Boom System

- Select and confirm the symbol (1, Figure 4-103).



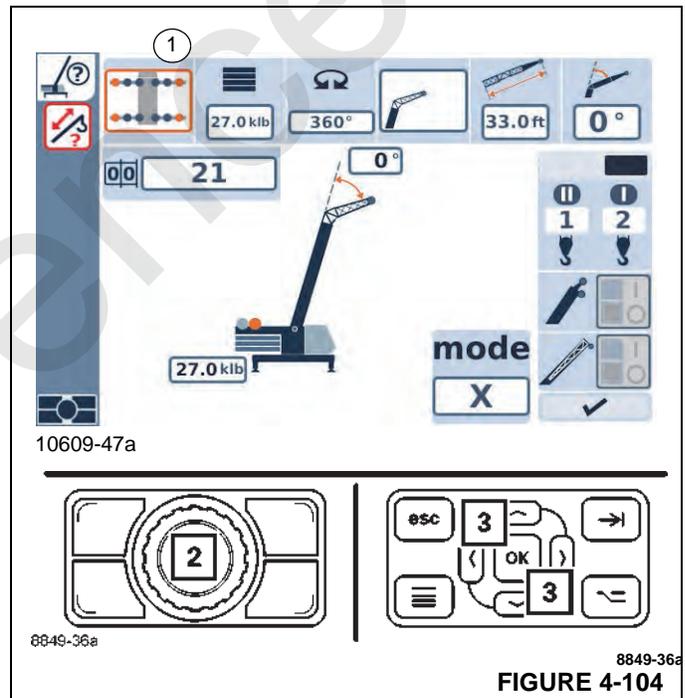
- Use symbol (1, Figure 4-103) to select the rigged boom system.

2	Main boom
3	Main boom with boom extension
4	Angle of the manual boom extension
5	Length of boom extension

- Confirm each selection.

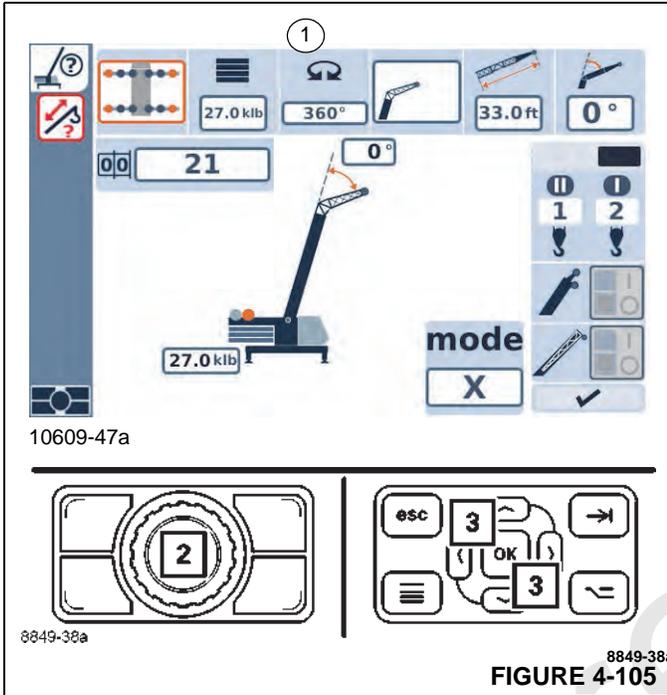
Outrigger Span

- Select and confirm the symbol (1, Figure 4-104).
- Use the buttons (2) or (3) to select the rigged outrigger span.
- Confirm the selection.



Swing Range

- Select and confirm the symbol (1, Figure 4-105).
- Use the buttons (2) or (3) to select the required swing range, e.g. 360°.
- Confirm the selection.



Entering the Rigging Code using the Direct Entry Method

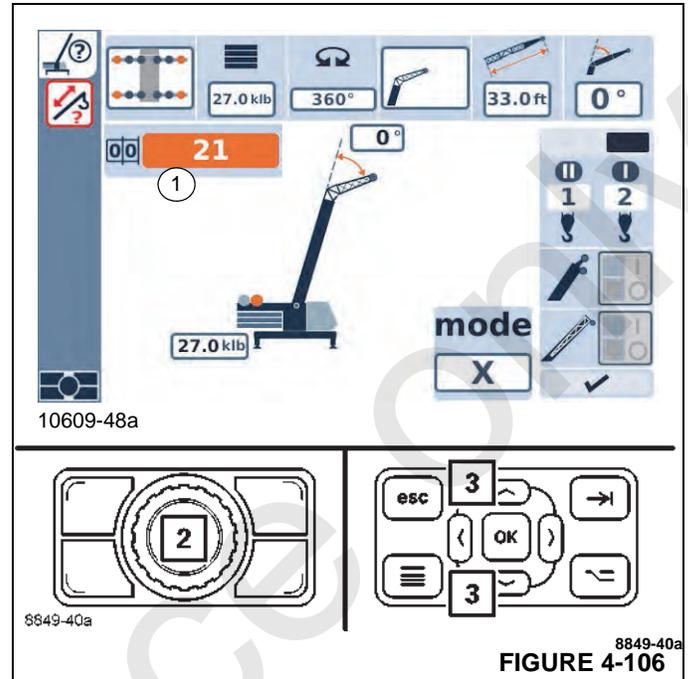
The operator can program the Rated Capacity Limiter (RCL) by directly entering the rigging code taken from the *Load Chart Manual*.

Refer to the *Load Chart Manual* for the proper rigging code for the current crane configuration.

Operator enters the rigging code directly in to the RCL following the same procedure used to enter the individual crane components (see *Switching on Input Mode and Selecting Values*, page 4-106 under the section titled *Entering Individual Components using the Setup Wizard*, page 4-106).

Directly enter the rigging code in the following manner:

- Select and confirm the symbol (1, Figure 4-106).
- Use the buttons (2) or (3) to select the required rigging code.
- Confirm the selection.

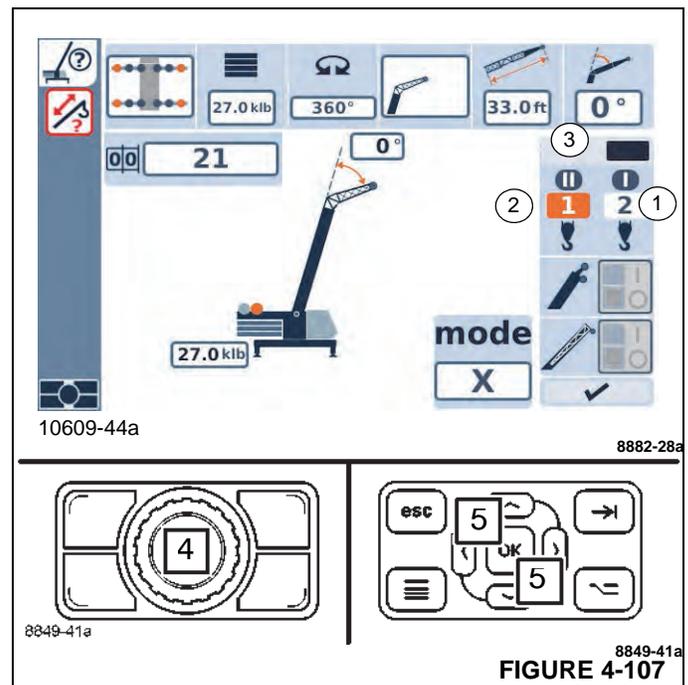


The other displays will show the corresponding rigging mode.

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 4-107) over the top of the hoist that is to be used. Example screen shot in Figure 4-107 shows the Auxiliary Hoist is selected.

I	Symbol for main hoist
II	Symbol for auxiliary hoist

- Confirm the selection.
- Use the buttons (4, Figure 4-107) 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.

- Select the symbol (1, Figure 4-108).
- Confirm the selection.

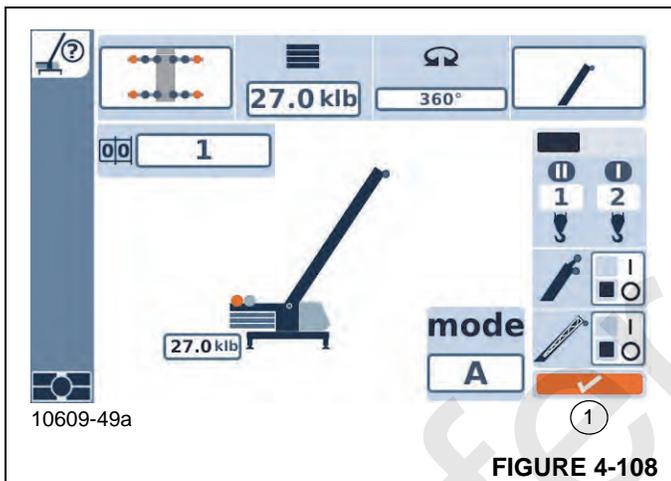


FIGURE 4-108

The Monitoring Screen 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.

Overriding the Outrigger Monitoring System

Refer to the section titled *Outrigger Monitoring System (OMS) (Optional—Standard in North America and European Union Countries)*, page 4-20 for a description of the OMS.

The outrigger span is monitored when the Outrigger Monitoring System (OMS) is installed. The operator must check the outrigger span when entering the rigging code.

If the OMS detects that one or more outrigger beams are extended to a position that does not match the outrigger beam configuration defined by the programmed rigging code, the Outrigger Beam Override Warning Screen will show.

NOTE: The OMS requires the measured length of the outrigger beam position to be within $\pm 3\%$ of the target outrigger position to be recognized as a valid setup.



DANGER

Crane Tipping Hazard!

When the OMS system is overridden, the RCL will not provide protection from overload. Death or serious injury will result if the crane tips over.

The operator is responsible for ensuring that the crane is not overloaded or operated in excess of the allowable published capacities for the actual outrigger configuration.

A qualified person shall be consulted to determine if any capacity reductions, special operating procedures, or limitation are required.

The Outrigger Beam Override Warning Screen shows red dots for the outrigger beam positions that are defined by the rigging code. Also, the warning screen shows color coded dots (which match the color painted on top of the actual outrigger) for the outrigger beam positions that are detected by the OMS. When the horizontal outrigger position detected by the OMS matches the outrigger position defined by the rigging code, only a color coded dot will show and the Outrigger Percentage Extended field will show in black text. When the two do not match, both a red and a color coded dot will show and the Outrigger Percentage Extended field will show in red text.

The operator has the choice to either 1) Click the RCL Setup Screen icon (2, Figure 4-109) to return to the RCL Setup Screen to change the rigging code selection –OR– 2) Override the OMS by clicking the Outrigger Beam Override icon (1, Figure 4-109) to confirm that the selected outrigger beam positions are to be used even though they do not match the OMS detected outrigger positions. Once the Outrigger Beam Override icon has been clicked, the screen transitions to the RCL Monitoring Screen (see *Using the RCL Monitoring Screen*, page 4-116).

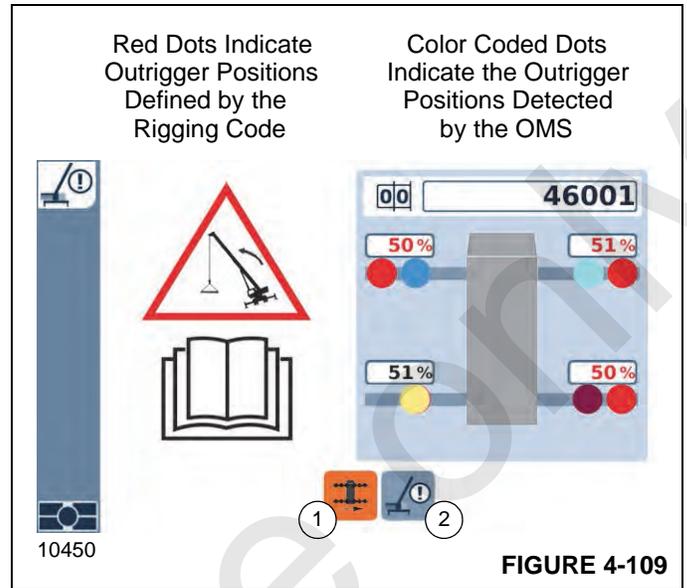


FIGURE 4-109

Load Chart Alerts and Other Alerts

Refer to Figure 4-110 for a list of alerts and their definitions that can show at the top of the RCL Monitoring Screen of the RDM.

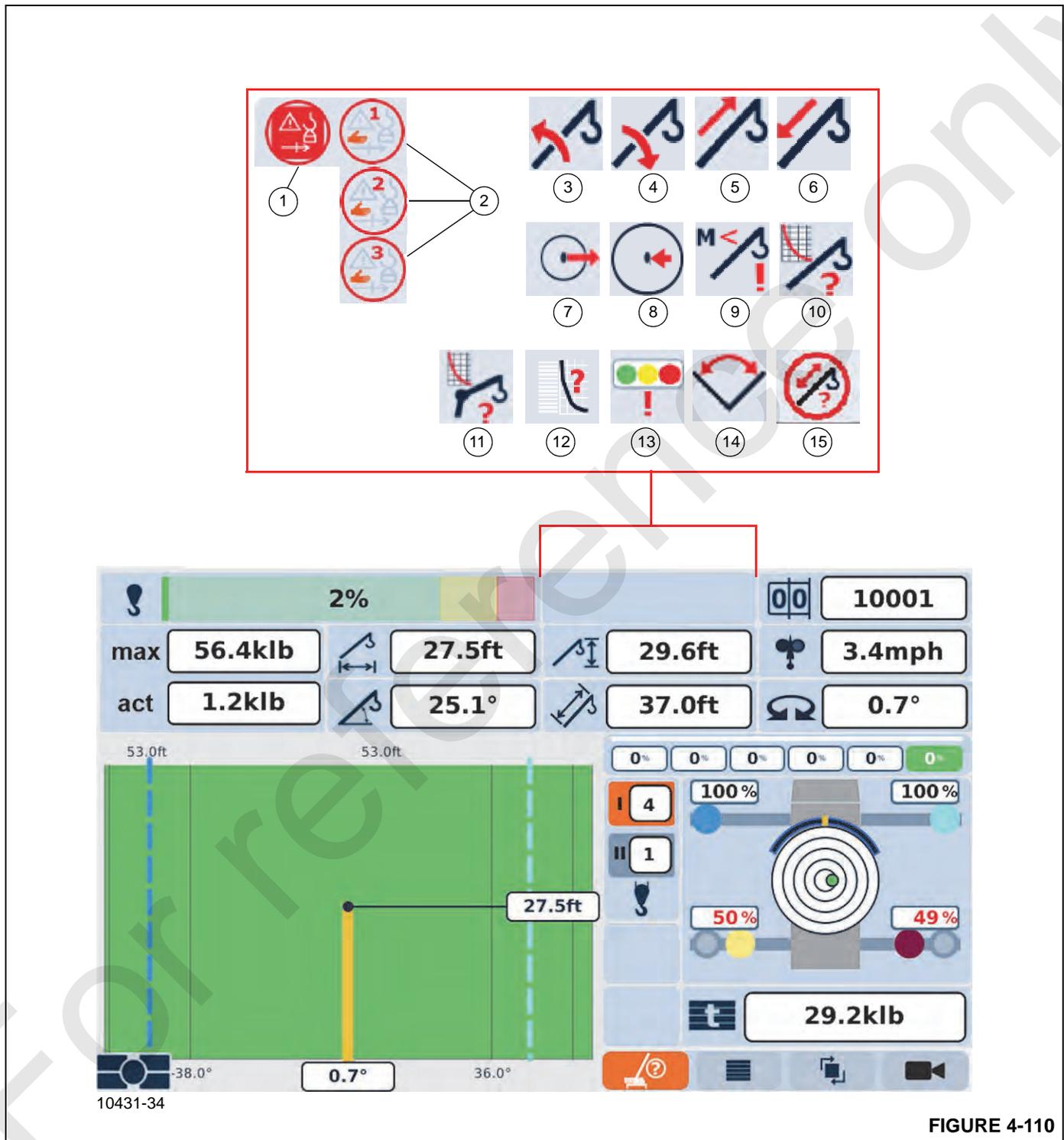


FIGURE 4-110

Item	Description	Graphic	Explanation
1	RCL Bypass Active Alert (Red - Constant On)		Indicates the RCL system is bypassed
2	Bypass 1 Pressed Alert (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 3-9 or <i>Limit Bypass Set-Up Switch (CE Certified Cranes)</i> , page 3-10 for more information on the switch's operation.
	Bypass 2 Pressed Alert (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 3-11 for more information on the switch's operation.
	Bypass 3 Pressed Alert (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 3-37 or <i>Bridging Switch (CE Certified Cranes)</i> , page 3-42 for more information on the switch's operation.
3	Boom Angle Too High Alert		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 Alert		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 Alert		Indicates the boom length is longer than the last length of the selected load chart.
6	Boom Length Too Short Alert		Indicates the boom length is shorter than the first length of the selected load chart.
7	Radius Too Long Alert		Indicates the radius is greater than the maximum radius in the selected load chart.

Item	Description	Graphic	Explanation
8	Radius Too Short Alert		Indicates the radius is smaller than the minimum radius in the selected load chart.
9	Load Too Small Alert		Indicates the load is smaller than the minimum load in the selected load chart
10	Boom - No Load Chart Alert		Indicates the main boom load chart is not available for the given crane configuration.
11	Boom Extension - No Load Chart Alert		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 Alert		Indicates there is no load chart found for the given crane configuration (off chart).
13	Status Light Bar Alert (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 Grove Product Support to those service technicians who have attended the Grove New Technology training course.
14	Swing Left/Right Stop Alert		Indicates the boom angle is at a left or right swing angle limit defined by the selected load chart.
15	Boom Out-of-Sequence Alert		Indicates the boom is out-of-sequence.

Overriding the Rated Capacity Limiter



DANGER

Crane Tipping Hazard!

When the RCL system is overridden, the RCL system will not provide protection from overload. Death or serious injury will result if the crane tips over.

The operator is responsible for ensuring that the crane is not overloaded or operated in excess of the allowable published capacities for the actual crane configuration.

In an emergency situation only, one of the Limit Bypass Switches can be used to bypass the different limiter systems on the crane. Refer to the following pages for information regarding the operation of these switches:

1. *Momentary Limit Bypass Switch (Non-CE Certified Cranes)*, page 3-9
2. *Limit Bypass Set-Up Switch (CE Certified Cranes)*, page 3-10

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 3-37
4. *Bridging Switch (CE Certified Cranes)*, page 3-42

When a Limit Bypass Switch is actuated, the following indicators (1 and 2, Figure 4-110) on the Rated Capacity Limiter Display Module (RDM) come on to confirm that the limiters are bypassed.

Using the RCL Monitoring Screen

Upon programming and confirming the rigging code using the RCL Setup Screen, the RCL Monitoring Screen will appear and show the following crane configuration information (Figure 4-111).

The Side Crane View (24, Figure 4-111) is the default screen variation shown on the RCL Monitoring Screen. The Monitoring Screen can be switched to show the Panorama

View (24, Figure 4-112), which is a screen variation that can further aid the operator in monitoring the status of the crane's capacity (see *Panorama View*, page 4-118).

NOTE: On cranes equipped with the optional MAXbase feature, the Side Crane View screen variation is not available when a MAXbase rigging code is programmed in to the RCL. The Side Crane View is available when a non-MAXbase code is selected.

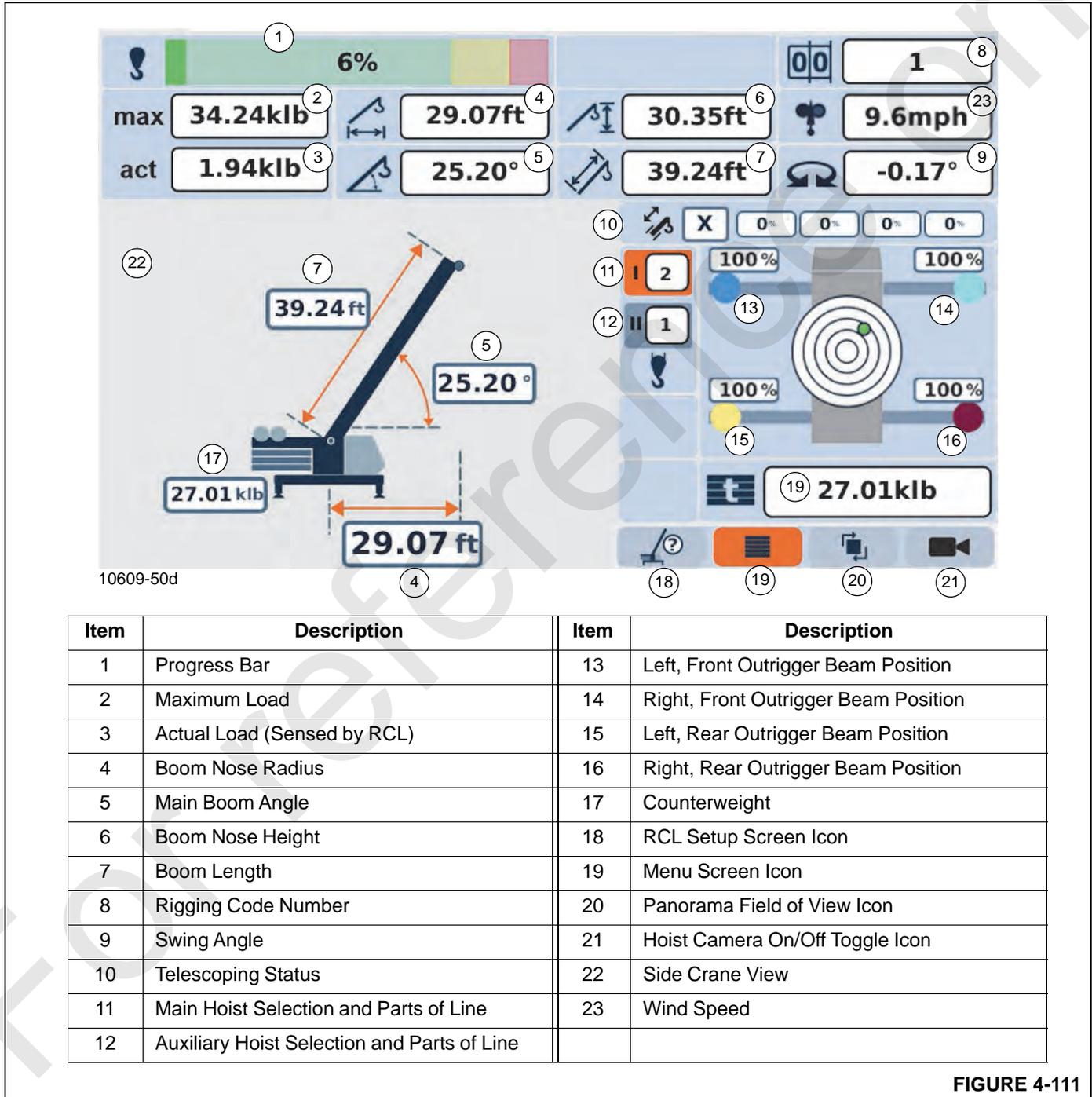
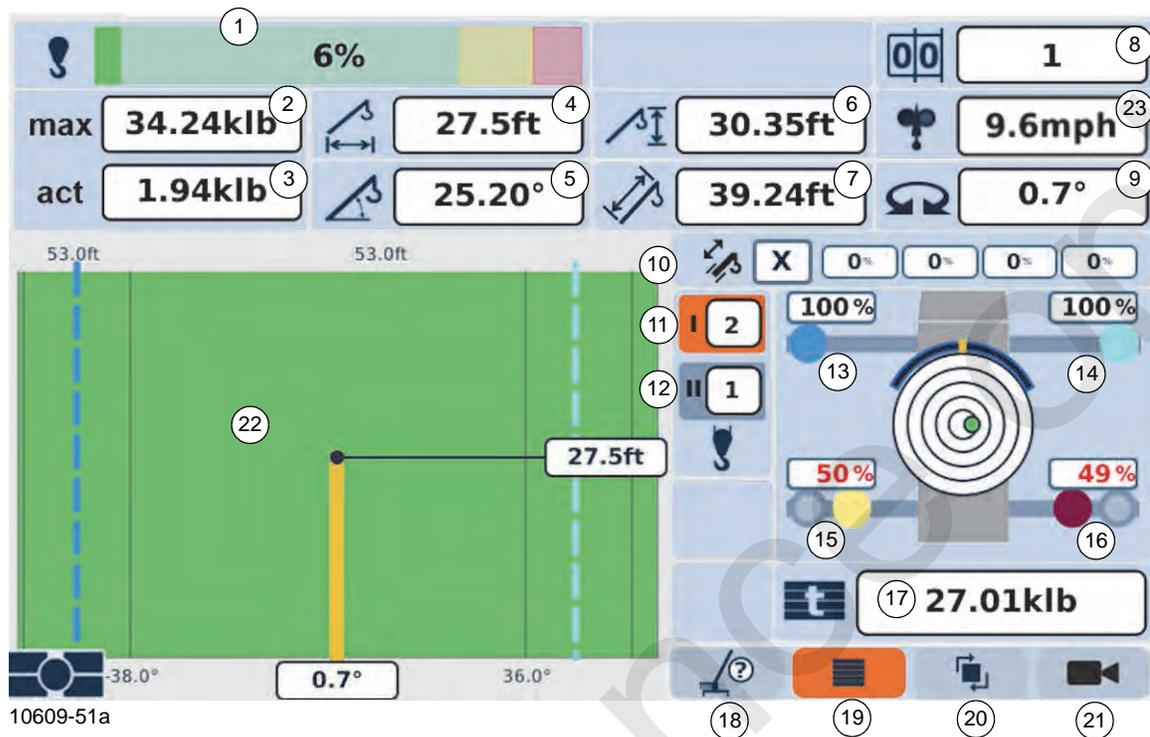


FIGURE 4-111



Item	Description	Item	Description
1	Progress Bar	13	Left, Front Outrigger Beam Position
2	Maximum Load	14	Right, Front Outrigger Beam Position
3	Actual Load (Sensed by RCL)	15	Left, Rear Outrigger Beam Position
4	Boom Nose Radius	16	Right, Rear Outrigger Beam Position
5	Main Boom Angle	17	Counterweight
6	Boom Nose Height	18	RCL Setup Screen Icon
7	Boom Length	19	Menu Screen Icon
8	Rigging Code Number	20	Panorama Field of View Icon
9	Swing Angle	21	Hoist Camera On/Off Toggle Icon
10	Telescoping Status	22	Panorama View
11	Main Hoist Selection and Parts of Line	23	Wind Speed
12	Auxiliary Hoist Selection and Parts of Line		

FIGURE 4-112

The progress bar (1, Figure 4-111 and Figure 4-112) is shown in the upper, left corner of the Monitoring Screen. Directly below it is the maximum allowable load (2) and the measured load or “act” load (3). The ratio of these loads is computed as a percentage and is displayed in the progress bar (1). The progress bar is filled according to this value. The color of the bar changes to yellow at 90% capacity and red at 100% capacity. The bar is completely filled at 110% capacity.

Additional RCL information is provided in boxes. The following information is shown:

- Boom Nose Radius (4)
- Main Boom Angle (5)
- Boom Nose Height (6)
- Boom Length (7)
- Rigging Code (8)
- Swing Angle (9)

The telescoping status (10, Figure 4-111 and Figure 4-112) is also shown on the RCL Monitoring Screen. The position of each boom section (Tele 1 through Tele 4) is shown, as a percentage, from left to right.

The Outrigger Monitoring System (OMS) status area shows the outrigger jacks as circles (13 thru 16, Figure 4-111 and Figure 4-112). The circles are color-coded to match the paint color on the top cap of each outrigger jack. The location of the circle is scaled using the percentage of beam extension from the OMS sensors. The Load Chart Rigging Code entered by the operator is read by the Crane Control System (CCS) and the target location of each outrigger is shown as a gray circle. If the target location does not match the measured location within the specified tolerance ($\pm 3\%$), the percentage text is shown in red (15 and 16, Figure 4-112).

The wind speed icon (23, Figure 4-111 and Figure 4-112) is black in color when wind speeds are below 15 mph. The icon color is yellow when the wind speed is between 15 mph and 30 mph. The buzzer comes on and the icon color is red when the wind speed is 30 mph or greater. Refer to the section titled *Wind Forces*, page 2-7 for information about determining safe operation in windy conditions.

Panorama View

MAXbase equipped cranes use different load charts throughout the crane’s 360° rotation; therefore, it is important for the operator to use the correct load chart from the *Load Chart Manual* for a given swing range. The Panorama View further aids the operator in monitoring the current boom swing angle and the crane’s load status (% of capacity) in that swing angle.

Multiple load charts are used by MAXbase to allow operation of the crane on non-symmetrically extended outriggers. In

general, there are four swing ranges defined by the position of the outrigger jacks. The load chart changes when the boom swings over each outrigger. In some cases the lifting capacities may not change because the limitations of the capacity are not related to the outrigger position. In other cases the change in the lifted capacity may be large, or swinging into the next range may not be permitted. In this case the Crane Control System (CCS) will override the operators swing command and may apply braking to stop the boom and load from swinging into another swing range (for more information on how and when CCS affects the swing motion, refer to *Limiting the Swing Speed Based on Utilization*, page 4-124 and *Stopping the Swing Motion*, page 4-122).

The Panorama View on cranes with and without the MAXbase option has two screen variations: a 120° Panorama View (Figure 4-113) and a 360° Panorama View (Figure 4-114).

The two Panorama Views show the location of the boom tip as a black circle (8, Figure 4-113 and Figure 4-114) and gives a top view of the working range of the crane based on the current status of the crane.

The two Panorama Views show a color plot of the swing angle (on the horizontal axis – 2, Figure 4-113 and Figure 4-114) and the load radius (on the vertical axis – 1).

The limits of the swing area are shown in the Panorama Views as a dark blue arc (7, Figure 4-113 and Figure 4-114) around the digital bubble level. The 120° Panorama View shows a 120° swing range limit and the 360° Panorama View shows a 360° swing range limit.

NOTE: The Crane Side View is not available on the RCL Monitoring Screen when a MAXbase Rigging Code is selected.

Late model cranes and MAXbase equipped cranes use color-coded circles (3 thru 6, Figure 4-113 and Figure 4-114) to represent each of the outrigger jacks in the OMS Status Area of the RCL Monitoring Screen. The color of the outrigger jack circle on the RCL Monitoring Screen matches the color painted on the top of the outrigger jack. The same color is displayed in the Panorama Views as a vertical dashed line. The vertical dashed lines correspond to the swing angle at which the boom crosses over each of the color-coded outrigger jacks. This visual system gives the operator the ability to relate the information on the Panorama Views to the crane’s actual boom swing angle.

The 120° Panorama View (Figure 4-113) is the default view that is shown in the Monitoring Screen when a MAXbase rigging code is selected. To show the 360° Panorama View (Figure 4-114), select the Panorama Field of View Icon (12). To change back to the 120° view, select the Panorama Field of View Icon again.

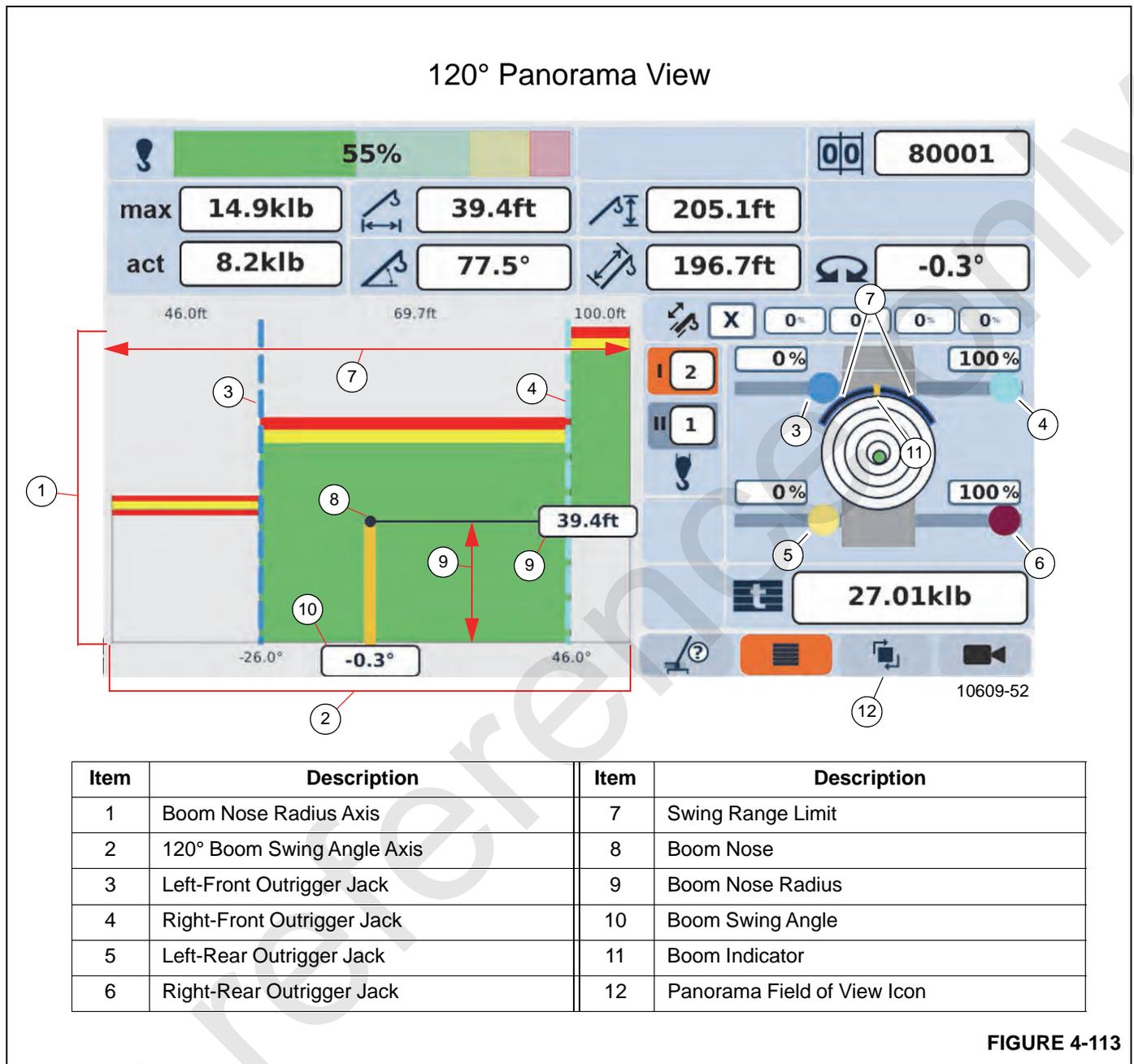
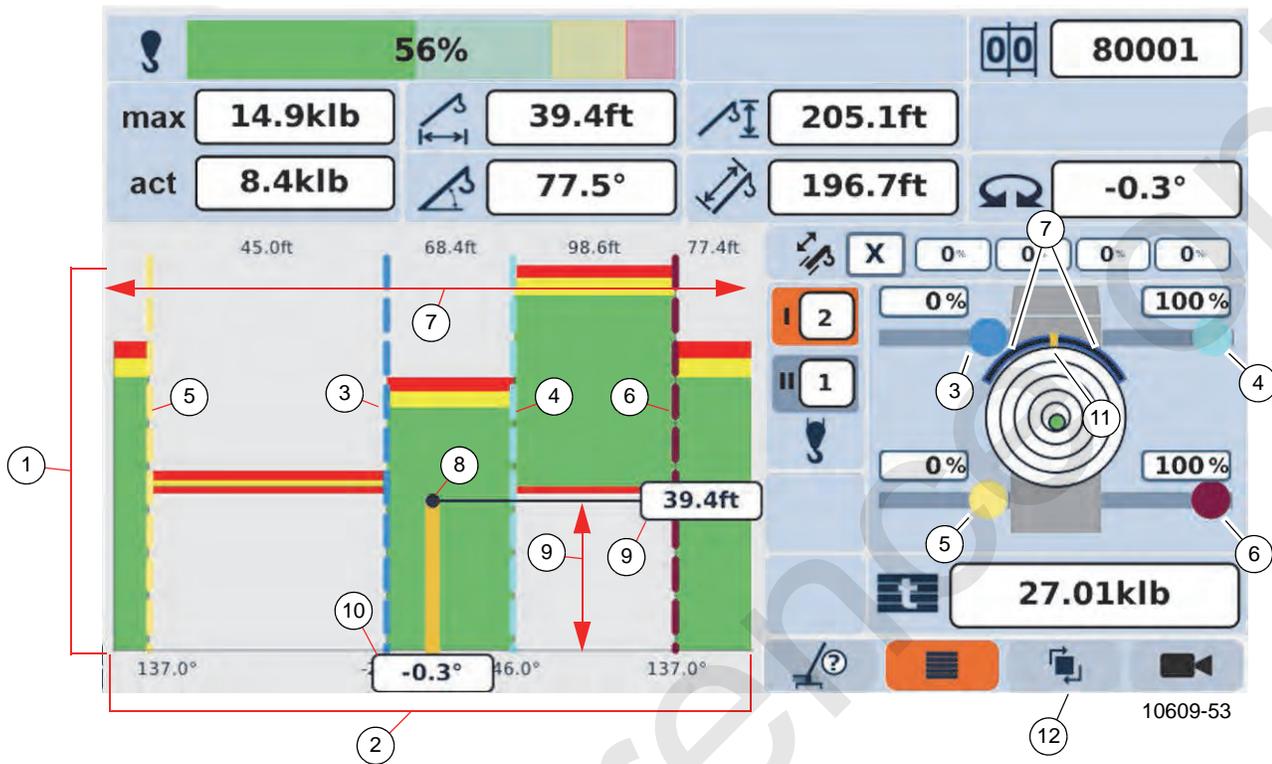


FIGURE 4-113

360° Panorama View



Item	Description	Item	Description
1	Boom Nose Radius Axis	7	Swing Range Limit
2	360° Boom Swing Angle Axis	8	Boom Nose
3	Left-Front Outrigger Jack	9	Boom Nose Radius
4	Right-Front Outrigger Jack	10	Boom Swing Angle
5	Left-Rear Outrigger Jack	11	Boom Indicator
6	Right-Rear Outrigger Jack	12	Panorama Field of View Icon

FIGURE 4-114

The RCL system uses the boom length, the telescoping sequence, and the measured hook load to determine the minimum and maximum working radius allowed for the current hook load.

The radius where the hook load exceeds 90% utilization is indicated in yellow (1, Figure 4-115). The radius at which the hook load is beyond 100% is indicated in red (2).

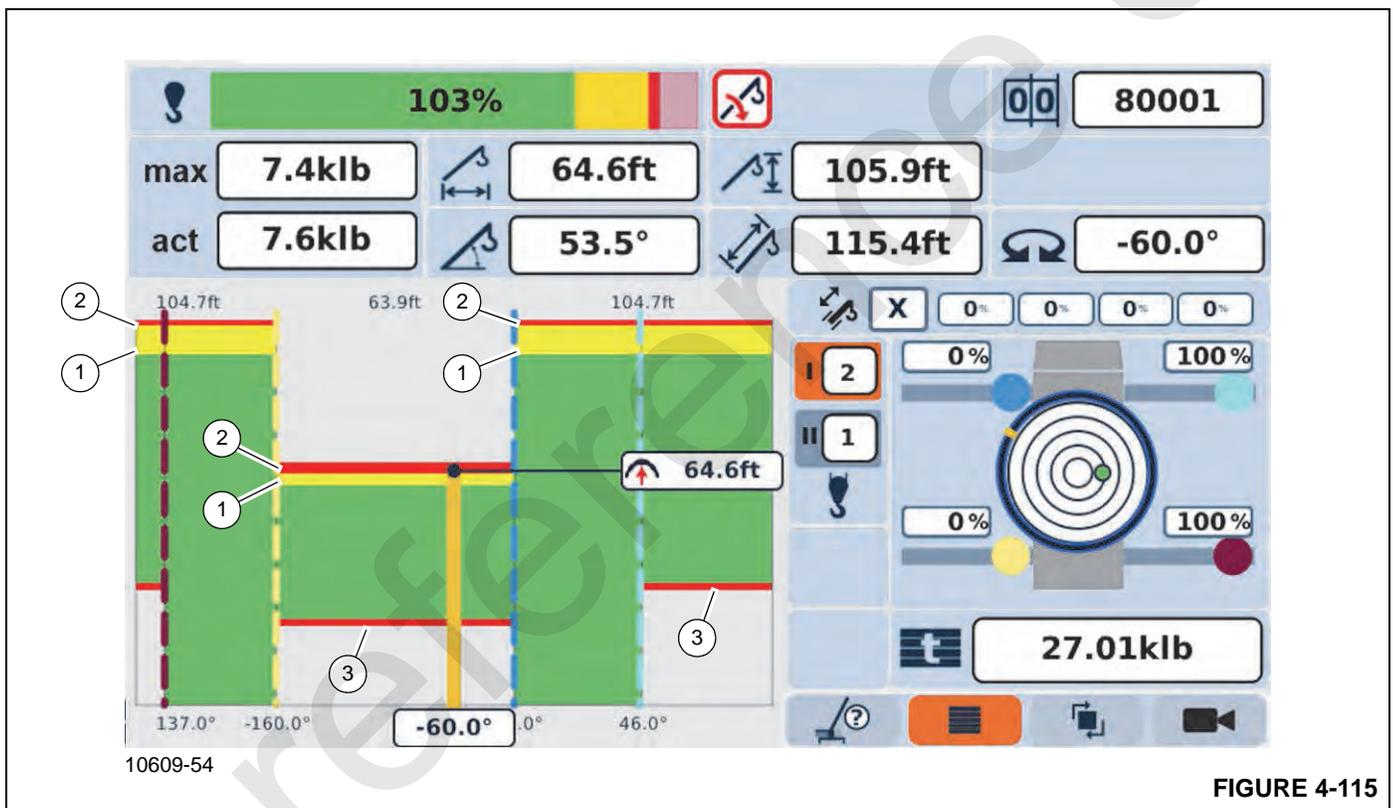
Some outrigger steps result in limitations of the working radius based on backward stability. In these cases the Panorama Views will show a red line at the minimum working radius (3, Figure 4-115).

The CCS system will slow and then stop motions that would cause the crane to decrease the load radius below the

minimum working radius. These motions include booming up or telescoping in.

CCS will also slow and stop swing motion that would result in the boom and load crossing into a swing range that is not permitted because of backward stability (for more information on how and when CCS affects the swing motion, refer to *Limiting the Swing Speed Based on Utilization*, page 4-124 and *Stopping the Swing Motion*, page 4-122).

When the CCS is stopping motions such as swinging left or right, booming up or down, and telescoping in or out, the RCL will show a related alert on the Monitoring Screen to warn the operator (refer to *Load Chart Alerts and Other Alerts*, page 4-112 for a list of all alerts and their definitions that can show).



Stopping the Swing Motion

When operating the crane with the Rated Capacity Limiter (RCL) programed to a MAXbase Rigging Code, the Crane Control System (CCS) may stop the swing motion in some conditions. To stop the swing motion in a smooth manner and prevent excessive side-loading of the boom, CCS performs the swing stop according to Figure 4-117.

The speed reduction slope is scaled based on the total rotational mass of the crane system. When the hook load is large or the radius is long, the angular distance for stopping increases. In some cases the maximum speed of the swing system will be limited.

When nearing a swing stop, the swing speed is limited to less than 0.8 degrees per second over the last 4 degrees of rotation. Speed is then reduced to 0 deg/s while still 1.0 degree from the stop target. The swing brake is also ramped on over the final 1.0 degree to the stop target.

The approximate swing speed of the crane is shown by the dashed line in Figure 4-117. To stop the swing motion, CCS may reduce the swing command below what is being commanded by the operator. In some conditions, CCS may also send a counter-swing command to reduce the swing speed according to the target lines shown.



WARNING

Crane Tipping Hazard!

The MAXbase swing motion stop function is an operational aid that should stop the swing motion before the boom enters a swing angle range that is unsafe for the crane's configuration or current load.

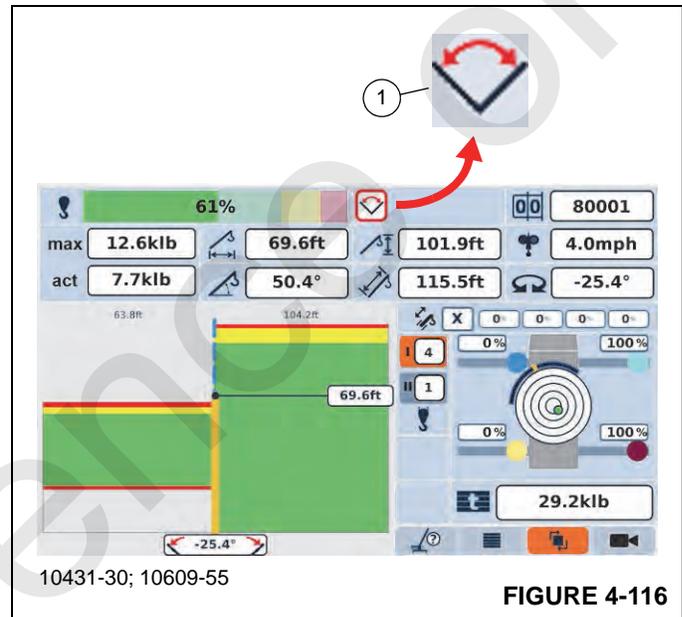
For the swing motion stop function to function properly the crane must be level to within 0.10° on the digital bubble level of the Operator Display Module (ODM).

At all times the operator can slow and stop the swing motion by doing the following:

- Further reduce the swing command
- Add counter-swing command (to stop faster)
- Add swing braking command (by the foot pedal)

When the CCS senses that the current boom swing angle is near a swing angle limit/range that is prohibited, the buzzer will make a slow intermittent sound. The buzzer will change to a fast intermittent sound when the current boom swing angle is within 5° of the prohibited swing angle limit/range. A constant buzzer sound will come on when the swing angle has reached the prohibited swing angle limit/range.

When the boom swing angle has reached the prohibited swing angle limit/range, the Swing Left/Right Stop Alert is shown in red at the top of the Monitoring Screen (1, Figure 4-116).





Limiting the Swing Speed Based on Utilization

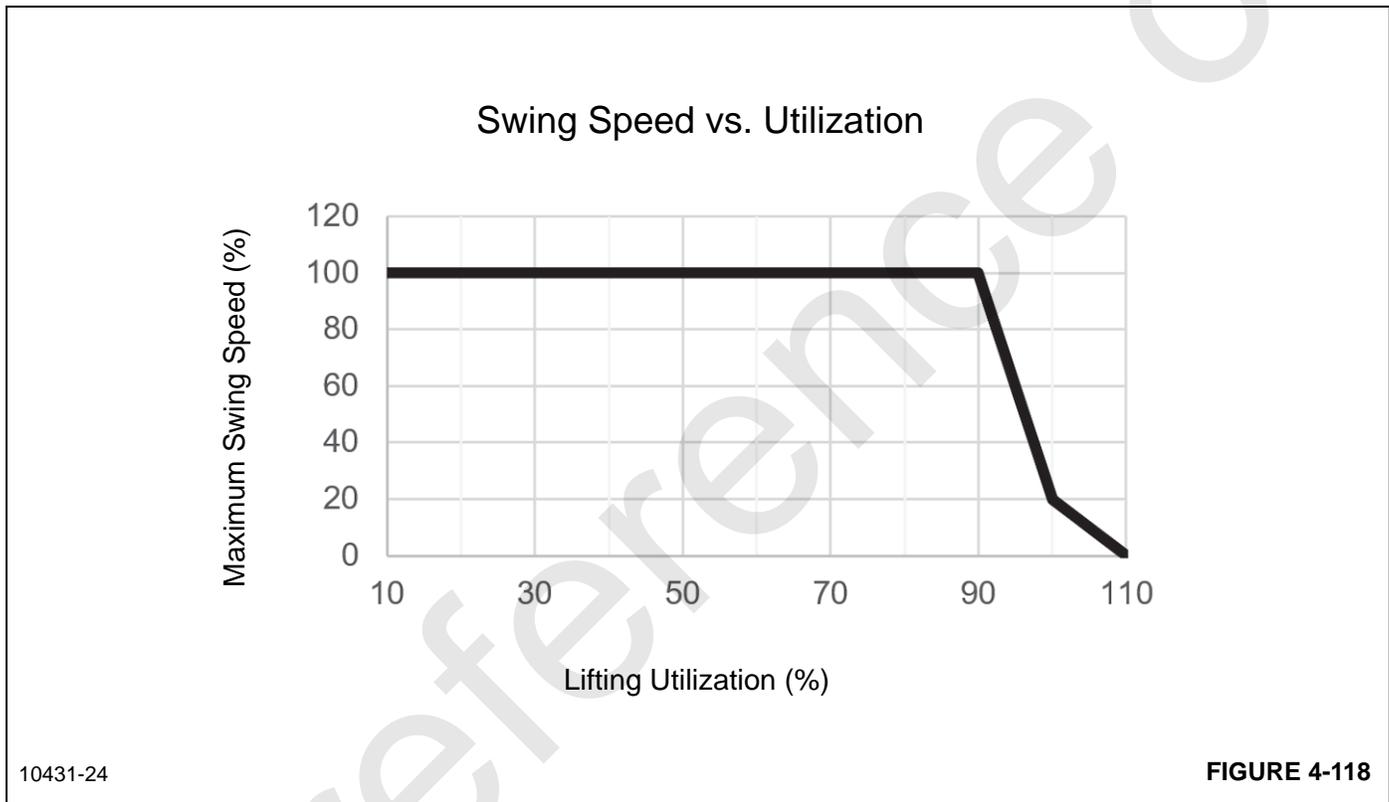
The Crane Control System (CCS) monitors the allowable hook load (shown as 'max' on the Monitoring Screen) and the measured hook load (shown as 'act'). The ratio of these values is shown as a percentage in the RCL Progress Bar. As the utilization of the crane approaches 100%, function speeds are limited to reduce the dynamic effect of stopping the swing motion. When swinging loads near 100% utilization, the swing speed is limited to 20% of the maximum speed (Figure 4-118). The swing motion is reduced to 0 deg/s when the utilization is 110%. This prevents the crane from suddenly stopping the swinging motion.



WARNING

Crane Tipping Hazard!

Deflection of the crane structure may result in the load radius increasing slightly while swinging. Be aware that maintaining the load radius may require booming up or telescoping in. Do not operate the crane above 100% capacity.



10431-24

FIGURE 4-118

MAXbase (Optional)

The optional MAXbase feature on the GRT8100-1 crane offers capacities for particular swing angles based on outrigger configuration as compared to a similar 360° Load Chart.

The MAXbase feature offers these capacities by using four different load charts throughout the crane's rotation. In comparison a standard 360° chart only uses one load chart. The MAXbase load charts calculate capacities based on four different swing angle ranges. This allows for increased capacities for some swing angle ranges based on the crane configuration when compared to another swing angle range. These swing angle ranges are identified in the MAXbase Load Charts and Rated Capacity Limiter (RCL) as follows:

- Over the Front
- Over the Rear
- Over the Sides
- Directly Over the Outriggers (± 10 Degrees)

The MAXbase feature also allows for the crane to be set up on outriggers that are not equally extended horizontally. This allows the crane to be more easily set up in work areas that have obstacles that may prevent the outriggers from being extended to equal horizontal lengths.

MAXbase Setup Screen

The same two methods used to program the Rated Capacity Limiter (RCL) Setup Screen on cranes without the MAXbase option are also used for cranes with the MAXbase option. These two programming methods include the following:

1. **Direct Rigging Code Entry** – operator enters the Rigging Code from the *Load Chart Manual* directly into the rigging code selection field (1, Figure 4-119)
2. **Setup Wizard** – operator selects each individual component configuration (2 through 5, Figure 4-119)

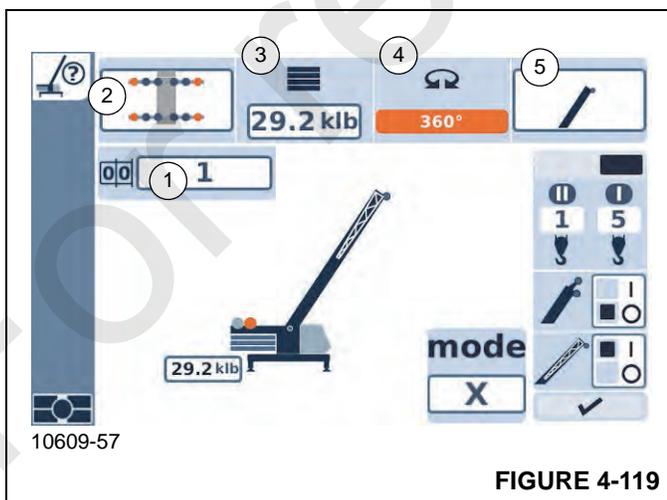


FIGURE 4-119

NOTE: The two programming methods are explained in detail under the section titled *Programming the RCL using the RCL Setup Screen*, page 4-105.

Differences in the RCL Setup Screen between cranes with the MAXbase option and those cranes without MAXbase include the following:

- MAXbase is a menu choice when programming the Swing Range selection field (1, Figure 4-120)
- Unequal Outrigger Configurations are menu choices when programming the Outrigger Configuration selection field (2, Figure 4-120)

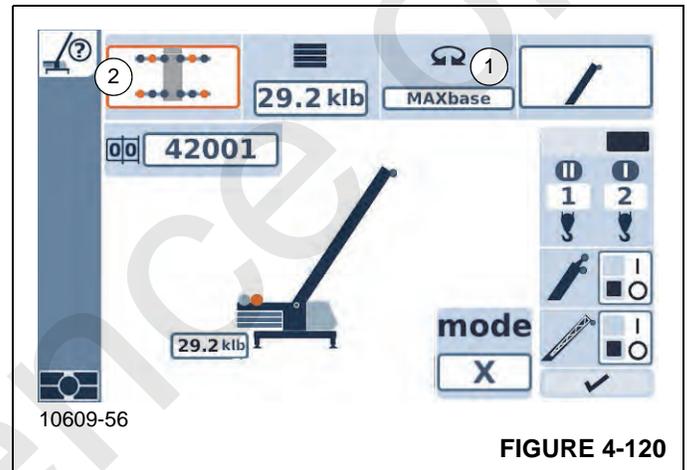


FIGURE 4-120

For MAXbase operations the operator can either use the Direct Rigging Code Entry method and enter a MAXbase Load Chart Rigging Code into the Rigging Code selection field (1, Figure 4-119) or use the Setup Wizard and select MAXbase in the Swing Range selection field (1, Figure 4-120).

When entering a MAXbase Load Chart Rigging Code directly, all of the component configurations (2 through 5, Figure 4-119) are automatically selected. When using the Setup Wizard and MAXbase is first selected in the Swing Range selection field (1, Figure 4-120), the RCL system will then limit the Outrigger Configuration selection field (2, Figure 4-120) to only MAXbase outrigger configurations. This limiting feature makes programming the RCL more efficient.

Once a MAXbase load chart has been selected, the operator must then complete the other RCL setup selections as needed (1 thru 4, Figure 4-121):

- 1 – Main or Auxiliary Hoist
- 2 – Parts of Line
- 3 – Auxiliary Boom Nose Installed
- 4 – Boom Extension Stowed on Main Boom

When all selections have been made, the operator must select and confirm the Check Box (5, Figure 4-121) to accept the programmed crane configuration.

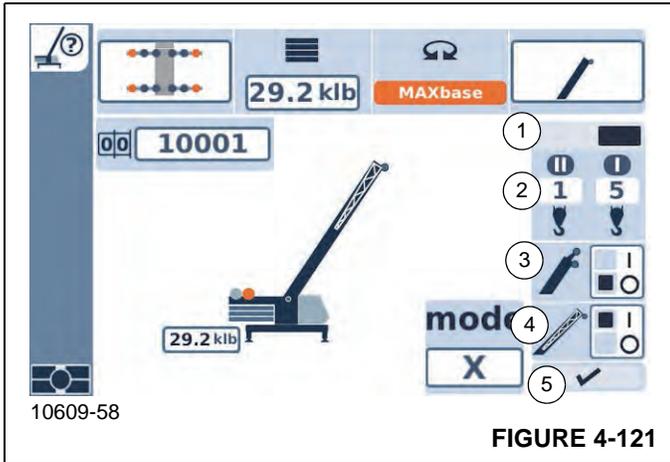


FIGURE 4-121

On cranes equipped with the Outrigger Monitoring System (OMS), upon accepting the programmed crane configuration the RCL will check to make sure the actual horizontal outrigger positions match the outrigger positions that were defined in the RCL Setup Screen. If the outrigger positions measured by the OMS do not match the outrigger positions defined in the RCL, then the Outrigger Beam Override Screen will show. Refer to the section titled *Overriding the Outrigger Monitoring System*, page 4-110 for information.

NOTE: When deploying the outriggers, the measured outrigger beam position must be within $\pm 3\%$ of the target outrigger position to be recognized as a valid setup.

For example: The three target outrigger positions are 100%, 50%, and 0%. If an outrigger beam is to be extended to 50%, the outrigger must be extended until its measured length is $50\% \pm 3\%$, or between 47% to 53%.

For a list of the supported MAXbase Load Charts and their outrigger configurations, refer to the section titled *MAXbase Load Charts*, page 4-126

MAXbase Load Charts

The MAXbase outrigger setups provided on the GRT8100-1 crane are shown on the Rated Capacity Limiter (RCL) Setup Screen in graphical form as a top view of the carrier with the front of the crane pointed upward on the picture (Figure 4-122). The orange dots represent the position of the outrigger jacks (100%, 50% or 0%).

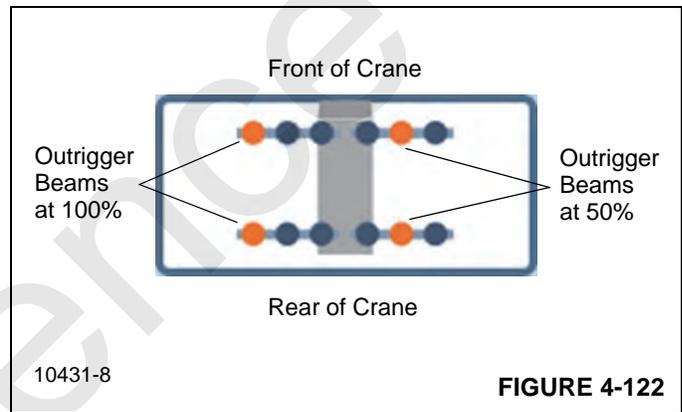
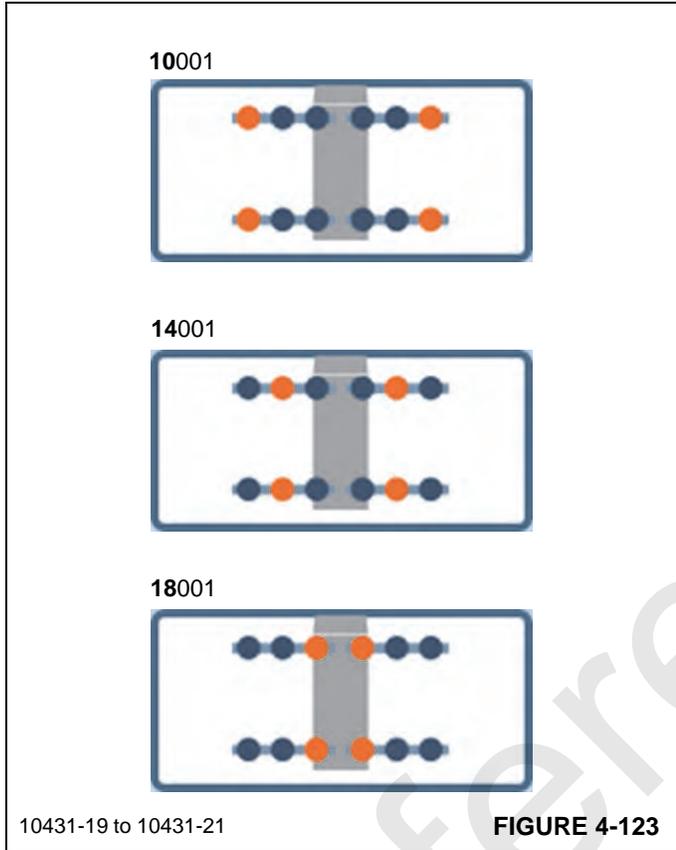


FIGURE 4-122

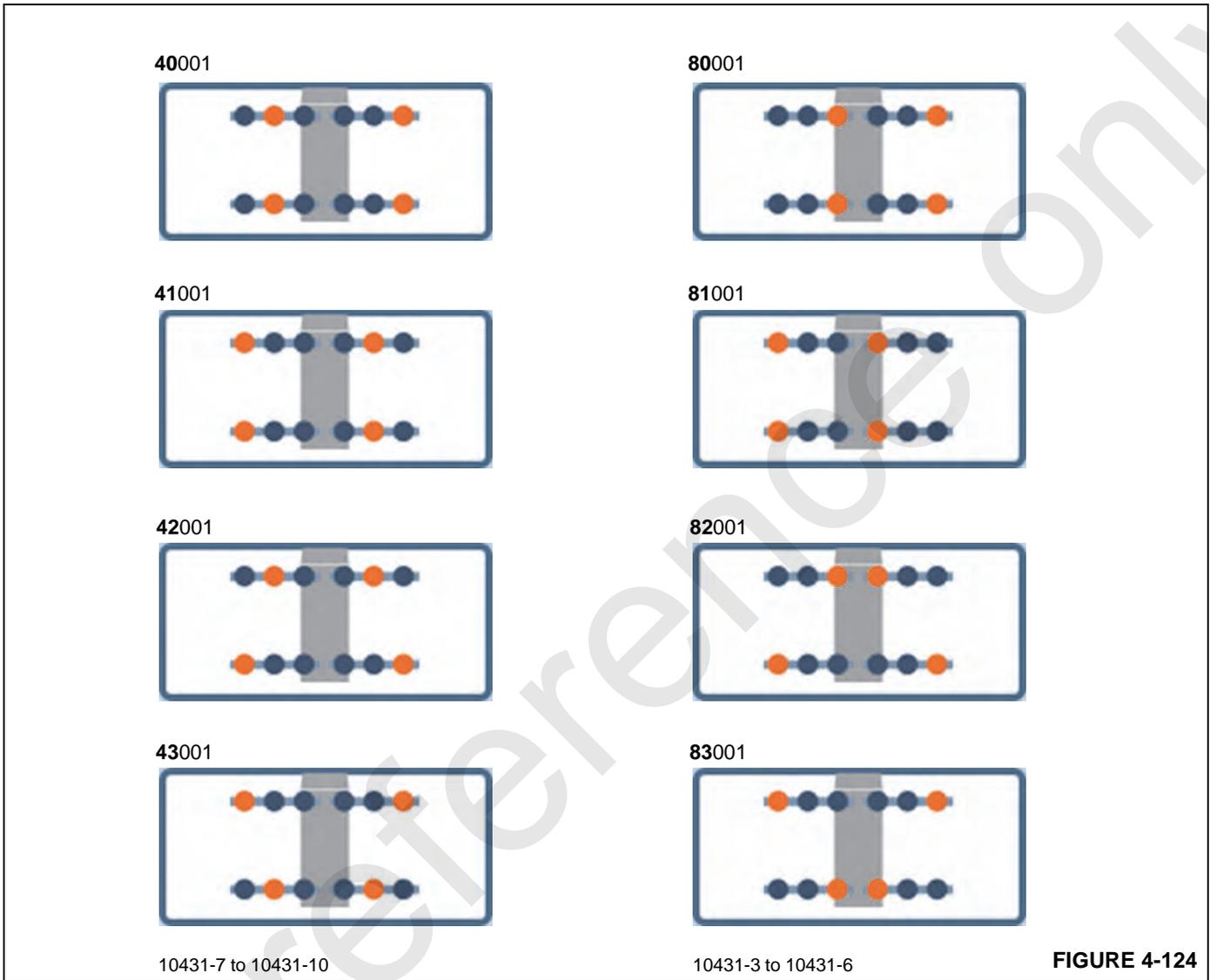
Refer to Figure 4-123 thru Figure 4-125 for the MAXbase Load Charts and their outrigger configurations available on the GRT8100-1 crane.

NOTE: Additional setups may be acquired by contacting Grove Product Support for a *Lift Solution*.

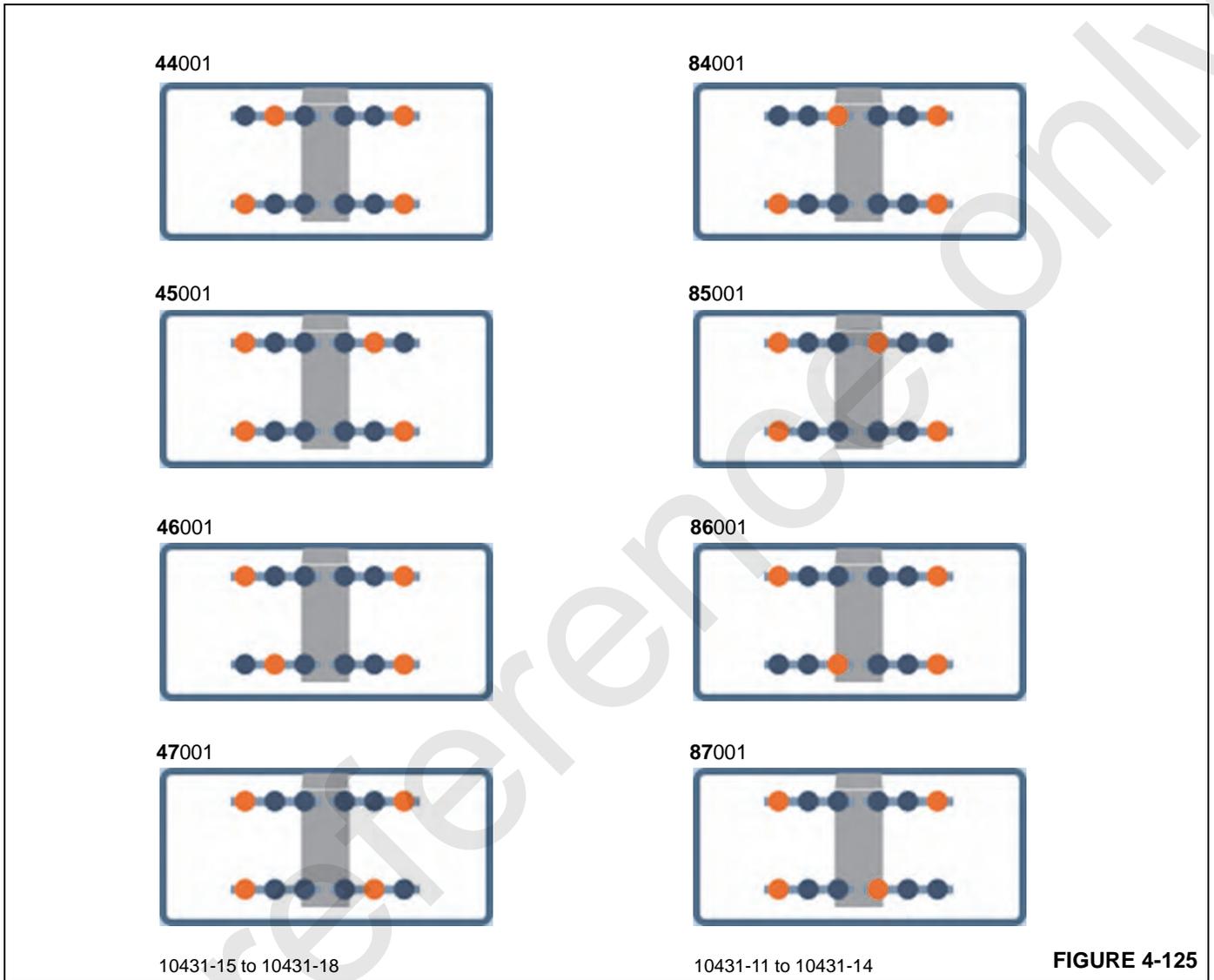
Three symmetrical outrigger extensions (Figure 4-123).



The standard MAXbase setups have at least two adjacent outrigger beams extended to 100%. The other two outrigger beams may be extended to 50% or 0% as shown in Figure 4-124.



The standard GRT8100-1 MAXbase setups also allow lifting with 3 outrigger beams extended to 100%. The remaining beam may be extended to 50% or 0% as shown in Figure 4-125.



Operation of Swing Brake Release Button on MAXbase Equipped Cranes

The Swing Brake Release Button, located on the upper front of the left controller, is disabled when a MAXbase Rigging Code is selected in the Rated Capacity Limiter (RCL). This prevents the button from being used to release the swing brake and cause the boom and superstructure to rotate toward a swing range/limit that is prohibited.

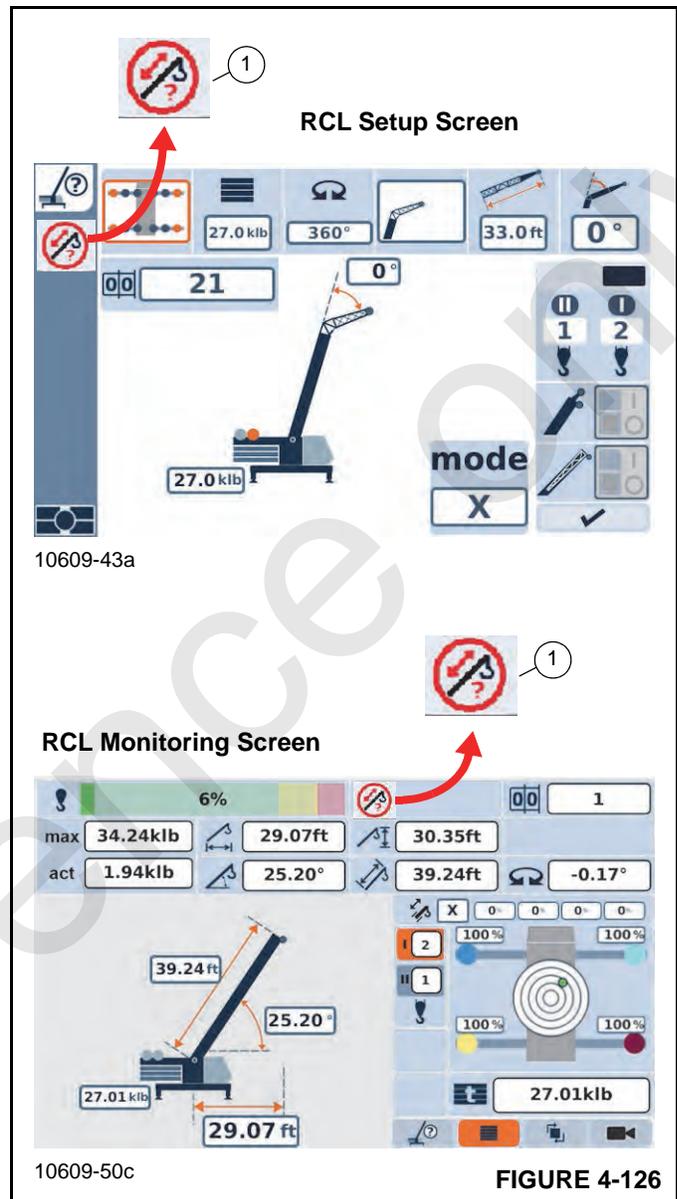
Boom Out-of-Sequence

If boom telescope system becomes out-of-sequence, the cab buzzer will come on and the Boom Out-of-Sequence alert (1, Figure 4-126) will show on the RCL Setup Screen and the RCL Monitoring Screen. The RCL Early Warning Indicator (6, Figure 3-6) will also come on and the RCL will lockout the following crane functions:

- boom lift (raise/lower)
- boom telescope (extend)
- boom swing (left and right)
- main and optional auxiliary hoists (raise).

To recover a boom that has become out-of-sequence, do the following:

1. Switch to Mode M (manual telescope mode) on the RCL Setup Screen.
2. Navigate to the Manual Telescope function screen (see *Manual Telescope*, page 4-55) on the Operator Display Module (ODM).
3. From the Manual Telescope function screen, manually telescope the T1 and T2-4 telescoping sections to return the boom to being in-sequence.



RCL Checks Before Operating the Crane

Open the Menu

Crane operation is only enabled when the RCL Monitoring Screen is open. The Monitoring Screen 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 4-127:

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
8	Rigging Code

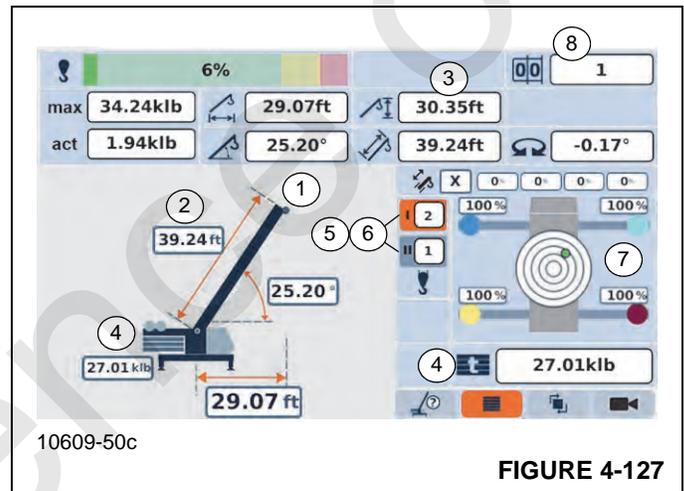


FIGURE 4-127

Viewing the Hoist Camera

The Hoist Camera View can be set to show on the Monitoring Screen of the Rated Capacity Limiter Display Module (RDM).

When enabled, the Hoist Camera View (1, Figure 4-128) will automatically show in place of the Outrigger Position View (2) when the main or optional auxiliary hoist is operating (reeling in or out). When the hoists are not operating, the Outrigger Position View will show on the Monitoring Screen.

Select and confirm the Hoist Camera View Icon (3, Figure 4-128) to enable or disable the hoist camera view.

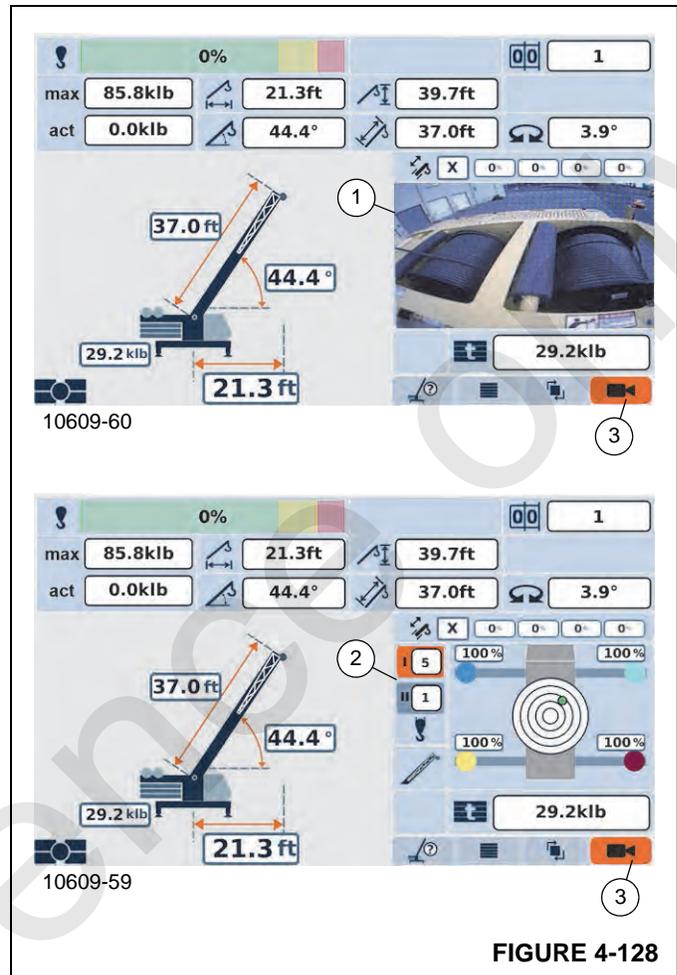


FIGURE 4-128

The Hoist Camera View can also be set to show continuously in full screen on the RDM (Figure 4-130).

The full screen view of the hoist camera is enabled in the Menu Screen of the RDM. The operator can access the Menu Screen from the Monitoring Screen by selecting and confirming the Menu Icon (1 Figure 4-129), or by pressing the Menu Button at the Jog Dial (2) or at the RDM Navigation Control Pad (3).

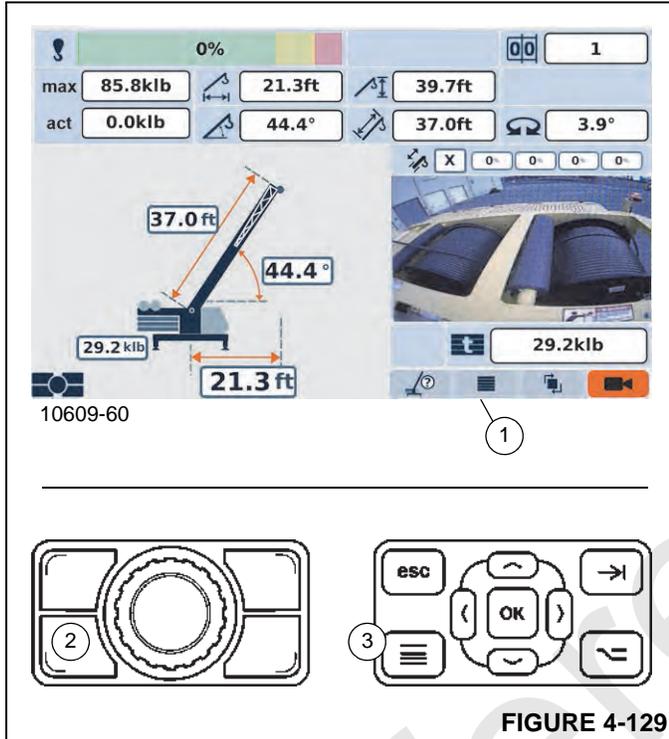


FIGURE 4-129

From the Menu Screen, select and confirm the Hoist Camera Icon (1, Figure 4-130) to open the full screen view of the hoist camera (2).



FIGURE 4-130

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 4-18 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 becket 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 4-131 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.

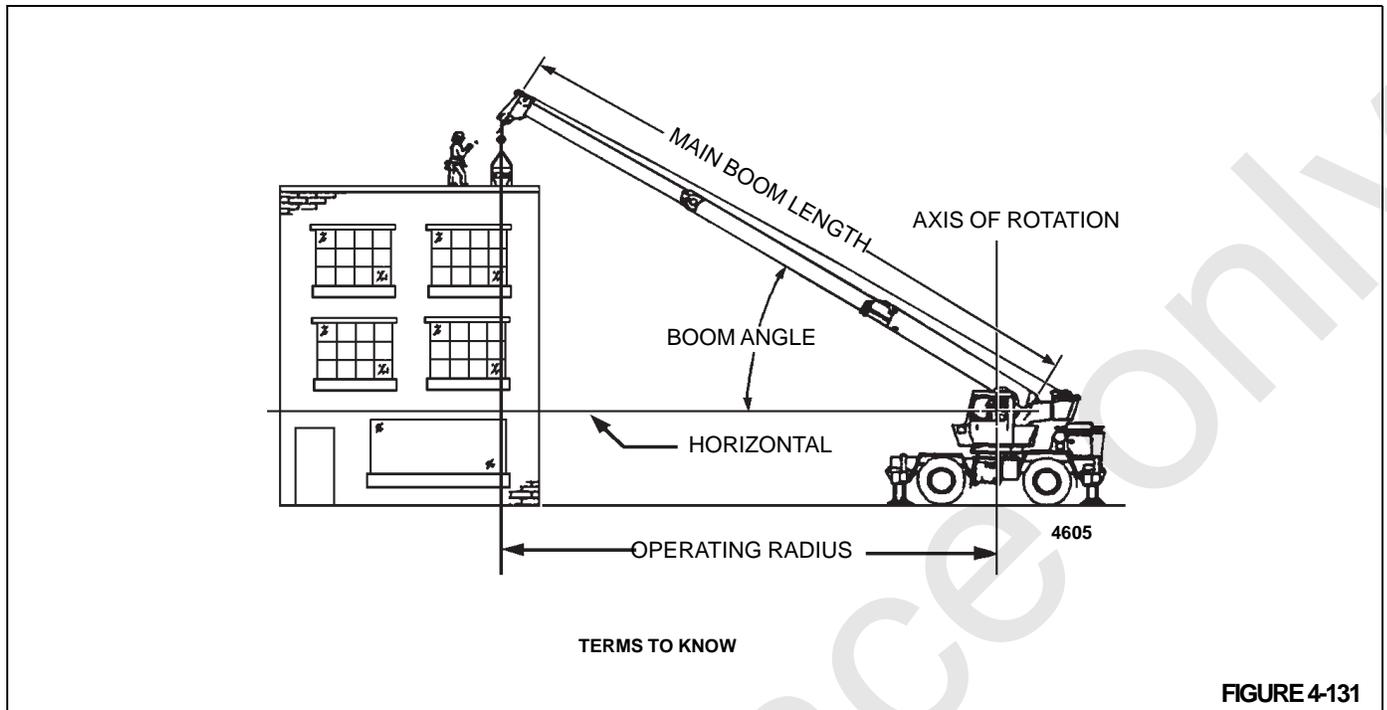


FIGURE 4-131

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 Manual*.

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) (maximum). 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.

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.

12. Set battery disconnect switch (1, Figure 4-132) to the OFF position if machine will be inactive for over 24 hours.



FIGURE 4-132

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, set crane up on outrigger jacks that are not fully extended to allow for thermal expansion and remove the load from the tires.

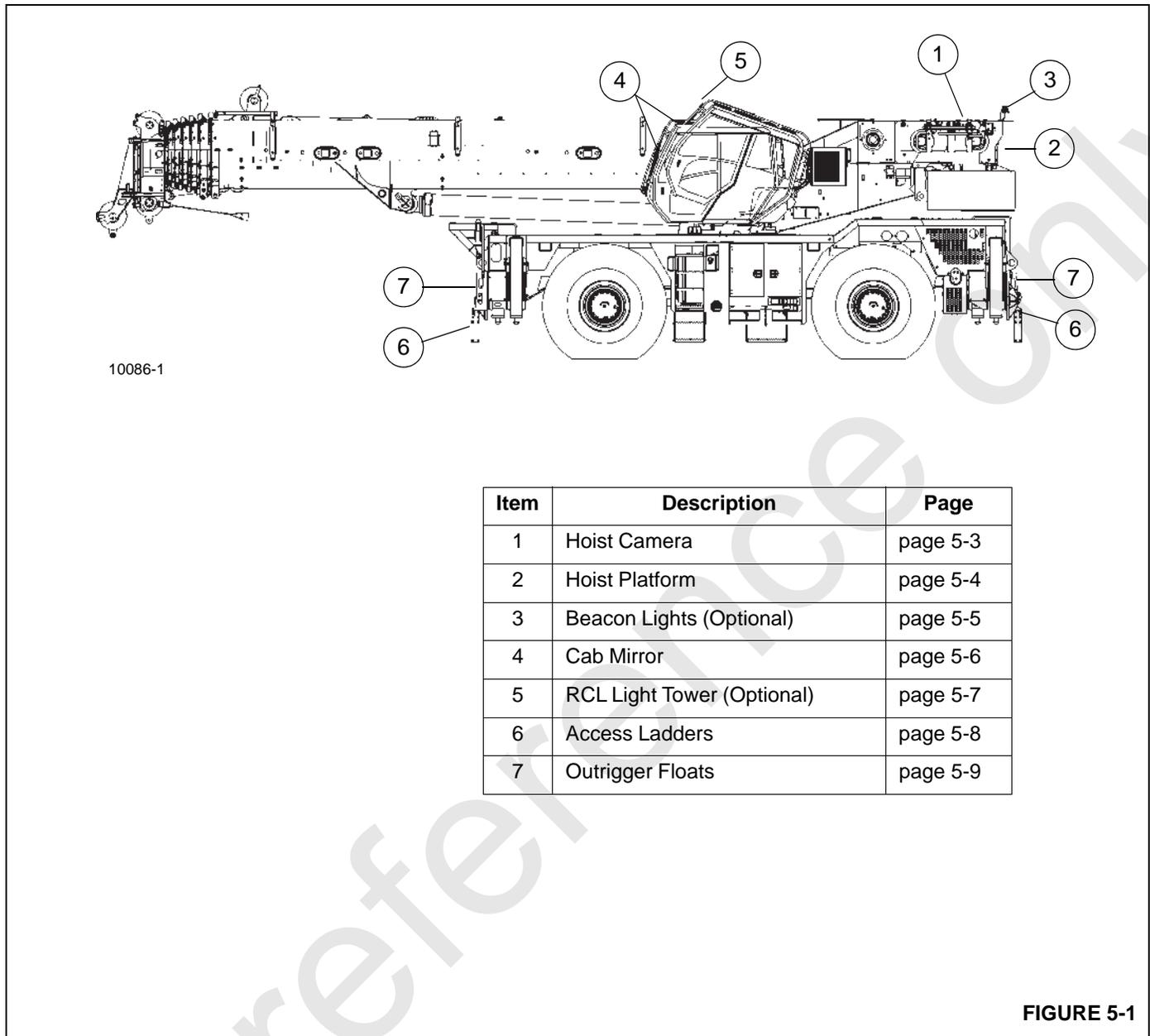
If the crane cannot be placed on outriggers, move the crane at least once a month to prevent permanent distortion of tires.
2. Keep the inflation pressure as recommended.

SECTION 5

SET-UP AND INSTALLATION

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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.

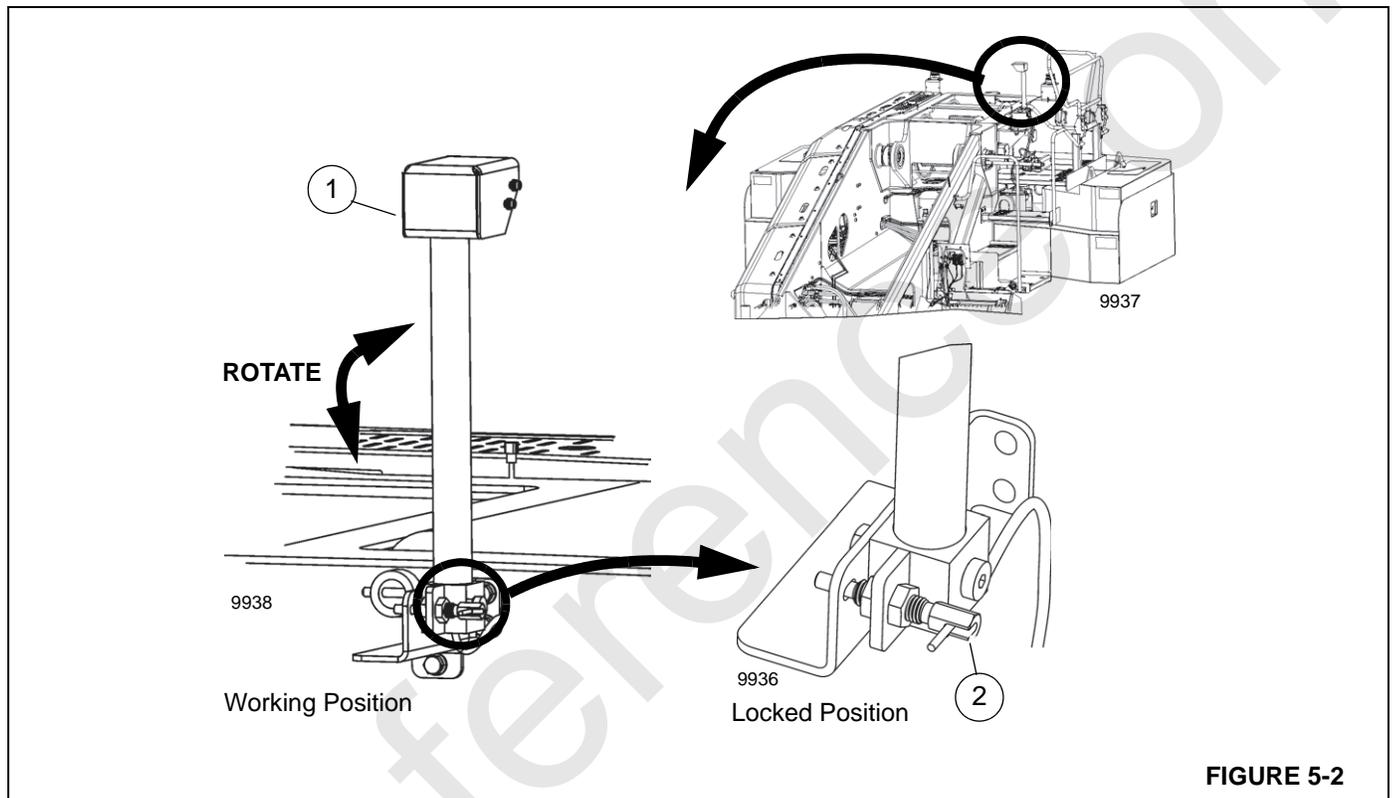


FIGURE 5-2

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 (4) 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.

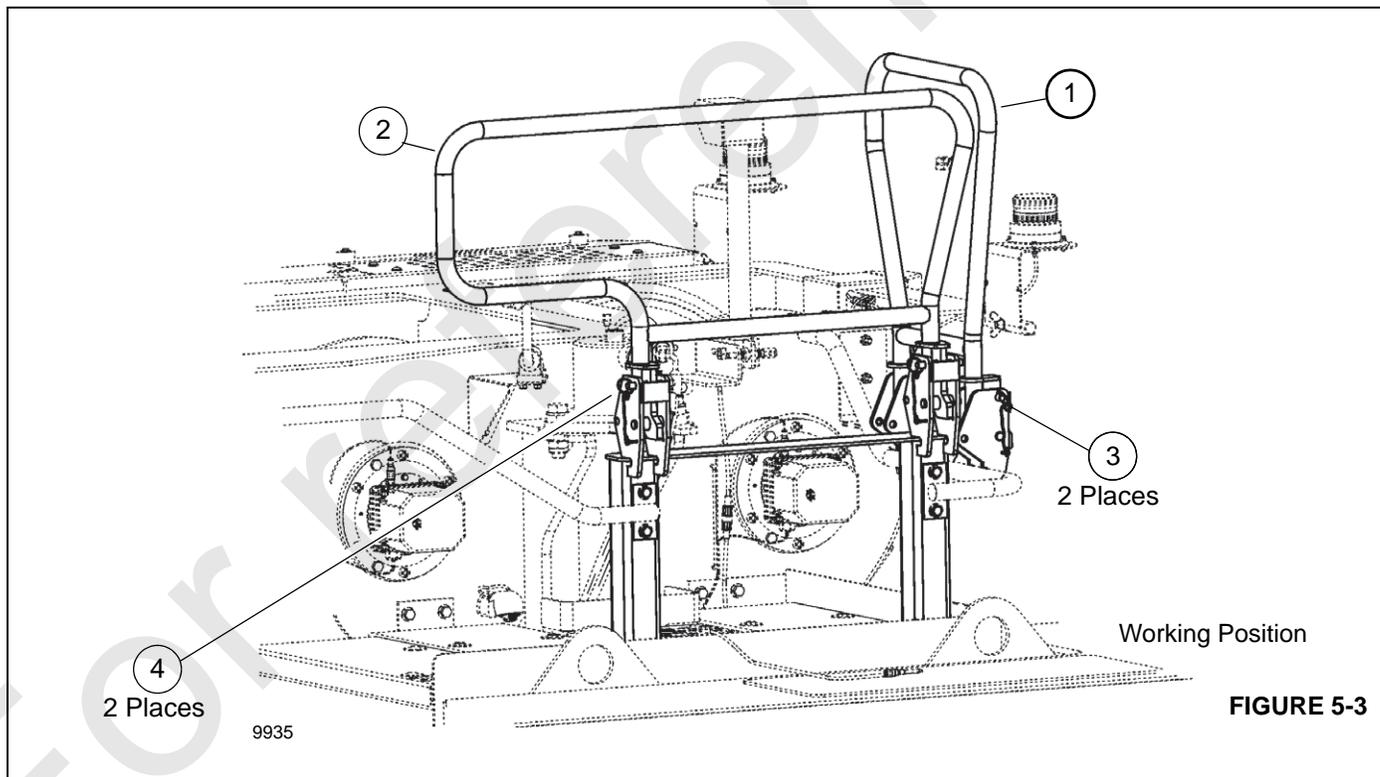


FIGURE 5-3

Beacon Lights (Optional)

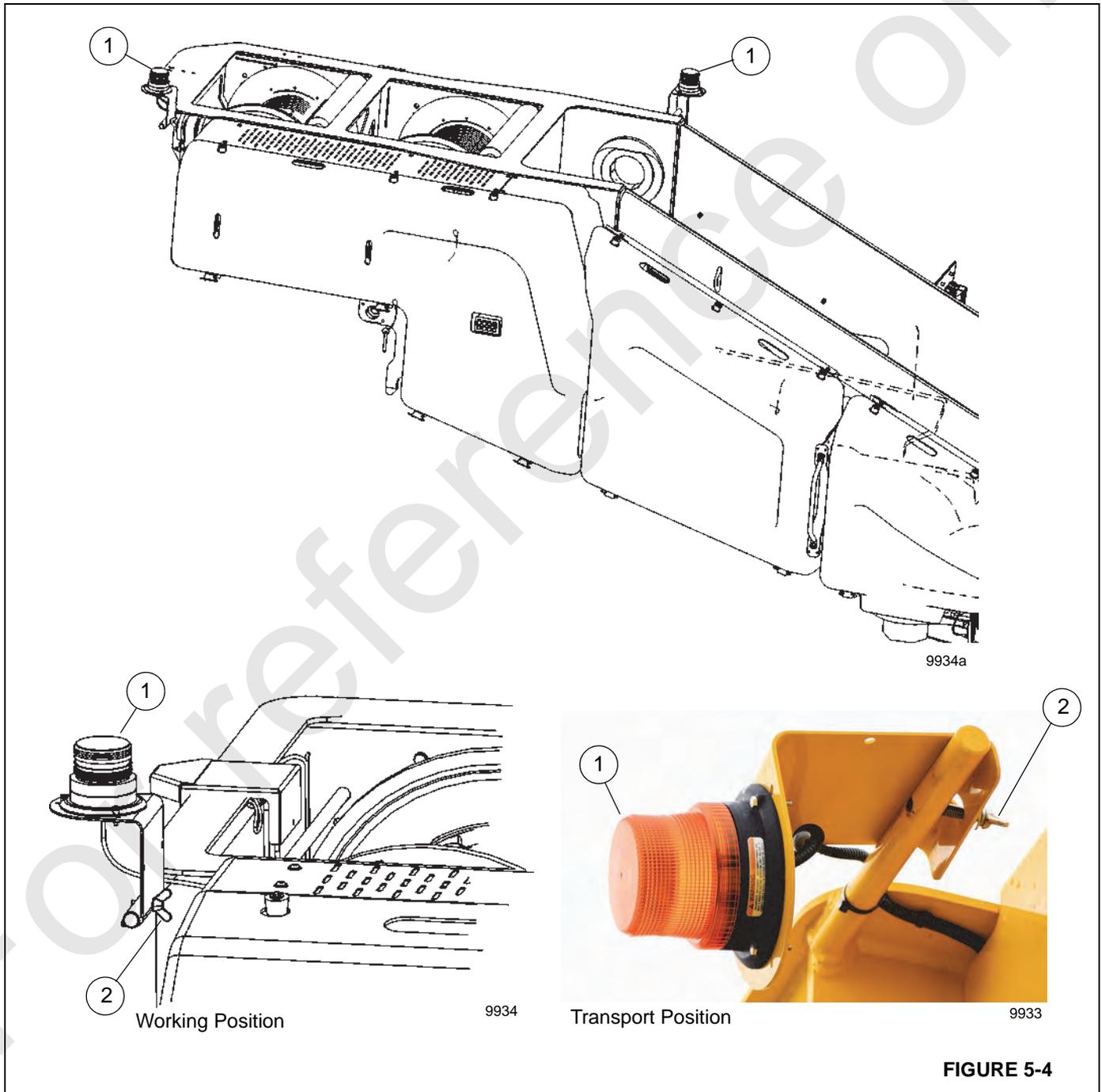
The optional beacon lights (1, Figure 5-4) can be installed as part of the optional Auxiliary Lighting and Convenience Package. When installed, the beacons are located on the rear of the superstructure. The beacons must be lowered for transport and raised for operation.

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

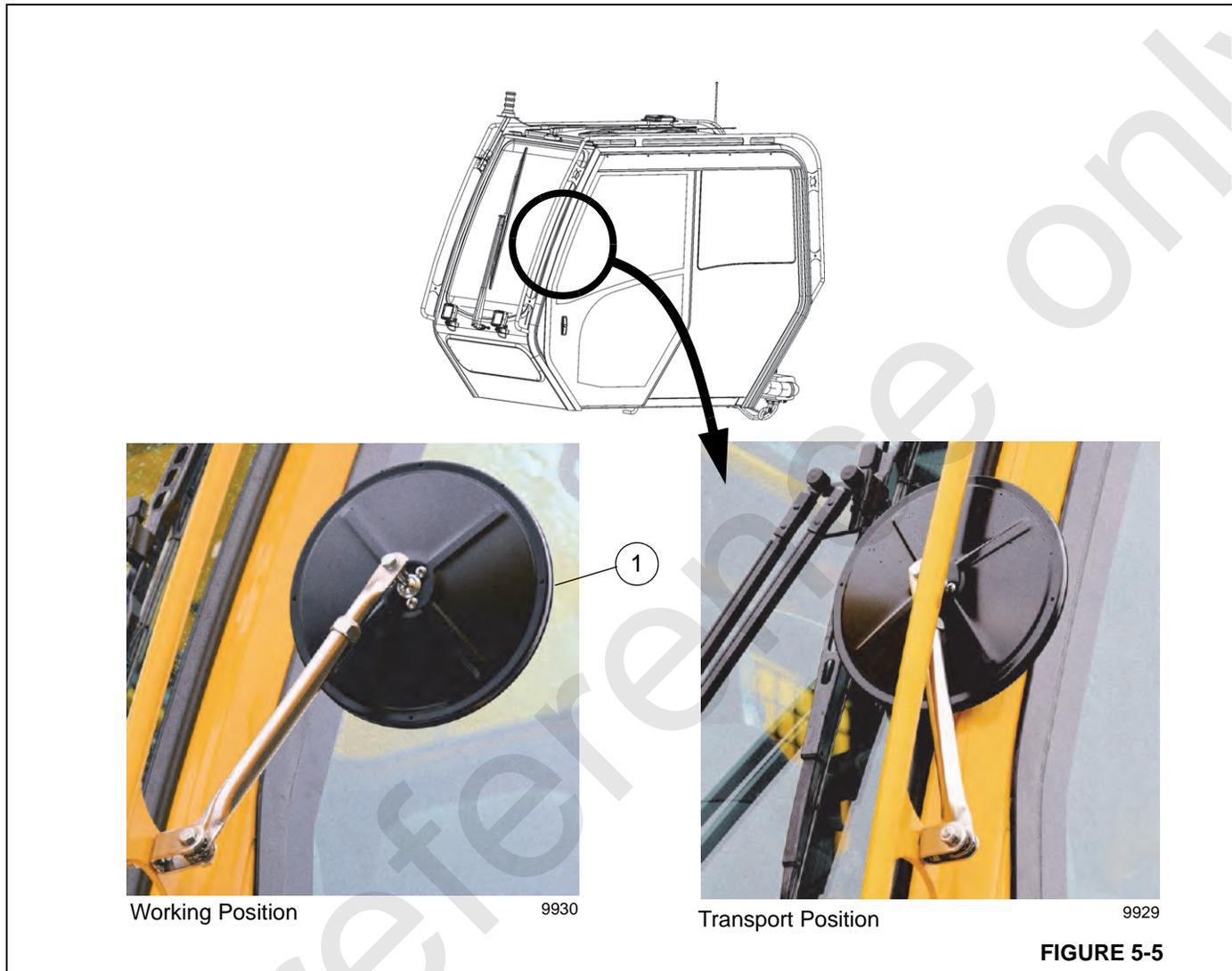
1. Loosen the wing nut (2). Raise the beacon light (1).
2. Tighten the wing nut (2) to secure the beacon light (1) in the working position.



Cab Mirrors

Figure 5-5 shows the working and transport positions for the side (1) cab mirror. The operator can use the side mirror to

view behind the left side of the cab. The cab mirror must be retracted for stowed during transport 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.

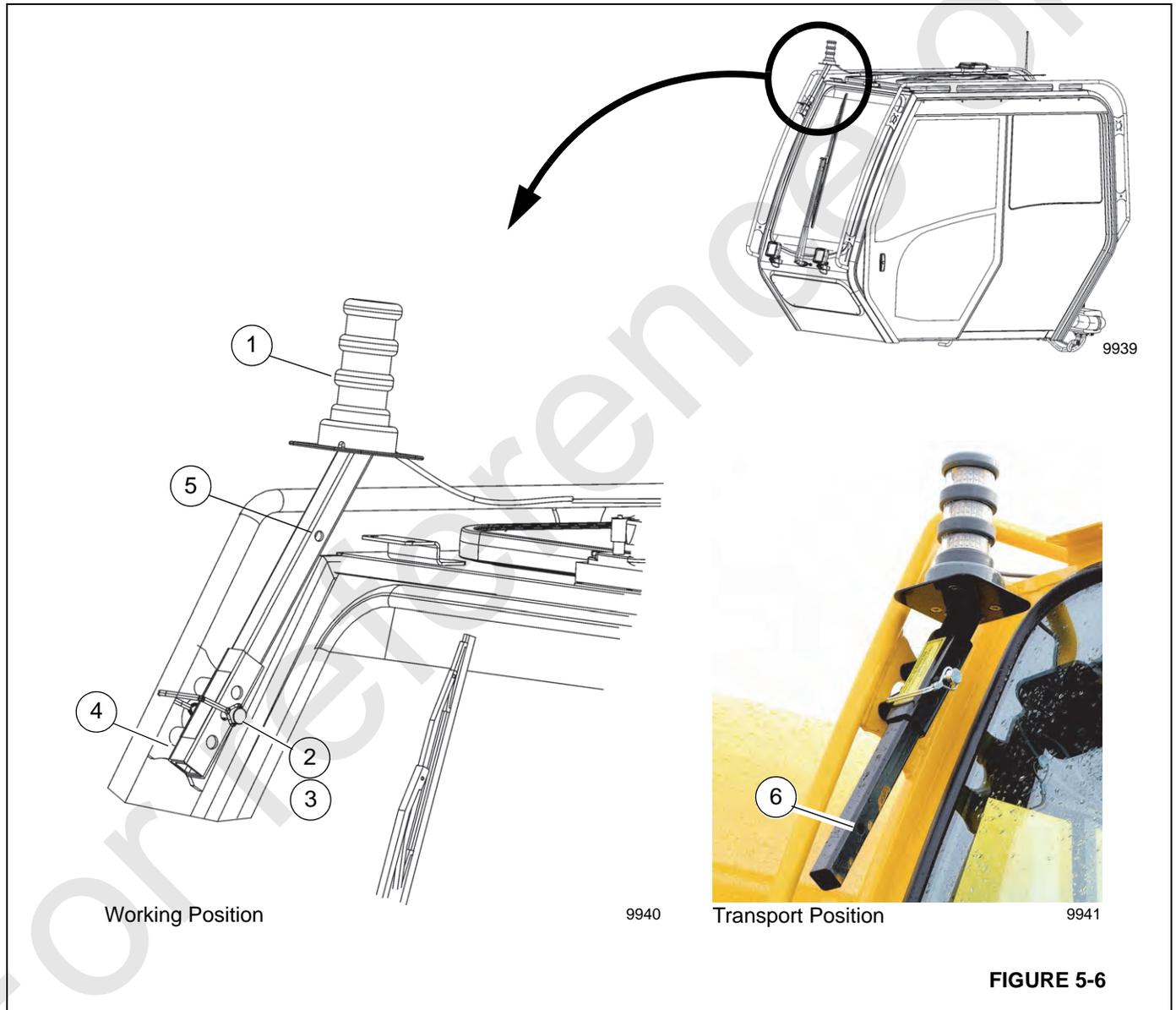
Retracting the RCL Light Tower for Transport

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.

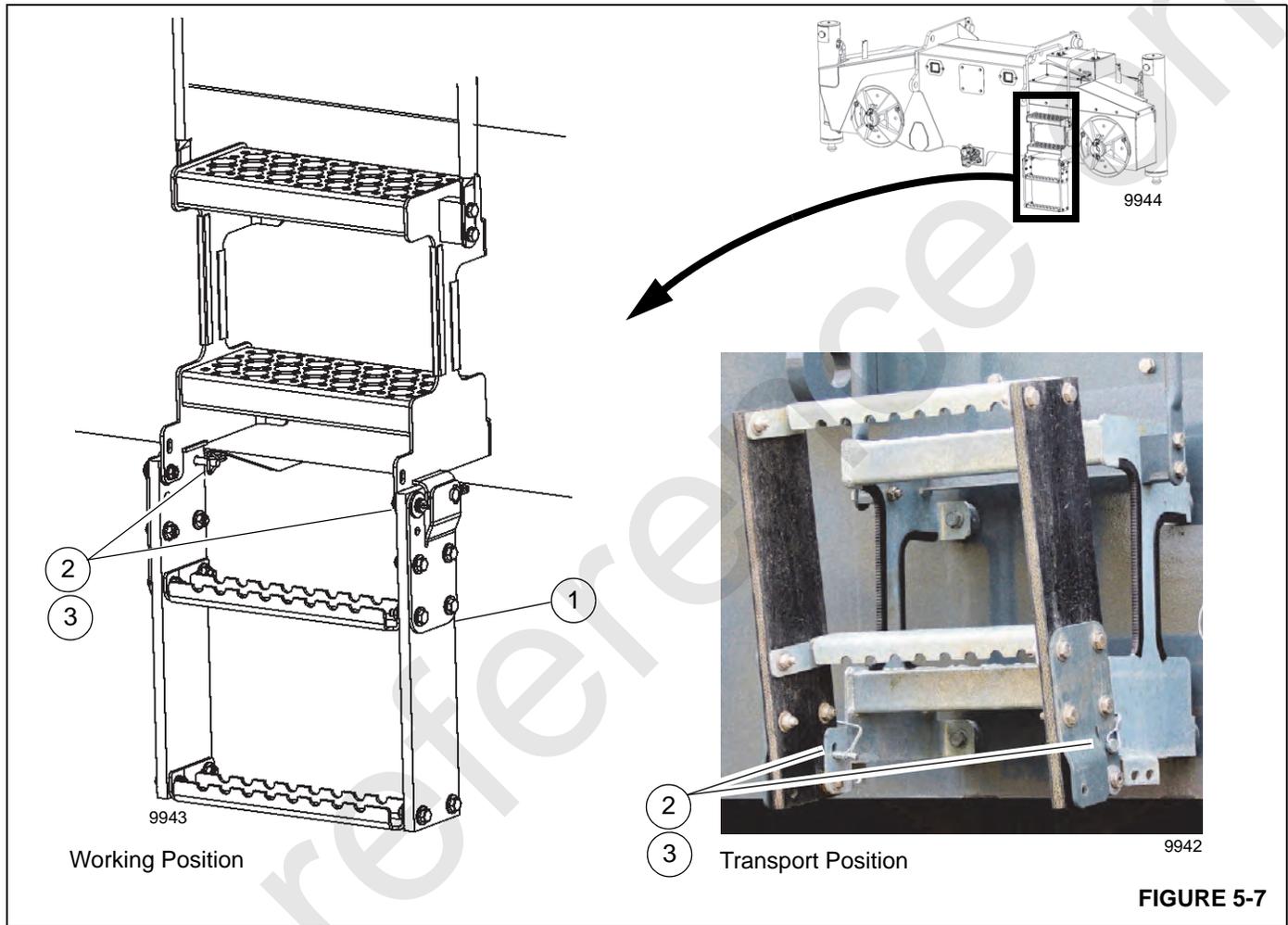


FIGURE 5-7

Outrigger Floats

The outrigger floats (1, Figure 5-8) are stowed on the outrigger boxes. The outrigger floats must be stowed prior to transport.



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Transport Position

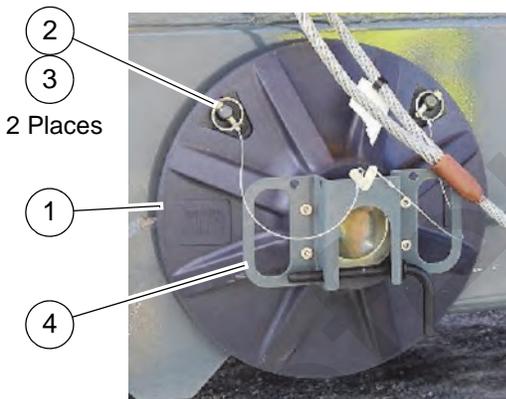


FIGURE 5-8

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).

INSTALLING CABLE ON TO THE HOIST – MTW 19-78-243

Refer to Figure 5-9.



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.

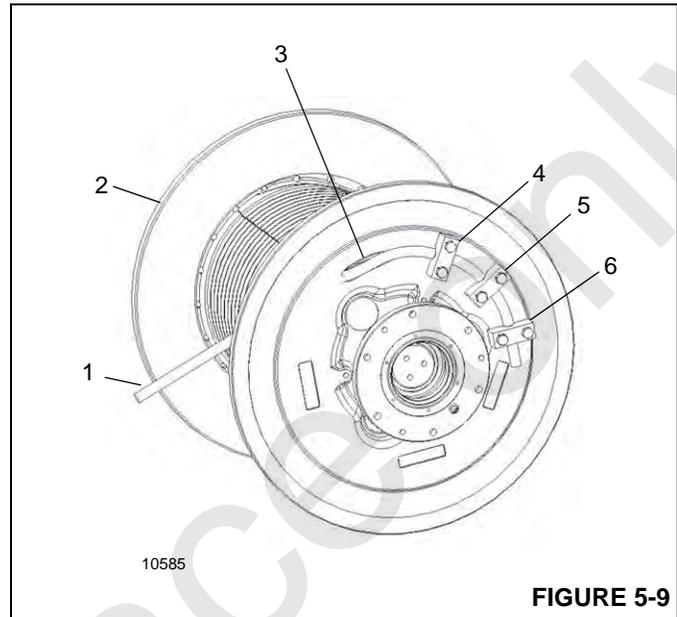
CAUTION

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 that clamps 4 and 5 are accessible, then remove clamps 4 and 5. Loosen clamp 6.
3. Rotate hoist drum so cable slot (3) is easily accessible.
4. Form a large loop of cable in front of the drum. This will allow the drum to be rotated forward without kinking the cable.
5. Insert cable (1) through slot (3). Pass enough cable through slot to make a large loop above drum, then guide the rope end through the last clamp until the entire welded end is beyond the clamp. Pull the excess rope back through the flange being careful not to pull rope out of the clamp.

6. Reinstall and tighten all clamps to a torque of 72 to 80 N·m (53 to 59 lb-ft), starting with clamp (6), followed by clamp (5), and ending with clamp (4).



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7. Slowly rotate drum and evenly wind first layer of cable. Install remainder of cable as required.

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

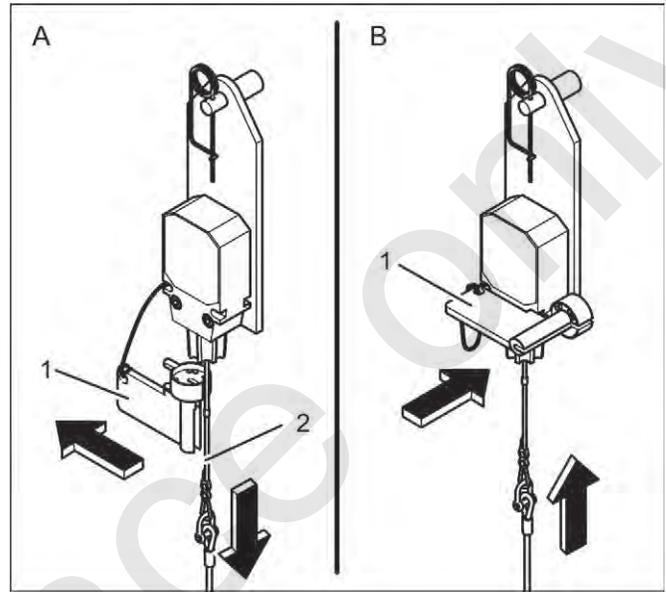
Two-Block Hazard!

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.

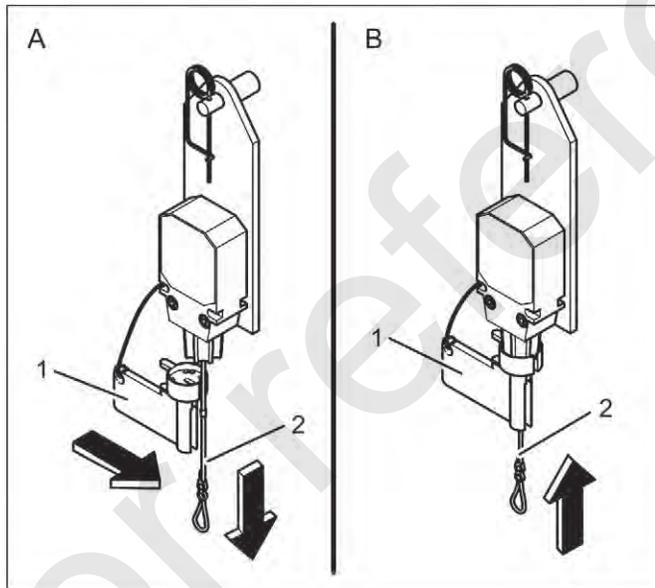
1. Remove A2B weight.
2. (A) Remove cap (1) from switch.
3. Pull lanyard (2) down.
4. (B) Secure lanyard (2) in this position using cap (1). A2B switch is locked (disabled).

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 5-11



8684-1

FIGURE 5-10

Unlocking

NOTE: Always remove the switch lock (enable) before installing an A2B weight around the hoist rope.

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

NOTE: The maximum load bearing capacity of individual hook blocks does not correspond to the maximum load bearing capacity of the GRT8100-1 together with this hook block. The load bearing capacity of the GRT8100-1 depends on the rope pull, the

reeving and friction force. It is lower than the load bearing capacity of the hook block.

NOTE: Please note that the maximum load bearing capacities already include the weight of the hook block and the lifting gear. You must subtract these weights in order to obtain the actual payload.

NOTE: The recommended hook-blocks are designed to be of sufficient weight to overhaul the rope properly when using the parts of line required for the allowed load at the chosen boom length. Operating with a higher number of parts of line than is necessary for a particular boom length may result in poor rope spooling behavior and loosely stored rope, which can result in future rope damage. If operation in these extended ranges is desired, extra weight should be carried by the hookblock or a heavier hookblock should be used.

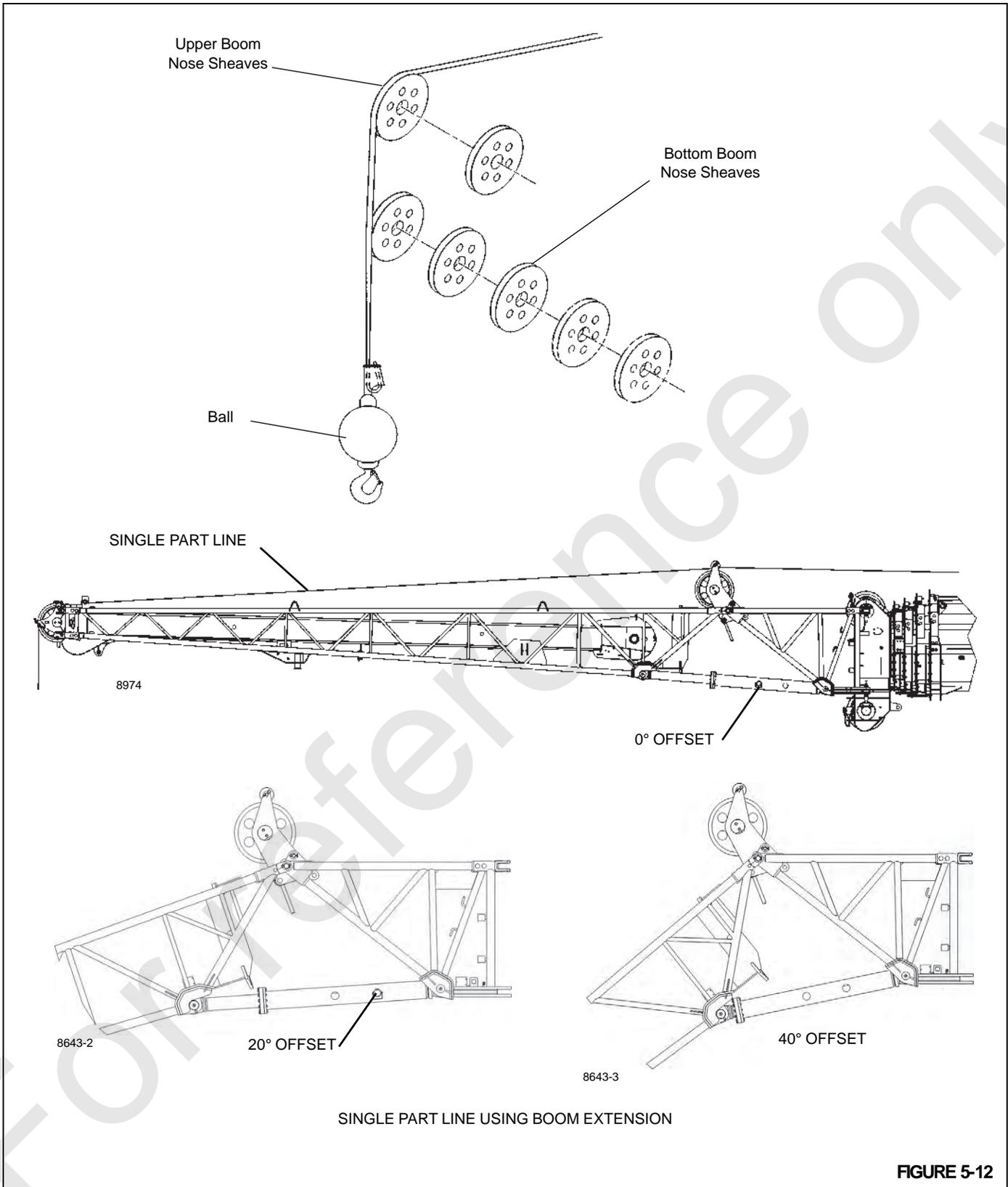


FIGURE 5-12

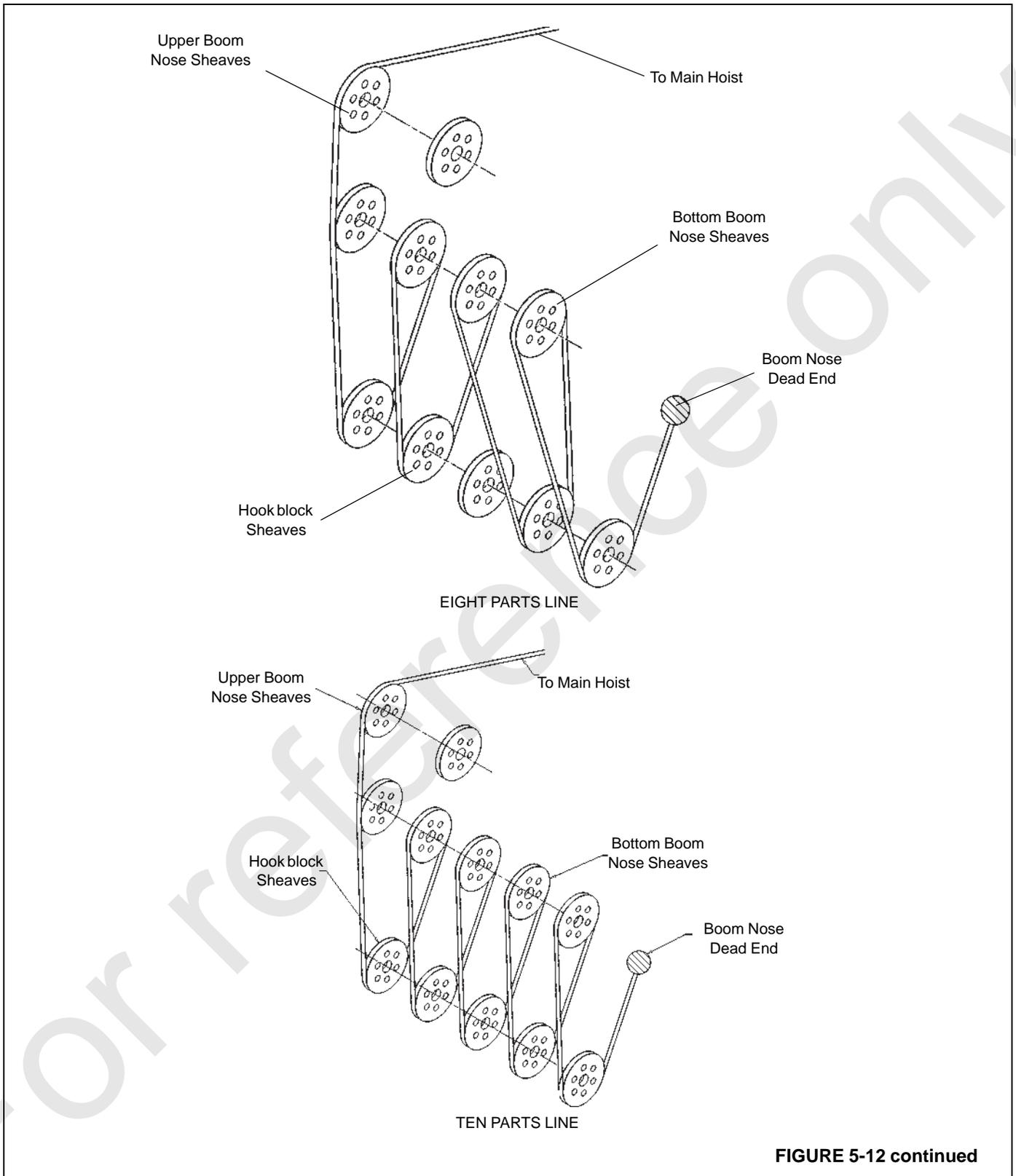


FIGURE 5-12 continued

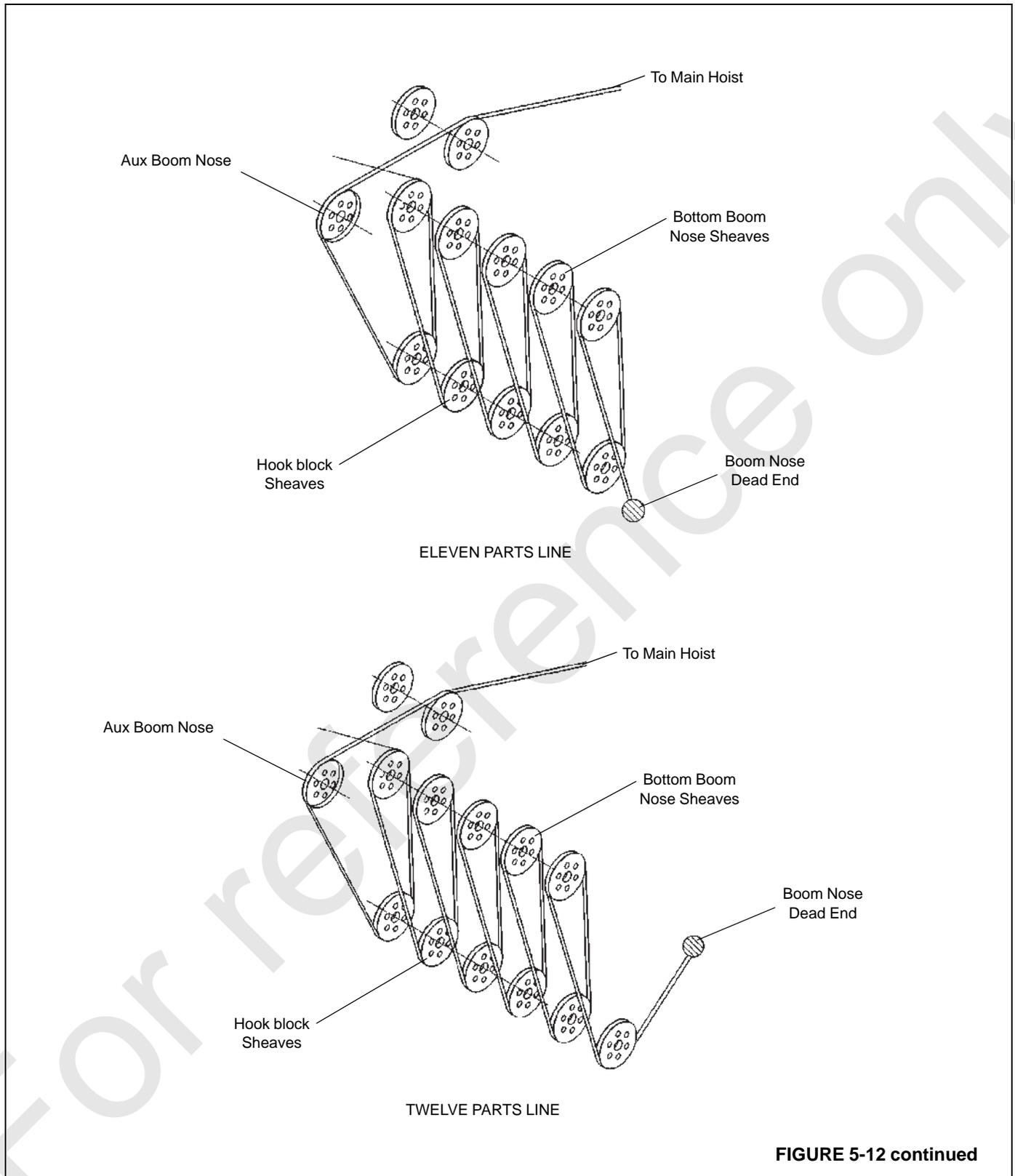


FIGURE 5-12 continued

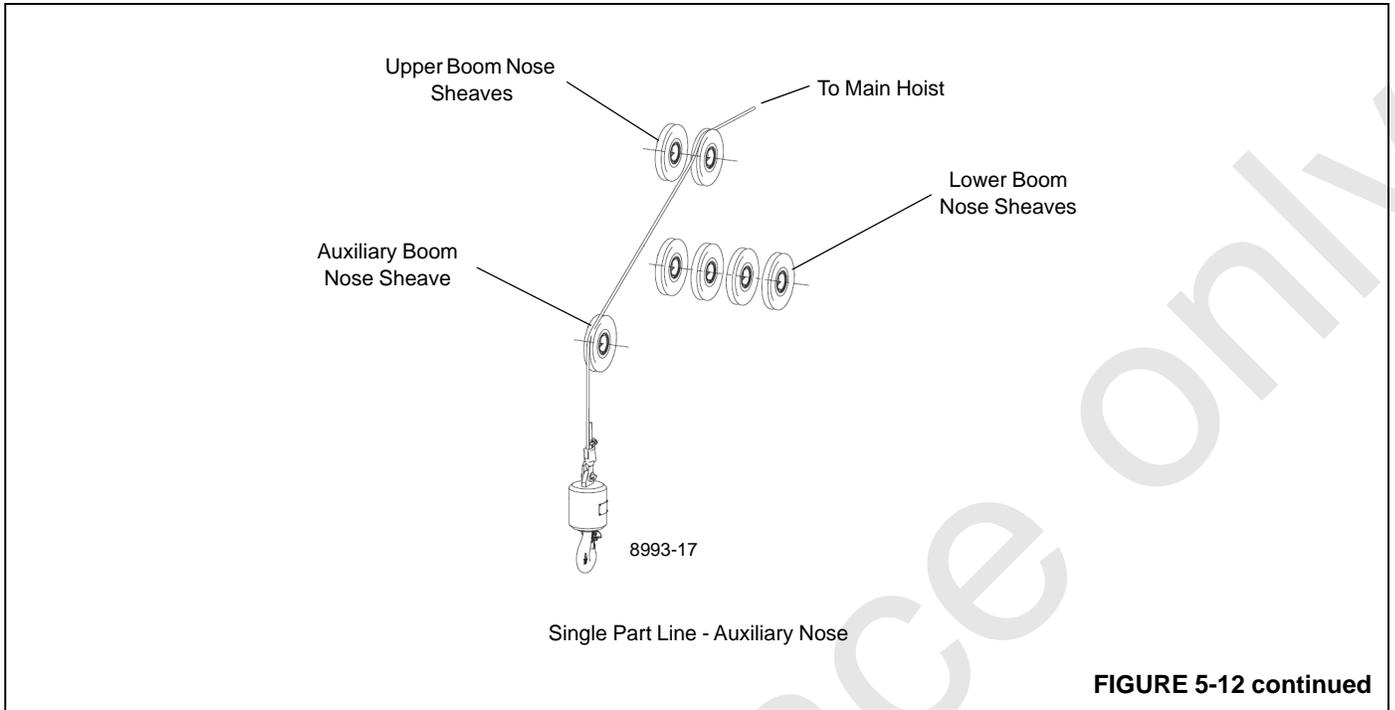


FIGURE 5-12 continued

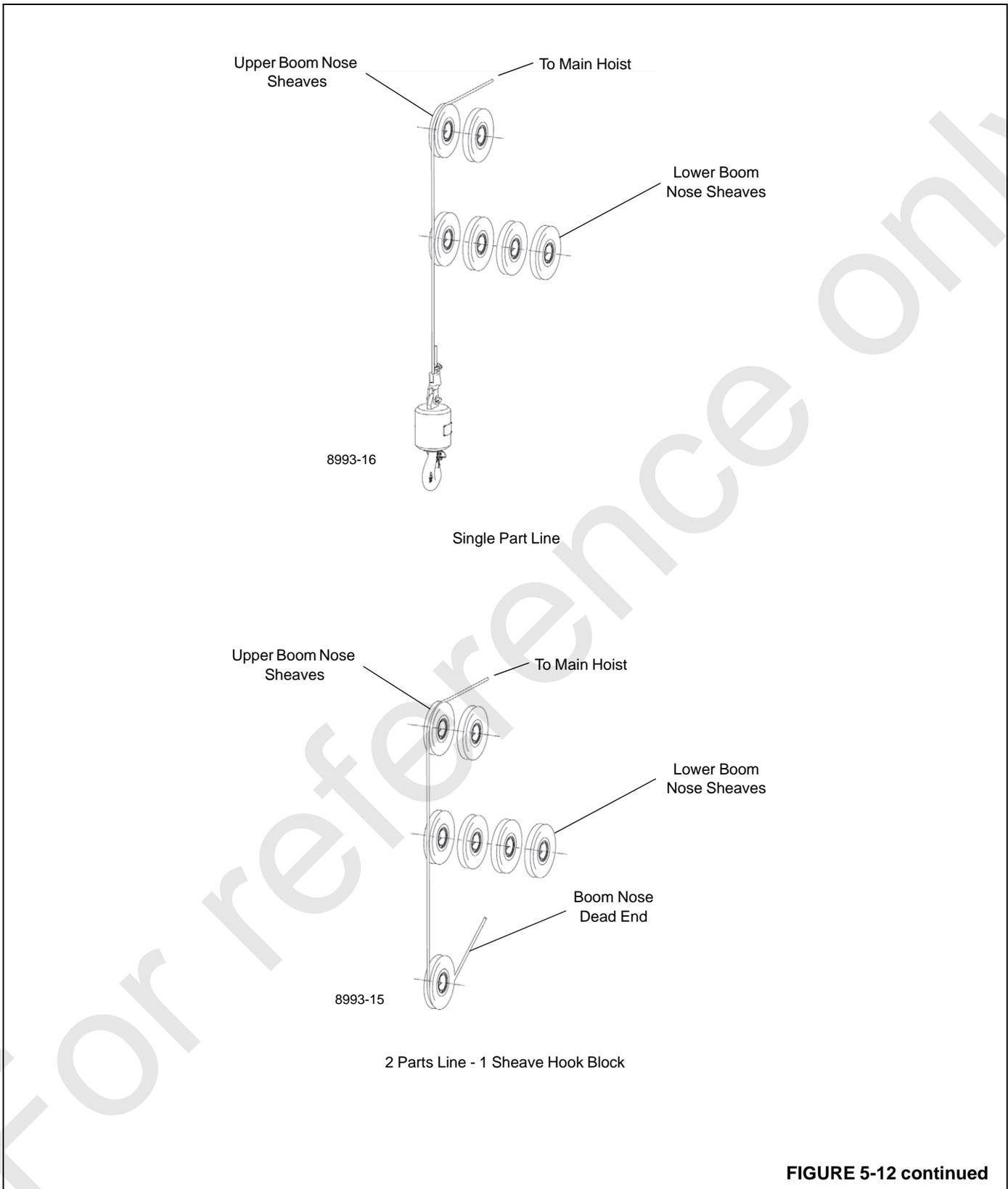
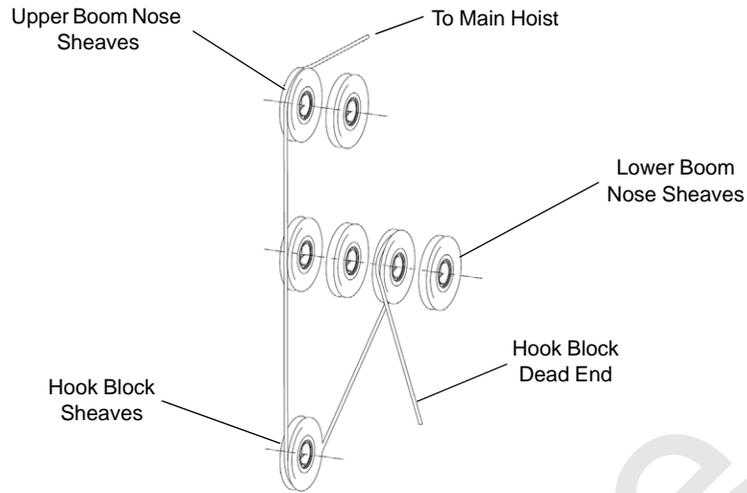
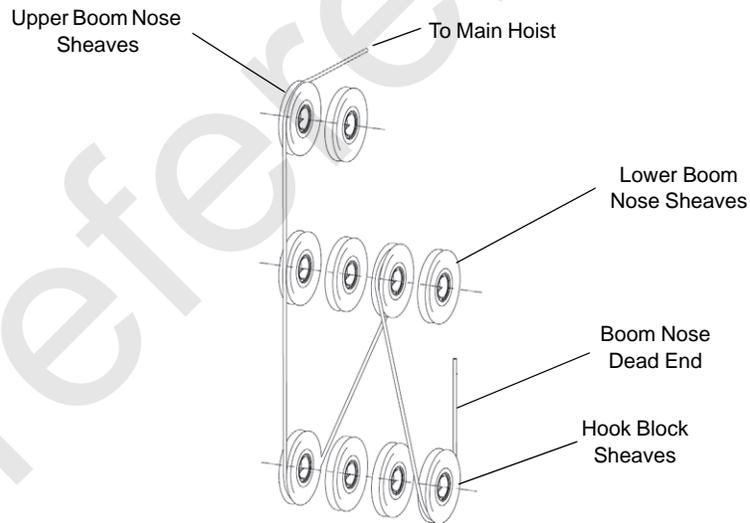


FIGURE 5-12 continued



8993-14

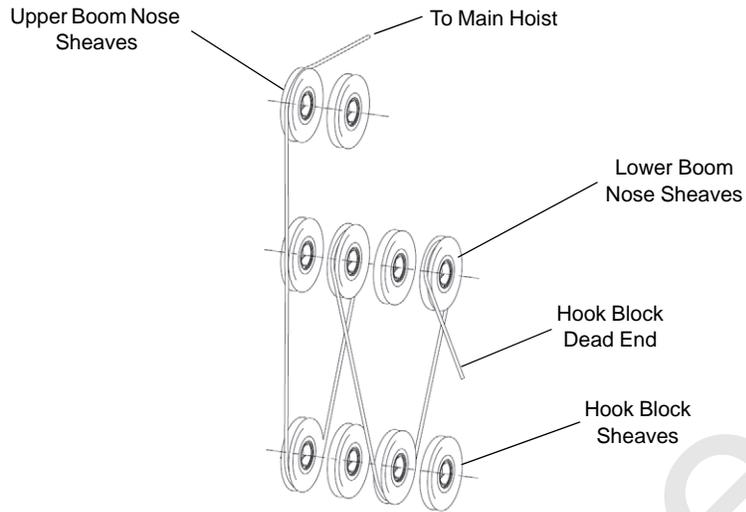
3 Parts Line - 1 Sheave Hook Block



8993-13

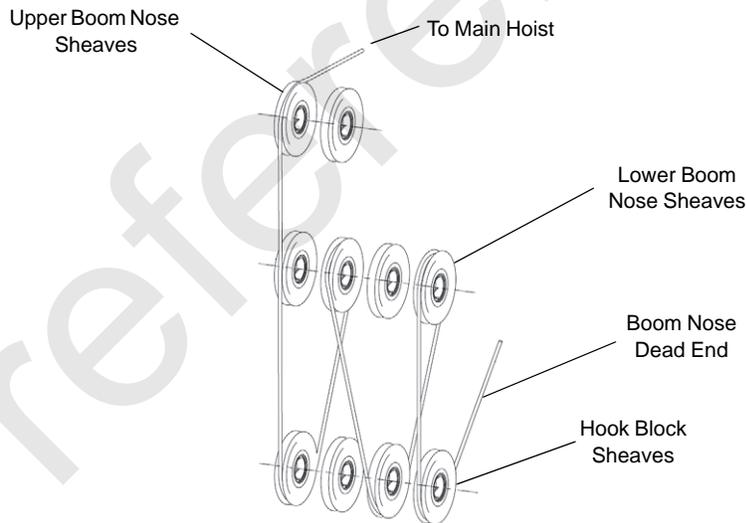
4 Parts Line - 4 Sheave Hook Block

FIGURE 5-12 continued



8993-12

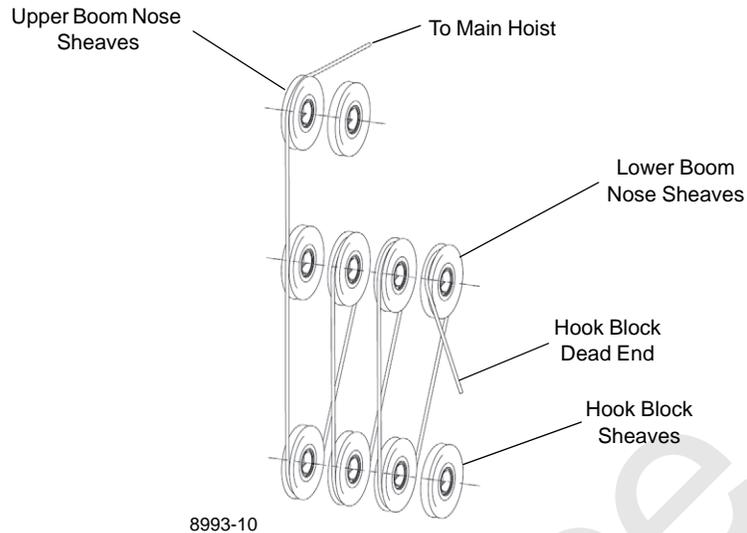
5 Parts Line - 4 Sheave Hook Block



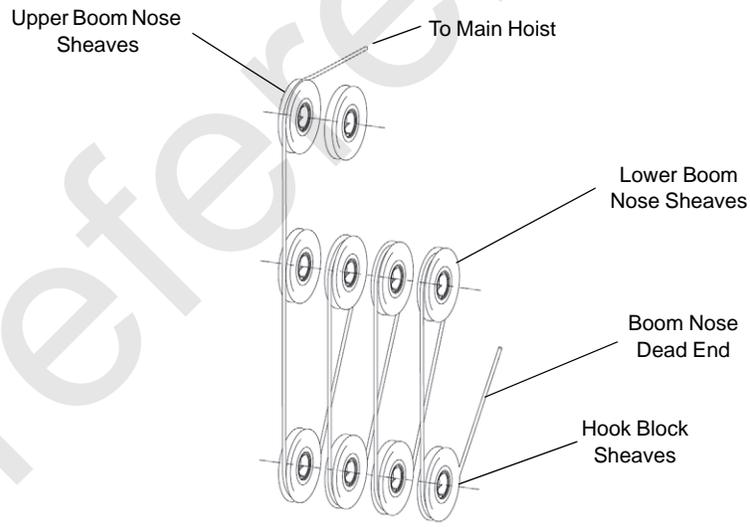
8993-11

6 Parts Line - 4 Sheave Hook Block

FIGURE 5-12 continued

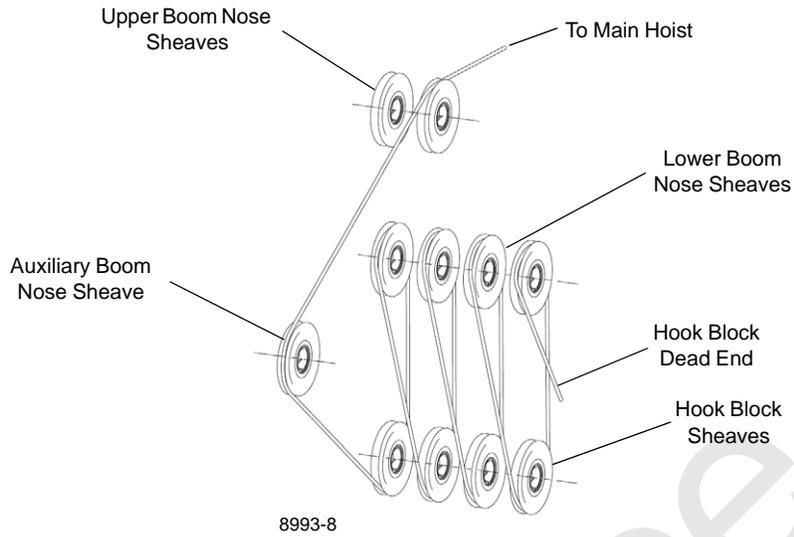


7 Parts Line - 4 Sheave Hook Block

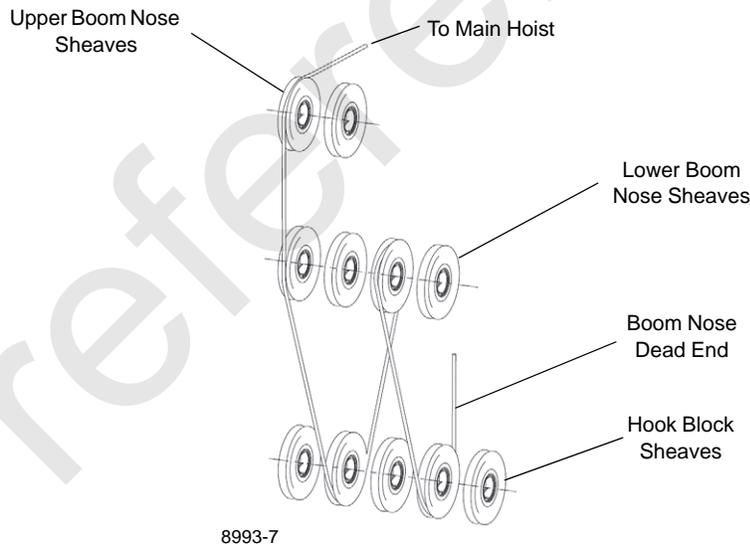


8 Parts Line - 4 Sheave Hook Block

FIGURE 5-12 continued



8993-8
9 Parts Line - 4 Sheave Hook Block with Auxiliary Boom Nose



8993-7
4 Parts Line - 5 Sheave Hook Block

FIGURE 5-12 continued

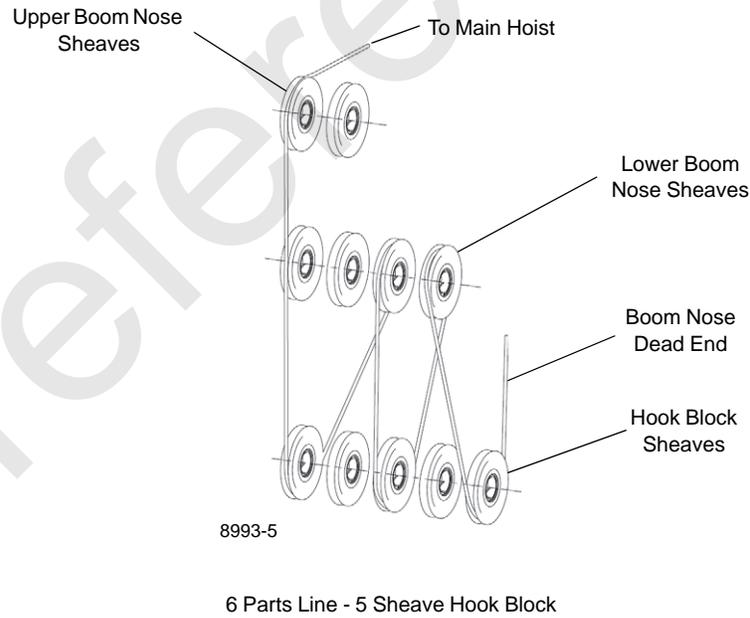
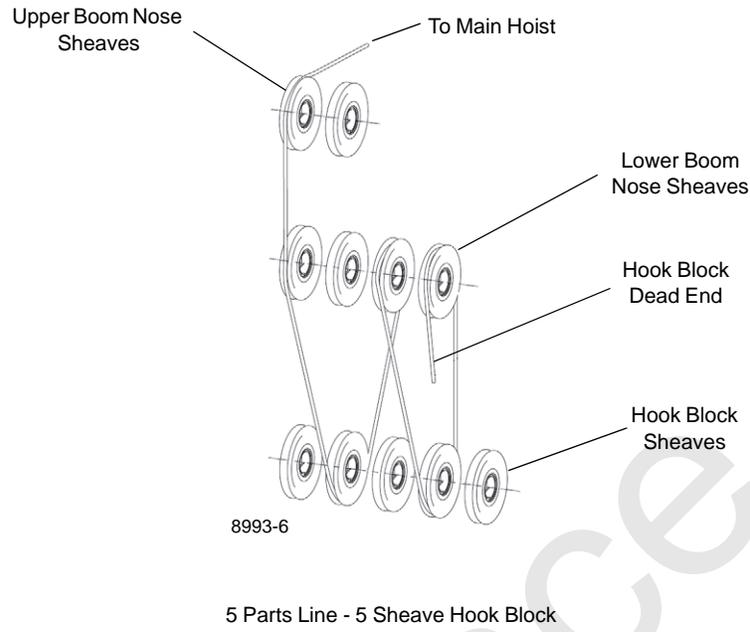


FIGURE 5-12 continued

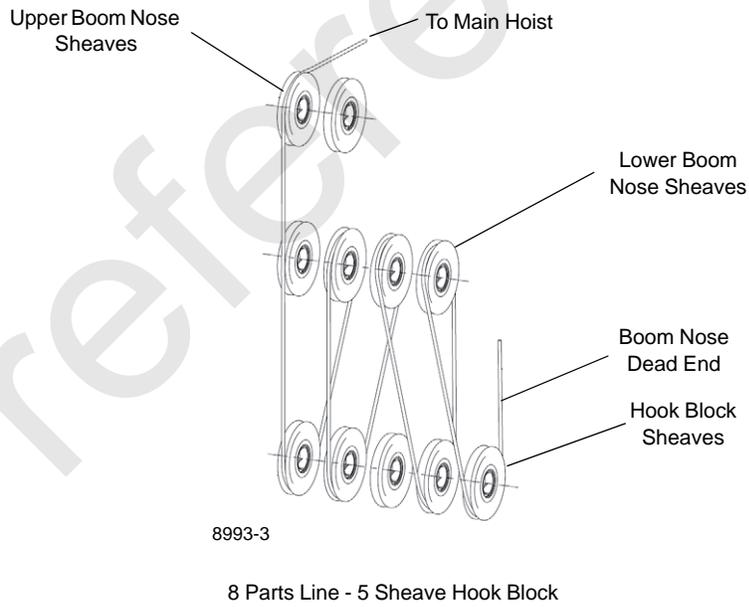
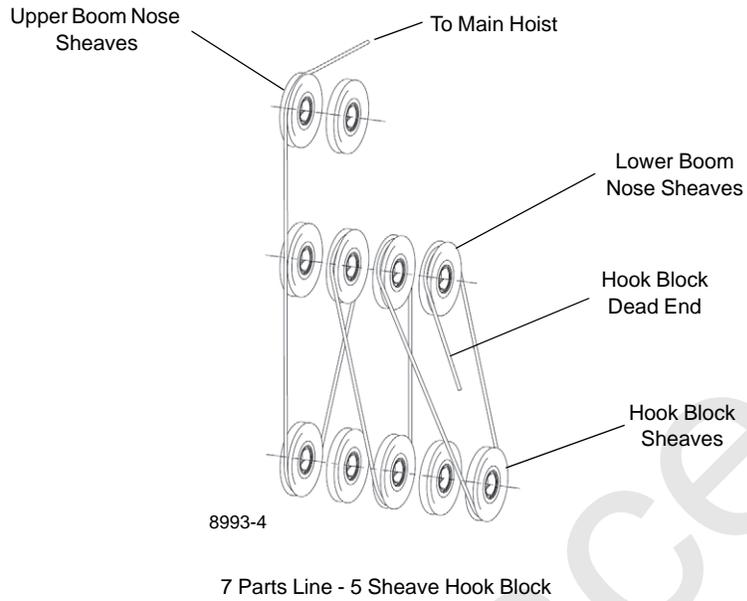


FIGURE 5-12 continued

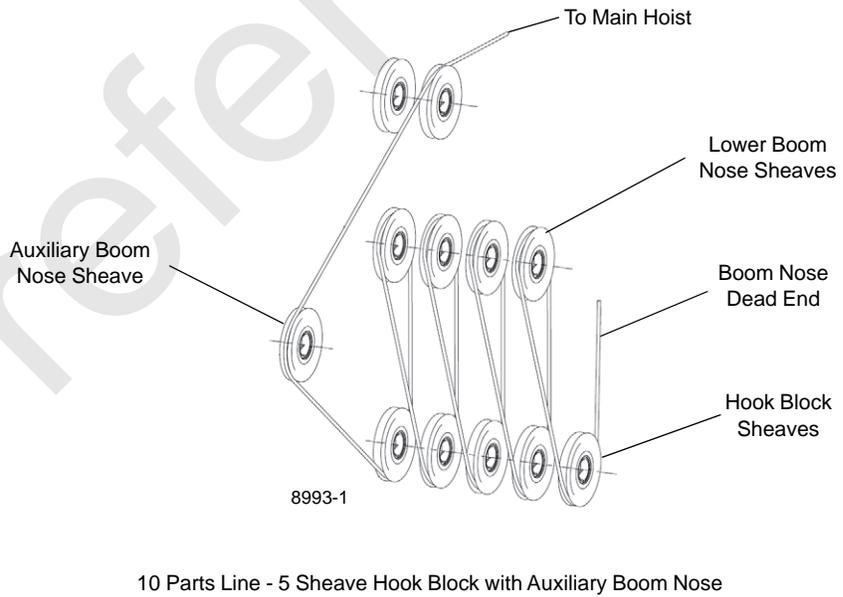
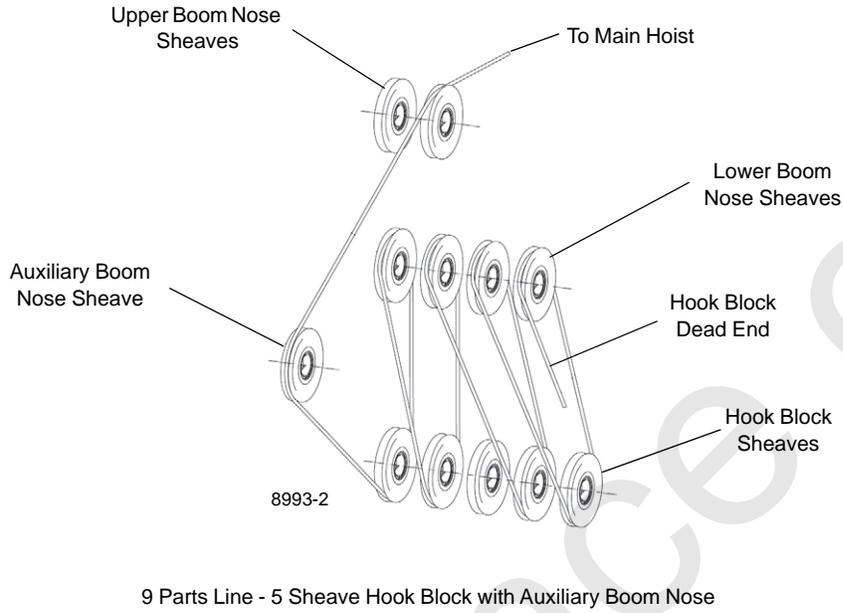
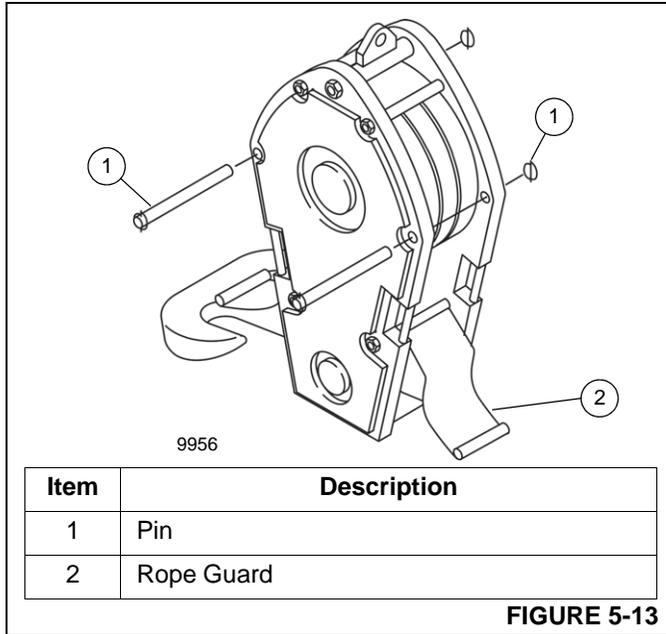


FIGURE 5-12 continued

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 5-13), then lower the two rope guards (2) to their lowered positions.

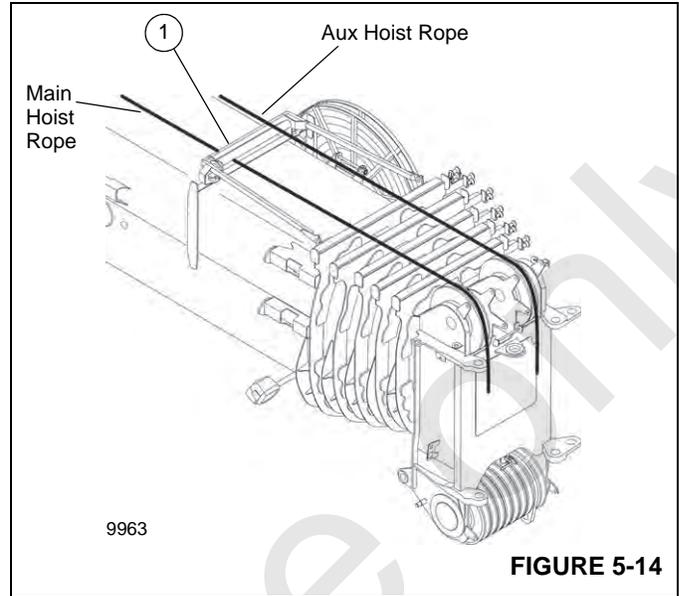


Reeving Hoist Rope Over the Boom

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 5-14). Always reeve auxiliary hoist rope *outside* of the rope guide.



Reeving/Unreeving the Hoist Rope

Use the following procedures to reeve and unreeve the hoist rope.

Reeving Hoist Rope

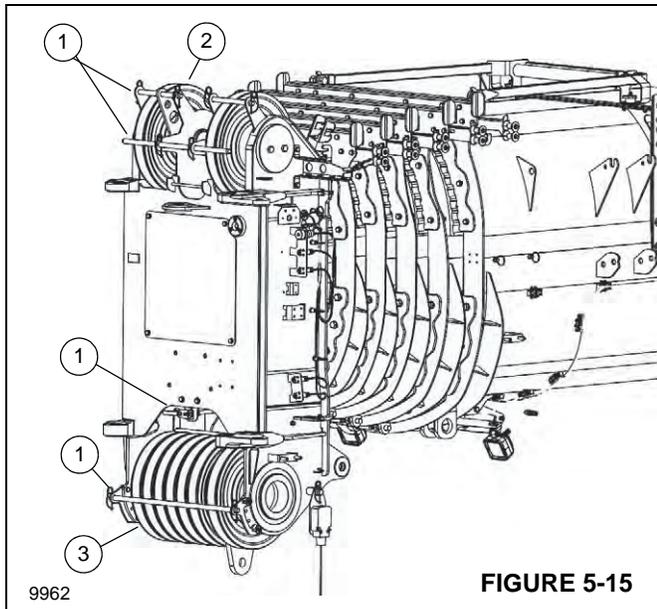


CAUTION

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 5-26.
2. Remove the retaining rods (1, Figure 5-15).
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.



Unreeving Hoist Cable

1. Remove the retaining rods (1, Figure 5-15).
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 Grove Product Support.

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.

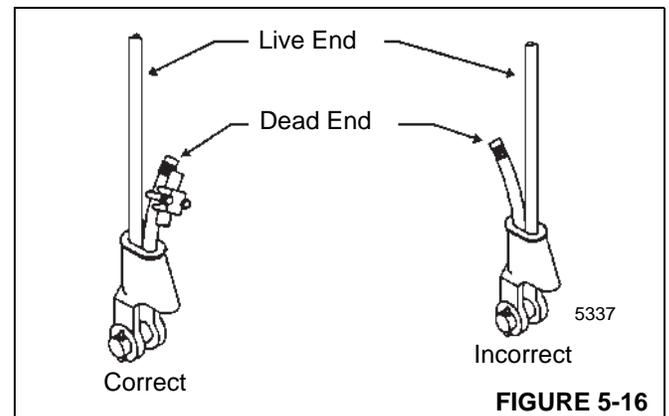
CAUTION

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 5-16) 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 5-17 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.

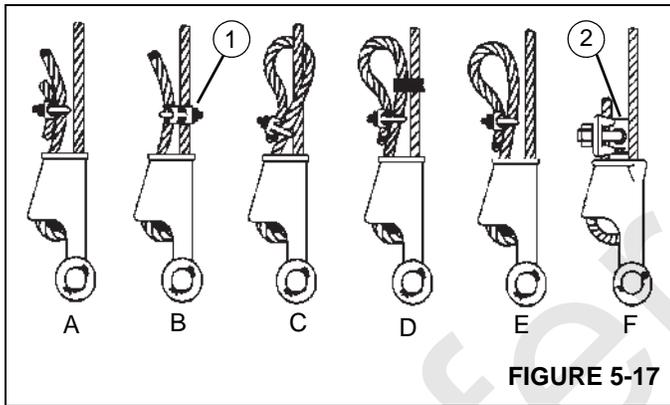


FIGURE 5-17

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 .

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 5-1 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.

BI-FOLD SWINGAWAY, OFF-SETTABLE BOOM EXTENSION

NOTE: Manual and hydraulic off-settable boom extensions install and remove the same way.

Description

A 10 m to 17 m (33 ft to 56 ft) bi-fold swingaway, manual or hydraulic off-settable boom extension provides additional boom reach. The boom extension weighs approximately 1,102 kg (2,430 lb).

The boom extension is stowed on the right side of the boom base and is easily attached or removed from the boom nose using a remotely operated electric extension support and two stowage pins.

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 boxed section portion is referred to as the boom extension fly section.



DANGER

Before attempting to erect or stow the boom extension, read and follow all safety decals installed on the boom, boom nose, boom extension, and stowage brackets.

Lifting over the boom extension base section is strictly prohibited when the boom extension fly section is erected or folded along side of the boom extension base section.



DANGER

Extending boom sections 2 through 4 during erection or stowage of the boom extension can cause disengagement of the anti-roll guides and allow uncontrolled movement of the boom extension, resulting in death, personal injury, or property damage.

Always ensure crane is in B mode during erection or stowage of the boom extension. Never erect or stow the boom extension in recovery mode.

Boom Extension Rigging Mode

This crane is equipped with a boom control system that enters a Boom Extension Rigging Mode when a minimum boom length is detected. The crane will not allow the following movements while in the Boom Extension Rigging Mode:

- Extension of boom in Auto Mode with A Mode selected.
- Extension of boom in Manual Mode, with Boom Section 2-4 selected.

The Boom Extension Rigging Mode requires the boom to be extended, in Auto Mode with B Mode selected or Manual Mode with Section 1 selected, until the boom automatically stops and is clear of the stowage ramps and stowage pins on the front stowage bracket.

To exit the Boom Extension Rigging Mode, the boom must be fully retracted, causing sections 1 and 2 proximity switches to activate. Boom operating mode restrictions are removed after exiting the Boom Extension Rigging Mode.

Erecting Boom Extension

Refer to (Figure 5-26).

1. Fully extend and set outriggers.
2. Position boom over front of crane.
3. Set boom manual/automatic mode selector switch to AUTO position.
4. Set boom A/B mode selector switch to B mode.
5. Fully retract all boom sections.
6. Lower boom to minimum elevation.
7. Lower front outriggers until front wheels are on ground.

NOTE: Auxiliary boom nose (rooster sheave) does not have to be removed. If reeved, remove hoist cable from sheave.

8. Rig main hoist or optional auxiliary hoist cable for single part line with only wedge socket on cable end.

CAUTION

If boom extension fly section is not to be erected, disconnect it from boom extension base section and keep attached to boom stowage brackets on boom base.

9. Attach rope to tip of boom extension base section to help swing it around to the front of the boom nose.
10. Remove caps and connect boom extension mount control pendant to connector on front of boom base.

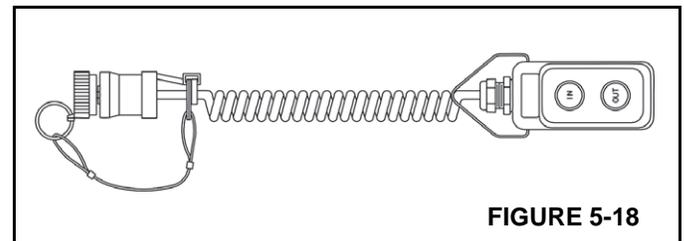


FIGURE 5-18

NOTE: If erecting boom extension base section with boom extension fly section, skip to step 13.

If erecting boom extension base section without boom extension fly section, perform steps 11 and 12.

11. Move locking bar (9, Figure 5-26; 2, Figure 5-19) to boom base attachment bar (1) and install pin (3). Secure with retaining clip.

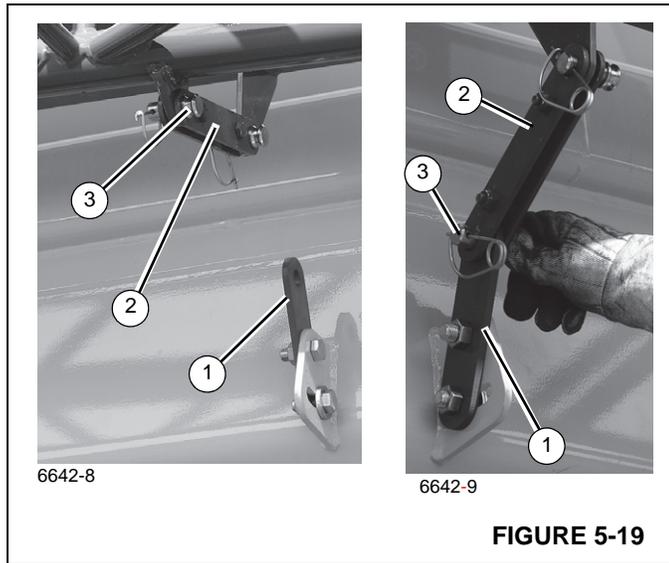


FIGURE 5-19

**DANGER**

Uncontrolled movement of the boom extension fly section can cause death, injuries, or damage to equipment. Ensure attachment pin securing the boom extension fly section to the boom extension fly section rear stowage bracket is in place.

12. Remove attachment pin connecting the boom extension fly section to the boom extension base section. Stow attachment pin in the stowage holder on the boom extension base section and secure with retaining clip.
- Skip to step 14.
13. Remove attachment pin securing the boom extension fly section to the rear stowage bracket assembly (1, (Figure 5-26)) on the boom base. Stow attachment pin in the stowage holder on the boom extension base section and secure with retaining clip.
14. Using control pendant, extend middle stowage bracket (10, (Figure 5-26)) until boom extension base section anchor fittings align with boom nose attachment fittings.
15. Remove attachment pins from stowage lugs on right side of boom extension base section and install into upper and lower right anchor and attachment fittings of

the boom extension base section and boom nose. Secure each attachment pin with a retaining clip.

16. Disconnect control pendant and replace caps.
17. Remove lock hitch pin (13, (Figure 5-26)) securing boom extension base section to the front stowage bracket (5, (Figure 5-26)) on the boom base. Stow lock hitch pin in the stowage holder underneath the stowage bracket and secure with retaining clip.

**DANGER**

When erecting the boom extension base section, keep all personnel and equipment clear of swing path.

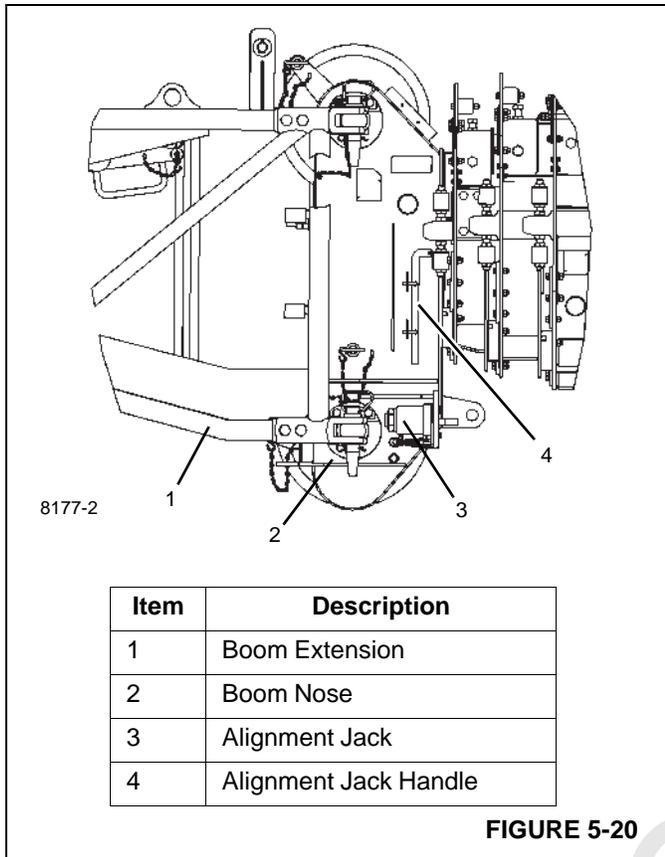
Uncontrolled movement of the boom extension base section can cause death, injuries, or damage to equipment.

18. Raise boom slightly above horizontal.
19. Extend boom until boom extension base section is clear of the middle stowage bracket ramp (10, (Figure 5-26)) and the front stowage bracket pins (14, (Figure 5-26)) on front stowage bracket assembly (5, (Figure 5-26))
20. Slightly raise or lower boom to help control the boom extension swing. Using rope attached to tip of the boom extension base section, swing boom extension base section in front of the boom nose until boom extension base section anchor fittings engage with left side boom nose attachment fittings.

**DANGER**

Do not modify attachment anchors or fittings to allow installation of the attachment pin.

21. Install attachment pin into the upper left anchor and attachment fittings of the boom extension base section and boom nose. Secure attachment pin with a retaining clip.
22. Using the jack handle (4, (Figure 5-20)) stored on the left side of the boom nose, extend boom extension alignment jack (3, (Figure 5-20)) until the lower left anchor and attachment fittings of the boom extension base section and boom nose are aligned. Install attachment pin and secure with retaining clip.



23. Retract alignment jack to its original position. Return jack handle to its stowed position on left side of the boom nose.

! DANGER

Do not attempt to erect the boom extension fly section unless it was attached to the boom extension base section during initial erection procedure.

24. If required, erect the boom extension fly section by performing the procedures under *Erecting Boom Extension Fly Section*, page 5-31.

Raise and lock the mast assembly (6, (Figure 5-26)) into an upright position.

- a. Remove mast assembly pin from the stowed position lug of the mast assembly.
- b. Raise the mast assembly and install pin in the upright position lug.
- c. Secure with clip pin.
- d. Remove cable retainer pin and clip pin from mast.

25. Extend boom until it automatically stops. Reaching this stopping point is required for the Boom Extension Rigging Mode process.

26. Lower boom and remove rope from tip of boom extension base section.

27. Fully retract boom until section 1 and section 2 proximity switches are activated. Boom Extension Rigging Mode is complete and boom operating mode restrictions are removed.

28. Connect the anti-two-block cable(s). Refer to *Connecting and Disconnecting Boom Extension*, page 5-42.

29. Connect hydraulic lines (if required). Refer to *Connecting and Disconnecting Boom Extension*, page 5-42.

30. If only the boom extension base section is erected, remove cable retainer pins and clip pins from the boom extension base section sheave.

If the boom extension fly section is erected, remove cable retainer pins and clip pins from the boom extension fly section sheave

NOTE: Hoist cable shall not be routed over the boom extension base section sheave when using the boom extension fly section.

31. Route hoist cable over mast sheave, then reinstall cable retainer pin and secure with clip pin.

If only the boom extension base section is erected, route cable over boom extension base section sheave, then reinstall cable retainer pins and secure with clip pins.

If the boom extension fly section is erected, route cable over roller at rear of boom extension fly section, then over boom extension fly section sheave. Reinstall cable retainer pins and secure with clip pins.

NOTE: Do not reeve hoist cable through sheaves on boom nose.

32. Rig hoist cable.

33. If required, set manual boom extension offset to 20° or 40°. Refer to *Setting Boom Extension Manual Offset*, page 5-35.

Erecting Boom Extension Fly Section

Refer to (Figure 5-26).

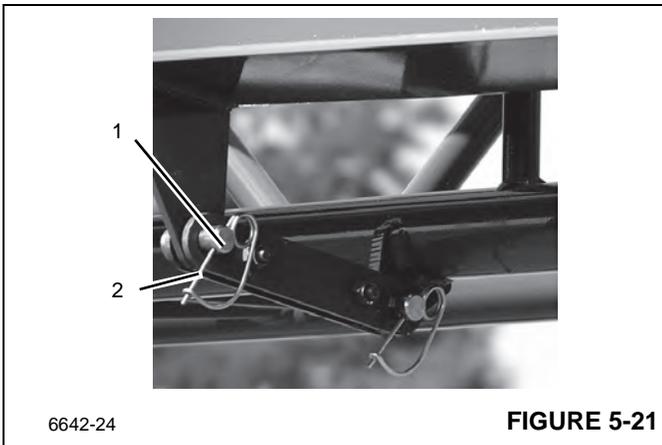
- 1. Attach rope to tip of boom extension fly section to help swing it around to the front of the boom extension base section.
- 2. Ensure attachment pin securing the right side of the boom extension base section to the boom extension fly section is in place.
- 3. Position boom to horizontal.
- 4. Position boom to horizontal.

**DANGER**

When erecting the boom extension fly section, ensure all personnel and equipment are kept clear of swing path.

Uncontrolled movement of the boom extension fly section can cause death, injuries, or damage to equipment.

5. Remove retainer clip (2, Figure 5-21) and remove pin (1).



6642-24

FIGURE 5-21

6. Slightly raise or lower boom to help control boom extension fly section swing. Using rope attached to tip of boom extension fly section, swing it in front of the boom extension base section until boom extension fly section attachment fittings engage with the left side boom extension base section anchor fittings.
7. Install attachment pin into left anchor and attachment fittings of the boom extension base section and boom extension fly section. Secure attachment pin with retaining clip.
8. Lower boom and remove rope from tip of the boom extension fly section.

Stowing Boom Extension

NOTE: Boom extension must be set at 0° offset. If boom extension is manually off-settable, refer to *Setting Boom Extension Manual Offset*, page 5-35.

Refer to (Figure 5-26).

1. Fully extend and set outriggers.
2. Position boom over front of crane.
3. Fully retract all boom sections.
4. Set offset to 0° if not already done so. Refer to the applicable procedures in this section.
5. Lower boom to minimum elevation.

6. Lower front outriggers until front wheels are on ground.
7. Set boom manual/automatic mode selector switch to the AUTO position.
8. Set boom A/B mode selector switch to the B mode.
9. If the boom extension fly section is erected, remove the clip pins and cable retaining pins at the boom extension fly section sheave, then remove the hoist cable. Reinstall cable retaining pins and secure with clip pins.

If only the boom extension base section is erected, remove the clip pins and cable retaining pins at the boom extension base section sheave, then remove the hoist cable. Reinstall cable retaining pins and secure with clip pins.

Remove the clip pin and cable retaining pin at the mast sheave (6, (Figure 5-26)), then remove the hoist cable. Reinstall cable retaining pins and secure with clip pins.

10. Stow mast assembly:
 - a. Remove pin from the upright position lug of the mast assembly.
 - b. Lower the mast assembly and install the pin in the stowed position lug.
 - c. Secure with clip pin.
11. Disconnect hydraulic lines (if required) Refer to *Connecting and Disconnecting Boom Extension*, page 5-42.
12. Disconnect the anti-two block cable(s). Refer to *Connecting and Disconnecting Boom Extension*, page 5-42.
13. If erected, stow boom extension fly section as follows:
 - a. Attach rope to the boom extension fly section tip.
 - b. Raise the boom to horizontal.

**DANGER**

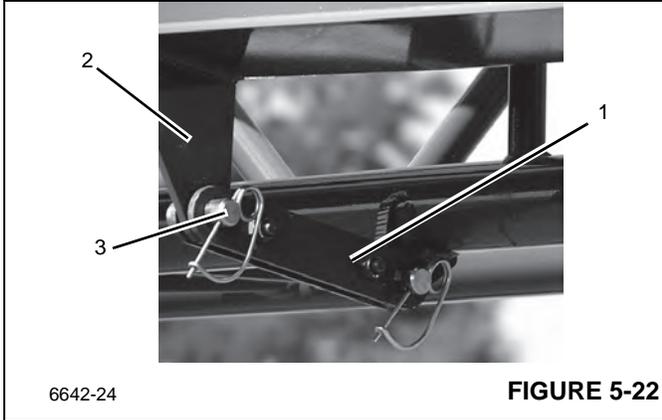
When stowing the boom extension fly section, ensure all personnel and equipment are kept clear of the swing path.

Uncontrolled movement of boom extension fly section can cause death, injuries, or damage to equipment.

- c. Remove left attachment pin connecting the boom extension fly section to the boom extension base section. Stow attachment pin in the stowage holder on the boom extension base section and secure with retaining clip.
- d. Slightly raise or lower boom to help control the boom extension fly section swing. Using rope attached to tip of boom extension fly section, swing

boom extension fly section to side of the boom extension base section.

- e. Connect locking bar (9, (Figure 5-26); 1, Figure 5-22) to boom extension base section attachment bar (2) using pin (3). Secure with retaining clip.



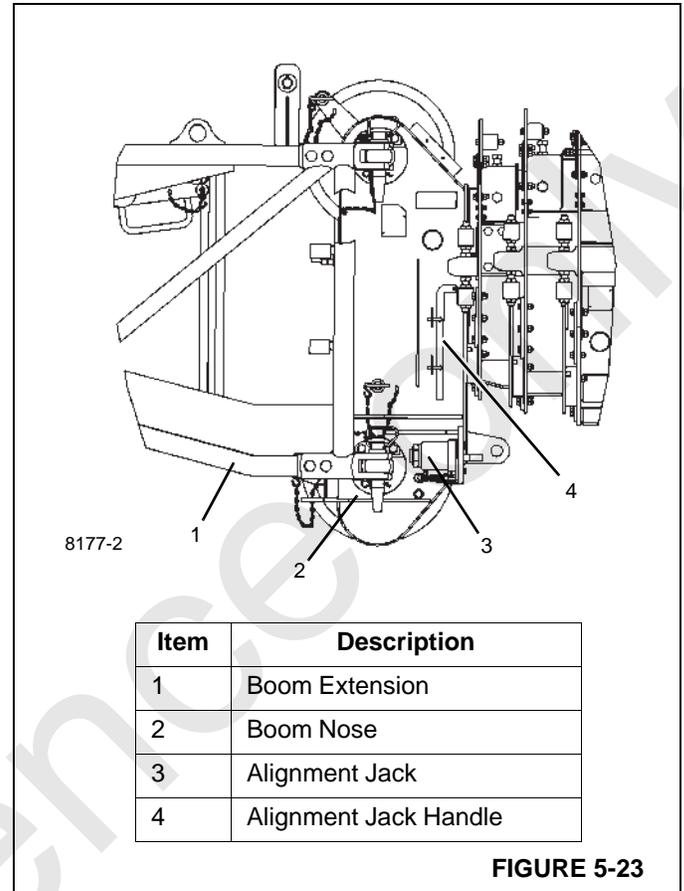
- 14. Lower boom to minimum elevation and remove rope.
- 15. Attach rope to boom extension base section tip.
- 16. Raise boom to horizontal.
- 17. Extend boom approximately 12 in so boom extension base section stowage lugs will line up in front of the middle stowage bracket guide ramp (10, (Figure 5-26)) and stowage pins (14, (Figure 5-26)) on the front stowage bracket assembly (5, (Figure 5-26)) when the boom extension is positioned to the side of the boom base.
- 18. Using the jack handle (4, (Figure 5-23)) stored on the left side of the boom nose, extend boom extension alignment jack (3, (Figure 5-23)) until the lower left attachment pin is free from the anchor and attachment fittings of the boom extension base section and boom nose. Remove attachment pin and stow on boom extension base section, then secure with retaining clip.
- 19. Retract alignment jack to its original position, then return the jack handle to its stowed position.



DANGER

When stowing the boom extension base section, ensure all personnel and equipment are kept clear of swing path. Uncontrolled movement of boom extension base section can cause death, injuries, or damage to equipment.

- 20. Remove top left attachment pin from the anchor and attachment fittings of the boom extension base section and boom nose. Stow attachment pin in boom extension base section and secure with retaining clip.



- 21. Slightly raise or lower boom to help control the boom extension base section swing. Using rope attached to tip of the boom extension base section, swing boom extension base section to the side of the boom base.
- 22. Elevate boom and push in on the boom extension base section to align the stowage lugs on the boom extension base section with the guide ramp and stowage pins on the stowage brackets, then fully retract the boom.
- 23. Fully lower boom.
- 24. Secure boom extension base section to front stowage bracket (5, (Figure 5-26)) on boom base using lock hitch pin (13, (Figure 5-26)). Ensure lock hitch pin is pushed in all the way, then secure with retaining clip.
- 25. Remove upper and lower right attachment pins from the anchor and attach fittings of the boom extension base section and boom nose. Stow attachment pins in the stowage lugs on the right side of the boom extension base section, then secure with retaining clips.
- 26. Remove caps and connect boom extension mount control pendant to connector on front of boom base.

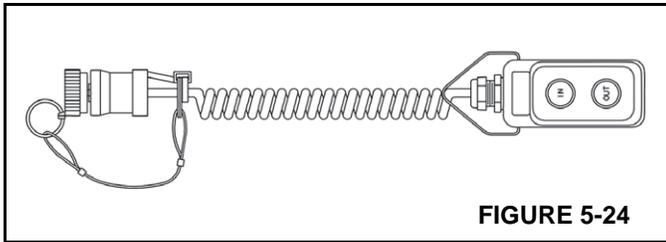


FIGURE 5-24

CAUTION

Failure to maintain proper clearance between the boom extension base section anchor fittings and boom nose attachment fittings could cause fittings to contact each other during operation of the boom.

27. Using control pendant, fully retract middle stowage bracket (10, (Figure 5-26)).
28. Ensure the two stowage lugs on the boom extension base section are fully engaged with the pins (14, (Figure 5-26)) on front stowage bracket (5, (Figure 5-26)).

NOTE: If boom extension fly section and boom extension base section are being stowed together, perform step 29.

If boom extension fly section remained on boom stowage brackets, perform steps 30 through 31.

29. Secure boom extension fly section to rear stowage bracket (1, (Figure 5-26)) on the boom base using the attachment pin. Secure attachment pin with retaining clip.

Skip to step 32.

30. Remove attachment pin from stowage holder on the boom extension base section and use it to secure the boom extension fly section to the boom extension base section. Secure attachment pin with retaining clip.

31. Remove pin (1, Figure 5-25) from boom base attachment bar (3). Move locking bar (2, Figure 5-25; 10, (Figure 5-26)) to boom extension base section and install pin (1). Secure with retaining clip.

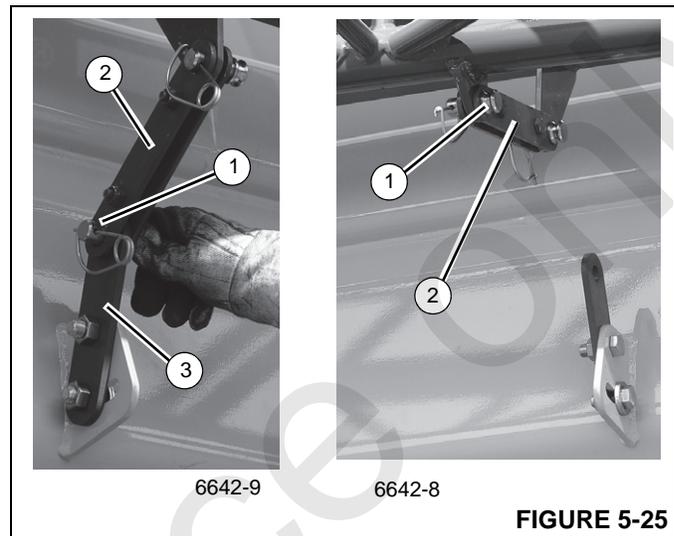


FIGURE 5-25

32. Disconnect control pendant and replace caps.
33. Extend boom in AUTO mode with B mode selected, or Manual Mode with Section 1 selected, until boom stops.

NOTE: Reaching this stopping point is required for the Boom Extension Rigging Mode process.
34. Retract boom until it stops.

NOTE: When boom reaches this stopping point and section 1 and section 2 proximity switches are activated, the Boom Extension Rigging Mode is complete and restrictions on the boom operating modes are removed.
35. Rig boom nose and hoist cable as desired. Operate crane using normal operating procedures.

Setting Boom Extension Manual Offset



DANGER

Crushing Hazard!

Ensure blocking material is adequate to support weight of extension assembly without tipping or falling.

Refer to (Figure 5-12).

Changing Offset from 0° to 20° or 40°

1. Extend and set outriggers. Swing boom over front of crane.
2. Raise and lock the mast assembly:
 - a. Remove mast assembly clip pin and pin from the stowed position on the extension
 - b. Raise the mast assembly to an upright position.
 - c. Install pin and clip pin.
 - d. Remove cable retainer pin and clip pin from mast.
3. Raise boom above horizontal.
4. Block under tip of boom extension section.

CAUTION

Possible Equipment Damage!

Do not overload boom extension anchor fittings or boom extension base section when lowering the boom.

5. Slowly lower boom until weight is removed from offset assembly.
6. Remove offset clip and pin securing offset assembly in the lesser degree offset position. If going to maximum offset stow in the stowage lug. If going to intermediate (20°) offset, install in offset hole for that degree of offset.
7. Reeve hoist cable as described under normal erecting procedures.
8. Slowly elevate and telescope boom at the same time so boom extension does not move off of the blocking until offset assembly takes full weight of the boom extension.

Changing Offset from 40° to 20° or 0°

CAUTION

Do not overload boom extension anchor fittings or boom extension base section when lowering the boom.

1. Extend and set outriggers. Swing boom over front of crane.
2. Block under tip of boom extension section.
3. Slowly lower boom until weight is removed from offset assembly.
4. Remove clip and pins from offset assembly. Lower boom until holes for lesser degree offset position align in offset assembly. Install offset pin and clip.
5. Slowly elevate and telescope boom at the same time so boom extension does not move off blocking until offset links take full weight of the extension.
6. Stow mast assembly:
 - a. Remove pin from the upright position lug on the extension
 - b. Lower the mast assembly and install the pin in the stowed position lug.
 - c. Secure with clip pin.
 - d. Reeve hoist cable as described under normal erecting procedures.

Setting Boom Extension Hydraulic Offset

1. Extend and set outriggers. Swing boom over front and raise above horizontal.
2. To change offset, press the Hydraulic Luffing Jib On/Off Switch to ON.
3. Using the Hydraulic Luffing Jib Adjustment Switch or the Luffing Jib Adjustment Switch on the luffing jib, press the appropriate button to increase or decrease the offset angle.

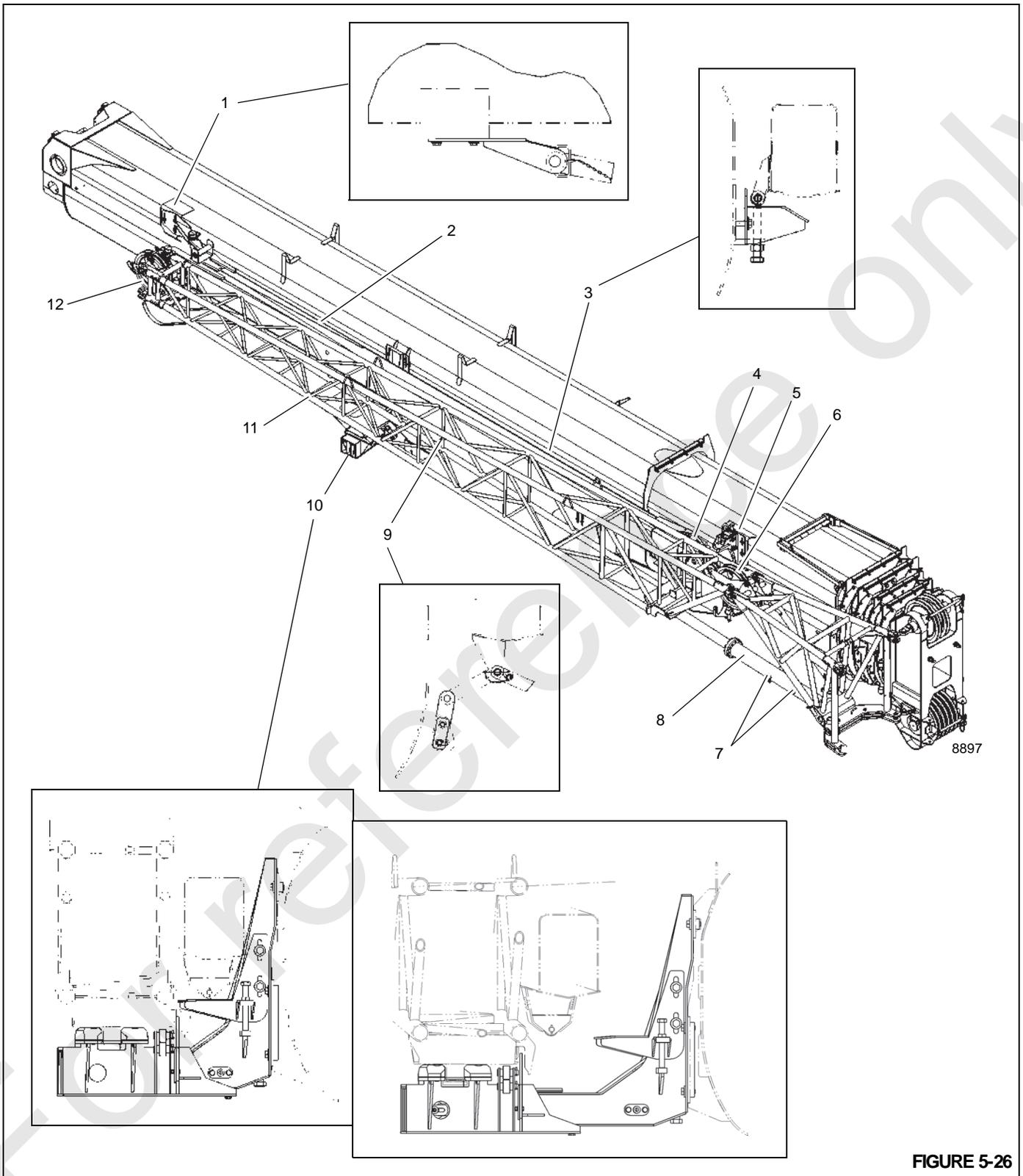


FIGURE 5-26

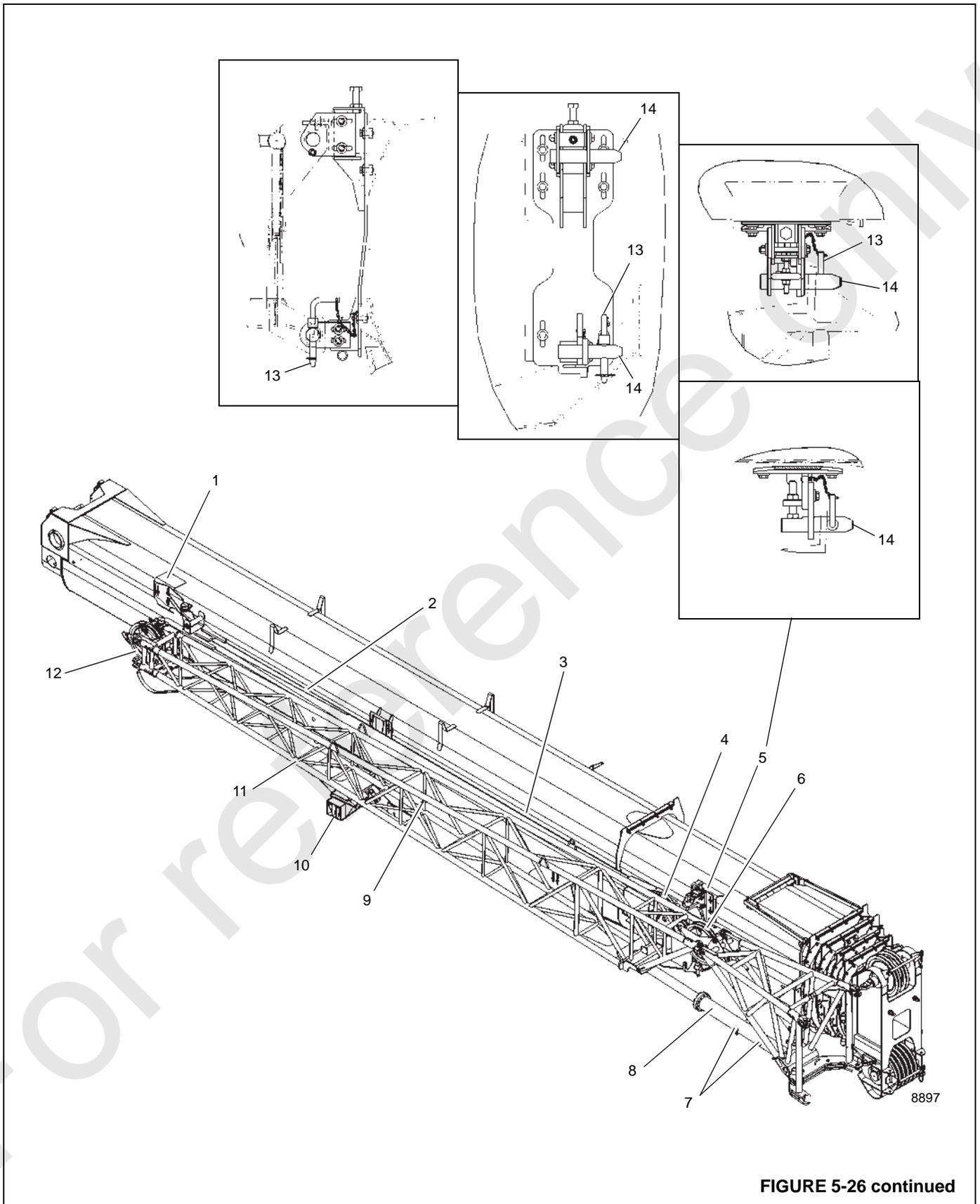


FIGURE 5-26 continued

Item	Description	Item	Description
1	Boom Extension Fly Section Rear Stowage Bracket Assembly	8	Offset Link
2	Boom Extension Fly Section	9	Boom Extension Locking Bar
3	Boom Extension Fly Section Front Stowage Ramp Assembly	10	Middle Stowage Bracket and Actuator Assembly
4	Boom Extension Fly Section Sheave	11	Boom Extension Base Section
5	Boom Extension Base Section Front Stowage Bracket Assembly	12	Boom Extension Base Section Sheave
6	Boom Extension Mast Assembly	13	Lock Hitch Pin
7	Offset Link Pinning Locations	14	Front Stowage Bracket Pins

ERECTING AND STOWING BI-FOLD BOOM EXTENSION WITH 6 M (20 FT) INSERT



DANGER

Crushing Hazard!

Before attempting to erect or stow boom extension with insert, read and follow all safety decals installed on boom/boom nose, boom extension, insert, and stowage brackets.

Erecting

NOTE: Auxiliary boom nose (rooster sheave) does not have to be removed. However, if reeved, the hoist cable must be removed from the sheave.

1. Fully extend and set outriggers.
2. Position boom over front of crane.
3. Fully retract the boom.
4. Lower boom to minimum elevation.
5. If not already done so, deploy the boom extension by performing the procedures under *Erecting Boom Extension*, page 5-29, but do not make the anti-two-block connection or hydraulic connection (if required) at the boom nose.
6. Extend boom as necessary to permit sufficient clearance for installation of the 6.1 m (20 ft) Extension Insert, then lower it until tip of boom extension is laying on the ground. Block under boom extension, approximately 2.4 m to 3.0 m (8 ft to 10 ft) ahead of the boom nose.
7. Remove four retainer clips and attachment pins that secure boom extension to the boom nose.
8. Retract boom leaving boom extension on blocking.
9. Using main or auxiliary hoist cable, lift Insert by the lifting lugs and position it at base end of boom extension.
10. Attach Insert to boom extension by installing the four attachment pins and retainer clips removed in step 7.

11. With hoist cable still attached to Insert, lift assembled unit. Move blocking erected in step 6, 2.4 m to 3.0 m (8 ft to 10 ft) ahead of boom nose attachment end of Insert.
12. Lower boom extension and insert assembly to blocks. Remove hoist cable.
13. Retract boom and lower to minimum elevation.
14. Rig hoist cable for single part line with only wedge socket on cable end.
15. Extend boom and mate anchor fittings on Insert with attachment fittings on boom nose. Raise or lower boom slightly to mate attachment anchor fittings as needed.

NOTE: If Insert anchor fitting holes are not in lateral alignment with holes in the boom nose attachment fittings to install the pins, adjust upper and lower cross strut adjustment screws on the Insert to align the holes.

16. Remove retainer clips from attachment pins stowed on Insert. Install in attachment and anchor fittings on both sides of boom nose. Install retainer clips.

CAUTION

Possible Equipment Damage!

Do not attempt to swing boom extension to right side of insert. Damage to insert may result.

17. Make anti-two block electrical connections between the insert and the boom nose and boom extension. If required, make hydraulic connections between the insert and the boom nose and boom extension.
18. Slowly elevate boom and remove blocking from under Insert and boom extension.
19. If required, erect the boom extension fly section. Refer to *Erecting Boom Extension Fly Section*, page 5-31.
20. Rig hoist cable.
21. If required, set offset. Refer to the applicable procedures in this section.

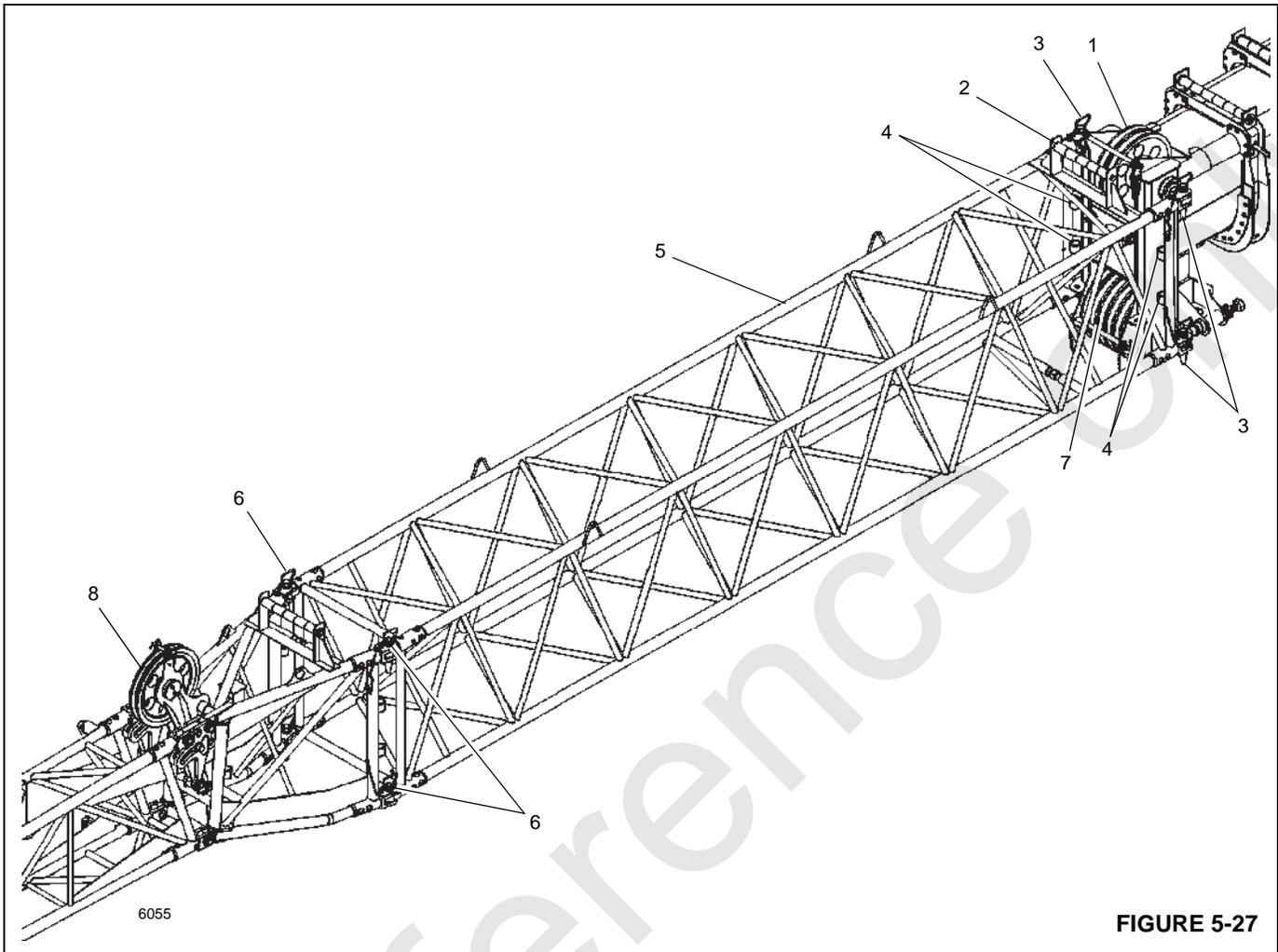


FIGURE 5-27

Item	Description	Item	Description
1	Boom Nose Upper Sheaves	5	6.1 m (20 ft) Insert
2	Cable Roller	6	Boom Extension Base Section Attachment Pins
3	Attachment Pins	7	Boom Nose Lower Sheaves
4	Attachment Pin Stowage Holder	8	Boom Extension Mast Assembly

Stowing

NOTE: When removing the insert, the boom extension fly section of the boom extension may be in the erected position or folded against the boom extension base section.

1. Fully extend and set outriggers.
2. Position boom over front of crane.
3. Fully retract the boom.
4. Set offset to 0° if not already done so. Refer to the applicable procedures in this section.
5. Lower boom to minimum elevation.
6. Remove cable retainer pins and clip pins from boom extension tip and mast assembly (if required). Remove hoist cable from boom extension sheave and/or mast. Install cable retainer pins and clip pins.
7. Disconnect anti-two block electrical connections between the insert and the boom nose and boom extension. If required, disconnect hydraulic connections between the insert and the boom nose and boom extension.

8. If required, stow the boom extension fly section by performing step 13 under *Stowing Boom Extension*, page 5-32.
9. Extend boom approximately 1.22 m to 1.52 m (4 ft to 5 ft). Lower boom until sheave is on ground.
10. Block under insert approximately 2.4 m to 3.0 m (8 ft to 10 ft) forward of boom nose.
11. Remove retainer clips from four pins in the attachment and anchor fittings. Remove attachment pins and stow in holders on insert.
12. Retract boom, disengaging attachment fittings on boom nose from anchor fittings on insert.
13. Attach a hook to the hoist cable.
14. Attach hoist cable hook to lifting lugs on insert. Lift assembly and reposition blocking approximately 2.4 m to 3 m (8 ft to 10 ft) forward of insert to boom extension attachment points.
15. While supporting insert with hoist cable, remove retainer clips from four pins attaching insert to boom extension. Remove four pins.
16. Remove insert and position to one side of crane.
17. Position boom and extend to engage boom nose with boom extension. Install four attachment pins and retainer clips removed in step 15.
18. If required, stow the boom extension by performing procedures 10 through 35 under *Stowing Boom Extension*, page 5-32.

CONNECTING AND DISCONNECTING BOOM EXTENSION

Connecting

Making Hydraulic Connection Between Boom Extension and Main Boom

⚠ WARNING

If hose couplings are detached from boom after hose drum lock pin has been released, do not release hose couplings until re-attached to boom. If hose couplings are released after being detached from boom, hoses will spring back uncontrollably due to hose drum spring force.

When working only with main boom for long periods of time, disconnect hydraulic connection between hose drum and main boom. This prevents unnecessary hydraulic hose reeling and unreeling.

If hoses are stowed on boom base holder, release hose drum (4) lock pin. Pull hydraulic hoses toward the boom nose. Anchor hydraulic couplings (1) at the boom nose holder (2). Route hydraulic hoses through guide rollers (3).

1. Unwind hoses on boom extension base section.
2. Remove dust caps from couplings on boom extension base section and drum hoses.
3. Connect boom extension base section hoses to drum hoses. Do not detach drum hoses from boom nose holder.

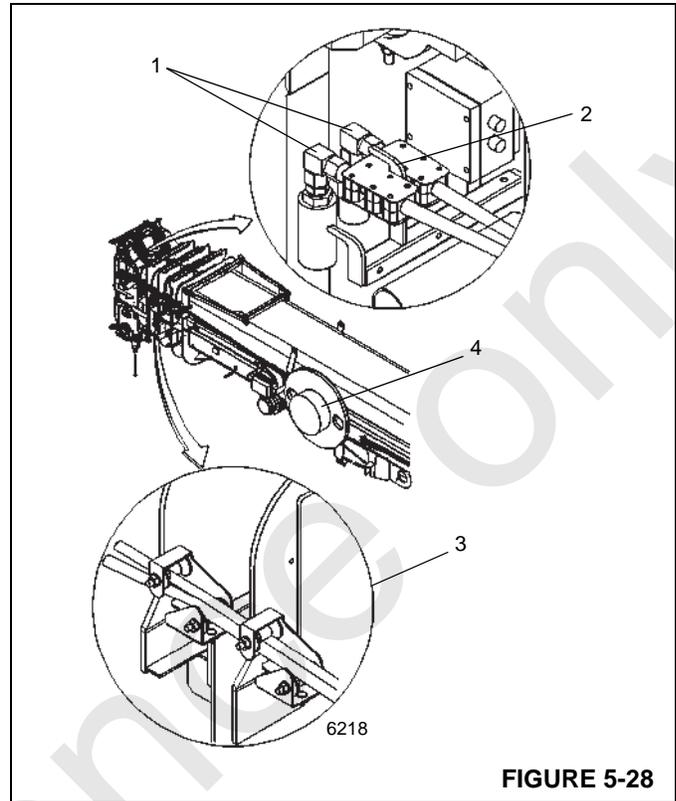


FIGURE 5-28

Item	Description
1	Hydraulic Couplers
2	Holder
3	Guide Rollers
4	Hose Drum

Making Electrical Connection Between Boom Extension Base Section and Boom Nose

1. Remove bypass plug from boom nose splitter connection and stow on cap near splitter connection.
2. Unwind cable from boom extension base section and connect to boom nose splitter connection.

Making Electrical Connection Between Boom Extension Base Section and Boom Extension Fly Section

1. Disconnect cable from boom extension base section anti-two block switch.
2. Connect boom extension base section cable to boom extension fly section cable.
3. Install cap onto anti-two block switch on boom extension base section.

Disconnecting

Disconnecting Electrical Connection Between Boom Extension Base Section and Boom Nose

1. Disconnect boom extension base section cable from boom nose splitter connection.
2. Install cap on cable and wind cable onto boom extension base section for storage.
3. Remove bypass plug from cap near splitter connection and install in splitter connection.

Disconnecting Electrical Connection Between Boom Extension Base Section and Boom Extension Fly Section

1. Remove cap from anti-two block switch on boom extension base section.
2. Disconnect boom extension base section cable from boom extension fly section cable.
3. Install cap onto plug of boom extension fly section cable.
4. Connect boom extension base section cable to anti-two block on boom extension base section.

Disconnecting Hydraulic Connection Between Boom Extension and Boom Base



WARNING

If hose couplings are detached from boom after hose drum lock pin has been released, do not release hose couplings until they are attached to the boom. If hose couplings are released after being detached from the boom, hoses will spring back uncontrollably due to spring force in the hose drum.

1. Disconnect boom extension hoses from drum hoses. Do not detach drum hoses from boom nose.

When working with main boom for longer periods of time, hydraulic hoses should be disconnected from boom nose and retracted. This prevents unnecessary reeling and unreeling of the hose.

2. Remove hoses from boom nose. Retract hydraulic hoses to holder on boom base.
3. Engage hose drum lock pin into hole on drum.
4. Wind hoses on boom extension base section for storage.
5. Install dust caps on boom extension base section and drum hose couplings.

3.05 M (10 FT) HEAVY DUTY BOOM EXTENSION (OPTIONAL)

Description

A 3.05 m (10 ft) manual off-settable heavy duty boom extension provides additional boom reach designed for tilt-up panel operations. The extension weighs approximately 700 kg (1,543 lb).

Installing Heavy Duty Boom Extension

1. Fully extend and set outriggers.
2. Position boom over front of crane.
3. Fully retract all boom sections.
4. Lower boom to minimum elevation.
5. Using a suitable lifting device, lift the heavy duty boom extension in front of the boom nose aligning the anchor fittings with boom attachment fittings.
6. Install attachment pins in anchor fittings and attachment fittings of the boom nose. Install retaining clips in attachment pins.
7. As required, rig main hoist or optional auxiliary hoist cable for single through four part line.
8. Connect RCL cables:
 - a. Remove RCL cable end connector from boom extension and route through boom extension.
 - b. Remove dummy plug from junction box on boom nose.
 - c. Install cable end connector from boom extension where dummy plug was removed.

Setting Heavy Duty Boom Extension Manual Offset



DANGER

Crushing Hazard!

Ensure blocking material is adequate to support weight of the extension assembly without tipping or falling.

Changing Offset from 0° to 35° or 55°

1. Extend and set outriggers.
2. Swing boom over front of crane.
3. Raise boom above horizontal.

4. Block under tip of boom extension.

CAUTION**Possible Equipment Damage!**

Do not overload boom extension anchor fittings or boom extension base section when lowering the boom.

5. Slowly lower boom until weight is removed from offset assembly.
6. Remove offset clip and pin securing offset assembly in the lesser degree offset position. If going to maximum offset, stow pin in the stowage lug. If going to intermediate (20°) offset, install pin in offset hole for that degree of offset. Secure with clip.
7. Reeve hoist cable as described under normal erecting procedures.
8. Slowly elevate and telescope boom at the same time so boom extension does not move off of the blocking until offset assembly takes full weight of the boom extension.

Changing offset from 55° to 35° or 0°

CAUTION

Do not overload boom extension anchor fittings when lowering the boom.

1. Extend and set outriggers.
2. Swing boom over front of crane.
3. Block under tip of boom extension.
4. Slowly lower boom until weight is removed from offset assembly.
5. Remove clip and pins from offset assembly. Lower boom until holes for lesser degree offset position align in offset assembly. Install offset pin and clip.
6. Slowly elevate and telescope boom at the same time so boom extension does not move off blocking until offset links take full weight of the boom extension.
7. Reeve hoist cable as described under normal erecting procedures.

Tilt-Up Panel Procedure Using the Heavy Duty Boom Extension

Refer to *Tilt-Up Panel Lifting*, page 2-21, in the *Safety Information* section for more information.

! 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.

The load's center of gravity must move towards the crane (Figure 5-29, A & B). Any other use is considered non-intended use and is prohibited. For examples see Figure 5-30, C & D.

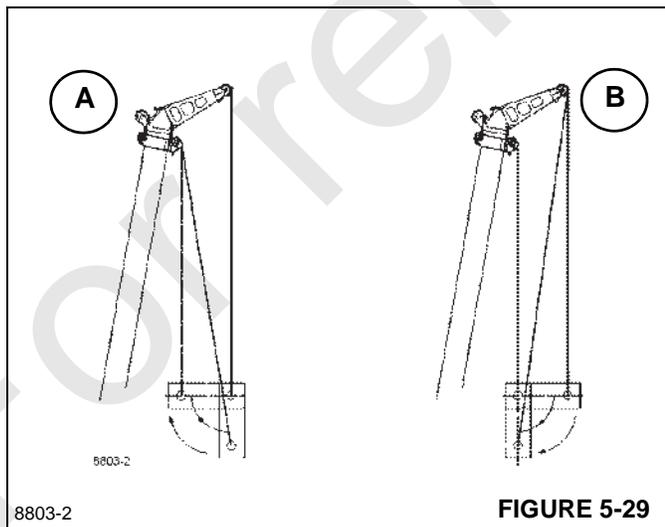
Movement of the load during tilting shall be done such that the moment decreases.

Tilting from Vertical to Horizontal

- Lift the load on the heavy duty boom extension (Detail A).
- 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

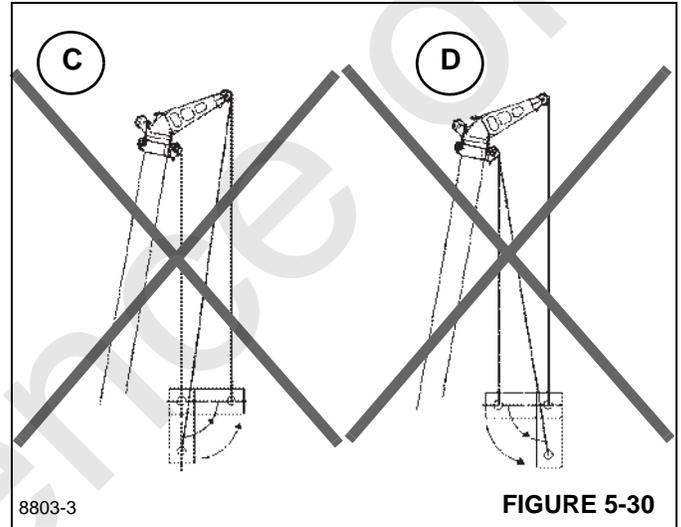
- Lift the load horizontally using the two hoists (Detail B).
- Then slacken the lifting rope of the boom extension until the load is suspended vertically. Lower the load via the main boom and pay-out the lifting rope of the boom extension. Ensure that the rope does not have slack.



! DANGER

Death or serious injury may result if the boom is overloaded.

If you proceed in accordance with Detail C / Detail D, the load will swing outward and the load torque will increase. This work method can cause the machine to tip or the boom system to become overloaded and is therefore strictly prohibited!



Removing Heavy Duty Boom Extension

1. Fully extend and set outriggers.
2. Position boom over front of crane.
3. Fully retract all boom sections.
4. Lower boom to minimum elevation.
5. Attach a suitable lifting device to the boom extension. Lift the boom extension enough to take the load off of the anchor fittings and attachment fittings.
6. Remove retainer clips from attachment pins. Remove attachment pins from anchor fittings and attachment fittings of the boom nose.
7. Lift the boom extension from in front of the boom nose.

COUNTERWEIGHT REMOVAL AND INSTALLATION

! DANGER

Falling counterweight can crush and cause death or serious injury.

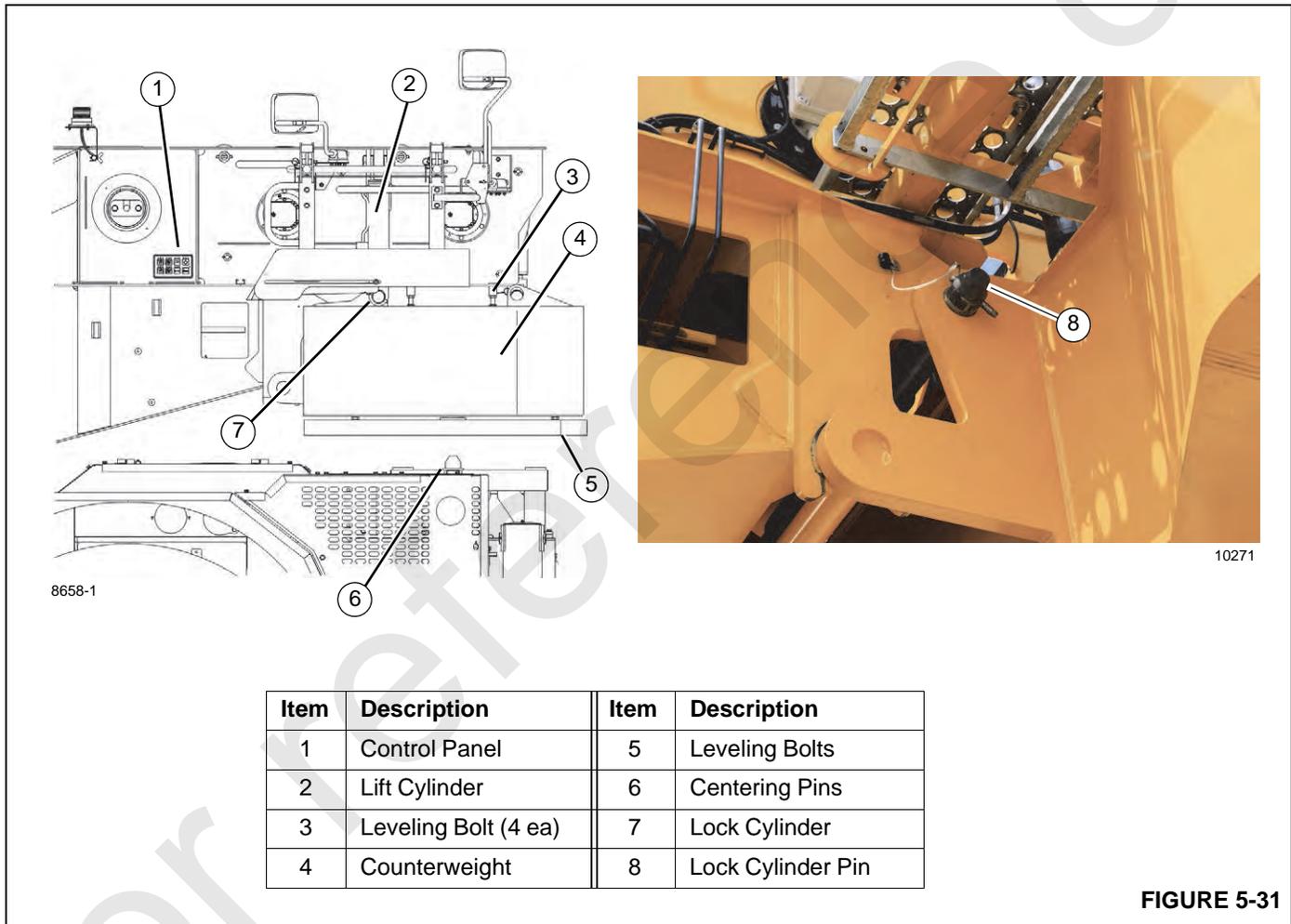
Ensure all mounting pins are properly installed and locked, during and after operating the counterweight removal system.

Counterweight is installed and removed using hydraulic cylinders controlled by a counterweight control panel located on each side of the superstructure. The counterweight assembly is held in place by a hydraulic cylinder and locking pins with pin clips.

Counterweight is lowered or lifted from two centering pins located on the rear deck.

! DANGER

Travel is not permitted with removable counterweight on carrier deck.



Item	Description	Item	Description
1	Control Panel	5	Leveling Bolts
2	Lift Cylinder	6	Centering Pins
3	Leveling Bolt (4 ea)	7	Lock Cylinder
4	Counterweight	8	Lock Cylinder Pin

FIGURE 5-31

Counterweight Control Panel

Counterweight control panels are located on each side of the superstructure between the boom pivot and main hoist. Only one control panel can be used at a time. The crane engine must be running with parking brake ON and no other functions enabled for system to be fully operational.

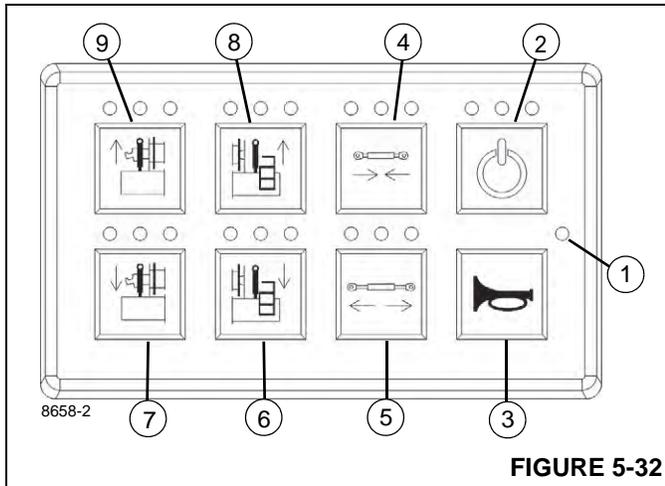


FIGURE 5-32

Item	Description
1	Main Power Indicator
2	Keypad Enable
3	Horn
4	Lock Cylinder Retract
5	Lock Cylinder Extend
6	Left Counterweight Cylinder Lower
7	Right Counterweight Cylinder Lower
8	Left Counterweight Cylinder Raise
9	Right Counterweight Cylinder Raise

Flashing green LED (1) indicates main power is on. Enable and Horn buttons are illuminated and active.

Three LED's above each button indicate:

Green - Function enabled.

Yellow - Error condition.

Red - Function not available or system not enabled.

NOTE: The horn button (3) is always active. Enable does not have to be pressed before using the horn.

The Enable button (2) must be pressed and released before selecting a function. The function must be selected within five seconds after pressing the Enable button or the system will time out and the Enable button must be pressed again.

If the Enable button is pressed and held for more than 2 seconds, the red LED will illuminate. No other functions are available until the button is released and pressed again.

Removing the Counterweight

Refer to Figure 5-32.

CAUTION

When raising or lowering the counterweight, make sure that the weight remains level by using the left and right cylinder control buttons

1. Position crane on a firm level surface. Fully extend and set outriggers.
2. Rotate superstructure so that the boom is over rear of crane and the counterweight is centered at front of vehicle. Engage turntable lock.
3. Make sure counterweight support (1, Figure 5-33) is securely attached at front of carrier.

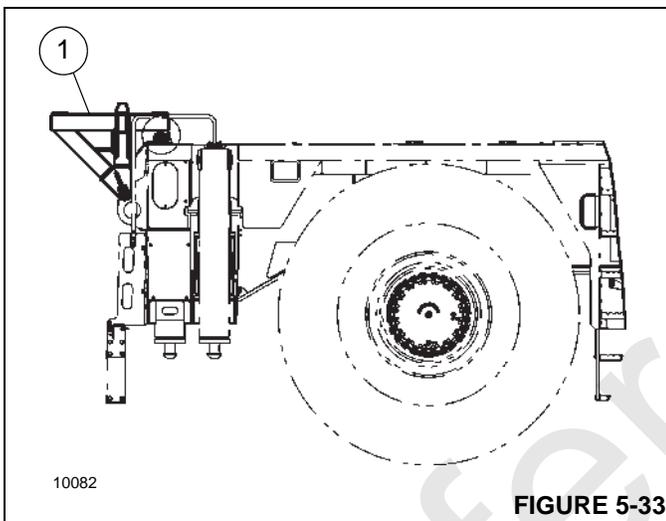


FIGURE 5-33

4. Remove pin clips from lock cylinder pin (8, Figure 5-31) on each side of superstructure.
5. Press and release Enable button (2). Press and hold Lock Cylinder Retract button (4) until lock cylinder pins are completely retracted.
6. Check area is clear around counterweight and carrier front deck. Press horn button (3).

CAUTION

To prevent machine damage, make sure that the Lock Cylinder Pins are fully retracted and the counterweight is hanging freely from the lifting cylinders before lowering the counterweight

CAUTION

When lowering the counterweight, make sure that the weight remains level to avoid crane damage.

7. Press and release Enable button (2). Press and hold Left (6) and Right (7) Counterweight Cylinder Lower buttons until counterweight is completely lowered on centering pins and front deck/counterweight stand.
8. Remove lock pins and retaining pins from lift cylinders and counterweight.

NOTE: Operate left or right cylinder as needed to remove pins.

9. Press and release Enable button (2). Press and hold Left (8) and Right (9) Counterweight Cylinder Lift buttons until cylinder rods are completely retracted. Reinstall retaining pins and lock pins.

NOTE: Do not leave cylinder rods extended. Corrosion or other damage may occur.



DANGER

Travel is not permitted with removable counterweight on carrier deck.

10. Release turntable lock. Rotate superstructure 90° for clear access to front deck with counterweight.

NOTE: Counterweight weighs 13,245 kg (29,200 lb).

11. Lift counterweight from carrier deck to transport vehicle.
12. Select proper "Without Counterweight" operating code on the RCL.

Removing the counterweight increases loading on the front axle. Refer to the *Load Chart Manual* and the section *Driving the Crane*, page 4-11 in this manual for details about travel with counterweight removed.

Installing the Counterweight

Refer to Figure 5-32.

CAUTION

When raising or lowering the counterweight, make sure that the weight remains level by using the left and right cylinder control buttons

1. Position crane on a firm level surface. Fully extend and set outriggers.
2. Make sure counterweight support (1, Figure 5-34) is securely attached at front of carrier.

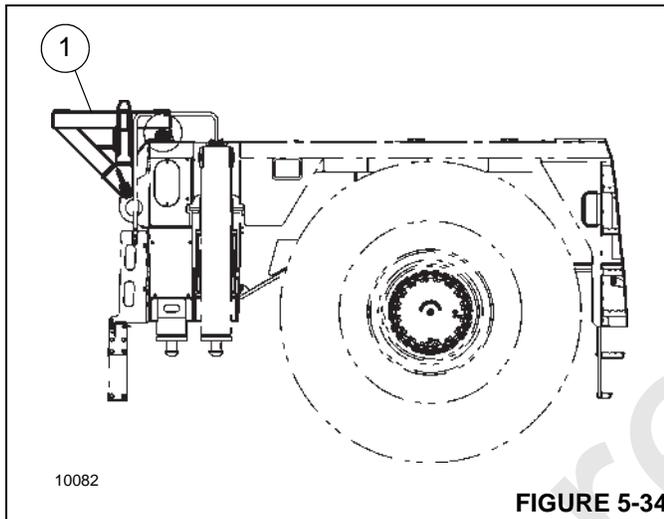


FIGURE 5-34

3. Rotate superstructure 90° for clear access to front deck.

NOTE: Counterweight weighs 13,245 kg (29,200 lb).

4. Lift counterweight from transport vehicle and position on front deck centering pins.
5. Place superstructure in normal travel position with boom centered over rear of vehicle. Engage turntable lock.
6. Remove lock pins and retaining pins from counterweight lift cylinders.

DANGER

Hand Crushing Hazard!

Do not place hand between counterweight cylinders and the top of the counterweight while cylinders are in motion.

7. Press and release Enable button (2). Press and hold Left (6) and Right (7) Counterweight Cylinder Lower buttons until cylinder rod ends engage counterweight.
8. Install lock pins and retaining pins in lift cylinders and counterweight.

NOTE: Operate left or right cylinder as needed to install pins.

CAUTION

When raising the counterweight, make sure that the weight remains level to avoid crane damage.

9. Press and release Enable button (2). Press and hold Left (8) and Right (9) Counterweight Cylinder Lift buttons until counterweight engages superstructure and lock cylinder holes are aligned with lock cylinder rods on both sides.

NOTE: Operate left or right cylinder as needed to align lock cylinder holes with lock cylinder pins.

10. Press and release Enable button (2). Press and hold Lock Cylinder Extend button (5) until lock cylinder pins (8, Figure 5-31) are completely extended.
11. Install pin clips in counterweight lock cylinder pins on each side of superstructure.
12. Adjust four counterweight bolts and jam nuts to provide a consistent stop and proper alignment with the pinning holes.
13. Select proper counterweight operating code on the RCL.
14. Crane is now ready for operation with counterweight installed.

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For reference only

SECTION 6

MAINTENANCE AND LUBRICATION

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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 Grove Product Support.

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 GRT8100-1 *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 Grove 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
Gear Lube: Axles Swing Drive Gear Box	6829012964	Century Unigear Semi-synthetic Texaco Multigear SS Chevron DELO Gear Lubricant Phillips 66 Triton® Synlube LDO Kendell SHP Syngear FE Super MPGO Castrol SP Gear	80W-90	GL-5
Engine Oil (SAE) (EO 15W-40)	6829104182	Conoco Fleet Supreme EC Mobil Delvac 1300 Super Mobile HDEO Mobil Delvac MX ESP Phillips 66 Fleet Supreme EC	15W-40	CJ-4
Hydraulic/Transmission Oil	6829006444	Phillips 66 PowerTran XP Exxon Mobil 424	ISO 46/68	Must meet John Deere Standard JDM J20C
Extreme Pressure Gear Lube: Hoist Swing Drive Gearbox Brake Assembly	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) Ipiranga Ipiflex Li-Comp EP-2 (red) Fuchs Renolit Hi-Temp 220 (ivory)	NLGI 2	GC-LB Certified
Open Gear Lube (EP-OGL)	6829102971	Fuchs Ceplattyn 300 Spray	NLGI 1-2	

Table 6-1 : Standard Lubricants [Down to -9°C (+15°F)] (Continued)

Lubricant/Fluid	Grove Spec.	Recommended Lubricant		
		Type	Grade	Classification
Antifreeze Coolant	6829101130	Old World Industries, Inc. Fleet SCA Pre-charged (red) Caterpillar DEAC (magenta) Fleetguard ES Compleat EG (blue) Purus Heavy Duty Pre-charged (red) Kostusa Defendal Heavy Duty Pre-charged (red) Prestone Command Heavy Duty Pre-charged	AFC - 50/50 Mix 50/50	
Liquid Coolant Conditioner (LCC)	6829012858	Fleetguard DCA4 Fleetguard DCA2 Penray Pencool 3000	LCC	
Diesel Exhaust Fluid (DEF)	80019225	Fleetguard StableGuard™ Urea 32 Premix AdBlue® TerraCair Ultrapure® DEF	DEF	
Extreme Pressure 3% Moly Grease (EM-3MG)	6829015304	Citgo Lithoplex CM2 Mobil Mobilgrease CM-P Phillips 66 Megaplex XD3 Ipiranga Ipiflex Li-comp Moly 2 (Gray)	NLGI 2 NLGI 2 NLGI 1 NLGI 2	GC-LB Certified GC-LB Certified
BECHEM PAL1	01373458			
BECHEM RHUS SW-2	03325216		NLGI 1-2	

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 Grove Product Support.

NOTE: All fluids and lubricants may be purchased by contacting your local Grove distributor or Grove Product Support.

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 4-10.

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 Gear Lube: Axles Swing Drive Gear Box	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 Kendell SHP Full Syngear FE Chevron Delo Syn-Gear HD Chevron Delo Syn-Gear XDM	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 Oil	6829006993	Exxon Mobil Univis HVI 26	ISO 26	
Transmission Oil	6829101559	Petro-Canada Duratran Synthetic THF Chevron All Weather THF Texaco TDH Oil SS		Must Meet John Deere Std. JDM J20C & J20D
Synthetic Gear Lube: Hoist Swing Drive Gear Box Brake Assembly	6829103636	Petro-Canada Enduratex Synthetic EP 150 Mobil SHC 629 Mobil Mobilgear SHC 150 Phillips 66 Syncon® EP Plus	ISO 150	AGMA No. 4 EP
Extreme Pressure Multipurpose Grease (EP-MPG)	6829104275	Mobil Mobilith SHC 220 (red) Petro-Canada Precision Synthetic EP1 Phillips 66 Multiplex FS 220 (purple)	NLGI 2	GC-LB Certified
Open Gear Lube	6829102971	Fuchs: Ceplattyn 300 Spray	NLGI 1-2	

Table 6-2 : Cold Weather Lubricants in Arctic Conditions [Down to -29°C (-20°F)] (Continued)

Lubricant/Fluid	Grove Spec.	Recommended Lubricant		
		Type	Grade	Classification
Antifreeze Coolant	6829101130	Old World Industries, Inc. Fleet SCA Pre-charged (red) Caterpillar DEAC (magenta) Fleetguard ES Compleat EG (blue) Purus Heavy Duty Pre-charged (red) Kostusa Defendal Heavy Duty Pre-charged (red) Prestone Command Heavy Duty Pre-charged	Mix 50/50	
Liquid Coolant Conditioner	6829012858	Fleetguard DCA4 Fleetguard DCA2 Penray Pencoool 3000		
Diesel Exhaust Fluid (DEF)	80019225	Fleetguard StableGuard™ Urea 32 Premix AdBlue® TerraCair Ultrapure® DEF		
Windshield Washer Fluid	90037773	Splash De-icer		
Diesel Fuel	80069407	NOCO Kerosene, 3, UN1223, III Product #1	#1	NLOCK08
BECHEM PAL1	01373458			
BECHEM RHUS SW-2	03325216		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
Synthetic Gear Lube: Axles Swing Drive Gear Box	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 Kendell SHP Full Syngear FE Chevron Delo Syn-Gear HD Chevron Delo Syn-Gear XDM	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 Oil	6829006993	Exxon Mobil Univis HVI 26	ISO 26	
Transmission Oil	6829101559	Petro-Canada Duratran Synthetic THF Chevron All Weather THF Texaco TDH Oil SS		Must Meet John Deere Std. JDM J20C & J20D
Synthetic Gear Lube: Hoist Swing Drive Gear Box Brake Assembly	6829103636	Petro-Canada ENDURATEX Synthetic EP 150 Mobil SHC629		AGMA No. 4 EP
Extreme Pressure Multipurpose Grease (EP-MPG)	6829104275	Mobil Mobilith SHC 220 (red) Petro-Canada Precision Synthetic EP1 Phillips 66 Multiplex FS 220 (purple)	NLGI 2	GC-LB Certified
Open Gear Lube	6829102971	Fuchs Ceplattyn 300 Spray	NLGI 1-2	
Antifreeze Coolant	6829104212	Old World Industries, Inc. Fleet Charge SCA Pre-charged Fleetguard Compleat EG Petro-Canada Purus® Heavy Duty	Mix 60/40	
Liquid Coolant Conditioner	6829012858	Fleetguard DCA4 Fleetguard DCA2 Penray Pencool 3000		

Table 6-3 : Cold Weather Lubricants in Arctic Conditions [Down to -40°C (-40°F)] (Continued)

Lubricant/Fluid	Grove Spec.	Recommended Lubricant		
		Type	Grade	Classification
Diesel Exhaust Fluid (DEF)	80019225	Fleetguard StableGuard™ Urea 32 Premix AdBlue® TerraCair Ultrapure® DEF		
Windshield Washer fluid	90037773	Splash De-icer		
Diesel Fuel	80069407	NOCO Kerosene, 3, UN1223, III	#1	NLOCK08
BECHEM PAL1	01373458			
BECHEM RHUS SW-2	03313195		NLGI 2	

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. Grove Product Support 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 crane 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 quickserv.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.

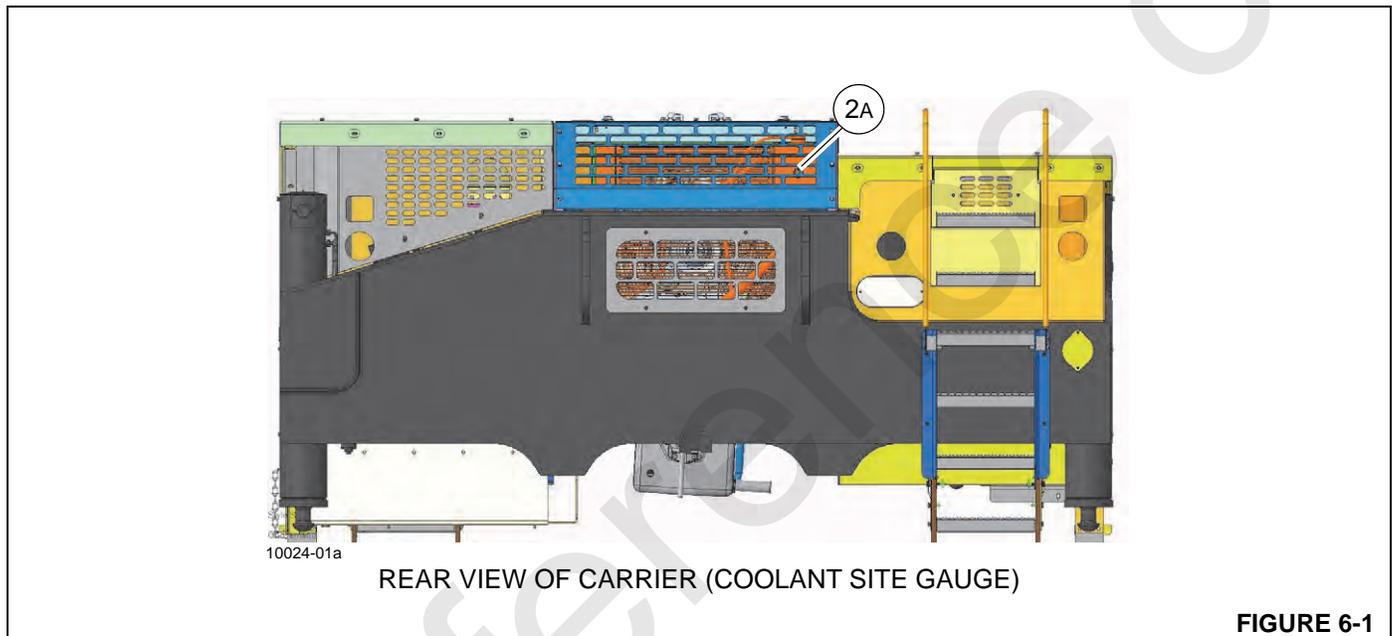
After positioning areas of the crane for lubrication, turn off the engine and make sure that the moving parts of the crane are stopped before approaching.

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	6829006993	6829006993
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 RHUS SW-2	033252126	03325216	03313195

Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Drive Train						
1	Air Cleaner Filter for Stage V / Tier 4F	Figure 6-2	—	—	When engine fault shows in ODM See NOTE 3.	REPLACE air cleaner filter See NOTE 1.
	Air Cleaner Filter for Tier 3 / non-certified				When indicator shows red (25" H ₂ O) See NOTE 2.	REPLACE air cleaner filter See NOTE 1.
2	Engine Cooling System (Cummins)	Figure 6-1	C	52.7 L (14 gal) See NOTE 4.	Every 10 hours, or daily, whichever interval comes first LIFETIME See Service Manual.	CHECK level using sight gauge (2A) See NOTE 5. DRAIN and FILL See NOTE 6.
	Liquid Cooling Conditioner (LCC)	Figure 6-1	D	As necessary	See Service Manual	TEST and ADD See NOTE 7.
3	Engine Crankcase with Filter - Stage V / Tier 4F	Figure 6-2	F	Stage V / Tier 4F 20 L (5.3 gal)	Every 10 hours of service, or daily, whichever interval comes first	CHECK oil level ADD oil to FULL on DIPSTICK (3A) See NOTE 8.
					Every 500 hours of service	DRAIN crankcase REPLACE filter (3B) FILL oil to FULL (3c) See NOTE 8.
	Engine Crankcase with Filter - Tier 3 / non-certified			Every 10 hours of service, or daily, whichever interval comes first	CHECK oil level ADD oil to FULL See NOTE 8.	
				Every 500 hours of service See NOTE 9 when using sulfur fuel that is >5000 ppm (it is not recommended)	DRAIN crankcase REPLACE filter See NOTE 9. FILL oil to FULL See NOTE 8.	
<p>NOTE 1: REMOVE decking side cover to access Engine Air Cleaner Filter element.</p> <p>NOTE 2: REPLACE Air Cleaner Primary Element when Indicator shows Red (25" H₂O).</p> <p>NOTE 3: REPLACE Air Cleaner Primary Element when engine fault comes on in the Crane Vitals Area of the Operator Display Module (ODM).</p> <p>NOTE 4: Anti-Freeze Coolant (AFC) capacities indicated are for a fully formulated mixture of 50% AFC and 50% water.</p> <p>NOTE 5: CHECK Coolant level using sight gauge (2A) visible through radiator grille at rear of crane. FILL Surge Tank to bottom of filler neck. OPERATE engine through two (2) thermal cycles. CHECK coolant level and FILL as necessary.</p> <p>NOTE 6: See your GRT8100-1 <i>Service Manual</i> for specified coolant fill instructions.</p> <p>NOTE 7: See your GRT8100-1 <i>Service Manual</i> for information about Liquid Cooling Conditioner (LCC) levels and testing.</p>						

Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
NOTE 8:	Engine Oil Fill (3c) is on top of the valve cover. Engine Oil Filter (3B) is located on inside left side of the frame, adjacent to the engine. Engine Oil Dipstick (3A) is on the top right side of the crankcase near Engine Oil Fill.					
NOTE 9:	Frequency for Engine Oil Filter (3B) service intervals will increase in special circumstance when using sulfur fuel that is >500 ppm. To keep your crane running smoothly, without causing engine damage, it is important to drain the engine crankcase and replace your engine oil filter (3B), using the following time line as your guide:					
	<ul style="list-style-type: none"> • If using 500–5000 ppm sulfur fuel in the engine, then drain the crankcase and replace your engine oil filter every 400 hours of service. • If using >5000 ppm sulfur fuel in the engine, then drain the crankcase and replace your engine oil filter every 250 hours of service. Grove does not recommend using >5000 ppm sulfur fuel in the engine. 					



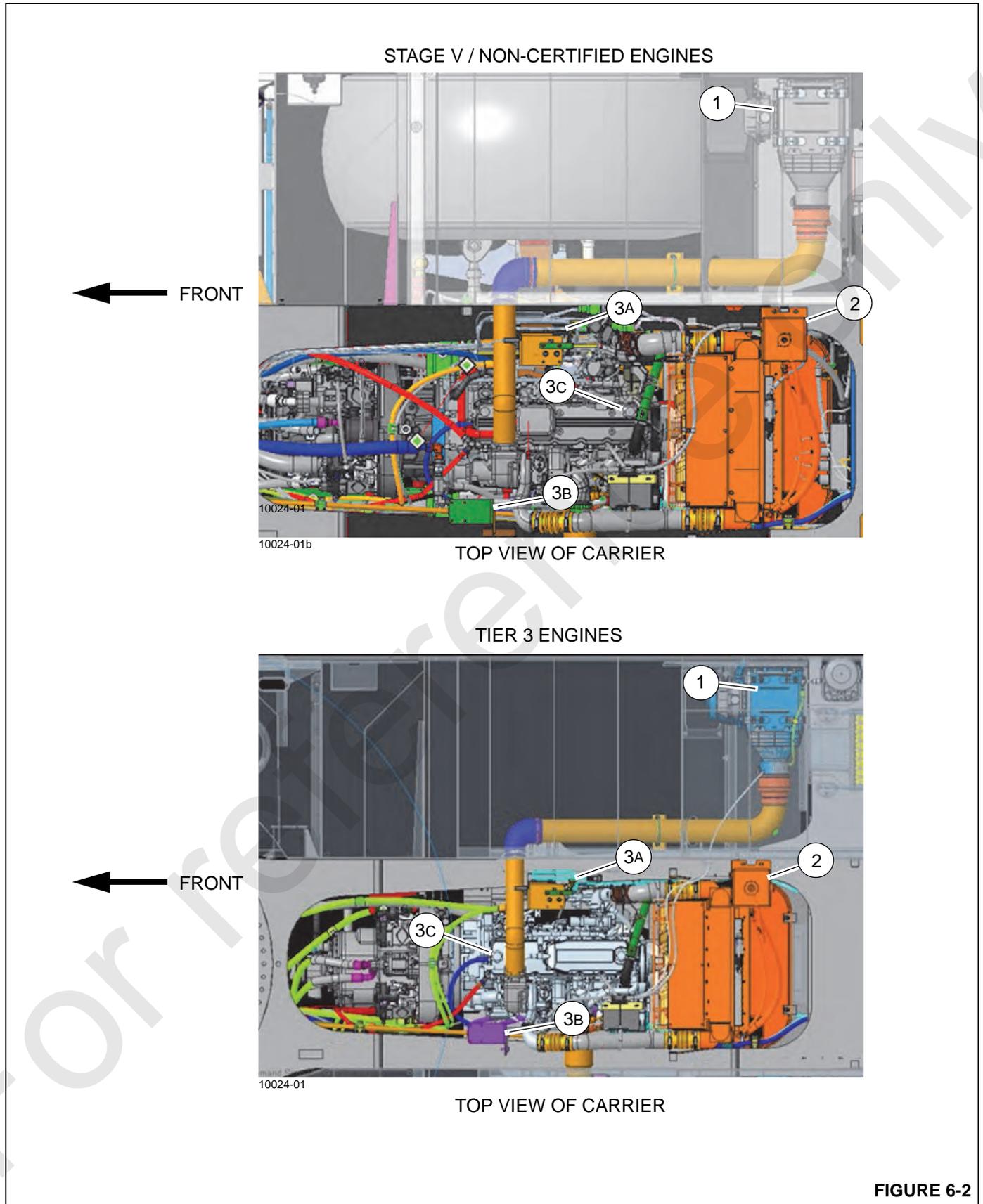
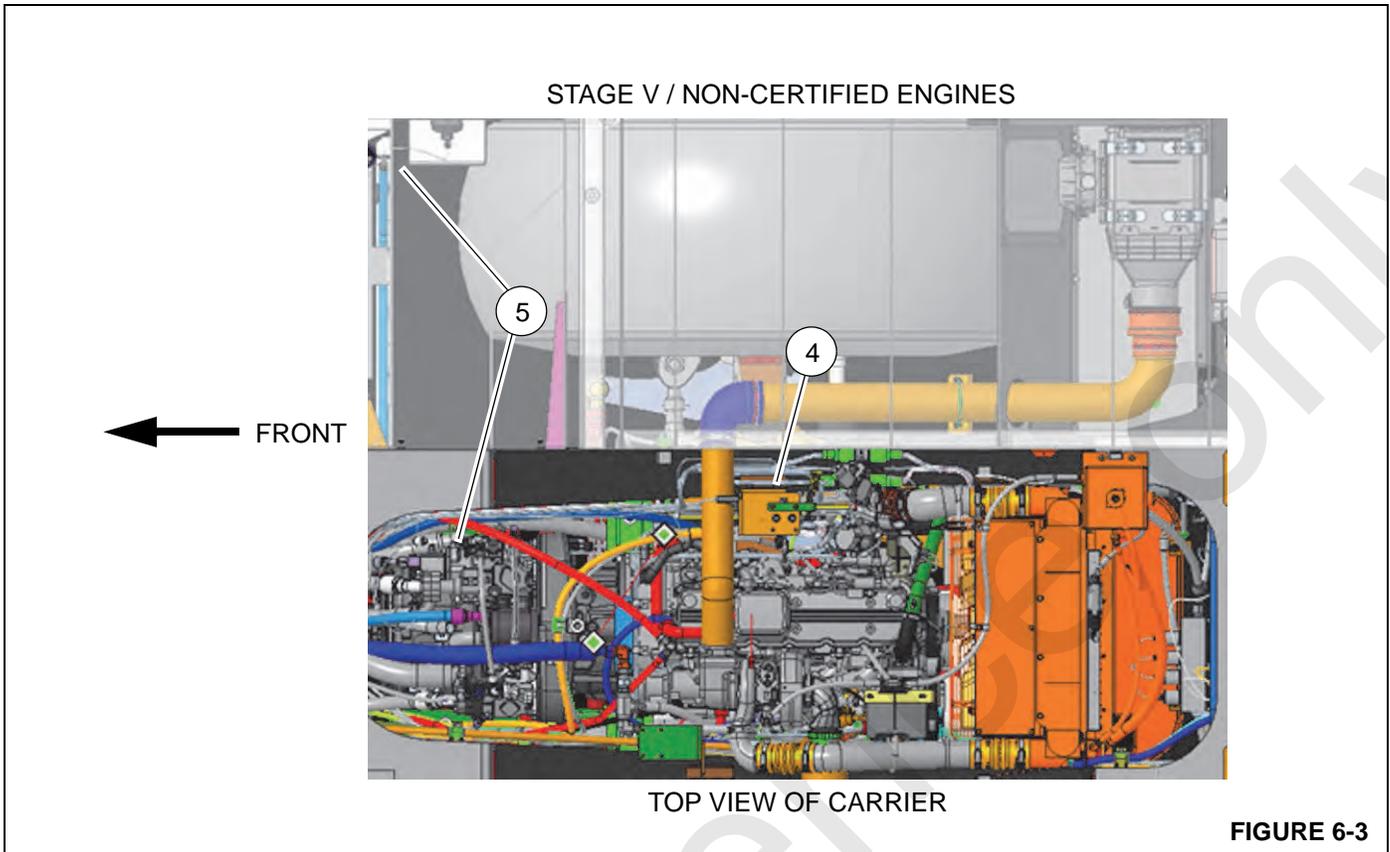


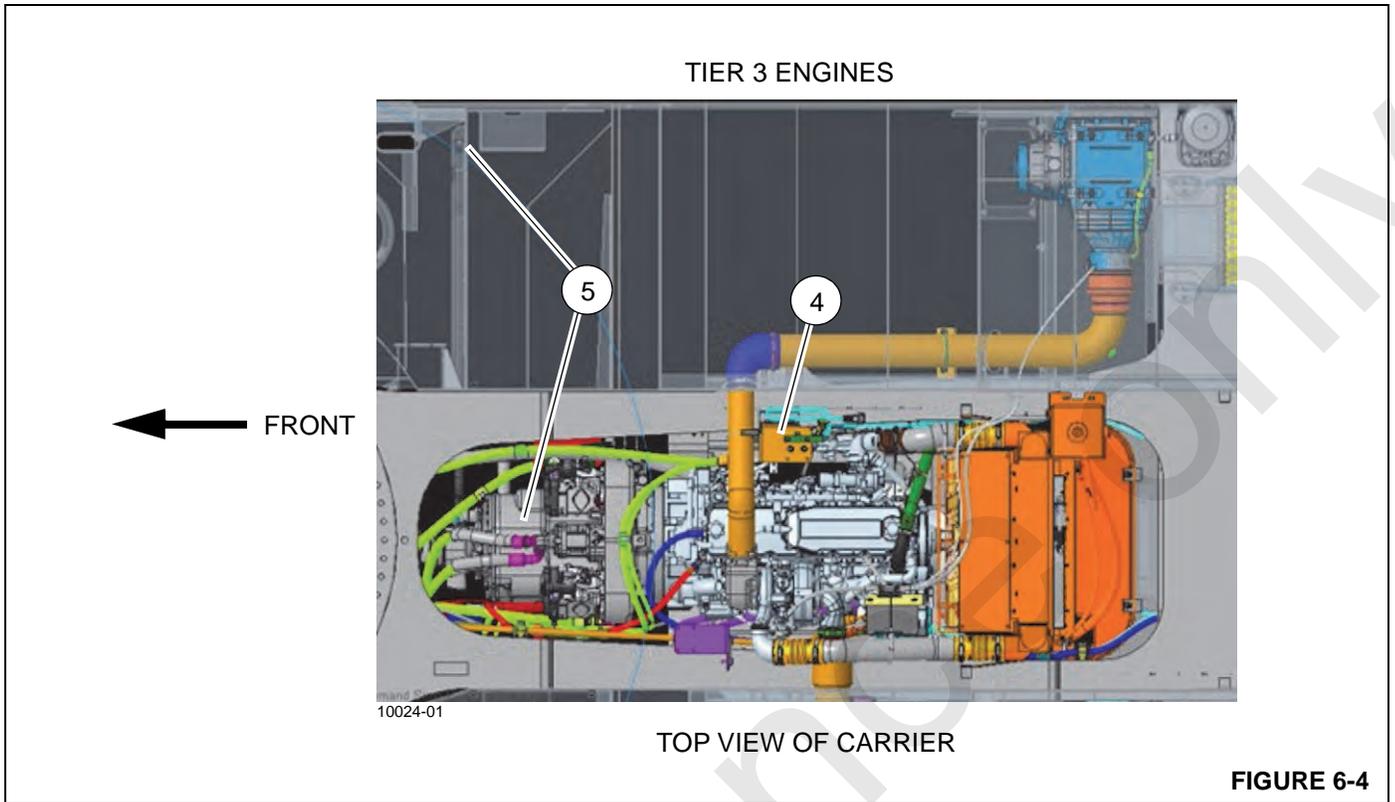
FIGURE 6-2

Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Drive Train (Continued)						
4	Fuel Filter	Figure 6-3, Figure 6-4	—	—	PERFORM every 500 hours of service, or 6 months, whichever interval is first	REPLACE fuel filter See NOTE 10.
5	Transmission and Torque Converter	Figure 6-3, Figure 6-4	E	41.6 L (11 gal)	PERFORM every 10 hours of service, or daily, whichever interval comes first	CHECK fluid level See NOTE 11. See NOTE 12. FILL transmission sump to FULL on DIPSTICK See NOTE 15.
					For Tier 4 and Tier 3 engines only – 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 13. REPLACE transmission and torque converter filter See NOTE 14.
					PERFORM every 1000 hours of service, or 6 months, whichever interval comes first	CLEAN magnetic drain plug INSTALL magnetic plug in drain port FILL transmission sump to FULL on DIPSTICK See NOTE 15.
<p>NOTE 10: The Fuel Filter is located on the inside right side of the frame adjacent to the engine.</p> <p>NOTE 11: Check Transmission Fluid level using the dipstick (6A) that is located on the right side of the carrier, behind the steps, adjacent to the hydraulic tank. Check fluid level with boom fully retracted and lowered, and all outrigger cylinders retracted.</p> <p>NOTE 12: Level should be checked with engine running at 850 rpm idle and torque converter fluid temp at 65°C to 93°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
<p>CAUTION</p> <p>Possible Equipment Damage!</p> <p>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.</p> <p>Excessive fluid temperature [120°C (250°F) maximum] will damage transmission clutches, transmission fluid, torque converter, and seals.</p> <p>Failure to follow this instruction may cause damage to equipment.</p>						
<p>NOTE 13: Follow these specified Transmission and Torque Converter Fluid DRAIN instructions:</p> <ul style="list-style-type: none"> a. DRAIN Transmission and Torque Converter Fluid at a temperature of 65°C to 93°C (150°F to 200°F). b. CLEAN magnetic drain plug when changing lubricant. 						
<p>NOTE 14: Transmission and Torque Converter filter is located on the outside left side of the frame adjacent to the fuel tank and behind the battery box.</p>						
<p>NOTE 15: Follow these specified Transmission and Torque Converter Sump Fluid FILL instructions:</p> <ul style="list-style-type: none"> a. Dipstick (6A) is used to FILL the Transmission and Torque Converter Sump, and is located on the right side of the carrier, behind the steps, adjacent to the hydraulic tank. Open cap on the DIPSTICK for the Transmission and Torque Converter sump, and FILL with transmission fluid through the DIPSTICK opening. FILL to FULL on DIPSTICK. b. OPERATE 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 93°C (150°F to 200°F). d. ADD transmission fluid, as necessary. FILL to FULL on DIPSTICK. 						

For reference only



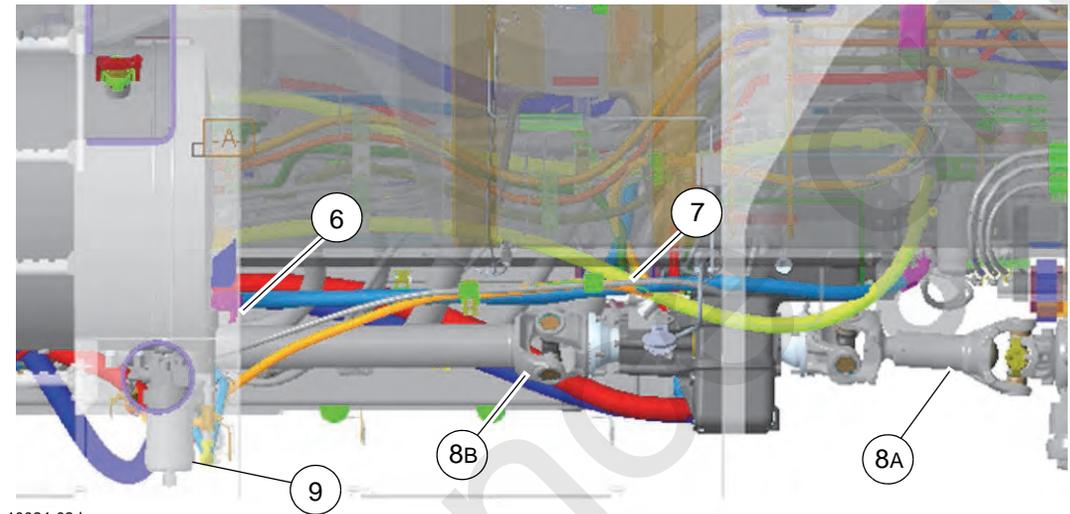


For reference

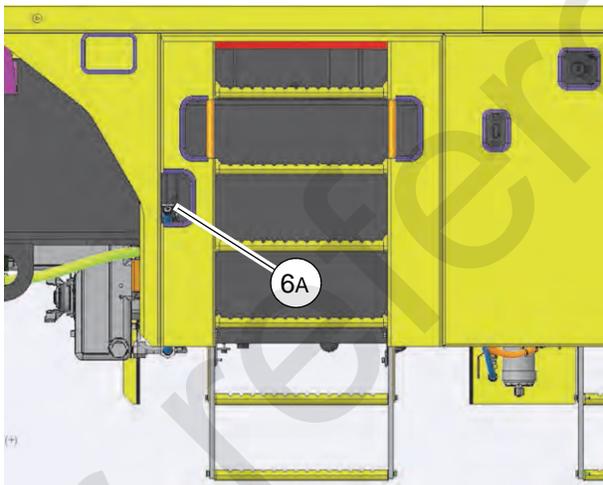
Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Drive Train (Continued)						
6	Transmission and Torque Converter Filter	Figure 6-5	—	—	PERFORM after first 50 hours of service	REPLACE filter See NOTE 14.
					For Tier 4 and Tier 3 engines only – REPEAT after another 50 hours of service for a total of 100 hours of service	
					REPEAT every 500 hours of service	
6A	Transmission and Torque Converter Dipstick Location	Figure 6-5	E	41.6 L (11 gal)	As necessary, in DRAIN and FILL routines	FILL transmission sump to FULL on DIPSTICK See NOTE 15. See NOTE 16.
7	Engine Cooling System – Coolant Strainer for Cab Heater	Figure 6-5	—	—	PERFORM after first 100 hours of service	CLEAN strainer
					Then, every 2000 hours of service or 1 year thereafter	REPLACE strainer
8A	Driveline – Slip	Figure 6-5	A	Brush on	Every 500 hours of service, or 3 months, whichever interval comes first	BRUSH ON grease to coat the driveline slip surface
8B	Driveline – Slip	Figure 6-5	A	Brush on	Every 500 hours of service, or 3 months, whichever interval comes first	BRUSH ON grease to coat the driveline slip surface
9	Fuel/Water Separator	Figure 6-5	—	—	Every 10 hours/daily	DRAIN water trap
10	DEF Supply Module Filter (Stage V / Tier 4)	Figure 6-7	—	—	Every 4500 hours or 3 years, whichever interval comes first	CHECK DEF Supply Module filter
11	DEF Tank (Stage V / Tier 4)	Figure 6-7	K	37.9 L (10 gal)	Every 10 hours/daily	CHECK DEF Tank Level and FILL See NOTE 17.
12	DEF Tank Filter (Stage V / Tier 4)	Figure 6-7	—	—	Every 2000 hours or 1 year, whichever interval comes first	CHECK DEF Tank filter
<p>NOTE 16: The Transmission Fluid FILL and DIPSTICK is located on the right side of the carrier, behind the steps, adjacent to the hydraulic tank for ease in servicing the transmission and torque converter.</p> <p>NOTE 17: 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 4%–10% FULL, and RED when the tank is <5% FULL.</p>						

STAGE V / NON-CERTIFIED ENGINES

← FRONT

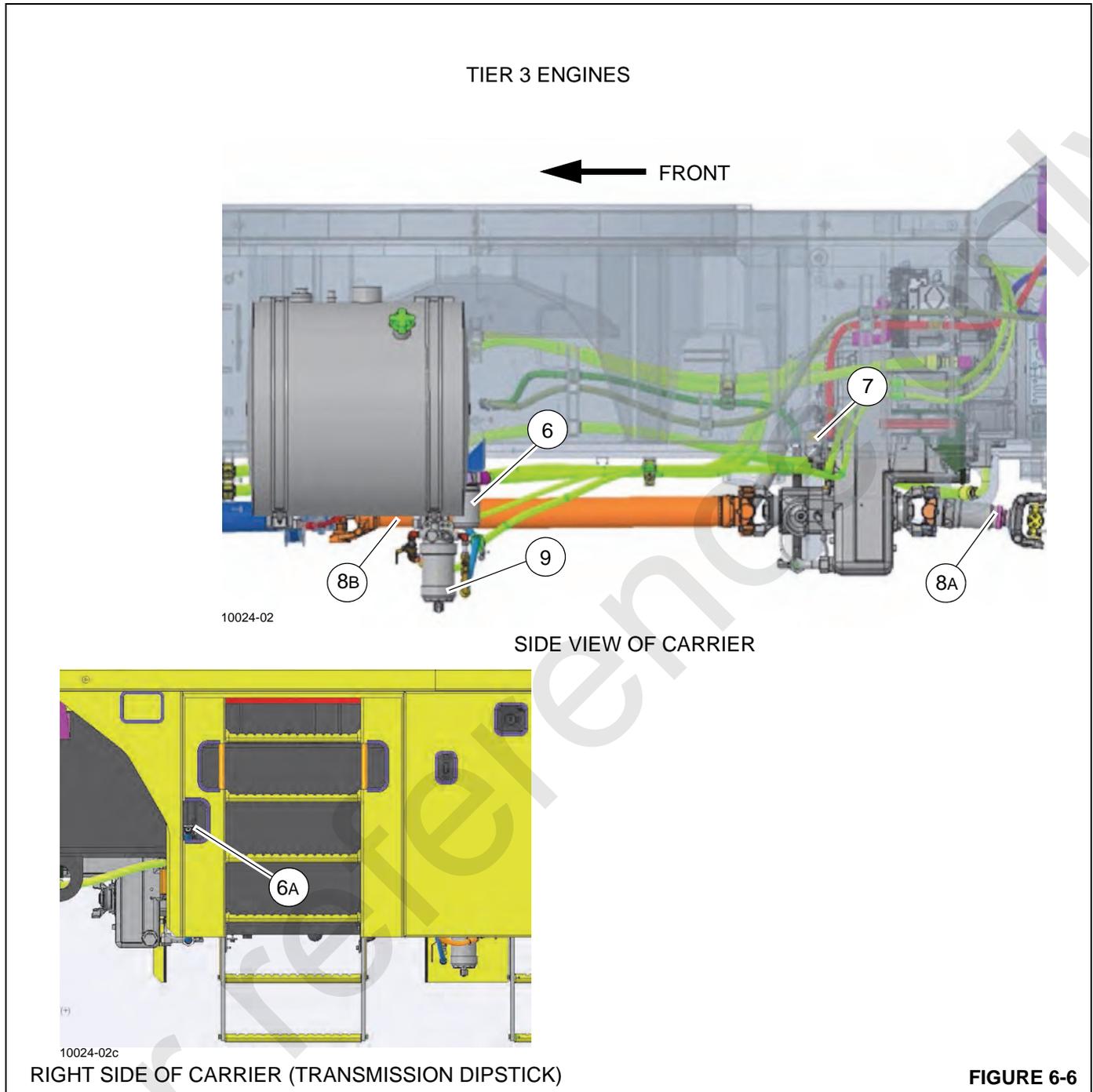


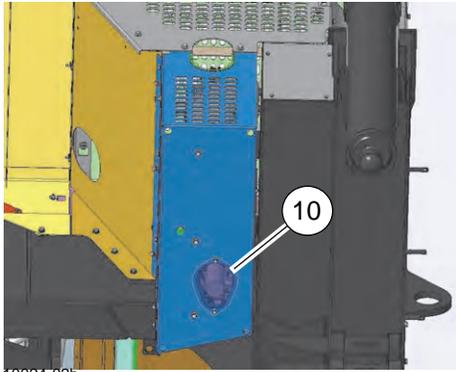
SIDE VIEW OF CARRIER



RIGHT SIDE OF CARRIER (TRANSMISSION DIPSTICK)

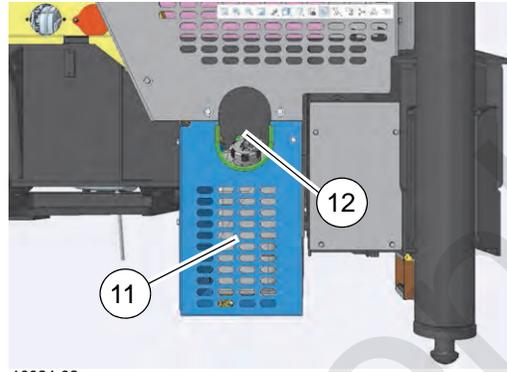
FIGURE 6-5





10024-02b

LEFT UNDERSIDE OF CARRIER



10024-02a

LEFT REAR SIDE OF CARRIER

FIGURE 6-7

For reference

Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Steering and Suspension – Meritor Axles						
20	Lockout Cylinder Pivot Pins See NOTE 18.	Figure 6-8	A	Until grease extrudes	Every 500 hours, or 3 months, whichever interval comes first	LUBRICATE 2 fittings per axle, 4 service points
21	Steering Cylinder Pivot Pins See NOTE 18.	Figure 6-8	A	Until grease extrudes	Every 500 hours, or 3 months, whichever interval comes first	LUBRICATE 4 fittings per axle, 8 service points
22	Tie Rod Pivot Pins See NOTE 18.	Figure 6-8	A	Until grease extrudes	Every 500 hours, or 3 months, whichever interval comes first	LUBRICATE 2 fittings per axle, 4 service points
23	King Pins (upper and lower) See NOTE 18.	Figure 6-8	A	Until grease extrudes	Every 500 hours, or 3 months, whichever interval comes first	LUBRICATE 4 fittings per axle, 8 service points
Steering and Suspension – Kessler Axles						
24	Lockout Cylinder Pivot Pins See NOTE 18.	Figure 6-9	A	Until grease extrudes	Every 500 hours, or 3 months, whichever interval comes first	LUBRICATE 2 fittings per axle, 4 service points
25	Steering Cylinder Pivot Pins See NOTE 18.	Figure 6-9	A	Until grease extrudes	Every 50 hours, or weekly, whichever interval comes first	LUBRICATE 4 fittings per axle, 8 service points
26	Tie Rod Pivot Pins	Figure 6-9	—	—	Maintenance Free	NO SERVICE
27	King Pins (upper and lower) See NOTE 18.	Figure 6-9	A	Until grease extrudes	PERFORM after first 100 hours of service	LUBRICATE 4 fittings per axle, 8 service points
				Until grease extrudes	REPEAT every 500 hours of service, or 3 months, thereafter, whichever interval comes first	LUBRICATE 4 fittings per axle, 8 service points

CAUTION

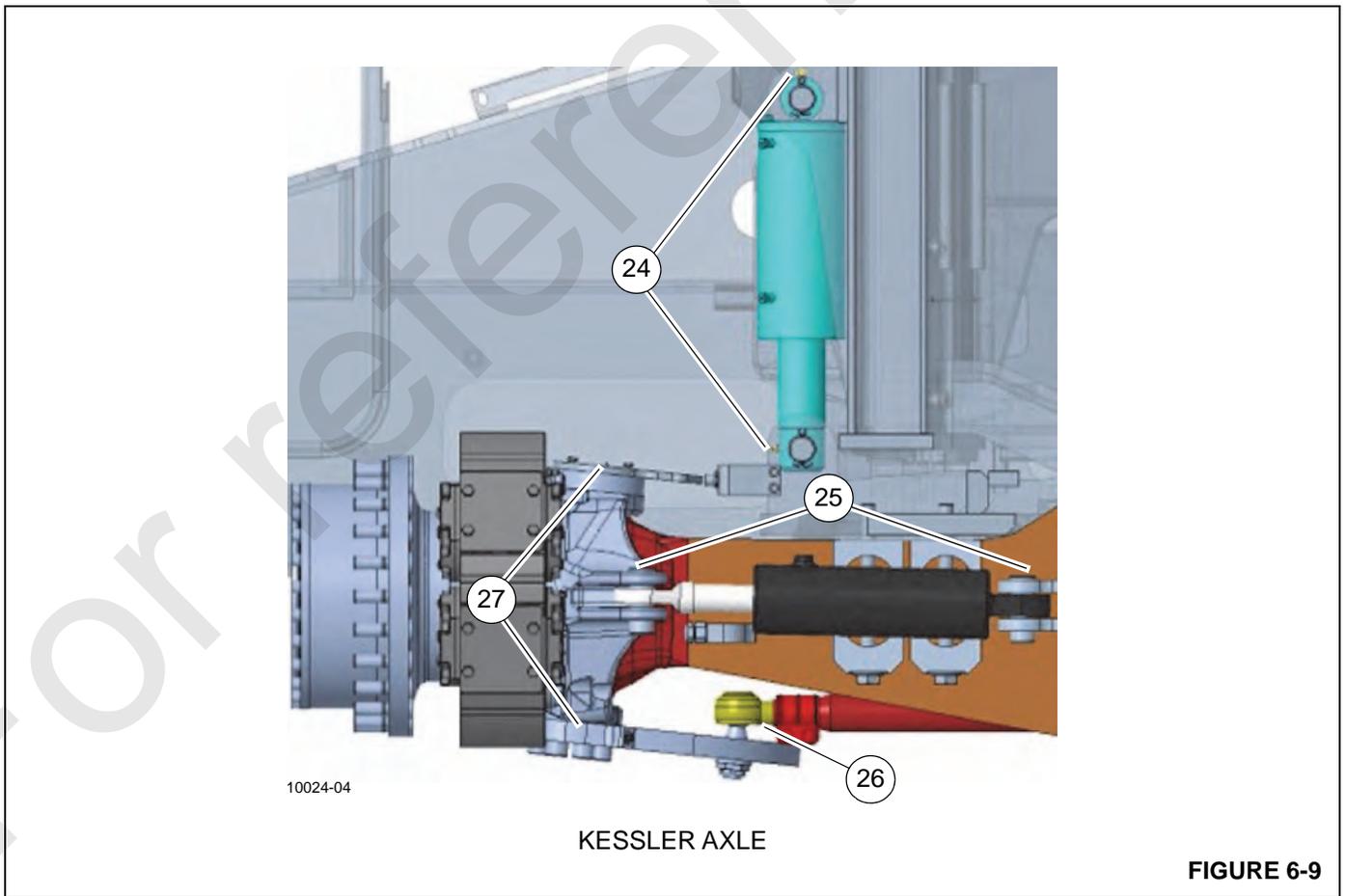
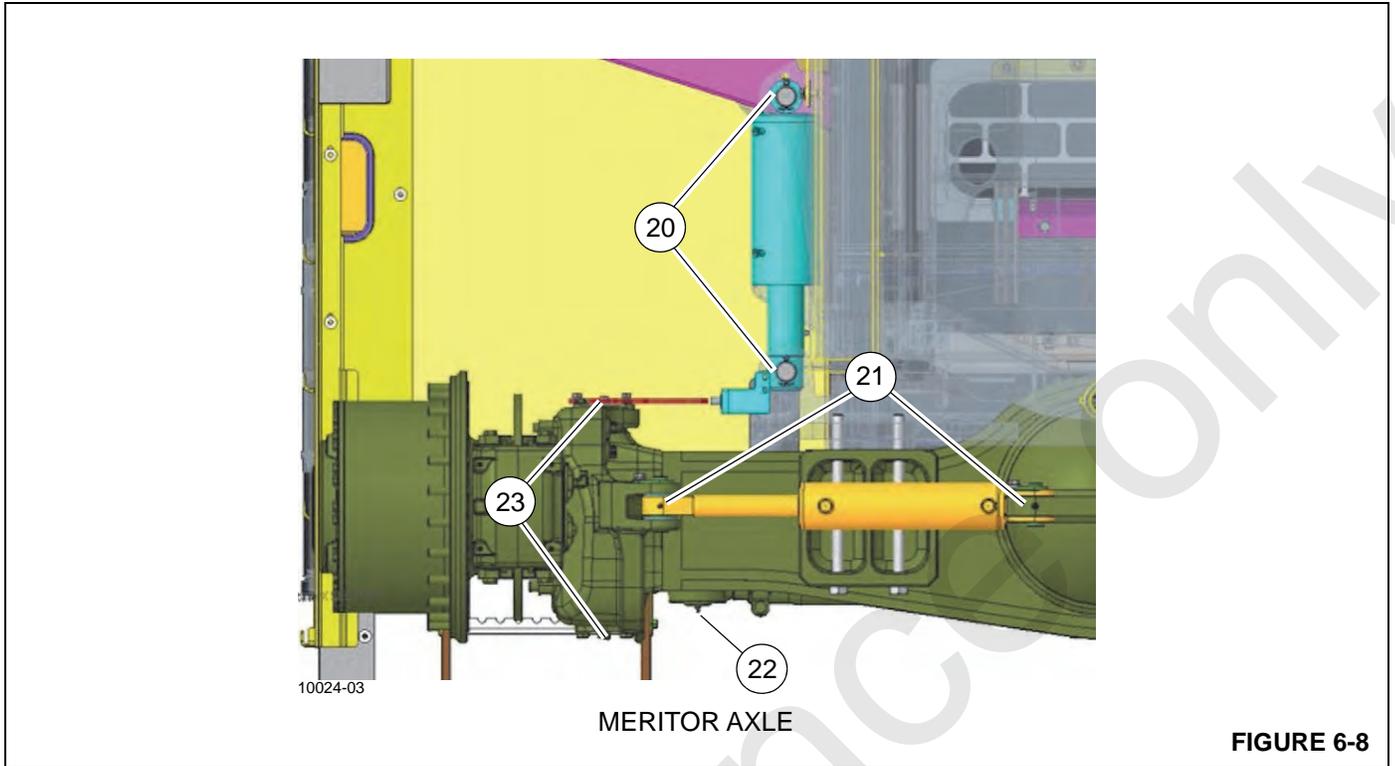
Possible Equipment Damage!

Use specified semi-synthetic or synthetic lubricants as listed in this section of your GRT8100-1 *Operator Manual*. See also your GRT8100-1 *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 18: Use grease fittings provided. **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
Steering and Suspension – Fifth Wheel Pivots						
28	Fifth Wheel Pivot Pins	Figure 6-10	A	Until grease extrudes	Every 500 hours, or 3 months, whichever interval comes first	LUBRICATE 2 service points See NOTE 19.

NOTE 19: Use grease fittings provided.

CAUTION

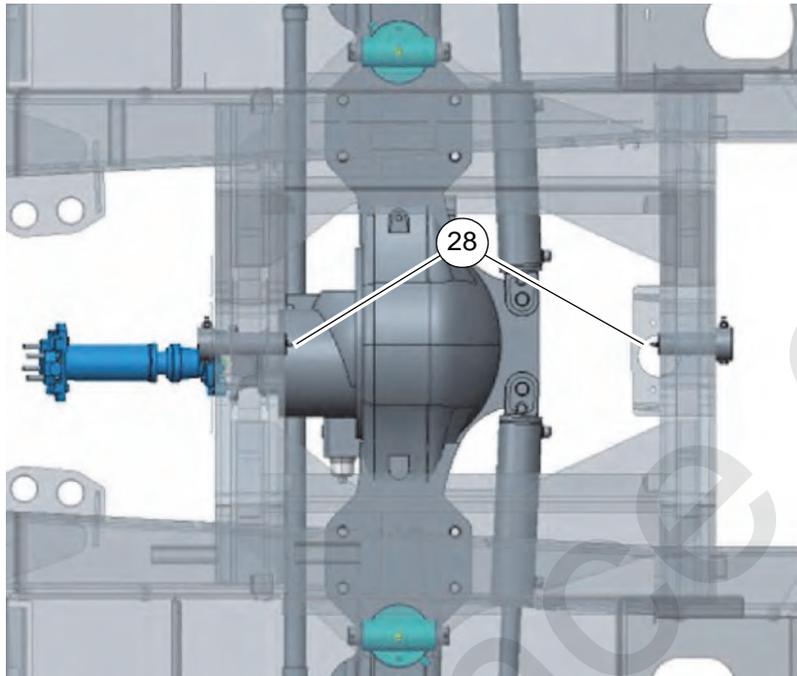
Possible Equipment Damage!

Use specified semi-synthetic or synthetic lubricants as listed in this section of your GRT8100-1 *Operator Manual*. See also your GRT8100-1 *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.

DO NOT USE non semi-synthetic lubricant. Use of non-approved lubricant may damage components.



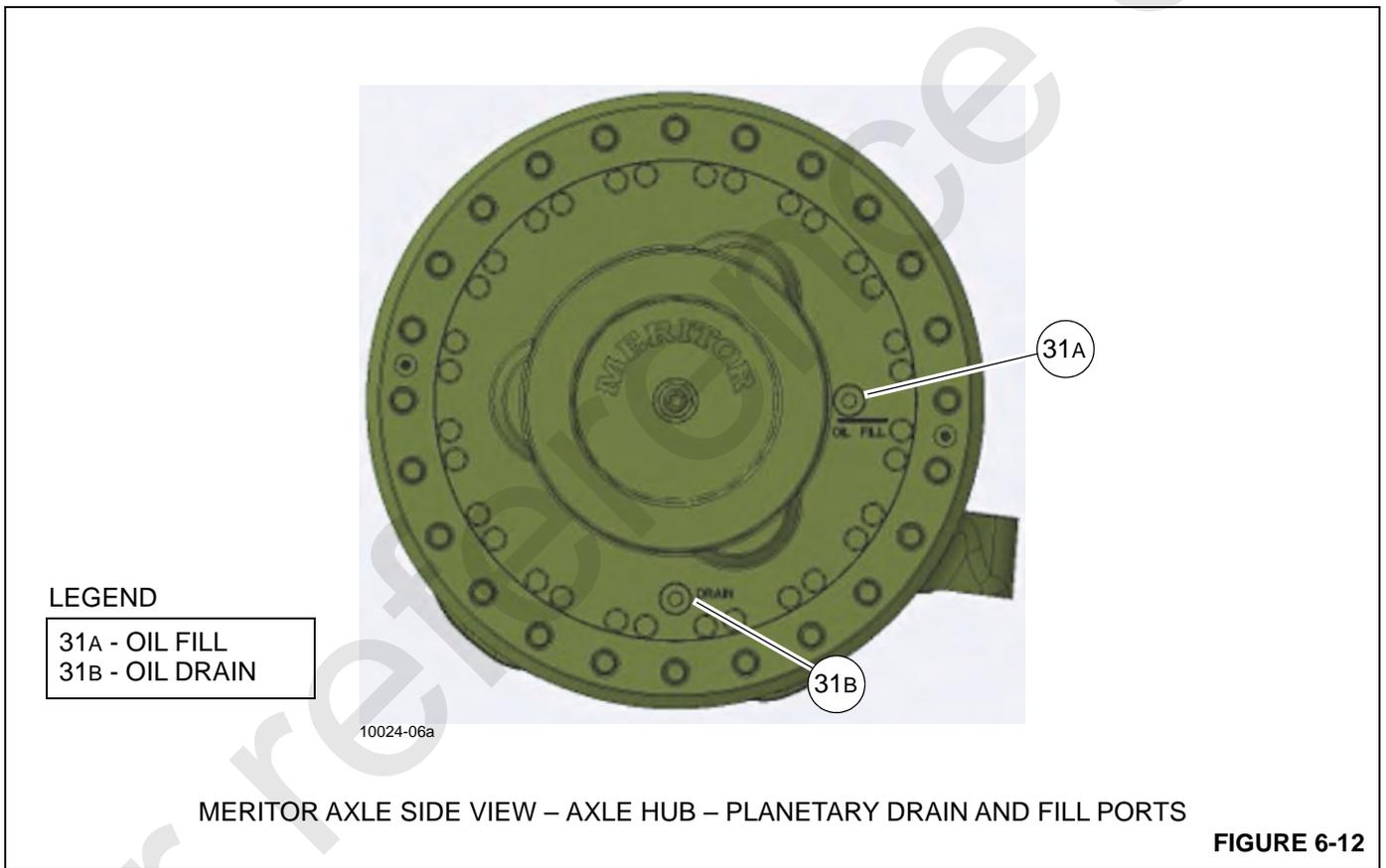
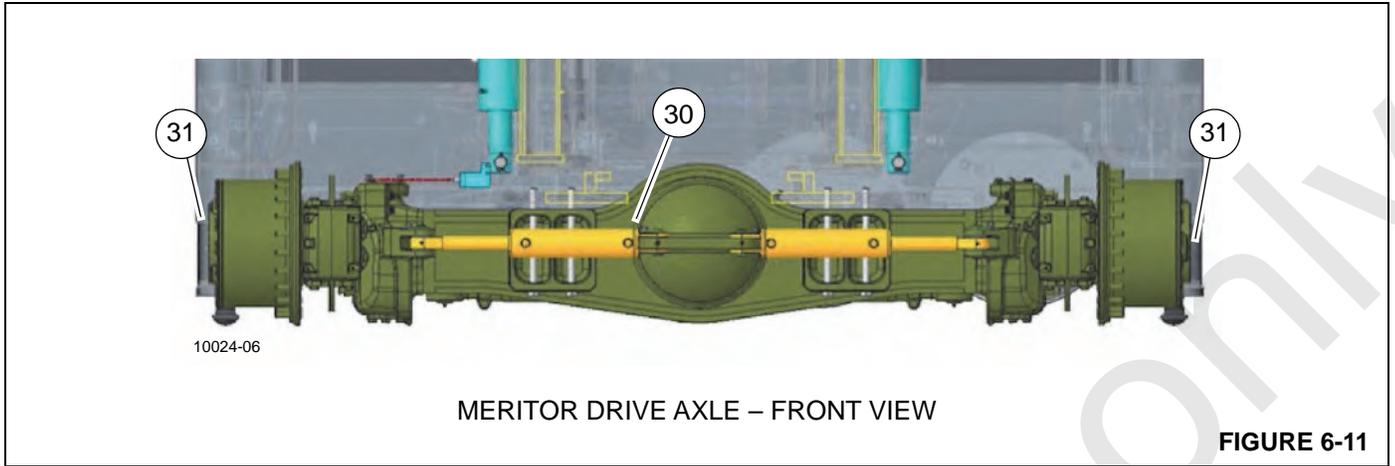
10024-05

FIFTH WHEEL PIVOTS

FIGURE 6-10

For reference only

Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Axle Lubrication – Meritor Axles						
30	Differentials	Figure 6-11	B	40 L (10.6 gal) ea NOTE 21. NOTE 22. NOTE 23.	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
31	Planetary Hubs & Wheel Bearings	Figure 6-12	B	9.8 L (10.4 qt) ea Wheel End NOTE 21. NOTE 22. NOTE 23.	Every 250 hours, or 1 month, whichever interval comes first	CHECK and FILL 4 service points See NOTE 20.
	Side View, Planetary DRAIN and FILL ports	Figure 6-12			Every 3000 hours, or 2 years, whichever interval comes first	DRAIN and FILL 4 service points See NOTE 20.
<p>NOTE 20: 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.</p> <p>NOTE 21: 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: <i>Approved Lubricant Reference Table</i>, page 6-12 in this <i>Operator Manual</i>. See also your GRT8100-1 <i>Service Manual</i> for maintenance and lubrication instructions.</p> <p>NOTE 22: If the makeup amount of fluid is substantially more than 0.23 L (0.5 pt), CHECK for leaks.</p>						
<p>CAUTION</p> <p>Possible Equipment Damage!</p> <p>Use specified semi-synthetic or synthetic lubricants as listed in this section of your GRT8100-1 <i>Operator Manual</i>. See also your GRT8100-1 <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 23: DO NOT USE non semi-synthetic lubricant. Use of non-approved lubricant may damage components.</p>						



Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Axle Lubrication – Kessler Axles						
32	Differentials	Figure 6-13	B	37 L (9.8 gal) ea NOTE 25. NOTE 26. NOTE 27.	Every 100 hours, or 1 month, whichever interval comes first	CHECK and FILL 2 service points
					PERFORM after first 100 hours of service REPEAT every 1000 hours of service, or 1 year, thereafter, whichever interval comes first	DRAIN and FILL 2 service points CLEAN magnetic drain plug INSTALL magnetic plug in drain port
33	Planetary Hubs & Wheel Bearings	Figure 6-13	B	2.8 L (2.9 qt) ea Wheel End NOTE 25. NOTE 26. NOTE 27.	Every 250 hours, or 1 month, whichever interval comes first	CHECK and FILL 4 service points See NOTE 24.
	Detail View, Planetary DRAIN and FILL ports	Figure 6-13			Every 3000 hours, or 2 years, whichever interval comes first	DRAIN and FILL 4 service points See NOTE 24.

NOTE 24: 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 25: 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 6-12 in this *Operator Manual*. See also your GRT8100-1 *Service Manual* for maintenance and lubrication instructions.

NOTE 26: If the makeup amount of fluid is substantially more than 0.23 L (0.5 pt), CHECK for leaks.

CAUTION

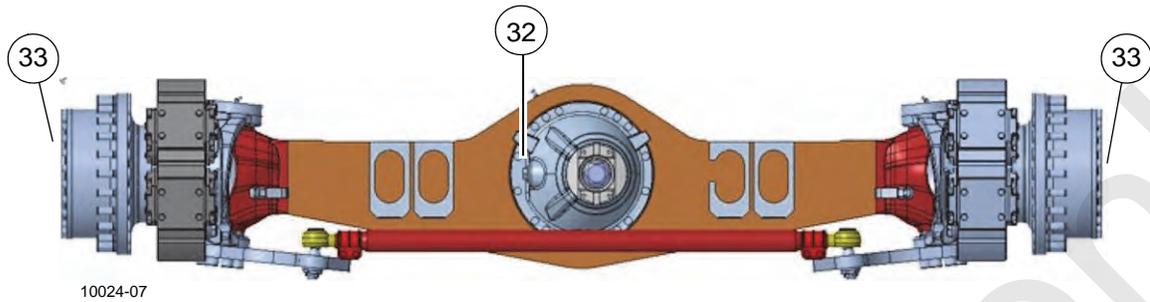
Possible Equipment Damage!

Use specified semi-synthetic or synthetic lubricants as listed in this section of your GRT8100-1 *Operator Manual*. See also your GRT8100-1 *Service Manual* for maintenance and lubrication instructions.

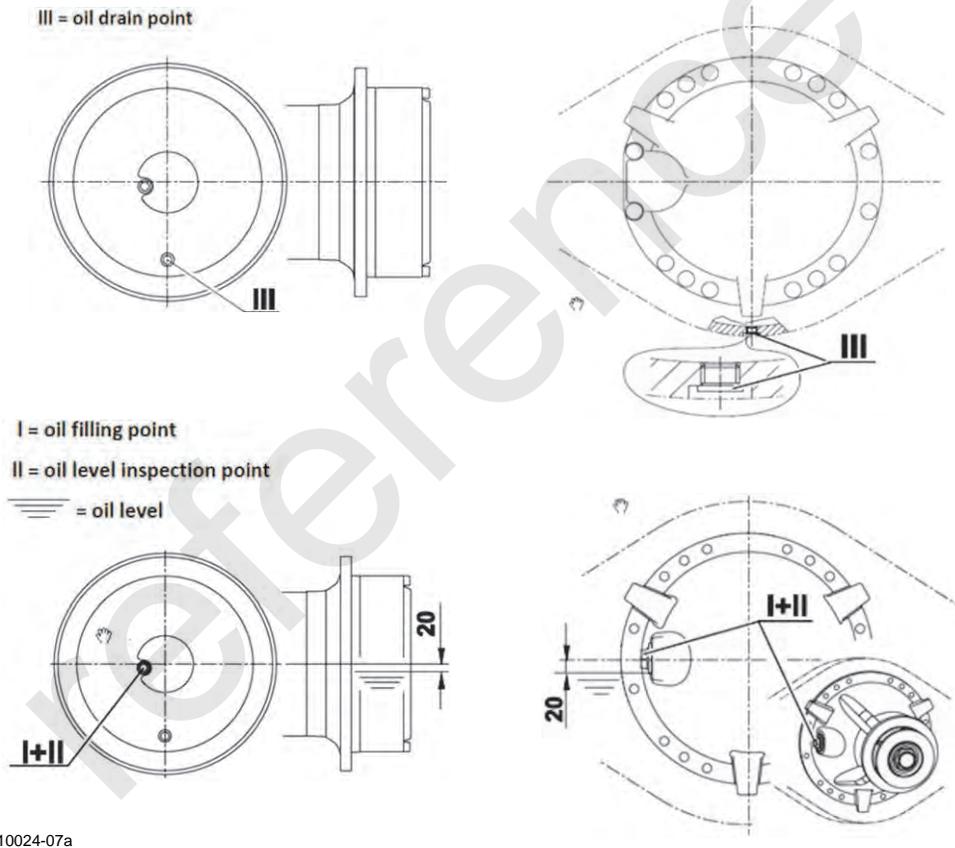
Use of non-approved, non semi-synthetic lubricant may damage components and/or invalidate published lubricant intervals.

Failure to follow this instruction may cause damage to equipment.

NOTE 27: DO NOT USE non semi-synthetic lubricant. Use of non-approved lubricant may damage components.



KESSLER DRIVE AXLE – FRONT VIEW

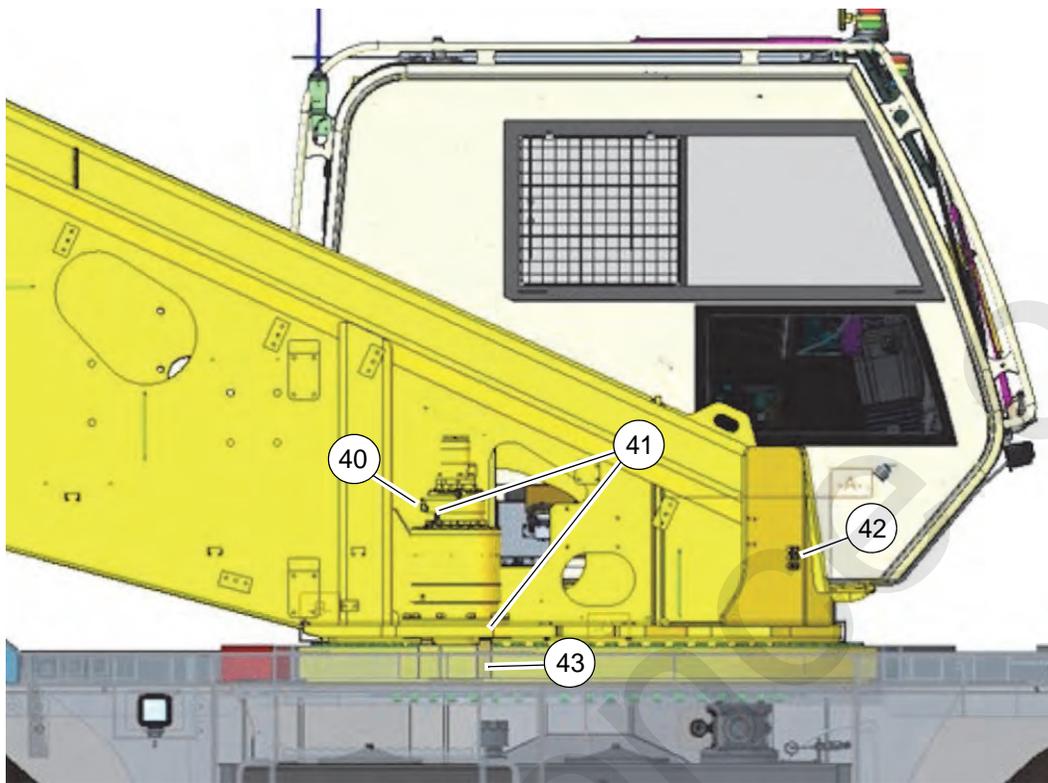


KESSLER DRIVE AXLE DETAIL VIEW

FIGURE 6-13

Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Turntable (Swing Drive) and Cab Tilt Lubrication						
40	Turntable (Swing Drive) Gearbox – Brake Assembly	Figure 6-14	H	0.3 L (0.63 pt) each gearbox	After first 50 hours of service Thereafter , every 50 hours of service, or 1 week, whichever interval comes first	CHECK oil level FILL swing drive gearbox brake assembly to TOP of ELBOW 1 service point See NOTE 28.
					After first 50 hours of service Thereafter , every 1000 hours, or 12 months, whichever interval comes first	DRAIN swing drive gearbox FILL swing drive gearbox brake assembly to TOP of ELBOW 1 service point See NOTE 28.
41	Turntable (Swing Drive) Gearbox	Figure 6-14	B	4.14 L (4.4 qt)	After first 50 hours of service Thereafter , every 50 hours of service, or 1 week, whichever interval comes first	CHECK oil level FILL swing drive gearbox to BOTTOM of FILL HOLE 1 service point See NOTE 29.
					After first 50 hours of service Thereafter , every 1000 hours, or 12 months, whichever comes first	DRAIN swing drive gearbox FILL to BOTTOM of FILL HOLE 1 service point See NOTE 29.
42	Turntable Bearing	Figure 6-14	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 6 grease fittings at front of superstructure (S/S) 6 service points See NOTE 30. See NOTE 31.
43	Turntable (Swing Drive) Gear and Drive Pinion	Figure 6-14	G	SPRAY ON	Every 500 hours, or 6 months of service, whichever interval comes first	SPRAY ON LUBRICATION swing drive gear and drive pinions COAT ALL TEETH 2 service points See NOTE 32.
NOTE 28: Check level in Swing Drive Gearbox Brake Assembly, and FILL to TOP of ELBOW. NOTE 29: Check level in Swing Drive Gearbox, and FILL to BOTTOM of FILL HOLE.						

Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Turntable (Swing Drive) and Cab Tilt Lubrication – Continued						
<p>NOTE 30: Apply grease to six (6) 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 31: The turntable bearing in this crane is lubricated 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, <i>Cold Weather Lubricants in Arctic Conditions [Down to -29°C (-20°F)]</i>. If temperatures below -9°C (15°F) are rare and intermittent, then greases from Table 6-1, <i>Standard Lubricants [Down to -9°C (+15°F)]</i>, are acceptable.</p>						
<p>CAUTION</p> <p>Possible Equipment Damage!</p> <p>Use specified semi-synthetic or synthetic lubricants as listed in this section of your GRT8100-1 <i>Operator Manual</i>. See also your GRT8100-1 <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 32: DO NOT USE non semi-synthetic lubricant. Use of non-approved lubricant may damage components.</p>						



10024-08

SIDE VIEW – SUPERSTRUCTURE

FIGURE 6-14

For reference only

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Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Turntable (Swing Drive) and Cab Tilt Lubrication – Continued						
44	Turntable Swivel Lock Pin	Figure 6-15	G	SPRAY ON	Every 500 hours, or 6 months of service, whichever interval comes first	SPRAY ON LUBRICATION 1 service point See NOTE 34.
50	Cab Tilt Cylinder Pivot Pins	Figure 6-15	A		Every 500 hours, or 3 months, whichever interval comes first	LUBRICATE 2 service points See NOTE 33.
51	Pillow Block	Figure 6-15	A		Every 500 hours, or 3 months, whichever interval comes first	LUBRICATE 4 service points See NOTE 33.
52	Cab Door Track and Rollers	Figure 6-16	Light Oil		Every 6 months	LUBRICATE top and bottom door track and rollers 2 service points
53	Air Conditioner Condenser Filter	Figure 6-17	–		Every 1000 hours, or 6 months, whichever interval comes first	CHECK and CLEAN condenser filter 1 service point

NOTE 33: USE grease fittings provided.

CAUTION

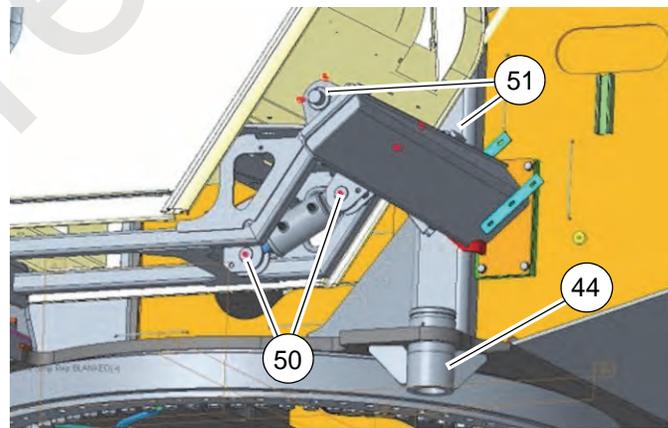
Possible Equipment Damage!

Use specified semi-synthetic or synthetic lubricants as listed in this section of your GRT8100-1 *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.

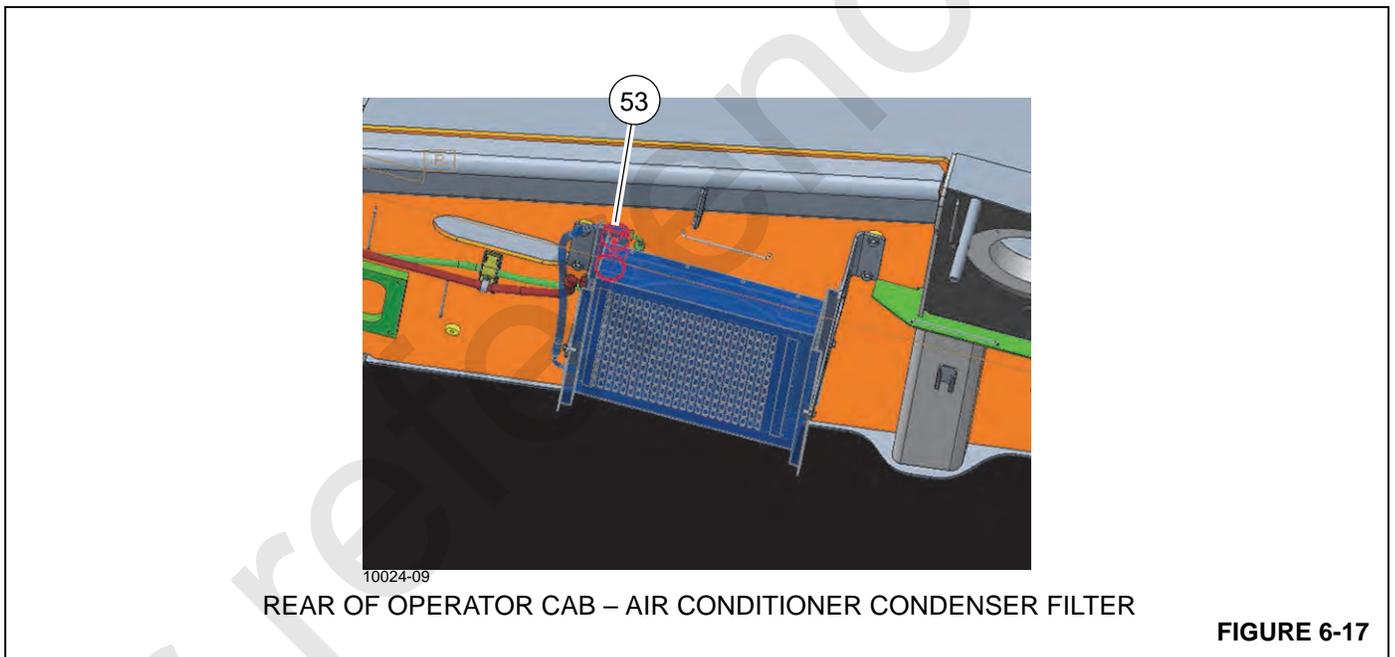
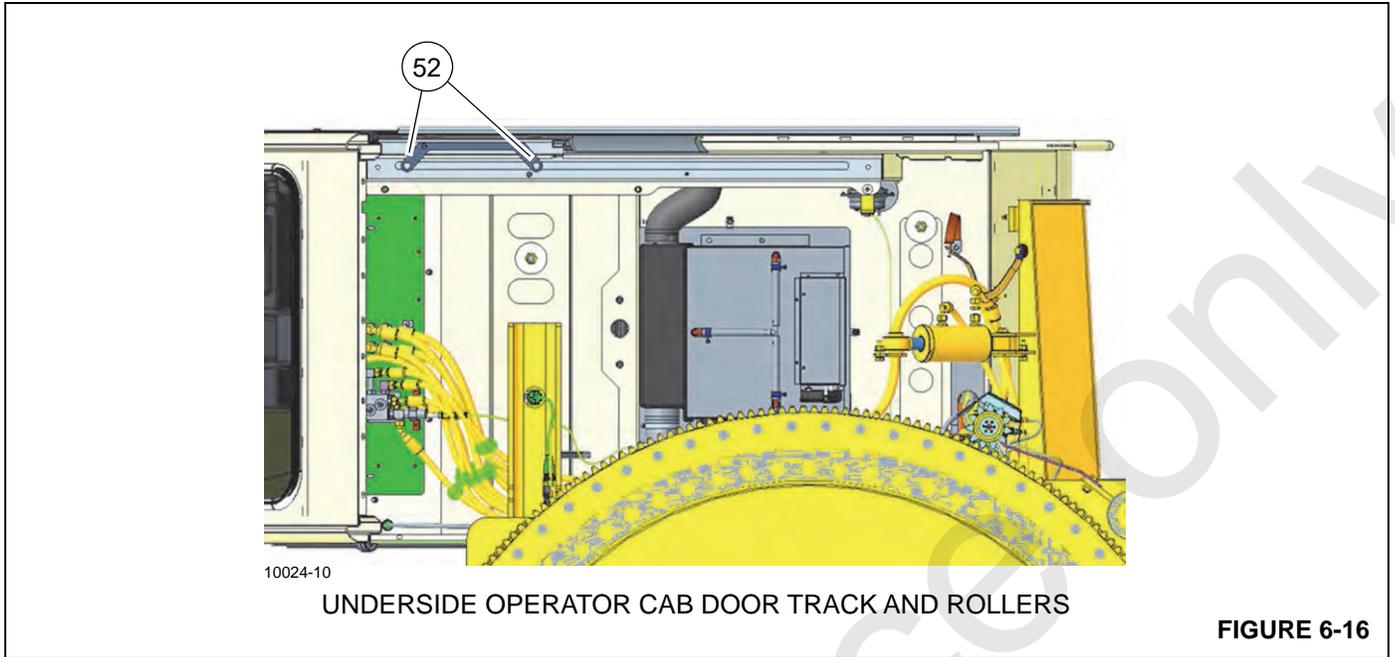
NOTE 34: DO NOT USE non semi-synthetic lubricant. Use of non-approved lubricant may damage components.



10024-09

SIDE VIEW – SUPERSTRUCTURE

FIGURE 6-15



Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Outrigger Lubrication						
60	Outrigger Beams –Top Plates	Figure 6-18	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 35. See NOTE 37. See NOTE 38. See NOTE 39.
	Outrigger Beams –Bump-outs See NOTE 35. See NOTE 37. See NOTE 38. See NOTE 39.	Figure 6-18	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
61	Wear Pads See NOTE 35. See NOTE 37.	Figure 6-18	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
62	Jack Cylinder Support Tubes	Figure 6-18	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 35. See NOTE 36.
63	Jack Cylinder Barrels	Figure 6-18	L	Brush on	Every 50 hours, or 1 week of service, whichever interval comes first	BRUSH ON 4 service points See NOTE 35. See NOTE 36.
64	Extend Cylinder Supports	Figure 6-18	L	Brush on	Every 50 hours, or 1 week of service, whichever interval comes first	BRUSH ON 8 service points See NOTE 35. See NOTE 37.
<p>NOTE 35: DO NOT USE non semi-synthetic lubricant. Use of non-approved lubricant may damage components.</p> <p>NOTE 36: Brush lubricant in I.D. of Jack Cylinder Support Tubes and Wear Bands before installing Jack Cylinders.</p> <p>NOTE 37: Brush lubricant on TOP wear pads (rectangular–rear), and BOTTOM wear pads (circular–front) of Outrigger Beams and Extend Cylinder Supports.</p> <p>NOTE 38: 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.</p> <p>NOTE 39: Perform same service for each of four (4) Outrigger Beams, for a total of 48 service points.</p>						

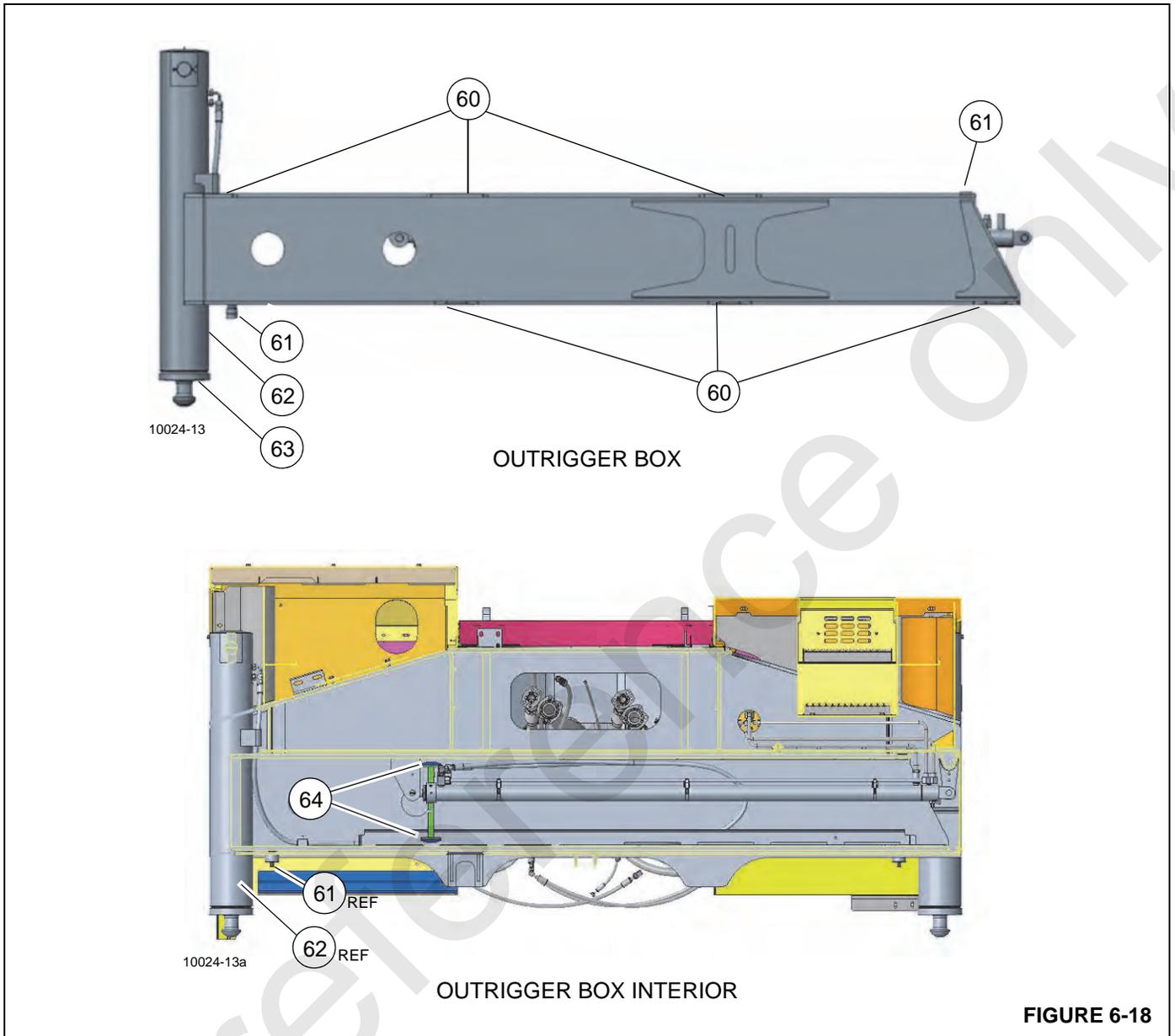


FIGURE 6-18

Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Lift Cylinder Lubrication						
70	Lower Lift Cylinder Pivot Pin	Figure 6-19	L	Until grease extrudes	Every 500 hours, or 3 months, whichever interval comes first	LUBRICATE 1 grease fitting, 1 service point See NOTE 40. See NOTE 41.

CAUTION

Possible Equipment Damage!

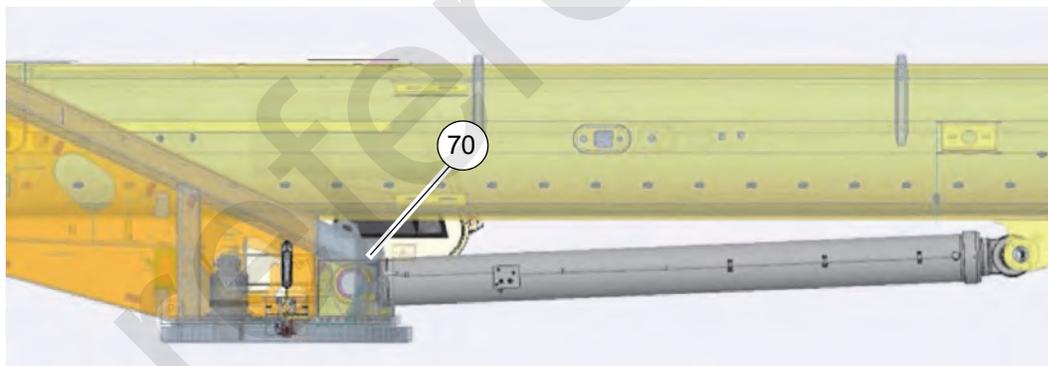
Use specified semi-synthetic or synthetic lubricants as listed in this section of your GRT8100-1 *Operator Manual*. See also your GRT8100-1 *Service Manual* for maintenance and lubrication instructions.

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 40: **DO NOT USE non semi-synthetic lubricant.** Use of non-approved lubricant may damage components.

NOTE 41: 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 6-12 in this *Operator Manual*. See also your GRT8100-1 *Service Manual* for specified maintenance and lubrication instructions.



10024-14

LIFT CYLINDER

FIGURE 6-19

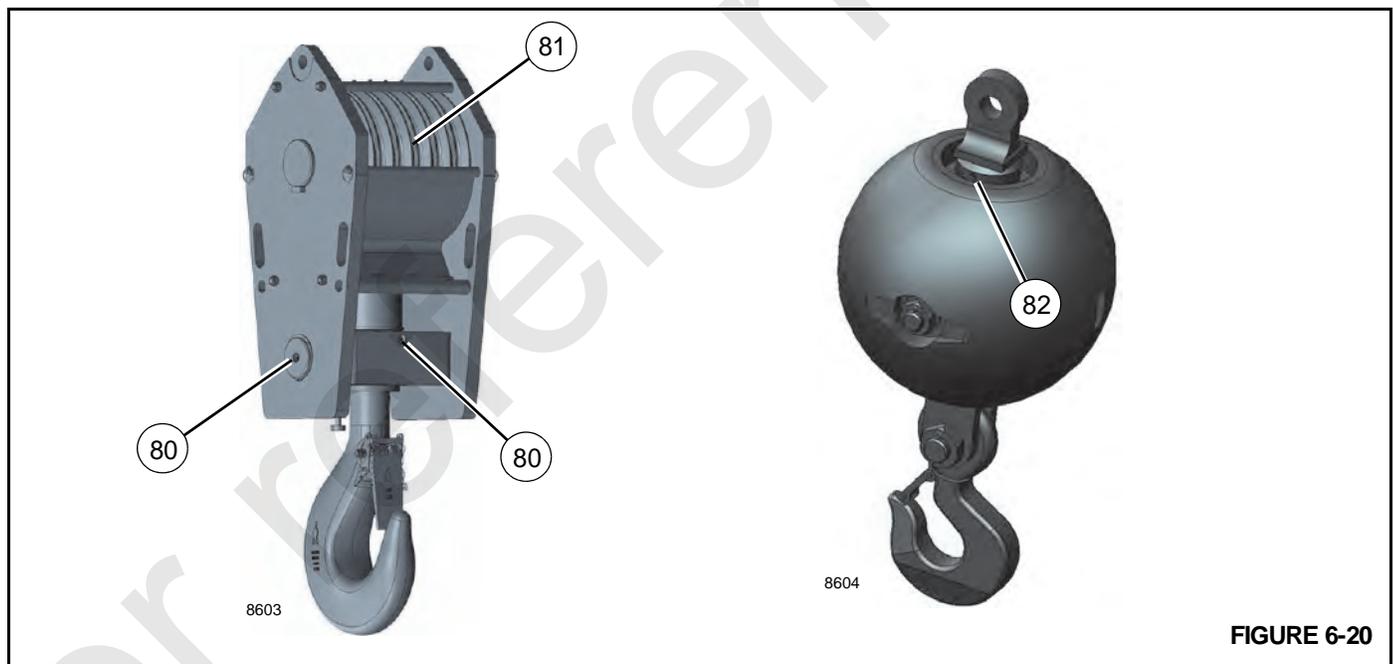
Boom

NOTE: Crane Setup: Machine shall be set up on firm level surface with fully extended outriggers and minimum 9979 kg (22,000 lb) counterweight installed. Ensure crane is level.

- Boom must be directly over the front with house lock engaged.
- Set boom angle at zero degrees (0°).
- Do not exceed 38.2 m (125.5 ft) boom length in Auto Mode A.
- Do not exceed 33.8 m (111.1 ft) boom length in Auto Mode B.
- All lubrication points can be accessed by operating crane in the 0001 RCL mode using A or B boom configurations.

CAUTION: Do not operate crane in RCL bypass to lubricate the boom.

Item	Lube Point Description	Figure No.	Approved Lubricant	Lube Capacity	Lube Interval	Application
80	Hook Block Swivel Bearing	Figure 6-20	A	Until grease extrudes	250 hours or 3 months	3 grease fitting
81	Hook Block Sheaves	Figure 6-20	N/A	N/A	250 hours or 3 months	Inspect
NOTE: Rotate sheaves and check for rough or dry operation. Look for grease leakage. Replace sheave if either is found.						
82	Overhaul Ball	Figure 6-20	A	Until grease extrudes	250 hours or 3 months	1 grease fitting



Boom (Continued)

NOTE: Crane Setup: Machine shall be set up on firm level surface with fully extended outriggers and minimum 9979 kg (22,000 lb) counterweight installed. Ensure crane is level.

- Boom must be directly over the front with house lock engaged.
- Set boom angle at zero degrees (0°).
- Do not exceed 38.2 m (125.5 ft) boom length in Auto Mode A.
- Do not exceed 33.8 m (111.1 ft) boom length in Auto Mode B.
- All lubrication points can be accessed by operating crane in the 0001 RCL mode using A or B boom configurations.

CAUTION: Do not operate crane in RCL bypass to lubricate the boom.

Item	Lube Point Description	Figure No.	Approved Lubricant	Lube Capacity	Lube Interval	Application
83	Telescope Cylinder Wear Pads	Figure 6-21	L	Coat thoroughly	Apply grease at assembly or tear-down.	<ul style="list-style-type: none"> • 12 places • Extend boom for access through holes in side of sections 3 & 4
84	Internal Side and Bottom Wear Pads - Inner Sections	Figure 6-21 & Figure 6-22	L	Thoroughly coat all areas wear pad moves on	250 hours/3 months	23 locations
85A	Boom Section Rear Upper Wear Pads - Tele 1	Figure 6-21	L	Thoroughly coat all areas the wear pad moves on	50 hours/1 week	<ul style="list-style-type: none"> • 2 locations • Extend Tele 1 to 57.8 FT and 67.8 FT, so the access holes line up with the grease fittings.
85B	Boom Section Rear Upper Wear Pads - Tele 2 - 4	Figure 6-21 & Figure 6-22	L	Thoroughly coat all areas wear pad moves on	50 hours/1 week	<ul style="list-style-type: none"> • 6 locations • Extend Tele 2 to 124.9 FT, so the access holes line up with the grease fittings.
86	Boom Section Lower & Upper Wear Pads	Figure 6-21 & Figure 6-22	L	Thoroughly coat all areas wear pad moves on	50 hours/1 week	12 locations
87	Extend Cable Sheave	Figure 6-21	A	Until grease extrudes	250 hours or 3 months	6 locations
88	Retract Cable Sheaves	Figure 6-21 & Figure 6-22	A	Until grease extrudes	250 hours or 3 months	<ul style="list-style-type: none"> • 4 grease fittings • Extend Tele 2 to 125.3 FT, so the access holes line up with the grease fittings.

NOTE: Lubricate items more frequently than interval in table if environmental conditions and/or operating conditions require.

CAUTION: Do not apply excessive pressure or force when greasing wear pads. This can cause grease fitting to separate from wear pad. Only apply grease until resistance is felt.

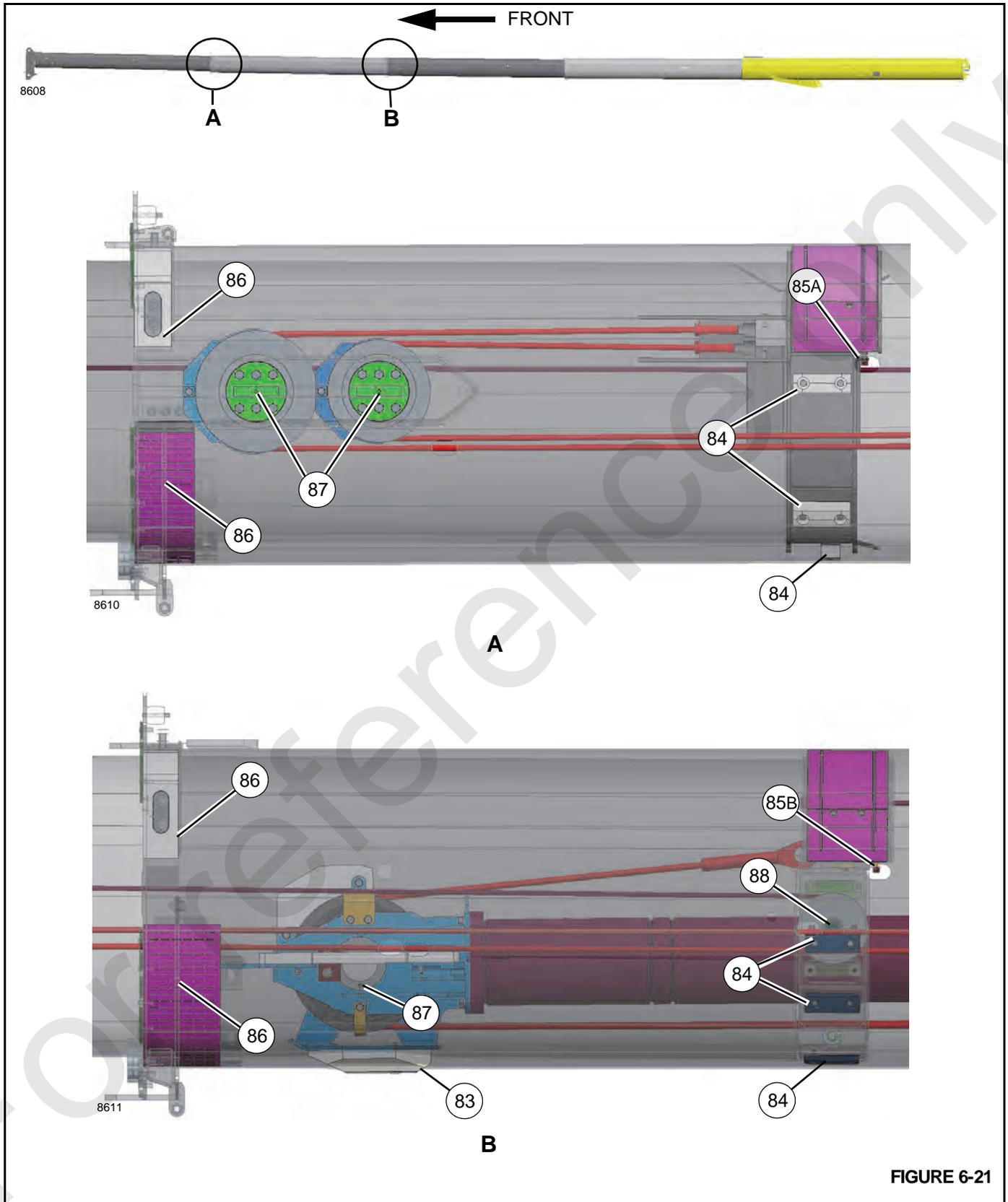


FIGURE 6-21

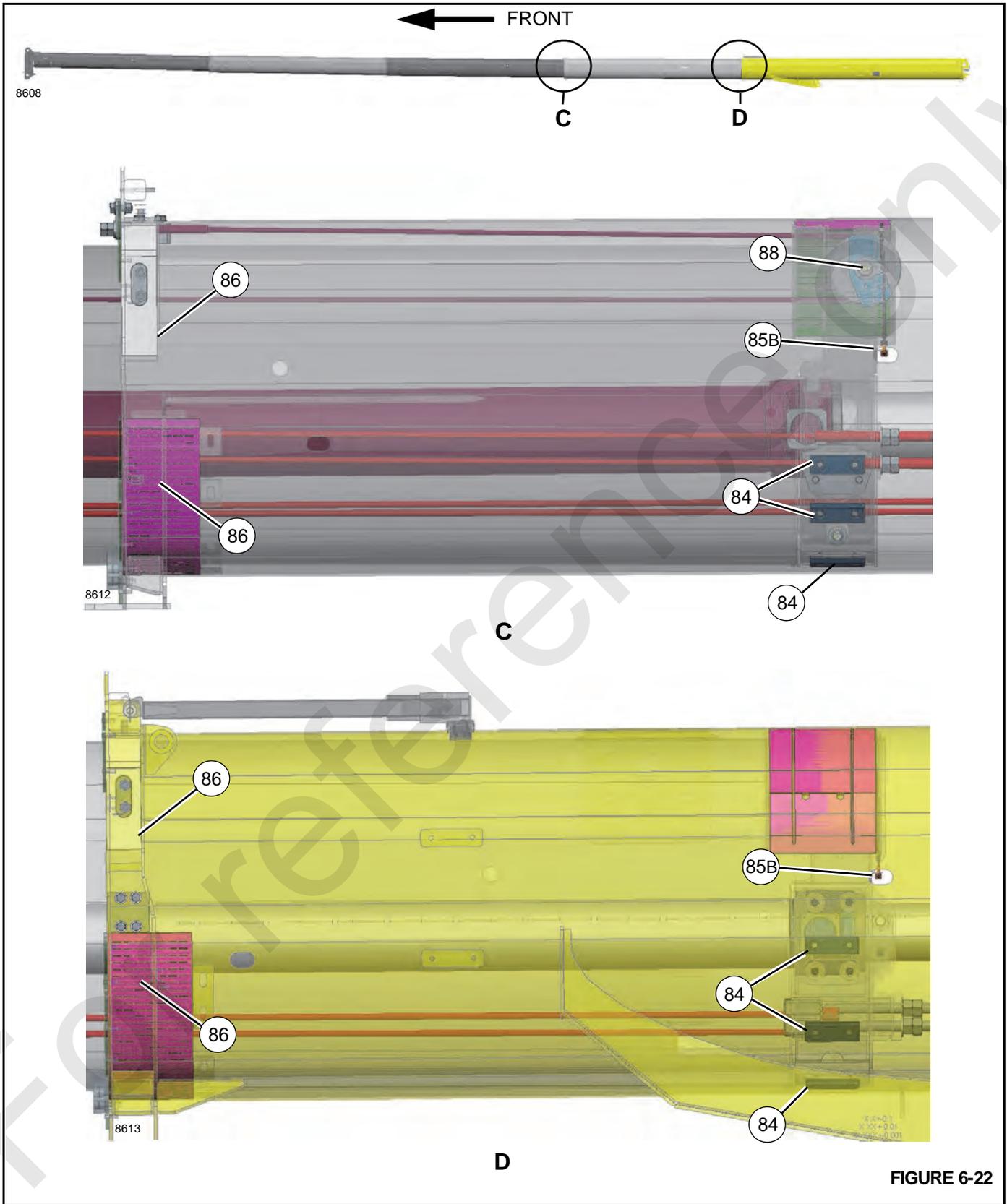


FIGURE 6-22

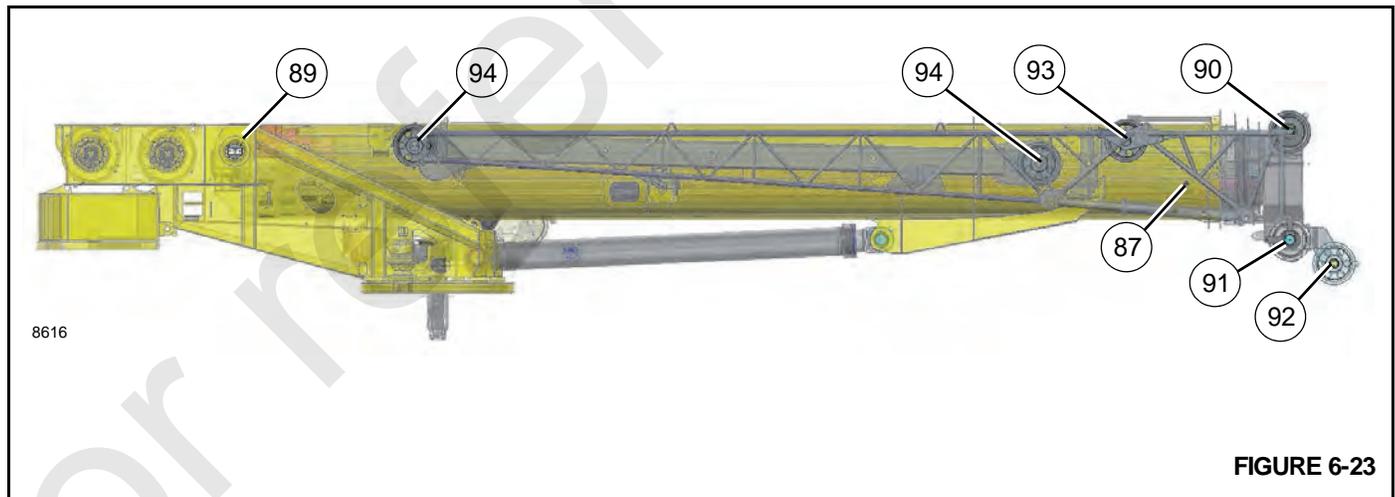
Boom (Continued)

NOTE: Crane Setup: Machine shall be set up on firm level surface with fully extended outriggers and minimum 9979 kg (22,000 lb) counterweight installed. Ensure crane is level.

- Boom must be directly over the front with house lock engaged.
- Set boom angle at zero degrees (0°).
- Do not exceed 38.2 m (125.5 ft) boom length in Auto Mode A.
- Do not exceed 33.8 m (111.1 ft) boom length in Auto Mode B.
- All lubrication points can be accessed by operating crane in the 0001 RCL mode using A or B boom configurations.

CAUTION: Do not operate crane in RCL bypass to lubricate the boom.

Item	Lube Point Description	Figure No.	Approved Lubricant	Lube Capacity	Lube Interval	Application
89	Boom Pivot Shaft	Figure 6-23	L	Until grease extrudes	250 hours or 3 months	4 grease fittings
90	Upper Boom Nose Sheave	Figure 6-23	A	Thoroughly coat	Apply grease at assembly or tear down.	2 grease points (1) per sheave
91	Lower Boom Nose Sheave	Figure 6-23	A	Thoroughly coat	Apply grease at assembly or tear down.	5 grease points (1) per sheave
92	Auxiliary Boom Nose Sheave	Figure 6-23	A	Until grease extrudes	250 hours or 3 months	1 grease fitting
93	Mast Sheave	Figure 6-23	A	Until grease extrudes	500 hours or 12 months	1 grease fitting
94	Jib Sheaves	Figure 6-23	A	Until grease extrudes	250 hours or 3 months	2 grease fittings



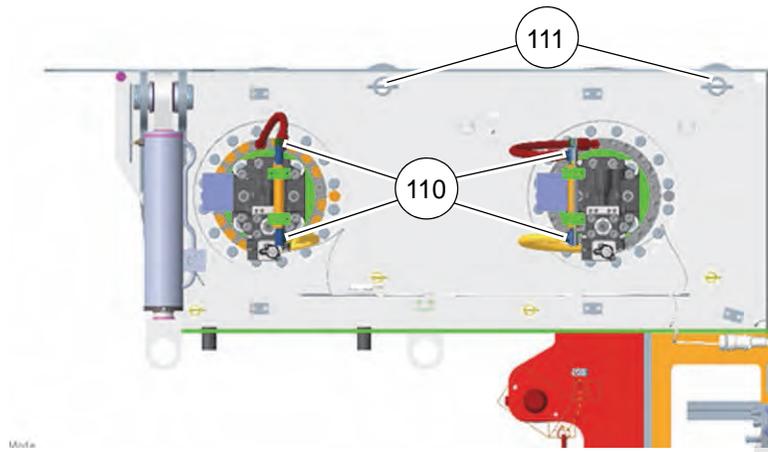
Item	Lube Point Description	Figure No.	Approved Lubricant	Approximate Capacity	Service Interval	Service Application
Hoist Lubrication – MTW 19-71-238						
110	Hoist Drums (Main & Auxiliary)	Figure 6-24	H	4.9 L (1.3 gal)	Every 50 hours of service, or weekly, whichever interval comes first	CHECK oil level 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 42. See NOTE 43.
						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 42. See NOTE 43. CHECK and CLEAN breather, as needed
111	Hoist Rope Rollers	Figure 6-24	A	Brush on inner surface of roller	Every 250 hours, or 3 months of service, whichever interval comes first	BRUSH ON 2 service points See NOTE 42. See NOTE 44.
112	Hoist Bearings	Figure 6-24	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 42.

NOTE 42: DO NOT USE non semi-synthetic lubricant. Use of non-approved lubricant may damage components.

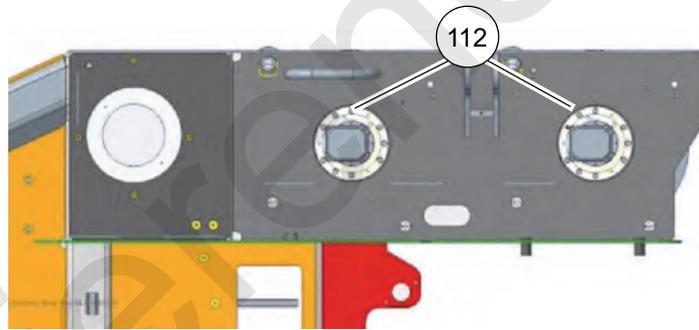
NOTE 43: Check oil level in hoist drum sight glass. Hoist oil level MUST be between the high and low marks on sight glass. If oil is not visible, hoist may be underfilled. If oil is escaping from the vent plug, hoist may be overfilled.

NOTE 44: 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.

Hoist Lubrication – MTW 19-71-238



HOIST DRUM – RIGHT SIDE

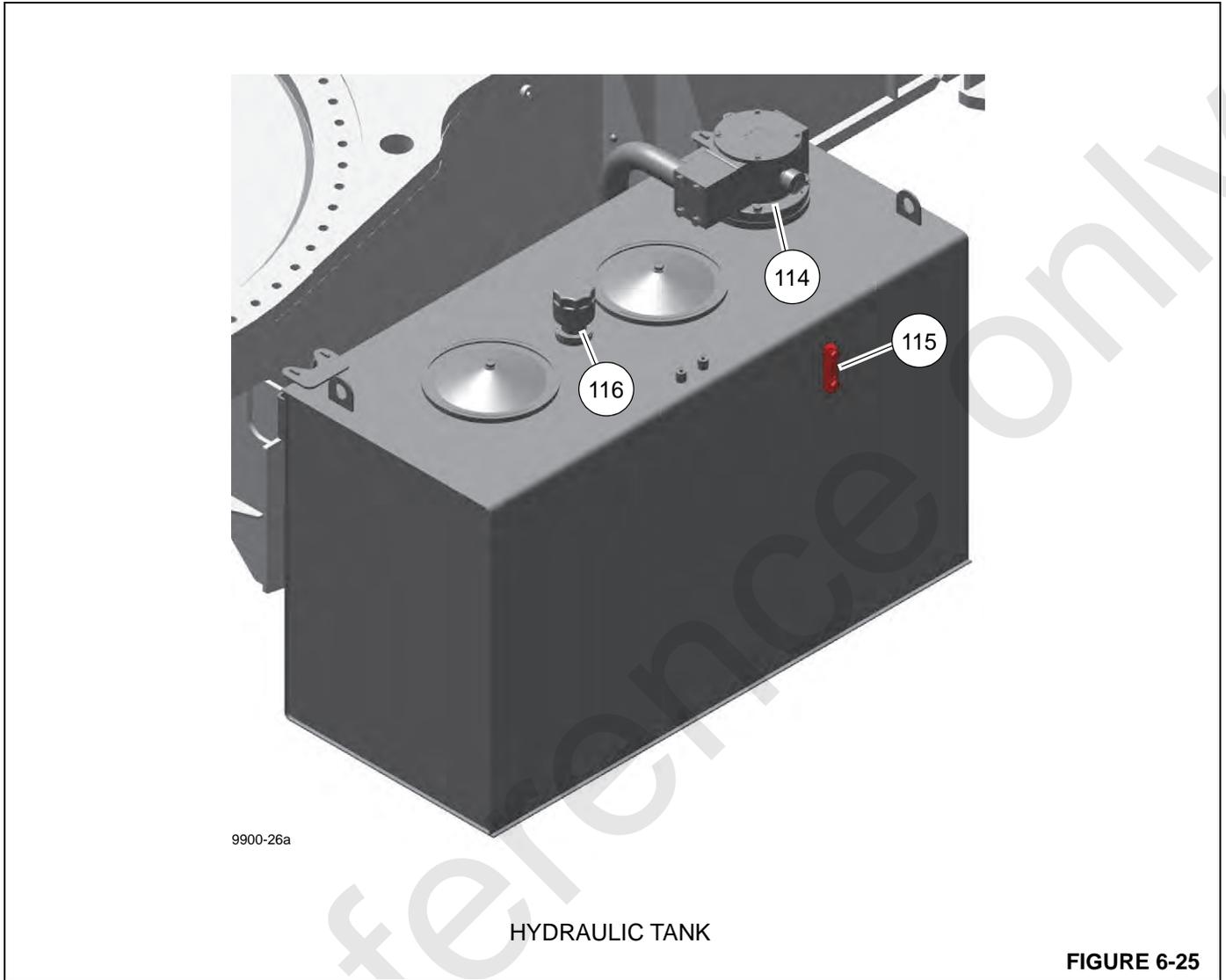


HOIST DRUM – LEFT SIDE

HOIST DRUMS – (MAIN and AUXILIARY)

FIGURE 6-24

Item	Lube Point Description	Figure No.	Approved Lubricant	Lube Capacity	Lube Interval	Application
Hydraulics Lubrication						
114	Hydraulic Filter	Figure 6-25	—	—	REPLACE hydraulic filter when restriction indicator gauge on the filter head shows red	REPLACE hydraulic filter element See NOTE 46. See NOTE 49.
115	Hydraulic Tank SIGHT GLASS See NOTE 45.	Figure 6-25	J	926.5 L (192.6 gal) Tank only	Every 10 hours of service, or daily, whichever interval comes first	CHECK oil level FILL hydraulic tank to LEVEL in SIGHT GLASS
116	Hydraulic Tank BREATHER				PERFORM SERVICE INSPECTION every 3 to 6 months See NOTE 49.	PERFORM SERVICE INSPECTION of oil, filters, and breathers See NOTE 47. See NOTE 48.
					SAMPLE hydraulic oil every 3 to 6 months	SAMPLE hydraulic oil
<p>NOTE 45: Check Hydraulic oil level using sight glass on tank with boom fully retracted and lowered, and all outrigger cylinders retracted.</p> <p>NOTE 46 REPLACE hydraulic filter element when the restriction indicator gauge on the filter head is in the red and oil is at operating temperature.</p> <p>NOTE 47: REPLACE hydraulic filter at first 50-hours of service and repeat after another 50-hours, for a total of 100 hours of service, thereafter, at normal intervals.</p> <p>NOTE 48: Hydraulic oil MUST BE at operating temperature at hydraulic filter and tank inspection and service. Hydraulic oil MUST be drained at a temperature of 65°C to 90°C (150°F to 200°F).</p> <p>NOTE 49: Hydraulic oil SHALL MEET or EXCEED ISO 4406 class 17/14 cleanliness level (reference SAE J1165).</p> <ul style="list-style-type: none"> 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. 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): <ol style="list-style-type: none"> DRAIN existing oil. FILL tank with oil per 6829101559 and cycle all cylinders. DRAIN oil. FILL tank with oil per 6829101559. See also your GRT8100-1 <i>Service Manual</i> for further details on Hydraulic Oil Sampling Test. Should you have any questions, please contact your local authorized Grove distributor. 						



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, Grove crane owners 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, Grove Product Support 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, Grove Product Support 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: Grove Product Support 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; using a single coat of primer only 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 Grove Product Support (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 Grove Product Support should you have any questions.

Areas of Application

Refer to Figure 6-26 and Figure 6-27 for location of crane components that need periodic application of Carwell[®] T32 (CP-90) for continued protection against corrosion.

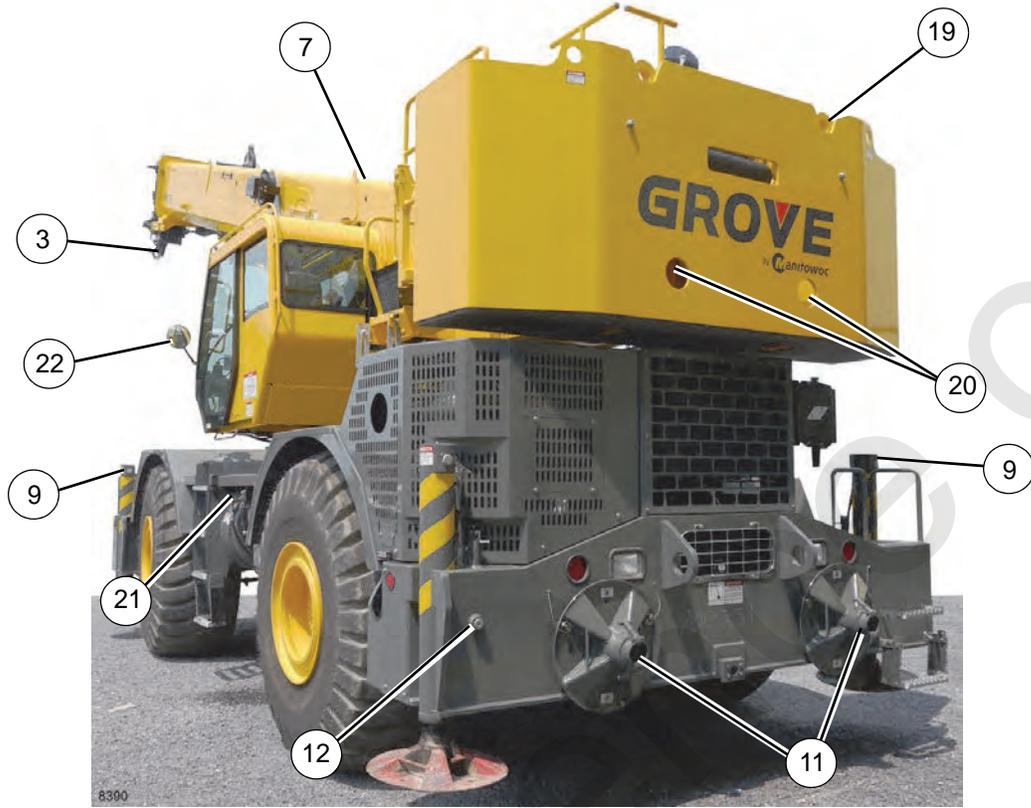
- Underside of crane will have full coverage of the rust inhibitor. These are the only areas that a full coat of rust inhibitor is acceptable on painted surfaces. Areas include; Valves, hose end and fittings, Swivel, pumps, axles, drive lines, transmission, slew ring fasteners and all interior surfaces 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, jib pins and shafts, all bare metal surfaces, overhaul ball pins/ hook block pins and fasteners.
- All hardware, clips, pins, hose connections not painted will have treatment applied.



7650-75

Picture may not be same model as your crane, it is for reference only.

Figure 6-26



Picture may not be same model as your crane, it is for reference only.

Figure 6-27

Table 6-1 Rust Inhibitor Application Locations

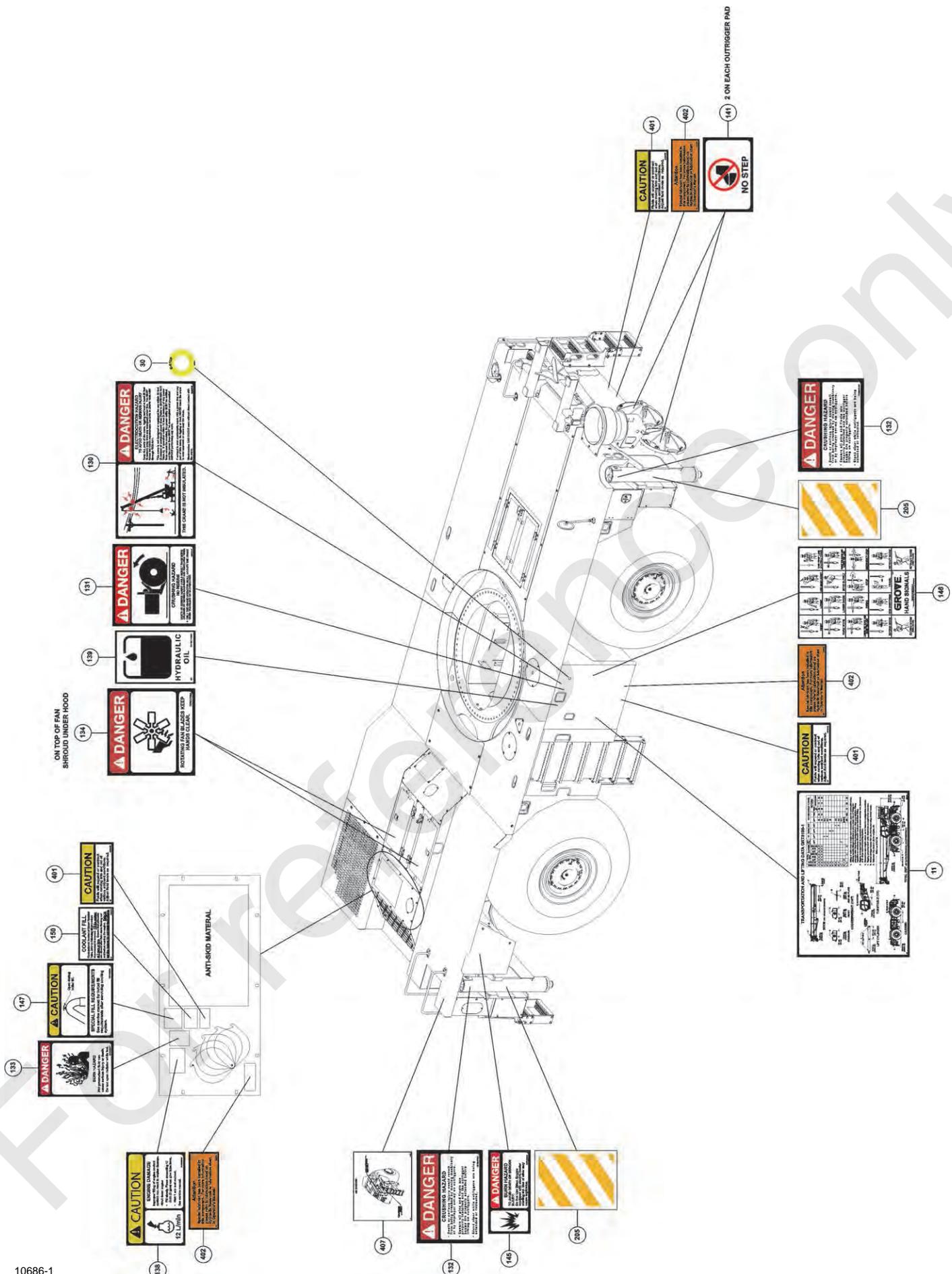
1	Boom Extension Pins, Clips	12	Entire underside of crane
2	Boom Nose Pins, Clips	13	Turntable Bearing Fasteners
3	Hook Block/Overhaul Ball	14	Powertrain Hardware Inside Compartment
4	Boom Extension Hanger Hardware	15	Valve Bank
5	Pivot Shaft	16	Hoist Hose Connections
6	Hose Connections Inside Turntable	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

APPENDIX 1 DECALS

Figure A-1 shows the locations of the decals on the GRT8100-1.

For reference only

FIGURE A-1



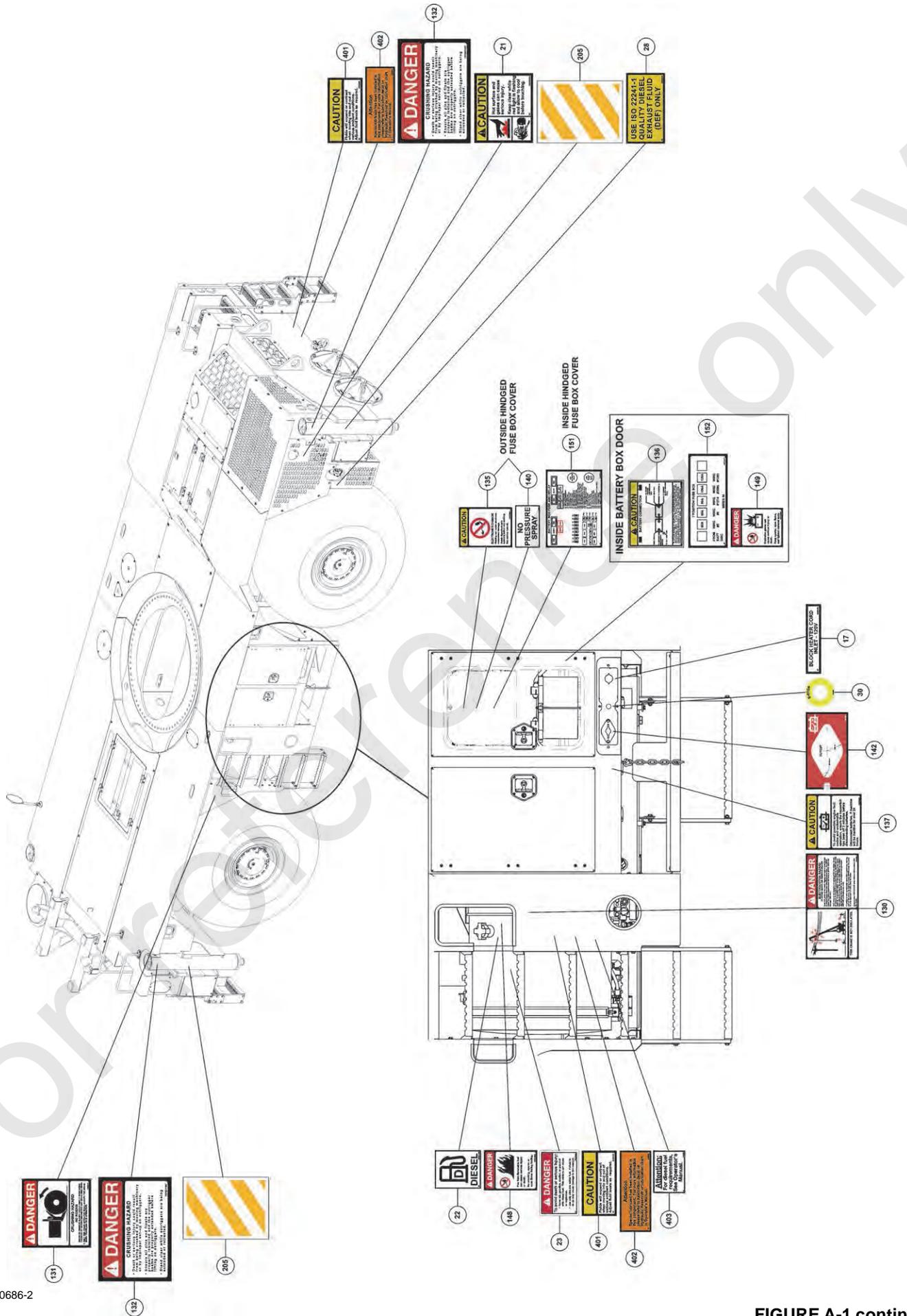


FIGURE A-1 continued

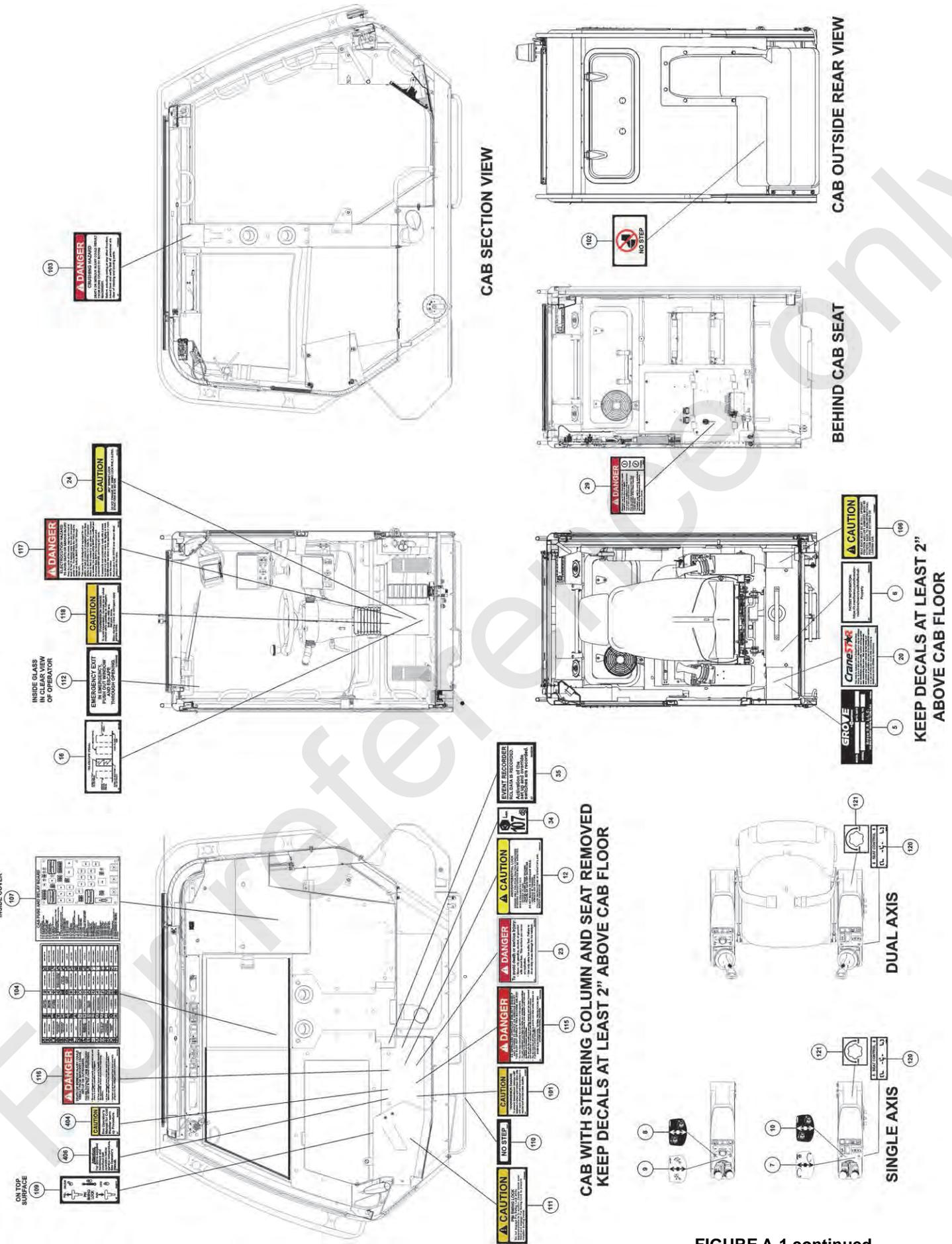


Table A-1 — Legend for Figure A-1

Item	Description
3	Reflector Striping
5	Panel-Nameplate-Crane
6	Patent
7	Swing
8	Main Hoist
9	Boom Lift
10	Aux Hoist
10	Boom Telescope
11	Transportation and Lifting GRT8100
12	CAUTION-4wd/Diff Lock
13	“Grove-7” White”
14	DANGER-Bm Ext Hazard
15	Transportation and Lifting-Power Luffing Boom Extension
16	Tele Pedal
17	Engine Block Heater-120v
17	Engine Block Heater-240v
18	Transportation and Lifting-Folding Bm Ext
19	Transportation and Lifting-Fly Section
20	Cranestar Monitoring
21	CAUTION-Hot Surface & Gases
22	Diesel
22	Panel-Low Sulfur Diesel Fuel
23	DANGER-Ultra Low Sulfur
24	CAUTION-360 Swing Lock
25	Transportation and Lifting-5m Inner Boom Extension Insert
27	CAUTION Lifting
28	Qty Diesel Fluid
29	DANGER-RCL Override Sw
30	E-Stop
31	Panel-Serial Number
32	Window Cling-Serial Number
33	DANGER-Boom Extension Hazard
34	107 Db
35	Event Recorder
35	“Decal, Data Recorder”
36	Decal Instl Maxbase O/R Colors

Table A-1 — Legend for Figure A-1 (Continued)

Item	Description
100	DANGER-Tip/2blkng Hazard
101	CAUTION-Transmission Damage
102	No Step
103	DANGER-Superstructure Swing Hazard
104	Symbol ID
106	CAUTION Armrest Position
107	Cab Fuse & Relay Board
108	Cranestar Logo
109	Pin Swing Lock
110	No Step
111	CAUTION-Pin Swing Lock
112	Emergency Exit
114	WARNING-California Proposition 65
115	DANGER-Untrained Opr
116	DANGER-O/R Mid Extend
117	DANGER-Electrocution Haz
118	CAUTION-Trans Damage
120	Seat Control
130	DANGER-Electroc Hazard
131	DANGER-Revolving Tires
132	DANGER-O/R Crush Hazard
133	DANGER-Pressurized Fluid
134	Decal DANGER Rotating Blades
135	CAUTION-Electronics Damage
136	Battery Connection
137	CAUTION-Batt Disconnection
138	CAUTION-Engine Coolant Fill
139	Hydraulic Oil
140	No Pressure Spray
141	No Step
142	Battery Disconnect
143	Mid Extend O/R ->
144	Mid Extend O/R <-
145	DANGER-Ether Hazard
146	Hand Signals
147	CAUTION-Special Fill
148	DANGER-Fire Hazard
149	DANGER-Battery Explosion

Table A-1 — Legend for Figure A-1 (Continued)

Item	Description
150	Coolant Fill Instruction
151	Battery Box Fuse & Relay
152	7-Position Fuse
160	DANGER-Cwt Crushing Hazard
161	DANGER-Cwt Lift Hazard
162	DANGER-Cable Wedge
163	No Step
164	Wear Body Harness
165	DANGER-Falling Hazard
166	DANGER-Hoist Entanglement
167	DANGER-Press Oil Leak
168	Tie Dwn Or Lift Pt Proh
169	DANGER-Counterweight Removal Instruction
170	Slew Drive Brake Fill
171	Slew Drive Gearbox Fill
172	DANGER-Access Cover
180	DANGER-Boom Not Walkway
181	DANGER-Aux Boom Nose
182	Auxiliary Boom Nose
183	CAUTION-Dead End Lug
184	CAUTION-Disconnect A2B
200	Grt8100-1
201	“Grove-3” Gray “
202	“Grove-6.5” Gray”
203	“Grove-7.7” Gray”
204	“Grove-7” White”
205	Chevron-Or Jack
206	“Manitowoc Cg-Gry/Red-3””
207	“Grove-4.5” Gray”
401	CAUTION-Fluids
402	Special Lube
404	Fuel
405	CAUTION-Cold Weather
406	Attention Hook Block
407	Attention Hook Block
408	Air Diverter
413	Coolant Fill Instruction

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