

# Grove TMS500-2

## Operator Manual



9826



## **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](http://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](http://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.

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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: \_\_\_\_\_

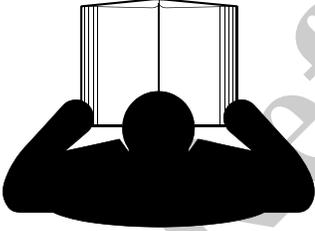
EMAIL ADDRESS: \_\_\_\_\_

DATE PURCHASED \_\_\_\_\_ CRANE MODEL \_\_\_\_\_ CRANE SERIAL NUMBER \_\_\_\_\_

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

# OPERATOR MANUAL

**TMS500-2**

 A black silhouette of a person from the back, holding an open book or manual up to their face as if reading. The book is open, showing two pages.	<p><b>⚠ DANGER</b></p> <p><b>An untrained operator subjects himself and others to death or serious injury. Do not operate this crane unless:</b></p> <ul style="list-style-type: none"><li>• You are trained in the safe operation of this crane. Grove is not responsible for qualifying personnel.</li><li>• You read, understand, and follow the safety and operating recommendations contained in the crane manufacturer's manuals and load charts, your employer's work rules, and applicable government regulations.</li><li>• You are sure that all safety signs, guards, and other safety features are in place and in proper condition.</li><li>• The Operator Manual and Load Chart are in the holder provided on crane.</li></ul>
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**For  
Reference  
Only**

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Reference Only

# SECTION 1 INTRODUCTION

## SECTION CONTENTS

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## GENERAL

This manual provides important information for the operator of the Grove Model TMS500-2 Series crane.

The mobile crane carrier incorporates an all welded steel frame. The 6 x 4 x 2 carrier utilizes two drive axles and one steer axle. Axle steering is provided by a power steering pump, and power steering gear. The engine is mounted in the front of the carrier and provides power through an 11 speed forward and 3 speed reverse automated transmission.

Hydraulic, single-stage double box telescopic beam with jack cylinder outriggers are integral with the carrier frame. The outriggers are utilized in three positions; fully extended, mid-extended and fully retracted (100%, 50% and 0%). The carrier is also equipped with a center front jack with a permanently installed pad.

The superstructure is capable of 360° rotation in either direction. All crane functions are controlled from the fully enclosed operators cab. The crane is equipped with either a 8.8 m to 29 m (29-95 ft) four section boom or a 9.8 m to 31.0 m (32-102 ft) four section boom.

Lifting is provided by a main hoist and optional auxiliary hoist. Additional reach is obtained by utilizing an optional swingaway manually offsettable boom extension. Extension offsets are 0, 15, and 30 degrees. Lengths are retracted 7.9m to extended 13.7m (25.9 ft. to 45.0 ft.).

**NOTE:** Throughout this 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’s seat with the superstructure facing forward over the front of the carrier frame.

Basic nomenclature is shown in Figure 1-1

## Ambient Operation Temperature

This crane is permitted to operate in ambient temperatures from -29 °C to 49 °C (-20 °F to 120 °F). Consult Manitowoc Crane Care for instructions on operation of this crane for ambient temperatures outside of the permitted range.

## Customer Support

Grove and our Distributor Network want to make sure 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.

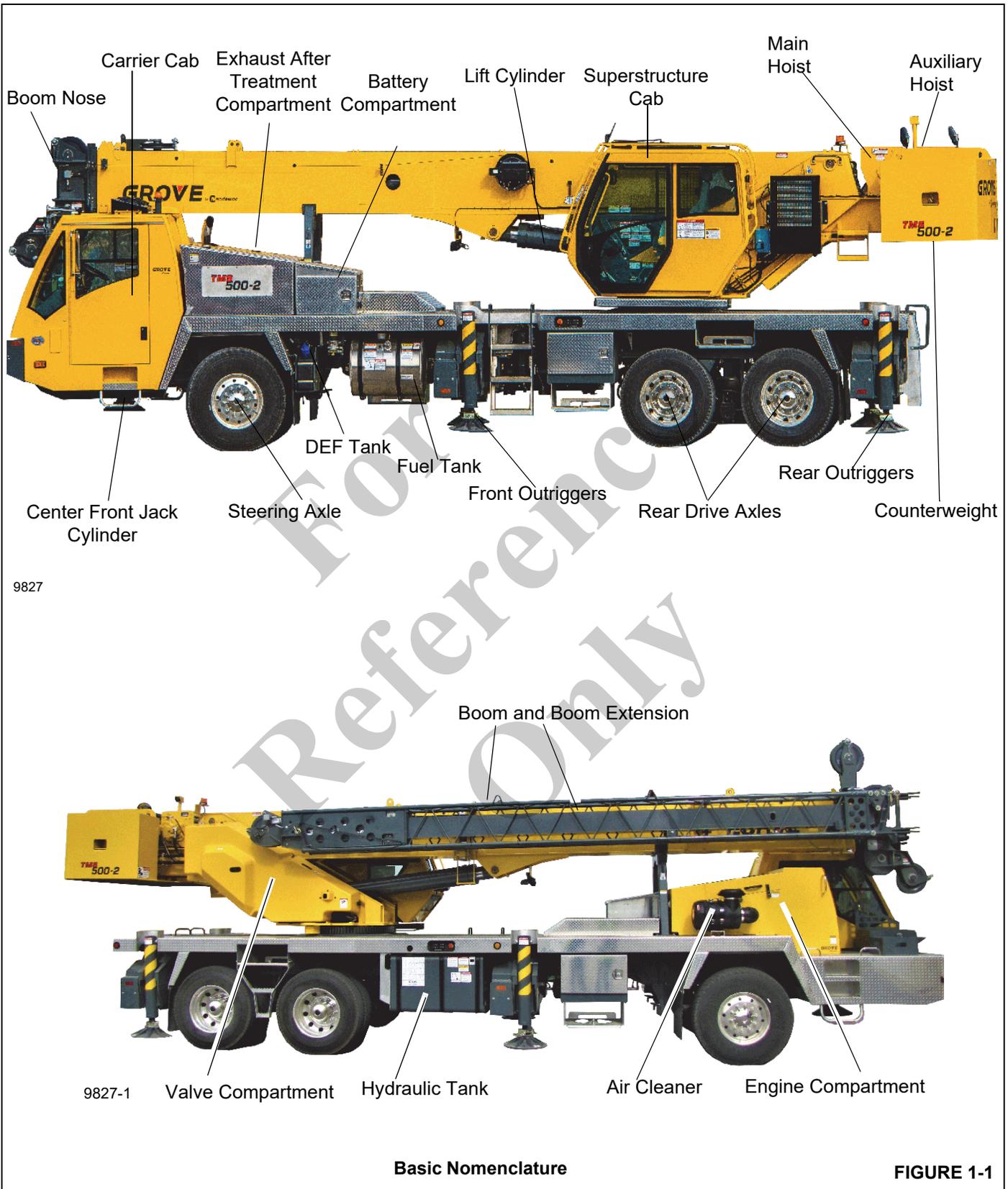
## Safety Information

A Safety Compact Disc (CD) or USB Flashdrive which includes sections on Operation, Safety, and Maintenance for Grove Crane operators and owners is supplied when the equipment is purchased new. Additional copies are available from your local distributor.

## New Owners

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

Go to: [https://www.manitowoccranes.com/en/Parts\\_Services/ServiceAndSupport/ChangeOfOwnershipForm](https://www.manitowoccranes.com/en/Parts_Services/ServiceAndSupport/ChangeOfOwnershipForm) and complete the form.



**LIST OF SPECIFICATIONS**

**General**

Model	TMS500-2 Series
Rated Capacity	See <i>Load Chart</i> in cab
Drive	6 x 4 x 2
Gross Weight 95' Boom	
No CWT	24741 kg (54545 lb)
Light CWT	26989- kg (59499 lb)
Full CWT	28576 kg (62999- lb)
Gross Weight 102' Boom	
Full CWT	29457- kg (64940 lb)

**Dimensions**

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

Wheelbase	5385 mm (212 in)
Overall Crane Length	11,684 mm (461 in)
Overall Crane Width (Over Fenders)	
Retracted	2540 mm (100 in)
Overall Crane Height	3429 mm (135in)
Tail-Swing	3658 mm (144 in)
Outrigger Spread	
Retracted	2388 mm (94 in)
Mid Extend	4267 mm (168 in)
Fully Extended	6096 mm (240 in)

**Capacities**

Fuel Tank	220 liters (58 gal)
Coolant System	152.2L (160.8 qt)
Engine Lubrication System	See Engine Specifications
Hydraulic Tank (Reservoir Capacity)	
Total	458 liters (121 gal)
at Full Level	405 liters (107 gal)
at Add Level	375 liters (99 gal)
Expansion Space	54 liters (14.2 gal)
Hoists	5.2 liters (5.5 qt)
Swing Gearbox	4.0 liters (4.25 qt)
Front Axle Hubs	0.57 liters (.6 qt)
Front Rear Axle Differentials	18.5 liters (39.1 pt)
Rear Rear Axle Differentials	16.3 liters (34.4 pt)
Transmission	13.2 liters (28.0 pt)

**Transmission**

Speeds	11 forward - 3 reverse
Gear Ratios	
First	26.08
Second	16.30
Third	11.85
Fourth	7.41
Fifth	5.23
Sixth	3.79
Seventh	2.77
Eighth	1.95
Ninth	1.38
Tenth	1.00
Eleventh	0.73
Reverse High	3.43
Reverse Low	13.03
Deep Reduction	20.85

**Engine**

**Cummins ISL9-2017**

Bore	114 mm (4.5 in)
Stroke	145 mm (57 in)
Displacement	8.9 liters (543 cu in)
Firing Order	1-5-3-6-2-4
Lube Amount	18.9 liters (20 quart)

**Suspension**

Front	Springs
Rear	Air

**Axles**

**Front**

Type	Non-drive steer
------	-----------------

**Rear**

Type	Single reduction tandem
Ratio	4.89:1

**Brakes**

**Front**

Type	Air operated S-Cam
Size	419 x 152 mm (16.5 x 6.0 in)

**Rear**

Type	Air operated S-Cam
Size	419 x 178 mm (16.5 x 7.0 in)

**Wheels and Tires**

Lugs	10
Torque	610 to 678 N-m (450 - 500 lb-ft)
Tire Size	
Front	425/65R22.5
Rear	11R22.5

**NOTE:** For roading and lifting pressures, refer to the Tire Inflation Decal.

**Swing Gearbox**

Reduction Ratio	36:1
Output Torque	3340 N-m (29,562 in-lb)

**Boom 95'**

Length	8.8 to 29.0 meters (29.0 to 95.0 ft)
Power	4 Section, Synchronized Full Power
Elevation	-3 to +76 degrees
Extensions	
Telescoping*	7.92 or 13.70 meters (26 or 45 ft)
*Extensions	are offsettable at 0,15 or 30 degrees.

**Boom 102'**

Length	9.8 to 31.0 meters (32.0 to 102.0 ft)
Power	4 Section, Synchronized Full Power
Elevation	-3 to +76 degrees
Extensions	
Fixed*	7.92 meters (26 ft)

Telescoping\* 7.92 or 13.70 meters (26 or 45 ft)  
\*Extensions are offsettable at 0,15 or 30  
degrees.

For  
Reference  
Only

## SECTION 2 SAFETY INFORMATION

### SECTION CONTENTS

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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 **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.

### Safety Decals

Refer to the *Parts Manual* for a drawing indicating the location of safety decals on the crane.

## ACCIDENTS

Following any accident or damage to equipment, the Grove distributor must be immediately advised of the incident and consulted on necessary inspections and repairs. Should the distributor not be immediately available, contact should be made directly with Grove Product Safety at the address below. The crane must not be returned to service until it is thoroughly inspected for any evidence of damage. All damaged parts must be repaired or replaced as authorized by your Grove distributor and/or Manitowoc Crane Care.

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

**Grove U.S. L.L.C.**

1565 East Buchanan Trail  
Shady Grove, PA 17256-0021

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

Fax: 717-593-5152

E-mail: [product.safety@manitowoc.com](mailto: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.

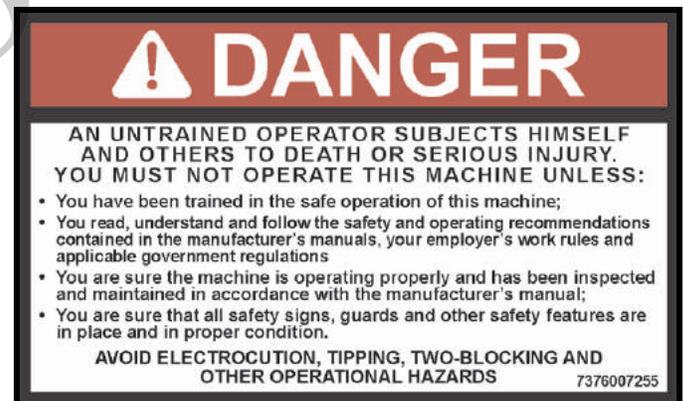
## OPERATOR QUALIFICATIONS

**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.

Refer to the *Parts Manual* for this crane for the locations of all safety decals.

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.

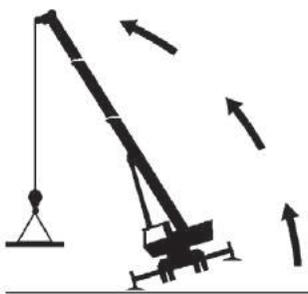


**Working Area Limiter (If Equipped)**

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;"><b>TIPPING HAZARD</b></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><b>TO AVOID DEATH OR SERIOUS INJURY:</b></p> <p><b>NEVER</b> handle personnel with this machine unless the requirements of the applicable national, state and local regulations and safety codes are met.</p> <p><b>NEVER</b> use this crane for bungee jumping or any form of amusement or sport.</p> <p><b>NEVER</b> permit anyone to ride loads, hooks, slings or other rigging for any reason.</p> <p><b>NEVER</b> get on or off a moving crane.</p> <p><b>NEVER</b> allow anyone other than the operator to be on this crane while it is operating or traveling.</p>
 <p style="text-align: center;"><b>TWO-BLOCKING HAZARD</b></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><b>ELECTRONIC EQUIPMENT</b> 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>

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

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## CRANE STABILITY/STRUCTURAL STRENGTH

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

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

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

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

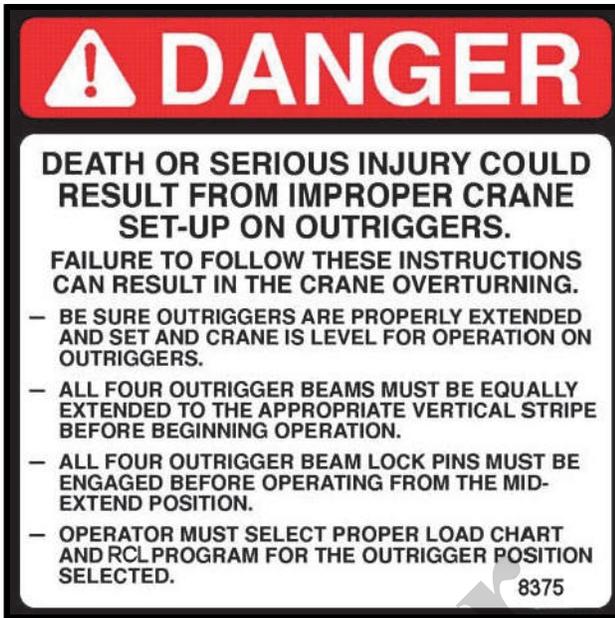
The operator must select the proper *Load Chart* and Rated Capacity Limiter (RCL) System program for the outrigger position selected.

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

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

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

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



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

## Load Charts

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

*Load Chart* capacities are based on freely suspended loads.

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

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

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

## Work Site

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

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

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

## WIND FORCES

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

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

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

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

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

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

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

**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:

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

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

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

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

**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.

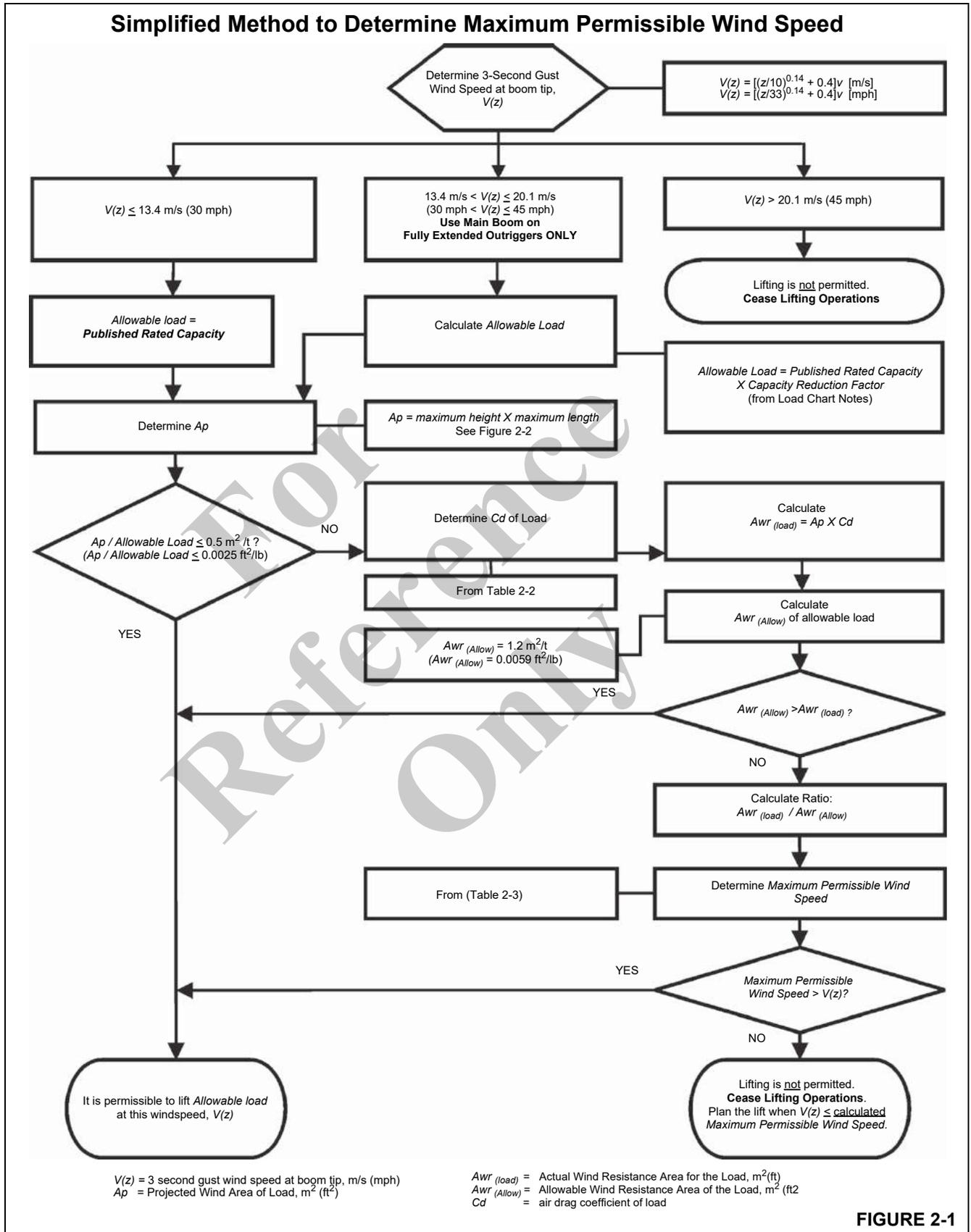


FIGURE 2-1

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

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

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

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

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

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

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

where:

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

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

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

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

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

then:

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

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

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

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

Since  $V(z)$  is  $\leq 13.4$  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:

$Awr_{(load)}$  [m<sup>2</sup>] [ft<sup>2</sup>] - Wind resistant area of the load

$A_p$  [m<sup>2</sup>] [ft<sup>2</sup>] - 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

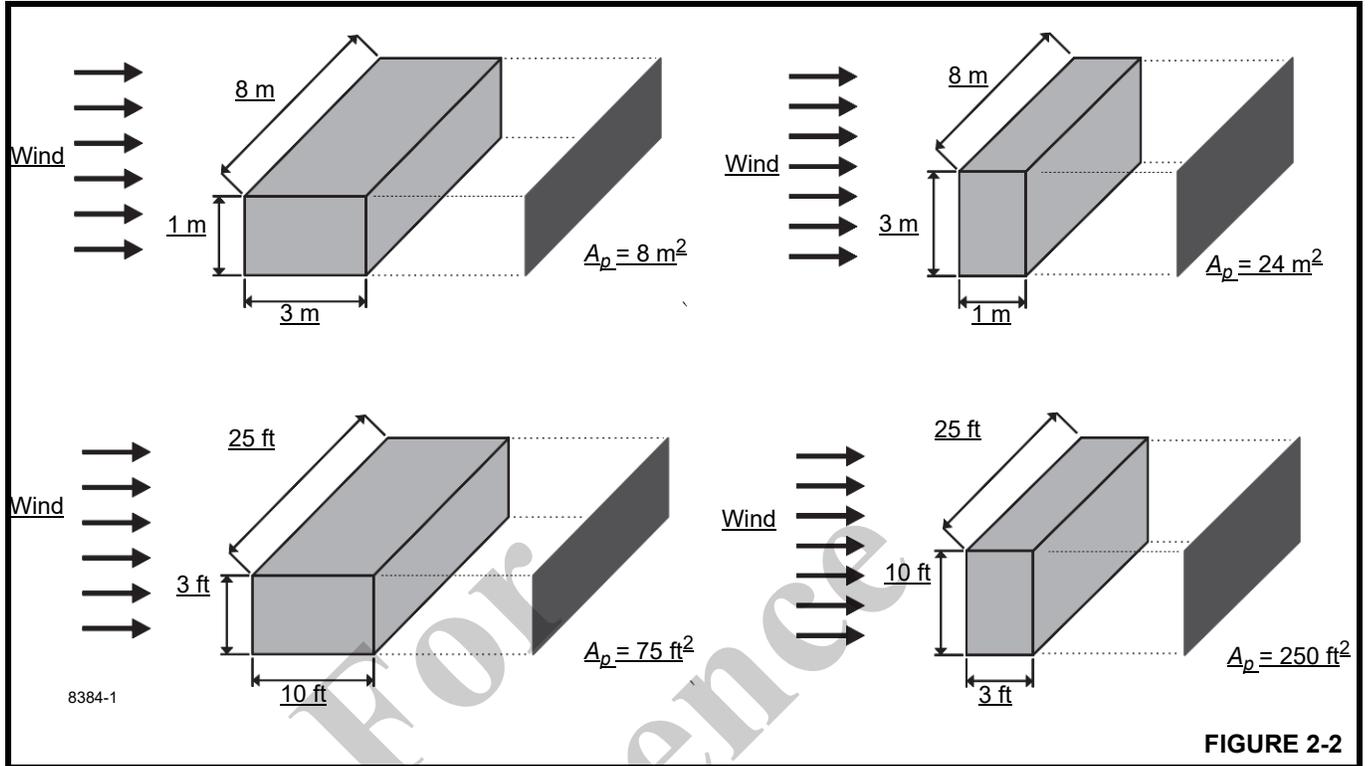
$$Awr_{(allow)} = 0.0012 \times m_{(load)} \quad (2.4)$$

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 ( $A_p$ ):



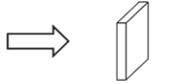
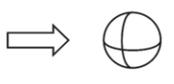
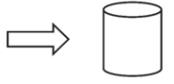
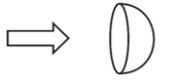
**Determining Wind Drag Coefficient ( $C_d$ )**

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
<b>NOTE:</b> 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)	7,470 (47)	7,920 (53)	7,980 (57.5)	7,470 (61.5)	
18					5,960 (47)	5,960 (39.5)	6,340 (47.5)	6,525 (53)	6,530 (57.5)	
20						4,755 (30.5)	5,145 (41)	5,320 (48)	5,495 (53)	
22							3,790 (16.5)	4,210 (33.5)	4,380 (42.5)	4,545 (48.5)
24								3,435 (23.5)	3,620 (36)	3,780 (43.5)
26									2,975 (28)	3,150 (37.5)
28									2,400 (16)	2,620 (31)
30										2,135 (22)
Minimum boom angle (°) for indicated length (no load)										0
Maximum boom length (m) at 0° boom angle (no load)										33.5

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

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

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

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

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

Maximum allowable wind resistance area,  $[m^2] Awr_{(allow)} = 0.0012 \times \text{calculated reduced capacity in kg}$ .

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

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

**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 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 1: Crane Configuration:**

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

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

The maximum allowable wind resistance area of load is:

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

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

**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 m<sup>2</sup>

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 m<sup>2</sup>

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 m<sup>2</sup>.

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 m<sup>2</sup>,
- 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<sub>(load)</sub>** less than **Awr<sub>(allow)</sub>**?  
13.8 m<sup>2</sup>  $\leq$  14.45 m<sup>2</sup> 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 m<sup>2</sup>,
- 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<sub>(load)</sub>** = **Ap** x **Cd** = 5.45 x 2.4 = 13.08 m<sup>2</sup>

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<sub>(load)</sub>** less than **Awr<sub>(allow)</sub>**?  
13.08 m<sup>2</sup>  $\leq$  14.45 m<sup>2</sup> 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<sub>(load)</sub>**,

- Load to be lifted of 14,000 kg,
- Projected Wind Area **Ap** = 21.85 m<sup>2</sup>,
- 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<sub>(load)</sub>** less than **Awr<sub>(allow)</sub>**?  
26.22 m<sup>2</sup>  $\leq$  18.06 m<sup>2</sup> 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:

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<sub>(load)</sub>**,



- Load to be lifted of 8,000 kg,
- Projected Wind Area  $A_p = 15.25 \text{ m}^2$ ,
- Wind Drag Coefficient  $C_d = 1.3$

the wind resistance area of load can be estimated as

$$A_{wr(\text{load})} = A_p \times C_d = 15.25 \times 1.3 = 19.83 \text{ m}^2$$

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

- Is the load to be lifted less than allowable load?  
8,000 kg  $\leq$  12,040 kg YES

- Is  $A_{wr(\text{load})}$  less than  $A_{wr(\text{allow})}$ ?  
 $19.83 \text{ m}^2 \leq 14.45 \text{ m}^2$  NO

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

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

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.

For Reference Only

Rated Load Chart Example - Non-metric

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

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

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

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

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

FIGURE 2-4



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

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

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

	Main Boom Length in Feet								
Wind Speed $Vz > 30$ mph $\leq 45$ 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 ft<sup>2</sup>

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 ft<sup>2</sup>

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 ft<sup>2</sup>.

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 ft<sup>2</sup>,
- 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<sub>(load)</sub>** less than **Awr<sub>(allow)</sub>**?  
105 ft<sup>2</sup>  $\leq$  119 ft<sup>2</sup> 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 ft<sup>2</sup>,
- 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<sub>(load)</sub>** less than **Awr<sub>(allow)</sub>**?  
108 ft<sup>2</sup>  $\leq$  119 ft<sup>2</sup> 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<sub>(load)</sub>**,

- Load to be lifted of 22,000 lb,
- Projected Wind Area **Ap** = 180 ft<sup>2</sup>,
- 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<sub>(load)</sub>** less than **Awr<sub>(allow)</sub>**?  
216 ft<sup>2</sup>  $\leq$  149 ft<sup>2</sup> ..... 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 ft<sup>2</sup>  $\leq$  119 ft<sup>2</sup> 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.**



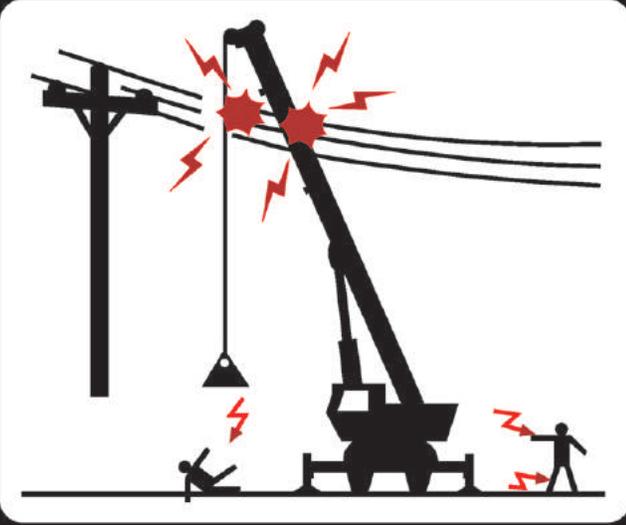
**DANGER**

### 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 TO AVOID DEATH OR SERIOUS INJURY

Keep **ALL** parts of the crane, rigging and load at least 20 feet (6 meters) away from any energized power line. You **MUST** follow the OSHA requirements set forth in 29CFR 1926.1407 through 1926.1411.

This crane is not designed or equipped for use within 10 feet (3 meters) of energized power lines [Refer to 29CFR1926.1410 Table A]. If operation within 10 feet (3 meters) 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.

If contact is ever accidentally made with a power line and any part of this crane, its rigging or load, **NEVER** touch the crane or even approach or come near the crane.

Electrocution **CAN OCCUR** even without direct contact with the crane.

THIS CRANE IS NOT INSULATED.

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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.

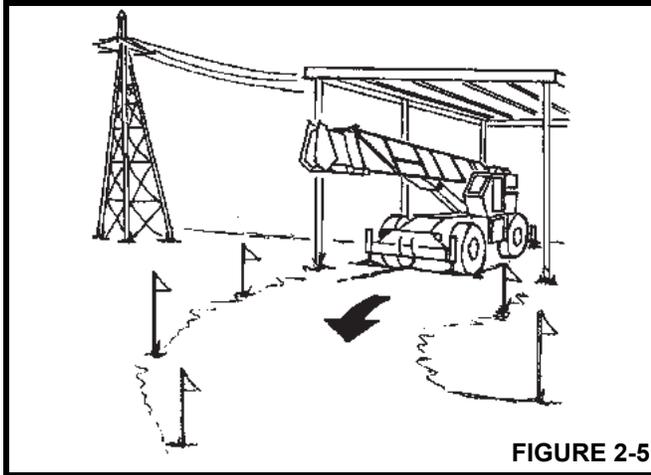
### Set-Up and Operation

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.



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

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

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

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

## Electrocution Hazard Devices

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

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

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

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

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

Proximity sensing and warning devices are available in different types. Some use boom nose (localized) sensors and others use full boom length sensors. No warning may be given for components, cables, loads, and other attachments located outside of the sensing area. Much reliance is placed upon you, the operator, in selecting and properly setting the sensitivity of these devices.

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

Some variables you must know and understand are:

- Proximity devices are advertised to detect the existence of electricity and not its quantity or magnitude.
- Some proximity devices may detect only alternating current (AC) and not direct current (DC).
- Some proximity devices detect radio frequency (RF) energy and others do not.
- Most proximity devices simply provide a signal (audible, visual, or both) for the operator; this signal must not be ignored.
- Sometimes the sensing portion of the proximity devices becomes confused by complex or differing arrays of power lines and power sources.

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

## Electrical Contact

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

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

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

Following any contact with an energized electrical source, the Grove distributor must be immediately advised of the incident and consulted on necessary inspections and repairs. Thoroughly inspect the hoist rope and all points of contact on the crane. Should the distributor not be immediately available, contact Manitowoc Crane Care. The crane must not be returned to service until it is thoroughly inspected for any evidence of damage and all damaged parts are repaired or replaced as authorized by your Grove distributor or Manitowoc Crane Care.

### Special Operating Conditions and Equipment

Never operate the crane during an electrical thunderstorm.

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

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

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

### Grounding the Crane

The crane may become charged with static electricity. This may occur especially when using outrigger pads made of plastic or when the outrigger pads are cribbed with insulating material (e.g., wooden planks).



### WARNING

#### Risk of accidents due to electric shock!

Ground the crane before you start to work with it

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

Use electrically conducting material for grounding.

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

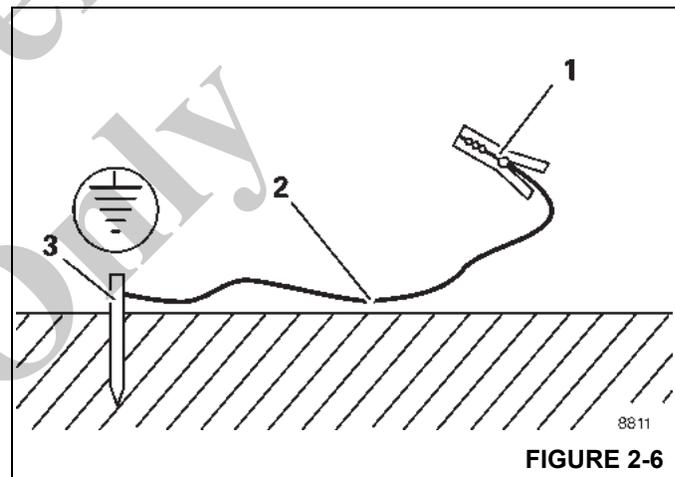


FIGURE 2-6



### WARNING

#### Risk of accidents due to electric shock!

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

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

## PERSONNEL HANDLING

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

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

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

General requirements. The use of a crane or derrick to hoist employees on a personnel platform is prohibited, except when the erection, use, and dismantling of conventional means of reaching the worksite, such as a personnel hoist, ladder, stairway, aerial lift, elevating work platform or scaffold, would be more hazardous or is not possible because of structural design or worksite conditions.

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

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

- The requirements of the applicable national, state and local regulations and safety codes are met.
- A determination has been made that use of a crane to handle personnel is the least hazardous means to perform the work.
- The crane operator shall be qualified to operate the specific type of hoisting equipment used in the personnel lift.
- The crane operator must remain at the crane controls at all times when personnel are off the ground.

- The crane operator and occupants have been instructed in the recognized hazards of personnel platform lifts.
  - The crane is in proper working order.
  - The crane must be equipped with a boom angle indicator that is visible to the crane operator.
  - The crane's *Load Chart* is affixed at the operator's station and readily accessible to the operator. The total weight of the loaded personnel platform and related rigging shall not exceed 50 percent of the rated capacity for the radius and configuration of the crane.
  - The crane is level within one percent of level grade and located on a firm footing. Cranes with outriggers shall have them all deployed following manufacturer's specifications.
  - The crane's *Operator Manual* and other operating manuals are at the operator's station and readily accessible to the operator.
  - The platform meets the requirements as prescribed by applicable standards and regulations.
  - For hoist rope suspended platforms:
    - The crane is equipped with a hook that can be closed and locked, eliminating the throat opening.
    - The crane is equipped with a functional anti-two-block device.
    - The platform is properly attached and secured to the load hook.
  - For boom mounted platforms:
    - The platform is properly attached and secure.
- To avoid death or serious injury:
- NEVER use this crane for bungee jumping or any form of amusement or sport.
  - NEVER handle personnel on the loadline unless the requirements of applicable national, state and local regulations and safety codes are met.
  - NEVER permit anyone to ride loads, hooks, slings or other rigging for any reason.
  - NEVER get on or off a moving crane.
  - NEVER allow anyone other than the operator to be on this crane while the machine is operating or traveling.
  - NEVER allow anyone on the hoist access platform while traveling.

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

- *ASME (formerly ANSI) B30 Series American National Safety Standards For Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings; ASME B30.5, Mobile And Locomotive Cranes, and ASME B30.23, Personnel Lifting Systems*, are available by mail from the ASME, 22 Law Drive, Fairfield, New Jersey, 07004-2900.

- or - check online at:

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

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

## ENVIRONMENTAL PROTECTION

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

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

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

When filling and draining crane components, observe the following:

- Do not pour waste fluids onto the ground, down any drain, or into any source of water.
- Always drain waste fluids into leak proof containers that are clearly marked with what they contain.
- Always fill or add fluids with a funnel or a filling pump.
- Immediately clean up any spills.

## MAINTENANCE

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

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

Shut down the crane while making repairs or adjustments.

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

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

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

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

## Service and Repairs



### WARNING

#### Fall Hazard!

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

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

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

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

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

All replacement parts must be Grove approved.

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

### Hydraulic Fluid

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

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

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



### WARNING

#### Pressurized Fluid Hazard!

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

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

#### Moving Parts

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

#### Before maintenance or repairs

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

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

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

#### After maintenance or repairs

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

#### Lubrication

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

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

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

#### Tires



### WARNING

#### Possible equipment damage and/or personal injury!

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

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

Make sure that all lug nuts are properly torqued.

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

## HOIST ROPE

### Synthetic Hoist Rope

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

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

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

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

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

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

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

### Wire Rope

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

- For rotation-resistant running ropes: more than two (2) broken wires in a length of rope equal to six (6) times the rope diameter, or more than four (4) broken wires in a length of rope equal to thirty (30) times the rope diameter.
- For running ropes other than rotation resistant: six (6) broken wires in one rope lay or three (3) broken wires in one strand.
- One valley break where the wire fractures between strands in a running rope is cause for removal.
- Abrasion of the rope resulting in a 5% reduction in the original wire diameter.
- Any kinking, bird caging, crushing, corrosion, or other damage resulting in distortion of the rope structure.
- Rope that has been in contact with a live power line or has been used as a ground in an electric circuit (e.g., welding) may have wires that are fused or annealed and must be removed from service.
- In standing ropes, more than three (3) breaks in one rope lay in sections beyond the end connection or more than two (2) broken wires at an end connection.
- Core deterioration, usually observed as a rapid reduction in rope diameter, is cause for immediate removal of the rope.

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

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

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

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

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

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

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

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

#### Installing a new rope

- Keep all parts of your body and clothing away from rotating hoist drums and all rotating sheaves.
- Never handle the wire rope with bare hands.
- Follow proper instructions for removing rope from a reel.
- Apply back tension to the storage/payoff reel of the new rope to ensure tight, even, spooling onto the hoist drum.

- Operate the new rope—first through several cycles at light load—then through several cycles at intermediate load, to allow the rope to adjust to operating conditions.

#### When using a wedge socket

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

#### Sheaves

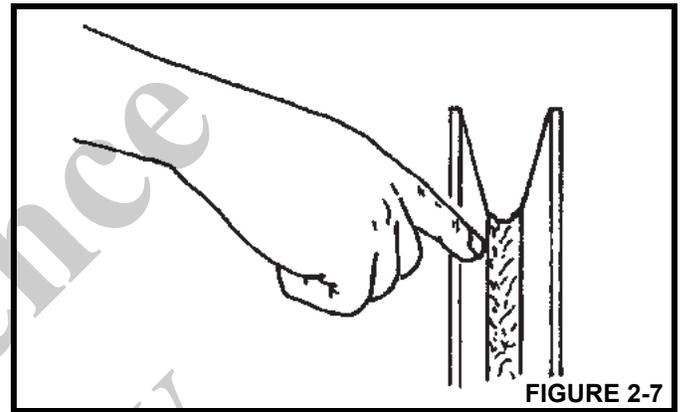


FIGURE 2-7

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

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

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

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

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

upon the user's experience and the demands of his application.

## Batteries

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

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

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

## Super Capacitor (If Equipped)

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

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

- Wear safety glasses when servicing.
- If equipped, disconnect battery with the battery disconnect switch before disconnecting the ground battery cable. For cranes with a Cummins engine using an engine ECM:

1. Make sure that the key switch has been off for 2 minutes.
  2. Turn the battery disconnect switch to the OFF position.
  3. Remove the ECM power fuse.
  4. Remove negative battery cables.
  5. Remove positive capacitor cable.
- Do not short across the capacitor posts to check charge. Short circuit will cause capacitor terminal damage. Spark or flame could cause capacitor explosion.
  - Check capacitor charge level with proper test equipment.

## General Maintenance

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

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

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

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

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

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

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

## TRANSPORTING THE CRANE

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

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

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

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

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

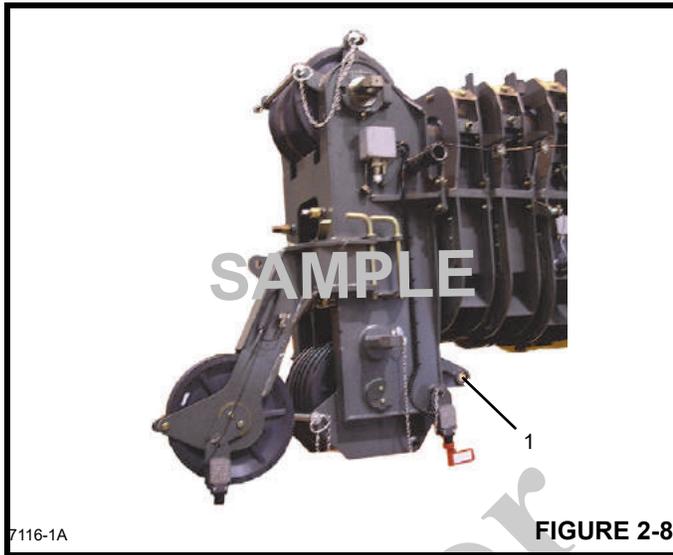


FIGURE 2-8

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

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

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

## TRAVEL OPERATION

Only the crane operator shall occupy the crane when traveling.

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

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

RT 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 air-operated brakes, do not attempt to move the crane until brake system air pressure is at operating level.

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

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

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

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

Stay alert at the wheel.

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

## Slopes

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

## WORK PRACTICES

### Personal Considerations

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

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

### Crane Access



#### WARNING

##### Fall Hazard!

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

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

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

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

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

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

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

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

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

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

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

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

Do not allow ground personnel to store their personal belongings (clothing, lunch boxes, water coolers, and the like) on the crane. This practice will prevent ground personnel from being crushed or electrocuted when they attempt to access personal belongings stored on the crane.

### Job Preparation

#### Before crane use

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

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

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

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

**Working**

Operator shall be responsible for all operations under his/her direct control. When safety of an operation is in doubt, operator shall stop the crane's functions in a controlled manner. Lift operations shall resume only after safety concerns have been addressed or the continuation of crane operations is directed by the lift supervisor.

Know the location and function of all crane controls.

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

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

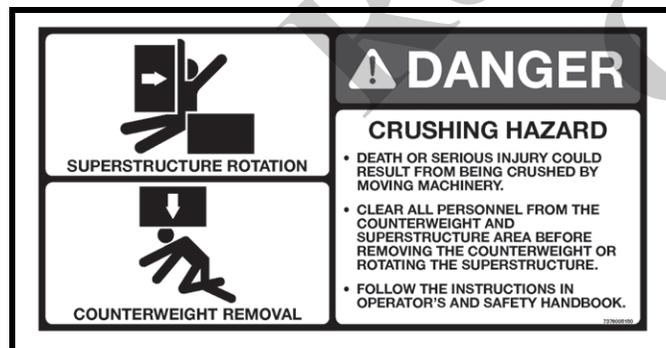
Carbon monoxide fumes from the engine exhaust can cause suffocation in an enclosed area. Good ventilation is very important when operating the crane.

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

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

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

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



Keep unauthorized personnel clear of the working area during operation.

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

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

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

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

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

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

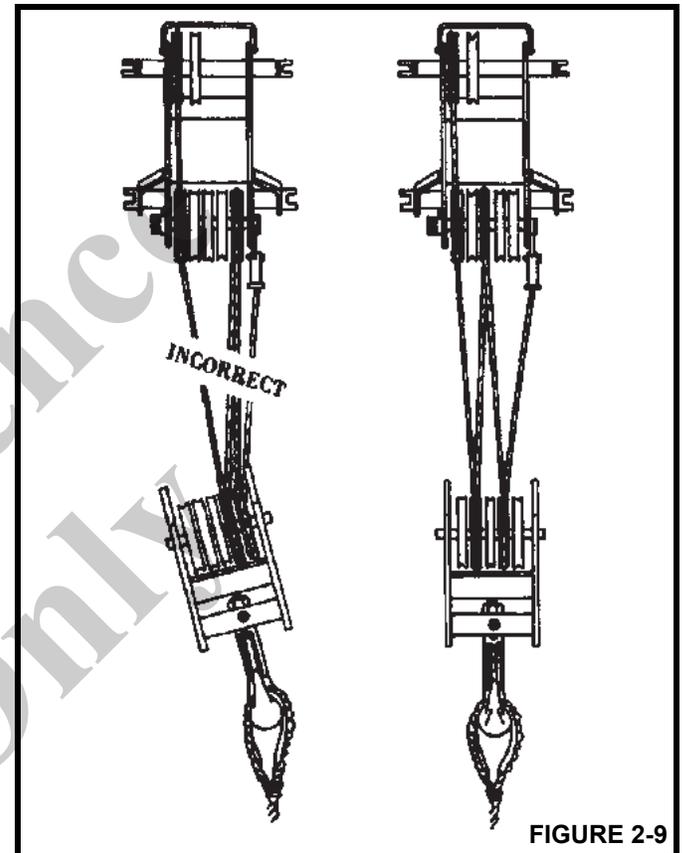


FIGURE 2-9

**Lifting**

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

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

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

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

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

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

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

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

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

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

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

Stop the hook block from swinging when unhooking a load.

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

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

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

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

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

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

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

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

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

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

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

## Hand Signals

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

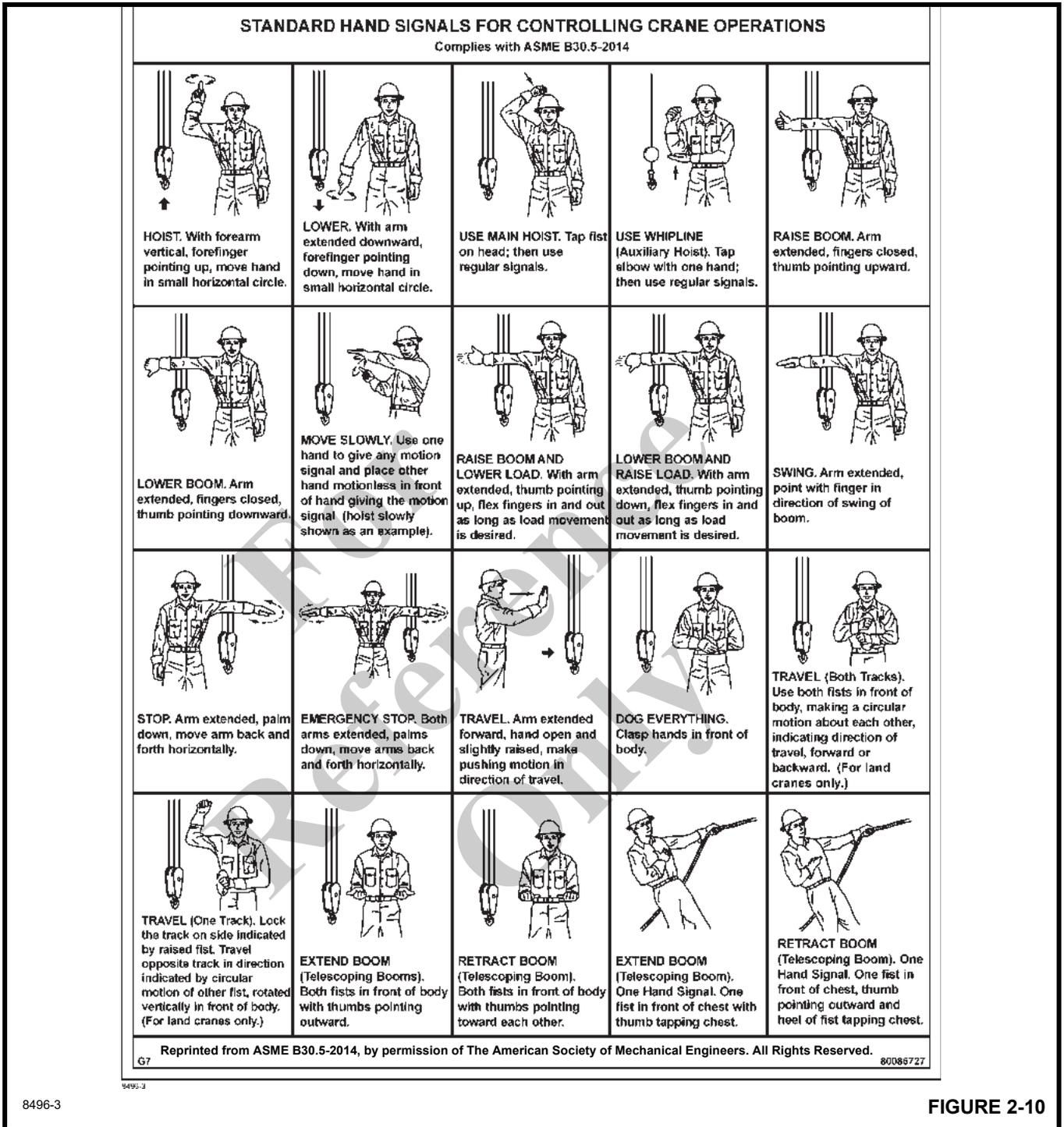
- Working in the vicinity of power lines.
- The crane operator cannot clearly see the load at all times.
- Moving the crane in an area or direction in which the operator cannot clearly see the path of travel.

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

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

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

Obey a signal to stop from anyone.



8496-3

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 cm<sup>3</sup> per cm<sup>3</sup> of volume for 1°C of temperature change (0.00043 in<sup>3</sup> per in<sup>3</sup> 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 <sup>3</sup> /in <sup>3</sup> / °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. (in<sup>3</sup>/in<sup>3</sup>/ °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

## MODEL SPECIFIC INFORMATION

### Overload Inspection

When the RCL system has acknowledged an overload on your crane, you must carry out specified inspections on the crane.

The inspections given in this publication apply only to overloads up to 50%. For overloads of 50% or higher, crane operation must be stopped immediately and Your Local Distributor or Manitowoc Crane Care must be contacted for corrective action.

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

---

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

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

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

---

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

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

For  
Reference  
Only

Boom Inspection



Overload less than 25%			
1	Sheaves	Inspect all for damage.	
Overload from 25% to 49%			
1	Sheaves	Inspect all for damage.	
2	Collar-welds	Inspect all for cracks.	
3	Telescopic Sections	Inspect for bent or twisted sections. Check the boom for straightness.	
4	Lift Cylinder Head Area	Inspect for bends or cracked welds.	
5	Turret-Base Section	Inspect for cracked welds.	
6	Welds	Inspect for cracks.	
7	Paint	Inspect for cracked paint which could indicate twisted, stretched, or compressed members.	

For Reference Only

Superstructure Inspection



9826

9827-1

Illustration for reference only. Your crane may be different.

FIGURE 2-12

<b>Overload less than 25%</b>			
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.
<b>Overload from 25% to 49%</b>			
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*

9826

FIGURE 2-13

Illustration for reference only.  
Your crane may be different.

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

For Reference Only

**For  
Reference  
Only**

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**SECTION 3**  
**OPERATING CONTROLS AND INDICATORS**

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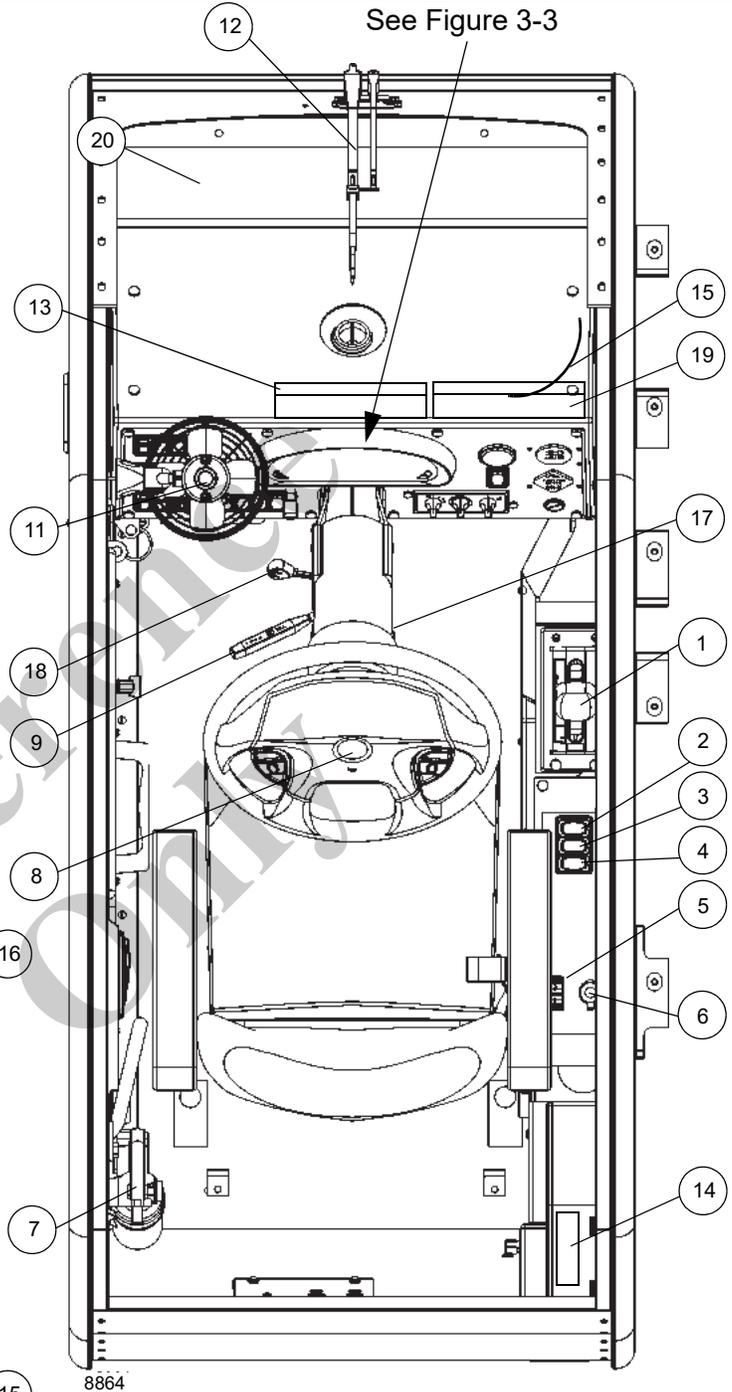
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**CARRIER CAB CONTROLS AND INDICATORS**

- 1. Transmission Shift Lever
- 2. Spare
- 3. Spare
- 4. Spare
- 5. USB Ports
- 6. 12 Volt Outlet
- 7. Fire Extinguisher
- 8. Horn
- 9. Turn Signal/High Beam-Low Beam Lever
- 10. Brake Pedal
- 11. Cab Circulating Fan
- 12. Windshield Wiper and Washer
- 13. Camera Display (Optional)
- 14. Dome Light and Switch
- 15. Air Horn Control
- 16. Throttle Pedal
- 17. Hazard Light Control Switch (Under Steering Column)
- 18. Steering Column Tilt/Telescope Lever
- 19. Radio AM/FM (Optional)
- 20. Sun Visor



**FIGURE 3-1**

## Transmission Shift Lever

The transmission shift lever (1), (Figure 3-1) is located on the right side of the cab. It is used to select the transmission gears. Refer to *Automated Transmission*, page 4-18 of this *Operator Manual*.

## Spare Switch/Indicator

The spare switch/indicators (2, 3, 4), (Figure 3-1) may be populated with future options.

## USB Ports

A USB Connector is provided (5), (Figure 3-1). The ODM/RDM (Figure 3-26) also contain USB ports which allow a service technician to connect to the ODM and update its software or download the data logger, which records events that can occur when operating the crane. (Refer to *ODM and RDM Panels*, page 3-19.)

## 12 Volt Outlet

The 12 volt outlet (6), (Figure 3-1) provides a place to plug in a 12 volt accessory with a maximum current draw of 3 amps.

## Fire Extinguisher

The fire extinguisher (7), (Figure 3-1) is mounted on the left inside rear of the cab.

## Horn Button

The horn button (8), (Figure 3-1) is located in the center of the steering wheel. Pressing the horn button energizes the circuit sounding the horn.

## Turn Signal/Headlight High Beam Low Beam Lever

The turn signal lever (9), (Figure 3-1) is located on the steering column. Positioning the lever down causes the indicator light on the console and the left front and left rear signals to flash. Positioning the lever up causes the indicator light on the console and the right front and right rear signals to flash. Pull back for high beam and push forward for low beam.

## Brake Pedal

The brake pedal (10), (Figure 3-1) is located on the right side of the cab floor and is used to apply the service brakes.

## Cab Circulating Fan

The cab circulating fan (11), (Figure 3-1) is mounted on the left front of the cab and is controlled by a two speed rocker switch on the base of the fan.

## Windshield Wiper and Washer

The windshield wiper and washer (12), (Figure 3-1) removes moisture from the windshield. The washer applies a liquid to the windshield so the wiper can clean it.

## Camera Display (Optional)

The camera display(optional) (13), (Figure 3-1) will show two images from the carrier cab, the rear view and the right side view. When selecting reverse gear, the display will show the rear view full screen. When the turn signal is selected for right turn, the display will show the right side view full screen. For additional information on optional camera's, refer to the *Camera Group for Crane Operation (Optional)*, page 6-14.

## Dome Light

The dome light and switch (14), (Figure 3-1) is located in the right rear corner of the cab and is used to illuminate the cab.

## Air Horn

Pull down on the air horn control (15), (Figure 3-1) to sound the air horn.

## Throttle Pedal

The throttle pedal (16), (Figure 3-1) is located on the right side of the cab floor. It is used to increase the engine speed.

## Hazard Light Control Switch

The hazard light control switch (17), (Figure 3-1) is located under the steering column. It is used to cause all four turn signals to flash.

## Steering Column Tilt/Telescope Lever

The steering column tilt/telescope lever (18), (Figure 3-1) is located on the left side of the steering column. Push the lever to telescope the steering column and pull the lever to tilt the steering column.

## Radio Control Panel (Optional)

There are two radios independent of each other: one in the carrier cab and a second in the superstructure cab. In the carrier cab, the Radio (19), (Figure 3-1) is located overhead on the right side of the carrier cab next to the air horn. The radio also contains a USB MP3/ WMA/ Bluetooth and auxiliary port (far right side of radio). Refer to *Superstructure Cab*, page 3-19.

## Sun Visor

The Sun Visor (20), (Figure 3-1) is located in the upper left corner of the carrier cab. The sun visor is a small screen above a vehicle's windshield, attached by a hinge so that it

can be lowered to protect the occupants' eyes from bright sunlight.

## STEERING WHEEL CONTROLS

The Steering Wheel (Figure 3-2) includes cruise control buttons, the flash headlights switch, windshield wiper switch, windshield wiper speed control switch, windshield washer switch and the flash marker lights switch.

### Flash Marker Lights Switch

The Flash Marker Light Switch (1), (Figure 3-2) is located on the steering wheel. This switch is used to flash the carrier marker lights. The light will come ON when the switch is held down. When the switch is released, the light will go OFF.

### Windshield Washer/Wiper/Speeds

The Windshield Washer (2), Intermittent Wiper Speed Control (3), Windshield Wiper Off (4) and the High/Low Wiper Speed Control (5), are located on the steering wheel (Figure 3-2). The Windshield Washer applies a liquid to the windshield so the wiper can clean it. The Windshield Wiper removes moisture from the windshield. The Windshield Wiper Off turns the wipers off and the Windshield Wiper Speed allows a faster or slower speed.

### Horn Switch

The Horn Switch (6), (Figure 3-2) is located in the middle of the steering wheel and is an acoustic warning device. To sound the electric horn, press the center of the steering wheel.

### Cruise Control ON/OFF Switch

The Cruise Control ON/OFF Switch (7), (Figure 3-2) is located on the steering wheel and is a system that automatically controls the speed of the vehicle. Also, refer to *Cruise Control Indicator*, page 3-14

### Cancel Set Speed Switch

The Cancel Set Speed Switch (8), (Figure 3-2) is located on the steering wheel and is a button used to cancel out the cruise control speed.

### Set Speed/Coast Switch

The Set Speed/Coast Switch (9), (Figure 3-2) is located on the steering wheel and is a button used to set the speed to a specific speed.

### Resume Set Speed/Accelerate Switch

The Resume Set Speed/Accelerate Switch (10), (Figure 3-2) is located on the steering wheel and is used to resume the set speed and/or accelerate within the cruise control settings.

### Flash Headlights Switch

The Flash Headlights Switch (11), (Figure 3-2) is located on the steering wheel. The headlights will come ON when the button is held down. When the button is released, the headlights will go OFF.



- 1. Flash Marker Lights Switch
- 2. Windshield Washer
- 3. Intermittent Wiper Speed Control
- 4. Windshield Wiper Off
- 5. High/Low Wiper Speed Control
- 6. Horn Switch
- 7. Cruise Control On/Off Switch
- 8. Cancel Set Speed Switch
- 9. Set Speed/Coast Switch
- 10. Resume Set Speed/Accelerate Switch
- 11. Flash Headlights Switch

FIGURE 3-2

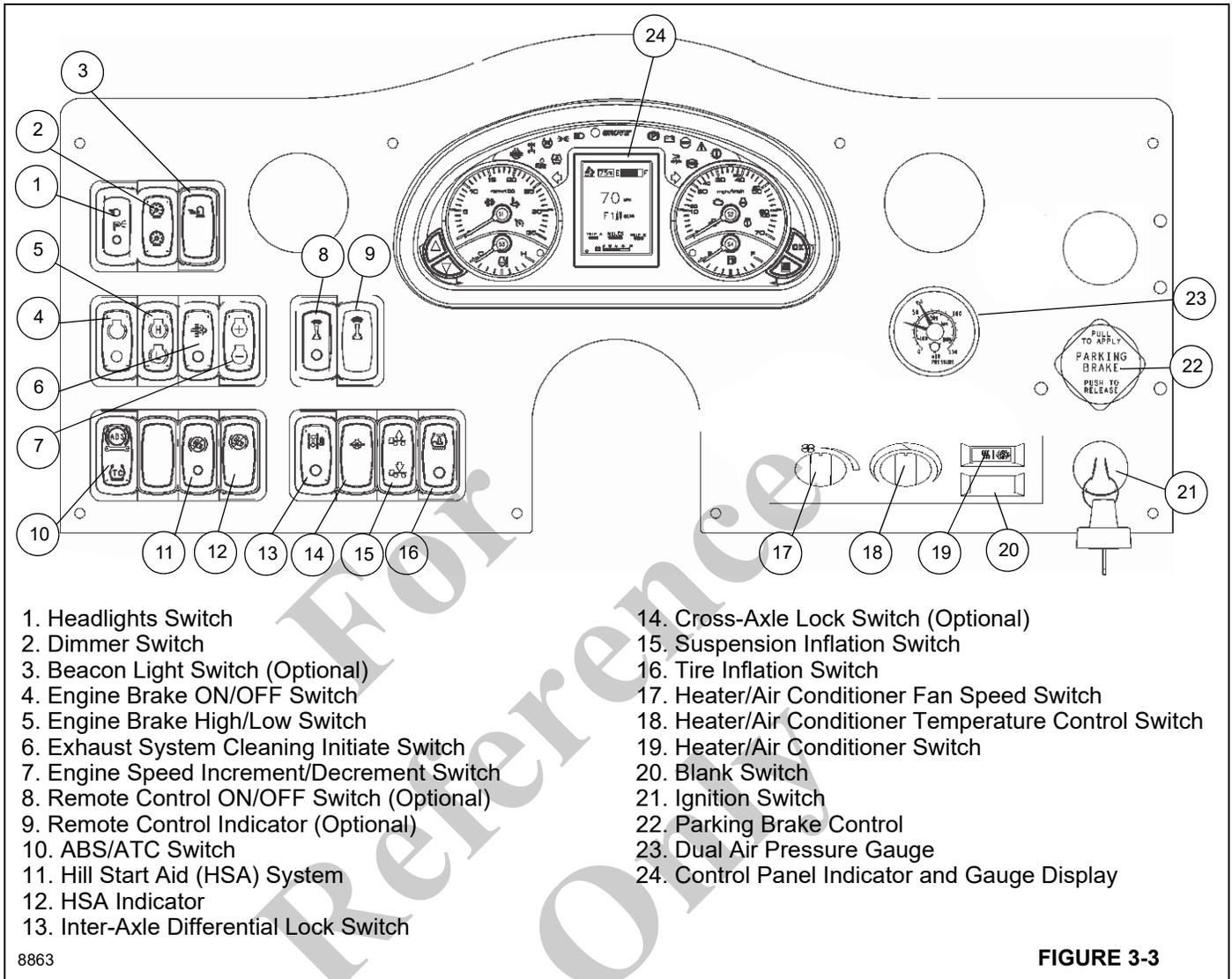


FIGURE 3-3

### Headlights Switch

The Headlights Switch (1), (Figure 3-3) is a three-position ON/OFF and illuminate switch located on the top left side of the front console. The bottom position is OFF. The center position will illuminate marker, clearance and gauge lights. The top position will turn the headlights ON in addition to the marker, clearance, and gauge lights.

### Dimmer Switch

The Dimmer Switch (2), (Figure 3-3) is a two-position control located on the left top side of the front console. Press top of switch to increase brightness and press bottom of switch to decrease brightness.

**NOTE:** The Headlight Switch (1), (Figure 3-3) must be in the center or top position before gauge lights will illuminate and the dimmer switch becomes functional.

### Beacon Light Switch (Optional)

The Beacon Light Switch (3), (Figure 3-3) is a two position, ON-OFF switch that controls the beacon light on the top of the carrier cab and is located on the left side of the front console. The Superstructure Beacon Light Switch is controlled by the Crane Control System (CCS).

### Engine Brake ON/OFF Switch

The Engine Brake ON/OFF Switch (4), (Figure 3-3) is a two position (ON/OFF) switch that energizes the engine brake, it is located on the left side of the front console. When the top of the switch is pushed, the engine braking system is in the ON position.

### Engine Brake High/Low Switch

The two position Engine Brake High/Low Switch (5), (Figure 3-3) controls the amount of engine braking. When

the top of the switch is pushed, the switch is in the high position and braking effort is at 100%. When the switch is in the low position, it gives 50% braking effort.

### Exhaust System Cleaning Initiate Switch

The Exhaust System Cleaning Initiate Switch (6), (Figure 3-3), located on the left side of the front console in the carrier cab, is used to initiate a stationary exhaust system cleaning. The switch must be cycled ON and OFF to initiate cleaning. The Exhaust System Cleaning Switch is a momentary switch.

The brake and throttle pedals must also be released. The engine will automatically change speed as needed. The cycle will take approximately 20 minutes. Also refer to *Exhaust System Cleaning*, page 4-10.

### Engine Speed Increment/Decrement Switch

The Engine Increment/Decrement Switch (7), (Figure 3-3), is located on the left side of the front console. The switch is a three position momentary rocker switch with the center maintained position being OFF. Use this switch to adjust the engine operating speed.

Pressing the top of the button will increase the engine idle speed in increments of 25 RPM every time the button is pushed until the maximum idle is reached. Pressing the bottom of the button decreases the engine idle speed in increments of 25 RPM down to the low idle speed.

### Remote Control ON/OFF Switch (Optional)

The Remote Control ON/OFF Switch (8), (Figure 3-3) is on the left side of the console. Push the top of the switch to enable the hand-held remote control.

### Remote Control Indicator (Optional)

The Remote Control Amber Indicator (9), (Figure 3-3) will illuminate amber when the remote control switch is ON and permissions for enabling have been met. It will flash if the switch is ON and all permissions have not been met.

### Anti-lock Braking System/Automatic Traction Control (ABS/ATC) Switch

The Anti-lock Braking System/Automatic Traction Control (ABS/ATC) Switch (10), (Figure 3-3) is on the bottom left row of the front console. The top half of this switch is used for ABS fault code diagnosis. The bottom deactivates the ATC for off-road operation.

The switch is programmed for momentary operation. ATC reverts to normal operation when the switch is cycled a second time and whenever the system goes through a power-up cycle. See *Anti-Lock Brake System (ABS)*, page 4-23 or for more information on the operation of these switches.

### Hill Start Aid (HSA) System

The Hill Start Aid (HSA) System (11), (Figure 3-3) is located on the lower left of the console. Push the top of the switch to de-activate the HSA system. Refer to *Hill Start Aid (HSA) System*, page 4-21.

### Hill Start Aid (HSA) Indicator

The Hill Start Aid (HSA) Indicator (12), (Figure 3-3) illuminates amber when the HSA system is inactive.

### Inter-Axle Differential Lock Switch

The Inter-Axle Differential Lock Switch (13), (Figure 3-3) is located on the left side of the front console. In the lock (press top of switch) position, both rear axles are locked together and turning at the same speed. In the unlocked (press bottom of switch) position, the axles operate independently of each other.

### Cross-Axle Lock Switch (Optional)

The Cross-Axle Lock Switch (14), (Figure 3-3) is located on the left side of the front console and is used to lock the right and left wheels in a tandem set. The cross-axle lock is only on the rear axle of the tandem, axle #3. The cross-axle lock increases traction on slippery roads. It is a two position lock/unlock switch. Press top of switch for the lock position or bottom of switch for the unlock position.

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#### CAUTION

Do not operate the cross-axle lock on dry roads as damage could occur.

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#### CAUTION

Do not operate the cross axle lock while crane wheels are spinning or at speeds over approximately 16 km/h (10 mph) as damage may occur.

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### Suspension Inflation Switch

The Suspension Inflation Control Switch (15), (Figure 3-3) is located on the left side of the front console. Push the top of the switch to inflate the suspension air bags. Push the bottom of the switch to deflate the suspension air bags.

**NOTE:** The suspension air bags should be inflated at all times except when on outriggers, or when traveling at less than 4 km/h (2.5 mph) on job site.

**NOTE:** While the superstructure key switch is on, the suspension solenoid will be energized, deflating the air bags regardless of the carrier cab rocker switch position.

## Tire Inflation Switch

The Tire Inflation Switch (16), (Figure 3-3) is located on the left side of the console. It is a two position switch that activates the tire inflation system. Push the top of the switch to activate the tire inflation system. An amber indicator will illuminate and a warning buzzer will sound when the switch is in the ON position.

**NOTE:** There are two tire inflation quick connect ports, one on the right side of the carrier and one on the left side of the carrier (1), (Figure 3-4) used to connect an air hose to manually inflate the tires.



FIGURE 3-4

## Heater/Air Conditioner Fan Speed Switch

The Heater/Air Conditioner Fan Speed Switch (17), (Figure 3-3) is located on the right of the console. The switch controls the speed which in turn regulates the volume of air output of the heater and air conditioner fan by positioning switch to one of three speeds.

## Heater/Air Conditioner Temperature Control Switch

The Heater/Air Conditioner Temperature Control Switch (18), (Figure 3-3) is located on the right side of the console. Turn the knob fully clockwise for maximum heat and turn the knob fully counter-clockwise for maximum cooling.

## Heater/Air Conditioner Select Switch

The Heater/Air Conditioner Select Switch (19), (Figure 3-3) is a rocker switch located on the right side of the console.

Pressing the left side of the switch turns on the heater system and pressing the right side of the switch turns on the air conditioner system.

## Ignition Switch

The Ignition Switch (21), (Figure 3-3) is located on the right side of the front console. The switch is key operated with three positions: OFF (vertical position), IGN (position between vertical and right), and START (right position).

With ignition switches in both cabs in the OFF position, all electrical power is off except for the headlights, marker lights, gauge lights, turn and stop light, carrier and superstructure cab dome lights, superstructure cab work lights, and carrier horn.

The IGN position energizes all electrical components including the Engine Electronic Control Module (ECM). The START position energizes the starter relay which in turn energizes the cranking motor solenoid and cranks the engine for starting. The switch will return to IGN when the switch is released after the engine is started. Turn the switch to OFF to shut down the engine.

## Parking Brake Control

**NOTE:** The parking brake must be set before the outrigger controls will operate.

The Parking Brake Control (22), (Figure 3-3) is located on the right side of the front console. The control is a push-pull type air valve used to apply and release the parking brakes on all four rear wheels. Push to release the parking brakes, pull to apply the parking brakes.

## Dual Air Pressure Gauge

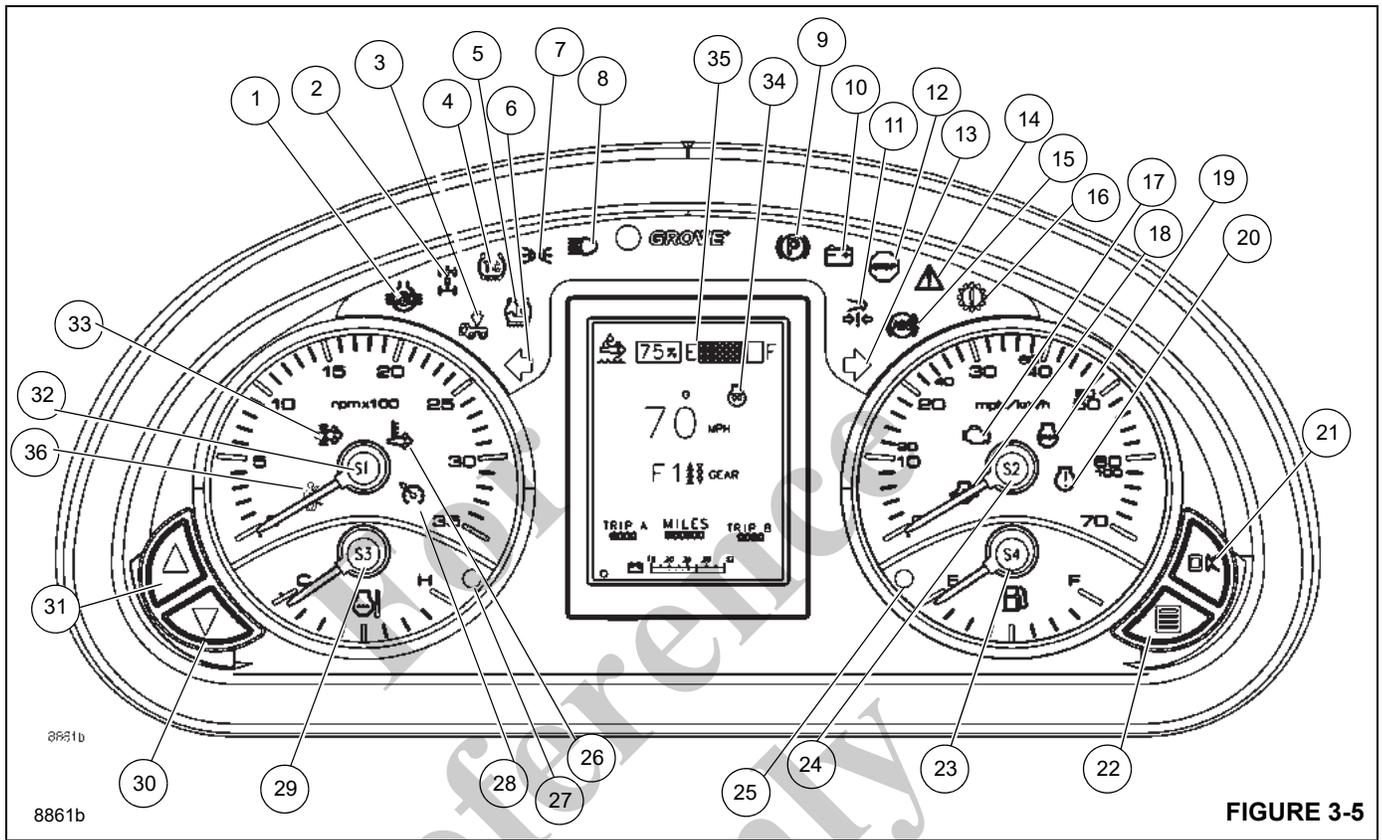
The Dual Air Pressure Gauge (23), (Figure 3-3) is located on the right side of the front console. The gauge is a direct reading pressure gauge with two needle indicating pointers, Orange for the primary system and White for the secondary system. The gauge has a dual scale calibrated from 100 to 1000 kPa and 0 to 150 psi. The gauge is connected to each air system separately through tubing.

## Control Panel Indicator and Gauge Display

The Control Panel Indicator and Gauge Display (24), (Figure 3-3) is located in the center of the front console. It includes indicator lamps and gauges that provide information on the engine, transmission, brakes, and other systems.

**CONTROL PANEL INDICATOR AND GAUGE DISPLAY**

As a system check, the indicators will come on for two seconds when the ignition switch is turned to the RUN position.



**FIGURE 3-5**

**(Figure 3-5) Item Numbers**

Item	Description
1	Cross-Axle Lock Indicator (Optional)
2	Inter-Axle Locked Indicator
3	Suspension Deflated Indicator
4	ABS Traction Control Indicator
5	Tire Inflation Indicator
6	Left Turn Signal Indicator
7	Marker Lights ON Indicator
8	High Beam Indicator
9	Park Brake Engaged Indicator
10	Battery Charge Indicator
11	Low Air Pressure Indicator
12	Emergency Stop Indicator
13	Right Turn Signal Indicator
14	Crane Control System (CCS) Fault Indicator
15	Anti-lock Braking System Indicator
16	Check Transmission Indicator
17	Malfunction Indicator Lamp

Item	Description
18	Low Oil Pressure Indicator
19	Engine Stop Indicator
20	Engine Warning Indicator
21	OK Button
22	Menu Button
23	Fuel Gauge
24	Speedometer
25	Low Fuel Level Indicator
26	High Exhaust System Temperature Indicator
27	Engine Coolant High Temperature Indicator
28	Cruise Control Indicator
29	Engine Coolant Temperature Gauge
30	Down Button
31	Up Button
32	Tachometer
33	Exhaust System Cleaning Needed Indicator
34	Wait to Start Indicator
35	LCD
36	Seat Belt Unfastened Indicator

### Cross-Axle Lock Indicator (Optional)

The Cross-Axle Lock Indicator (1), (Figure 3-5) is located at the left side of the gauge cluster. The amber indicator illuminates to show that the differential is locked.

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#### CAUTION

Do not operate the cross-axle lock on dry roads as damage could occur.

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### Inter-Axle Lock Indicator

The Inter-Axle Lock Indicator (2), (Figure 3-5) is located at the left side of the gauge cluster. The amber indicator illuminates to show that the inter-axle is locked.

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#### CAUTION

Do not operate the inter-axle lock on dry roads as damage could occur.

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### Suspension Deflated Indicator

The Suspension Deflated Indicator (3), (Figure 3-5) is located on the left side of the gauge cluster. The amber indicator illuminates when the air is removed from the suspension air bags.

### ABS Traction Control Indicator

The ABS Traction Control Indicator (4), (Figure 3-5) is the primary indicator of the traction control status.

- Lights at key-ON and turns off after a two second lamp check. Traction control is active after the lamp check.
- Flashes rapidly when traction control is operating.
- Flashes slowly when the off-road mode is selected and then flashes more rapidly when the automatic traction control system operates.
- Remains ON if an engine data link failure occurs.

### Tire Inflation Indicator

The Tire Inflation Indicator (5), (Figure 3-5) is located on the left side of the gauge cluster. The indicator illuminates amber when the tire inflation system is activated. In addition to illuminating the indicator, a warning buzzer will sound.

### Left Turn Signal Indicator

The Left Turn Signal Indicator (6), (Figure 3-5) is located on the left side of the gauge cluster. The green indicator flashes when the turn signal lever or hazard switch is activated.

### Marker Lights ON Indicator

The Marker Lights ON Indicator (7), (Figure 3-5) is located on the left side of the gauge cluster. The green indicator illuminates when the headlights or marker lights are on.

### High Beam Indicator

The Headlight High Beam Indicator (8), (Figure 3-5) is located at the top left center of the gauge cluster. The blue indicator illuminates when the headlights are on high beam.

### Parking Brake Engaged Indicator

The Parking Brake Engaged Indicator (9), (Figure 3-5) is located at the top right of the gauge cluster. The red indicator illuminates when the crane parking brakes are applied.

**NOTE:** The parking brake must be set before the outrigger controls will operate.

### Battery Charge Indicator

The Battery Charge Indicator (10), (Figure 3-5) is located at the top right center of the gauge cluster. The red indicator will illuminate when any of the following conditions are active:

- Battery voltage falls below 22V
- Battery voltage is greater than 30V
- Engine is running and alternator is not charging.

### Low Air Pressure Indicator

The Low Air Pressure Indicator (11), (Figure 3-5) is located on the right side of the gauge cluster. The red indicator illuminates when the pressure in the air brake circuit falls below normal operating requirements. A warning buzzer will also sound.

### Emergency Stop Indicator

The Emergency Stop Indicator (12), (Figure 3-5) is located on the right side of the gauge cluster. The red indicator illuminates when any Emergency Stop Switch is actuated (refer to *Emergency Stop Switch*, page 3-18 or *Emergency Stop Switch*, page 3-21) and a warning buzzer will sound.

### Right Turn Signal Indicator

The Right Turn Signal Indicator (13), (Figure 3-5) is located on the right side of the gauge cluster. The green indicator light flashes when the turn signal lever or hazard switch is activated.

### Crane Control System (CCS) Fault Indicator

The Crane Control System (CCS) Fault Indicator (14), (Figure 3-5) is located on the right side of the gauge cluster. The amber indicator illuminates when any crane system fault is active.

## Anti-lock Braking System (ABS) Indicator

The Anti-lock Braking System Indicator (15), (Figure 3-5) is the primary indicator of the ABS system.

- The ABS amber indicator illuminates steadily for a two-second lamp check whenever the ignition is switched ON. The amber indicator will remain ON until the brake pedal has been pressed and the system senses the activation.
- If the amber indicator lamp remains ON, after the lamp check, there is an ABS diagnostic trouble code that requires service. This lamp will blink the diagnostic fault codes when the ECU is in the self-diagnostic mode.

**NOTE:** In the case of a speed sensor failure which has been corrected, the indicator lamp will remain on until sensor output has been verified by the control unit. In this case, it is necessary to move the vehicle above 5 mph before the indicator lamp will turn off.

## Check Transmission Indicator

The Check Transmission Indicator (16), (Figure 3-5) is located on the right side of the gauge cluster. The red indicator illuminates when commanded by the TCU (transmission control unit) via J1939 serial communications. A warning buzzer may also sound.

## Malfunction Indicator Lamp

The Malfunction Indicator Lamp (MIL) (17), (Figure 3-5) is located in the speedometer. The amber indicator illuminates when there is an emission-related system error. When this indicator illuminates have the crane serviced as soon as possible.

Note that, per EPA requirement, the MIL will stay illuminated until three successful cycles have occurred after the fault is cleared. If neither the Engine Stop nor the Engine Warning lamp is illuminated but the MIL is illuminated, the fault is no longer valid and the vehicle is attempting to get three successful cycles.

## Low Oil Pressure Indicator

The Low Oil Pressure Indicator (18), (Figure 3-5) is located in the speedometer. The red indicator illuminates as commanded by the Engine Control Module (ECM) via J1939 serial communications.

## Engine Stop Indicator

The Engine Stop Indicator (19), (Figure 3-5) is located in the speedometer. The red indicator illuminates when energized by a signal from the Engine Control Module (ECM) that signifies a serious engine problem that requires the vehicle and the engine to be stopped as soon as safely possible. In addition, a warning buzzer will also sound.

When either the engine red stop lamp or amber warning lamp is on solid or flashing, an engine fault code will be available on the superstructure cab Operating Display (ODM). This code will be an SAE J1939 SPN, accompanied with an engine manufacturer Failure Mode Identifier (FMI) value. With these two values the exact engine fault code may be looked up through engine manufactures' documentation or by contacting Manitowoc Crane Care.

## Engine Warning Indicator

The Engine Warning Indicator (20), (Figure 3-5) is located in the speedometer. The amber indicator illuminates when commanded by a signal from the Engine Control Module (ECM) that signals the operator of an engine problem which must be corrected.

## OK Button

The OK Button (21), (Figure 3-5) is used to accept the current display screen on the LCD.

## Menu Button

The Menu Button (22), (Figure 3-5) is used to scroll through the LCD screens.

## Fuel Gauge

The Fuel Gauge (23), (Figure 3-5) is located on the right side of the gauge cluster. The gauge indicates the quantity of fuel in the fuel tank and has a scale calibrated from E (Empty 0%) to F (Full 100%). The fuel gauge receives a signal from the Engine Control Module (ECM) via J1939 serial communications.

### CAUTION

#### Engine Damage Hazard!

Ultra low sulfur diesel fuel required in On-Highway engines.

If "Ultra Low Sulfur" fuel is not used in engines that require it, the Cummins warranty will be void and the engine performance will quickly deteriorate and may stop running.

## Speedometer

The Speedometer (24), (Figure 3-5) is located on the right side of the gauge cluster. The speedometer indicates road speed in both km/h (kilometers per hour) and mph (miles per hour).

## Low Fuel Level Indicator

The Low Fuel Level Indicator (25), (Figure 3-5) illuminates when the fuel level goes below 45 L (12 gal). This is based on calculated fuel level from Engine Control Module (ECM).

## High Exhaust System Temperature Indicator

The High Exhaust System Temperature (HEST) Indicator (26), (Figure 3-5) is located in the tachometer.



### WARNING

#### Extreme Heat Hazard!

During the cleaning process the exhaust becomes very hot. Do not park the vehicle near objects that are flammable.

Use caution near the exhaust tailpipe as it will also become very hot.

During cleaning it is possible for the engine exhaust to reach temperatures exceeding 800°C (1472°F). The HEST indicator will illuminate amber to warn the operator of when temperatures reach 800°C (1472°F) and will stay on until the temperature falls below 350°C (662°F).

For more information on the cleaning process, refer to Exhaust System Cleaning Indicator, below.

## Engine Coolant High Temperature Indicator

The Engine Coolant High Temperature Indicator (27), (Figure 3-5) is located in the temperature gauge. The red indicator illuminates when the cooling system water temperature reaches 107°C (225°F). The red indicator illuminates as commanded by the Engine Control Module (ECM) via J1939 serial communications.

## Cruise Control Indicator

The Cruise Control Indicator (28), (Figure 3-5) is located in the tachometer. The indicator illuminates green when the cruise control system is active.

**NOTE:** Cruise control is not operational below 56 km/h (35 mph).

## Engine Coolant Temperature Gauge

The Engine Coolant Temperature Gauge (29), (Figure 3-5) is located on the lower left of the gauge cluster. The gauge indicates the engine coolant temperature on a scale from cold (C) to hot (H). The Indicator illuminates as commanded by the Engine Control Module (ECM) via J1939 serial communications.

## Down Button

The Down Button (30), (Figure 3-5) is used to scroll down through the screens on the LCD.

## Up Button

The Up Button (31), (Figure 3-5) is used to scroll up through the screens on the LCD.

## Tachometer

The Tachometer (32), (Figure 3-5) is located on the left side of the gauge cluster. The tachometer indicates engine speed. The tachometer is calibrated in RPM x 100 with a range of zero (0) to 35. The indicator illuminates as commanded by the Engine Control Module (ECM) via J1939 serial communications.

## Exhaust System Cleaning Indicator

The Exhaust System Cleaning Indicator (33), (Figure 3-5) is located in the tachometer. This indicator illuminates amber when the exhaust system is in need of cleaning.

The indicator will be lit continuously during the early stages of required cleaning. If this condition continues, the lamp will begin to flash and a slight engine derate will occur.

If this condition continues further, the Engine Warning Indicator light (20), (Figure 3-5) will illuminate in addition to the Exhaust System Cleaning Needed Indicator (33) (Figure 3-5) and a severe engine derate will occur.



### WARNING

#### Extreme Heat Hazard!

During exhaust system cleaning, exhaust temperatures may reach 800°C (1472°F) which is hot enough to ignite or melt common materials. Do not park the vehicle near combustible materials and keep all materials at least 0.6 m (2 ft) away from the exhaust outlet.

Use caution near the exhaust tailpipe as it will also become very hot.

The only way in which either of these conditions can occur is if cleaning has been inhibited or a manual cleaning was interrupted. Refer to *Exhaust System Cleaning Initiate Switch*, page 3-9 for more details.

The cleaning process can take place in three different modes:

**Passive:** the exhaust is hot enough during normal working operation to burn off any hydrocarbon (soot) accumulation.

**Active:** Active cleaning occurs when there is not sufficient heat in the exhaust to perform the cleaning operation when it is required. Exhaust temperatures are raised by the system sufficiently high to enable a cleaning to occur. This is all done without any operator intervention.

**Manual:** Manual or stationary, cleaning is the same as active cleaning but takes place while the equipment is not being operated. It offers the equipment operator the option, if needed, of performing cleaning outside the normal duty

cycle. When the Cleaning Switch (6),(Figure 3-3) is momentarily placed in the manual cleaning position, manual cleaning is initiated.

**Wait to Start Indicator**

The Wait to Start Indicator (34), (Figure 3-5) is located in the LCD. This amber indicator illuminates while a J1939 message from the Engine Control Module (ECM) is commanding it on. It is recommended to not start the engine while the icon is illuminated.

**LCD**

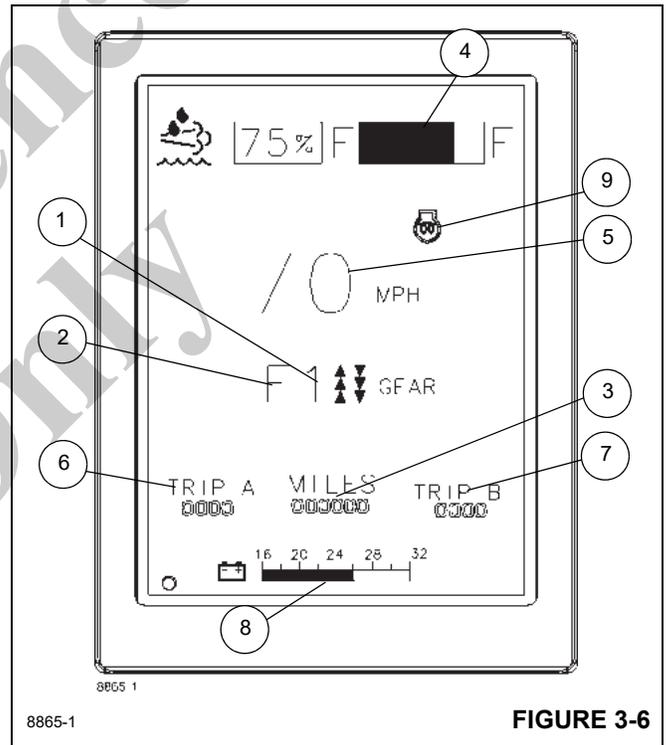
The LCD (35), (Figure 3-5) includes the following:

- Diesel Exhaust Fluid (DEF) Percent/Gauge
- Vehicle Speed
- Automatic Transmission Gear
- Battery Voltage Level Indicator
- Wait-to-Start Indicator
- Depending on which screen is active:
  - Odometer
  - Engine Hours
  - Reset Trip Odometer A
  - Reset Trip Odometer B
  - Units of Measure
  - Brightness of Display
  - Cluster Software Version

Use the Up and Down Buttons (Figure 3-5), (Items 30 and 31) along with the Menu and OK Buttons (Figure 3-5, Items 21 and 22) to open the various screens and options available. The following procedures will access the various options:

- At any time, pressing and holding the Menu button the display will return to the default Main Screen with Odometer.
- Pressing and holding the OK button will switch between Main Screen with Odometer and Main Screen with Engine Hours.
- Pressing the Up/Down buttons will scroll the Reset Trip A/Reset Trip B/Units/Brightness/Software Version. With the Reset Trip A option displayed, pressing and holding the OK button will reset the Trip A value.
- Pressing the Up/Down buttons will scroll the Reset Trip A/Reset Trip B/Units/Brightness/Software Version. With the Reset Trip B option displayed, pressing and holding the OK button will reset the Trip B value.

- Pressing the Up/Down buttons will scroll the Reset Trip A/Reset Trip B/Units/Brightness/Software Version. With the Units option displayed, pressing and holding the OK button will reset the Units value.
- Pressing and holding OK button a line appears below brightness value, so brightness is in Edit Mode.
- Edit Mode:
  - Pressing Up/Down buttons brightness value will change.
  - Press and hold OK button brightness value will be saved and the display will exit from Edit Mode.
  - Keeping the Menu button pressed, brightness value will be discarded and the display will exit from Edit Mode.
- Pressing Up/Down buttons scroll to software version. The software version will be displayed as four individual numbers.



Item	Description
1	Transmission Gear
2	Forward or Reverse, Transmission
3	Odometer, Engine Hours, Reset Trip A, Reset Trip B, Units of Measure, Brightness of Display, Master Software Version
4	DEF Level/Gauge
5	Speedometer

Item	Description
6	Trip A Distance Traveled
7	Trip B Distance Traveled
8	Voltmeter
9	Wait-to-Start Indicator

### Seat Belt Unfastened Indicator

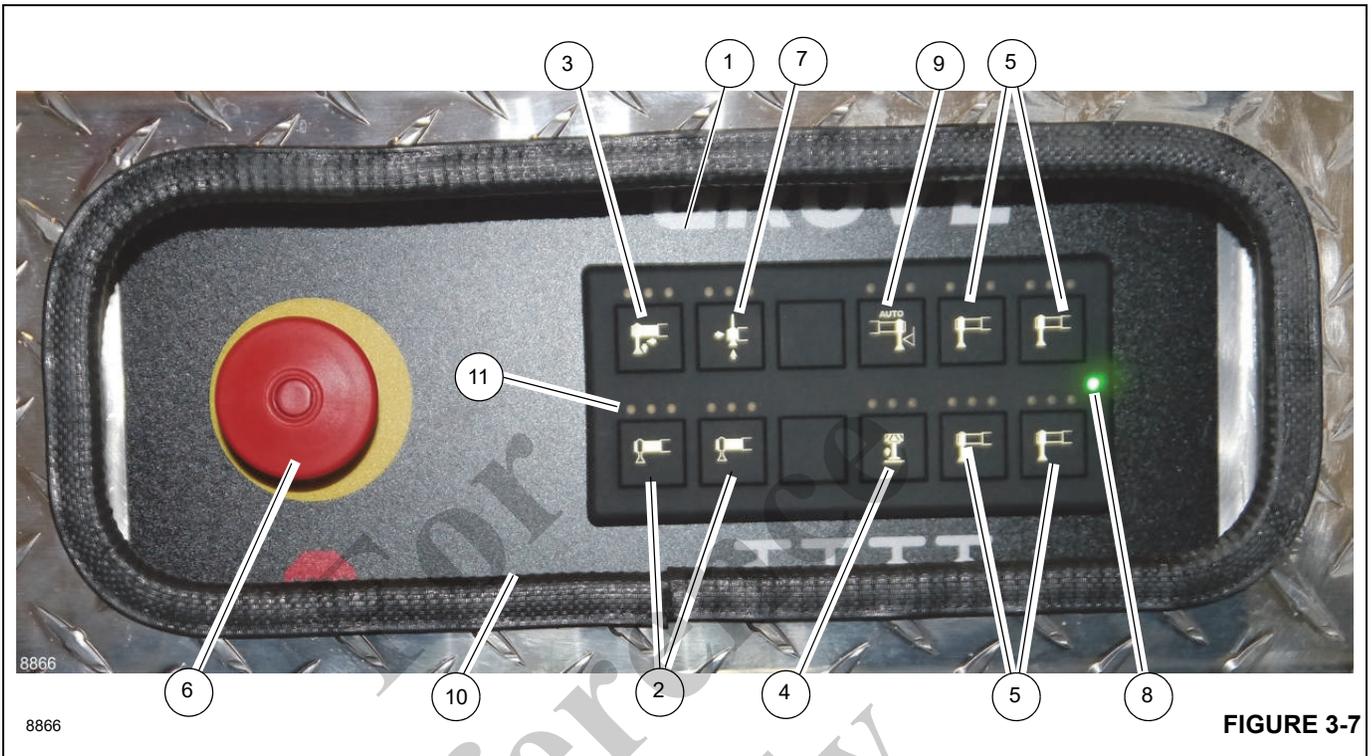
The Seat Belt Unfastened Indicator (36), (Figure 3-5) is located in the tachometer. The indicator illuminates when the ignition is on and the seat belt is not fastened. A buzzer will sound until the seat belt is fastened.

For  
Reference  
Only

**OUTRIGGER CONTROLS AND INDICATORS**

The following paragraphs describe the additional controls and indicators located on the carrier to operate the

outriggers. The numbers in parentheses ( ) represent the index number from the outrigger panel illustration.



**FIGURE 3-7**

Item	Description
1	Outrigger Control Panel
2	Outrigger Beam Selector Switches
3	Extend Switch
4	Center Front Jack Switch
5	Jack Selector Switches
6	Emergency Stop Switch
7	Retract Switch
8	Power Indicator Light
9	Auto Level Switch
10	Bubble Level Indicator (Not Shown)
11	Outrigger Operation Indicator Lights

**Outrigger Control Panel**

**NOTE:** Outrigger controls are only active when the engine is turned on and the park brake is set.

There is an outrigger control panel located on each side of the crane carrier. Each control panel contains switches for

extending and retracting the outrigger beams on that side of the crane, and for raising and lowering the outrigger jack cylinders on both sides of the crane. Each control panel also contains a control switch for raising and lowering the center front jack.

A push button Emergency Stop Switch (6), (Figure 3-7) is installed on the panel.

**NOTE:** Outrigger functions on controller are de-activated when the emergency stop switch is activated, which also turns off the engine and all hydraulic functions.

There is one Outrigger Control Panel (1), (Figure 3-7) on each side of the crane's frame. The panel on the right side operates the outrigger beams for that side only. The panel on the left side operates the outrigger beams for that side only. The jacks may be operated from the left or right side of the crane. Also refer to *Setting the Outriggers from the Superstructure Cab*, page 4-27.

**Outrigger Beam Selector Switches**

The Outrigger Beam Selector Switches (2), (Figure 3-7) are used to select the desired operation of the front or rear outrigger beam for the side of the unit the control panel is on.

**Extend Switch**

The Extend Switch (3), (Figure 3-7) will operate both the outrigger beams or the jacks. After pushing the desired selector switch, pushing the extend switch will move the selected component in the extend direction.

**Center Front Jack Switch**

The Center Front Jack will retract automatically when any main outrigger jack is retracted. Continued operation without resetting the center front jack could result in loss of stability.

Always reset the center front jack after adjusting the main outriggers.

**NOTE:** Retracting any jack will cause the center front jack to automatically retract.

The Center Front Jack Switch (4), (Figure 3-7) is located in the center of the outrigger control panel. It must be used in conjunction with the extend/retract switch to control the operation of the center front jack. The center front jack will retract automatically when any of the other four jacks are retracted; therefore, it must be reset if lifting is to be continued.

**Jack Selector Switches**

The Jack Selector Switches (5), (Figure 3-7) are used to select which jack is to be operated. There are four Jack Selector Switches located on each of the Outrigger Control Panels. An Outrigger Control Panel is located on each side of the crane.

**Emergency Stop Switch**

An Emergency Stop Switch (6), (Figure 3-7) is located on each outrigger panel. Push the switch to stop the engine and all hydraulic functions.

Pulling the switch out, will allow the crane to return to normal operating conditions.

**NOTE:** If the emergency stop switch on either outrigger control panel or in the superstructure cab is not pulled out for normal operation, the emergency stop indicator in the carrier cab will illuminate red, a buzzer will be turned on, and the engine will be shut down (if running) and starting prohibited.

**Retract Switch**

The Retract Switch (7), (Figure 3-7) will operate both the outrigger beams or the jacks. After pushing the desired selector switch, pushing the retract switch will move the selected component in the retract direction.

**Power Indicator Light**

The Power Indicator Light (8), (Figure 3-7) illuminates green when power is available to the control panel.

**Auto Level Switch**

The Auto Level Switch (9), (Figure 3-7) is used to automatically level the crane. The auto leveling algorithm adjusts the crane carrier angle while retracting the outrigger jacks. Thus, it is necessary to fully extend the outrigger jacks prior to pushing the auto level button.

To activate auto level, press and hold the auto level button and the extend or retract button. The system will make a series of retracting movements of the outrigger jacks, pausing between each movement to assess the levelness of the crane. When the movements have been completed, verify visually that all tires are off of the ground. If any of the tires have made contact with the ground, consider adding cribbing under the outriggers, or leveling the crane manually.

Once the crane has been leveled and tire lift-off verified, extend the center front jack. Verify visually that the center front jack has made contact with the ground or outrigger mat.

**NOTE:** The auto level should be checked periodically. This procedure should be done by a trained technician using the Crane Service Tool.

**Bubble Level Indicator (Not Shown)**

A Bubble Level Indicator (10), (Figure 3-7) (Not Shown) is located at the bottom of each outrigger control panel. If suspected that the bubble level indicator is out of adjustment, refer to *Bubble Level Indicator Adjustment*, page 4-26.

**Outrigger Operation Indicator Lights**

Each switch (11), (Figure 3-7) has three (3) LED lights above it. Green indicates the button is active and the function is allowed. Yellow is located in the center of the three buttons/lights and indicates a fault condition. For example, if someone tries to activate the button when it is not allowed, it will indicate that there is an error. Red indicates that the function is not allowed or not enabled.

### SUPERSTRUCTURE CAB

This section shows the position and designations of the operating elements for crane operation. This also includes display elements such as lights or displays.

**NOTE:** Operating elements available only with optional equipment are designated accordingly. These designations are made in this section only and are not repeated in the following sections.

All the controls and indicators to operate and monitor crane functions are found inside the crane superstructure cab (Figure 3-8).

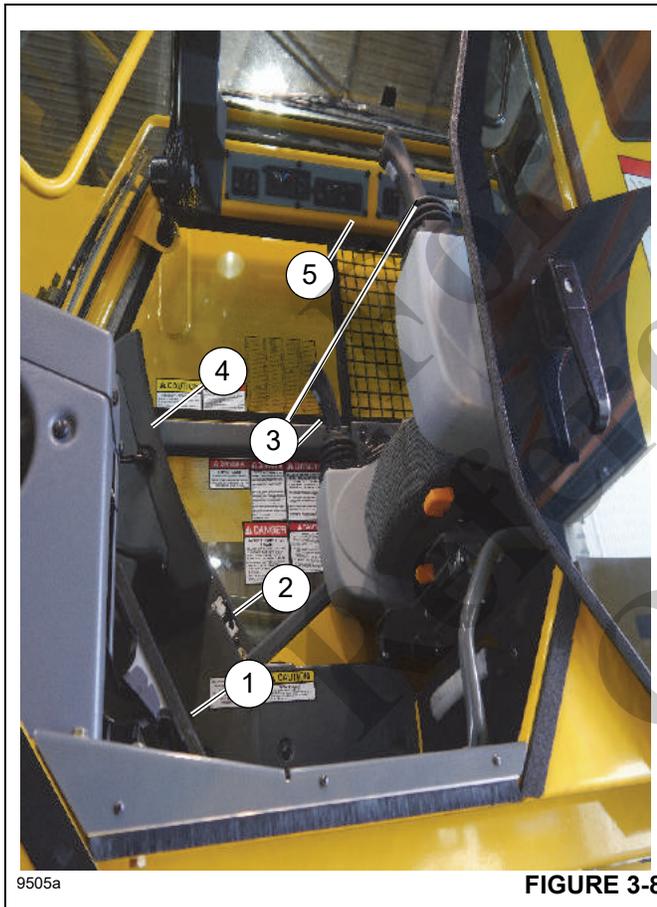


FIGURE 3-8

Item	Description
1	Foot Pedals
2	Turntable Swing Lock Pin Control Handle
3	Seat Joystick and Armrest Controls
4	ODM and RDM Panels
5	Superstructure Overhead Control Panels

### Foot Pedals

For a description of the foot pedals (1), (Figure 3-8), refer to Foot Pedal Controls, page 3-25.

### Turntable Swing Lock Pin Control Handle

The Turntable Swing Lock Pin Control Handle (2), (Figure 3-8) is located on the lower right console. When the control handle is pushed down and the superstructure is directly over front of carrier, the swing lock pin drops into the socket on the carrier frame, locking the superstructure in place. When the control handle is pulled up, the pin is pulled out of the socket, unlocking the superstructure.

### Seat Joystick and Armrest Controls

The seat joystick and armrest controls (3), (Figure 3-8) are located on each side of the chair seat. The armrest contains the joystick controls and switches. Refer to *Right Hand Arm Rest Controls*, page 3-27 and *Left Hand Arm Rest Controls*, page 3-27.

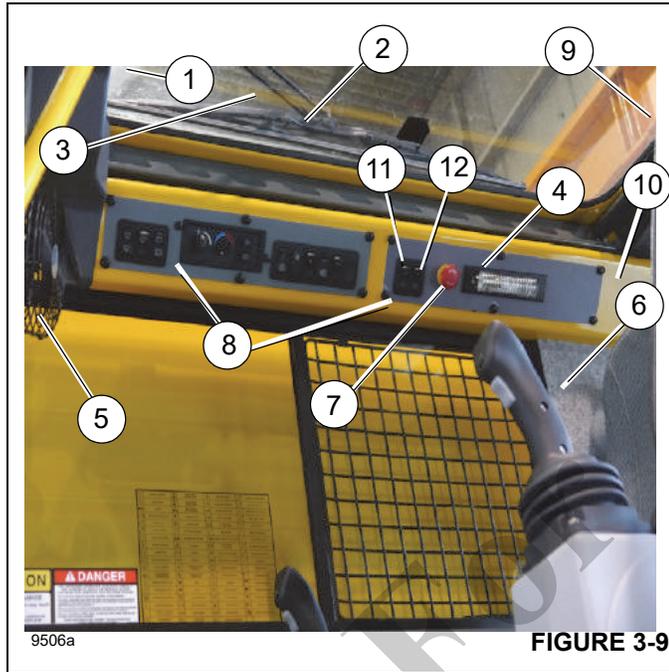
### ODM and RDM Panels

The Operator Display Module (ODM) and Rated Capacity Limiter Display Module (RDM) Panels (4), (Figure 3-8) are located to the right of the cab. For more details on the ODM and RDM, refer to Operator Display Module and Rated Capacity Limiter Display Module, page 3-33.

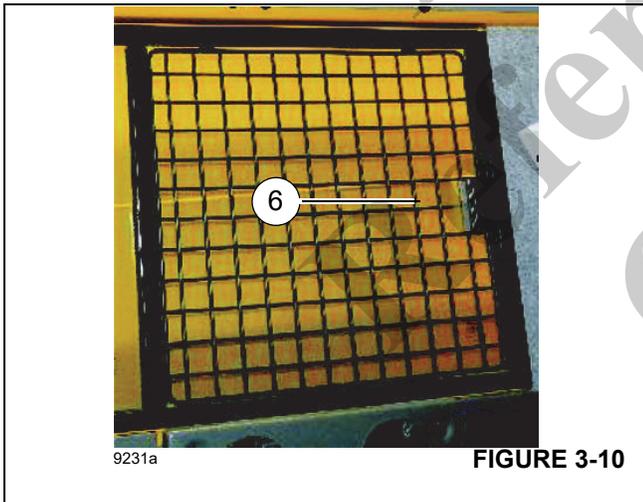
### Superstructure Overhead Control Panels

The Superstructure Overhead Control Panels (5), (Figure 3-8) are located overhead to the right side of the superstructure cab. Specific items located on the overhead control panels can be found in Figure 3-18.

**SUPERSTRUCTURE CAB OVERHEAD CONTROLS**



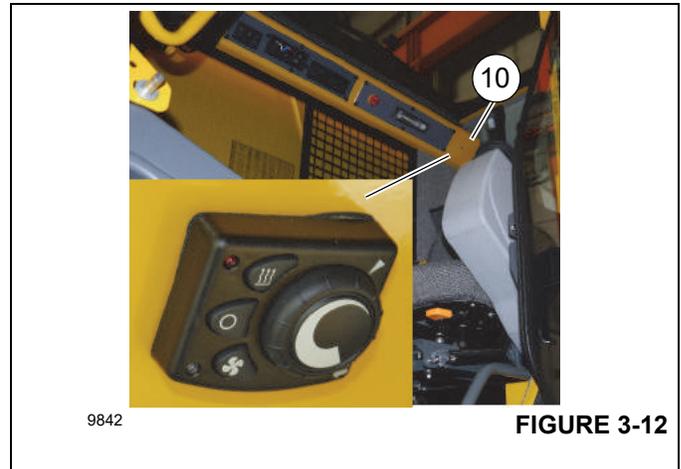
**FIGURE 3-9**



**FIGURE 3-10**



**FIGURE 3-11**



**FIGURE 3-12**

Item	Description
1	Skylight Window Latch
2	Skylight Wiper
3	Skylight Sunscreen
4	Dome Light
5	Cab Circulating Fan
6	Right Side Window Latch
7	Emergency Stop Switch
8	Overhead Control Panels
9	Radio (Optional)
10	Diesel Fired Cab Heater Controls (Optional)
11	Work Lights Switch
12	Boom Lights Switch (Optional)

**Skylight Window Latch**

The Skylight Window Latch (1), (Figure 3-9) indicates the area location where the latch is located on the overhead window. Squeeze the latch and slide the window to the rear to open. To close, slide the window forward until the latch engages.

**Skylight Wiper and Wiper Controls**

The Skylight Wiper and Wiper Controls (2), (Figure 3-9) are located on the superstructure cab overhead control panel. Item 2 indicates the area where the wiper is located overhead. To set the wiper intermittent speeds, refer to Setting the Wiper Interval Function, page 4-78).

## Skylight Sunscreen

The Skylight Sunscreen (3), (Figure 3-9) is located toward the rear of the window. It is used to diminish direct sunlight. The sunscreen is self retracting and can be set to screen all the light or adjusted rearward by moving it into the notches provided.

## Dome Light

The Cab Dome Light (4), (Figure 3-9) is on the right rear corner of the cab overhead console and provides illumination in the cab. The dome light is controlled by a switch on the light.

## Cab Circulating Fan

The Cab Circulating Fan (5), (Figure 3-9) is located on the right front side of the cab, above the window frame. A swivel allows the fan to be rotated and a switch on the fan base controls the fan. The switch has a high, low, and off position.

## Right Side Window Latch

The Right Side Window Latch (6), (Figure 3-9), is located on the right side of the cab window area. Squeeze the window latch (6), (Figure 3-9) to release and slide forward. To close, slide the window rearward until the latch engages.

## Emergency Stop Switch

The Emergency Stop Switch (7), (Figure 3-9) is provided as a means to shut off the engine and stop crane functions in the case of an emergency.

Press the switch until it latches, the engine will shut off and all crane functions will stop.

Turn the latched switch clockwise to return to normal operating condition.

## Overhead Control Panels

The Overhead Control Panels (8), (Figure 3-9) are located overhead on the right side of the superstructure cab and contains switches used in the superstructure cab (also shown in Figure 3-18).

## Radio (Optional)

The Radio (Optional) (9), (Figure 3-11) is located in the back on the top left side of the superstructure cab. The radio also contains a USB MP3/ WMA/ bluetooth and auxiliary port (far right side of radio).

## Diesel Fired Cab Heater Controls (Optional)

The Diesel Fired Cab Heater Controls (Optional) (Figure 3-12) controls are mounted in the right side overhead back panel. The heating system fan delivers warm air into an air distribution box. Heat is circulated according to the control settings and then delivered into the cab by a fan through various heating vents.

## Work Lights Switch

The Work Lights Switch (11), (Figure 3-9) controls the crane's work lights mounted on the bottom front of the superstructure cab. Press the top of the switch to turn on the work lights. Press the bottom of the switch to turn off the work lights.

## Boom Lights Switch (Optional)

The Boom Lights Switch (Optional) (12), (Figure 3-9) controls the crane's boom lights mounted under the boom. Press the top of the switch to turn on the boom lights. Press the bottom of the switch to turn off the boom lights.

## RCL Internal Light Bar (Optional)

The Rated Capacity Limiter (RCL) Internal Light Bar (Figure 3-13) 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 five green LEDs are on, the load being lifted is at approximately 90% of the crane's RCL programmed capacity.
- Yellow LEDs - when the yellow LEDs are on, the load being lifted is between 90% to 100% of the crane's RCL programmed capacity.
- Red LED - when the red LED is on, the load being lifted is greater than 100% of the crane's RCL programmed capacity.



FIGURE 3-13

### RCL External Light Tower (Optional)

The Rated Capacity Limiter (RCL) External Light Tower (Figure 3-14) is located on the outside upper right hand corner of the crane cab.

The RCL External Light Tower 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 tower come on in the following manner:

- Green LED - when the green LED is on, the load being lifted is less than 90% of the crane's RCL programmed capacity.
- Yellow LED (Constant On) - when the yellow LED is on (constant), the load being lifted is between 90% to 100% of the crane's RCL programmed capacity.
- Yellow LED (Flashing) - when the yellow LED is on (flashing), the load being lifted is between 100% to 110% of the crane's RCL programmed capacity.
- Red LED - when the red LED is on, the load being lifted is greater than 110% of the crane's RCL programmed capacity.

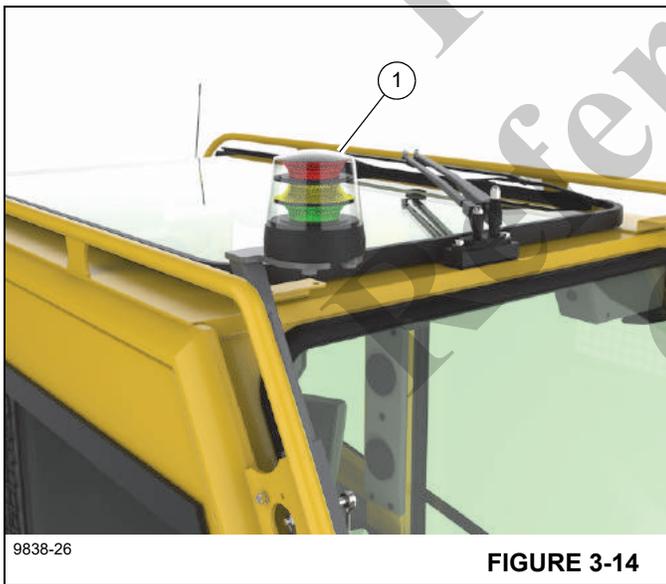


FIGURE 3-14

### Anemometer (Optional)

The crane features an optional wind speed indicator (or Anemometer) to measure wind speed at the end of the boom. The wind speed indicator features a radio anemometer assembly and a wireless gateway router (2), (Figure 3-15). The anemometer (1), (Figure 3-15) which captures wind speed data at the end of the boom or jib, is battery powered and communicates wirelessly with the gateway router (2), (Figure 3-15) located in the crane cab. The gateway router receives data from the anemometer and routes the data to the RCL Display.

If using a jib, the anemometer assembly should be relocated to the end of the jib to ensure accurate wind speed readings. If not in use, the anemometer should be stored in the operator cab.

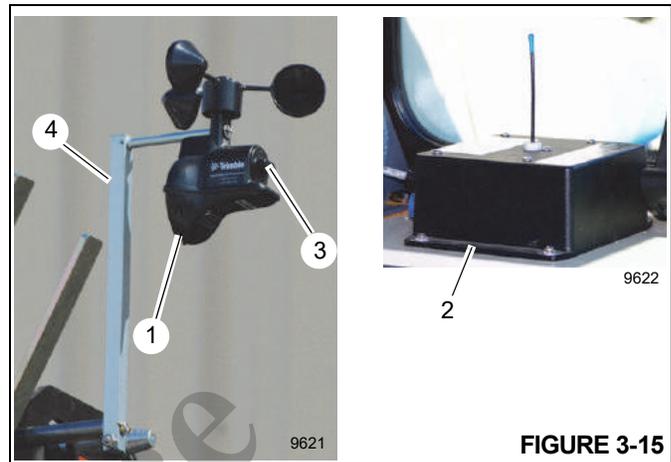


FIGURE 3-15

### Removing the Anemometer Assembly

Use the following procedure to remove the anemometer assembly, including the mast, from the end of the boom or jib.

**NOTE:** The battery should be removed if the anemometer will be stored for a prolonged period of time.

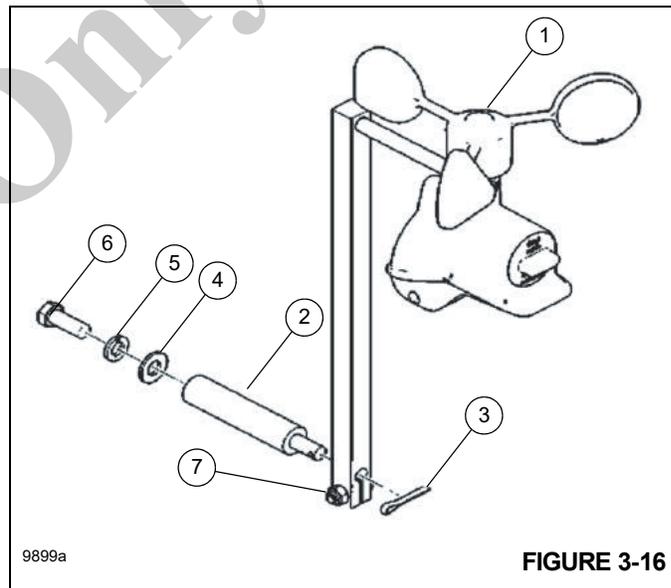


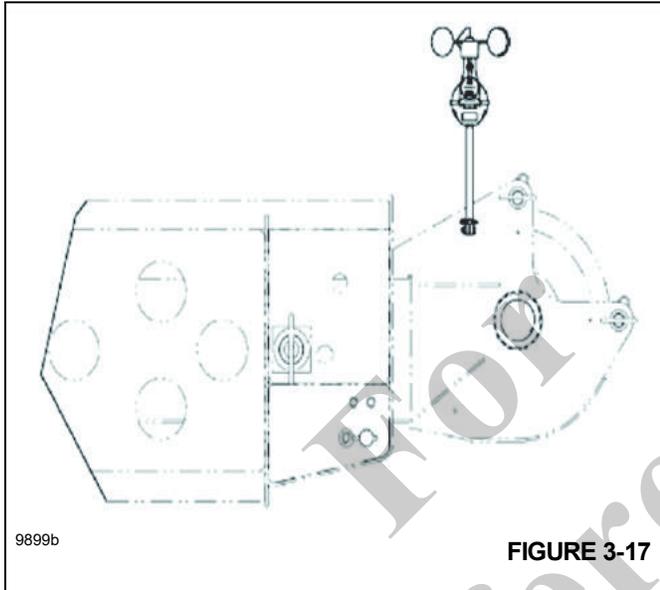
FIGURE 3-16

1. Lower the boom as necessary to access the anemometer.
2. Remove the cotter pin (3), (Figure 3-16).
3. Remove the anemometer and mast assembly (1), (Figure 3-16) and stow in crane cab.

4. Re-install the cotter pin (3), (Figure 3-16) on the rod (2), (Figure 3-16).

### **Installing the Anemometer Assembly**

Use the following procedure to install the anemometer assembly, including the mast, on the boom or jib. Install the anemometer assembly on the right side of the boom or jib sheave case as shown in (Figure 3-17).



1. Lower the boom as necessary to access the anemometer.
2. Remove the cotter pin (3), (Figure 3-16) from the rod (2), (Figure 3-16).
3. Install the anemometer and mast assembly (1), (Figure 3-16) on the rod (2), (Figure 3-16).
4. Install the cotter pin (3), (Figure 3-16) in the rod (2), (Figure 3-16).

### **Changing the Anemometer Battery**

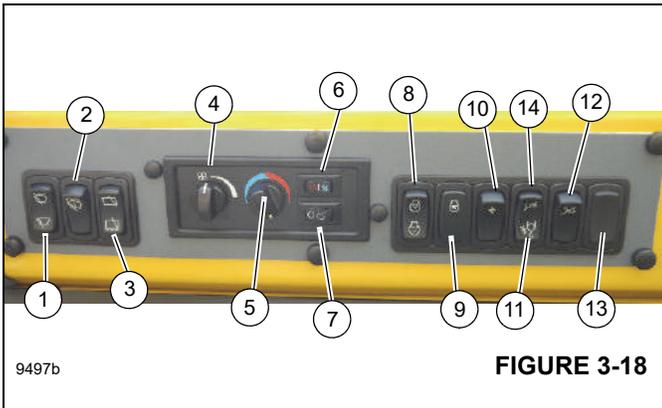
Use the following procedure to change the battery in the wireless anemometer.

1. Lower the boom as necessary to access the anemometer.
2. Remove the battery cover (3), (Figure 3-15) and old battery from the anemometer.
3. Install the replacement battery using D Cell Lithium 3.6V or Alkaline 1.5V battery.
4. Replace the battery cover.
5. Turn power on to the crane and use the RCL screen, verify that the anemometer is transmitting data.

### **Stowing the Anemometer Assembly for Travel**

1. Loosen the clamp bolt (6), (Figure 3-16).
2. Rotate the anemometer and mast assembly (1), (Figure 3-16) towards rear of the crane until the mast is horizontal.
3. Tighten the clamp bolt (7), (Figure 3-16).

**SUPERSTRUCTURE OVERHEAD CONTROL PANEL**



**FIGURE 3-18**

1	Windshield Wiper Switch
2	Windshield Washer Switch
3	Skylight Wiper Switch
4	Heater/Air Conditioner Fan Speed Switch
5	Heater/Air Conditioner Temperature Control Switch
6	Heater/Air Conditioner Switch (Standard)
7	Fresh Air/Recirculation Air Switch
8	Engine Speed Increment/Decrement Switch
9	Wait-to-Start Indicator
10	Crane Function Enable/Disable Switch
11	Hoist -Bypass <sup>2)</sup> Switch
12	Boom-Up Bypass Switch
13	Blank Switch (Optional)
14	Limits Bypass <sup>1)</sup> Switch

1) RCL lockout, WRL lockout, Carrier Avoidance, Anti-two Block Lockout, Minimum Wrap Lockout

2) Anti-two Block Lockout, Minimum Wrap Lockout

**Windshield Wiper Switch**

The Windshield Wiper Switch (1), (Figure 3-18) is used to turn the wiper motor on and off.

**NOTE:** A wiper delay interval may be set using the operator display (see *Setting the Wiper Interval Function*, page 4-78)

**Windshield Washer Switch**

The electrically-operated Windshield Washer is installed to spray washing fluid onto the windshield. The Windshield

Washer is controlled by the Windshield Washer Switch (2) (Figure 3-18).

**Skylight Wiper Switch**

The Skylight Wiper Switch (3), (Figure 3-18) is used to turn the wiper motor on and off.

**NOTE:** A wiper delay interval may be set using the ODM (see *Setting the Wiper Interval Function*, page 4-78)

**Heater/Air Conditioner Fan Speed Switch**

The Heater/Air Conditioner Fan Speed Switch (4), (Figure 3-18) controls the cab fan's speed. Fan speed controls the volume of heated air output (or cooled air output) of the fan. Settings are low speed to high speed.

**Heater/Air Conditioner Temperature Control Switch**

The Heater/Air Conditioner Temperature Control Switch (5), (Figure 3-18) controls intensity of heating or cooling. Turn the knob to the right (clockwise) to open the valve for heat. Turn the switch to the left (counterclockwise) to increase the amount of cooling.

**Heater/Air Conditioner Switch (Standard)**

The Heater/Air Conditioner Switch (6), (Figure 3-18) issued to turn on either the heater or the air conditioner system. Pressing the left side of the switch turns on the heater system and pressing the right side of the switch turns on the air conditioner system.

**Fresh Air/Recirculation Air Switch**

The Fresh Air/Recirculation Air Switch (7), (Figure 3-18) controls whether outside air is drawn into the cab. Pressing the left side of the switch causes outside air to be drawn into the cab when operating the heater system or air conditioner system. Pressing the right side of the switch causes the air inside the cab to be recirculated, with minimal outside air being drawn into the cab.

**Engine Speed Increment/Decrement Switch**

The Engine Speed Increment/Decrement Switch (8), (Figure 3-18) is a three position momentary rocker switch with center maintained position being OFF. This switch has two primary functions starting or stopping the engine and controlling engine speed.

If the engine is not running, pressing and holding the top of the switch will start the engine. If the engine is already running and RPM is at idle, pressing and holding the bottom of the switch will shutdown the engine.

The Engine Speed Idle Increment/Decrement Switch is used to adjust engine speed. Quickly press the top of the switch

once to go to full engine speed; quickly press the bottom of the switch once to return to low engine idle. If the engine speed is below the maximum speed setting, pressing and holding the top of the switch will cause the engine speed to slowly increase; release the switch when the desired speed is attained. If the engine speed is above the minimum speed setting, pressing and holding the bottom of the switch will cause the engine speed to slowly decrease; release the switch when the desired speed is attained.

**NOTE:** The ECO mode does not work when the carrier cab is active. The ECO mode is a fuel-savings mode that lets the crane go to low idle speed when functions are not being used.

**Wait-to-Start Indicator**

The Wait-to-Start Indicator (9), (Figure 3-18) is controlled by a message received from the Engine Control Module (ECM) via J1939. When commanded ON because the outside ambient temperature is low, this lamp will illuminate amber. Do not attempt to start the engine while this indicator is ON.

**Crane Function Enable/Disable Switch**

The Crane Function Enable/Disable Switch (10), (Figure 3-18) is located on the overhead control panel. This momentary switch permits the operator to enable all crane functions at once or disable all crane functions controlled by the controllers on the armrests. Pressing it one time enables all crane functions. Disable all crane functions to prevent inadvertent operation of functions due to bumping the controllers while roading or any other operation.

**Hoist Bypass Switch**

The Hoist Bypass Switch (11), (Figure 3-18) is located on the Superstructure Overhead Panel. Press the bottom of the switch (11), (Figure 3-18) to bypass the Anti- Two-Block lockout or Minimum Wrap lockout. It will be bypassed only as long as the switch is held in this position.

**Boom Up Bypass Switch**

The Boom Up Bypass Switch (12), (Figure 3-18), is a momentary two-position rocker switch that is located on the right armrest. While lift function is enabled and in an RCL lock-out condition, pressing and releasing the Boom Up Bypass Switch will enable boom lift up. It will be bypassed only as long as the switch is held in this position.

Blank Switch (13), (Figure 3-18) is a blank empty switch that is not used for other options.

**Limits Bypass Switch**

The Limits Bypass Switch (14), (Figure 3-18) is for overriding the following lockouts:

- Rated Capacity Limiter (RCL) Lockout
- Carrier Avoidance Lockout

- Anti-two Block Lockout
- Minimum Wrap Lockout

Working Range Limiter (WRL) System

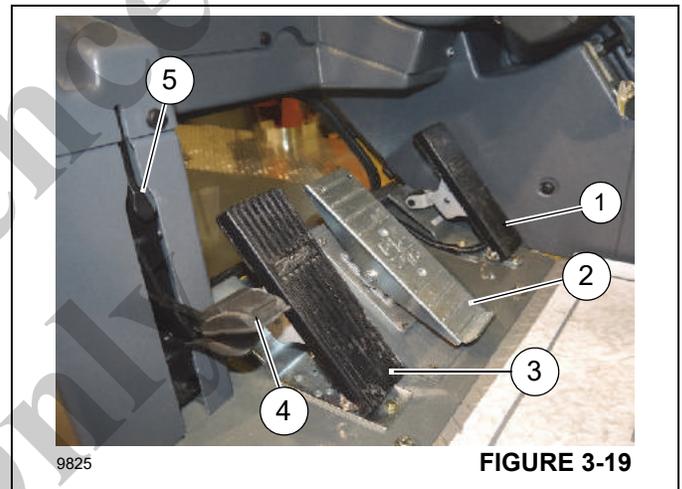
**! WARNING**  
**Overload Hazard!**

The Limits Bypass Switch prevents the function lock outs from activating.

When the Limits 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.

**FOOT PEDAL CONTROLS**



Item	Description
1	Foot Throttle Pedal
2	Telescope Control Foot Pedal (Optional)
3	Swing Brake Pedal
4	360° Swing Lock Pedal (Optional)
5	360° Swing Lock Release Lever

**Foot Throttle Pedal**

The Foot Throttle Pedal (1), (Figure 3-19) is located on the right side of the floor. It controls engine speed which increases or decreases proportionately with the amount of foot pressure applied to the pedal.

**Telescope Control Foot Pedal (Optional)**

The Telescope Control Pedal (2), (Figure 3-19) (Optional) is located in the middle of the cab floor. Pushing the top of the pedal extends the boom and pushing the bottom of the pedal retracts the boom.

**Swing Brake Pedal**

The Swing Brake Pedal (3), (Figure 3-19) is located on the left side of the cab floor. It actuates the swing brake to slow or stop swing motion. Braking increases or decreases proportionately with the amount of foot pressure applied to the pedal.

**360° Swing Lock Pedal (Optional)**

The 360° Swing Lock Pedal (4), (Figure 3-19) is located on the left side of the cab floor. The pedal activates the swing lock to prevent superstructure from turning.

**360° Swing Lock Release Lever (Optional)**

The 360° Swing Lock Release Lever (5), (Figure 3-19) is located on the left side of the cab floor, directly above the 360° Swing Lock Pedal (4). Lifting up on the lever releases the 360° swing lock

For  
Reference  
Only

CONTROL SEAT ASSEMBLY

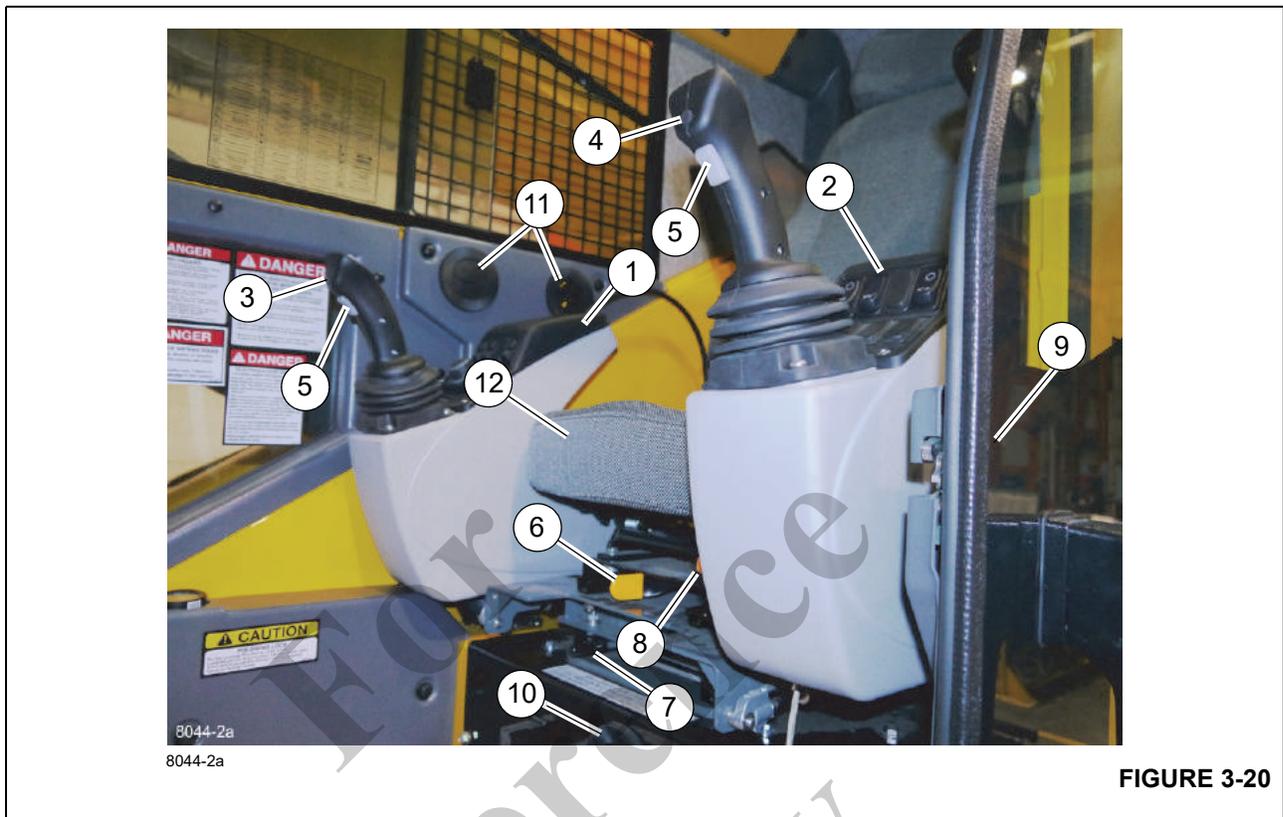


FIGURE 3-20

3

Item	Description
1	Right Hand Arm Rest Controls
2	Left Hand Arm Rest Controls
3	Horn
4	Free Swing Button
5	Deadman Switches (Dual Axis Controllers Only)
6	Seat Slide Lever
7	Seat Frame Slide Lever
8	Seat Height Adjustment Lever
9	Seat Back Adjustment Lever
10	AC/Heater Climate Unit
11	AC/Heater Vents
12	Seat Switch

**Right Hand Arm Rest Controls**

Refer to the Right Hand Arm Rest Controls, page 3-30.

**Left Hand Arm Rest Controls**

Refer to the Left Hand Arm Rest Controls, page 3-27.

**Horn Button**

The Horn Button (3), (Figure 3-20) is located on the upper front of the right controller. The button sounds the horn during crane operations.

**Free Swing Button**

The Free Swing Button (4), (Figure 3-20) is located on the upper front of the left controller. Pressing and holding the Free Swing Button releases the Swing Brake and allows the boom to be centered over the load.

**Deadman Switches (Dual Axis - Controllers Only)**

The Deadman Switches (5), (Figure 3-20) are located on the front of both control levers. Either of these switches can be used instead of the seat switch to keep crane functions active.

**Seat Slide Lever**

Moving the Seat Slide Lever (6), (Figure 3-20) will enable only the seat to slide, either forward or backward.

**Seat Frame Slide Lever**

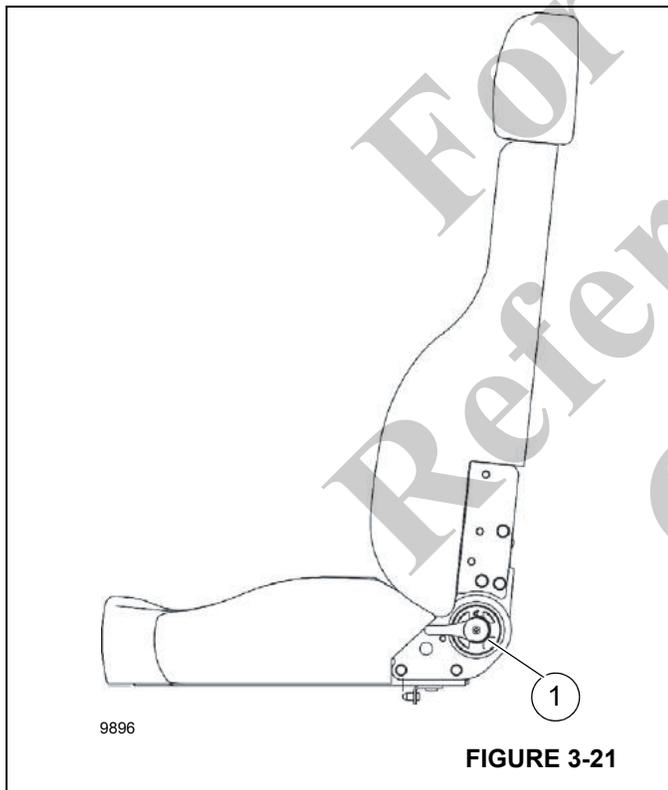
Moving the Seat Frame Slide Lever (7), (Figure 3-20) will slide both the seat and the arm rests either forward or backward.

**Seat Height Adjustment Lever**

To adjust the height of the seat, lift the height adjustment lever (8), (Figure 3-20) and then adjust the seat as needed.

**Seat Back Adjustment Lever**

The Seat Back Adjustment Lever (1), (Figure 3-21) allows the operator to adjust the pitch of the seat back.



**Seat Switch (Not Shown)**

This switch is located within the seat. An operator must be sitting in the seat, enabling the switch, or pressing one of the deadman switches before any crane function can be activated.

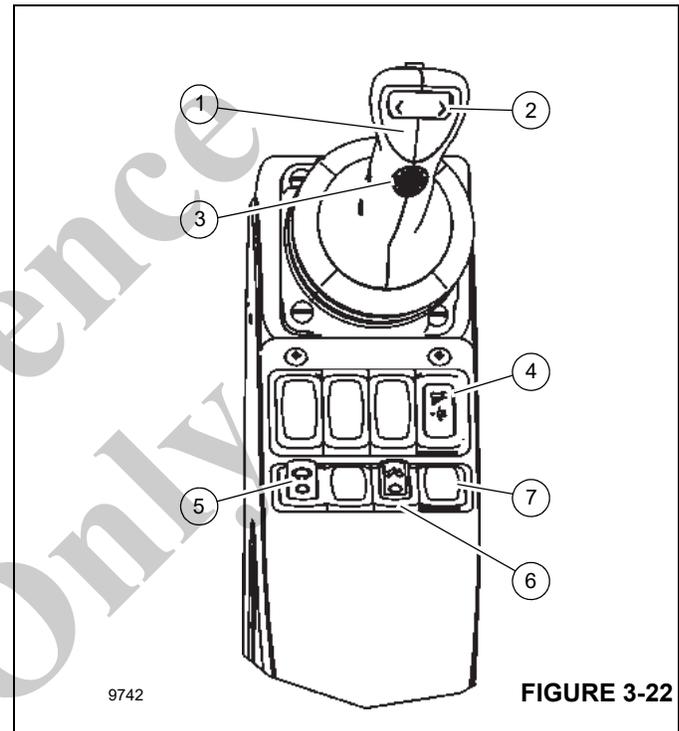
Optional Deadman Switches are available on cranes

equipped with Dual Axis Controllers. Refer to Deadman Switches (Dual Axis - Controllers Only), page 3-27. Pressing a Deadman Switch allows the crane functions to remain active when the operator is not sitting in the seat.

**Air Conditioner/Heater Climate Unit**

The Air Conditioner/Heater Climate Unit (10), (Figure 3-20) is located in the cab under the operator's seat. The HVAC vents (11), (Figure 3-20) are part of the climate unit and can be adjusted to direct the flow of air. Vents are also remote mounted as shown in (Figure 3-20).

**LEFT HAND ARM REST CONTROLS**



Item	Description
1	Swing/Telescope or Swing/Auxiliary Hoist Control Lever
2	Hoist Speed Toggle Switch
3	Auxiliary Hoist Rotation Indicator (Optional)
4	Outrigger Extend/Retract Switch
5	Swing Enable/Disable Switch
6	Boom Telescope Enable/Disable Switch
7	Auxiliary Hoist Enable/Disable Switch (Optional)

## Swing/Telescope or Swing/Auxiliary Hoist Control Lever (Dual Axis)



### DANGER

#### Crushing Hazard!

Death or serious injury could result from being crushed by moving machinery.

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

The Swing/Telescope or Swing/Auxiliary Hoist (Swing/Tele or Swing/Aux) Control Lever (1), (Figure 3-22) is located on the end of the left armrest. The lever controls the swing and, telescope function when the crane is not equipped with an auxiliary hoist. When the crane is equipped with an auxiliary hoist, the lever controls swing and auxiliary hoist functions and telescope functions are controlled through a foot pedal.

Positioning the lever to the left or right actuates a control valve to provide 360 degree continuous rotation in the desired direction. Positioning the lever forward actuates a control valve to telescope the boom out and pulling the lever back actuates the boom to telescope in.

If equipped with an auxiliary hoist, positioning the lever forward actuates the control valve to let out hoist rope and pulling the lever back reels the cable in. Moving the lever in a diagonal direction actuates the two functions at the same time.

### Hoist High Speed Toggle Switch

The Hoist High Speed Toggle Switch (2), (Figure 3-22) is a thumb operated three-position center spring return switch. Push and hold switch closest to the operator to change hoist speed to high – release switch to return hoist speed to normal. Push and release switch farthest from the operator to change hoist speed to high – push and release switch again to return hoist speed to normal.

The hoist control lever must be in neutral before changing speed.

### Auxiliary Hoist Rotation Indicator (Optional)

The Auxiliary Hoist Rotation Indicator (3), (Figure 3-22) is located near the top of each hoist control lever. The Auxiliary Hoist Rotation Indicator pulses when its hoist is running so the operator can sense it.

### Outrigger Extend/Retract Switch

The Outrigger Extend/Retract Switch (4), (Figure 3-22) allows the operator to switch between extension/retraction of the outrigger beams and raising/lowering of the jacks. Press and hold this switch to force the ODM to change to the outrigger page.

### Swing Enable/Disable Switch

The Swing Enable/Disable Switch (5), (Figure 3-22) is a momentary switch that is located on the left arm rest. Pressing the switch one time enables the swing function and pressing the switch again disables the swing function.

The Swing Enable/Disable Indicator (refer to *Status Bar Icons*, page 3-42) on the Operating Display Module (ODM) comes on green (background) when the swing function is enabled and it goes off when the swing function is disabled (blue background).

When the joystick moves to swing the crane, the brake releases. When the crane stops swinging, the swing brake re-engages.

### Boom Telescope Enable/Disable Switch

The Boom Telescope Enable/Disable Switch (6), (Figure 3-22) is a momentary switch located on the left armrest. Pressing the switch one time enables the boom telescope function and pressing the switch again disables the boom telescope function.

The Boom Telescope Enable/Disable Switch Indicator (refer to *Status Bar Icons*, page 3-42) on the Operating Display Module (ODM) comes on green (background) when the telescope function is enabled and it goes off when the telescope function is disabled (blue background).

### Auxiliary Hoist Enable/Disable Switch (Optional)

The Auxiliary Hoist Enable/Disable Switch (7), (Figure 3-22) is a momentary switch located on the left arm rest. Pressing the switch one time enables the auxiliary hoist function and pressing the switch again disables the auxiliary hoist function.

The Auxiliary Hoist Enable/Disable Switch Indicator (refer to *Status Bar Icons*, page 3-42) on the Operating Display Module (ODM) comes on green (background) when the auxiliary hoist function is enabled and it goes off when the auxiliary hoist function is disabled (blue background).

RCL Bypass Switch

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

The Limits Bypass Switch prevents the function lock outs from activating.

When the Limits 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 the crane's capacity, or when a two-block condition exists. Locking out these functions prevents the overload or two-block condition from worsening. The RCL Bypass Switch or RCL Bridging Mode NonEn Switch (1), (Figure 3-23) is located in the Superstructure behind the seat.

The RCL Bridging Mode NonEn Switch (1), (Figure 3-23) is a two-position, momentary switch located behind the operator seat. During maintenance or troubleshooting work, or to recover the crane, turning the switch clockwise bypasses the following limiter systems and their crane function lock outs:

- RCL System (boom up/down, telescope extend, hoist up)
- Anti Two-Block System (boom up/down, telescope extend, hoist up)
- Minimum Wrap Limiter System (hoist down) (optional)
- Working Range Limiter (WRL) System
- Carrier Avoidance System

Turning the Switch counter clockwise turns the switch OFF. The following indicators come on to indicate the limiters are bypassed:

- RCL Bridging Mode NonEn Switch is active



- RCL Lock Out LED is flashing
- Anti-two-block indicator is flashing
- Minimum Wrap indicator is flashing
- Working Range Limiter (WRL) indicator is flashing
- Low Boom Angle indicator is flashing

All craning functions locked out are bypassed when this key switch has been actuated and bypass mode becomes active.

Overriding the RCL with this switch should only be done by a qualified operator or technician.

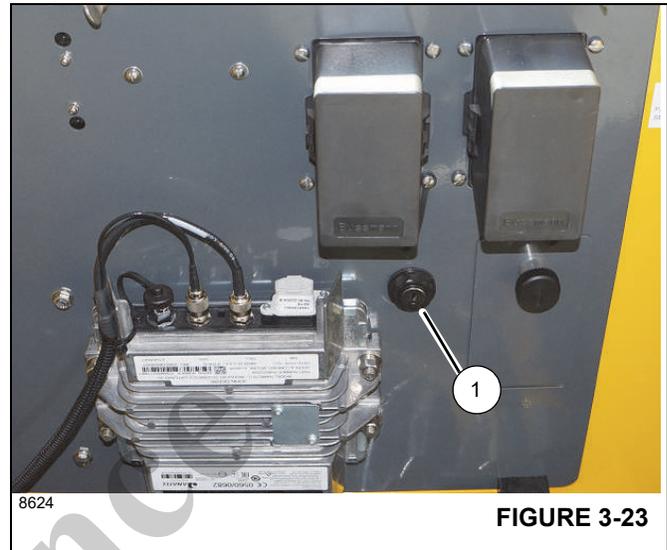


FIGURE 3-23

RIGHT HAND ARM REST CONTROLS

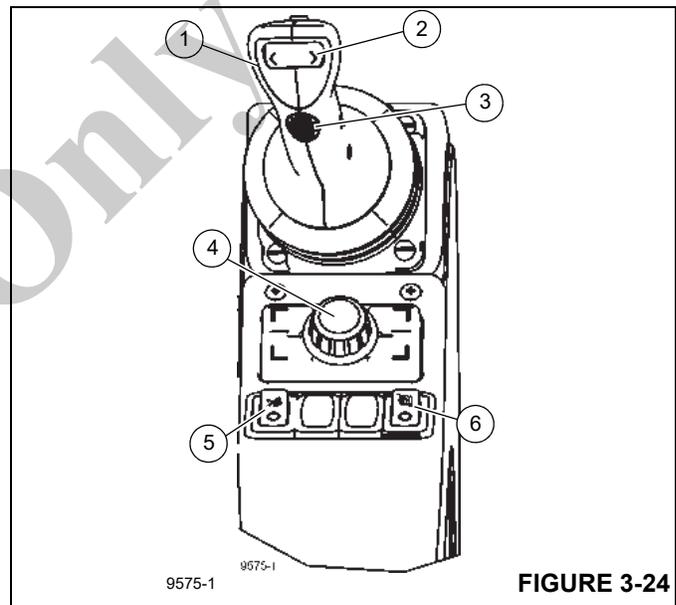


FIGURE 3-24

1	Boom Lift/Main Hoist Control Lever (Dual Axis)
2	Hoist Speed Toggle Switch
3	Main Hoist Rotation Indicator
4	Jog Dial

5	Boom Lift Function Enable/Disable Switch
6	Main Hoist Enable/Disable Switch

### Boom Lift/Main Hoist Control Lever (Dual Axis)

The Boom Lift/Main Hoist Control Lever (1), (Figure 3-24) is located on the right armrest. The controller, when pushed to the right lowers the boom, or pushed left raises the boom.

When used for main hoist, the controller, when pushed forward lowers the hoist rope, or pulled back raises the hoist rope.

### Hoist High Speed Toggle Switch

The Hoist High Speed Toggle Switch (2), (Figure 3-24) is a thumb operated three-position center spring return switch. Push and hold switch closest to the operator to change hoist speed to high – release switch to return hoist speed to normal. Push and release switch farthest from the operator to change hoist speed to high – push and release switch again to return hoist speed to normal.

The hoist control lever must be in neutral before changing speed.

### Hoist Rotation Indicator

The Hoist Rotation Indicator (3), (Figure 3-24) is located near the top of each hoist control lever. The hoist rotation indicator pulses when its hoist is running so the operator can sense it.

### Jog Dial

The Jog Dial Control (4), (Figure 3-24) located on the right arm rest, selects and chooses functions on the ODM or RDM to navigate the Crane Control System.

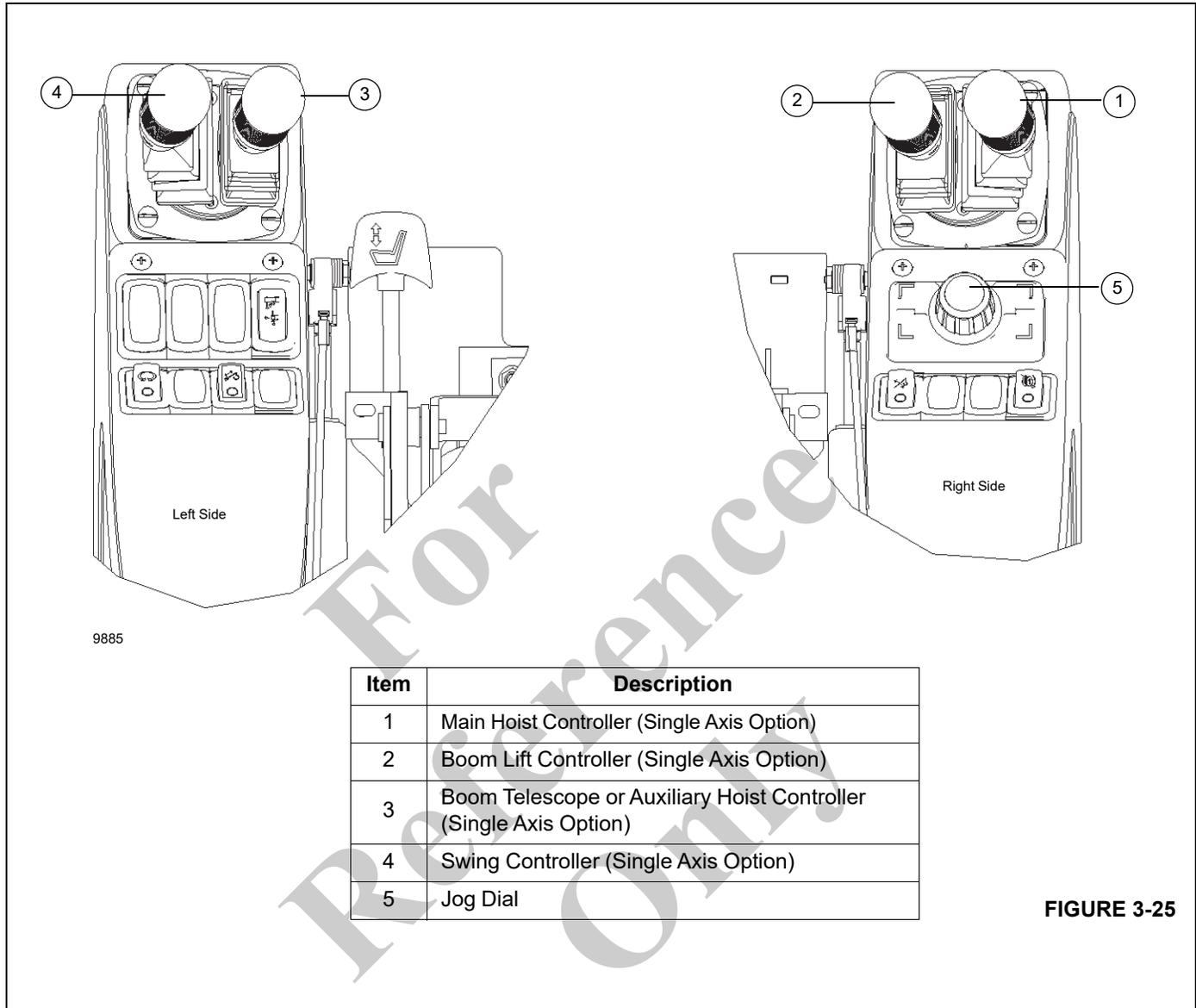
### Boom Lift Function Enable/Disable Switch

The Boom Lift Function Enable switch (5), (Figure 3-24) is a momentary switch that enables boom up and boom down. Press once to enable boom lift and press again to disable the boom lift switch.

### Main Hoist Enable/Disable Switch

The Main Hoist Enable Switch (6), (Figure 3-24) is a momentary switch that is located on the right armrest. Press once to enable hoist; press again to disable hoist. Pressing the switch twice rapidly enables hoist at high speed. Pressing once and holding the switch for about 2 seconds also enables high speed.

**MAIN HOIST CONTROLLER (SINGLE AXIS OPTION)**



9885

Item	Description
1	Main Hoist Controller (Single Axis Option)
2	Boom Lift Controller (Single Axis Option)
3	Boom Telescope or Auxiliary Hoist Controller (Single Axis Option)
4	Swing Controller (Single Axis Option)
5	Jog Dial

**FIGURE 3-25**

**Main Hoist Controller (Single Axis Option)**

The Main Hoist Controller (1), (Figure 3-25) is located on the right armrest. Pushing the controller forward lowers the hoist rope and pulling the controller rearward raises the hoist rope.

**Boom Lift Controller (Single Axis Option)**

The Boom Lift Controller (2), (Figure 3-25) is located on the right armrest. Pushing the controller forward lowers the boom and pulling the controller rearward raises the boom.

**Boom Telescope or Auxiliary Hoist Controller (Single Axis Option)**

The Telescope or Auxiliary Hoist (Tele or Aux) Controller (3), (Figure 3-25) is located on the left armrest. The controller controls the telescope functions when the crane is not equipped with an auxiliary hoist. Pushing the controller forward extends the boom and pulling the controller rearward retracts the boom in.

When equipped with an auxiliary hoist, the controller controls auxiliary hoist functions and telescope functions are controlled through a foot pedal. Pushing the controller forward lowers the hoist rope and pulling the controller rearward raises the hoist rope.

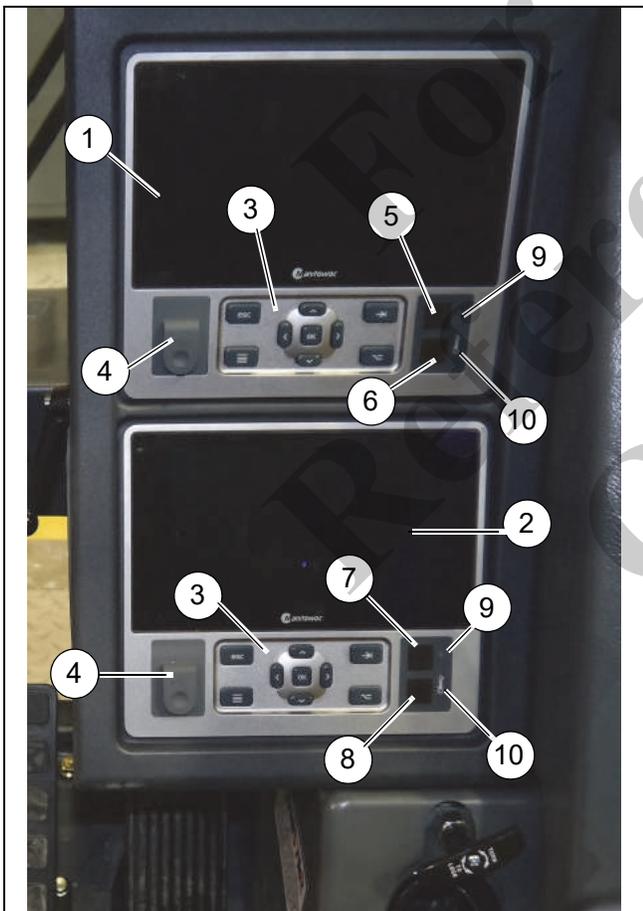
### Swing Controller (Single Axis Option)

The Swing Control Lever (4), (Figure 3-25)) is located on the left armrest. Pushing the controller forward rotates the superstructure clockwise and pulling the controller rearward rotates the superstructure counterclockwise. The superstructure can be continuously rotated 360° in the desired direction.

### OPERATOR DISPLAY MODULE AND RATED CAPACITY LIMITER DISPLAY MODULE

The Rated Capacity Limiter Display Module (RDM) and the Operator Display Module (ODM), (Figure 3-26) are located to the right of the superstructure cab.

Each module consists of a display screen, navigation control pad, warning indicators, a screen brightness sensor, and a USB diagnostic connector.



9521-A **FIGURE 3-26**

Item	Description
3	Navigation Control Pad
4	USB Connector
5	RCL Shutdown Warning Indicator
6	RCL Early Warning Indicator
7	Anti Two-Block (A2B) Indicator
8	Swing Brake Engaged Indicator
9	Brightness Sensor
10	Internal Temperature Warning Indicator

### Rated Capacity Limiter Display Module (RDM)

The Rated Capacity Limiter Display Module (RDM) (1), (Figure 3-26) allows the operator to easily program the RCL by entering a code number from the Load Chart Manual or by following the RCL setup wizard.

Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-82 for more information regarding the module's use in the operation of the crane.

### Operator Display Module (ODM)

The Operator Display Module (ODM) (2), (Figure 3-26) allows the operator to do the following:

- Monitor crane performance.
- Extend/retract the outriggers.
- Choose the different camera views to be displayed on the ODM Main Screen (if equipped with 3-View Camera option).
- Set the working range limits (WRL).
- Set the screen display brightness, units of measure (metric/imperial), and controller settings; and turn the ECO mode ON/OFF.
- View engine/transmission fault codes, crane fault codes, software versions installed, and hours of operation for each function.

Refer to *Using the Operator Display Module (ODM)*, page 4-38 for more information regarding the module's use in the operation of the crane.

### Navigation Control Pad

The Navigation Control Pads (3), (Figure 3-26) on the Rated Capacity Limiter Display Module (RDM) and the Operator Display Module (ODM) allow the operator to navigate through the function screens for the related module. The control buttons on the two Navigation Control Pads are identical in configuration and perform the same functions.

The Tab Button (2), (Figure 3-27) on the ODM's Navigation Control Pad can be pressed to temporarily silence active audible alarms.

Item	Description
1	Rated Capacity Limiter Display Module (RDM)
2	Operator Display Module (ODM)



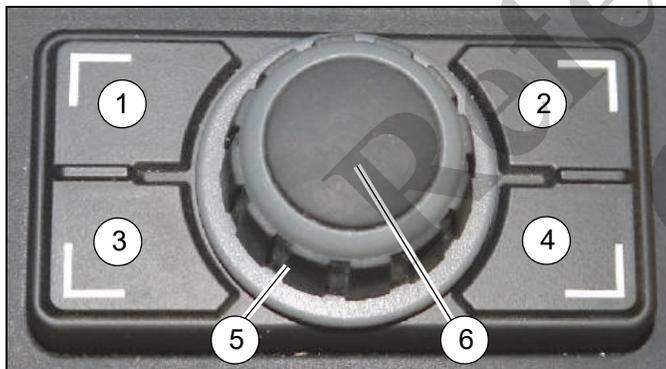


9221-1

Item	Description
1	Escape Button
2	Tab Button
3	Menu Button
4	Left/Right/Up/Down (Directional) Arrow Buttons
5	OK Button

FIGURE 3-27

The Jog Dial (5), (Figure 3-28), mounted on the right armrest (see *Jog Dial*, page 3-31), can be used to navigate the two modules in a similar manner as the Navigation Control Pads.



9221-2

Item	Description
1	Escape Button
2	Tab Button
3	Menu Button
4	Screen Toggle Button
5	Jog Dial (Rotate dial to move cursor)
6	OK Button (Press Jog Dial to select)

FIGURE 3-28

Refer to *Navigating the Operator Display Module (ODM) and Rated Capacity Limiter (RCL) Display Module*, page 4-37 for information on how the Navigational Control Pads and Jog Dial are used in the operation of the crane.

**USB Connector**

A USB Connector (4), (Figure 3-26) is provided for the Rated Capacity Limiter Display Module (RDM) and the Operator Display Module (ODM). Each USB Connector is located immediately below and to the left of its related display module screen.

The USB Connector allows a service technician to connect to the display module and update its software or download the data logger, which records certain events that can occur when operating the crane.

**NOTE:** These USB connectors are NOT to be used to charge electronic devices. ONLY use the USB ports in the Carrier Cab for charging electronic devices. Refer to *USB Ports*, page 3-5 to charge electronic devices.

**RCL Shutdown Warning Indicator**

The RCL Shutdown Warning Indicator (5), (Figure 3-26) is located immediately below and to the right of the Rated Capacity Limiter Display Module (RDM) screen.

The RCL Shutdown Warning Indicator comes on (red) when the RCL senses a lift that is greater than 100% of capacity for the programmed crane configuration. When the RCL senses a lift that is greater than 100% of capacity, the crane control system will lockout the boom up/down, telescope extend, and hoist up crane functions, which would worsen the overload condition.

If the crane function lockouts are engaged, overriding the crane function lockouts is accomplished using either the Upper Limits Bypass Switch or the Rear Limits Bypass Switch.

**RCL Early Warning Indicator**

The RCL Early Warning Indicator (6), (Figure 3-26) is located immediately below and to the right of the Rated Capacity Limiter Display Module (RDM) screen.

The RCL Early Warning Indicator comes on (amber) when the RCL senses a lift that is between 90% to 100% of capacity for the programmed crane configuration.

**Anti- Two-Block Indicator**

The Anti- Two-Block Indicator (7), (Figure 3-26) is located immediately below and to the right of the Operator Display Module (ODM) screen.

The Anti- Two-Block Indicator comes on (red) when the anti-two-block system is activated. 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. The anti- two-block system locks out the system prior to a two-block condition occurring

**Minimum Wrap Limiter System Indicator (Optional)**

The Minimum Wrap Limiter System is an aid to help the operator maintain at least three wraps of rope on the hoist drum during normal operation. Loading the rope when there is less than three wraps present on the hoist drum may cause the rope to slip at the hoist anchor, resulting in limited retention. The operator should be aware of operation near the three wrap limit and operate at slow speed. The limiter will engage suddenly which can increase load values on other systems and the crane. Also refer to the 3rd Wrap Indicator located in the *Alert Icons*, page 3-39.

**Swing Brake Engaged Indicator**

The Swing Brake Engaged Indicator (8), (Figure 3-26) is located immediately below and to the right of the Operator Display Module (ODM) screen. The indicator comes on (amber) when the swing brake is applied and the indicator goes off when the swing brake is released.

The swing brake is automatically released when the swing controller is actuated and the swing brake is automatically applied when the superstructure stops rotating.

**Brightness Sensor**

A Brightness Sensor (9), (Figure 3-26) is located immediately below and to the right of the Rated Capacity Limiter Display Module (RDM) screen and the Operator Display Module (ODM) screen.

The Brightness Sensors sense the amount of light in the operator cab. As the amount of light inside the cab changes, the Rated Capacity Display Module screen and the Operator Display Module 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 3-26) is located immediately below and to the right of the Rated Capacity Limiter Display Module (RDM) screen and the Operator Display Module (ODM) screen.

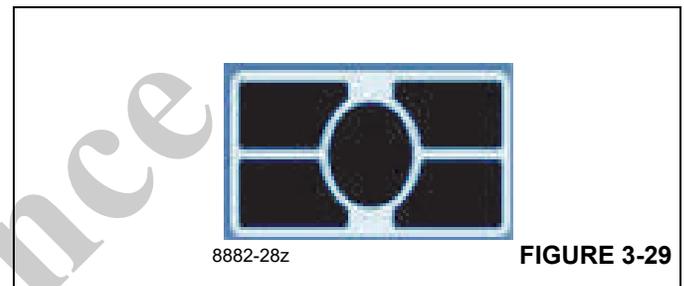
For the RDM and ODM screens to come on, their internal temperatures must be between -30°C (-22°F) and 70°C (158°F).

When the ignition key switch is turned to the I (RUN) position and the internal temperature of either the RDM or the ODM is below -30°C (-22°F), the related module’s Internal

Temperature Warning Indicator will come on (blue) and the module’s screen will remain blank. When the ignition key switch is turned to the I (RUN) position and the internal temperature of either the RDM or the ODM is above 70°C (158°F), the related module’s Internal Temperature Warning Indicator will come on (red) and the module’s screen will remain blank.

**Switching Displays**

The Active Display Symbol (Figure 3-29) will appear at the bottom left hand corner of the active display on the ODM. No symbol will be displayed on the inactive display. Use the Jog Dial (5), (Figure 3-28) or the Screen Toggle Button(4), (Figure 3-28) to switch between screens.



9469b FIGURE 3-30

Item	Description
1	Ignition Switch
2	Turntable Swing Lock Pin Control Handle

**Ignition Switch**

The Ignition Switch (1), (Figure 3-30) is located on the lower right side of the front console. The switch is key operated with two positions: OFF (vertical position), IGN (right position). The Engine Increment/Decrement switch in the Overhead Panel starts the engine.

With ignition switches in both cabs in the OFF position, all electrical power is off except for the headlights, marker lights, gauge lights, turn and stop light, carrier and superstructure cab dome lights, superstructure cab work lights, and carrier horn when one of these battery functions are energized.

The IGN position energizes all electrical components including the Engine Control Module (ECM). Turn the switch to OFF to shut down the engine.

**Turntable Swing Lock Pin Control Handle**

The Turntable Swing Lock Pin Control Handle (2), (Figure 3-30) is located on the lower right side of the console. When the control handle is pushed in and the superstructure is directly over the front of the carrier, the swing lock pin drops into the socket on the carrier frame, locking the superstructure in place. When the control handle is pulled

out, the pin is pulled out of the socket, unlocking the superstructure. Rotate the Turntable Swing Lock Handle to release the lock on the cable. Pull the handle to release the lock pin. Push the handle to engage the turntable swing lock pin. The vertical position indicates unlocked. The horizontal position indicates locked.

**OPERATOR DISPLAY MODULE (ODM) – MAIN SCREEN**

The Operator Display Module (ODM) is located above the Ignition Switch in the Superstructure Cab. The home screen shows the key indicators as shown below in Figure 3-31 and Figure 3-32. The optional camera package is also shown in Figure 3-32. For additional information on the optional camera package, refer to Camera Group for Crane Operation (Optional), page 6-14 and the Camera Group (Optional) Display on ODM, page 6-15. For additional information on the ODM, refer to Navigating the Operator Display Module (ODM) and Rated Capacity Limiter (RCL) Display Module, page 4-37.

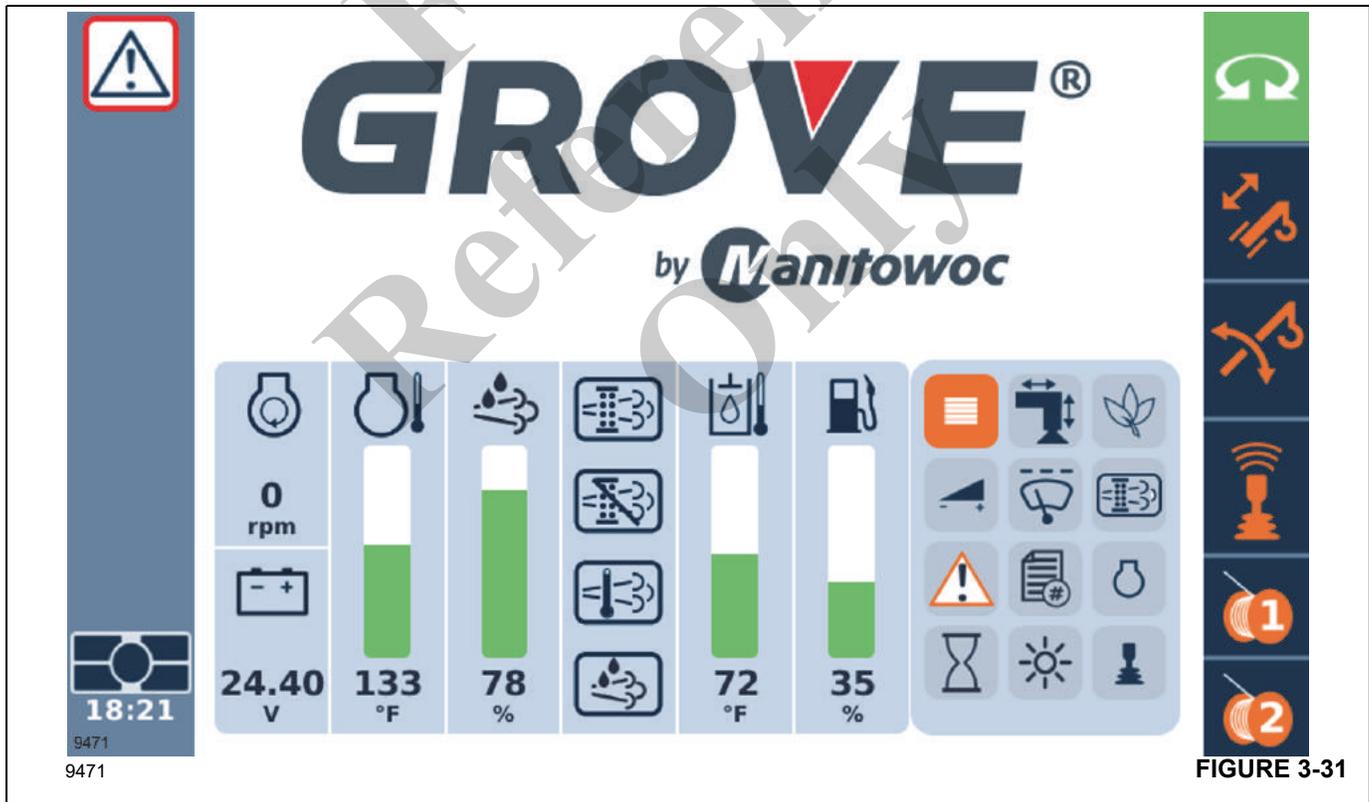
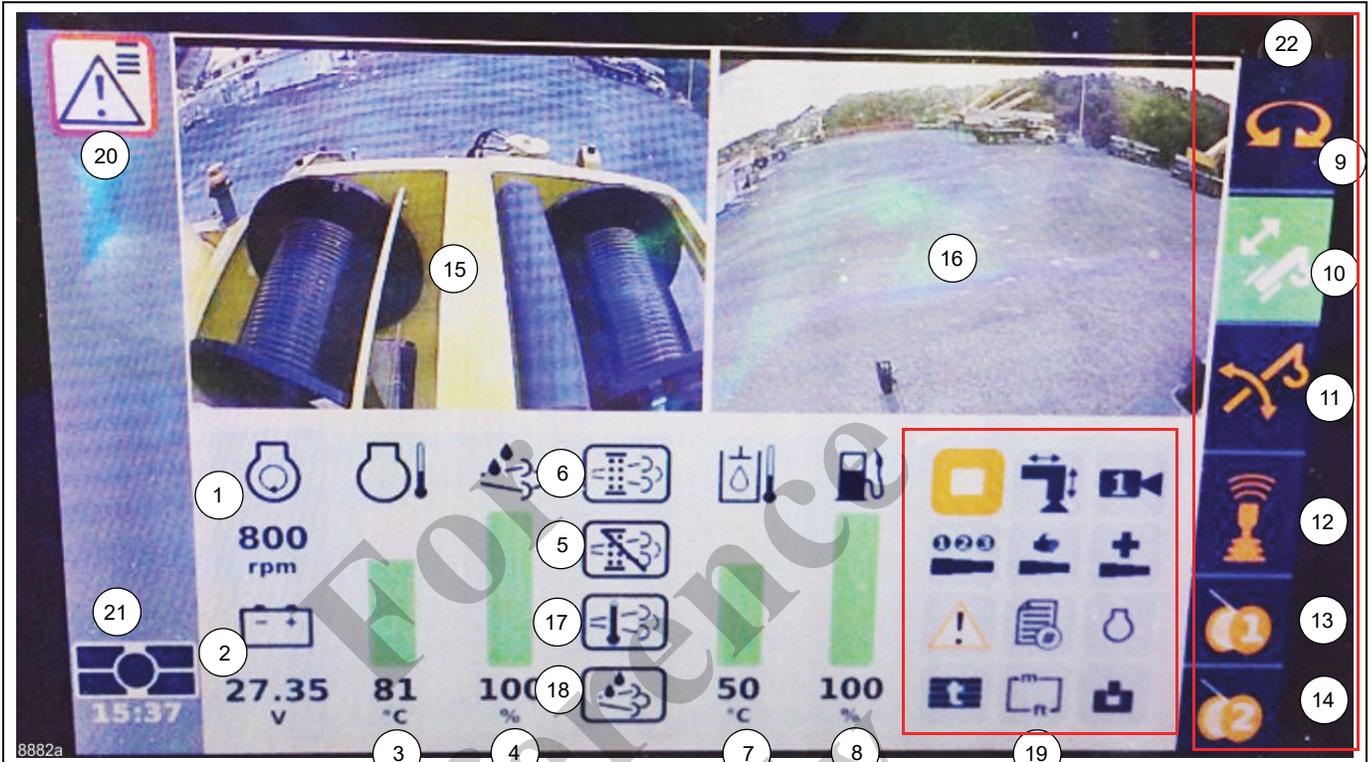


FIGURE 3-31



8882a  
8882a

FIGURE 3-32

Example: Camera Views 1 and 2 Displayed on Main Screen

3

Item	Item	Description
1	Engine Speed Display	Displays current engine speed
2	Voltage Monitoring Display	Displays system voltage
3	Coolant Temperature Display	Displays engine coolant temperature
4	DEF Level	Displays amount of DEF in reservoir tank
5	Exhaust System Cleaning Inhibited	Indicates exhaust system cleaning function is prevented
6	Exhaust System Cleaning Needed	Indicates the exhaust system needs to be cleaned
7	Hydraulic Oil Temperature	Displays the temperature of the hydraulic oil
8	Fuel Level Display	Displays the amount of fuel in the reservoir tank
9	Swing Function Status Indicator	Indicates when the swing function is active
10	Telescoping Function Status Indicator	Indicates when the telescoping function is active
11	Lift Function Status Indicator	Indicates when the lift function is active
12	Remote Controller Status Indicator	Indicates when the remote controller function is active
13	Main Hoist Function Status Indicator	Indicates when the main hoist function is active
14	Auxiliary Hoist Function Status Indicator (Optional)	Indicates when the auxiliary hoist function is active
15	Hoist Camera (Optional)	Camera view of hoists
16	Right Side 3-View Camera (Optional)	Camera view of the right side of the crane or any 3 camera views
17	High Exhaust System Temperature	Indicates the exhaust system temperature is high
18	DEF Low Warning	Indicates that the DEF is getting low in the tank
19	Most Often Used Menus	Indicates the most often used menus
20	Alert Icon	Displays up to 5 Icons when errors are present (refer to <i>Alert Icons</i> , page 3-39)
21	Active Display	Indicates which display is currently active
22	Status Bar	Displays up to 6 crane function status Icons (refer to <i>Status Bar Icons</i> , page 3-42)

**Alert Icons**

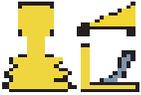
The following Alert Icons can appear on the ODM Main Screen when an error is present during the operation of the crane. This is an all-inclusive list of Alert Icons and this crane may not have some of these Icons. If equipped, the Icon will appear in the bottom Alerts Area of the ODM Main Screen.

Name	Icon	Description
<b>New fault</b>		A new fault was added to the list.
<b>Fault</b>		There is at least one fault on the list.
<b>Malfunction indicator lamp-critical</b>		Engine critical alarm lamp. This is commanded by the engine.
<b>Malfunction indicator lamp-warning</b>		Engine warning alarm lamp. This is commanded by the engine.
<b>Engine stop</b>		Engine Stop lamp (red). This is commanded by the engine.
<b>Engine warning</b>		Engine Warning lamp (amber). This is commanded by the engine.
<b>New engine fault</b>		A new engine fault was added to the list.
<b>Engine fault</b>		There is at least one engine fault on the list.
<b>Engine oil pressure low</b>		The engine oil pressure is low. This is commanded by the engine.

Name	Icon	Description
<b>Engine temperature high</b>		The engine coolant temperature is high. This is commanded by the engine.
<b>Engine overspeed</b>		The engine speed (RPM) is above the max expected value.
<b>Engine wait to start</b>		The engine is warming up before starting. This is commanded by the engine.
<b>Engine data invalid</b>		The engine RPM data is not valid.
<b>Emergency stop</b>		One of the emergency stop switches is pressed.
<b>System voltage</b>		The supply voltage measured at the main control module is less than 22V or more than 30V.
<b>Transmission temperature</b>		The transmission oil temp is heated up to the warning level.
<b>Transmission temperature invalid</b>		The transmission oil temp is invalid.
<b>Transmission not in neutral</b>		Indicates the transmission is not in neutral when it is required to be, such as starting engine or running outriggers.
<b>Parking brake</b>		Indicates the parking brake is required to be secured but is not, such as engine start or running outriggers.
<b>Alternator charge error</b>		The engine is running but the alternator is not charging.

Name	Icon	Description
<b>Alternator charge low</b>		The battery voltage is too low (about 22V or less) or too high (30V or more).
<b>Carrier key on</b>		The carrier cab key is in the ON or START position.
<b>Cab not down</b>		Cab tilt is blocked. This could be during engine start, or because the seat switch is not active.
<b>Center stabilizer overload</b>		The pressure in the center front jack cylinder is too high.
<b>Fuel level</b>		The fuel level is low.
<b>Counterweight blocking swing</b>		The counterweight is blocking swinging because the cylinders are not fully up.
<b>Settings speed or Speed adjust</b>		The speed settings or joystick curves are not at their default value (100% or linear joystick).
<b>Boom Angle too low</b>		The boom is near the driving cab and motion is blocked.
<b>Forbidden zone blocking range</b>		The boom is near the driving cab and motion is blocked.
<b>Forbidden zone bypassed</b>		The boom is near the driving cab and motion would be blocked but the bypass switch is allowing motion.

Name	Icon	Description
<b>Minimum wrap aux. hoist</b>		Only 3 wraps remain on the aux hoist. Hoist lowering is blocked.
<b>Minimum wrap main hoist</b>		Only 3 wraps remain on the main hoist. Hoist lowering is blocked.
<b>Hydraulic oil temp high</b>		The hydraulic oil temp is heated up to the warning level.
<b>Hydraulic oil temp invalid</b>		The hydraulic oil temp cannot be read correctly.
<b>Level sensor not OK</b>		The level sensor is not communicating, is not calibrated, or is self-reporting an error.
<b>Diesel Particulate Filter Indicator (Tier 4 and EPA ON-Highway Engines)</b>		Indicates the exhaust system does not require cleaning.
<b>Diesel Particulate Filter Clogged Indicator (Tier 4 and EPA ON-Highway Engines) (Amber)</b>		Indicates the exhaust system requires cleaning. Stop and perform a manual exhaust system cleaning. See <i>When to Manually Clean the Exhaust System</i> , page 4-10 (Tier 4 and EPA ON-Highway Engines).

Name	Icon	Description
Settings Speed		Joystick curve/speed not at default.
RCL Bridging Mode NonEn Switch		Switch is Active.

For Reference Only

**Status Bar Icons**

The following Status Bar Icons can appear in the Status Bar (3), (Figure 3-32) area of the ODM Main Screen:

Description	Graphic	Explanation
<p><b>Swing Disabled Indicator</b></p>		<p>Indicates the swing function is disabled (refer to <i>Crane Function Enable/Disable Switch</i>, page 3-25 and <i>Swing Enable/Disable Switch</i>, page 3-29).</p>
<p><b>Swing Standby Indicator (Amber - Constant On)</b></p>		<p>Indicates the swing function is enabled, but is in a standby mode due to the operator not being seated (causing seat switch to open). The swing 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 <i>Deadman Switches (Dual Axis - Controllers Only)</i>, page 3-27].</p>
<p><b>Swing Standby Indicator (Amber - Flashing)</b></p>		<p>Indicates the swing function is actuated (controller actuated) when the swing function is changed from disabled to enabled. Allow controller to return to its neutral position, then re-enable the swing function.</p>
<p><b>Swing Enabled Indicator (Green)</b></p>		<p>Indicates the swing function is enabled (refer to <i>Crane Function Enable/Disable Switch</i>, page 3-25 and <i>Swing Enable/Disable Switch</i>, page 3-29).</p>
<p><b>Telescope Disabled Indicator</b></p>		<p>Indicates the telescope function is disabled (refer to <i>Crane Function Enable/Disable Switch</i>, page 3-25 and <i>Boom Telescope Enable/Disable Switch</i>, page 3-29).</p>
<p><b>Telescope Standby Indicator (Amber - Constant On)</b></p>		<p>Indicates the telescope function is enabled, but is in a standby mode due to the operator not being seated (causing switch to open). The telescope 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 <i>Deadman Switches (Dual Axis - Controllers Only)</i>, page 3-27].</p>
<p><b>Telescope Standby Indicator (Amber - Flashing)</b></p>		<p>Indicates the telescope in or out function is actuated (controller actuated) when the telescope function is changed from disabled to enabled. Allow controller to return to its neutral position, then re-enable the telescope function.</p>
<p><b>Telescope Enabled Indicator (Green)</b></p>		<p>Indicates the telescope function is enabled (refer to <i>Crane Function Enable/Disable Switch</i>, page 3-25 and <i>Boom Telescope Enable/Disable Switch</i>, page 3-29).</p>

Description	Graphic	Explanation
<b>Boom Lift Disabled Indicator</b>		Indicates the boom lift function is disabled (refer to <i>Crane Function Enable/Disable Switch</i> , page 3-25 and <i>Boom Lift Function Enable/Disable Switch</i> , page 3-31).
<b>Boom Lift Standby Indicator (Amber - Constant On)</b>		Indicates the boom lift function is enabled, but is in a standby mode due to the operator not being seated (causing seat switch to open). The boom lift 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 <i>Deadman Switches (Dual Axis - Controllers Only)</i> , page 3-27].
<b>Boom Lift Standby Indicator (Amber - Flashing)</b>		Indicates the boom up or down function is actuated (controller actuated) when the boom lift function is changed from disabled to enabled. Allow controller to return to its neutral position, then re-enable the boom lift function.
<b>Boom Lift Enabled Indicator (Green)</b>		Indicates the boom lift function is enabled (refer to <i>Crane Function Enable/Disable Switch</i> , page 3-25 and <i>Boom Lift Function Enable/Disable Switch</i> , page 3-31).
<b>Wireless Remote (Optional) Indicator (Green)</b>		Indicates the Wireless Remote (Optional) function is enabled (refer to <i>Remote Control (Optional)</i> , page 3-55).
<b>Wireless Remote (Optional) Indicator (Orange)</b>		Indicates the Wireless Remote (Optional) is disabled (refer to <i>Remote Control (Optional)</i> , page 3-55).
<b>Main Hoist Disabled Indicator</b>		Indicates the main hoist function is disabled (refer to <i>Crane Function Enable/Disable Switch</i> , page 3-25 and <i>Main Hoist Enable/Disable Switch</i> , page 3-31).
<b>Main Hoist Standby Indicator (Amber - Constant On)</b>		Indicates the main hoist function is enabled, but is in a standby mode due to the operator not being seated (causing seat switch to open). The main hoist 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 <i>Deadman Switches (Dual Axis - Controllers Only)</i> , page 3-27].
<b>Main Hoist Standby Indicator (Amber - Flashing)</b>		Indicates the main hoist function is actuated (controller actuated) when the main hoist function is changed from disabled to enabled. Allow controller to return to its neutral position, then re-enable the main hoist function.
<b>Main Hoist Enabled Indicator (Green)</b>		Indicates the main hoist function is enabled (refer to <i>Crane Function Enable/Disable Switch</i> , page 3-25 and <i>Main Hoist Enable/Disable Switch</i> , page 3-31).

Description	Graphic	Explanation
Main Hoist High Speed Indicator (Green)		Indicates the main hoist function and the high speed function are enabled.
Auxiliary Hoist Disabled Indicator (Optional)		Indicates the auxiliary hoist (optional) function is disabled (refer to <i>Crane Function Enable/Disable Switch</i> , page 3-25 and <i>Auxiliary Hoist Enable/Disable Switch (Optional)</i> , page 3-29).
Auxiliary Hoist Standby Indicator (Amber - Constant On) (Optional)		Indicates the auxiliary hoist (optional) function is enabled, but is in a standby mode due to the operator not being seated (causing seat switch to open.) The auxiliary hoist 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 <i>Deadman Switches (Dual Axis - Controllers Only)</i> , page 3-27].
Auxiliary Hoist Standby Indicator (Amber - Flashing) (Optional)		Indicates the auxiliary hoist function is actuated (controller actuated) when the auxiliary hoist function is changed from disabled to enabled. Allow controller to return to its neutral position, then re-enable the auxiliary hoist function.
Auxiliary Hoist Enabled Indicator (Green) (Optional)		Indicates the auxiliary hoist (optional) function is enabled (refer to <i>Crane Function Enable/Disable Switch</i> , page 3-25 and <i>Auxiliary Hoist Enable/Disable Switch (Optional)</i> , page 3-29).

**OPERATING ELEMENTS OF THE CRANE CONTROL SYSTEM (CCS)**



**DANGER**

**An untrained operator subjects himself and others to death or serious injury. Do not operate this crane unless:**

- You are trained in the safe operation of this crane. Grove is not responsible for qualifying personnel.
- You read, understand, and follow the safety and operating recommendations contained in the crane manufacturer’s manuals and load charts, your employer’s work rules, and applicable government regulations.
- You are sure that all safety signs, guards, and other safety features are in place and in proper condition.
- The Operator Manual and Load Chart are in the holder provided on the crane.

**Crane Directional Information**

**Basic Rule**

Direction information always depends on whether the carrier or the superstructure is being operated.

**On the Carrier**

The driver's cab is always at the front, which means that sitting in the driver's seat looking forward the left of the crane is on your left side, right is on your right side, forward is the front and the rear is behind you.

**On the Superstructure**

The main boom nose is always at the front (Figure 3-33), which means that:

1:	front	2:	right
3:	rear	4:	left

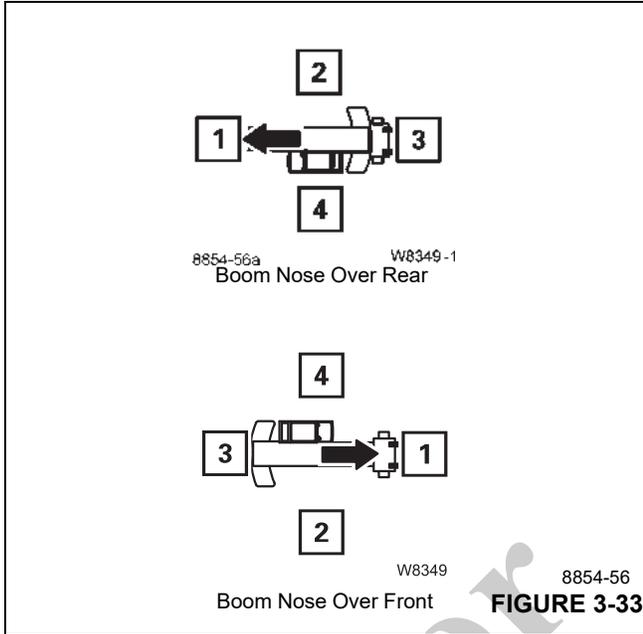


FIGURE 3-33

### General Rules for Buttons and Symbols on the CCS Display

The symbols shown as an example are not present on all crane types. The following rules apply in all menus:

- A menu can only be opened if the related symbol has been selected with the Jog Dial (5), (Figure 3-28) or directional arrow buttons (4), (Figure 3-27).
- A selected menu is marked in orange color and can be opened (Figure 3-34).

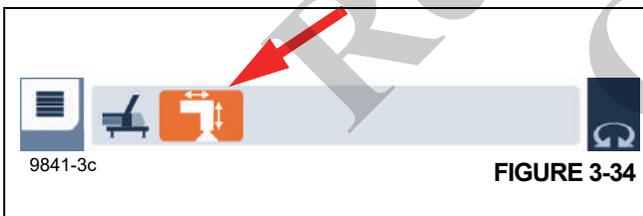


FIGURE 3-34

The color of the Icon indicates the symbol function status. An example of symbol function status is shown in different colors in the *Status Bar Icons*, page 3-42. Below is a table indicating an example of the symbol function color relative to its status:

	Symbol Function Color	Symbol Function Status
1	Grey:	Unavailable
2	Orange	Disabled
3	Green:	Enabled

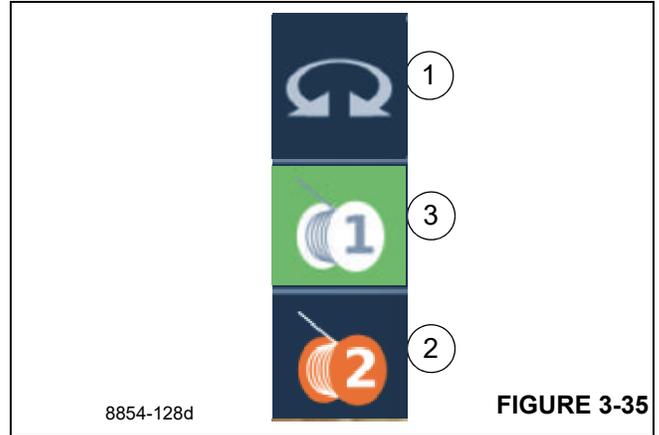


FIGURE 3-35

For the ODM crane function status, the possibilities are:

- Not Enabled: Navy Blue background, orange icon (this is at the first key on without pushing any buttons).
- Enabled: Green background, white icon (this is after the Enable button has been selected).
- Standby: Yellow background, white icon (this is after the function has been Enabled, and you get out of the seat).
- Standby Function Actuated: Yellow background flashing, white icon (this occurs when a function is presently in standby and a joystick is actuated – before sitting back in the seat, to prevent unwanted movement).
- Disabled: Blue background, gray icon (function is Disabled – this is set by going into the ODM screen and setting the function speed to '0'. While at 0, a function can not be enabled).

**NOTE:** In the operating instructions, we refer to colors in terms of the symbol used. For example, the symbol is green or orange, and so on.

If the instruction given in this section is to “Press the Button once...”, for instance, this always refers to the indicated Button not always the Jog Dial (5), (Figure 3-28) or the OK Button (5), (Figure 3-27). This is the case if a menu is opened or a function is to be carried out. Also, refer to the *Status Bar Icons*, page 3-42.

### Changing Menu

To change the display menu, press the Menu Button (3), (Figure 3-27) and (Figure 3-28) page 3-34.

## CRANE CONTROL SYSTEM (CCS) – OVERVIEW

The truck crane is equipped with the crane control system (CCS). The crane control system consists of a monitor and control buttons and jog dial in the superstructure cab.

The main screen appears after switching on the ignition (1), (Figure 3-36).

While on the ODM Home Screen (1), (Figure 3-36) and scrolling so that the 'menu' icon is selected (as shown with the orange icon) and select 'OK' display button or with the jog dial, the Main Menu screen will appear (2), (Figure 3-36).

**NOTE:** Refer to *Using the Operator Display Module (ODM)*, page 4-38.



FIGURE 3-36

**Exiting the Menu/Input Mode**

Press the Escape Button (1), (Figure 3-27) and (Figure 3-28) on the Jog Dial or on the Display to exit the menu or input mode.

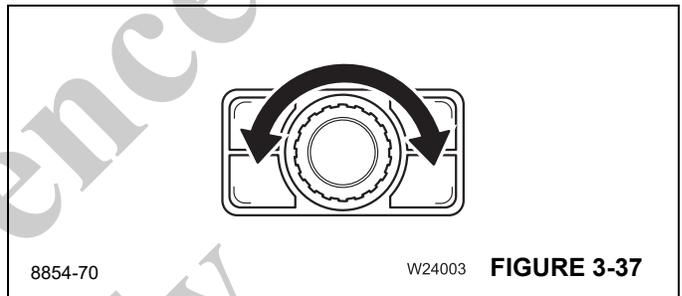
Press the Escape Button once:	The opened menu closes – the menu from the next higher level is opened
	Input mode is deactivated

**Enter the Values with Jog Dial**

When you depress the input confirmation button after highlighting a selection on the screen, the input mode is active 46

Turn the Jog Dial knob clockwise:	Increases the value
Turn the Jog Dial knob counterclockwise:	Decreases the value

To enter values with the jog dial, rotate dial until desired icon is highlighted. Depress the input confirmation button to highlight the input field. Rotate the jog dial clockwise to increase or counterclockwise to decrease the value slowly. Depressing and holding the input confirmation button while rotating it will cause the value to change more rapidly.



8854-70

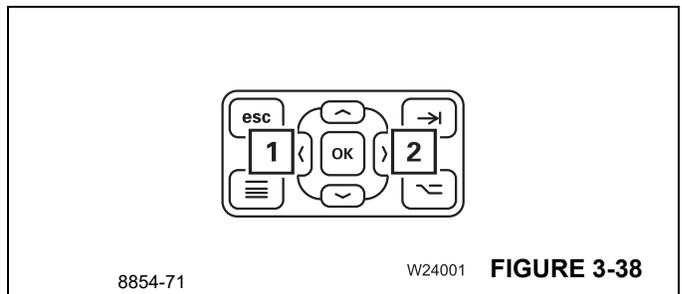
W24003

FIGURE 3-37

**Enter Values on the Crane Control System (CCS) Panel**

When the input mode is active Figure 3-38:

Arrow pointing to the right, Button 2:	Increases the value
Arrow pointing to the left, Button 1:	Decreases the value



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W24001

FIGURE 3-38

**Input Confirmation**

An input can be confirmed with Button (6), (Figure 3-28) or Button (5), (Figure 3-27) labeled OK as shown on page 3-34.

Press the Button once:	A newly entered value is confirmed.
------------------------	-------------------------------------

**CCS Display and Menus**

The Start Menu or Home Page appears after switching on the ignition (1), (Figure 3-36).

After pressing a button on the CCS control panel, the main menu (2), (Figure 3-36) appears.

A symbol is selected with the arrow buttons (4), (Figure 3-27) or Jog Dial (5), (Figure 3-28) in order to call up a menu. The selected symbol is highlighted.

The OK Button (5), (Figure 3-27) on the control panel is pressed in order to open a menu. The Jog Dial (1), (Figure 3-

28) indicates the Active Screen. Item 2, (Figure 3-39) indicates the Menu Screen. The additional menu items are listed in Figure 3-39 and on the following Table.

**Menu Groups**

The overall menu shows the Menu Groups and symbols that the operator can select. Use the arrow buttons (4), (Figure 3-27) or the Jog Dial (5), (Figure 3-28) to move over the menu symbols and select the Menu Group.

Below is the menu screen with symbol call-outs to indicate each symbol group.



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FIGURE 3-39

<b>Item</b>	<b>Description</b>	<b>Item</b>	<b>Description</b>
1	Active Screen Indicator Icon	17	Crane Operation Function Icon
2	Menu Screen Indicator Icon	18	Engine Fault Function Icon
3	Status Bar Indicator Icon	19	Information Group Menu Icon
4	Camera Group Menu Icon (Optional)	20	Operating Hours Function Icon
5	Camera View 1 Icon (Optional)	21	Software Version Function Icon
6	Camera View 2 Icon (Optional)	22	Legal Notice Function Icon
7	Camera View 1 and 2 Icon (Optional)	23	Tools Group Menu Icon
8	Crane Function Group Icon	24	Controller Sensitivity Function Icon
9	Outrigger Group Function Icon	25	Controller Speed Function Icon
10	Working Range Limiter (WRL) Group Menu Icon	26	Wiper Interval Function Icon
11	WRL Swing Angle Limitation Function Icon	27	Economy (ECO) Mode Function Icon
12	WRL Boom Angle Limitation Function Icon	28	Exhaust System Cleaning Function Icon
13	WRL Boom Height Limitation Function Icon	29	Tools User Settings Group Menu Icon
14	WRL Working Radius Limitation Function Icon	30	Setting Time Zone Function Icon
15	WRL Virtual Walls Limitation Function Icon	31	Setting Display Screen Brightness Function Icon
16	Errors (Fault Code) Group Menu Icon	32	Units of Measure Function Icon

Reference Only

**Warning Message/Error Message Display Area**

In the Warning Message/Error Message Display area (1) (Figure 3-40) error message icons will appear on the left side of the display with a red border around the icon. The icon will disappear when the error is resolved.

:

Red:	Warning message / error message
Off:	No warning message / error message present

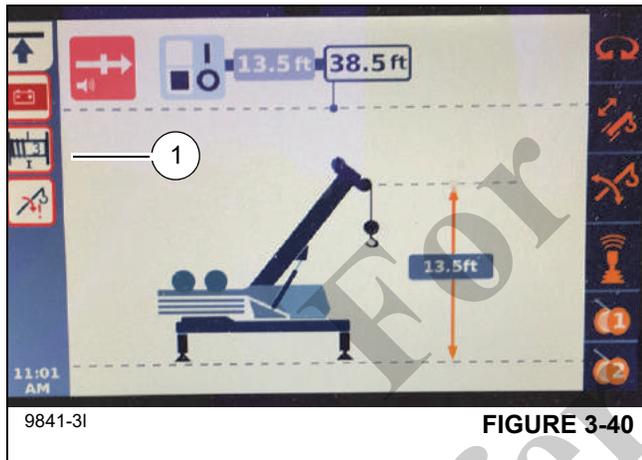


FIGURE 3-40

**Camera Group (Optional)**

The Camera Group Menu (4), (Figure 3-39) or (Figure 3-42) includes camera view 1, camera view 2 and/or camera view 1 and 2. Refer to *Camera Group (Optional) Display on ODM*, page 6-15 for additional information.



FIGURE 3-41

**Crane Function Menu Group**

The Crane Function Menu Group (8), (Figure 3-39) includes the Outrigger Menu. Refer to *Camera Group Menu*, page 4-42.

**Outrigger Function**

The Outrigger Menu is used to deploy and monitor the outriggers. Refer to *Outrigger Group Functions*, page 4-42.

**WORKING RANGE LIMITER (WRL) GROUP MENU**

**Introduction**

The Working Range Limiter (WRL) is a feature of the crane control system that allows the operator to define obstacles 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.

The WRL Menu Group (Figure 3-42) allows the operator to set limits on the location of the boom. For more information, refer to the *Working Range Limiter (WRL) Menu Group*, page 4-48.

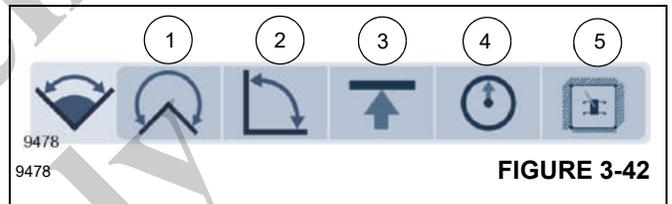


FIGURE 3-42

Item	Description
1	WRL Swing Angle Limitation Function
2	WRL Boom Angle Limitation Function
3	WRL Boom Height Limitation Function
4	WRL Working Radius Limitation Function
5	WRL Virtual Walls Limitation Function

**WRL - Swing Angle Limitation Function**

The WRL Swing Angle Limitation Function allows the operator to set limits for the swing angles which the crane can operate within. Refer to *WRL Limitation Screen Symbols*, page 4-52.

**WRL - Boom Angle Limitation Function**

The WRL Boom Angle Limitation Function allows the operator to set upper and lower limits for the boom to operate

within. Refer to *WRL - Boom Angle Limitation Menu*, page 4-58.

**WRL - Boom Height Limitation Function**

The WRL Boom Height Limitation Function allows the operator to set a limit for the maximum boom height. Refer to *WRL - Boom Height Limitation Menu*, page 4-61.

**WRL - Working Radius Limitation Function**

The WRL Working Radius Limitation Function allows the operator to set minimum and maximum radius limits for the boom. Refer to *WRL - Working Radius Limitation*, page 4-63.

**WRL - Virtual Walls Limitation Function**

The WRL Virtual Walls Limitation Function allows the operator to define up to five (5) locations which the boom is not allowed to operate. Refer to *WRL - Virtual Walls Limitation Menu*, page 4-66.

**Errors (Fault Code) Group Menu**

The Errors Menu Group is made up of Crane Operation (Fault Code) Errors and the Engine (Fault Code) Errors.

For information on the Errors Menu (Fault Code) Group, refer to *Errors (Fault Code) Group Menu*, page 4-70.

**Crane Operation Error Function**

For more information on the Crane Operation Error Fault Codes, refer to *Errors (Fault Code) Group Menu*, page 4-70

**Engine Error Function**

For information on Engine Error Functions, refer to *Engine Fault Function*, page 4-70.

**Information Group Menu**

The Information Group Menu is made up of the Cranes Operating Hours, the Software Version, and Legal Notice Functions. Refer to Figure 3-40.

**Operating Hours Function Icon**

For more information on the cranes operation hours, refer to *Viewing the Operating Hours*, page 4-71.

**Software Version Icon**

For more information on the crane's software versions, refer to *Viewing the Software Version Screen*, page 4-73.

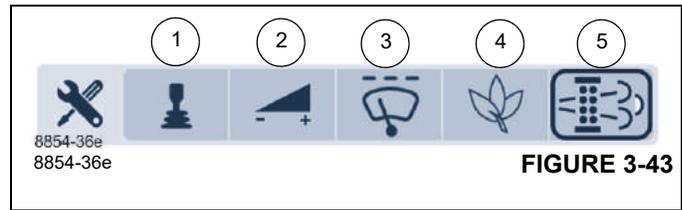
**Legal Notice Icon**

For more information on the crane's legal notice refer to *Legal Notice Screen*, page 4-85.

**Tools Group Menu**

The Tools Group Menu is made up of the Icons shown in Figure 3-43 that allows the operator to select sub-menus to

adjust parameters, set display options, and control functions.



Item	Description
1	Controller Sensitivity Function Icon
2	Controller Speed Function Speed Icon
3	Wiper Interval Function Icon
4	Economy Mode Function Icon
5	Exhaust System Cleaning Function Icon

**Controller Sensitivity Function**

The Controller Sensitivity Function (1), (Figure 3-43) allows the operator to adjust the sensitivity of the controllers and foot pedal (optional). For more information on setting the controller sensitivity function, refer to *Setting the Controller Sensitivity Function*, page 4-74.

**Controller Speed Function**

The Controller Speed Function Screen (2), (Figure 3-43) allows the operator to adjust the crane function speeds relative to the positions of the controllers. Adjustment is made as a percentage of full rated speed. For more information on Setting the Controller Function Speed, refer to *Setting the Controller Speed Function*, page 4-76.

**Wiper Interval Function**

The Wiper Interval Function Screen (3), (Figure 3-43) allows the operator to set a value between 3 and 30 seconds for the front and skylight wiper interval. For more information on setting the wiper interval, refer to *Setting the Wiper Interval Function*, page 4-78.

**Economy (ECO) Mode Function**

The Economy (ECO) Mode Function(4), (Figure 3-43) will reduce the throttle command when the crane functions are not being used. For additional information on Setting the Economy (ECO) Mode Function, refer to *Setting the Economy (ECO) Mode Function*, page 4-79.

### Tools User Settings Group Menu

The Tools User Settings Group Menu is made up of the Setting the Time Zone; Display Brightness; and the Units of Measure Function. Refer to *Tools User Settings Group Menu*, page 4-80.

#### Time Zone Function

The Time Zone Function allows the operator to set the time zone. To set the time zone (Figure 4-54), refer to *Setting the Time Zone Function*, page 4-81.

#### Display Screen Brightness Function

The Screen Brightness Function allows the operator to set the display screen brightness. To set the brightness of the display refer to *Setting the Display Screen Brightness Function*, page 4-81.

#### Unit of Measure Function

The Unit of Measure Function allows the operator to set the unit of measure to Metrics or Imperial Units. To open: Select symbol (3), (Figure 3-51) and confirm. (Refer to *Setting the Units of Measure Function*, page 4-82.)

### REMOTE DRIVE (OPTIONAL)

The Remote Drive Option allows limited operation of the truck carrier from the superstructure cab.

#### Carrier Cab Controls and Indicators

The Pushbutton Shifter (2, Figure 3-44) is located in the Right-Hand Console of the Carrier Cab. The Remote Drive Indicator (1) will appear on the LCD of the gauge cluster when Remote Drive is active. A Steering Wheel Cover is provided to Caution anyone who may enter the Carrier Cab while in Remote Drive Mode. Use the provided Cable Lock to secure the cover.

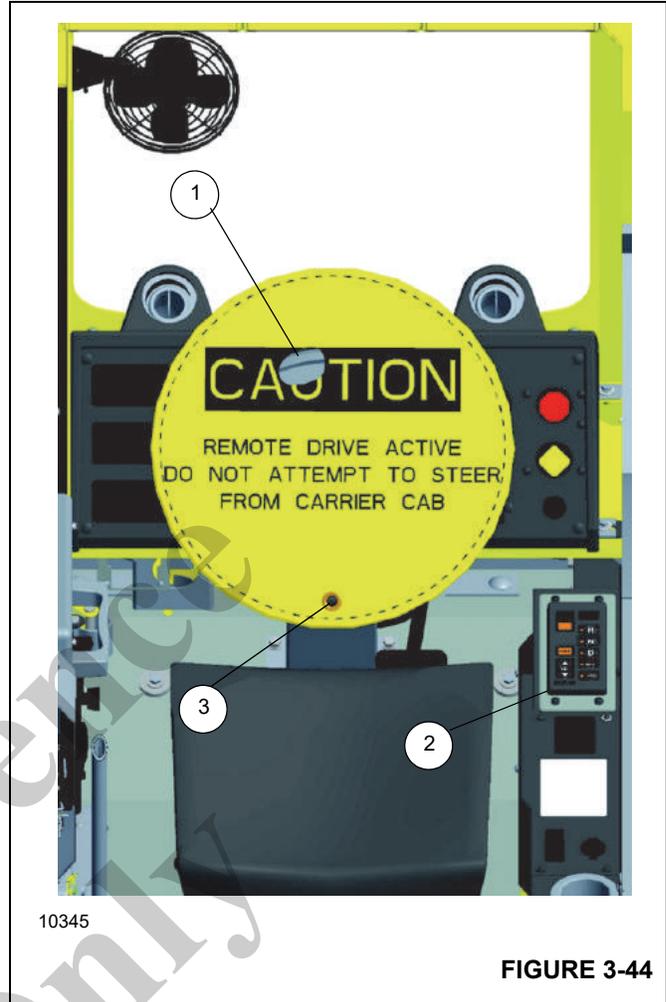


FIGURE 3-44

Item	Description
1	Remote Drive Active Indicator (on LCD Dash Cluster)
2	Pushbutton Shifter
3	Cable Lock Mounting Location

The Shift Selector is an Eaton Automated Transmission Pushbutton Shifter. The Pushbutton Shifter (Figure 3-45) consists of seven push buttons, with indicator lamps beside the Reverse, Neutral, Drive, Manual, and Low push buttons, an indicator labeled 'Service' and an LCD screen. Refer to the Decal located on the right console in the Carrier Cab and/or the Eaton Operator's Manual for operation instructions.

Table 3-10

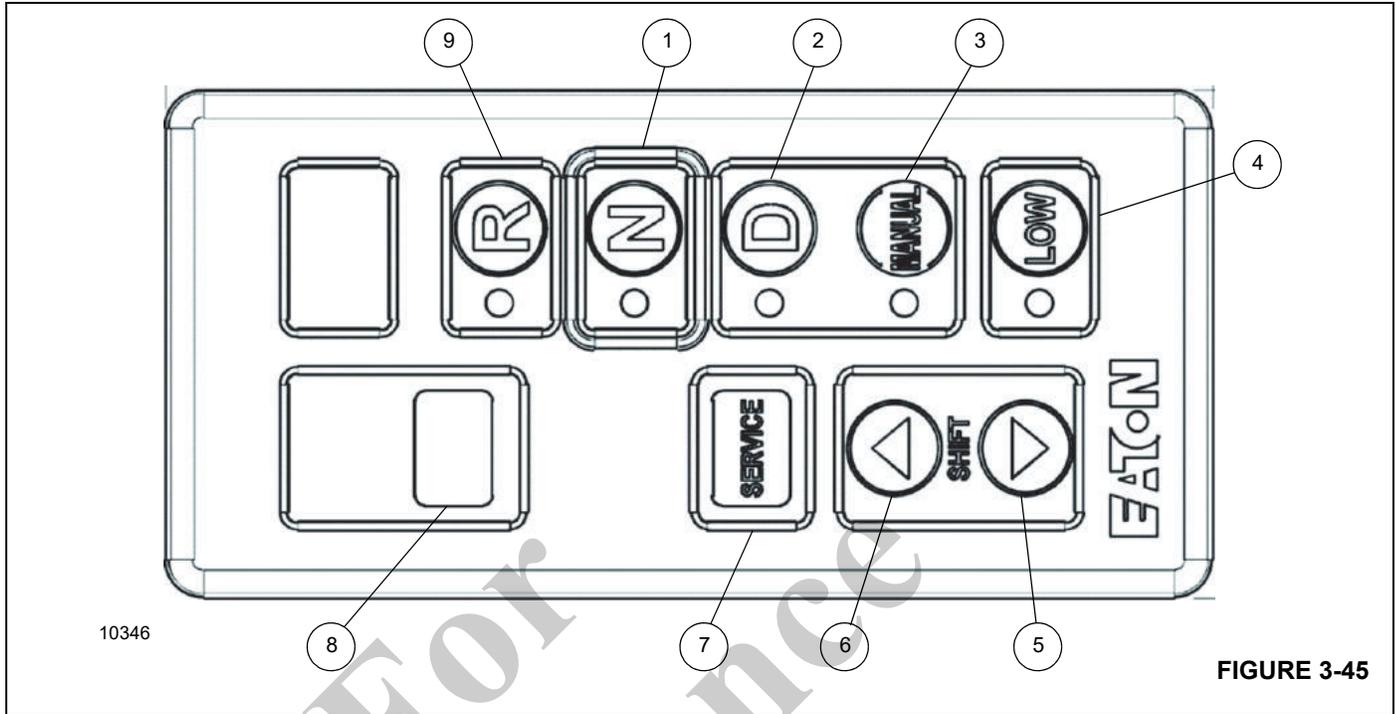


FIGURE 3-45

Item	Component
1	Neutral
2	Drive (Forward)
3	Manual Mode
4	Low
5	Shift Down
6	Shift Up
7	Service Indicator
8	LCD
9	Reverse

The movement of the joystick will be used to steer the front axle.

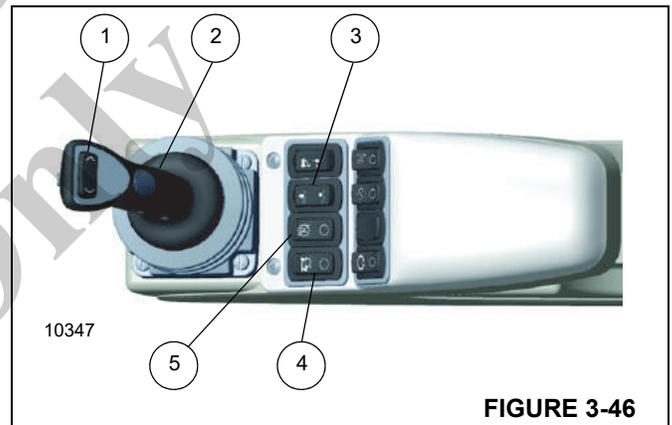


FIGURE 3-46

Item	Description
1	Thumb Toggle Switch
2	Joystick
3	Suspension Inflate/Deflate
4	Remote Drive Enable
5	Park Brake On/Off

**Superstructure Remote Drive Controls**

**Left Arm Rest**

There are three switches on the lower row of the Left Arm Rest (Figure 3-46) used for Remote Drive Operation: Remote Drive Enable, Park Brake On/Off, and Suspension Inflate/Deflate (from Outside to Inside of arm rest).

The Thumb Toggle Switch on the joystick will be used to shift the Transmission when operating in Remote Drive Mode.

### Service Brake Pedal

The service brakes (Figure 3-47) are actuated using the electronic pedal located in the superstructure cab between the Throttle (right most) and Telescope pedal (if equipped).

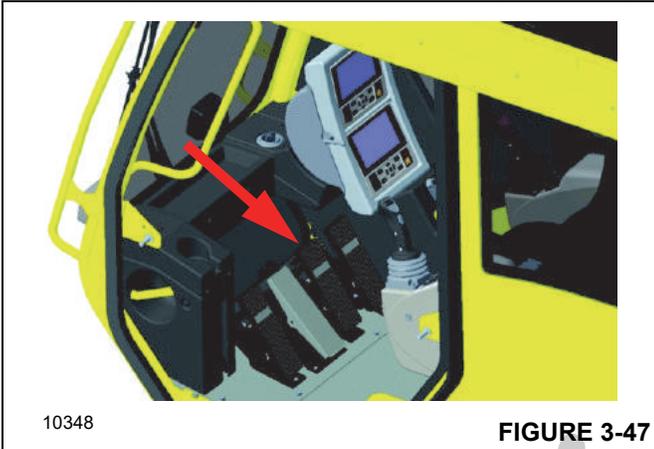


FIGURE 3-47

## Operation

### Enable the Remote Drive Option

1. From the carrier cab, set the transmission to Neutral, apply the park brake, and turn the key to the off position. Place the 'Remote Drive Active' cover over the steering wheel and secure with the provided cable lock.

**NOTE:** It is recommended to turn on the four-way flashers and the headlights before leaving the carrier cab, as this cannot be done from the superstructure cab.

2. Move to the superstructure cab and start the crane.
3. Verify that the turntable lock pin is engaged with the boom over the front or over the rear, and swing function is disabled.

**NOTE:** Inflating the Suspension may be done only when traveling with the boom in the rest. For any travel with the boom over the rear, or when lifting loads on rubber, the air bags must be deflated. Use the Inflate/Deflate Switch (Figure 3-46) on the left Armrest to actuate the air bags.

4. Enable the Remote Drive switch on the left armrest (Figure 3-46). An indicator with the Remote Drive symbol will appear on the Operator Display Module (ODM).

**NOTE:** If the crane is set up on the outriggers, adjust the stabilizers so that they will not come into contact with the ground.

5. Push the Service Brake pedal to engage the service brakes and then select the Park Brake On/Off switch on the left armrest to release the park brake. The Park Brake Disengage indicator will appear on the ODM.
6. With the Service Brake Pedal still pushed, select either the Right or Left thumb toggle to shift the transmission. Right will shift into 1st Gear Forward and Left will shift into 1st Gear Reverse. When the transmission is in Forward, press the Reverse Toggle once to shift into neutral. A second press is needed to shift the transmission into Reverse. When the transmission is in Reverse, press the Forward Toggle once to shift into Neutral. A second press is needed to shift the transmission into Forward.

**NOTE:** Any shift into Forward or Reverse from Neutral will need to be done with the Service Brake Pedal pushed in. Shifts from Forward or Reverse to Neutral may be done without pushing the Service Brake Pedal.

**NOTE:** Forward/Reverse are in relation to the superstructure, NOT the orientation of carrier.

### Disable the Remote Drive Option

1. Push the Service Brake pedal to engage the service brakes and then shift the transmission to neutral.
2. With the Service Brake pedal still pushed, select the Park Brake On/Off switch on the left armrest to apply the park brake. The Park Brake Disengage indicator will disappear on the ODM.
3. Disable the Remote Drive switch on the left armrest (Figure 3-46). An indicator with the Remote Drive symbol will disappear on the Operator Display Module (ODM).

**NOTE:** The suspension will automatically deflate when the remote drive function is disabled.

4. Turn the key to the off position and move to the carrier cab.
5. Remove the 'Remote Drive Active' cover over the steering wheel.

**Truck Steering Operation**

With the Swing Function disabled and the Remote Drive enabled, use the left joystick to steer the truck using the same controller movement as swing. Moving the stick to the left will steer the truck to the left and moving the stick to the right will steer the truck to the right. Steering is in relation to the orientation of the superstructure.

**NOTE:** Centering or moving the joystick back into its neutral position will not center the wheels on the steer axle. After steering in one direction, a counter steer input will be required to return the wheels to center.

**Pedal Operation**

The Superstructure Service Brake Pedal (Figure 3-47) is used to actuate the service brakes on the carrier axles when operating in Remote Drive Mode. The Service Brake Pedal must be pushed while releasing the Park Brake and for any transmission shift requests from neutral to forward or from neutral to reverse. The Superstructure Service Brake Pedal is only active when Remote Drive mode is ON.

Use the Throttle Pedal to control engine speed. The engine speed increment/decrement switch will be disabled in Remote Drive Mode.

**Suspension**

Inflating the Suspension may be done only when traveling with the boom in the rest. For any travel with the boom over the rear or when lifting loads on rubber, the air bags must be deflated. See Figure 3-46 for switch locations. To inflate the suspension, hold the Inflate Suspension Switch until fully inflated. To deflate the suspension, push and release the Deflate Suspension Switch.

**Troubleshooting**

Reference the table below for error indication when attempting to engage or while operating in Remote Drive Mode.

Indication/ Problem	Cause(s)
Cannot Enable Remote Drive	-Swing function is enabled -Turntable lock pin disengaged -Carrier key is in the on position -Transmission is not in neutral
Cannot Release Parking Brake	-Low air pressure -Remote drive not enabled
<b>NOTE:</b> When remote drive is disabled, the park brake will automatically apply & the suspension will automatically deflate.	
Cannot Steer with Joystick	-Remote drive not enabled -CAN communication loss -E-Stop enabled
Cannot Enable Swing Function	Remote drive enabled
Turntable Pin Unlocked Indicator	Turntable lock pin has been disengaged while in remote drive mode
No Throttle Pedal Response when Remote Drive Enabled	-Operator not in seat -Turntable lock pin disengaged -CAN communication loss -E-Stop enabled
Unable to Shift	-Service brake not pushed or disconnected -Operator not in seat -Swing enabled -Turntable lock pin disengaged -CAN communication loss -E-Stop enabled -Remote drive not enabled

**Indicators**

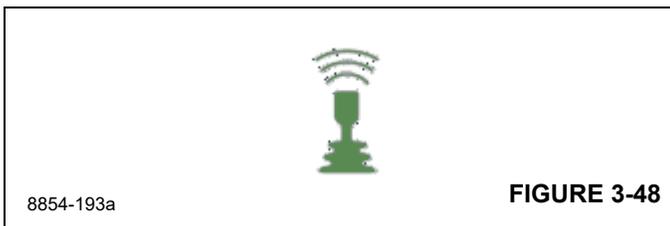
Refer to the table below for indicators that are associated with the Remote Drive Mode.

Operator Display Module (ODM) Remote Drive Symbols	
Remote Drive Enabled	
Park Brake Released	
Turntable Pin Disengaged	
Transmission Not In Neutral	

**REMOTE CONTROL (OPTIONAL)**

**Remote Control Icon**

With the Hand-held Wireless Remote Control switched on, the Crane Control System (CCS) operation from the superstructure cab is blocked. The Icon (Figure 3-48) is shown green on all menus. For more information on the Remote Control, review the following pages.



**WARNING**

**Tipping/Overload Hazard!**

RCL lockouts and limiters are not functional when remote control is used.

When operating functions from remote control, operator must be positioned to see crane movement.

This section does not contain:

- Operating instructions for the controls on the crane.
- Setup and installation instructions.

Before using the hand-held wireless remote control, the operator shall read and become thoroughly familiar with the following instructions.

**Remote Control Operation**

The remote control has been provided to operate the following crane functions during **crane set-up only**:

- Superstructure horn.
- Engine start/stop and throttle control.
- Outrigger beams and jacks.
- Hoists (main hoist and auxiliary hoist, if equipped).
- Boom lift.
- Swing.
- Emergency Stop.

The remote control is not intended to operate crane functions during normal crane operation.

When the remote control is used during crane set-up, the RCL is disabled and associated lockouts and limiters are not functional, to include:

- Anti two-block.
- Hoist minimum wrap.
- Carrier avoidance.

**Remote Control System Components**

The Remote Control System Components are listed below in Table 3-11.

**NOTE:** The top of the remote control corresponds to the front of the crane (carrier cab is at front). The terms left and right correspond to the operator's left and right sides when looking forward from the front of the crane.



Table 3-11 Remote Control System Components

Item	Component (Figure 3-49)	Description
1	Remote Control (Transmitter)	<p>The remote control communicates with the receiver to control the crane functions identified in this publication.</p> <ul style="list-style-type: none"> <li>Powered by a 3.2Ah Lithium-Po rechargeable battery</li> <li>Stored in a pocket on the inside of the carrier cab door (1)</li> </ul>
2	Receiver Module	<p>Communicates with the remote control and the Crane Control System (CCS) over the CAN network.</p> <ul style="list-style-type: none"> <li>Mounted on the cab wall behind the driver's seat.</li> </ul>
3	Battery Charger	<p>Charges the batteries (quantity 2) supplied with the remote control. The charger is active whether the carrier engine is running or off (3).</p> <ul style="list-style-type: none"> <li>Mounted on the cab wall behind the driver's seat</li> </ul> <p>The charger lights (3a) indicate the following:</p> <ul style="list-style-type: none"> <li>Four red lights = CHARGING</li> <li>Three green lights = FULLY CHARGED</li> </ul>
4	Emergency Stop	<p>The Remote Control has an Emergency Stop push-pull switch located at the bottom of the remote. Push in to STOP.</p>

Table 3-12 Remote Control Operating Conditions

Working range	Approximately 30 m (100 ft) depending on obstructions and environment
Battery operating time	Approximately 10 hours
Operating temperature	-20°C to 70°C (-4°F to 158°F)
Storage temperature	-40°C to 75°C (-40°F to 167°F)

Remote Control Components



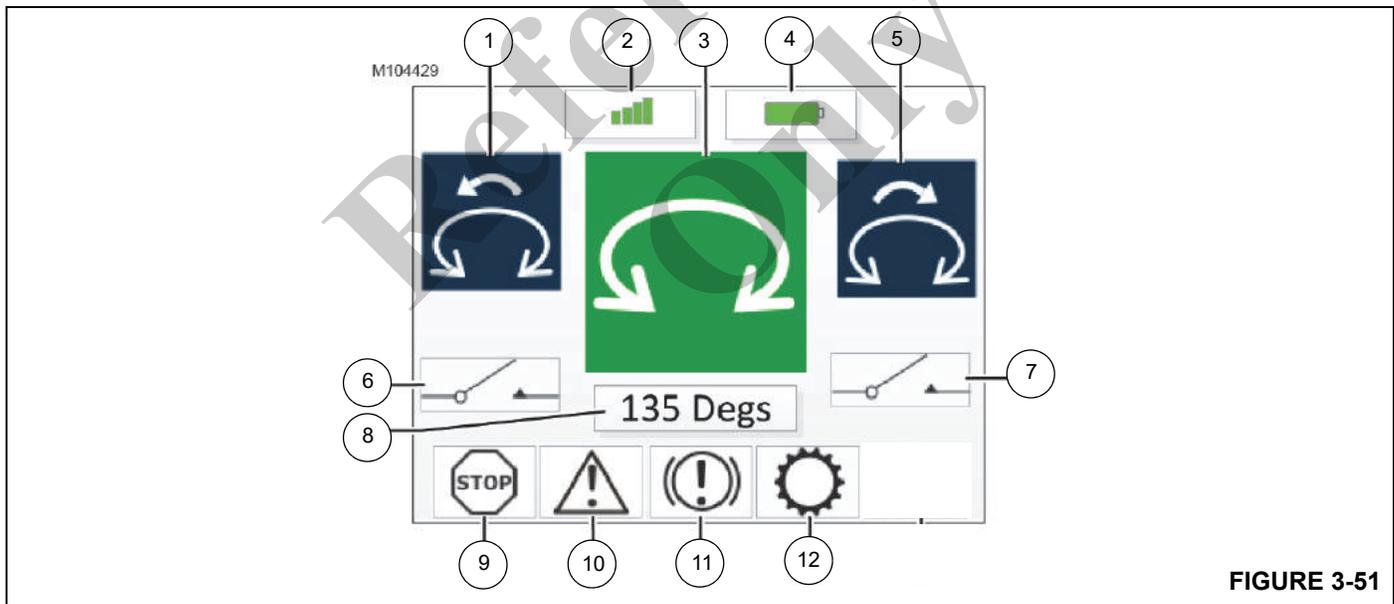
FIGURE 3-50

Table 3-13 Remote Control Components

Item	Component (Figure 3-50)	Description
1	Programming Port	For Grove factory authorized use only
2	Color Display	Displays information for the selected function
3	Power Button	ON/OFF switch which activates and deactivates the remote control
4	Indicator LED	Amber, solid = remote control in boot loader mode (ready to be programmed) Green, slow blink = wireless communication OK Red, slow blink = E-stop relay open or wireless communication stopped Red, fast blink = battery low Red, solid = remote controlling error

5	Function Selector Buttons (qty 10)	<p>Momentary buttons that activate the selected function in the display:</p> <ul style="list-style-type: none"> <li>5a - Outrigger beams</li> <li>5b - Outrigger jacks</li> <li>5c - Boom lift</li> <li>5d - Option:</li> <li>5e - Horn (activates the superstructure horn)</li> <li>5f - Escape: exits the selected function screen</li> <li>5g - Information (software version/revision and crane serial number)</li> <li>5h - Engine</li> <li>5i - Swing</li> <li>5j - Main/aux hoist</li> </ul>
6	Left Motion Button	<p>Holding down either button operates the selected function in the desired direction (for example: turn a hoist up or down, extend or retract a jack or beam, swing right or left).</p> <p>Speed depends on how far either button is depressed</p>
7	Right Motion Button	
8	Left Enable Button	<p>Holding down either button allows (enables) a selected function to be operated in the desired direction by the corresponding motion button</p>
9	Right Enable Button	
10	Battery	3.2Ah Lithium-Po rechargeable battery
11	E-Stop Knob	<p>Pull out = allow operation of the crane functions from the remote control</p> <p>Push in = STOP engine and current function</p>

**Display Components**



**FIGURE 3-51**

**Table 3-14 Display Components**

Item	Component (Figure 3-51)	Description
1	Left Motion Command	Depicts the operation that is controlled by the left motion command button
2	Transmission Strength	More bars = greater strength, and vice versa
3	Function Screen	Depicts the function that is being operated (swing in this example)

4	Battery Power	Green = full charge Amber = discharging
5	Right Motion Command	Depicts the operation that is controlled by the right motion command button
6	Left Enable	White = neither enable button is depressed (function cannot be operated)
7	Right Enable	Green = either enable button is depressed (function can be operated)
8	DEG or RPM	When appropriate, shows the position of the superstructure in degrees or the rotational speed of the selected motion.
9	E-Stop	White = not active (operation allowed) Red = active (operation not allowed until E-stop is pulled out)
10	Crane Fault	White = not active (operation allowed) Red = active (take corrective action as indicated in Crane Operator Manual)
11	Carrier Park Brake	White = brake applied Red = brake released
12	Carrier Transmission	White = transmission in neutral Red = transmission in gear (must be in neutral)

**NOTE:** The top of the remote control corresponds to the front of the crane (carrier cab is at front). The terms left and right correspond to the operator's left and right sides when looking forward from the front of the crane.

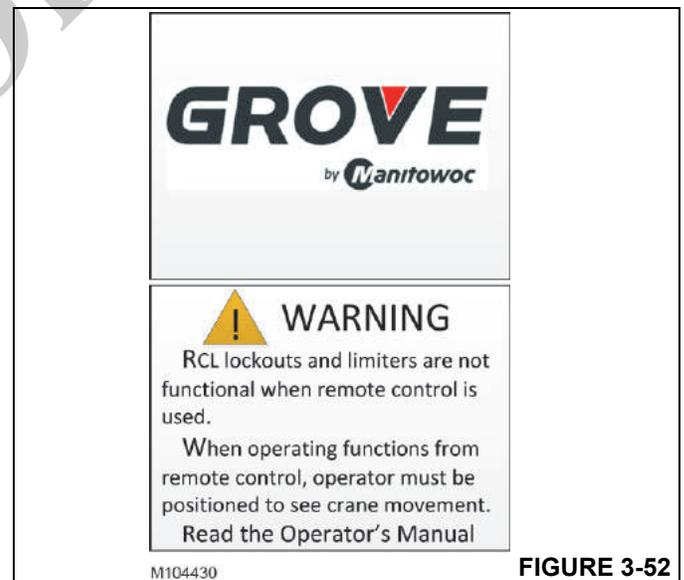
**Preparing for Remote Control Operation**

1. Position the crane in the desired location.
2. Apply the carrier parking brake.
3. Shift the carrier transmission to neutral.
4. Stop the engine with the carrier ignition switch (the engine will be re-started with the remote control).
5. Set the carrier ignition switch to ON.
6. Set the remote control switch on the carrier control console to ON.

In this mode, power is supplied to the remote module and the E-Stop relay (in remote module) is added in series to the E-Stop electrical circuit.

7. The amber remote control indicator (next to remote control switch) indicates the following:
  - Amber ON = remote control has control of crane functions
  - Amber OFF = remote control powered off
  - Amber FLASHING = A crane condition is preventing the remote from gaining control of the crane functions. For example:
    - Carrier park brake not applied
    - Carrier transmission is in gear
    - Active fault codes exist

- Superstructure is in control of crane functions
8. Turn ON the remote control, as follows:
    - a. Press the power button on the top of the remote control.
    - b. Make sure the E-stop button on the remote control is pulled out and then press any button on the remote control. This action closes the E-stop relay in the receiver module.
    - c. The SPLASH screen will appear for a few seconds, followed by the WARNING screen, See (Figure 3-52).



**FIGURE 3-52**

- d. Press the ESC button on the remote control to acknowledge that you have read the warning.

e. The MAIN screen appears.



FIGURE 3-53

f. Press the engine button on the remote control. The engine screen appears in the display.

The operator must start the engine from the remote control. See *Engine Start/Stop/Throttle*, page 3-63.

Once the engine is started, the operator can operate the crane functions from the remote control.

The remote control remains ON until one of the following occurs:

- Operator presses the power button on the remote control
- Battery power is too low to operate the display

9. Turn OFF the remote control, as follows:

- a. If desired, stop the engine with the remote control. See *Engine Start/Stop/Throttle*, page 3-63.
- b. Turn off the remote control by pressing the power button on the top of the remote control.
- c. Set the remote control switch on the carrier control console to OFF.
- d. If you want to keep the engine running:
  - First, set the remote control switch on the carrier control console to OFF.

- Then, turn off the remote control by pressing the power button on the top of the remote control. If you fail to perform this step the remote control will remain ON (not operable) and its battery will discharge.

**Operating Remote Control**

**Superstructure Horn**



Press and hold the horn button (5e) (Figure 3-50) on the remote control to sound the superstructure horn. The superstructure horn button can also be used to sound the horn.

**Emergency Stop**

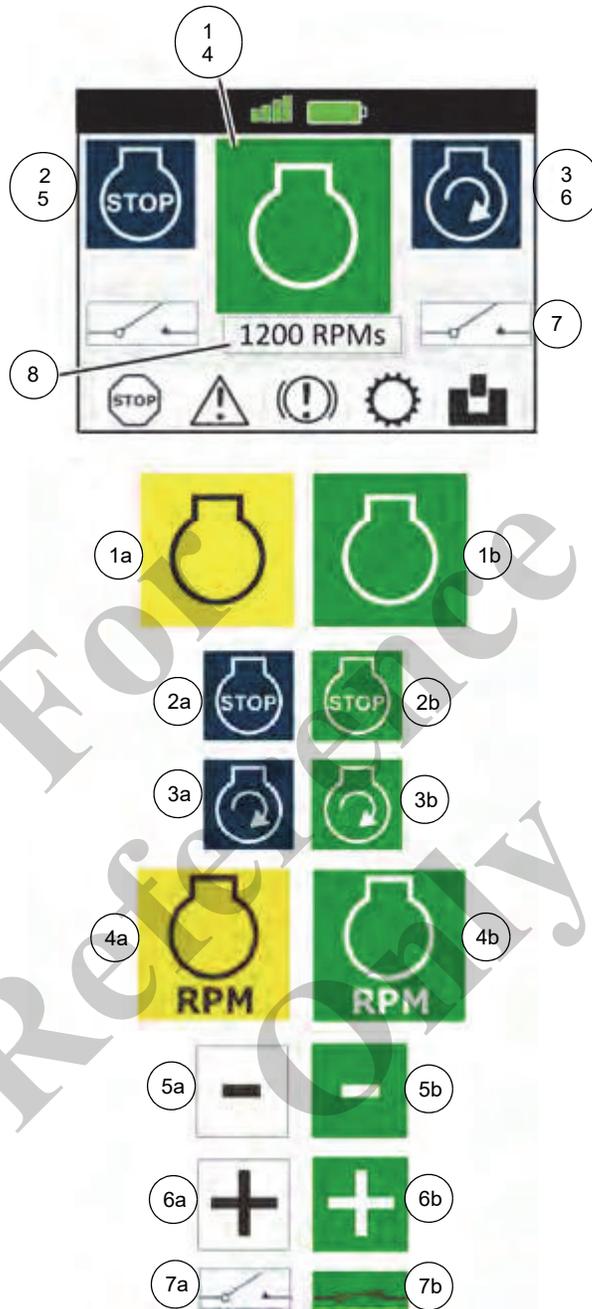
When the E-stop knob (see Figure 3-50) is pushed in:

- The engine stops
- The function being operated stops
- The STOP screen appears.



FIGURE 3-54

To restart the engine, the E-stop knob must be pulled out.



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FIGURE 3-55

**Table 3-15** Engine Start/Stop/Throttle Function Screen

Item	Indicator Name	Description
1	Engine (start/stop) Function	1a - Yellow = engine cannot be started or stopped due to a crane fault 1b - Green = engine can be started or stopped
2	Stop Engine	2a - Blue = engine cannot be stopped until either enable button is held down 2b - Green = engine can be stopped with left motion button
3	Start Engine	3a - Blue = engine cannot be started until either enable button is held down 3b - Green = engine can be started with right motion button
4	Engine RPM Function	4a - Yellow = engine RPM cannot be changed due to a crane fault 4b - Green = engine RPM can be changed
5	Decrease RPM	5a - White = engine RPM cannot be decreased until either enable button is held down 5b - Green = engine RPM can be decreased with left motion button
6	Increase RPM	6a - White = engine RPM cannot be increased until either enable button is held down 6b - Green = engine RPM can be increased with right motion button
7	Enable Button Status	7a - White = both enable buttons released (operation disabled) 7b - Green = either enable button held down (operation enabled)
8	RPM Screen	Shows the engine speed

**Engine Start/Stop/Throttle**

See Figure 3-55 and Figure 3-50.

**Starting/Stopping Engine**

1. Press the Engine Button(Figure 3-50) on the remote control ONCE. The engine screen (1) appears.
2. To START the engine, hold down either enable button and the right motion button at the same time. Release both buttons as soon as the engine starts.

If a condition exists that prevents the engine from being started, information will be provided in the display. Common conditions that prevent the engine from being started are: the carrier transmission is in gear or the carrier park brake is released.

3. To STOP the engine, hold down either enable button and the left motion button at the same time. Release both buttons once the engine stops.

**Changing Engine Speed**

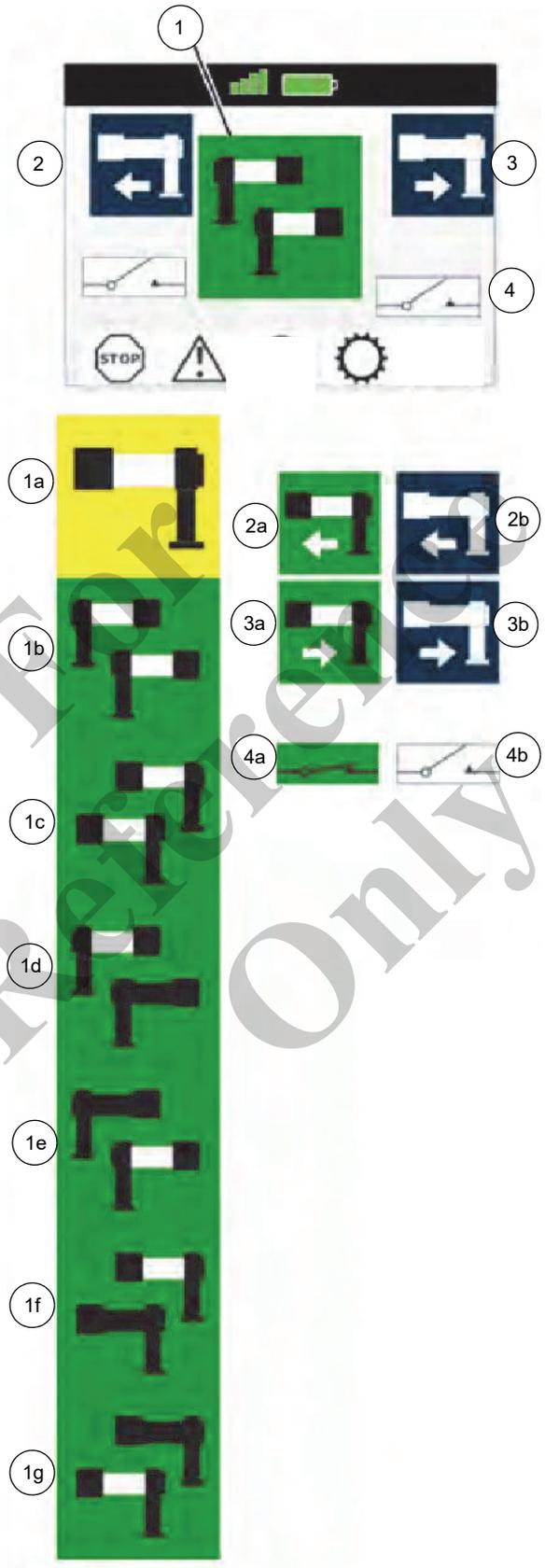
1. Press the engine button(Figure 3-50) on the remote control ONCE if already at the engine screen, or TWICE if at the main screen. The throttle screen (4) appears.
2. To INCREASE engine speed, hold down either enable button and the right motion button at the same time.
3. To DECREASE engine speed, hold down either enable button and the left motion button at the same time.

The engine's speed is shown in the RPM screen (8), (Figure 3-55).

When the remote control is on, engine speed cannot be controlled from the crane.

**Exiting Start/Stop/Throttle Screen**

To exit this screen, press the ESC Button (Figure 3-50) on the remote control. The main screen appears.



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FIGURE 3-56

Table 3-16 Outrigger Beams Function Screen

Item	Indicator Name	Description
1	Outrigger Beams Function	1a - Yellow = beams cannot be operated due to a crane fault 1b - Both left side beams will be operated 1c - Both right side beams will be operated 1d - Left front beam will be operated 1e - Left rear beam will be operated 1f - Right front beam will be operated 1g - Right rear beam will be operated
2	Retract Beams	2a - Green = beams can be retracted with left motion button 2b - Blue = beams cannot be retracted until either enable button is held down
3	Extend Beams	3a - Green = beams can be extended with right motion button 3b - Blue = beams cannot be extended until either enable button is held down
4	Enable Button Status	4a - Green = either enable button held down (operation enabled) 4b - White = both enable buttons released (operation disabled)

**NOTE:** The top of the remote control corresponds to the front of the crane (carrier cab is at front). The terms left and right correspond to the operator's left and right sides when looking forward from the front of the crane.

**Outrigger Beams**

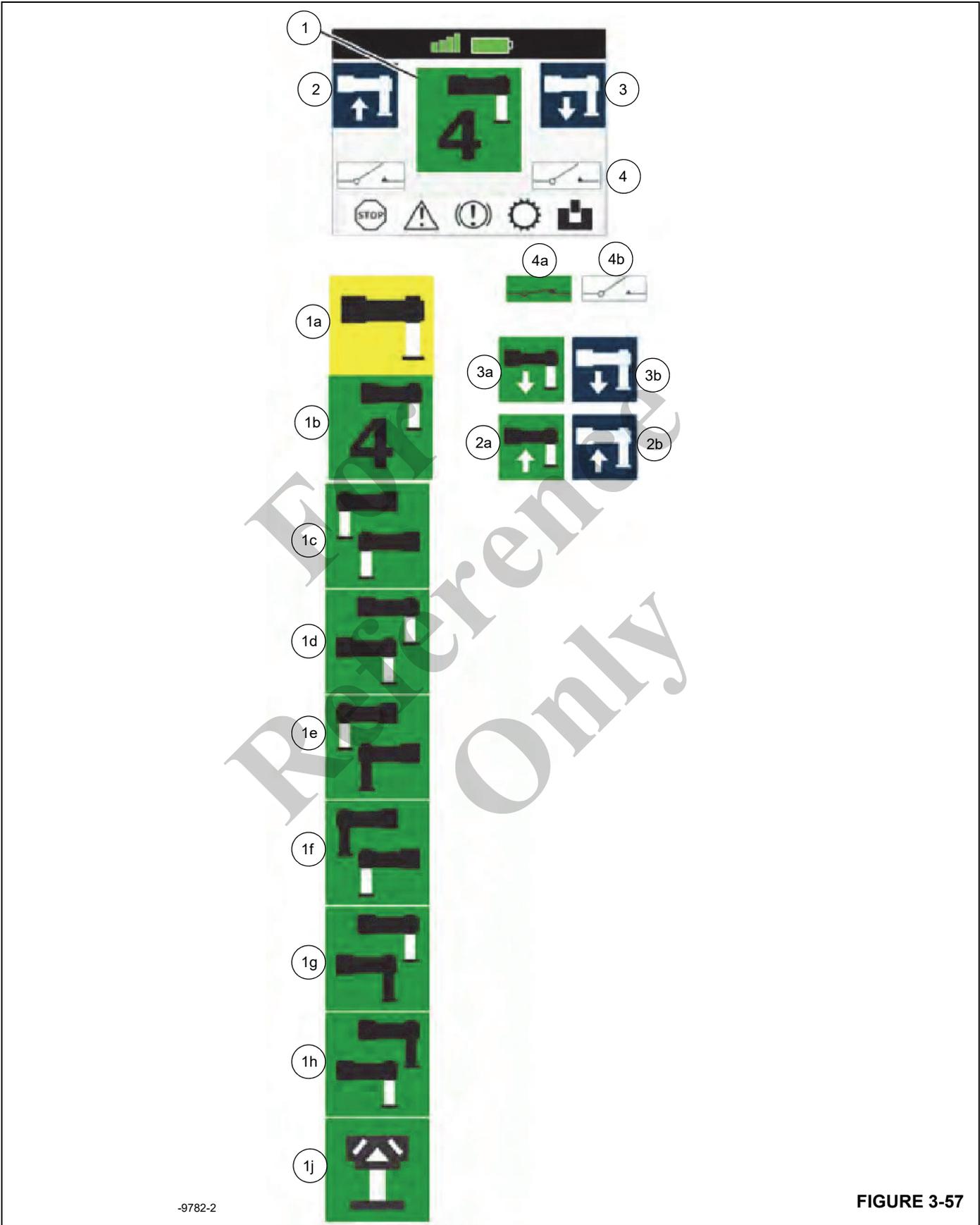
**NOTE:** Outrigger controls are only active when the engine is turned on and the park brake is set.

See Figure 3-56 and (Figure 3-50).

1. Press the Outrigger Beams Button(5a), (Figure 3-50) on the remote control as many times as needed until the

desired beam screen (1a through 1g), (Figure 3-56) appears.

2. To RETRACT the selected beams, hold down either enable button and the left motion button at the same time. Release both buttons to stop the beams at the desired position.
3. To EXTEND the selected beams, hold down either enable button and the right motion button at the same time. Release both buttons to stop the beams at the desired position.
4. To exit this screen, press the ESC Button(5f), (Figure 3-50) on the remote control. The main screen appears.



-9782-2

FIGURE 3-57

Table 3-17 Outrigger Jacks Function Screen

Item	Indicator Name	Description
1	Outrigger Jacks Function	1a - Yellow = jacks cannot be operated due to a crane fault 1b - All four jacks will be operated at same time 1c - Both left side jacks will be operated 1d - Both right side jacks will be operated 1e - Left front jack will be operated 1f - Left rear jack will be operated 1g - Right front jack will be operated 1h - Right rear jack will be operated 1j - Front (stabilizer) jack will be operated
2	Retract Jack	2a - Green = jacks can be retracted with left motion button 2b - Blue = jacks cannot be retracted until either enable button is held down
3	Extend Jack	3a - Green = jacks can be extended with right motion button 3b - Blue = jacks cannot be extended until either enable button is held down
4	Enable Button Status	4a - Green = either enable button held down (operation enabled) 4b - White = both enable buttons released (operation disabled)

**NOTE:** The top of the remote control corresponds to the front of the crane (carrier cab is at front). The terms left and right correspond to the operator’s left and right sides when looking forward from the front of the crane.

time. Release both buttons to stop the jacks at the desired position.

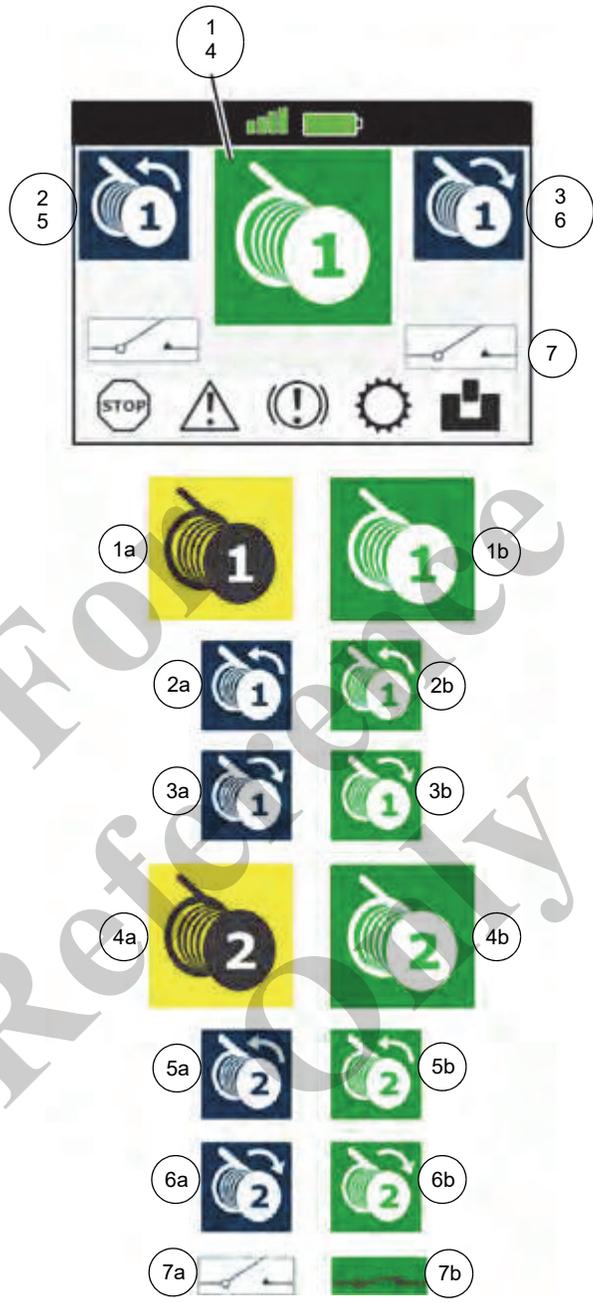
**Outrigger Jacks**

See (Figure 3-57) and (Figure 3-50).

1. Press the Outrigger Jacks Button(5b), (Figure 3-50) on the remote control as many times as needed until the desired jack screen (1a through 1j), (Figure 3-57) appears.
2. To RETRACT the selected jacks, hold down either enable button and the left motion button at the same

**NOTE:** The front jack will retract any time a main outrigger jack is retracted.

3. To EXTEND the selected jacks, hold down either enable button and the right motion button at the same time. Release both buttons to stop the jacks at the desired position.
4. To exit this screen, press the ESC Button(5f), (Figure 3-50) on the remote control. The main screen appears.



-9782-3

FIGURE 3-58

Table 3-18 Main/Aux Hoist Function Screen

Item	Indicator Name	Description
1	Main Hoist Function	1a - Yellow = main hoist cannot be operated due to a crane fault 1b - Green = main hoist can be operated
2	Let Out (lower)	2a - Blue = main hoist cannot be operated until either enable button is held down 2b - Green = wire rope can be payed out from main hoist with left motion button
3	Reel In (hoist)	3a - Blue = main hoist cannot be operated until either enable button is held down 3b - Green = wire rope can be hauled in on main hoist with right motion button
4	Aux Hoist Function (Optional)	4a - Yellow = aux hoist cannot be operated due to a crane fault 4b - Green = aux hoist can be operated
5	Let Out (lower)	5a - Blue = aux hoist cannot be operated until either enable button is held down 5b - Green = wire rope can be payed out from aux hoist with right motion button
6	Reel In (hoist)	6a - Blue = aux hoist cannot be operated until either enable button is held down 6b - Green = wire rope can be hauled in on aux hoist with right motion button
7	Enable Button Status	7b - White = both enable buttons released (operation disabled) 7a - Green = either enable button held down (operation enabled)

**Hoist Control (Main and Aux)**

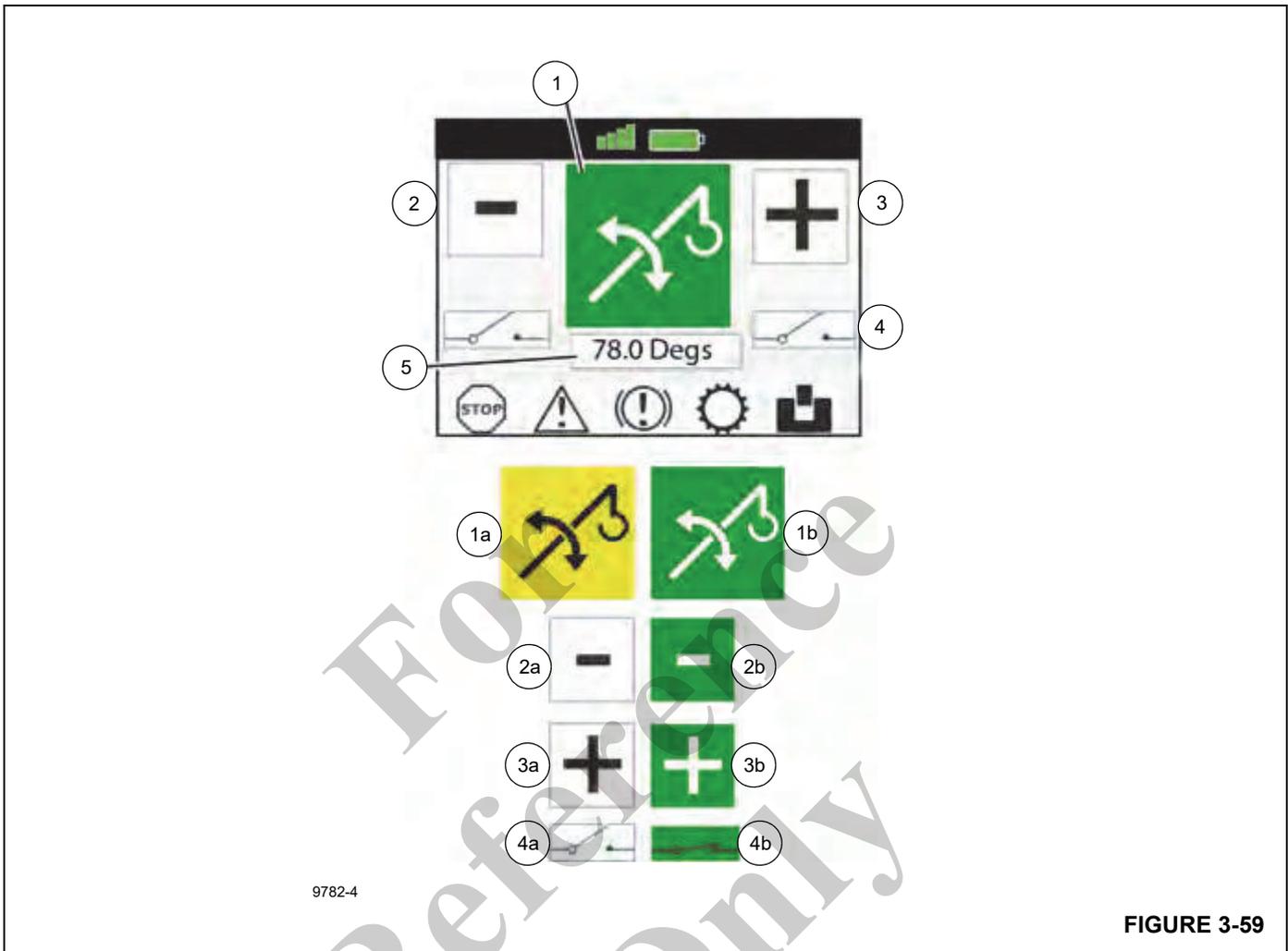
See (Figure 3-58) and (Figure 3-50).

1. Press the Hoist Button(5j), (Figure 3-50) on the remote control ONCE. The main hoist screen appears.
2. Press the Hoist Button on the remote control TWICE. The Aux Hoist Screen appears.

**NOTE:** The Main Hoist Screen (5j), (Figure 3-50) is the default.

Speed in either direction is proportional to how far the motion button is depressed.

3. To LET OUT wire rope from the selected hoist, hold down either enable button and the left motion button at the same time. Release both buttons to stop the hoist.
4. To REEL IN wire rope on the selected hoist, hold down either enable button and the right motion button at the same time. Release both buttons to stop the hoist.
5. To exit this screen, press the ESC Button (Figure 3-50) on the remote control. The main screen appears.



9782-4

FIGURE 3-59

Table 3-19 Boom Lift Function Screen

Item	Indicator Name	Description
1	Boom Lift Function	1a - Yellow = boom cannot be operated due to a crane fault 1b - Green = boom can be operated
2	Boom Down	2a - White = boom cannot be operated until either enable button is held down 2b - Green = boom can be lowered with left motion button
3	Boom Up	3a - White = boom cannot be operated until either enable button is held down 3b - Green = boom can be raised with right motion button
4	Enable Button Status	7a - White = both enable buttons released (operation disabled) 7b - Green = either enable button held down (operation enabled)
5	DEG Screen	Shows the boom angle in degrees

## SECTION 4 OPERATING PROCEDURES

### SECTION CONTENTS

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For Reference Only

## PRE-STARTING CHECKS

A complete walk-around visual inspection of the crane should always be made with special attention to structural damage, loose equipment, leaks, or other conditions that would require immediate correction for safe operation.

The following items are suggested to be checked to make sure the crane is prepared for starting the day's work.

### Fuel Supply

Fill fuel tank and make sure cap is on tight.

### Fuel System Description

The fuel system consists of the fuel tank, DEF tank, fuel-water separator, and secondary filter. The DEF tank and fuel-water separator are not mounted on the engine.

#### Fuel Tank

The fuel tank is an aluminum cylinder-type tank located on the left side of the machine. The tank is equipped with a non-vented filler cap, chain-attached to the tank and a fuel quantity sender unit which provides a signal to a fuel quantity gauge on the instrument panel in the cab.

The fuel tank should be kept filled, especially overnight, to reduce condensation to a minimum.

#### Fuel Filter-Water Separator

The fuel filter-water separator removes impurities from the fuel and also removes water from the fuel before it reaches the engine. The filter is mounted near the fuel tank on the left side of the crane.

The water in fuel sensor is located in the fuel filter housing. Once the storage space in the bottom of the filter housing fills with a certain amount of water, the sensor will signal the ECM. The Water In Fuel Lamp will illuminate at the operator controls, indicating that the water should be drained from the fuel filter assembly.

#### Draining

---

### CAUTION

Fuel is considered a Hazardous Material.

---

The sump of the fuel filter-water separator should be drained daily, 30 minutes after the engine is shut down, to remove any water and sediment. Adhere to the following procedure.

1. Open the drain plug.
2. Drain until fuel appears.
3. Close the drain plug.

## Diesel Exhaust Fluid (DEF) Supply

Check Diesel Exhaust Fluid (DEF) level and make sure cap is on tight. Level is checked on Control Panel Indicator in carrier cab and ODM in superstructure cab.

### Engine Oil

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### 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 engine coolant level sight gauge located in the surge tank and fill to the proper level. Do not overfill. Make sure radiator cap is secure.

### Batteries

Check battery cables and clamps are tight and not corroded.

### Hydraulic Reservoir and Filter

Check hydraulic level sight gauge and filter condition indicator on the hydraulic tank. Hydraulic fluid should be at normal operating temperature, with boom and outriggers in a retracted position, and boom level.

Check breather for cleanliness and make sure it is secure.

### Hoist Rope

Inspect hoist rope in accordance with applicable Federal Regulations. Sheaves, guards, guides, drums, flanges, and any other surfaces that come in contact with the rope should be inspected for any condition that could cause possible damage to the rope.

### Hook Block and Overhaul Ball

Inspect for nicks, gouges, cracks, and evidence of any other damage. Replace a hook that has cracks or shows evidence of excessive deformation of the hook opening (including twist). Be sure safety latch is free and aligned.

### Seats and Mirrors

Adjust seat and mirrors for clear vision and safe driving.

## Seat Belt

### 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. Be sure to check the seat belt warning light in the carrier cab and also check the seat belt latching and unlatching.

### 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.

## Signal and Running Lights

Check all signal and running lights for proper operation. Replace burned out lamps with those of the same number, or equivalent.

## Service and Parking Brakes

Check for proper operation. The Parking Brake Control (Figure 4-1) is located on the right side of the front console. The control is a push-pull type air valve used to apply and release the parking brakes on all four rear wheels. Push to release the parking brakes, pull to apply the parking brakes.



FIGURE 4-1

## Anti-lock Braking System (ABS)

Check for proper operation. The crane has a standard brake system, equipped with an electronic speed monitoring and control system, Anti-Lock Brake System (ABS). ABS monitors wheel speed continuously but is not involved in controlling the wheel speed unless there is a reduction in traction. In normal braking applications, the standard air brake system is in effect. See *Anti-lock Braking System (ABS) Indicator*, page 3-13.

There is a sensor installed in each wheel. Since this is a three-axle crane, all axles are monitored. The sensors transmit information to the EC-60™ Premium electronic control unit (ECU). The ECU interprets the signals and calculates wheel speed, wheel retardation and a crane reference speed. If the calculations indicate a wheel lock-up situation, a signal is sent from the ECU to the appropriate ABS modulator valve to reduce braking pressure. During emergency braking, the modulator valve alternately reduces, increases or maintains air pressure in the brake chamber to prevent wheel lock-up.

During emergency or reduced-traction stops, fully depress the foot brake pedal until the crane comes to a safe stop. DO NOT PUMP the brake pedal. With the brake pedal fully depressed, the ABS will control all wheels to provide steering control and a reduced braking distance.

Although the ABS improves crane control during emergency braking situations, the operator still has the responsibility to change driving styles depending on the existing traffic, road and/or weather conditions. For example, the ABS cannot prevent an accident if the driver is speeding or following too closely on slippery surfaces.

The ABS control unit contains a self-testing program that is engaged each time the ignition is turned on. The operator can verify the testing by listening for the burst of air from the ABS modulator valves actuating twice in series. To increase the sound, hold down the foot brake pedal when the ignition is turned on. The self-test is not finished and the indicator will stay on until the brake pedal has been pressed. The wheel speed sensors are tested when the crane starts to move.



### CAUTION

If the ABS indicator comes on during driving or does not go out after a short time after turning on the ignition, take the crane to a Grove distributor to repair the ABS or brake system. The crane will not have full function of the ABS system making it harder for the crane to stop which could cause moderate to minor injury.

## ABS Power-Up Sequence

When ignition power is applied, the ECU will illuminate the ABS indicator lamp (15), (Figure 3-5), for approximately three seconds, after which the lamp will extinguish if no diagnostic trouble codes are detected.

The ECU will cause the ABS indicator lamp to remain on whenever full ABS operation is not available due to a diagnostic trouble code. Refer to the *Anti-lock Braking System/Automatic Traction Control (ABS/ATC) Switch*, page 3-9.

## ABS Switch Operation

The ABS/Traction Control Indicator (3), (Figure 3-5) is used to diagnose system problems along with blink codes displayed on the ABS Indicator. Refer to the ABS Traction Control Indicator, page 3-12.

## Tires

Check for severe cuts, foreign objects embedded in treads, and for correct inflation pressures. A tire inflation chart providing the correct air pressures are located in the Load Chart Manual in the crane cab and carrier cab on the Tire and Rim Information decal.

## Wheels

Maintain proper torque on wheel lugs and check for proper wheel mounting. If equipped with steel or aluminum wheels, re-torque wheels 80 to 160 km (50 to 100 mi) 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 800 km (500 mi) thereafter.

## Accessories

Check all lights, windshield wipers, washers, washer liquid supply, horn, fire extinguisher, instruments, signaling devices, and so on.

## Daily Lubrication

Make sure all components requiring daily lubrication have been serviced. Refer to *Lubrication*, page 5-1.

## Air Cleaner

Check filter and tubing for security.

## Preload Check

After crane has been readied for service, an operational check of all crane functions should be performed. Refer to *Craning Functions*, page 4-26 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.

---

Perform Steps 1 thru 4 with no load applied.

1. Fully 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 75°, 35°, and 0° boom angles, 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.
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°.



### 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*.

After performing these basic load functions, it is best to properly tension hoist rope on the hoist before performing normal operations.

## Using Your Load Chart

**NOTE:** One of the most important tools of every Grove crane is the load chart in the crane operator's cab.

**NOTE:** Refer to the Example in Figure 4-4 for terms to know in determining lifting capacities. To view an example load chart, refer to (Figure 4-2).

The load chart example (Figure 4-2) 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 allowable load limit for that load radius and boom length. The number in parentheses below the total load limit is required boom angle (in degrees) for that load.

Another important section is the range diagram. (Refer to example in Figure 4-3). 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.

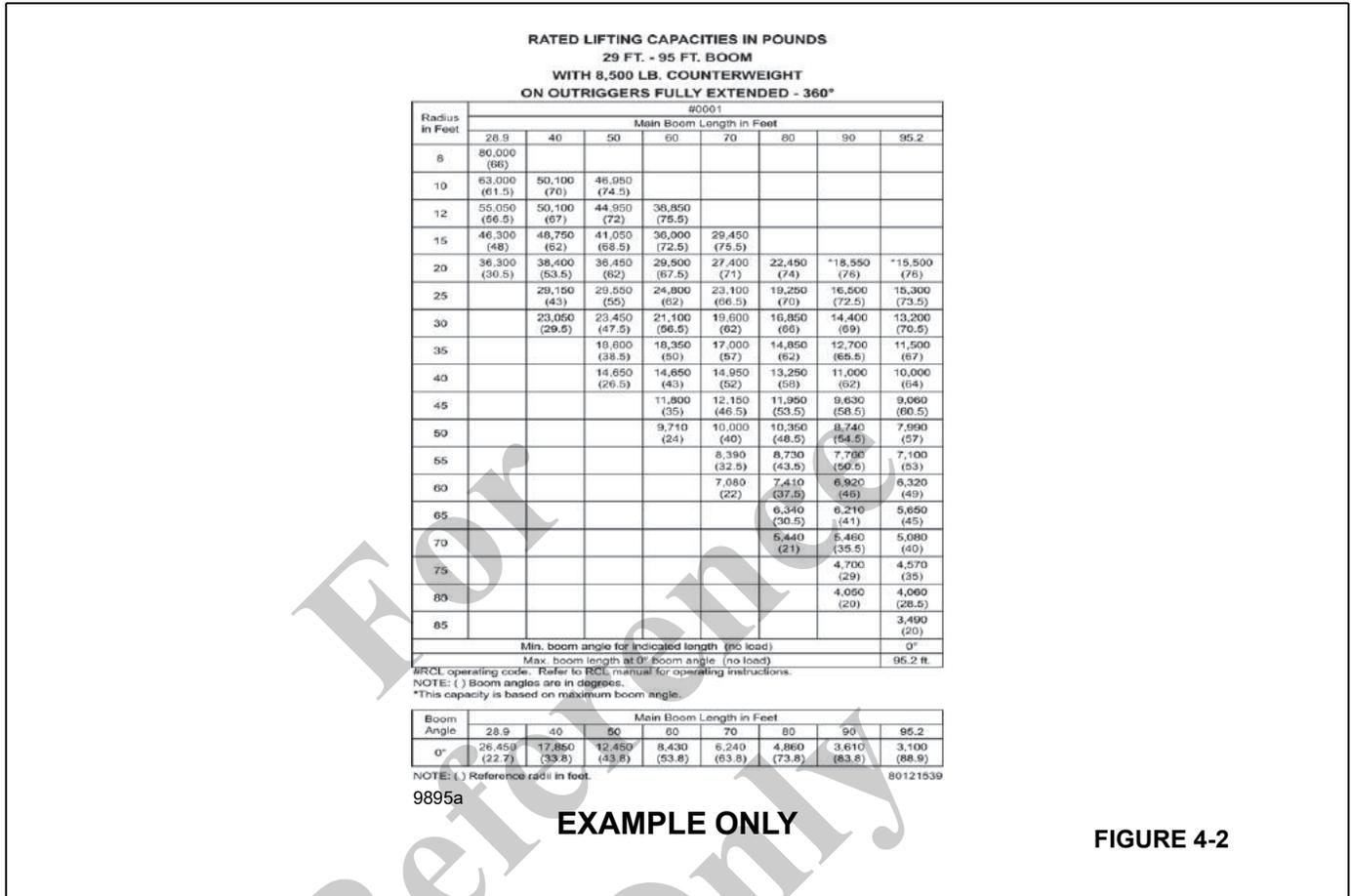
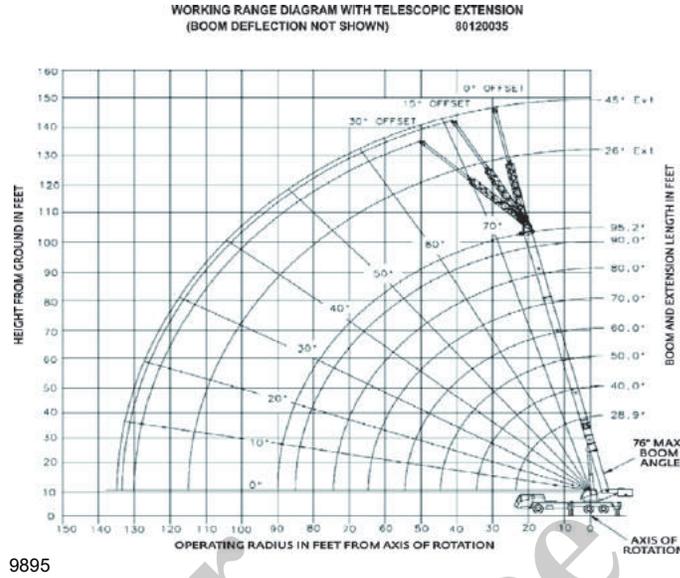
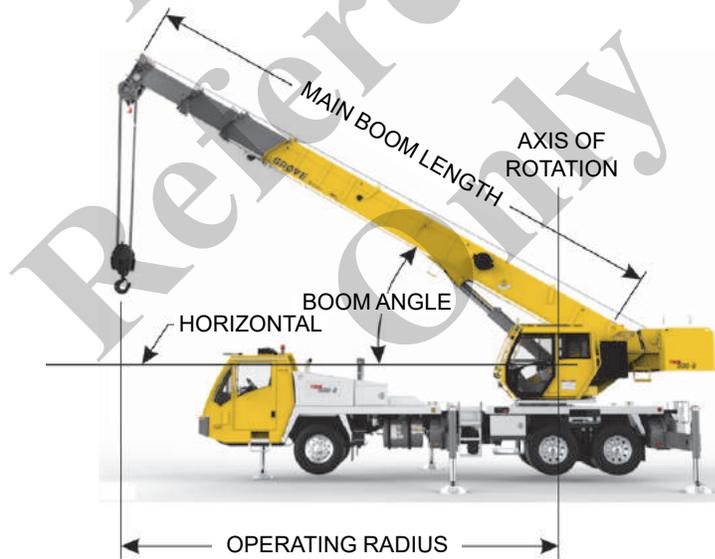


FIGURE 4-2



EXAMPLE ONLY

FIGURE 4-3



TERMS FOR REFERENCE

EXAMPLE ONLY

FIGURE 4-4

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.

The load chart also gives weight reductions for Grove load handling devices such as hook blocks, overhaul balls, and boom extension sections, 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.

**NOTE:** **Figures 4-2 and 4-3 are SAMPLE Charts ONLY. They are only examples of what the two charts look like.**

**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.

## 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).

### 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 (1) (Figure 4-5) is in the ON position.



FIGURE 4-5

5. Make sure emergency stop switch is not pressed.-

**NOTE:** There are three emergency stop switches: one located on each side of the carrier and one in the Superstructure cab.

6. Make sure the parking brake is set to the APPLY position when starting from the cab.
7. When starting from the carrier cab make sure 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.

8. When starting from the Superstructure cab, make sure the transmission shift lever is positioned to Neutral.
9. Turn ignition switch to the RUN position (first position).

The Engine Warning Indicator and the Engine Stop Indicator (refer to *Alert Icons*, page 3-39) will come on and go off in sequence after approximately two seconds (as a check).

If the Engine Wait-to-Start Indicator 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.

10. Sound horn by pressing button on right controller or by pressing the center of the steering wheel.
11. Turn the ignition switch to START position (far right position) and release immediately when the engine starts.

**NOTE:** Do not push or hold the throttle down. The Engine Control Module (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.

---

12. Warm up engine and all crane components following the procedures under *Crane Warm-up Procedures*, page 4-12.

### Idling 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 1200 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 Engine*, page 4-10.

To reduce these adverse effects, the crane control system will automatically increase the engine idle speed (when this

feature is enabled) 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 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

#### *When to Manually Clean the Exhaust System*

The Diesel Particulate Filter (DPF) Clogged Indicator (refer to *Alert Icons*, page 3-39) is located on the front console of the carrier cab and also in the Operator Display Module (ODM). This indicator comes on (amber) when the exhaust system requires cleaning. See *High Exhaust System Temperature Indicator*, page 3-14.

When the DPF Clogged indicator comes on or flashes, start the manual cleaning process at the next opportune time.

The indicator will come 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 will come on in addition to the Diesel Particulate

Filter Clogged 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.

### Initiating the Manual Exhaust Cleaning Process

To manually clean the exhaust system, do the following:

#### **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. Set transmission lever to the neutral position.
4. Engage the crane parking brake,
5. Release the brake and throttle pedals.
6. With engine idling, press the top of the Exhaust System Cleaning Initiate Switch (refer to *Exhaust System Cleaning Initiate Switch*, page 3-9) to start manual cleaning.

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.

Pressing the brake or throttle pedal during cleaning or pressing the bottom (Inhibit Manual Cleaning) of the Exhaust System Cleaning Switch will interrupt the manual cleaning process.

Make sure the crane and surrounding area are monitored during manual cleaning. If any unsafe condition occurs, shut off engine immediately.

Engine will return to normal idle speed when the manual cleaning process is complete.

### Inhibiting the Exhaust System Cleaning

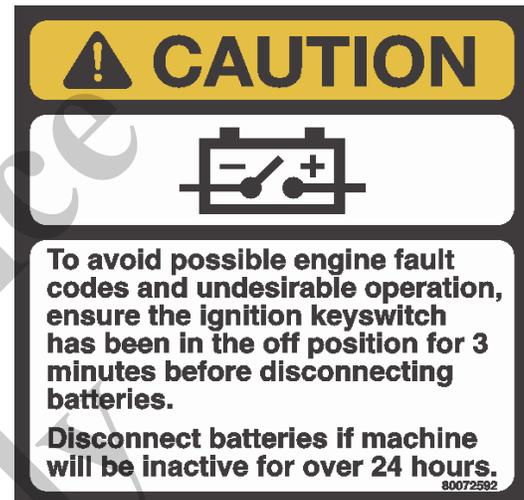
To inhibit or prevent the exhaust system entering the active cleaning mode or to stop the exhaust cleaning process that was manually initiated, press the bottom of the Exhaust System Cleaning Initiate Switch (refer to *Exhaust System Cleaning Initiate Switch*, page 3-9). The Inhibit Exhaust System Cleaning Indicator, is located on the front console of the carrier cab and also on the Operator Display Module

(ODM), will come on (amber) and the active and manual modes of exhaust system cleaning are prevented.

### 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. Set ignition switch to OFF position.
3. Drain fuel filter-water separator. See *Fuel Filter-Water Separator*, page 4-4

### Battery Disconnect



Battery disconnect switch is located on the rear of the battery box on the left side of the crane, behind the exhaust system compartment. To disconnect batteries, turn battery disconnect switch to the OFF position. Turn switch to the ON position to connect batteries.

### 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 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 4-12. For proper cold weather lubricants, refer to the section *Arctic Lubricants and*

*Conditions, page 5-5 and Cold Weather Lubricants, page 5-5.*

If in doubt of suitability for a specific fluid or lubricant, check with an authorized Grove distributor or Manitowoc Crane Care. Cranes should have appropriate hydraulic oil, lubricants, and other auxiliary items required for operation in -sub-zero temperatures. Individual crane functions should be operated to ensure they are sufficiently warmed prior to performing a lift. Operation of cranes at full rated capacities in temperatures between -18°C (0°F) and -29°C (-20°F) should be accomplished only by competent operators who possess the skill, experience, and dexterity to ensure smooth operation. Shock loading shall be avoided.

**NOTE:** Contact your local distributor or Manitowoc Crane Care to determine requirements and lift solution for operation down to -40°C (-40°F).

Grove recommends the crane be equipped with the following cold weather accessories:

#### Down to -29°C (-20°F)

- Battery heater
- Fuel line heater
- Engine hood insulation
- Fan clutch
- Radiator air shutters
- Air diverter
- Diesel-fired cab heater
- Cold weather alternator
- Fluids suitable to -29°C (-20°F) (Refer to *Cold Weather Lubricants, page 5-5.*)

#### Auxiliary Cab Heater (Optional)

The Superstructure 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.

Refer to *Superstructure Overhead Control Panels, page 3-19*

To heat the operator's cab, activate the auxiliary diesel heater and adjust temperature control switch mounted in the overhead panel. The heating system fan delivers warm air into an air distribution box. Air is circulated according to control settings and then delivered into the cab by a fan through various air extraction and air delivery vents.

Do not cover vents with bags, articles of clothing or any other objects. Keep hot air inlet and hot air outlet free of dirt and foreign material. Soiled or blocked hot air lines may cause overheating, and result in damage.

The crane auxiliary cab heater can be operated when engine is running or stopped as part of the programmable auxiliary

heating system. Maximum cab temperature is achieved by running only the auxiliary heater and using the standard cab heater fan when engine is sufficiently warmed up. The standard hot water crane cab heater can also be turned on after engine has started and is warmed to operating temperature.

**NOTE:** When using heater at high altitudes, factory heater setting must be re-calibrated for proper heater operation.

- Heating at altitudes up to 1,500 m (4,900 ft)  
Unlimited heating is possible
- Heating at altitudes over 1,500 m - 3,000 m (4,900 ft - 9,900 ft):

Heating is possible for short periods at this altitude (example: driving over a mountain pass or taking a break while traveling between job sites).

During longer stays, (example: construction job project), the fuel supply must be adjusted to the altitude or the heater will malfunction. This can be done by installing an air pressure sensor kit (Grove part number 90037674). Contact an authorized Grove distributor or Manitowoc Crane Care for additional assistance.

**NOTE:** Accelerated discharging of battery will occur when crane engine is switched off. If heater is operated with crane engine stopped, batteries will need to be recharged after a short period of time.

#### 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.

---

### 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.

---

#### CRANE WARM-UP PROCEDURES

The following procedures must be followed to properly warm different crane components before operating 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 the Lubrication section of your crane's *Operator Manual*, by contacting your local Grove distributor, or by contacting Manitowoc Crane Care directly). Refer to *Standard Lubricants*, page 5-3.

## 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 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.

## Hydraulic Oil System

### Operating Limits and Warm-up Procedures:

- **Hydraulic Oil Temperatures from 4°C to -10°C (40°F to 15°F):** Crane operation without a load is allowed with medium engine RPM 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 with a load is allowed with medium engine RPM 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. For proper cold weather lubricants, refer to the section *Arctic Lubricants and Conditions*, page 5-5.

## Hoist

Warm-up procedures are recommended at every startup and required at ambient temperatures below 4°C (40°F).

### Warm-up Procedures:

1. Without operating the hoist function, warm the hydraulic oil (see *Driving the Crane*, page 4-14).
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.

## 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):

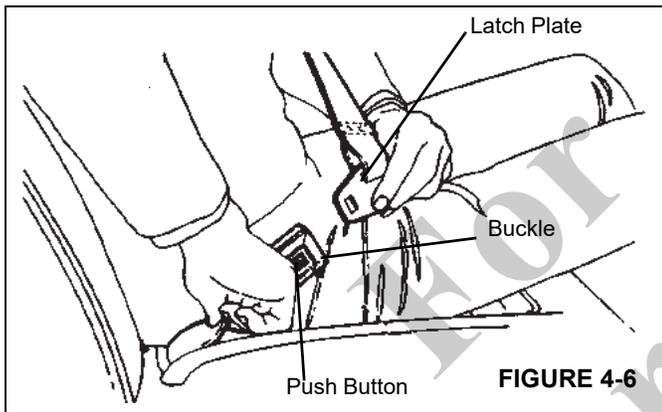
1. Setup crane on outriggers.
2. Release the parking brake.
3. Engage transmission and allow crane to run at idle until transmission sump temperature reaches normal operating temperature and re-apply parking brake.

**! DANGER**  
**Roll Hazard!**

When operating the outrigger controls, as a precaution to keep the crane from rolling, apply the parking brake. The parking brake should be set before lowering the crane back to the ground.

**DRIVING THE CRANE**

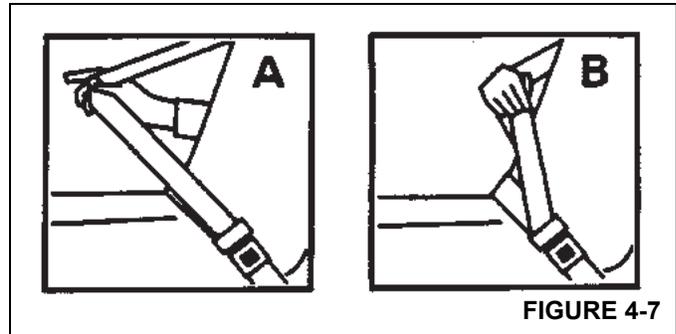
**Seat Belts**



1. Before fastening a seat belt, always adjust driver's seat to position in which you will drive.
2. Pull belt across your lap and push latch plate into buckle until it clicks (Figure 4-6).
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 so the retractor can take up the slack.

**NOTE:** The lap/shoulder belt is designed to lock only during a sudden stop or impact. At other times it should move freely.

4. If the shoulder belt is too snug, do the following:
  - a. Pull the shoulder belt out (A) at least 130 mm (5 in) so that when it is let go, it returns to your chest (Figure 4-7).
  - b. Then pull down on the shoulder belt (B) the least amount needed to ease pressure but no more than 25 mm (1 inch) and let go.



5. To reduce slack in the belt, pull the belt out as you did in Step 4.a.

**! DANGER**

Keep any shoulder belt slack to a minimum, no more than 25 mm (1 inch). Belt slack beyond the specified amount could significantly reduce the amount of protection in an accident because the belt is too loose to restrain you as intended.

To unfasten the belt, push in on the button in the center of the buckle. To store the belt, pull out about 180 mm (7.1 in) and let go. The belt should retract when the buckle is unlatched. To help prevent damage to the seat belt and interior, before closing the door be sure the belt is fully retracted and the latch plate is out of the way.

**Traveling — General**

When driving on roadways, the operator must follow all applicable regulations and/or restrictions.

**! WARNING**

**Accidental Operation Hazard!**

Before traveling, if any crane functions were enabled in the Superstructure Cab, 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.

**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 bottomed. At a minimum, position boom to horizontal.

Fully retract outrigger jacks and properly store pads.

Disengage pumps (if applicable) for extended traveling.

**Securing the Superstructure For Travel**

Do not move the crane until the superstructure has been secured as outlined below:

- Make sure outrigger beams and jacks are fully retracted with pads properly stowed.

If on a jobsite, conduct all travel with the assistance of a ground person to warn the operator of any changing conditions in the terrain being traversed.

**WARNING****Tipping Hazard!**

Avoid holes, rocks, extremely soft surfaces, and any other obstacles which might subject crane to undue stresses or possible overturn.

Center boom over front, disable swing functions, and engage Turntable Lock Pin.

Fully retract boom. Make sure swingaway jib is properly stowed and secured.

**CAUTION**

Check cold tire pressure daily. Refer to tire inflation decal on crane.

Job site travel with deflated suspension must be limited to 8 km/h (5 mph). Attempting to travel at higher speeds may cause drive train component failure.

- Make sure that the axles and/or suspension are not overloaded.
- Be sure that all boom sections are fully retracted or set to whatever extension is necessary for a balanced load on the axles.
- Make sure that the boom is fully lowered into the boom rest.

**NOTE:** When lowering the boom into the rest, once at 10 degrees, make sure that the turntable lock pin is fully engaged before proceeding to set the boom into the rest.

- If equipped, engage the optional 360° swing lock.
- Make sure that the swingaway, if so equipped, is properly stowed and secured.
- Remove the hook block or overhaul ball from the hoist rope and stow securely before traveling or make sure the overhaul ball is properly secured to the tie down provided for that purpose.
- Close all superstructure cab windows and lock the door.

**Securing the Carrier for Travel**

- Make sure that the outrigger jacks and outrigger beams are fully retracted and the floats are removed.
- Make sure that the outrigger floats are properly stowed in their holding racks.
- Make sure that the center front jack is fully retracted.
- Make sure that the cover doors on the sling boxes are closed.

**Tie-Down Procedure for Hook Block**

Do not travel with an empty hook in a position where it can swing freely (except where noted). Remove the hook block and/or overhaul ball from hoist rope and stow securely or make sure the hook block or overhaul ball is properly secured to the tie-down provided for that purpose.

**WARNING**

Ensure that the hook block does not block the operator's vision for driving when attached to the front bumper.

To attach the hook block or overhaul ball:

**NOTE:** For the 102' boom:

6. Hoist down so that there is enough slack to hold the hook block to the retaining rope.
7. Operator will manually position the ball just in front of the tie-down point that is attached to the bumper.
8. Latch the ball to the tie-down point (1), (Figure 4-8) and hoist up to remove slack.
9. Make sure that the boom is in the boom rest.

**NOTE:** For the 95' boom: Extend the boom to 34.25 ft, then hoist down to get some slack and connect to the retaining rope, then hoist up to remove slack.



FIGURE 4-8

**NOTE:** If the anti-two block switch is deactivated while you tighten the hoist rope, you can override the lockout of the anti-two block switch, refer to *Hoist Bypass Switch*, page 3-25.

### CAUTION

#### Wire Rope Damage!

Ensure that the hook block being used has sufficient overhaul weight to prevent the hoist rope from becoming slack when operating with no load on the hook.

## 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. 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 drive train 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.
- Make sure boom is fully retracted.
- 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.
- 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

If being towed or pulled, Grove recommends connecting to the pintle hook on back of crane for towing backwards or using the tow cable under the front bumper for towing forward or when being towed by another vehicle.

**NOTE:** Do not use the lugs on the front bumper for pulling or towing. These are for the Hookblock tie-down only.

### 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 the boom is in a horizontal position and not elevated above 0°.
- Make sure the outrigger beams and jacks are fully retracted with pads properly stowed.

To avoid severe damage to drive train while crane engine is disabled:

- Disconnect drivelines.
- Disengage parking brake by inserting release bolt, which is stowed on the chamber housing, into center hole of chamber and engage into piston until locked. Turn release nut clockwise until (Figure 4-9) until axle turns free.

**NOTE:** Return release bolt to chamber housing for stowage when towing operation is accomplished.



### DANGER

#### Run-away Crane Hazard!

Disabling parking brake may result in crane rolling away freely without the ability of the operator to stop the crane.

Make sure that the crane is attached to an adequately sized tow vehicle before disabling the parking brake.

Death or serious injury and damage to machinery could result from moving machinery.



- Secure steering to prevent turning while towing.
- Conduct all travel with assistance of a ground person to warn operator of any changing conditions in terrain being traversed.

### Traveling on Slopes

Crane operators must exercise caution whenever operating the crane on uneven surfaces. Travel on slopes is permitted if the following conditions are met.

#### General Conditions

- Travel must be on an improved surface or hard-packed dry earth. Crane operators are required to inspect the surface for good tire adhesion.
- All boom sections must be fully retracted.
- Boom extension must be in stowed position or removed from the crane.
- Boom must be positioned over the front of the crane. Boom angle must be limited to horizontal (0°).
- Swing brake must be applied and turntable lock pin engaged.
- Either the hook block may be reeved over the main boom nose, or the overhaul ball may be reeved over the main boom nose or auxiliary boom nose; the other must be removed. If hook block or overhaul ball remains reeved on the boom, it must be secured at the tie down on the carrier to prevent swinging.
- Tires must be inflated to the recommended pressure for pick and carry operations.
- 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 must be filled to the specified levels.

- No loads may be supported by the boom (for example, 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 12% (6.8°), follow the normal crane travel procedures outlined in this manual.
- Use wheel chocks when parking on slopes greater than 15% but less than 25%. Do not park crane on a slope equal to or greater than 25% (14°).
- Travel on a fore/aft slope, 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 slope limitations when traveling with an elevated boom or an erected boom extension and inserts, refer to the specific traveling instructions in this section.

#### **Slope Limitations - Side Slope Travel**

- Side slope shall not exceed 10% (5.7°).

Operator should carefully consider the conditions and travel at the appropriate speed given these conditions.

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 US LLC for further guidance.

#### **Traveling with Boom Extension Erected**

**NOTE:** Travel with the stinger extended 13.7 m (45 ft) extension length is **NOT** permitted.

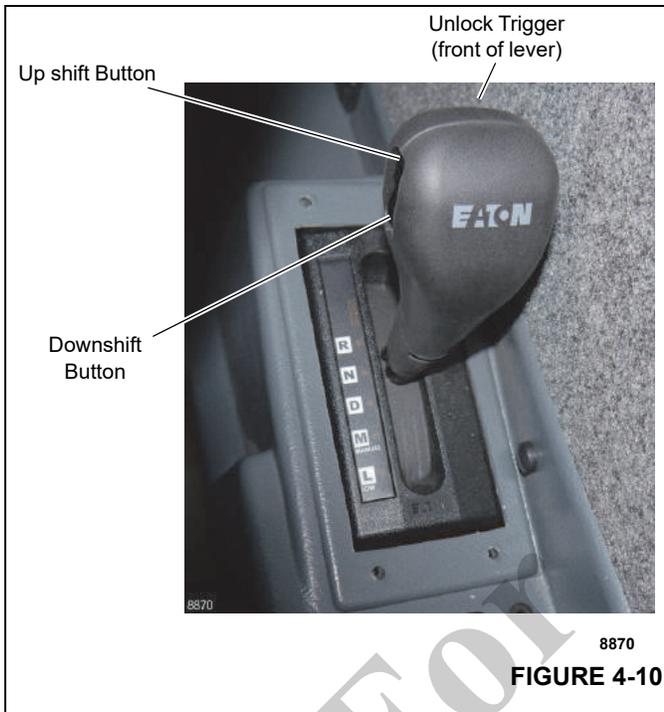
#### **For 7.9 m (26 ft) Boom Extension**

Travel is permissible under the following conditions:

- The 7.9 m (26 ft) boom extension shall be erected at minimum offset. The stinger section must be fully retracted and pinned in the extension base section.
  - The main boom shall be fully retracted.
  - The auxiliary hoist or IPO counterweight must be installed.
  - The tires shall be inflated to the appropriate pressure for pick and carry operation.
  - The hook block must be removed from the main boom nose.
  - The overhaul ball may be reeved over the boom extension, hanging 0.9 m (3 ft) below the sheave.
  - Jobsite travel must be in the forward direction only, on a firm level surface.
  - The maximum travel speed: 2.4 km/h (1.5 mph). This is equivalent to 1500 Engine RPM, with the transmission in first gear and forward direction. (Speed must be limited to ensure that excessive bouncing or swinging of the overhaul ball is avoided.)
  - The following counterweight/boom configuration can be used:
    - With the boom over the front, with or without any counterweight installed, the main boom elevation angle must be from 0 to 30 degrees.
    - With the boom over the rear, with the 3856 kg (8500 lb) or 2268 kg (5000 lb) counterweights installed, the main boom elevation angle must be from 0 to 10 degrees.
- NOTE:** The full 8500 lb counterweight must always be used with the 102' boom. The 95' boom can be used with the various counterweight options as noted.
- With the boom over the rear, without any counterweight installed, the main boom elevation angle must be from 0 to 30 degrees.
  - The swing lock and house lock pin shall be engaged.
  - Suspension air bags shall be inflated.

#### **Automated Transmission**

The automated transmission has eleven speeds forward and three speeds reverse. The shift lever (Figure 4-10) has five positions; Reverse, Neutral, Drive, Manual, and Low. The unlock trigger must be pressed to shift the lever. It has an up shift/downshift button to be used when in the manual or reverse modes.



8870  
**FIGURE 4-10**



**WARNING**

Do not release the parking brake or attempt to select a gear until the air pressure is at least 827 kPa (120 psi).

**NOTE:** If engine cranks in any gear other than neutral, service vehicle immediately.

Before working on a vehicle, parking the vehicle, or leaving the cab with the engine running, place the transmission in neutral, set the parking brakes, and block the wheels.

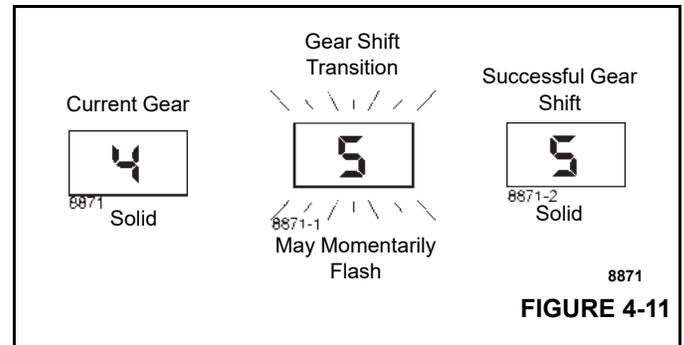
For safety reasons, always engage the service brakes prior to selecting gear positions from "N".

**CAUTION**

Battery (+) and (-) must be disconnected prior to any type of welding on any UltraShift® PLUS transmission equipped vehicle.

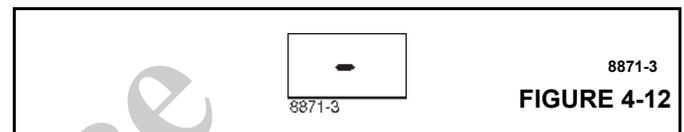
**Gear Display**

The Gear Display, located in the front gauge cluster, indicates the current gear position of the transmission. During an up shift or downshift the gear display may momentarily flash the target gear position (Figure 4-11).



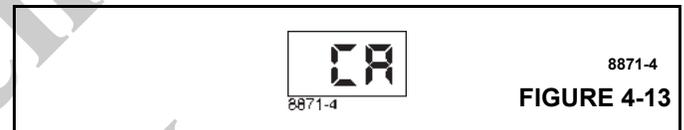
8871  
**FIGURE 4-11**

The "DASH" Figure 4-12 indicates the transmission may be torque locked in gear. See Service Manual for more information.



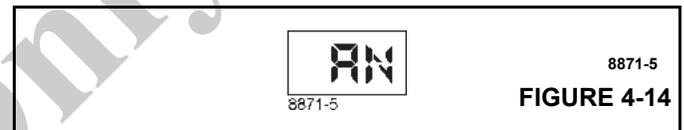
8871-3  
**FIGURE 4-12**

"CA" will appear in the gear display if a clutch abuse event is occurring Figure 4-13.



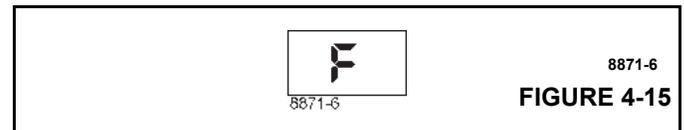
8871-4  
**FIGURE 4-13**

"AN" will appear in the gear display if the transmission goes into Auto Neutral Figure 4-14.



8871-5  
**FIGURE 4-14**

"F" will appear in the gear display if the transmission experiences a fault Figure 4-15.



8871-6  
**FIGURE 4-15**

**Start-up**

1. Turn the ignition key to "ON" and allow the transmission to power-up.

Engine cranking is delayed until the transmission power-up is complete and the gear display shows a solid "N."

2. Start the engine.
3. Apply service brake.

With the Auto-Neutral feature, you need to release the park brake before selecting a gear. Otherwise the transmission will stay in Neutral.

4. Select the desired mode and starting gear on the shift console.

**NOTE:** The transmission will over-ride inappropriate start gear selections to avoid driveline damage.

5. Release the vehicle parking brakes.
6. Release service brake and apply accelerator.

### **Power Down**

1. Select Neutral on the shift control.

If gear display does not show solid "N," neutral has not yet been obtained.

**NOTE:** Neutral should always be reached before the transmission power down is performed except in cases of emergency.

2. Set the vehicle parking brakes.
3. Turn off the ignition key and allow the engine to shut down.

### **Reverse Mode**

- Selects default Reverse gear (see Note).
- Each time Reverse is selected from Neutral, the default Reverse gear is engaged.
- The vehicle will not engage Reverse above 2 mph.

**NOTE:** If the driver attempts to select a non-neutral mode without depressing the service brakes the transmission will not shift into gear and transmission will have to be returned to Neutral. Depress the brakes before selecting the desired mode again.

---

### **CAUTION**

Important: Launching the vehicle in high range increases the likelihood of clutch abuse, and depending on the level of usage, could have a detrimental impact on clutch life.

---

### **Drive Mode**

- Automatically selects the start gear (see Note). The selected start gear will vary depending on several vehicle inputs like load, grade, and axle/transmission ratio. This start gear can be changed by using the up/down buttons, as long as the selection still falls into a gear that would allow the vehicle to launch without allowing the transmission to obtain damage.
- If the start gear is changed using the up/down buttons, it will remain as the default until the vehicle is powered down or the selection is changed with the buttons again.
- Automatically performs all up-shifts and downshift in all gears except 1st and Reverse.

- A shift can be advanced by pressing the up/down buttons when the transmission is near the shift point.
- The transmission may also deny a shift while ascending or descending grades if the load of the vehicle, and grade of the terrain in combination with the drivetrain ratio and engine torque will fall outside of the acceptable range to perform a shift. If the shift is denied it will sound a tone.

**NOTE:** Multiple gear up-shifts and down-shifts may be allowed when the shift buttons are pushed multiple times (Each button push equals one gear change request).

---

### **CAUTION**

Prior to ascending a steep grade the driver should reduce default start gear by one or full throttle is applied for the duration of the grade so the vehicle maintains the proper engine and vehicle speed during the entire grade. Driver can button down by using the down arrow on the shift lever.

**NOTE:** If the driver attempts to select a non-neutral mode without depressing the service brakes the transmission will not shift into gear and the driver will have to return to Neutral and depress the brakes before selecting the desired mode again.

---

### **CAUTION**

If the driver depresses and holds both pedals (even if done accidentally) the launch will be abrupt and the engine and brake forces may rock and bounce the vehicle. Releasing either pedal will stop this immediately.

---

### **MANUAL Mode**

MANUAL mode should be used whenever the driver wants to select the shifts instead of letting the transmission select them automatically. For example, when the driver is moving around the yard, over railroad tracks, or on steep grades.

- Driver manually selects the start gear and uses the up/down buttons to shift (see Note).
- System holds current gear unless otherwise prompted by using up / down-shift buttons, except for the "Transmission Override" conditions noted below.

**NOTE:** Multiple gear up-shifts and down-shifts may be allowed when the shift buttons are pushed multiple times. (Each button push equals one gear change request.)

**NOTE:** For optimal vehicle performance, it is recommended the vehicle be operated in "D" Drive mode.

**MANUAL / Hold Mode**

- The ability to restrict driver use of MANUAL mode is configurable. The default setting for this configuration is “Disabled” which allows standard MANUAL mode operation in all gears.
- When configured the MANUAL mode becomes a Hold gear function only (in other words the up/down buttons have no effect). In addition, provides an alert tone every 10 seconds.
- If the driver has selected MANUAL mode, and the transmission is in a gear equal to or greater than the configured Hold Gear; the transmission will remain in the current gear, up/down buttons are disabled (except for “Transmission Override” conditions).
- Gears lower than the configured hold gear will allow standard MANUAL mode operation.

**CAUTION**

The transmission initiates up-shifts from MANUAL and LOW for engine overspeed protection. Some engines do not use the Eaton engine overspeed protection.

- The system will automatically shift or inhibit shifts to prevent overspeed or underspeed of the engine.
- The transmission may also deny a shift while ascending or descending grades if the load of the vehicle, and grade of the terrain in combination with the drivetrain ratio and engine torque will fall outside of the acceptable range to perform a shift. If the shift is denied it will sound a tone.

**Transmission MANUAL Override**

- If the vehicle back-drives the engine to an overspeed condition, the transmission system will override the MANUAL position and perform an up shift.
- If the start gear is changed and it causes the engine to lug at takeoff, the transmission system will override the MANUAL position and select the best available gear.

**NOTE:** If the driver attempts to select a non-neutral mode without depressing the service brakes, the transmission will not shift into gear and the driver will have to return to Neutral and depress the brakes before selecting the desired mode again.

**CAUTION**

If the driver depresses and holds both pedals (even if done accidentally) the launch will be abrupt and the engine and brake forces may rock and bounce the vehicle. Releasing either pedal will stop this immediately.

**LOW Mode**

LOW mode should be used to maximize engine braking and minimize the use of the brake pedal. For example, when driving down long grades or when coming to a stop.

- Selects lowest available gear for start gear. (see Note). The starting gear cannot be changed in LOW mode.
- If LOW is selected while moving, the transmission will not up shift (except for the Transmission Override conditions noted below). The transmission system will downshift at the earliest opportunity to provide maximum engine braking.

**Transmission LOW Override**

If the vehicle is being back driven and the engine is approaching a higher than normal level, the transmission system will override the MANUAL position and perform an up shift.

**CAUTION**

The transmission initiates up-shifts from MANUAL and LOW for engine over speed protection. Some engines do not use the Eaton engine overspeed protection.

**NOTE:** At higher engine speeds additional engine braking in LOW Mode could cause a loss of traction when on slippery surfaces.

**NOTE:** LOW is the only means to achieve the curbing gear or 1st on the UltraShift PLUS Vocational Multipurpose Series (VMS) mixer models.

**NOTE:** If the driver attempts to select a non-neutral mode without depressing the service brakes the transmission will not shift into gear and the driver will have to return to Neutral and depress the brakes before selecting the desired mode again.

**CAUTION**

If the driver depresses and holds both pedals (even if done accidentally) the launch will be abrupt and the engine and brake forces may rock and bounce the vehicle. Releasing either pedal will stop this immediately.

**Hill Start Aid (HSA) System**

The Hill Start Aid System prevents the vehicle from rolling in an unintended direction for up to 3 seconds when launching the vehicle on a grade.

The Hill Start Aid System defaults to the ON position. It can be turned OFF for a single launch by pressing and releasing the Hill Start Aid switch, refer to *Hill Start Aid (HSA) System*, page 3-9.

When stopped on an incline, the ABS system will apply the brakes on the rear axles. When pulling away again, it will keep the brakes applied until the transmission tells the ABS to release them. The transmission won't tell ABS to release the brakes until it senses the engine has produced enough torque to pull up the incline without drifting backwards. This is done to protect the drivetrain components downstream of the transmission.

## Differential Control Switches

There are two differential switches for controlling the tandem axle differentials, the Inter-Axle Control Switch and the Cross-Axle Control Switch (Optional).

The Inter-Axle Control Switch is used to control the locking capability between the front and rear axles in the tandem set. The switch has two positions, LOCK and OFF.

The Cross-Axle Control Switch is used to control the locking capability between the right and left wheels in the tandem set on the rear-rear axle #3. The switch has two positions, LOCK and OFF.

### CAUTION

Do not engage the Inter-Axle Control Switch or Cross-Axle Control Switch while the wheels are actually slipping or spinning. This will result in damage to the drive train components.

Operation of the vehicle with differentials locked increases wear on tires, axles, drive shafts, and the transmission. These features should only be utilized as required for mobility.

### Operating the Differential Locks

The Inter-Axle and Cross-Axle differential locks should preferably be engaged when the crane is STATIONARY but may be engaged when moving if the following conditions are met.

1. The crane is moving very slowly (creep speed).
2. The wheels are not spinning at the time of engagement.

When traveling with the lock(s) engaged do not deviate from a straight path more than is absolutely necessary.

1. When operating the differential lock(s), position the appropriate switch to the LOCKED position with the crane stationary or at slow speed.
2. If moving at slow speed, let up momentarily on the accelerator. This will engage the differential lock(s).
3. Proceed over the poor road condition cautiously.

When the adverse condition has passed, adhere to the following:

1. Position the appropriate differential lock(s) switch to the OFF position while maintaining slow speed.
2. Let up momentarily on the accelerator to allow the shift.
3. Resume driving at a safe speed.

## BRAKES



### WARNING

If low pressure occurs and the buzzer sounds during operation, stop immediately and determine the cause of air loss. Downshift, use the engine as a brake, and make the final stop using a single brake pedal movement to avoid excessive loss of air and consequent sudden engagement of the automatic spring brakes.

Ensure the brakes are released before making any attempt to drive or drive train damage will result. The parking brake is to be used for parking only. Do not use the parking brake for stopping the crane except in case of an emergency, as a severe sudden stop will occur.

**NOTE:** If the pressure drops below 14 kPa/0.14 bar (2 psi) per minute with the engine stopped, have the air system checked for leaks.

This Grove crane is equipped with an anti-lock braking system (ABS) which controls the braking for three axles.

For most effective braking and for maximum life from brake system components, the following suggestions are made.

- Air brakes have light pedal operation and the driver is cautioned to use extreme care in application until a good feel is achieved.
- With ABS, push the brake pedal while steering normally and keep your foot firmly on the brake pedal until the crane comes to a complete stop. Don't take your foot off the brake pedal or pump the brakes, because that will disengage the anti-lock system. It is normal to feel a pulsing sensation from the brake pedal with ABS brakes.
- Remember that you can steer while you are braking with anti-lock brake systems. Steer clear of hazards while keeping your foot firmly on the brake pedal. Be aware that your vehicle will not turn as quickly on a slippery road as it would on dry pavement.
- Use the engine as a brake when approaching a stop or when going down a long grade. On a downgrade, use the same transmission gear as would be needed to go up the same grade.
- When necessary to use brakes to reduce crane speed on a downgrade, use on-and-off application to minimize heat and wear. Do not hold a continuous brake application or slide the wheels.

- When driving on slippery pavement or under icy conditions, alternately and smoothly apply and release the brakes to prevent skidding. DO NOT pump the brakes.
- Keep the tires properly inflated. Improperly inflated tires can reduce the efficiency of the brakes.
- After driving through water, dry the brakes by applying them lightly while maintaining a slow forward speed with an assured clear distance ahead until brake performance returns to normal.
- Regularly check the air pressure gauge indication. System air pressure should never be allowed to fall below 310 kPa (45 psi). If both systems drop below between 138 kPa (20 psi) and 207 kPa (30psi), the automatic spring brakes will actuate. Normal operating pressure range is 724 to 827kPa (115 to 135 psi).

**NOTE:** If the pressure drops below 14 kPa (2 psi) per minute with the engine stopped, have the air system checked for leaks.

- Parking brakes are controlled by a readily identified push-pull knob on the dash panel. To apply the parking brake, pull the knob out. To release the parking brake, push the knob in.

### Anti-Lock Brake System (ABS)

The crane has a standard brake system, equipped with an electronic speed monitoring and control system, Anti-Lock Brake System (ABS). ABS monitors wheel speed continuously but is not involved in controlling the wheel speed unless there is a reduction in traction. In normal braking applications, the standard air brake system is in effect.

**NOTE:** For more information on the ABS/ATC systems refer to the *Service Manual*.



#### WARNING

For proper ABS operation, do not change tire sizes. The size of the tires installed during production are programmed into the electronic control unit. Installing different size tires could result in a reduced brake force, leading to longer stopping distances, which may cause serious injury or death.

There is a sensor installed in each wheel. The sensors transmit information to the EC-60™ Premium electronic control unit (ECU). The ECU interprets the signals and calculates wheel speed, wheel retardation and a crane reference speed. If the calculations indicate a wheel lock-up

situation, a signal is sent from the ECU to the appropriate ABS modulator valve to reduce braking pressure. During emergency braking, the modulator valve alternately reduces, increases or maintains air pressure in the brake chamber to prevent wheel lock-up.

During emergency or reduced-traction stops, fully depress the foot brake pedal until the crane comes to a safe stop. DO NOT PUMP the brake pedal. With the brake pedal fully depressed, the ABS will control all wheels to provide steering control and a reduced braking distance.

Although the ABS improves crane control during emergency braking situations, the operator still has the responsibility to change driving styles depending on the existing traffic, road and/or weather conditions. For example, the ABS cannot prevent an accident if the driver is speeding or following too closely on slippery surfaces.

The ABS control unit contains a self-testing program that is engaged each time the ignition is turned on. The operator can verify the testing by listening for the burst of air from the ABS modulator valves actuating twice in series. To increase the sound, hold down the foot brake pedal when the ignition is turned on. The self-test is not finished and the indicator will stay on until the brake pedal has been pressed. The wheel speed sensors are tested when the crane starts to move.



#### CAUTION

If the ABS indicator comes on during driving or does not go out after a short time after turning on the ignition, take the crane to a Grove distributor to repair the ABS or brake system. The crane will not have full function of the ABS system making it harder for the crane to stop which could cause moderate to minor injury.

#### ABS Power-Up Sequence

When ignition power is applied, the ECU will illuminate the ABS indicator lamp (1) (Figure 4-16) for approximately three seconds, after which the lamp will extinguish if no diagnostic trouble codes are detected.

The ECU will cause the ABS indicator lamp to remain on whenever full ABS operation is not available due to a diagnostic trouble code. Refer to the *Service Manual* for trouble code information.

#### ABS Switch Operation

The ABS/Traction Control switch (3), (Figure 4-16) is used to diagnose system problems along with blink codes displayed on the ABS indicator, see the *Service Manual* for more information.

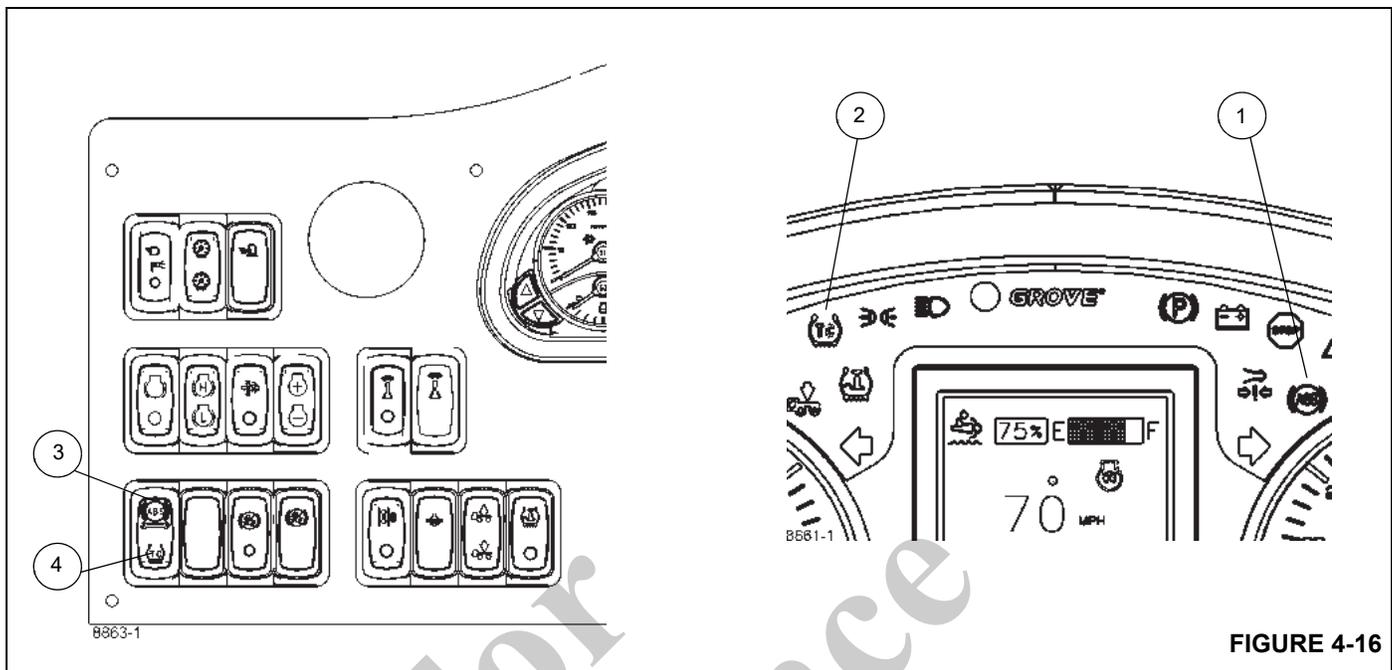


FIGURE 4-16

### Automatic Traction Control (ATC) Functional Overview

Just as ABS improves vehicle stability during braking, ATC improves vehicle stability and traction during vehicle acceleration. The EC-60™ Premium controller (ECU) ATC function uses the same wheel speed information and modulator control as the ABS function. The ECU detects excessive drive wheel speed, compares the speed of the front, non-driven wheels, and reacts to help bring the wheel spin under control. The ECU is configured to use engine torque limiting and differential braking to control wheel spin. The ATC system is controlled by the ABS ECU. It helps improve traction on slippery or unstable driving surfaces by preventing excessive wheel spin. ATC also enhances vehicle stability by prevention of initial loss of traction.

**NOTE:** For more information on the ABS/ATC systems refer to the *Service Manual*.

### ATC Operation

During periods of wheel slip, the Electronic Control Unit enters an Automatic Traction Control mode. There are various modes of Automatic Traction Control.

#### System Operation

- At speeds above 40 km/h (25 mph), the engine is throttled back via the data link to control wheel spin.
- At speeds below 40 km/h (25 mph), both engine control and differential brake control are activated as required to control wheel slip. Once triggered, differential braking mode remains active regardless of vehicle speed.

- The ATC off-road switch (4), (Figure 4-16) allows greater wheel spin (more torque) when activated. It is intended for adverse conditions, usually off-highway. The switch turns on ATC off-road when pushed once and off when pushed a second time and whenever the system goes through a power-up cycle.

The ATC Indicator (2), (Figure 4-16) will flash rapidly when ATC is operating.

#### Component Function

When brake control is utilized, the ATC valve is activated, diverting supply tank air to the modulator valves on the drive axle(s). The ECU then activates the appropriate solenoids in order to apply a brake force to the spinning wheel. The Automatic Traction Control System cannot increase traction to a particular wheel; it can only utilize the available traction.

#### Traction Control Power-Up Sequence

The ECU will illuminate the Automatic Traction Control (ATC) lamp (2), (Figure 4-16), for approximately 2.5 seconds when ignition power is applied, after which the lamp will extinguish, if no diagnostic trouble codes are detected.

The ECU will illuminate the ATC Indicator Lamp whenever ATC is disabled due to a diagnostic trouble code or when the ECU has been placed in the off-road mode. Refer to the *Service Manual* for trouble code information.

#### Traction Control Switch Operation

To activate ATC off-road mode, push the bottom of the ABS/Traction Control switch, (4) (Figure 4-16), once. When the ECU is placed in the ATC off-road mode, the ATC

indicator lamp will flash slowly at a rate of 1.0 seconds on, 1.5 seconds off to notify the vehicle operator that the off-road mode is active.

Pushing the switch again will turn off the ATC off-road mode.

### **Thermal (Brake Heat) Protection**

To prevent excessive brake and drum temperature resulting from brake activity, ATC incorporates a brake temperature estimation algorithm to determine when differential braking mode should be suspended. The differential braking function is re-enabled after a cool-down period.

### **ABS/ATC Partial Shutdown**

Depending which component the trouble code is detected on, the ABS and ATC functions may be fully or partially disabled. Even with the ABS indicator lamp on, the ECU may still provide ABS function on wheels that are not affected. The ECU should be serviced as soon as possible. Refer to the *Service Manual* for more information.

### **Engine Brake**

**NOTE:** Do not keep a foot lightly on the throttle pedal. This will cause the engine brake not to come on.

By energizing the engine brake (4), and (5), (Figure 3-3), the power producing diesel engine, in effect, becomes a power absorbing air compressor. To retard a crane on a downgrade using the Engine Brake, the operator selects a gear which will provide a balance between engine speed and road speed, then engages the engine brake. If the engine speed exceeds maximum rated RPM for a desired speed, a lower gear can be selected or intermittent use of the service brakes can be made. This selection of a lower gear will generally allow complete control of the crane by the engine brake, leaving the service brakes in reserve to be used for emergency stops. With the engine brake turned on, the engine brake will not be energized until the momentum is driving the engine.

### **Recommended Crane Shutdown Procedures**

The following procedures will extend serviceable life of various crane components, reduce vandalism and accidents during crane shutdown periods or anytime the crane is left unattended.



### **WARNING**

Never park the crane near holes, or on rocky or extremely soft surfaces. This may cause the crane to overturn, resulting in injury to personnel.

1. Park the crane on a proper surface with the outrigger jacks and beams fully retracted. Do not park in a location where it may become frozen to the ground or may settle unevenly and overturn.
2. Apply parking brakes and, if necessary, chock the wheels.
3. Ensure all controls are in neutral or off.
4. Shut down the engine using the proper procedures as specified by this manual and the engine manual.
5. Perform any other specified procedures required at the end of the workday such as draining water from the air tanks and fuel filter/water separator or refueling.
6. Close all windows.
7. Remove the keys from the crane.
8. Lock up the crane. Install vandal guards (optional), if used.



### **CAUTION**

Step 9 does not take the place of the pre-starting checks which must be performed just prior to using the crane at the next working day.

9. Make a thorough walk around inspection to make sure that all cylinders that can be retracted are retracted. The only exceptions are those cylinders which cannot be fully retracted, that is, steer cylinders. Also, look for anything that could hinder or prevent starting the next day's work.

### **SUPERSTRUCTURE CAB PLATFORM**

To pull out the cab platform, pull both retaining pins (there are two pins that need to be pulled, one on each side). See Figure 4-17 for the left side pin. There are notches at the back of the retaining pins to unlatch the pins while evenly pulling out on the platform. The operator should then insert the pins back into the platform once it is fully extended and the platform is locked in place.

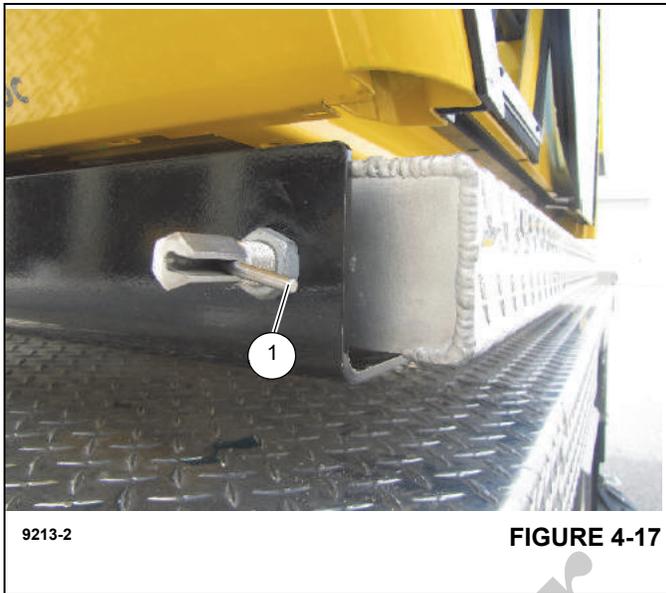


FIGURE 4-17

## 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. Return the controller to neutral to hold the load. Do not feather hoist control to hold the load. Also refer to Figure 3-43 and *Controller Sensitivity Function*, page 3-50.

**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 bubble level indicator provided on the crane is calibrated to be accurate within 1% of grade.

To properly level the crane, the boom must be positioned over the front of the crane. The boom must be fully lowered to a horizontal position, fully retracted, and stowed in the boom rest prior to leveling. Raise and level the crane following the instructions for *Using the Outriggers*, below.

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. If necessary, re-level the crane following instructions for *Using the Outriggers*, page 4-26.

## Bubble Level Indicator Adjustment

**NOTE:** To check and adjust Auto level refer to the *Service Manual*.

The Bubble Level Indicator should be checked periodically. If it is suspected that the bubble level indicator is out of adjustment, verify and adjust the bubble level as follows:

1. Position the crane on a firm, level surface.
2. Extend and set the outriggers. Level the crane, as indicated by the bubble level indicator, using the outriggers.
3. Place a miracle pointer level, carpenter level, or similar type device on a machined surface such as the turntable bearing or bearing mounting surfaces.
4. Using the outriggers, level the crane as indicated on the leveling device used in Step 3.
5. Using the bubble level indicator mounting screws, adjust the bubble level indicator to show level.
6. Repeat process, if necessary, on opposite side.

## 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 4-38] or *There is one Outrigger Control Panel (1)*, (Figure 3-7) on each side of the crane's frame. The panel on the right side operates the outrigger beams for that side only. The panel on the left side operates the outrigger beams for that side only. The jacks may be operated from the left or right side of the crane. Also refer to *Setting the Outriggers from the Superstructure Cab*, page 4-27., page 3-17] for the control panels on either side of the crane or with the remote control.



### 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, including the center front outrigger jack, and the crane is level for operation on outriggers.

All four outrigger beams must be equally extended to the mid position vertical stripe 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. Mid extended outriggers must also be locked in position.

### Setting the Outriggers from the Superstructure Cab

1. Enable the outrigger functions by doing the following:
  - Engage the Parking Brake.
  - Engage the Swing Brake
  - Disable all crane functions
2. Position the outrigger pads directly out from each outrigger to where the outriggers will be properly extended.
3. If required, extend the outrigger beams to the mid-extend or fully extended position using the Outrigger Extend/Retract Switch and the Operator Display Module (refer to *Outrigger Extend/Retract Switch*, page 3-29 and *Extending/Retracting the Outrigger Jacks*, page 4-44).

Refer to *Engaging the Outrigger Mid-Extend Lock Pin*, page 4-29 if the crane is to be operated with the outriggers at the mid-extend position.

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

All four outrigger beams must be deployed to one of three positions before beginning operation, which include fully retracted, mid-extend, or fully extended. Do not operate the crane with the outriggers in any other position.

**NOTE:** More than one outrigger beam can be extended at a time. To make sure each outrigger is fully extended, repeat Step 3 for each outrigger after a multi-outrigger extension.

4. Extend the outrigger jacks using the Outrigger Extend/Retract Switch and the Operator Display Module.

Extend each outrigger jack until the jack cylinder barrel engages the pad and insert retaining pin.

**NOTE:** More than one jack can be extended at a time, if using the outrigger keypads on the carrier OR if you are in the operators cab.

5. Extend front jacks approximately 8 to 10 cm (3 to 4 in).
6. Extend rear jacks approximately 8 to 10 cm (3 to 4 in).
7. Repeat steps 5 and 6 until all jacks are fully extended.
8. To activate auto level press and hold the auto level button and the extend or retract button (also refer to Figure 3-22 and *Outrigger Extend/Retract Switch*, page 3-29). The system will make a series of retracting movements of the outrigger jacks, pausing between each movement to assess the levelness of the crane. When the movements have been completed, verify visually that all tires are off of the ground. If any of the tires have made contact with the ground consider adding cribbing under the outriggers, or leveling the crane manually.
9. Once the crane has been leveled and tire lift-off verified, extend the center front outrigger jack. Verify visually that the center front outrigger jack has made contact with the ground or outrigger mat.

**NOTE:** The auto level should be checked periodically. This procedure should be done by a trained technician using the Crane Service Tool.

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

The mid-extend outrigger beam lock pin must be engaged before operating on any beam from the mid-extend position.

### Setting the Outriggers from the Outrigger Control Panels

To set the Outriggers from the Outrigger Control Panels, follow the steps below.

**NOTE:** A push-button emergency stop switch (6), (Figure 4-18) is installed on the outrigger control panel.

Outrigger Control Panel

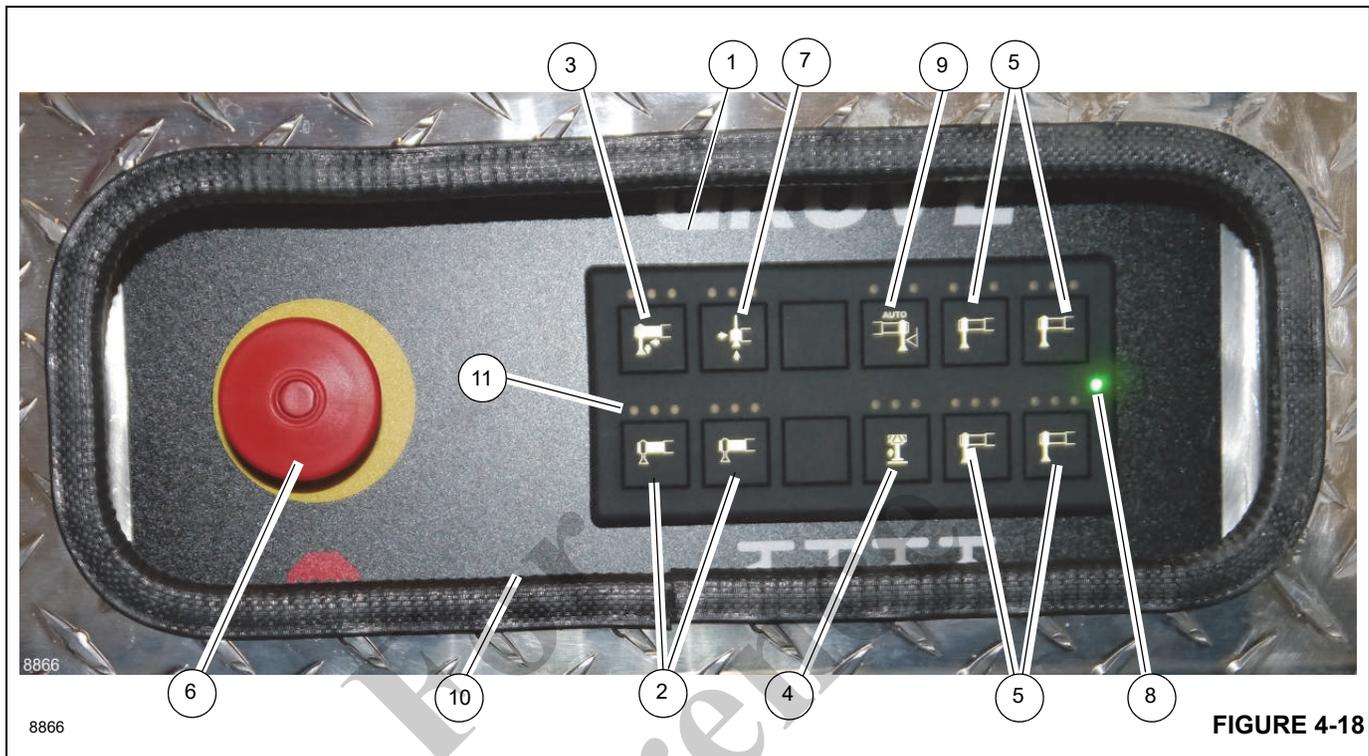


FIGURE 4-18

Item	Description
1	Outrigger Control Panel
2	Outrigger Beam Selector Switches
3	Extend Switch
4	Center Front Jack Switch
5	Jack Selector Switches
6	Emergency Stop Switch
7	Retract Switch
8	Power Indicator Light
9	Auto Level Switch
10	Bubble Level Indicator (Not Shown)
11	Outrigger Operation Indicator Lights

3. If required, extend the outrigger beams to the mid-extend or fully extended position by pressing the Outrigger Beam Selector Switch (2), (Figure 4-18) and the Extend Switch (3), (Figure 4-18). You can only activate the outrigger beams on the actual outrigger control panel side you are using (versus both sides at once).

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

All four outrigger beams must be deployed to one of three positions before beginning operation, which include fully retracted, mid-extend, or fully extended. Do not operate the crane with the outriggers in any other position.

1. Enable the outrigger functions by doing the following:
  - Engage the Parking Brake.
  - Engage the Swing Brake
  - Disable all crane functions
2. Position the outrigger pads directly out from each outrigger to where the outriggers will be properly extended.

4. Extend the outrigger jacks using the Outrigger Jack Selector Switches (5), (Figure 4-18). Extend each outrigger jack until the jack cylinder barrel engages the pad and insert retaining pin.

**NOTE:** More than one jack can be extended at a time, if using the outrigger keypads on the carrier OR if you are in the operators cab.

5. Extend front jacks approximately 8 to 10 cm (3 to 4 in).

6. Extend rear jacks approximately 8 to 10 cm (3 to 4 in).
7. Repeat steps 5 and 6 until all jacks are fully extended.
8. To activate auto level, press and hold the Auto Level Switch (9), (Figure 4-18) and the Extend Switch (3), (Figure 4-18). The system will make a series of retracting movements of the outrigger jacks, pausing between each movement to assess the levelness of the crane. When the movements have been completed, verify visually that all tires are off of the ground. If any of the tires have made contact with the ground consider adding cribbing under the outriggers.
9. Once the crane has been leveled and tire lift-off verified, use the Center Front Jack Switch (4), (Figure 4-18) and the Extend Switch to extend the center front jack. Verify visually that the center front jack has made contact with the ground or outrigger mat.

### Outrigger Monitoring System (OMS)

The Outrigger Monitoring System (OMS) aids the operator in accurately programming the Rated Capacity Limiter (RCL) by automatically identifying the horizontal position of each outrigger beam. The OMS uses four sensors, one per outrigger beam, to indicate when an outrigger beam is positioned to one of three pre-defined locations, including fully retracted, mid-extend, and fully extended.

Outrigger setup is the same for cranes equipped with OMS; refer to *Setting the Outriggers from the Superstructure Cab*, page 4-27.

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 *Overriding the Outrigger Monitoring System*, page 4-87). The RCL does not lock-out the crane or select a different load chart based on the outrigger beam position that is identified by the OMS.

### Engaging the Outrigger Mid-Extend Lock Pin

**NOTE:** It may be necessary to jog the Outrigger Extend/Retract Switch slightly to make sure proper pin engagement.

1. With the outriggers fully retracted, turn locking pin (1), (Figure 4-19) 90° from its stowed position and allow pin to slip into the lug on the jack beam. If pin will not slip into

the lug, slowly extend or retract the outrigger beam, allowing locking pin to drop into the lug.



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FIGURE 4-19

### Stowing the Outriggers from the Superstructure Cab

1. Enable the outrigger functions by doing the following:
  - Engage the Parking Brake.
  - Engage the Swing Brake.
  - Disable all crane functions.
2. Retract the center front jack using the Outrigger Extend/Retract Switch and the Operator Display Module (ODM). (Also refer to *Outrigger Extend/Retract Switch*, page 3-29.)
3. Retract the rear outrigger jacks using the Outrigger Extend/Retract Switch and the Operator Display Module (ODM). Retract the rear outrigger jacks until they have adequate clearance to remove the outrigger pads.
4. Retract the front outrigger jacks using the Outrigger Extend/Retract Switch and the Operator Display Module (ODM).
5. Retract the front outrigger jacks until they have adequate clearance to remove the outrigger pads.



### CAUTION

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

6. Remove retaining pin from outrigger pad and remove outrigger pads from jack cylinders.
7. Continue to retract jacks until all four jacks are fully retracted.
8. Disengage the Mid-Extend Lock Pin if outrigger beams are at the mid-extend position. (Refer to *Stowing the Outrigger Mid-Extend Lock Pin*, page 4-30). If required, fully retract the outrigger beams using the Outrigger Extend/Retract Switch and the Operator Display Module. (Also refer to *Outrigger Extend/Retract Switch*, page 3-29.)

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

9. Make sure the outrigger pads are secured in position with the retaining pins before traveling (Figure 4-20).



**FIGURE 4-20**

**Stowing the Outriggers Using the Carrier Outrigger Control Panels**

1. Enable the outrigger functions by doing the following:
  - Engage the Parking Brake.
  - Engage the Swing Brake.
  - Disable all crane functions.
2. Retract the center front jack using the Jack Selector Switch (5), (Figure 4-18) and the Retract Switch (7), (Figure 4-18).

3. Retract the rear outrigger jacks until they have adequate clearance to remove the outrigger pads.
4. Retract the front outrigger jacks using the Jack Selector Switch (5), (Figure 4-18) and the Retract Switch (7). Retract the front outrigger jacks until they have adequate clearance to remove the outrigger pads.



**CAUTION**

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

5. Remove retaining pin from outrigger pad and remove outrigger pads from jack cylinder.



**CAUTION**

Be sure to secure the retaining pin in position after removing/stowing the pads. If the clip is not secured, it could cause damage.

6. Continue to retract jacks until all four jacks are fully retracted.
7. Disengage the Mid-Extend Lock Pin if outriggers beams are at the mid-extend position (refer to *Stowing the Outrigger Mid-Extend Lock Pin*, below).
8. If required, fully retract the outrigger beams using the Outrigger Beam Selector Switch (2), (Figure 4-18) and the Retract Switch (7), (Figure 4-18).

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

9. Stow outrigger pads (Figure 4-20).

**Stowing the Outrigger Mid-Extend Lock Pin**

1. With outriggers extended, lift and turn locking pin (1), (Figure 4-19) 90° from its engaged position and allow handle of pin to rest on top the lug.
2. Retract outrigger beam to the stowed position.

**Swinging the Superstructure**

For crane functions such as swing, lift, telescope, and hoist, the Enable Indicator could also be Amber-constant on or Amber-flashing. For additional information on these indicators, refer to *Alert Icons*, page 3-39 and *Status Bar Icons*, page 3-42.


DANGER

**ELECTROCUTION HAZARD**

**TO AVOID DEATH OR SERIOUS INJURY**

Keep ALL parts of the crane, rigging and load at least 20 feet (6 meters) away from any energized power line. You MUST follow the OSHA requirements set forth in 29CFR 1926.1407 through 1926.1411.

This crane is not designed or equipped for use within 10 feet (3 meters) of energized power lines [Refer to 29CFR1926.1410 Table A]. If operation within 10 feet (3 meters) or 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.

If contact is ever accidentally made with a power line and any part of this crane, its rigging or load, NEVER touch the crane or even approach or come near the crane.

Electrocution CAN OCCUR even without direct contact with the crane.

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### DANGER

#### Crushing Hazard!

Death or serious injury could result from being crushed by moving machinery. Before activating swing, sound the swing 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.

### CAUTION

Never push or pull swing controller through neutral to the opposite direction to stop swing motion. Automatic swing brake is activated by the controller to stop swing rotation.

**NOTE:** The swing brake will automatically disengage when the swing function is enabled AND the swing joystick is moved off center, or also when the free swing button is active. Once the swing joystick is back in neutral position, the swing brake will start ramping on, or if using free swing and the free swing button is released, the brake will start ramping back on.

The Swing Brake Engaged Indicator (8), *Swing Brake Engaged Indicator*, page 3-35) on the Operator Display Module (ODM) comes on

(amber) when the swing brake is engaged and goes off when the swing brake is disengaged.

**NOTE:** Always operate controller with a slow, even pressure.

#### **Dual Axis Controllers**

1. Press the Swing Enable/Disable Switch (*Status Bar Icons*, page 3-42) to enable the swing function.

The Swing Enable Indicator will come on (green).

2. Push controller on left armrest to the right and hold to swing right (rotates turntable clockwise) or push controller to the left and hold to swing left (rotates turntable counterclockwise).

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

#### **Single Axis Controller (Optional)**

**NOTE:** For additional information, refer to Main Hoist Controller (Single Axis Option), page 3-32 and (Figure 3-25).

1. Press the Swing Enable/Disable Switch (*Status Bar Icons*, page 3-42) to enable the swing function.

The Swing Enable Indicator will come on (green).

2. Push outer controller on left armrest forward and hold to swing right (rotates turntable clockwise) or pull controller rearward and hold to swing left (rotates turntable counterclockwise).

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

### Elevating and Lowering the Boom

#### **Elevating the Boom**



### DANGER

#### Crushing Hazard!

Keep area above and below boom clear of all obstructions and personnel when elevating the boom.


DANGER

ELECTROCUTION HAZARD  
TO AVOID DEATH OR SERIOUS INJURY

Keep ALL parts of the crane, rigging and load at least 20 feet (6 meters) away from any energized power line. You MUST follow the OSHA requirements set forth in 29CFR 1926.1407 through 1926.1411.

This crane is not designed or equipped for use within 10 feet (3 meters) of energized power lines [Refer to 29CFR1926.1410 Table A]. If operation within 10 feet (3 meters) or 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.

If contact is ever accidentally made with a power line and any part of this crane, its rigging or load, NEVER touch the crane or even approach or come near the crane.

Electrocution CAN OCCUR even without direct contact with the crane.

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### Dual Axis Controllers

1. Press the Boom Lift Enable/Disable Switch to enable the boom lift function.  
The Boom Lift Enable Indicator will come on (green).
2. Push controller on right hand armrest to the left and hold to raise the boom.
3. When boom angle gets to the desired elevation, let controller return to the center (neutral) position to stop boom lift function.

### Single Axis Controller (Optional)

1. Press the Boom Lift Enable/Disable Switch to enable the boom lift function.  
The Boom Lift Enable Indicator will come on (green).
2. Pull inner controller on right armrest rearward and hold to raise the boom.
3. When boom angle gets to the desired elevation, let controller return to the center (neutral) position to stop boom lift function.

### Lowering the Boom



### DANGER

#### Crushing and/or Tipping Hazard!

Keep area beneath boom clear of all obstructions and personnel when lowering boom.

Long cantilever booms can create a tipping condition, even when unloaded in an extended, lowered position.

### DANGER

#### Two-Block Hazard!

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

When lowering boom, simultaneously let out hoist rope to prevent two-blocking the boom nose and the hook block.

### CAUTION

The closer the load is carried to the boom nose, the more important it becomes to simultaneously let out hoist rope as boom is lowered.

### Dual Axis Controllers

1. Press the Boom Lift Enable/Disable Switch to enable the boom lift function.  
The Boom Lift Enable Indicator 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)

**NOTE:** For additional information, refer to Main Hoist Controller (Single Axis Option), page 3-32 and (Figure 3-25).

1. Press the Boom Lift Enable/Disable Switch 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**

**NOTE:** Telescope function is controlled by a foot pedal or optionally by left hand controller. The tele-function foot pedal is provided any time an auxiliary hoist is installed.

**Extending the Boom**

 **DANGER**  
**Crushing Hazard!**

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

**DANGER**

**Two-Block Hazard**

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

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

 **DANGER**

**ELECTROCUTION HAZARD**  
**TO AVOID DEATH OR SERIOUS INJURY**

Keep ALL parts of the crane, rigging and load at least 20 feet (6 meters) away from any energized power line. You MUST follow the OSHA requirements set forth in 29CFR 1926.1407 through 1926.1411.

This crane is not designed or equipped for use within 10 feet (3 meters) of energized power lines [Refer to 29CFR1926.1410 Table A]. If operation within 10 feet (3 meters) or 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.

If contact is ever accidentally made with a power line and any part of this crane, its rigging or load, NEVER touch the crane or even approach or come near the crane.

Electrocution CAN OCCUR even without direct contact with the crane.

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**Dual Axis Controller**

1. Press the Boom Telescope Enable/Disable Switch to enable the boom telescope function.  
  
The Boom Telescope Enable Indicator will come on (green).
2. Push controller on left armrest forward and hold to extend the boom.
3. When boom gets to the desired length, let controller return to the center (neutral) position to stop extending the boom.

**Single Axis Controller (Optional)**

**NOTE:** For additional information, refer to Main Hoist Controller (Single Axis Option), page 3-32 and (Figure 3-25).

1. Press the Boom Telescope Enable/Disable Switch to enable the boom telescope function.  
  
The Boom Telescope Enable Indicator will come on (green).
2. Push inner controller on left armrest forward and hold to extend the boom.
3. When boom gets to the desired length, let controller return to the center (neutral) position to stop extending the boom.

**Foot Pedal**

1. Press the Boom Telescope Enable/Disable Switch to enable the boom telescope function.  
  
The Boom Telescope Enable Indicator will come on (green).
2. Press the top of the Telescope Control Pedal and hold to extend the boom.
3. When boom gets to the desired length, let foot pedal return to the center (neutral) position to stop extending the boom.

**Selecting the Hoist Speed Range**

**CAUTION**

Do not change speeds while hoist is active.

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 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 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 (25), (Figure 3-32) or Auxiliary Hoist High Speed Indicator (26), (Figure 3-32) will come on.

On dual axis controllers only, push and release the outside (farthest from operator) of the respective Hoist Speed Toggle Switch to enable high speed (maintained state). Push the switch again to disable the high speed. Push and hold the inside (closest to operator) of the respective Hoist Speed Toggle Switch to temporarily enable high speed (momentary state) and release the switch to disable the high speed.

**Retracting the Boom**

 **DANGER**  
**Crushing Hazard!**

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

**Dual Axis Controller**

1. Press the Boom Telescope Enable/Disable Switch to enable the boom telescope function.  
  
The Boom Telescope Enable Indicator will come on (green).
2. Push controller on left armrest rearward and hold to retract the boom.
3. When boom gets to the desired length, let controller return to the center (neutral) position to stop retracting the boom.

**Single Axis Controller (Optional)**

**NOTE:** For additional information, refer to Main Hoist Controller (Single Axis Option), page 3-32 and (Figure 3-25).

1. Press the Boom Telescope Enable/Disable Switch to enable the boom telescope function.  
  
The Boom Telescope Enable Indicator will come on (green).

2. Push inner controller on left armrest rearward and hold to retract the boom.
3. When boom gets to the desired length, let controller return to the center (neutral) position to stop retracting the boom.

**Foot Pedal**

1. Press the Boom Telescope Enable/Disable Switch to enable the boom telescope function.  
  
The Boom Telescope Enable Indicator will come on (green).
2. Press the bottom of the Telescope Control Pedal and hold to retract the boom.
3. When boom gets to the desired length, let foot pedal return to the center (neutral) position to stop retracting the boom.

**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.

 **DANGER**  
**Machine Damage Hazard!**

Always maintain at least three full wraps of rope on the drum. Less than three wraps may allow the rope to slip from the hoist anchor.

**NOTE:** When load is stopped at desired height, the automatic brake will engage and hold the load as long as the controller remains in neutral.

**Lowering the Main Hoist Rope****Dual Axis Controllers**

1. Press the Main Hoist Enable/Disable Switch to enable the main hoist function.

The Main Hoist Enable Indicator will come on (green).

2. Push controller on right armrest forward and hold to lower the main hoist rope. Always maintain at least three wraps on the drum.
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.

**Single Axis Controller (Optional)**

**NOTE:** For additional information, refer to Main Hoist Controller (Single Axis Option), page 3-32 and (Figure 3-25).

1. Press the Main Hoist Enable/Disable Switch to enable the main hoist function.

The Main Hoist Enable Indicator will come on (green).

2. Push outer controller on right armrest forward and hold to lower the main hoist rope. Always maintain at least three wraps on the drum.
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.

**Minimum Wrap Limiter System (Optional)**

If equipped, the minimum wrap limiter system will lock out hoist down motion when only three wraps remain on the drum. The related warning symbol will appear (refer to the *Warning Message/Error Message Display Area*, page 3-49) on the left side of the Operator Display Module (refer to the *Alert Icons*, page 3-39). Raise the hoist slightly to return to operating condition.

**Raising the Main Hoist Rope****DANGER****Two-Block Hazard!**

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

**Dual Axis Controllers**

1. Press the Main Hoist Enable/Disable Switch to enable the main hoist function.

The Main Hoist Enable Indicator 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.

**Single Axis Controller (Optional)**

**NOTE:** For additional information, refer to Main Hoist Controller (Single Axis Option), page 3-32 and (Figure 3-25).

1. Press the Main Hoist Enable/Disable Switch to enable the main hoist function.

The Main Hoist Enable Indicator 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.

**Lowering and Raising the Auxiliary Hoist Rope (Optional)****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.

**DANGER****Machine Damage Hazard!**

Always maintain at least three full wraps of rope on the drum. Less than three wraps may allow the rope to slip from the hoist anchor.

**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. Press the Auxiliary Hoist Enable/Disable Switch to enable the auxiliary hoist function.

The Auxiliary Hoist Enable Indicator will come on (green).

2. Push controller on left armrest forward and hold to lower the auxiliary hoist rope. Always maintain at least three wraps on the drum.
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.

**Single Axis Controller (Optional)**

**NOTE:** For additional information, refer to Boom Telescope or Auxiliary Hoist Controller (Single Axis Option), page 3-32.

1. Press the Auxiliary Hoist Enable/Disable Switch to enable the auxiliary hoist function.  
The Auxiliary Hoist Enable Indicator will come on (green).
2. Push inner controller on left armrest forward and hold to lower the auxiliary hoist rope. Always maintain at least three wraps on the drum.
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.

**Minimum Wrap Limiter System (Optional)**

If equipped, the minimum wrap limiter system will lock out hoist down motion when only three wraps remain on the drum. The related warning symbol will appear (refer to the *Warning Message/Error Message Display Area*, page 3-49) on the left side of the Operator Display Module (refer to the *Alert Icons*, page 3-39). Raise the hoist slightly to return to operating condition.

**Raising the Auxiliary Hoist Rope****DANGER****Two-Block Hazard!**

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

**Dual Axis Controllers**

1. Press the Auxiliary Hoist Enable/Disable Switch to enable the auxiliary hoist function.

The Auxiliary Hoist Enable Indicator 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.

**Single Axis Controller (Optional)**

**NOTE:** For additional information, refer to Boom Telescope or Auxiliary Hoist Controller (Single Axis Option), page 3-32.

1. Press the Auxiliary Hoist Enable/Disable Switch to enable the auxiliary hoist function.  
The Auxiliary Hoist Enable Indicator 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.

**STOWING AND PARKING**

When parking crane, do the following:

**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.

1. Remove load from hook.
2. Remove or stow boom extensions if equipped.
3. Fully retract all boom sections.
4. Lower boom to normal travel position.
5. Engage swing brake and swing lock pin.
6. Retract all jack cylinders and outrigger beams. Make sure all operating controls are in neutral position.
7. 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.

8. Apply parking brakes and if necessary, chock wheels.
9. Shut down engine following proper procedures specified in this *Operator Manual* and applicable engine manual.
10. Remove keys.
11. Close and lock, if applicable, all windows, covers, and doors.
12. Set battery disconnect switch (1), (Figure 4-5) to the OFF position if machine will be inactive for over 24 hours. **CAUTION:** Be aware of the time delay to switch the disconnect off. This CAUTION is a decal that is placed on the inside of the battery box door.

**Leaving Crane Unattended**

**! WARNING**  
**Tipping Hazard!**

Changing weather conditions including, but not limited to, wind, ice accumulation, precipitation, flooding, or lightning, 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.

**NAVIGATING THE OPERATOR DISPLAY MODULE (ODM) AND RATED CAPACITY LIMITER (RCL) DISPLAY MODULE**

For a description of the Operator Display Module and Rated Capacity Limiter Display Module (ODM and RDM), refer to *Operator Display Module and Rated Capacity Limiter Display Module*, page 3-33.

The Operator Display Module and Rated Capacity Limiter Display Module (ODM and RDM) each have an integral Navigation Control Pad (Figure 4-21) 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.



FIGURE 4-21

The Jog Dial (Figure 4-22) mounted on the right armrest (Figure 3-25), can also be used to navigate the Operator Display Module (ODM) and the Rated Capacity Limiter Display Module (RDM) in a similar manner:

- Rotating the Jog Dial (5), (Figure 4-22) performs the same function as pressing the Left/Right/Up/Down Arrow Buttons (4), (Figure 4-21) on the Navigational Control Pads.
- Pressing the Jog Dial (5), (Figure 4-22) performs the same function as pressing the OK Button (5), (Figure 4-21) 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.

The Jog Dial can control one display module at a time. An active screen Indicator (3), (Figure 4-23) appears in the lower left corner of either the ODM or RDM to indicate to the operator which display module is being controlled by the Jog Dial at that time. The Screen Toggle Button (3), (Figure 4-22) is used to switch between controlling the ODM or RDM.

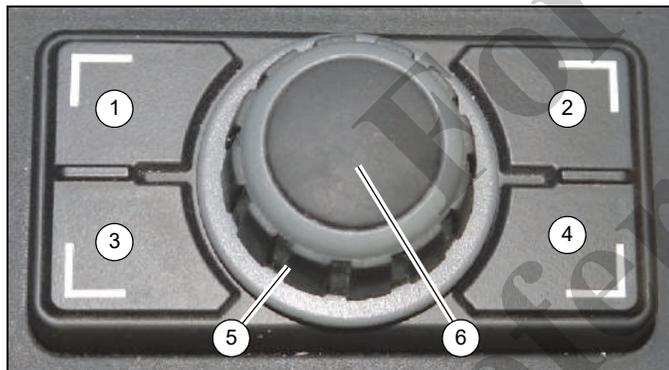
The ODM has a Main Screen and a Menu Screen. The operator can return to the Main Screen by pressing the Escape Button (1), (Figure 4-21 and Figure 4-22) or to the Menu Screen by pressing the Menu Button (4), (Figure 4-21 and Figure 4-22).

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 4-21 and Figure 4-22) or he can return to the Menu Screen by pressing the Menu Button (4), (Figure 4-21 and Figure 4-22).

**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 *Extending/Retracting the Outrigger Jacks*, page 4-44).

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

The Tab Button (2), (Figure 4-21) on the ODM's Navigation Control Pad can be pressed to temporarily silence active audible alarms.



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Item	Description
1	Escape Button
2	Tab Button
3	Menu Button
4	Screen Toggle Button
5	Jog Dial (Rotate dial to move cursor)
6	OK Button (Press Jog Dial to select)

FIGURE 4-22

### USING THE OPERATOR DISPLAY MODULE (ODM)

**NOTE:** Refer to *Operator Display Module and Rated Capacity Limiter Display Module*, page 3-33 for additional information.

The Operator Display Module (ODM) has two primary screens, Main (Home) Screen and Menu Screen.

Main (Home) Screen

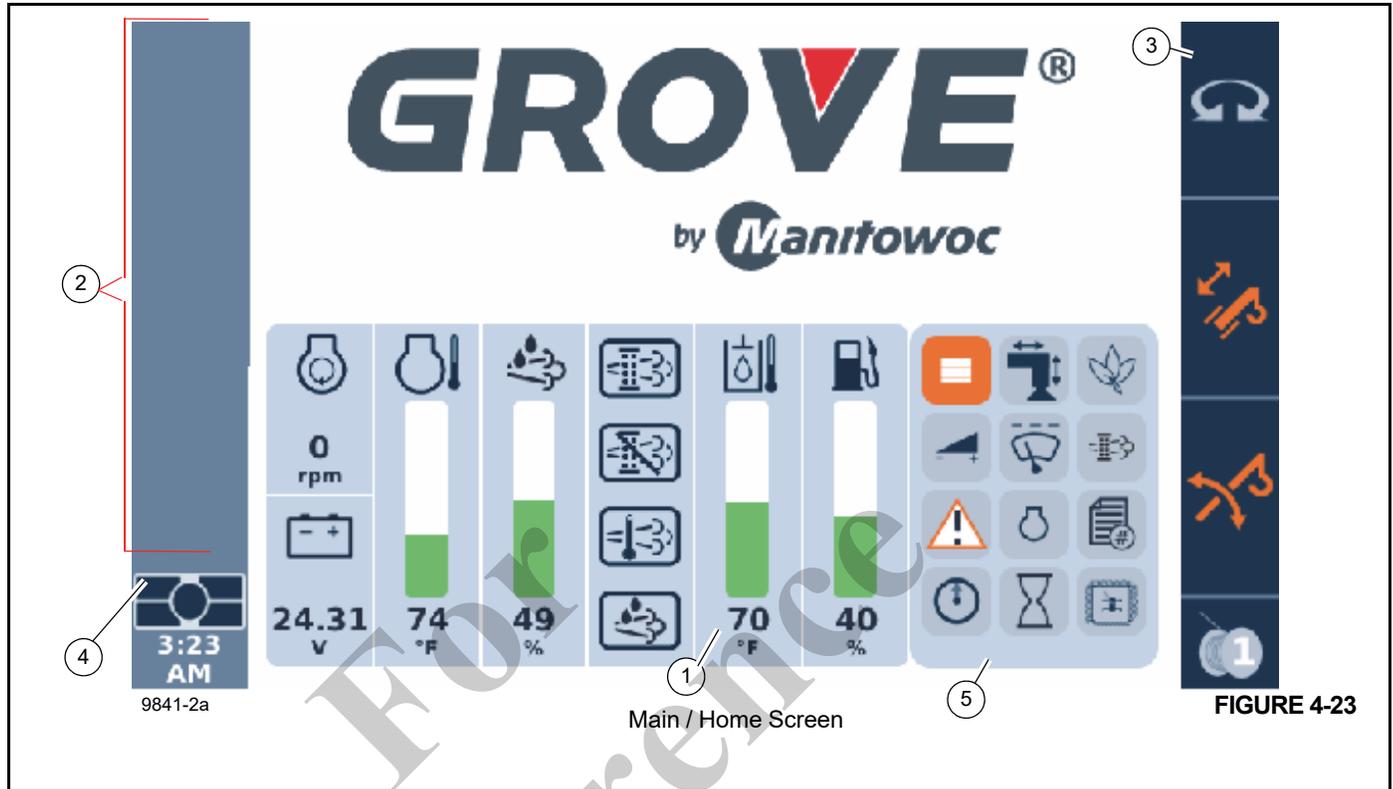


FIGURE 4-23

The Main (Home) Screen (Figure 4-23) appears on the ODM (lower display) when the key switch is initially set to the ON position.

Navigating back to the Main Screen can be accomplished by performing one of the following:

- Press the Screen Toggle Button (1), (Figure 4-21) at the Jog Dial to select the ODM screen control, then press the Escape Button (1), OR
- Press the Escape Button (1), (Figure 4-22) on the Navigation Control Pad at the ODM.

The Main Screen is separated into the following areas:

- **Status Area** (1), (Figure 4-23) displays icons and level gauges status for crane's system variables.

- **Alerts Area** (2), (Figure 4-23). (Refer to *Alert Icons*, page 3-39)
- **Status Bar** (3), (Figure 4-23). (Refer to *Status Bar Icons*, page 3-42)
- **Active Screen Indicator Area** (4), (Figure 4-23). The icon shown appears in the active screen.
- **Quick Menu** or most often used Icons (5), (Figure 4-23). Displays the icons for the most often used menus.

**Active Screen Indicator Area**

The following icon can appear in the Active Screen Indicator Area (4), (Figure 4-23) of the ODM Main Screen:

Item	Description	Graphic	Explanation
4	Active Screen Indicator		Indicates the ODM screen is being controlled by the Jog Dial. Refer to <i>Navigating the Operator Display Module (ODM) and Rated Capacity Limiter (RCL) Display Module</i> , page 4-37.

Menu Screen Layout

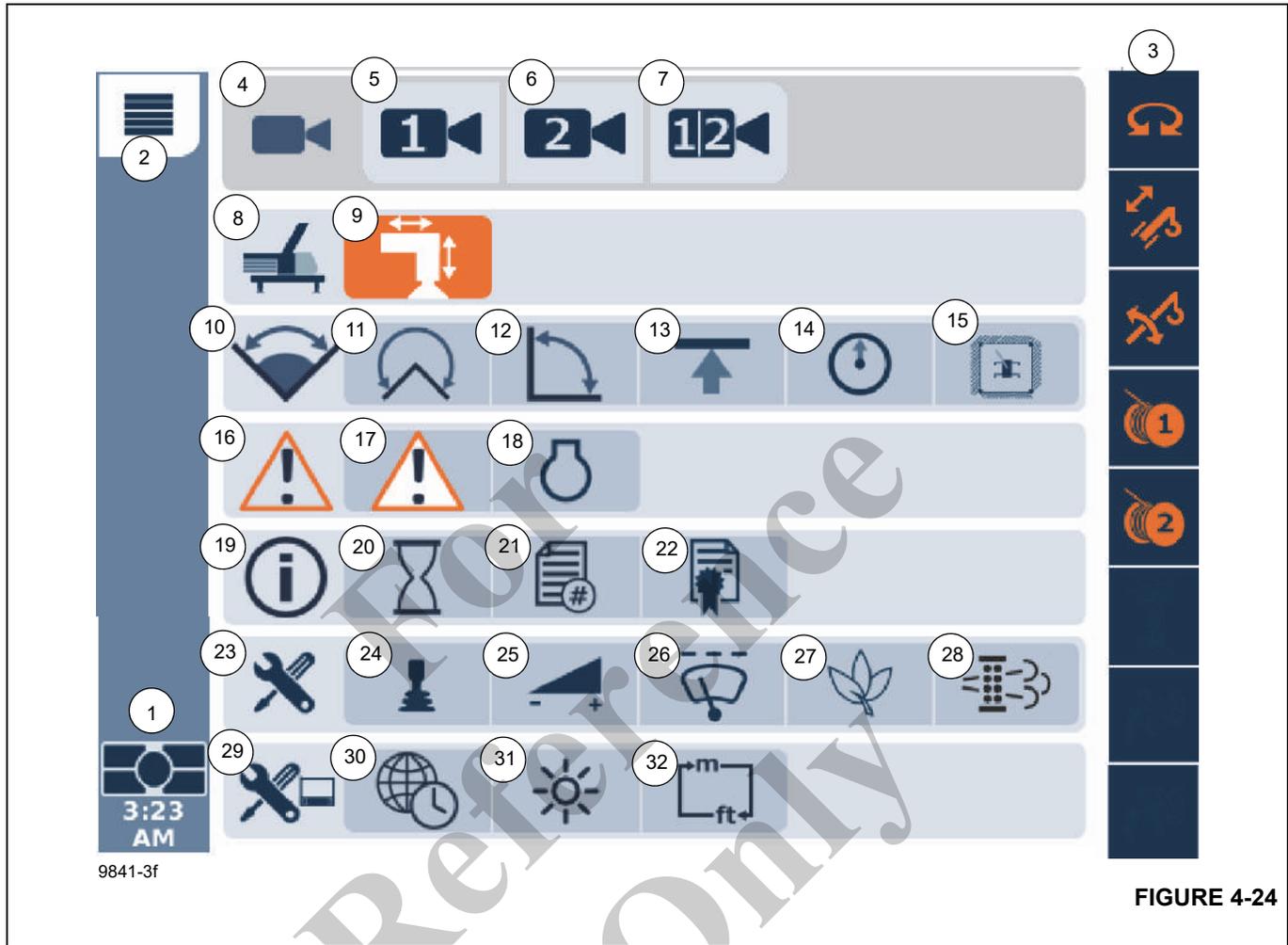


FIGURE 4-24

Item	Description	Item	Description
1	Active Screen Indicator Icon	17	Crane Operation Function Icon
2	Menu Screen Indicator Icon	18	Engine Fault Function Icon
3	Status Bar Indicator Icon	19	Information Group Menu Icon
4	Camera Group Menu Icon (Optional)	20	Operating Hours Function Icon
5	Camera View 1 Icon (Optional)	21	Software Version Function Icon
6	Camera View 2 Icon (Optional)	22	Legal Notice Function Icon
7	Camera View 1 and 2 Icon (Optional)	23	Tools Group Menu Icon
8	Crane Function Group Icon	24	Controller Sensitivity Function Icon
9	Outrigger Group Function Icon	25	Controller Speed Function Icon
10	Working Range Limiter (WRL) Group Menu Icon	26	Wiper Interval Function Icon
11	WRL Swing Angle Limitation Function Icon	27	Economy (ECO) Mode Function Icon
12	WRL Boom Angle Limitation Function Icon	28	Exhaust System Cleaning Function Icon
13	WRL Boom Height Limitation Function Icon	29	Tools User Settings Group Menu Icon
14	WRL Working Radius Limitation Function Icon	30	Setting Time Zone Function Icon
15	WRL Virtual Walls Limitation Function Icon	31	Setting Display Screen Brightness Function Icon
16	Errors (Fault Code) Group Menu Icon	32	Units of Measure Function Icon

Reference Only

## Menu Screen

The Menu Screen (Figure 4-24) of the ODM is accessed by doing one of the following:

- Press the Screen Toggle Button (4), (Figure 4-22) at the Jog Dial to select the ODM screen control, then press the Menu Button (3), (Figure 4-22).
- - OR -
- Press the Menu Button (3), (Figure 4-21) on the Navigation Control Pad at the ODM.

The ODM Menu Screen has the following menu items for operating the crane:

- **Camera Group Menu (Optional)** (4), (Figure 4-24) (Refer to *Camera Group (Optional) Display on ODM*, page 6-15 for additional information).
  - Camera View 1
  - Camera View 2
  - Camera View 1 and 2
- **Crane Function Group Menu** (8), (Figure 4-24) (Refer to *Crane Function Group Menu*, page 4-42 for detailed information).
  - Extending/Retracting the Outriggers
- **Working Range Limiter (WRL) Group Menu** (10), (Figure 4-24) (Refer to *Working Range Limiter (WRL) Menu Group*, page 4-48, for detailed information)
  - Setting the Swing Angle Limitation
  - Setting the Boom Angle Limitation
  - Setting the Boom Height Limitation
  - Setting the Working Radius Limitation
  - Setting the Virtual Walls Limitation
- **Errors (Fault Code) Group Menu** (16) (Figure 4-24) (Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-82 for detailed information)
  - Viewing the Crane Operation Functions
  - Viewing the Engine Fault Functions
- **Information Group Menu** (19), (Figure 4-24) (refer to *Information Group Menu*, page 4-70, for detailed information)
  - Viewing the Operating Hours. Hours of Operation can also be set/reset on this screen.
  - Viewing the Software Versions (Viewing Only).
  - Viewing the Legal Notice (Viewing Only).

- **Tools Group Menu** (23), (Figure 4-24) (Refer to *Tools Group Menu*, page 4-74 for detailed information)
  - Setting the Controller Sensitivity
  - Setting the Controller Speed Function
  - Setting the Wiper Interval Function
  - Setting the ECO Mode
  - Setting the Exhaust System Cleaning Options
- **Tools User Settings Group Menu** (30) (Figure 4-24)
  - Setting the Time Zone
  - Setting the Display Screen Brightness
  - Setting the Units of Measure (Metric/Imperial)

## Camera Group Menu

The Camera Group Menu (4), (Figure 4-24) includes the Camera View 1 (5), Camera View 2 (6), and Camera View 1 and 2 (7), (Figure 4-24). For additional information, refer to *Camera Group for Crane Operation (Optional)*, page 6-14.

## Crane Function Group Menu

The Crane Function Group Menu (8), (Figure 4-24) includes the Outrigger Group Function (9), (Figure 4-24) and (Figure 4-25).

## Outrigger Group Functions

The Outrigger Group (9), (Figure 4-24) is used to deploy and monitor the outriggers. The Outrigger Extend/Retract Function Screen (9), (Figure 4-25) is used to extend and retract the outrigger beams and jacks.



### WARNING

#### Tip-Over Hazard!

Center Front Jack will retract automatically when any main outrigger jack is retracted. Continued operation without resetting the center front jack could result in loss of stability.

Always reset the center front jack after adjusting the main outriggers.

**NOTE:** Retracting any jack will cause the center front jack to automatically retract.

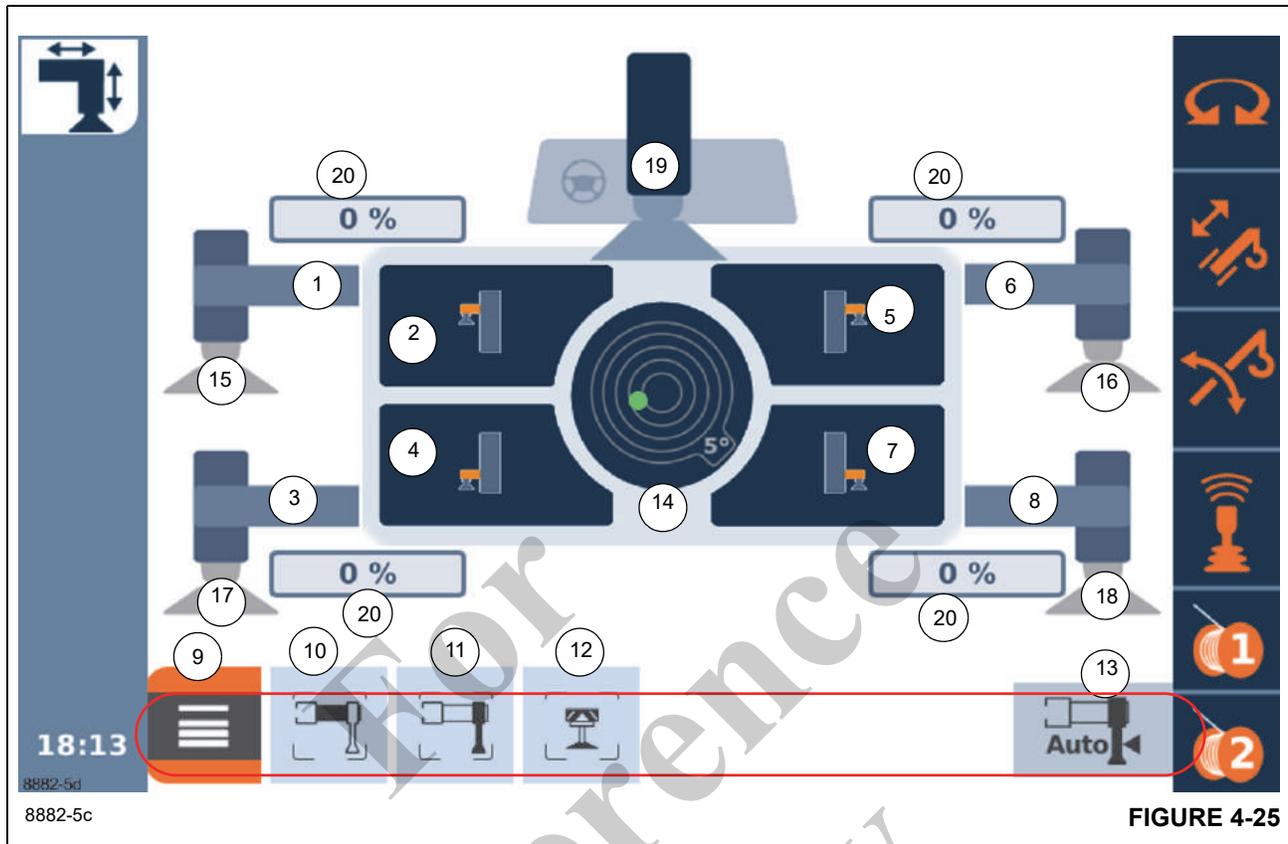


FIGURE 4-25

Item	Description
1	Left Front Beam
2	Jog Dial top left button - left front beam/jack select. This will turn into center front jack when item #12 is selected.
3	Left Rear Beam
4	Jog Dial bottom left button - left rear beam/jack select
5	Jog Dial top right button - right front beam/jack select
6	Right Front Beam
7	Jog Dial Right Bottom Button - Right Rear Beam/jack select
8	Right Rear Beam
9	Exiting the Menu
10	Outrigger Beams select
11	Outrigger Jacks select
12	Center Front Jack select
13	Automatic level select

Item	Description
14	Current Inclination Indicator
15	Left Front Jack
16	Right Front Jack
17	Left Rear Jack
18	Right Rear Jack
19	Center Front Jack
20	Percentage the outrigger beam is extended

**Accessing the Outrigger Group Function Screen**

Access the Outrigger Group Function screen (Figure 4-25) of the ODM by doing one of the following:

- Press the Screen Toggle Button (4), (Figure 4-22) at the Jog Dial to select the ODM screen control.  
Press the Menu Button (3), (Figure 4-22) to go to the Menu Screen.  
Using the Jog Dial (5), (Figure 4-22) to select the Outrigger Group Function Icon (Figure 4-25). **Note:** The Outrigger Group Function Screen Icon is shown in the top left of the screen (Figure 4-25).

- OR -

- Press the Menu Button (3), (Figure 4-21) on the Navigation Control Pad at the ODM to go to the Menu Screen.

Using the Arrow Buttons (4), (Figure 4-21), choose and select the Outrigger Group Function Icon (Figure 4-25), then press the OK Button (6), (Figure 4-22) to activate the desired function.

The Outrigger Group Function screen will appear as shown in the red circle in Figure 4-25. A Table of the Outrigger Icons follows:

Icon	Description
	Menu Screen Icon - not selected
	Menu Screen Icon - selected
	O/R Beams Icon - not selected
	O/R Beams Icon - selected
	O/R Beams Icon - active
	O/R Jacks Icon - not selected
	O/R Jacks Icon - selected
	O/R Jacks Icon - active

Icon	Description
	Center Front Jack Icon - not selected
	Center Front Jack Icon - selected
	Center Front Jack Icon - active
	Auto Level Icon - not selected
	Auto Level Icon - selected

**! WARNING**  
**Tip-Over Hazard!**

Center Front Jack will retract automatically when any main outrigger jack is retracted. Continued operation without resetting the center front jack could result in loss of stability. Always reset the center front jack after adjusting the main outriggers.

**NOTE:** Retracting any jack will cause the center front jack to automatically retract.

**Extending/Retracting the Outrigger Jacks**

**NOTE:** Refer to *Setting the Outriggers from the Superstructure Cab*, page 4-27 for complete procedures to extend and retract the O/R Beams and Jacks.

To extend or retract the O/R beams, perform the following procedure:

- Using the Jog Dial (5), Jog Dial (5), (Figure 4-22), or the Arrow Buttons (4), (Figure 4-21) at the Navigation

Control Pad, select the O/R Beam Icon (Figure 4-25) (Icon will turn orange when selected).

- Press the Jog Dial (5), Jog Dial (5), Figure 4-22) or the OK Button (5), (Figure 4-21) at the ODM to make the O/R Beam Icon active (Icon will turn green when active).
- To extend the O/R Beams, position the Outrigger Extend/Retract Switch (refer to *Outrigger Extend/Retract Switch*, page 3-29) in the left-hand armrest to the extend position, then press any or all of the four buttons (Figure 4-26) at the Jog Dial or the Navigation Control Pad (Figure 4-26).

To retract the O/R Beams, position the Outrigger Extend/Retract Switch to the retract position, then press any or all of the four buttons (Figure 4-26) at the Jog Dial or the Navigation Control Pad (Figure 4-26).

**NOTE:** The O/R Beam positions correspond to the four buttons at the Jog Dial and ODM Navigation Control Pad (Refer to Figure 4-26 and Figure 4-27).

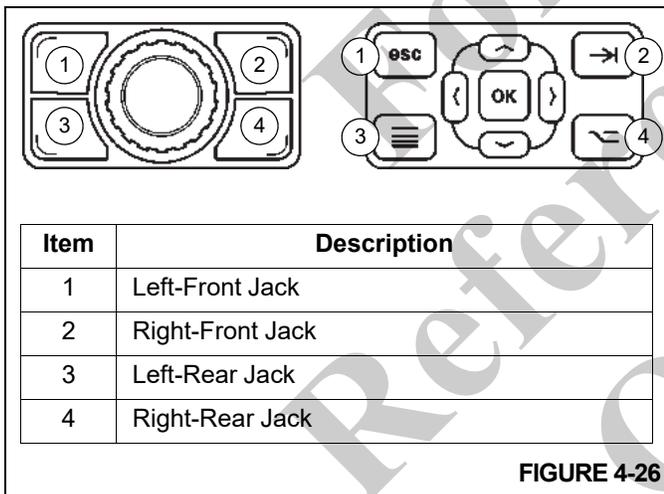


FIGURE 4-26

When a button at the Jog Dial or Navigation Control Pad is pressed and held, the corresponding O/R Beam image turns orange to indicate that it is active. An arrow will appear to indicate whether the beam is extending or retracting. The following (EXAMPLE ONLY), (Figure 4-27) shows the Left-Front O/R Beam is extending or retracting.

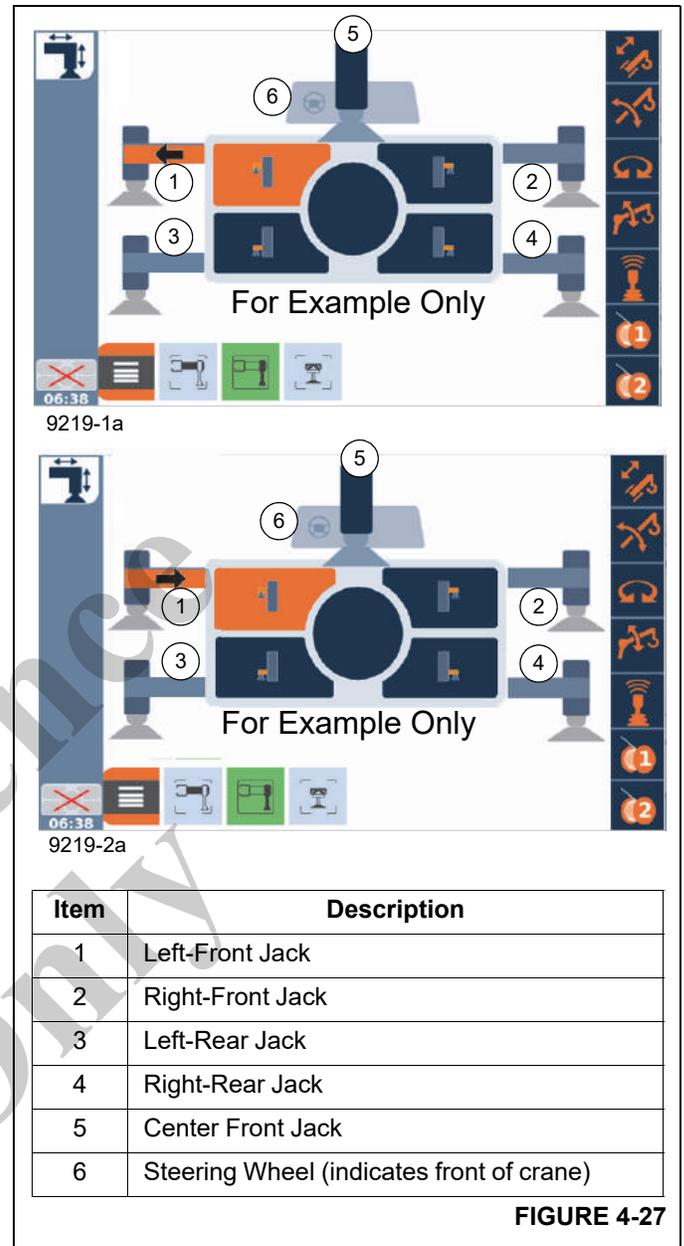


FIGURE 4-27

**Extending/Retracting the Outrigger Jacks - Individually**

**NOTE:** Refer to *Setting the Outriggers from the Superstructure Cab*, page 4-27 for complete procedures to extend and retract the O/R Beams and Jacks.

To extend or retract the O/R Jacks individually, perform the following procedure:

- Using the Jog Dial (5), Jog Dial (5), (Figure 4-22) or the Arrow Buttons (4), (Figure 4-21) at the Navigation

Control Pad, select the O/R Jack Icon (the Icon will turn orange when selected).

2. Press the Jog Dial (5), Jog Dial (5), (Figure 4-22) or the OK Button(5), (Figure 4-21) 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 (refer to *Outrigger Extend/Retract Switch*, page 3-29) in the left-hand armrest to the extend position, then press any or all of the four buttons (Figure 4-26) at the Jog Dial or Navigation Control Pad (Figure 4-26).

To retract the O/R Jacks, position the Outrigger Extend/Retract Switch to the retract position, then press any or all of the four buttons (Figure 4-26) at the Jog Dial or Navigation Control Pad (Figure 4-26).

**NOTE:** The O/R Jack positions correspond to the four buttons (Figure 4-26) at the Jog Dial and ODM Navigation Control Pad (Figure 4-26).

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 active. An arrow appears to indicate whether the Jack is extending or retracting. The following example (Figure 4-28) Item 1 shows the Left-Front O/R Jack is extending or retracting (as can be seen by the orange highlight).

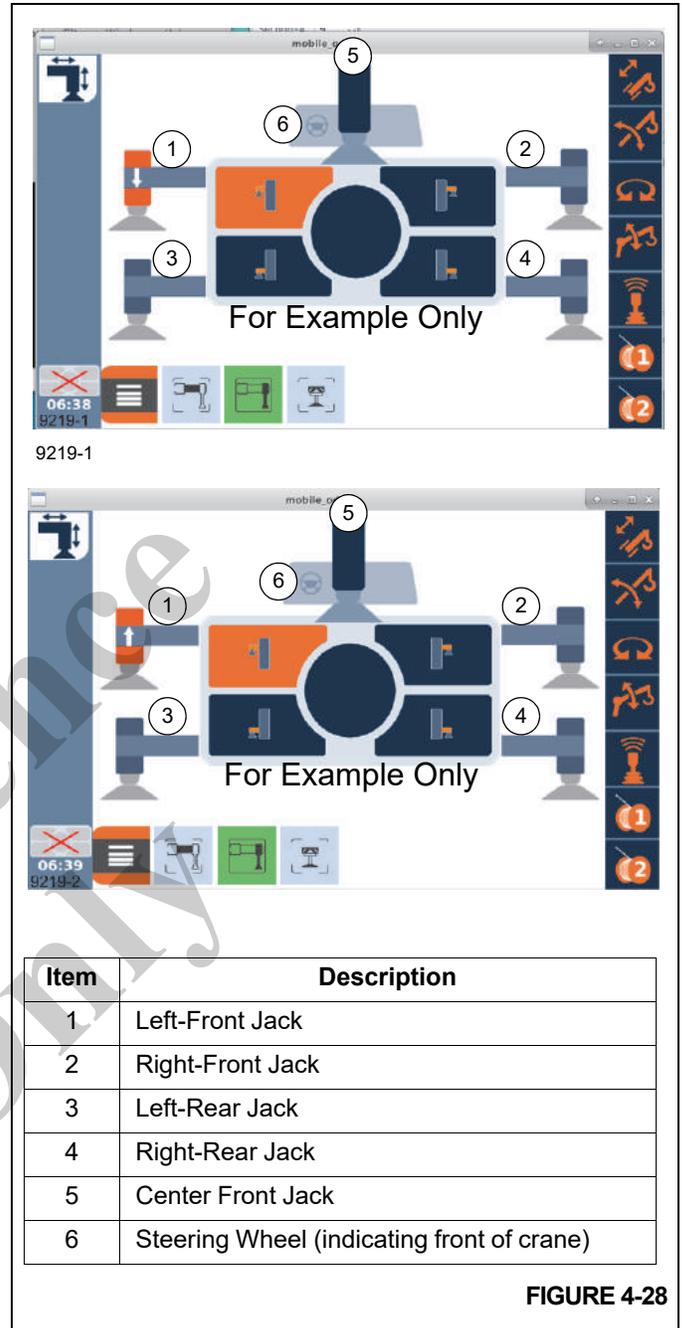


FIGURE 4-28

**! WARNING**  
**Tip-Over Hazard!**

Center Front Jack will retract automatically when any main outrigger jack is retracted. Continued operation without resetting the center front jack could result in loss of stability.  
Always reset the center front jack after adjusting the main outriggers.

**NOTE:** Retracting any jack will cause the center front jack to automatically retract.

### **Extending/Retracting the Center Front Jack**

**NOTE:** Refer to *Setting the Outriggers from the Superstructure Cab*, page 4-27 for complete procedures to extend and retract the O/R Beams and Jacks.

To extend or retract the Center Front Jack (5), (Figure 4-28), perform the following procedure:

1. Using the Jog Dial (5), (Figure 4-22) or the Arrow Buttons (4), (Figure 4-21) at the Navigation Control Pad, select the Center Front Jack Icon (12), (Figure 4-24) (Icon will turn orange when selected).
2. Press the Jog Dial (5), (Figure 4-22) or the OK Button(5), (Figure 4-21) at the ODM, to make the Center Front Jack Icon active (Icon will turn green when active).
3. Press the Jog Dial (5), (Figure 4-22), to select the Center Front Jack Switch. Then position the Outrigger Extend/Retract Switch (refer to *Outrigger Extend/Retract Switch*, page 3-29) to the extend position from the left-hand armrest.
4. Verify visually that all tires are off of the ground. If any of the tires have made contact with the ground consider adding cribbing under the outriggers.
5. To retract the Center Front Jack, position the Outrigger Extend/Retract Switch to the retract position, then press the Jog Dial Button (5), (Figure 4-22) on the Navigation Control Pad.

### **Exiting the Outrigger Extend/Retract Function Screen**

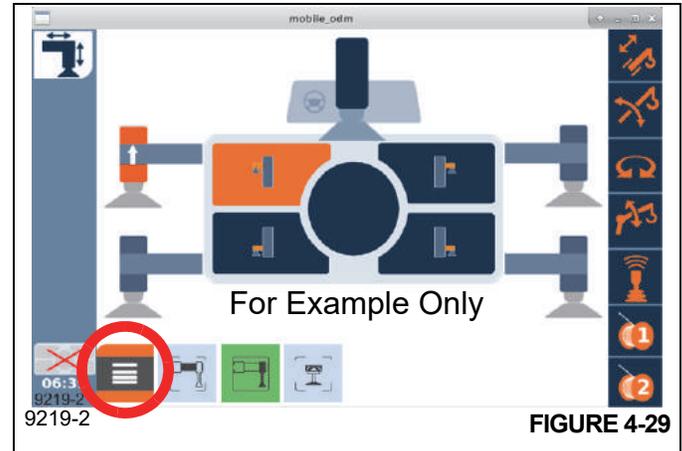
Exit the Outrigger Extend/Retract function screen of the ODM by doing one of the following:

- Press the Screen Toggle Button (4), (Figure 4-22) at the Jog Dial (5), (Figure 4-22) to select the ODM screen control.

Using the Jog Dial (5), select the Menu Icon (Figure 4-29), (Icon will turn orange and is noted in the red circle), then press the Jog Dial (5), (Figure 4-22).

- OR -

- Using the Arrow Buttons (4), (Figure 4-21), select the Menu Icon (Figure 4-29) (Icon will turn orange), then press the OK Button (5), (Figure 4-21).



**FIGURE 4-29**

## Working Range Limiter (WRL) 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 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, page 4-51 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 .WRL Alarm Characteristics, page 4-51 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 4-30) and sub-menu (2 thru 6) allows the operator to set limits on the location of the boom.



FIGURE 4-30

WRL Menu Group

Item	Description
1	WRL Menu Group
2	WRL Swing Angle Limitation Menu
3	WRL Boom Angle Limitation Menu
4	WRL Boom Height Limitation Menu
5	WRL Working Radius Limitation Menu
6	WRL Virtual Walls Limitation Menu

The following limitations are available under the WRL Menu Icon (1), (Figure 4-30) as noted below. The number next to the limitation indicates the Menu Limitation Icon reflective of that group as shown in Figure 4-30.

- 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): Boom 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 remembered 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 4-32, 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 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 Limitation, 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 (as shown below) in the left margin (of the Active Screen Indicator area):

Icon	Description
	<b>Working Range Limiter (WRL) Indicator (Green):</b> Indicates one or more working range limiters are defined.

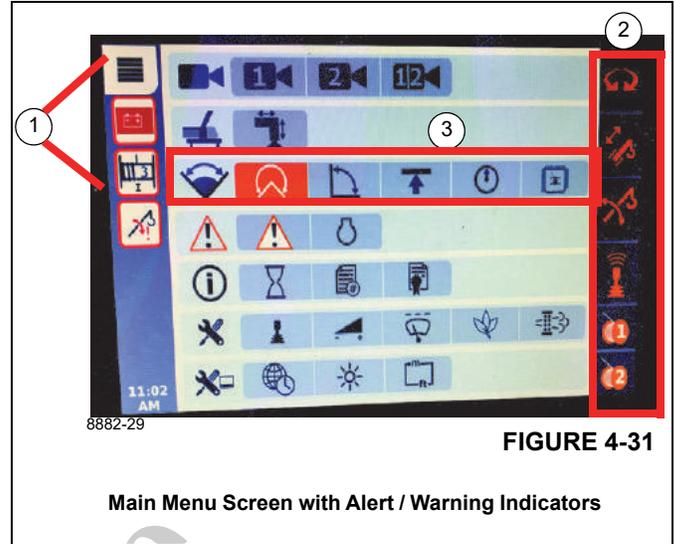


FIGURE 4-31 Main Menu Screen with Alert / Warning Indicators

Item	Description
1	Alerts and Warnings Area
2	Status Bar Area
3	WRL Menu Group

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
	<b>Working Range Limiter (WRL) Swing Angle Warning Indicator (Amber):</b> 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 4-30 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
	<p><b>Working Range Limiter (WRL) Swing Angle Stop Indicator (Red):</b> Indicates the swing angle is at a swing angle limit set point. The warning buzzer is on (constant).</p> <p>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.</p>

If there are multiple limitations enabled, such as a swing limitation and a height limitation, there will be multiple alert icons shown on 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
Swing Angle Limitation	10 deg before limit	Slow beeping
	5 deg before limit	Fast beeping
	At limit	Solid sound
Boom Angle Limitation	10 deg before limit	Slow beeping
	5 deg before limit	Fast beeping
	At limit	Solid sound
Boom Height Limitation	10 ft before limit	Slow beeping
	5 ft before limit	Fast beeping
	At limit	Solid sound
Working Radius Limitation	10 ft before limit	Slow beeping
	5 ft before limit	Fast beeping
	At limit	Solid sound
Virtual Walls Limitation	10 ft before limit	Slow beeping
	5 ft before limit	Fast beeping
	At limit	Solid sound

**NOTE:** The audible alarm can be silenced using the Tab Button on the Navigation Control Pad (2), (Figure 4-21). 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.

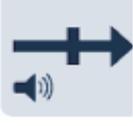
The Jog Dial (5), (Figure 4-22), mounted on the right armrest (see *Jog Dial*, page 3-31), can be used to navigate the two-display modules in a similar manner as the Navigation Control Pads.

### **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 4-30).

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 Tab Key (2), (Figure 4-21) or the Arrow Keys (4), (Figure 4-21) or the Jog Dial (5), (Figure 4-22) to move to the corresponding Function Icon you wish to set the limitation on as shown in (Figure 4-30).

Table 4-2 WRL Limitation Screen Symbols

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

### WRL - Swing Angle Limitation Menu

If the Swing Angle Limitation is selected from the menu of WRL Limitations, then the Swing Angle Limitation Screen will be shown (6), (Figure 4-32).

Using the Left Arrow and Right Arrow Function keys (4), (Figure 4-21) on the Navigation Control Pad or the Jog Dial (5), (Figure 4-22) 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 4-32, 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 4-30) 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.

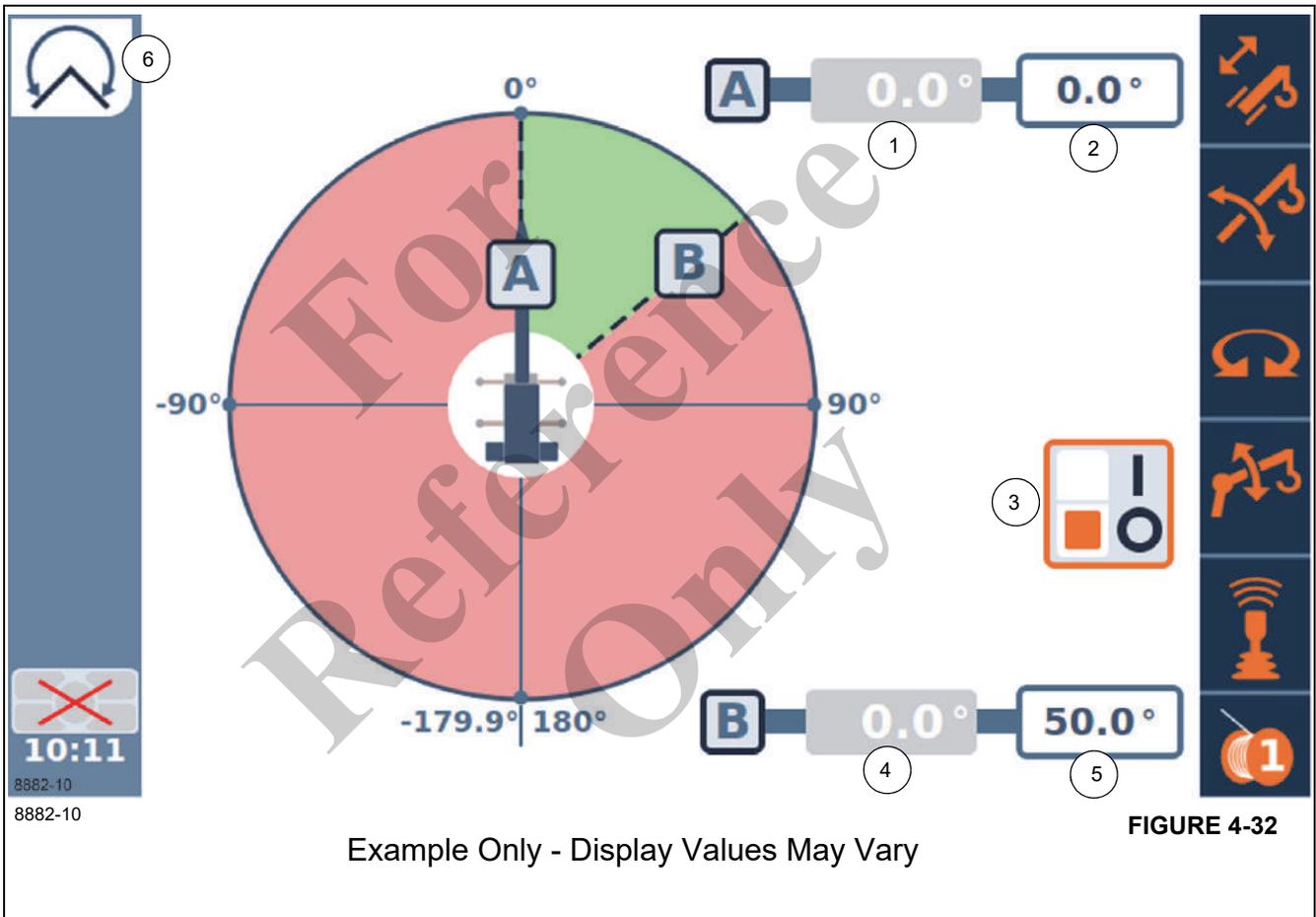


FIGURE 4-32

**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 A	Figure 4-32
2	Swing Angle Limit Left Direction - A	
3	Enable / Disable Switch	
4	Current Swing Angle B	
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 4-82.
2. Using the Jog Dial (5), (Figure 4-22), go to the ODM Main Menu Screen (Figure 4-31). Then choose the Working Range Limiter (WRL) Group Menu Icon (1), (Figure 4-30) by using the Arrow keys (4), (Figure 4-21) or the Jog Dial (5), (Figure 4-22).
3. Select the Swing Angle Menu Screen (2), (Figure 4-30). **NOTE:** The Swing Angle Screen (6), (Figure 4-32) Icon is shown on the top left side of the ODM screen.
4. Enable the limitation by using the Jog Dial (5), (Figure 4-22) or the Arrow Keys (4), (Figure 4-21) and move to the Enable / Disable Switch ON/OFF (3), (Figure 4-32). **NOTE:** The Switch (3), (Figure 4-32) is the Swing Enable / Disable Switch ON/OFF and is a toggle switch. Click OK (5), (Figure 4-21), or the Jog Dial (5), (Figure 4-22) 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 4-22) or the Arrow Keys (4), (Figure 4-21) and move to the Limitation Value (1), (Figure 4-32). Click OK to set the current value Limitation A (1), (Figure 4-32) position.

**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 4-32) 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 4-82.
2. Using the Jog Dial (5), (Figure 4-21), go to the ODM Main Menu Screen. Then choose the Working Range Limiter (WRL) Group Menu Icon (10), (Figure 4-24).
3. Select the Swing Angle Menu Screen (11), (Figure 4-24). **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 4-32) at the top of the screen should show the Swing Angle Limitation Icon.
4. Enable the limitation by using the Jog Dial (5), (Figure 4-22) or the Arrow Keys (4), (Figure 4-21) and move to the Enable / Disable Switch ON/OFF (3), (Figure 4-32). **NOTE:** The Switch (3), (Figure 4-32) is the Enable / Disable Switch ON/OFF and is a toggle switch. Click OK (5), (Figure 4-21), or the Jog Dial (5), (Figure 4-22) to toggle the switch.
5. Use the Jog Dial (5), (Figure 4-22), to move and select the Swing Angle Left Limitation A (2), (Figure 4-32) 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 4-22) or the upper and lower arrow keys (4), (Figure 4-21) to change the value (in tenths) to the desired swing angle value. Use the OK Button (5), (Figure 4-21) to finish entering the values.

**NOTE:** The Limitation is dependent on the accuracy of the Swing Angle Sensor, which can be  $\pm 2$  degrees.

**NOTE:** The current value in Limitation A (1) will automatically populate in the value for Limitation A (2).

6. Repeat Steps 4 thru 6 to set the Limitation B (5), (Figure 4-32) 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 4-32).

**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 4-30).  
**NOTE:** The Swing Angle Screen (6), (Figure 4-32) 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 4-21) to highlight the Switch Enable/Disable Symbol (3), (Figure 4-32). Enable is "I" and Disable is "O".
3. Use the OK Button (5), (Figure 4-21), or the Jog Dial (5), (Figure 4-22) 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.

**WRL - Boom Angle Limitation Menu**

If the Boom Angle Limitation Menu is selected from the Main Menu of WRL Limitations (3), (Figure 4-30), then the Boom Angle Limitation Screen will be shown (Figure 4-33).

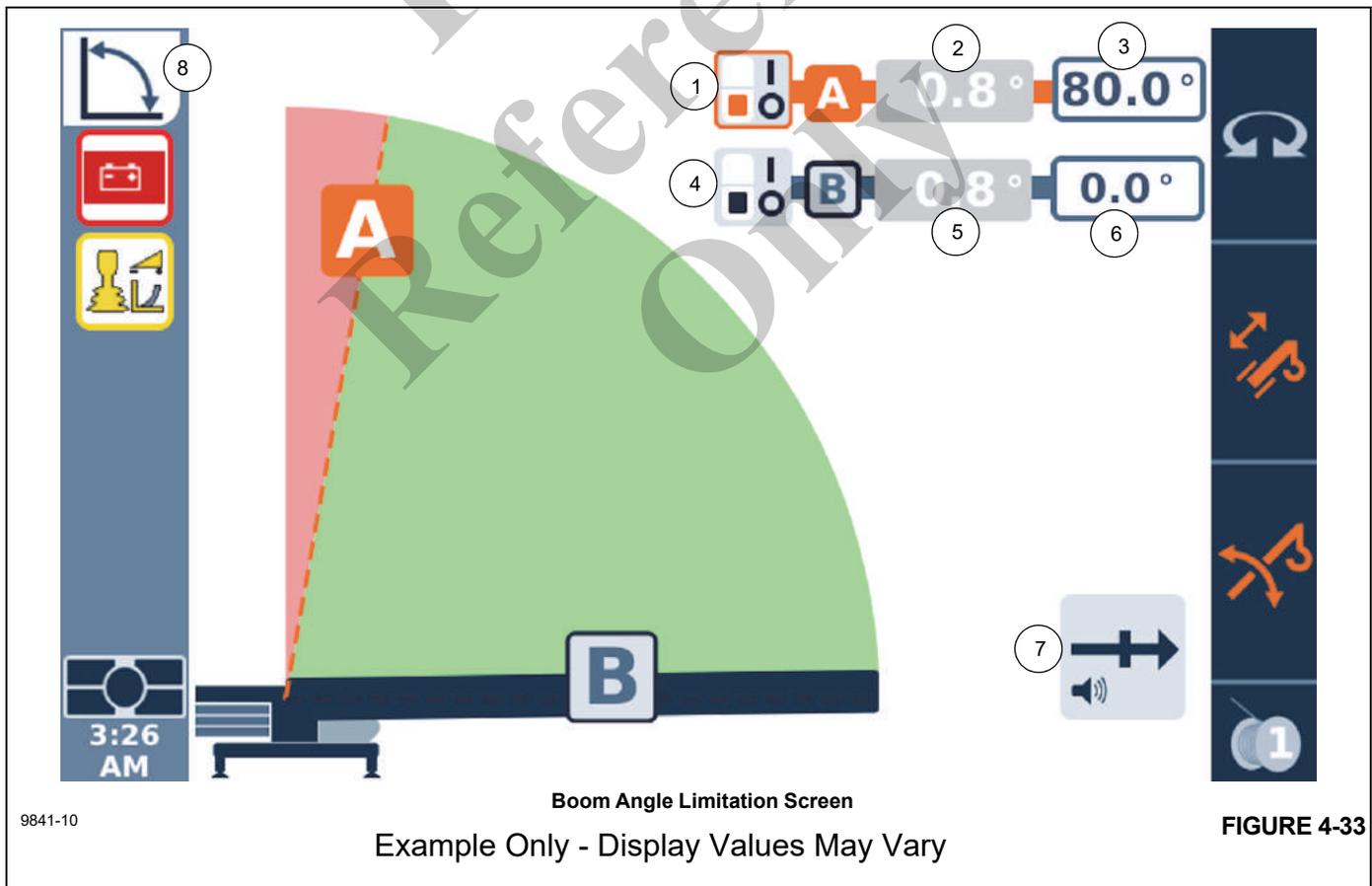


FIGURE 4-33

9841-10

Using the Left Arrow and Right Arrow Function keys on the Navigation Control Pad (4), (Figure 4-21) or the Jog Dial (5), (Figure 4-22) 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 4-33, 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 Limit Enable/Disable Switch	Figure 4-33
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 4-82.
2. Using the Jog Dial (5), (Figure 4-22), go to the ODM Main Menu Screen (Figure 4-24). Go to the Working Range Limiter (WRL) Group Menu Icon (3), (Figure 4-30) by using the Arrow keys (4), (Figure 4-21) or the Jog Dial (5), (Figure 4-22).
3. Select the Boom Angle Limitation Menu Screen(3), (Figure 4-30). **NOTE:** The Boom Up Limitation Screen (8), (Figure 4-33) Icon is shown on the top left side of the ODM screen.
4. Enable the Limitation by using the Jog Dial (5), (Figure 4-22), or the Arrow Keys (4), (Figure 4-21) to

move and select the Enable/Disable Switch Symbol ON/Off (1), (Figure 4-33). **NOTE:** The Switch (1), (Figure 4-33) is a toggle switch. Click OK (5), (Figure 4-21), or the Jog Dial (5), (Figure 4-22) to enable the switch.

5. Move the Boom to the desired position. This position will indicate the boom angle current value A (2) position.
6. Use the Jog Dial (5), (Figure 4-22) or the Arrow Keys (4), (Figure 4-21) and move to the Limitation Value (2), (Figure 4-33). Click OK to set the current value Limitation A (2), (Figure 4-33) 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 4-82.
2. Using the Jog Dial (5), (Figure 4-22), go to the ODM Main Menu Screen (Figure 4-24). Go to the Working Range Limiter (WRL) Group Menu Icon (3), (Figure 4-30) by using the Arrow keys (4), (Figure 4-21) or the Jog Dial (5), (Figure 4-22).
3. Select the Boom Angle Limitation Menu (3), (Figure 4-30). **NOTE:** The Boom Angle Limitation Icon (8), (Figure 4-33) is shown on the top left side of the ODM screen.
4. Enable the Lower Boom Limitation Angle by using the Jog Dial (5), (Figure 4-22), or the Arrow Keys (4), (Figure 4-21) to move and select the Enable/Disable Switch Symbol ON/Off (4), (Figure 4-33). **NOTE:** The Switch (4), (Figure 4-33) is a toggle switch. Click OK (5), (Figure 4-21), or the Jog Dial (5), (Figure 4-22) to enable the switch.
5. Move the Boom to the desired position. This position will indicate the boom angle current value B (5) position.
6. Use the Jog Dial (5), (Figure 4-22), or the Arrow Keys (4), (Figure 4-21) and move to the Limitation Value (5), (Figure 4-33). Click OK to set the current value Lower Boom Angle Limitation B (5), (Figure 4-33) position.

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



- The lower boom angle is now at the limitation, so alarms will sound. The boom can now be moved away from the current boom angle to cease the alarm.

### Setting Boom Up Limitation by Value

To set parameters and enable the Boom Up Elevation Limits Menu using a "typed in" value as the limitation, the following steps can be used:

- Set the RDM screen parameters first. Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-82.
- Using the Jog Dial (5), (Figure 4-21), go to the ODM Main Menu Screen. Then choose the Working Range Limiter (WRL) Group Menu Icon (10), (Figure 4-24).
- Select the Boom Angle Limitation Menu Screen (3), (Figure 4-30). **NOTE:** The Boom Angle Limitation Icon (8), (Figure 4-33) is shown on the top left side of the ODM screen.
- Enable the limitation by using the Jog Dial (5), (Figure 4-22) or the Arrow Keys (4), (Figure 4-21) and move to the Enable/Disable Switch (1), (Figure 4-32). **NOTE:** The Switch (1), (Figure 4-33) is the Enable/Disable Switch and is a toggle switch. Click OK (5), (Figure 4-21), or the Jog Dial (5), (Figure 4-22) to set the switch.
- Use the Jog Dial (5), (Figure 4-22), or the Right Arrow Key (4), (Figure 4-21) to move and select the Maximum Boom Angle (3), (Figure 4-33), Limitation A. Enable the value entry by clicking on OK (5), (Figure 4-21). Enter a value by using the Jog Dial (5), (Figure 4-22) or the upper and lower arrow keys (4), (Figure 4-21) to change the value (in tenths) to the desired boom angle value (3), (Figure 4-33).

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

- Use the OK Button (5), (Figure 4-21) to finish entering the value.

**NOTE:** The boom may now be near the limitation (depending on the value entered), so alarms may be active. The boom can now be moved away from the current boom elevation to cease the alarm, if needed.

- The Boom Up Limit is now defined and enabled.

### Setting Boom Down Limits Menu by Value

To define and enable the Boom Down Elevation Limits Menu using a "typed in" value as the limitation, the following steps can be used:

- Set the RDM screen parameters first. Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-82.
- Using the Jog Dial (5), (Figure 4-21), go to the ODM Main Menu Screen. Then choose the Working Range Limiter (WRL) Group Menu Icon (10), (Figure 4-24).
- Select the Boom Angle Limitation Menu Screen (3), (Figure 4-30). **NOTE:** The Boom Angle Limitation Icon (8), (Figure 4-33) is shown on the top left side of the ODM screen.
- Enable the limitation by using the Jog Dial (5), (Figure 4-22) or the Arrow Keys (4), (Figure 4-21) and move to the Enable/Disable Switch (4), (Figure 4-33). **NOTE:** The Switch (4), (Figure 4-33) is the Enable/Disable Switch and is a toggle switch. Click OK (5), (Figure 4-21), or the Jog Dial (5), (Figure 4-22) to set the switch.
- Use the Jog Dial (5), (Figure 4-22), or the Right Arrow Key (4), (Figure 4-21) to move and select the Minimum Boom Angle Symbol (6), (Figure 4-33), Limitation B. Enable the value entry by clicking on OK (5), (Figure 4-21). Enter a value by using the Jog Dial (5), (Figure 4-22) or the upper and lower arrow keys (4), (Figure 4-21) to change the value (in tenths) to the desired boom angle value (6), (Figure 4-33). **NOTE:** The Limitation is dependent on the accuracy of the Boom Angle Sensor, which can be  $\pm$  degrees.
- Use the OK Button (5), (Figure 4-21) to finish entering the value. **NOTE:** The boom may now be near the limitation (depending on the value entered), so alarms may be active. The boom can now be moved away from the current boom elevation to cease the alarm, if needed.
- The Boom Down Limit is now defined and set.

### Boom Up/Down Limitation Disable Procedure

To disable an active Boom Up or Boom Down Limitation, the following steps are to be used (note that turning off the power to the control system also disables the WRL limitations):

- Select the Boom Up or Boom Down Limitation Menu (3), (Figure 4-30) Screen.
- Use the Left Arrow and/or Right Arrow Function keys (4), (Figure 4-21) to highlight the Switch Enable/Disable Symbol (1) or (4), (Figure 4-33). Enable is "I" and Disable is "O".
- Use the OK Button (5), (Figure 4-21), or the Jog Dial (5), (Figure 4-22) to toggle to disable the limitation.

**WRL - Boom Height Limitation Menu**

If the Boom Height Limitation is selected from the menu of WRL Limitations, then the Boom Height Limitation Screen will be shown (4), (Figure 4-30).

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 4-34, Item 5 is highlighted in orange.

Using the Left Arrow and Right Arrow Function keys (4), (Figure 4-21) on the display or the Jog Dial (5), (Figure 4-22)

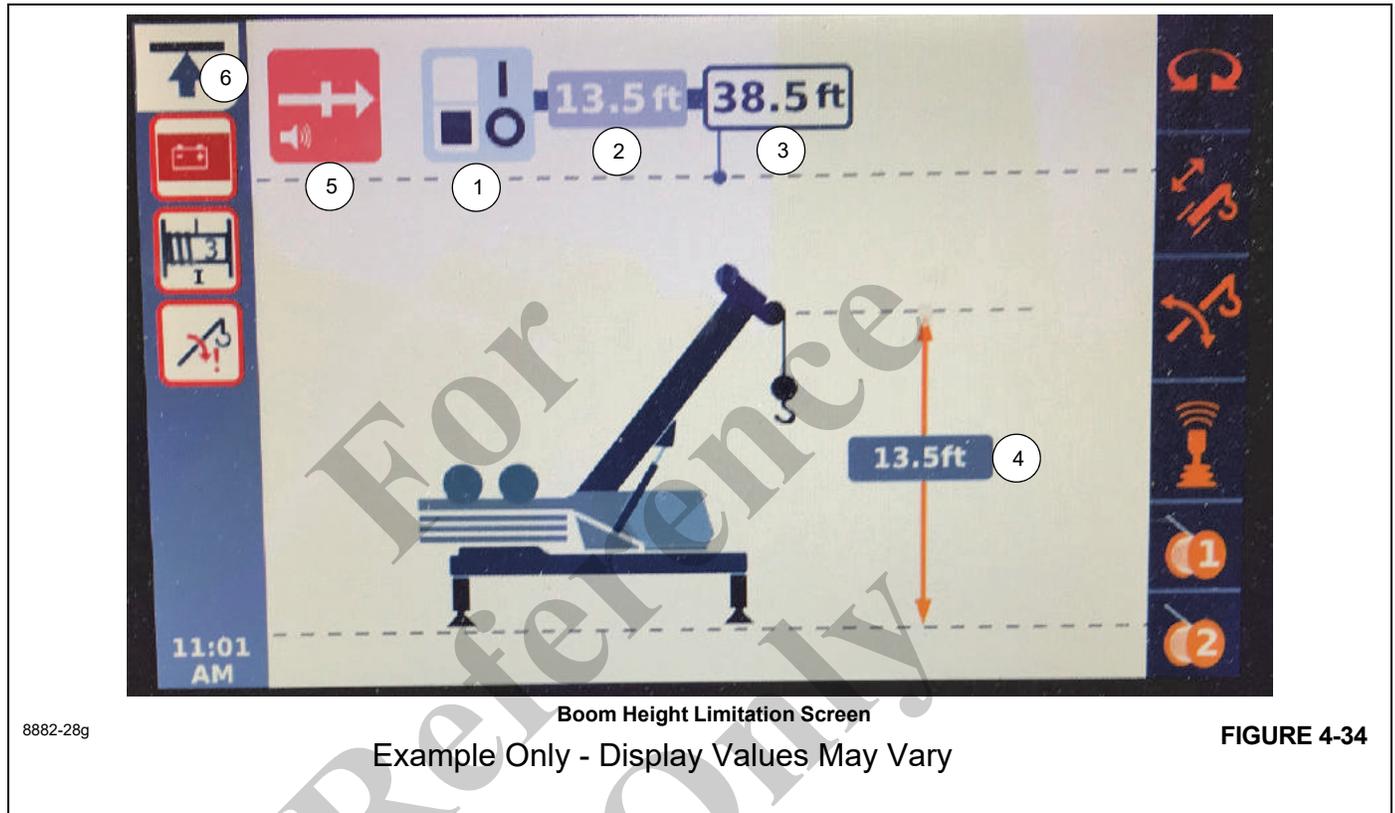


FIGURE 4-34

**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 4-34) 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 4-34
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	

**Setting 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 4-82.
2. Using the Jog Dial (5), (Figure 4-22), go to the ODM Main Menu Screen (Figure 4-24). Go to the Working Range Limiter (WRL) Group Menu Icon (4), (Figure 4-30) by using the Arrow keys (4), (Figure 4-21) or the Jog Dial (5), (Figure 4-22).
3. Select the Boom Height Limitation Menu (4), (Figure 4-30). **NOTE:** The Boom Height Limitation Icon (6), (Figure 4-34) is shown on the top left side of the ODM screen.
4. Enable the Limitation by using the Jog Dial (5), (Figure 4-22), or the Arrow Keys (4), (Figure 4-21) to move and select the Enable/Disable Switch Symbol ON/Off (1), (Figure 4-33). **NOTE:** The Switch (1), (Figure 4-34) is a toggle switch. Click OK (5), (Figure 4-21), or the Jog Dial (5), (Figure 4-22) to toggle the switch.
5. Move the Boom tip to the desired position. This position will indicate the boom height current value (2 and 4) positions.

**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 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 4-82.
2. Using the Jog Dial (5), (Figure 4-21), go to the ODM Main Menu Screen. Then choose the Working Range Limiter (WRL) Group Menu Icon (4), (Figure 4-30).
3. Select the Boom Height Limitation Menu Screen (4), (Figure 4-30). **NOTE:** The Boom Height Limitation Icon (6), (Figure 4-34) is shown on the top left side of the ODM screen.
4. Enable the limitation by using the Jog Dial (5), (Figure 4-22) or the Arrow Keys (4), (Figure 4-21) and move to the Enable/Disable Switch (1), (Figure 4-32). **NOTE:** The Switch (1), (Figure 4-34) is the Enable/Disable Switch and is a toggle switch. Click OK (5), (Figure 4-21), or the Jog Dial (5), (Figure 4-22) to toggle the switch. Click OK.

**NOTE:** The alarm will sound if boom tip is above limit, when enabled.

5. Use the Right Arrow Function key to highlight the Limitation Value (3), (Figure 4-34). Use the OK Button (5), (Figure 4-21) to begin entering the value. Use the Up Arrow or the Down Arrow or Jog Dial (5), (Figure 4-22) to change the value (in tenths) to the desired tip height value.

**NOTE:** The Limitation is dependent on the accuracy of the Tip Height Calculation, which can be  $\pm 5\%$ .

6. Use the OK Button (5), (Figure 4-21) to finish entering the value.

**NOTE:** The boom may now be near the limitation (depending on the value entered), so alarms may be active. The boom can now be moved away from the current tip height to cease the alarm, if needed.

7. The Overall Boom Height is now defined and enabled.

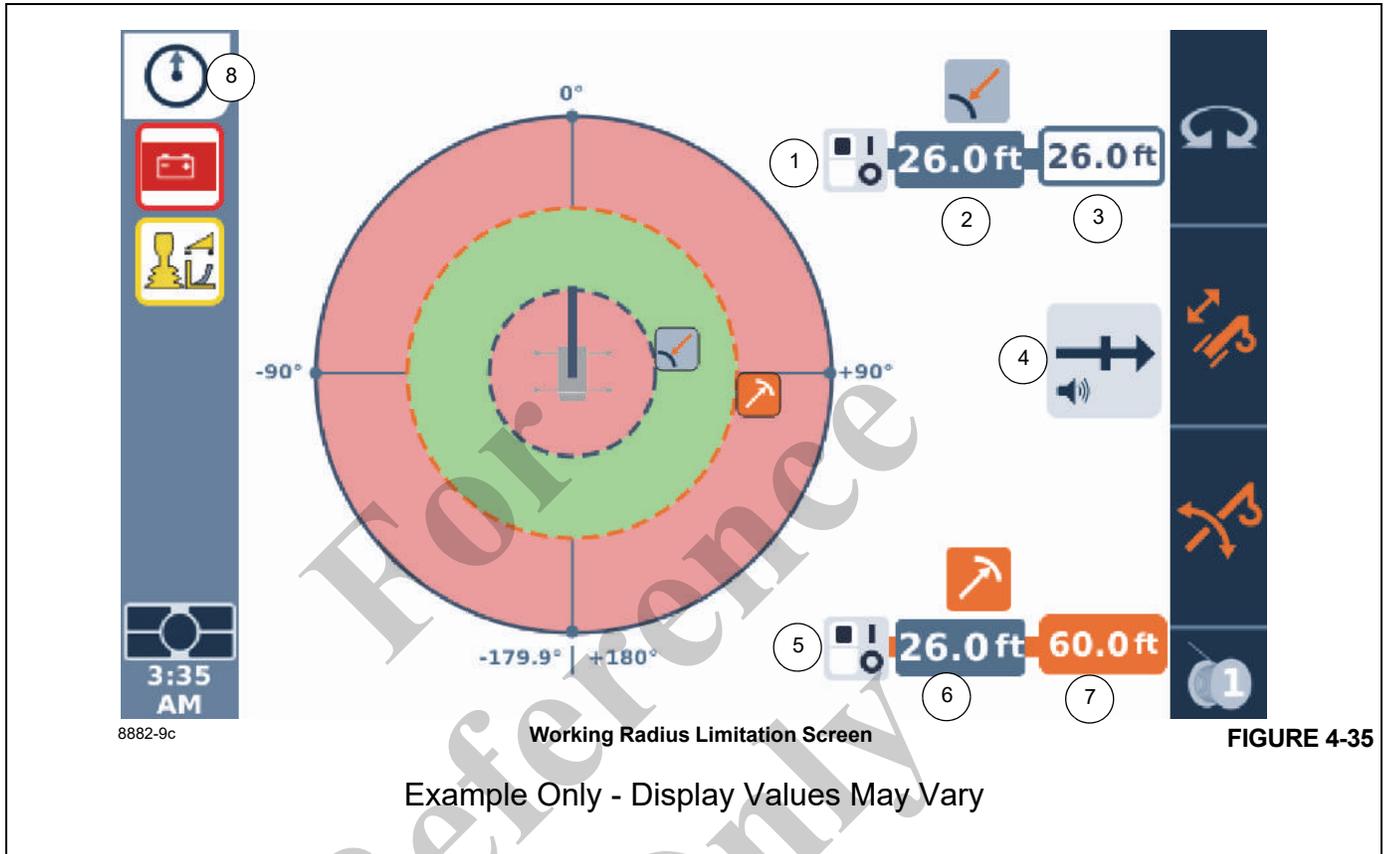
### Boom Height Limitation Disable Procedure

To disable an active Overall Height, the following steps can be used (note that turning off the power to the control system also disables the WRL limitations):

1. Select the Overall Height Menu (4), (Figure 4-30) screen on the Main Menu Screen.
2. Use the Left Arrow and/or Right Arrow Function keys (4), (Figure 4-21) to highlight the Switch Enable/Disable Symbol (3), (Figure 4-32). Enable is "I" and Disable is "O".
3. Use the OK Button (5), (Figure 4-21), or the Jog Dial (5), (Figure 4-22) to toggle to disable the limitation.

### WRL - Working Radius Limitation

If the Radius Limitation is selected from the Menu of WRL Limitations, then the Radius Limitation Screen will be shown (5), (Figure 4-30).



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 radius limits for the boom.

Item	Description	Refer to
1	Minimum Radius Enable/Disable Switch	(Figure 4-3 5)
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 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 4-82.
2. Using the Jog Dial (5), (Figure 4-22), go to the ODM Main Menu Screen (Figure 4-32). Then choose the Working Range Limiter (WRL) Group Menu Icon (5), (Figure 4-30) by using the Arrow keys (4), (Figure 4-21) or the Jog Dial (5), (Figure 4-22).
3. Select the Working Radius Limitation Menu Screen (5), (Figure 4-30). **NOTE:** The Working Radius Limitation Icon (8), (Figure 4-35) is shown on the top left side of the ODM screen.
4. Enable the limitation by using the Jog Dial (5), (Figure 4-22) or the Arrow Keys (4), (Figure 4-21) and move to the Enable/Disable Switch (1), (Figure 4-35). **NOTE:** The Switch (1), (Figure 4-35) is the Enable/Disable Switch and is a toggle switch. Toggle to "I" and click OK (5), (Figure 4-21), or the Jog Dial (5), (Figure 4-22) to enable the switch.
5. Move the Boom to the desired position. This position will indicate the inner or minimum radius limitation current value (2), (Figure 4-35) position.
6. Use the Jog Dial (5), (Figure 4-22) or the Arrow Keys (4), (Figure 4-21) and move to the Limitation Value (2), (Figure 4-35). Click OK to set the current value Limitation (2), (Figure 4-35) 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 4-35) 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 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 4-82.
2. Using the Jog Dial (5), (Figure 4-21), go to the ODM Main Menu Screen. Then choose the Working Range Limiter (WRL) Group Menu Icon (5), (Figure 4-30).
3. Select the Working Radius Limitation Menu Screen (11), (Figure 4-24). **NOTE:** The Working Radius Limitation Icon (8), (Figure 4-35) is shown on the top left side of the ODM screen.
4. Enable the limitation by using the Jog Dial (5), (Figure 4-22) or the Arrow Keys (4), (Figure 4-21) and move to the Enable/Disable Switch (1), (Figure 4-35). **NOTE:** The Switch (1), (Figure 4-35) is the Enable/Disable Switch and is a toggle switch. Toggle to "I" and click OK (5), (Figure 4-21), or the Jog Dial (5), (Figure 4-22) to set the switch. Click OK.
5. Use the Jog Dial (5), (Figure 4-22), to move and select the Limitation (3), (Figure 4-35) to set the Inner or Minimum Radius Limitation value. Enter a value by using the Jog Dial (5), (Figure 4-22) or the upper and lower arrow keys (4), (Figure 4-21) to change the value (in tenths) to the desired radius value. Use the OK Button (5), (Figure 4-21) 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 4-35) 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 4-35) on the Main Menu Screen.
2. Use the Left Arrow and/or Right Arrow Function keys (4), (Figure 4-21) to highlight the Switch Enable/Disable Symbol (3), (Figure 4-32). Enable is "I" and Disable is "O".
3. Use the OK Button (5), (Figure 4-21), or the Jog Dial (5), (Figure 4-22) to toggle to disable the limitation.

For  
Reference  
Only

### WRL - Virtual Walls Limitation Menu

If the Virtual Wall Limitation is selected from the menu of WRL Limitations, then the Virtual Wall Limitation Screen will be shown (Figure 4-36).

Using the Left Arrow and Right Arrow (4), (Figure 4-21) Function Keys on the Display or the Jog Dial (5), (Figure 4-22) 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 4-36, one can see that the wall Point "A" Symbol is selected since it has the orange color highlighting.

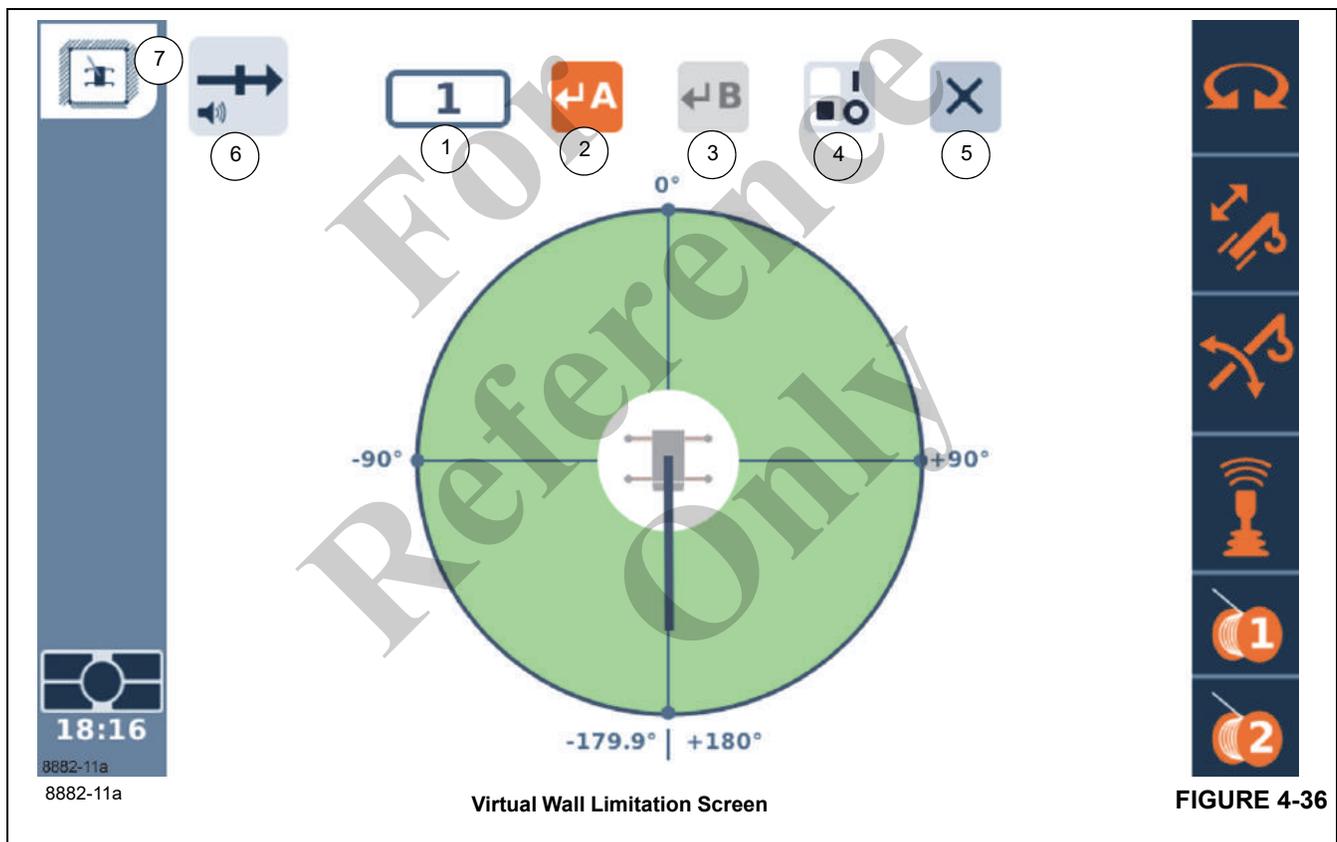


FIGURE 4-36

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 4-3 6
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 4-30) 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 4-36). (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 4-21) Function key to highlight the Accept Crane Position Point A Symbol (2), (Figure 4-36).
4. Use an OK Button (5), (Figure 4-21) 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 4-37).
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 4-36). **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 4-21) Function key to highlight the Accept Crane Position Point B Symbol (3), (Figure 4-36).

7. Use an OK Button (5), (Figure 4-21) 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 4-37).

**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 4-37, increments if the second wall was just defined, so that it is ready to define a subsequent Virtual Wall, if so desired.

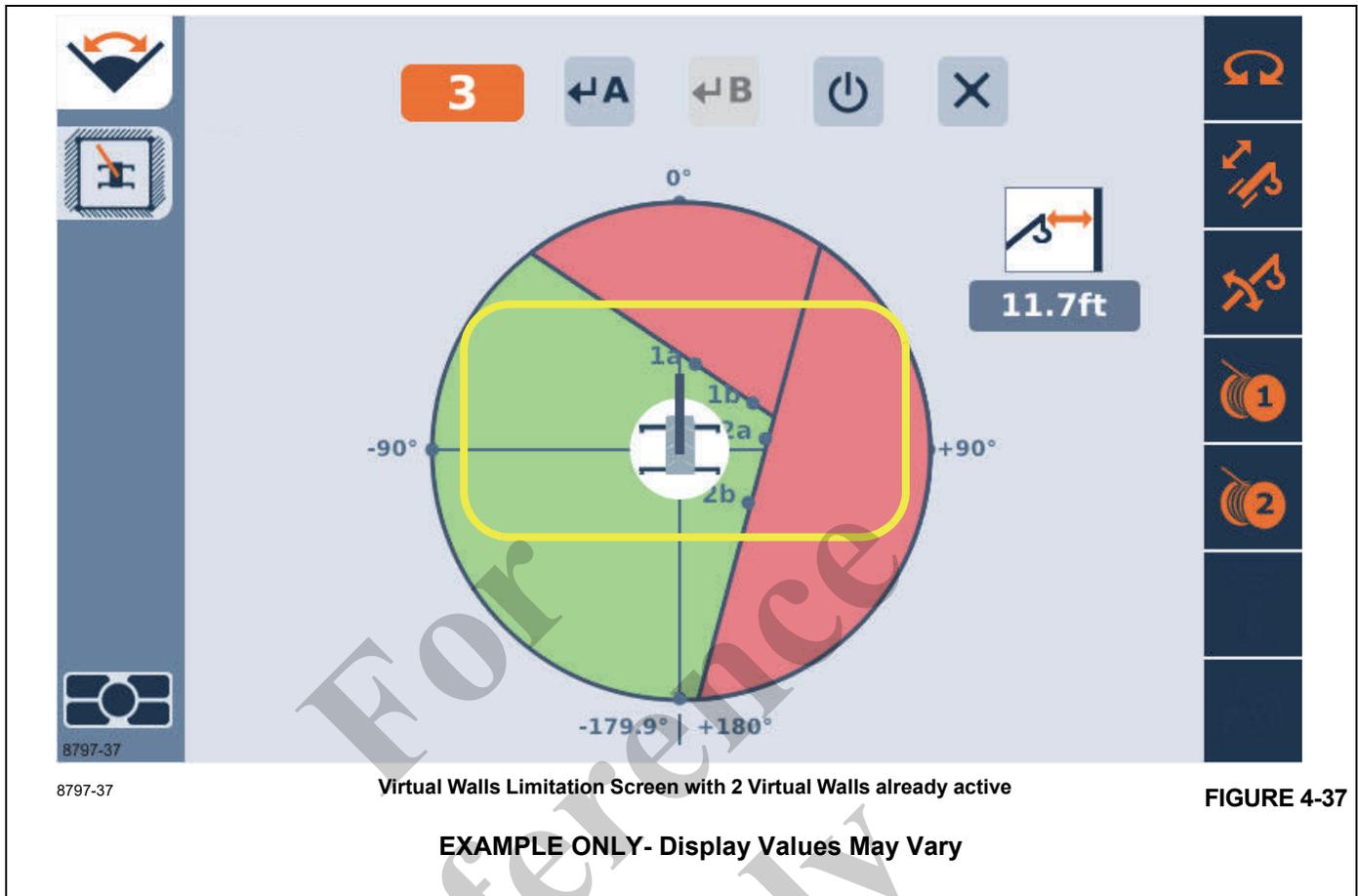


FIGURE 4-37

### 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 4-36).
  2. Use the Right Arrow (4), (Figure 4-21) function key to highlight the Virtual Wall Number Item (1), (Figure 4-36).
  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 4-21) to allow modifying the value. Use the Up/Down Arrow Keys (4), (Figure 4-21) to alter the Virtual Wall number to the desired value. Use an OK Button (5), (Figure 4-21) 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 4-36.
  5. Use the Right Arrow (4), (Figure 4-21) Function key to highlight the Accept Crane Position Point A Symbol (2), (Figure 4-36).
  6. Use an OK Button (5), (Figure 4-21) to accept the current crane position to be Point A as shown in Figure 4-36. 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 4-37.
  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 4-36).
- 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 4-21) Function key, if needed, to highlight the Accept Crane Position Point B Item (3), (Figure 4-36).
  9. Use an OK (5), (Figure 4-21) Button to accept the current crane position to be Point B (3), (Figure 4-36). The location of the point should now be shown on the screen with a label (1b) as shown in yellow highlight in Figure 4-37.
- 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. The 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 4-22) go to the Working Range Limiter (WRL) Group Menu (1), (Figure 4-30). Then choose the Virtual Walls Limitation Menu (6), (Figure 4-30).
2. Use the Right Arrow (4), (Figure 4-21) key and to highlight the Virtual Wall Number (1), (Figure 4-36).
3. If the wall number shown is not the correct number for wall to be disabled, use an OK Button (5), (Figure 4-21) 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 4-36).
4. Use the Up/Down Arrows (4), (Figure 4-21) to alter the Virtual Walls number to the desired value. Use an OK Button (5), (Figure 4-21) to finish entering the value.
5. Use the Left Arrow and/or Right Arrow (4), (Figure 4-21) keys or the Jog Dial (5), (Figure 4-22) to highlight the Enable/Disable Switch Symbol (4), (Figure 4-36).
6. Use an OK Button (5), (Figure 4-21) 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 4-30) on the WRL Menu Group Screen (Figure 4-30).
2. Use the Right Arrow (4), (Figure 4-21) Function to highlight the Virtual Wall Number (1), (Figure 4-36).
3. If the wall number shown is not the correct number for wall to be disabled, use an OK Button (5), (Figure 4-21) 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 4-36).
4. Use the Left Arrow and/or Right Arrow (4), Figure 4-21 key to highlight the "X" or the Remove Virtual Walls Symbol (5), (Figure 4-36). Use an OK Button (5), (Figure 4-21) or the Jog Dial (5), (Figure 4-22) to delete the wall.

Reference Only

### Errors (Fault Code) Group Menu

The Errors Menu (Fault Code) Group is made up of the following icons:

- **Crane Operation Function Icon**  
(refer to *Crane Operation Function*, page 4-70)
- **Engine Fault Function Icon**  
(refer to *Engine Fault Function*, page 4-70).

When an error message (or Error Icon) appears, go to Error Message Menu (16), (Figure 4-24) on the second page of the main menu and select the appropriate sub menu based on the error message being displayed.

#### Crane Operation Function

The Crane Operation Function Screen (Figure 4-38) displays any active crane Error and/or Fault codes.

If several fault codes are active, use the Jog Dial (5), (Figure 4-22) or Arrow Buttons (4), (Figure 4-21) on the Navigation Control Pad to select the arrow at the top or bottom of the screen to scroll through the codes.

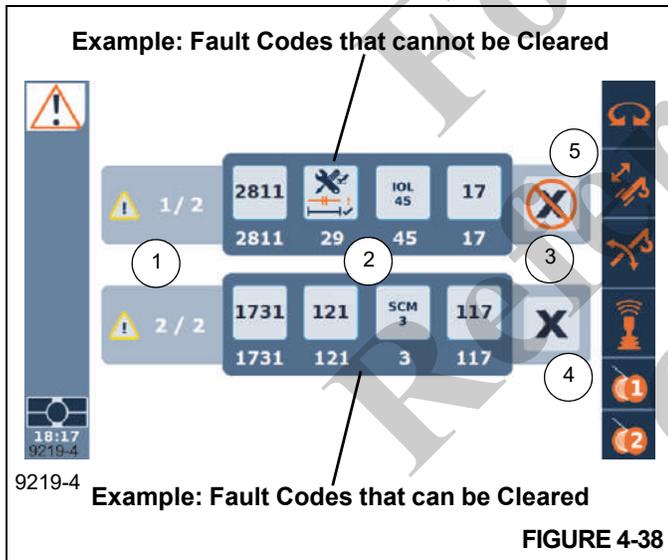


FIGURE 4-38

Item	Description	Refer to
1	Display of Error / Total Errors	Figure 4-38
2	Error Message Display	
3	Acknowledging the Error	
4	Fault Codes that can be Cleared	
5	Fault Codes that cannot be Cleared	
6	Crane Error Code Icon	

Crane fault codes with an “X” beside them can be cleared by the operator. Crane fault codes with an “X” surrounded by an orange 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.

A list of all fault codes and their definitions are available through Manitowoc Crane Care to those service technicians who have attended the Grove New Technology Training Course.

#### Engine Fault Function

The Engine Fault Function Screen (Figure 4-39) displays the active engine Errors and/or Fault codes.

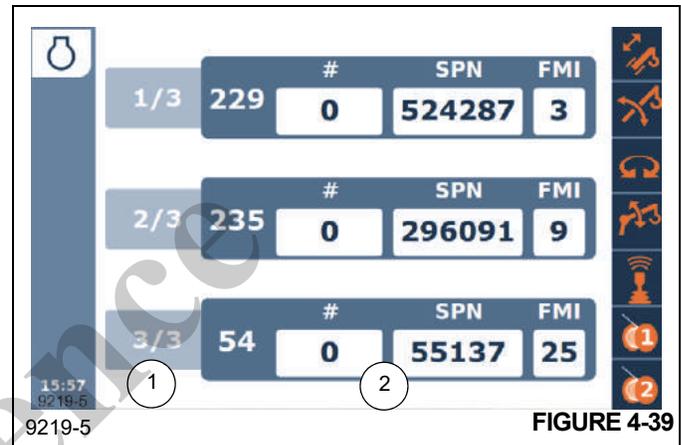


FIGURE 4-39

Item	Description	Refer to
1	Display of Error / Total Errors	Figure 4-39
2	Error Message Display	
3	Engine Error Code Icon	

If several fault codes are active, use the Jog Dial (5), (Figure 4-22) or Arrow Buttons(4), (Figure 4-21) 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.

Record the error(s) and contact your Grove distributor or Manitowoc Crane Care.

#### Information Group Menu

The Information Menu Group is made up of the Cranes Operating Hours, the Software Version, and Legal Notice Functions. Refer to Figure 4-40.

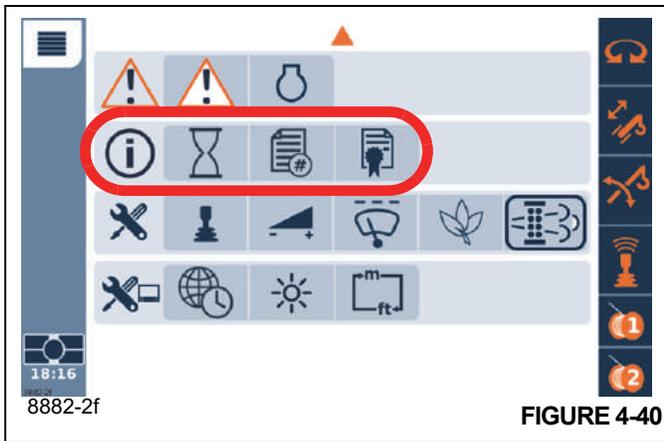


FIGURE 4-40

Icon	Description
	Operating Hours Icon - not selected
	Operating Hours Icon - selected
	Software Version Icon - not selected
	Software Version Icon - selected
	Legal Notice Icon - not selected
	Legal Notice Icon - selected

**Accessing an Information Group Function Screen**

Access an Information Group Function Screen (Figure 4-40) by doing one of the following:

- Press the Screen Toggle Button (4), (Figure 4-22) at the Jog Dial (5), (Figure 4-22) to select the ODM screen control.

Press the Menu Button (3), (Figure 4-22) to go to the Menu Screen.

Using the Jog Dial (5), (Figure 4-22) select one of the Information Group Function Icons (Icon will turn orange), then press the Jog Dial (5), (Figure 4-22).

- Press the Menu Button (3), (Figure 4-22) on the Navigation Control Pad at the ODM to go to the Menu Screen.

Using the Arrow Buttons (4), (Figure 4-21) select one of the Information Group Function Icons (Icon will turn orange), then press the OK Button (5), (Figure 4-21).

**Exiting an Information Group Function Screen**

Perform one of the following procedures to exit an Information Group Function Screen and navigate to the Main Screen or Menu Screen:

- Press the Screen Toggle Button (4), (Figure 4-22) at the Jog Dial to select the ODM screen control, then press the Escape Button (1), (Figure 4-22) for the Main Screen or the Menu Button (3), (Figure 4-22) for the Menu Screen.
- Press the Escape Button (1), (Figure 4-22), on the Navigation Control Pad at the ODM, for the Main Screen or the Menu Button (3), (Figure 4-22) for the Menu Screen.

**Viewing the Operating Hours**

The Operating Hours Function Screen (Figure 4-41) displays the total accumulated operating hours for the different crane functions as well as offers a resettable trip meter for each crane function.

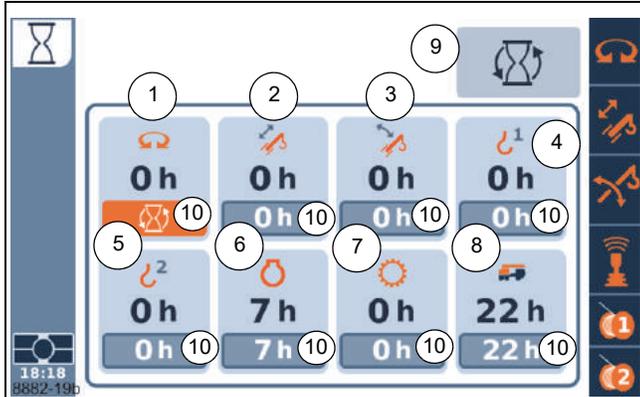


FIGURE 4-41

Item	Description
1	Swing
2	Telescoping
3	Lift
4	Main Hoist
5	Auxiliary Hoist (Optional)
6	Engines
7	Transmission
8	Superstructure
9	Reset all Operating Hours
10	Operating Hours that can be Reset (Trip Hours)

- OR -

Icon	Description
	Swing Operating Hours Icon - not selected
	Swing Operating Hours Icon - selected
	Boom Telescope Operating Hours Icon - not selected

Icon	Description
	Boom Telescope Operating Hours Icon - selected
	Boom Lift Operating Hours Icon - not selected
	Boom Lift Operating Hours Icon - selected
	Main Hoist Operating Hours Icon - not selected
	Main Hoist Operating Hours Icon - selected
	Transmission Operating Hours Icon - not selected
	Transmission Operating Hours Icon - selected
	Engine Operating Hours Icon - not selected
	Engine Operating Hours Icon - selected
	Auxiliary Hoist (Optional) Operating Hours Icon - not selected
	Auxiliary Hoist (Optional) Operating Hours icon - selected

Icon	Description
	Reset All icon - not selected
	Reset All icon - selected

To view the total operating hours, open the Operating Hours Menu (20), (Figure 4-24).

**NOTE:** The total operating hours cannot be reset.

The operating hours are recorded as follows:

1. The value (6), (Figure 4-41) indicates the total engine operating hours as 7 hours.
2. The value (10), (Figure 4-41) shows the operating hours, which can be reset.

To reset an individual hour meter, use the Jog Dial (5), (Figure 4-22) or the Arrow Buttons (4), (Figure 4-21) on the Navigation Control Pad to select the time to reset. The selected function will show the Icon hour-glass in orange.

To reset the trip meter for a crane function, do the following:

1. Using the Jog Dial (5), (Figure 4-22) or Arrow Buttons (4), (Figure 4-21) 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 (5), Figure 4-22) or OK Button (5), (Figure 4-21) 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 to zero (0), select the Reset All Icon (the Icon will turn orange) on the Operating Hours Function Screen and press the Jog Dial (5), (Figure 4-22) or the OK Button (5), (Figure 4-21).

**Viewing the Software Version Screen**

The Software Version Screen (Figure 4-42) displays the current software version for all of the software installed on the crane. This is a view only screen.

**NOTE:** The Software Version shown in Figure 4-42 may not match those installed in the crane.

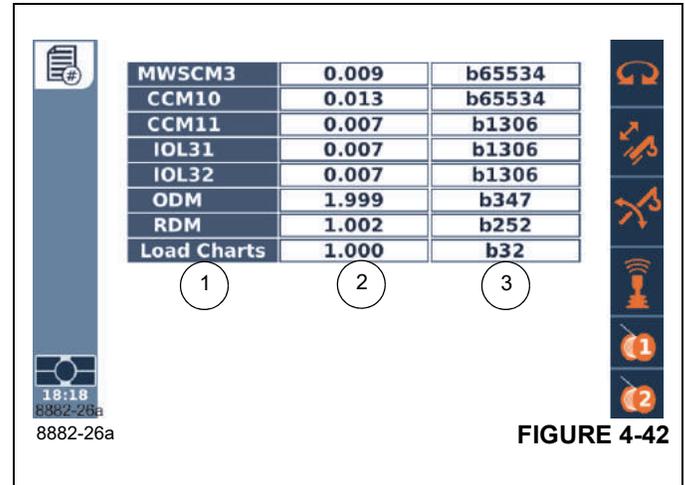


FIGURE 4-42

Item	Description
1	Module
2	Software version
3	Software build tag

**Viewing the Legal Notice Screen**

The Legal Notice Screen (Figure 4-43) displays the software licensing notice for the crane's software. This is a view only screen.

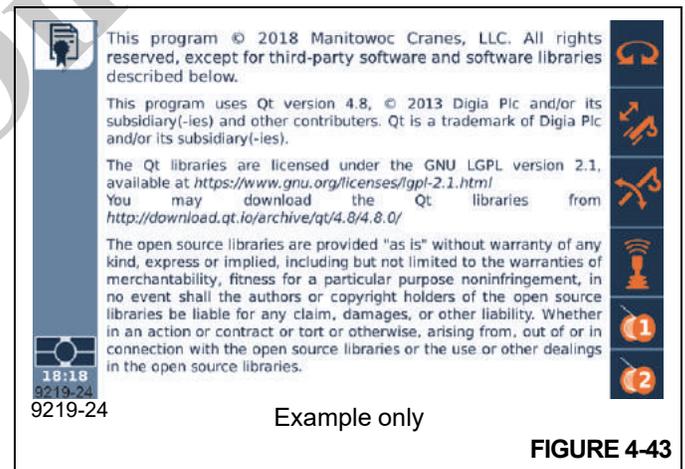


FIGURE 4-43

**Tools Group Menu**

The Tools Group Menu is made up of the Icons shown in Figure 4-44 that allows the operator to select sub-menus to adjust parameters, set display options, and control functions.

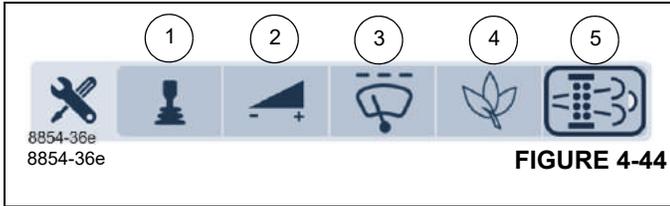


FIGURE 4-44

Item	Description
1	Controller Sensitivity Function Icon
2	Controller Function Speed Icon
3	Wiper Interval Function Icon
4	Economy Mode Function Icon
5	Exhaust System Cleaning Function Icon

**Accessing a Tools Group Function Screen**

Access a Tools Group Function Screen (Figure 4-44) by doing one of the following:

- Press the Screen Toggle Button (4), (Figure 4-22) at the Jog Dial to select the ODM Screen.

Press the Menu Button (3), (Figure 4-22) to go to the Menu Screen.

Using the Jog Dial (5), (Figure 4-22) select one of the Tools Group Function Icons as shown in (Figure 4-44). When selected, the Icon will turn orange. Then press the Jog Dial (5), (Figure 4-22) to select it.

- OR -

- Press the Menu Button (3), (Figure 4-21) on the Navigation Control Pad at the ODM to go to the Menu Screen.

Using the Arrow Buttons (4), (Figure 4-21) select one of the Tools Group Function Icons (Icon will turn orange), then press the OK Button (5), (Figure 4-21).

**Exiting a Tools Group Function Screen**

Perform one of the following procedures to exit a Tools Group Function Screen and navigate to the Main Screen or Menu Screen:

Press the Screen Toggle Button (4), (Figure 4-22) at the Jog Dial (5), (Figure 4-22) to select the ODM screen

control, then press the Escape Button (1), (Figure 4-22) for the Main Screen or the Menu Button (3), (Figure 4-22) for the Menu Screen.

- OR -

- Press the Escape Button (1), (Figure 4-21), on the Navigation Control Pad at the ODM for the Main Screen or the Menu Button (3), (Figure 4-21) for the Menu Screen.

**Setting the Controller Sensitivity Function**

The Controller Sensitivity Function Screen (Figure 4-45) allows the operator to adjust the sensitivity of the controllers and foot pedal (optional).

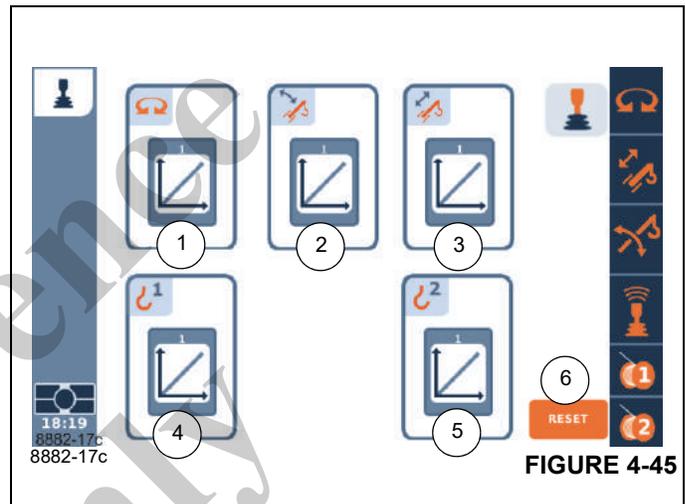


FIGURE 4-45

Item	Description	Refer to
1	Swing function curve	Figure 4-45
2	Boom lift/lowering function curve	
3	Telescope function curve	
4	Main hoist curve	
5	Auxiliary hoist function curve <sup>1)</sup>	
6	Reset function curves	

**NOTE:** When a Reset Function is enabled (6), (Figure 4-45), everything is then placed at 100%.

Icon	Description
	Swing Function Sensitivity icon - not selected
	Swing Function Sensitivity icon - selected
	Swing Function Sensitivity icon - active
	Telescope Function Sensitivity icon - not selected
	Telescope Function Sensitivity icon - selected
	Telescope Function Sensitivity icon - active
	Boom Lift Function Sensitivity icon - not selected
	Boom Lift Function Sensitivity icon - selected

Icon	Description
	Boom Lift Function Sensitivity icon - active
	Main Hoist Function Sensitivity icon - not selected
	Main Hoist Function Sensitivity icon - selected
	Main Hoist Function Sensitivity icon - active
	Auxiliary Function Sensitivity icon - not selected
	Auxiliary Hoist Function Sensitivity icon - selected
	Auxiliary Hoist Function Sensitivity icon - active

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 4-48).

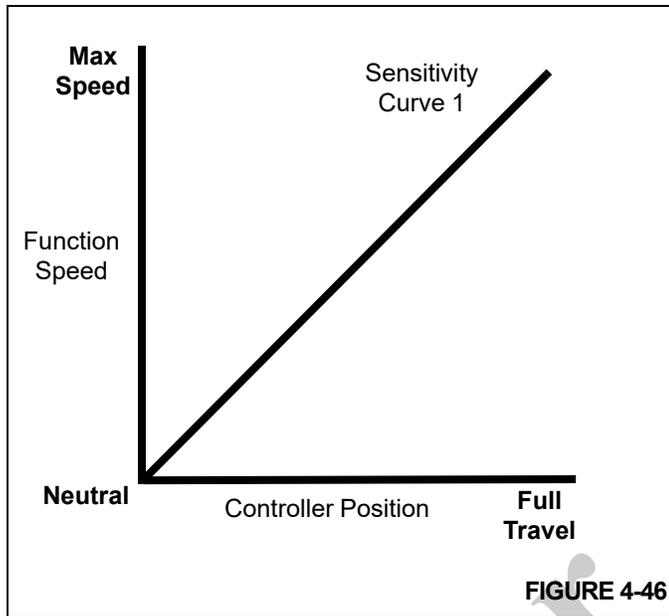


FIGURE 4-46

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 4-47). Sensitivity curve 1 (default) is the most sensitive and sensitivity curve 5 is the least sensitive (Figure 4-47).

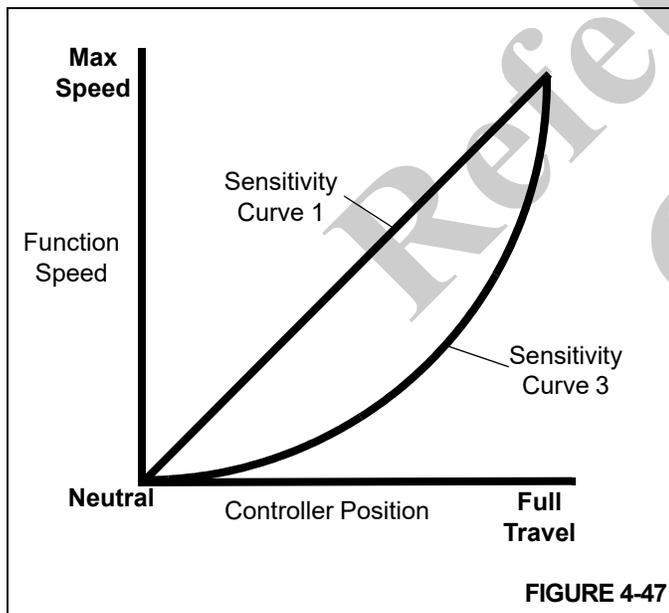


FIGURE 4-47

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

1. Using the Jog Dial (5), (Figure 4-22) or Arrow Buttons (4), (Figure 4-21) 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 4-48).

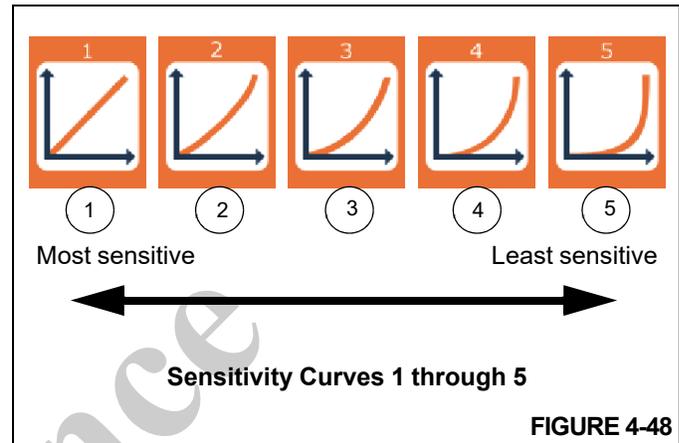


FIGURE 4-48

4. Press the Jog Dial or OK Button on the Navigation Control Pad to accept the new setting.

Select the Reset icon on the Controller Sensitivity function screen and press the Jog Dial or the OK Button to set the sensitivity on both controllers and the foot pedal (optional) back to the factory default settings.

**Setting the Controller Speed Function**

The Controller Speed Function Screen (Figure 4-45) allows the operator to adjust the crane function speeds relative to the positions of the controllers and the foot pedal (optional). Adjustment is made as a percentage of full rated speed.

A setting of 100% results in the crane function moving at full rated speed relative to the position of the controller or foot pedal (optional). A setting of 75% results in the crane function moving at 75% of full rated speeds throughout the range of the controller or foot pedal.

To promote proper machine functionality, certain functions may not allow low percentage and be forced to 0%.

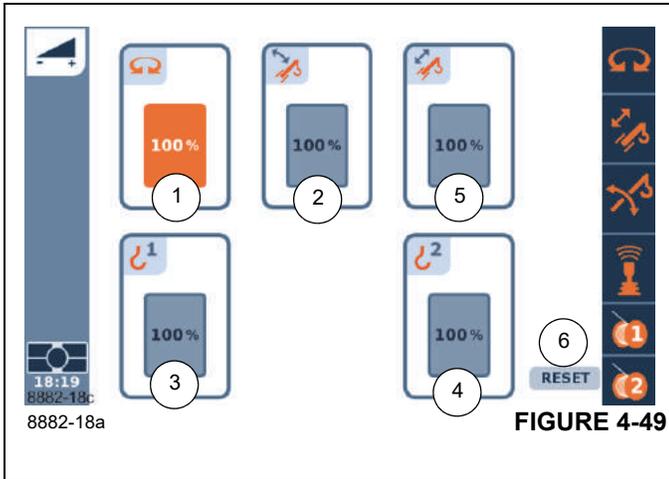
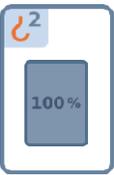


FIGURE 4-49

Item	Description	Refer to
1	Swing Speed Percentage	Figure 4-49
2	Boom Lifting/lowering Speed Percentage	
3	Main Hoist Speed Percentage	
4	Auxiliary Hoist Speed Percentage	
5	Telescope Speed Percentage	
6	Reset all Speed Percentages	

Icon	Description
	Swing Speed Function Icon - not selected
	Swing Speed Function Icon - selected

Icon	Description
	Swing Speed Function Icon - active
	Telescope Speed Function Icon - not selected
	Telescope Speed Function Icon - selected
	Telescope Speed Function Icon - active
	Boom Lift Speed Function Icon - not selected
	Boom Lift Speed Function Icon - selected
	Boom Lift Speed Function Icon - active
	Main Hoist Speed Function Icon - not selected

Icon	Description
	Main Hoist Speed Function Icon - selected
	Main Hoist Speed Function Icon - active
	Auxiliary Hoist Speed Function Icon - not selected (Optional)
	Auxiliary Hoist Speed Function Icon - selected (Optional)
	Auxiliary Hoist Speed Function Icon - active

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

- Using the Jog Dial (5), (Figure 4-22) or Arrow Buttons(4), (Figure 4-21) on the Navigation Control Pad, select the controller function icon that is to be adjusted (icon will turn orange).
- Press the Jog Dial(6), (Figure 4-22) or OK Button (5), (Figure 4-21) on the Navigation Control Pad to make the controller function icon active (icon background will turn gray).
- Using the Jog Dial (5), (Figure 4-22) or the Up/Down Arrow Buttons (4), (Figure 4-21), adjust the percentage to the desired setting.

Adjustments are made in 1% increments/decrements. To quickly make large adjustments, hold the Jog Dial down while rotating it.

- Press the Jog Dial (5), (Figure 4-22) or OK Button(5), (Figure 4-21) on the Navigation Control Pad to accept the new setting.

Select the Reset icon on the Controller Speed function screen and press the Jog Dial or the OK Button to set the speed of both controllers and the foot pedal (optional) back to the factory default settings of 100%.

**Setting the Wiper Interval Function**

You can set a value between 3 and 30 seconds for the front and roof window wiper interval (3), (Figure 4-51).

**NOTE:** The higher the selected value, the longer the pauses between the strokes of the wiper.

Select and confirm the symbol (3), (Figure 4-50). The Windshield Wiper Menu opens.

- The displays (1), (Figure 4-50) and (2), (Figure 4-50) show the current values.

3	Interval for windshield wiper
4	Interval for skylight window wiper

- Select and confirm the symbol:

1	For the windshield wiper – symbol (5) displayed
2	For the skylight window wiper – symbol (6) displayed

- Select and confirm the symbol (7). Symbol is orange – input on.

To cancel the input – press the ESC Button (1), (Figure 4-21) once.

- Change the value by pressing the Jog Dial (5), (Figure 4-22) or the Arrow Keys (4), (Figure 4-21). Confirm the changed value with the OK Button (5), (Figure 4-21).

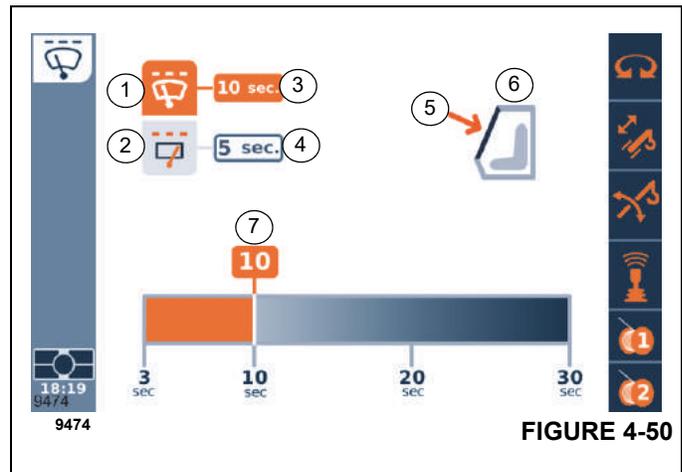


FIGURE 4-50

**Setting the Economy (ECO) Mode Function**

In Economy (ECO) Mode, the crane software will control the throttle command to the engine over J1939. Based on the state of the crane and inputs from the throttle pedal and the Increment/Decrement Throttle Switch, the ECO mode will reduce the throttle command when crane functions are not being used. This is intended to encourage the operator to run crane functions with enough power provided by the engine and reduce the fuel consumption when the crane is not doing any work.

**NOTE:** The ECO mode does not work when the carrier cab is active.

To open: Select symbol (4), (Figure 4-44) and confirm. To set or adjust economy mode refer to Figure 4-51.

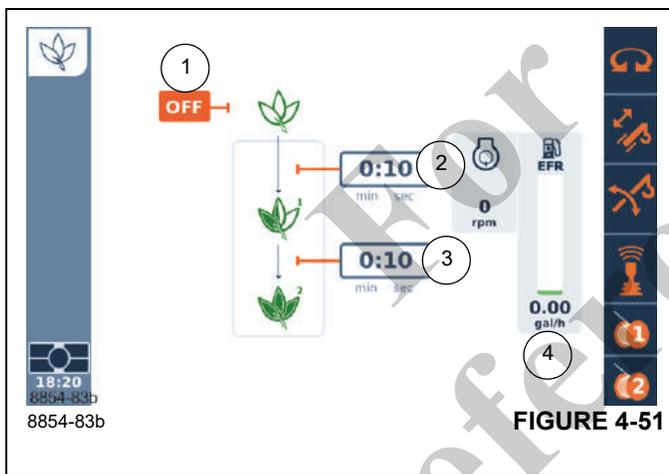


FIGURE 4-51

Item	Description	Refer to
1	Switching Economy mode ON/OFF	Figure 4-51
2	Set Interval 1	
3	Set Interval 2	
4	Average Fuel Consumption	

The OFF Button (1), (Figure 4-51) enables/disables ECO mode. When turned OFF there is no RPM reduction. The engine RPM follows the Increment/Decrement Switch and throttle pedal.

Item (2),(Figure 4-51) is the time delay the engine will derate to a preset idle speed from the operator selected RPM level. Activating any joystick will return the crane to the operator selected idle speed.

Item (3),(Figure 4-51) is the time after the ECO mode has been activated due to inactivity when the engine RPM will be reduced to an even lower idle speed. Also, the hydraulic oil

cooler operation will be reduced to also reduce fuel consumption.

Item (4), (Figure 4-44) is only to display the fuel usage rate.

**ECO Terminology**

Term	Definition
Disabled ECO Mode	ECO mode is OFF (throttle command percent is always 0% in this mode)
Enabled ECO mode	ECO mode is ON and can be operated at commanded throttle percentage
Active ECO mode	ECO mode has commanded a throttle percent greater than 0% (Must be enabled to become active)
Inactive ECO mode	ECO mode is active and the command throttle percentage is 0%
Throttle Setpoint (Setpoint)	The throttle percentage set by crane operator by pressing the Increment/Decrement Switch in the superstructure cabin.

**ECO Requirements**

ECO mode can be enabled by the crane operator on the Operating Display (ODM). The default is for ECO mode to be disabled when shipped from the factory. Once enabled, the system stays enabled until disabled through the ODM.

**NOTE:** ECO mode stays disabled (or enabled) independent of ignition key cycles and disconnect switch cycles.

When enabled, the throttle set point will be set to the ECO mode throttle percent set point unless the operator had previously set it to a higher value using the Increment / Decrement switch.

The operator can increase the throttle command using the throttle pedal independent of whether the ECO mode is active or inactive.

ECO mode is forced to inactive when the crane's transmission is being shifted to Forward or Reverse, or if any crane functions are enabled.

When active, ECO mode will ramp the throttle percent from 0 to set point when any crane function command goes above 5% command. Once ECO mode's output is at the set point, the output will stay at the set point until no crane functions are being commanded for the set time interval. Then the ECO mode's throttle command is to be set to 0% (step down).

**NOTE:** Ramp time for increasing throttle percent is 2 seconds from 0% to 100% throttle (slope = 50% per second).

**ECO Operation**

- Crane is able to idle at 600 RPM when crane functions are not enabled.
- Crane idles at 800 RPM when any crane function has been enabled.
- Operating Display menu allows user to turn on “ECO Mode” and set the operating engine speed for the crane.
- When user turns ECO mode ON:
  - Crane ramps engine from idle to operating speed using the first 15% of the controller movement to control the ramp.
  - Crane maintains operating speed while crane functions are active and for a period of 3 seconds after crane functions go inactive.
  - Crane ramps engine speed back down to idle point.

**ECO Benefits**

- Less noise and less fuel consumption versus maintaining crane at fixed “operating speed”.
- Set point for engine operating speed is easily changed by the user.
- User can command additional engine speed at any time using the throttle pedal.
- Lower idle speed is better for “creep speed” driving, and improves braking performance.

**Exhaust System Cleaning Function**

To open: Select Icon (5), (Figure 4-44), and confirm.

The Exhaust System Cleaning Menu allows the operator to either initiate an exhaust system cleaning, select Item (1), (Figure 4-52) or inhibit an exhaust system cleaning, select Item (2), (Figure 4-52).

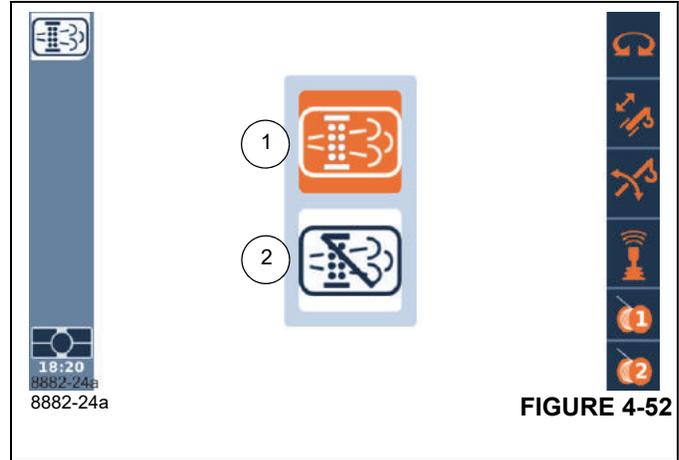


FIGURE 4-52

Item	Description	Refer to
1	Initiate Exhaust System Cleaning	Figure 4-52
2	Inhibit Exhaust System Cleaning	

**Tools User Settings Group Menu**

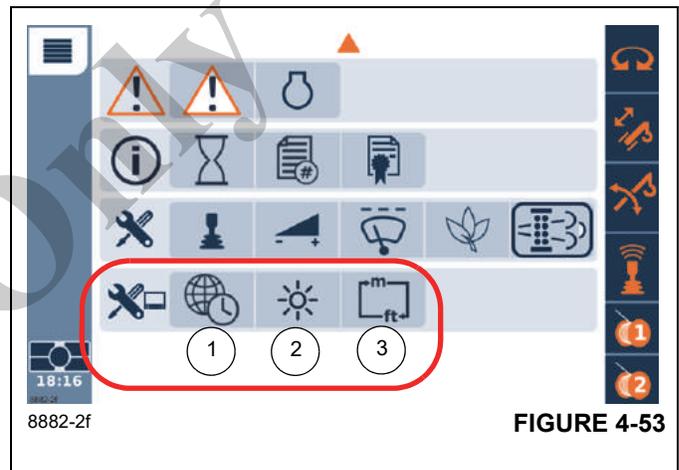


FIGURE 4-53

The Tools User Settings Group Menu is made up of the following:

- Menu for Setting the Time Zone Function (1), (Figure 4-53), (refer to *Setting the Time Zone Function*, page 4-81).
- Menu for Setting the Display Screen Brightness Function (2), (Figure 4-53), (refer to *Setting the Display Screen Brightness Function*, page 4-81).
- Units of Measure Function (3), (Figure 4-53), (refer to *Setting the Units of Measure Function*, page 4-82).

**Setting the Time Zone Function**

To set the time zone function (1), (Figure 4-54), select the Symbol (1) and confirm.

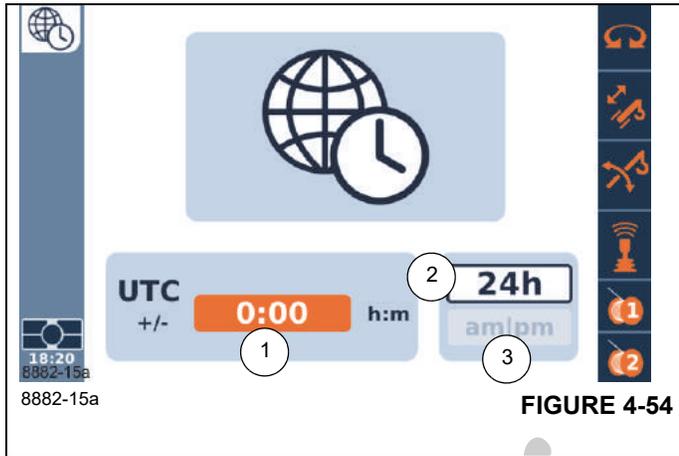


FIGURE 4-54

Item	Description
1	Setting the Time Zone
2	Select Clock Type
3	Select AM/PM for 12-Hour Clock

Using the Jog Dial (5), (Figure 4-22) highlight the hours number (1), (Figure 4-54), then use the Up or Down Arrow keys (4), (Figure 4-21) to enter the UTC (Coordinated Universal Time). **NOTE:** UTC is considered interchangeable with Greenwich Mean Time (GMT). Use the plus or minus time zone and push enter. Then highlight the minutes number and using the up or down arrows or jog dial set the current minute value and press enter. Then highlight the 24h or 12h option and press enter. Select either AM or PM and press enter.

**Setting the Display Screen Brightness Function**

To set the display screen brightness, select Item (2), (Figure 4-55) and confirm.

The brightness of the display is regulated automatically by the display, depending on the ambient brightness. An arrow (1), (Figure 4-55) appears on the left and right of the percentage (2), (Figure 4-55).

- Set the desired minimum brightness.
- Confirm the selection.

The brightness of the display changes while setting. View the set value (0 to 100%) on the display (2), (Figure 4-55).

The brightness set here is the minimum value for automatic regulation.

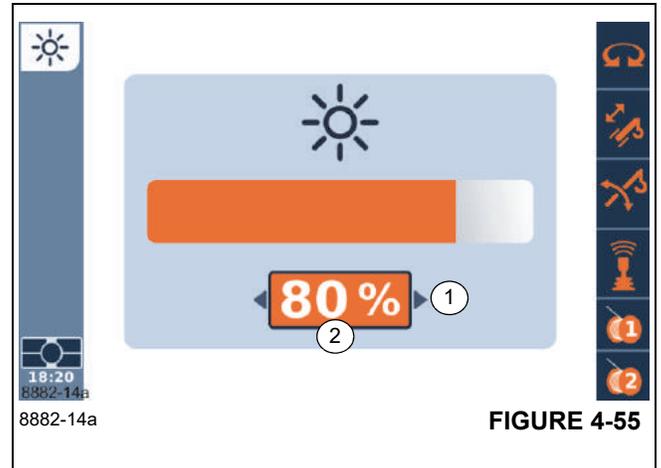


FIGURE 4-55

**NOTE:** There is no automatic regulation if setting the brightness to 100%.

The Display then always show maximum brightness.

Cancel the entry, at any time, by using the Escape Button (1), (Figure 4-21) or (1), (Figure 4-22). The settings are then reset.

If the temperature on the display is too high, the brightness is reduced automatically – lamp (1), (Figure 4-56) lights up.

When the temperature falls, the specified brightness is restored – lamp (10) goes out.

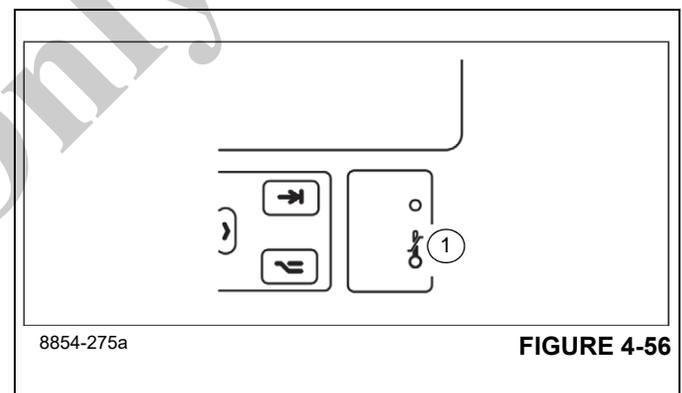
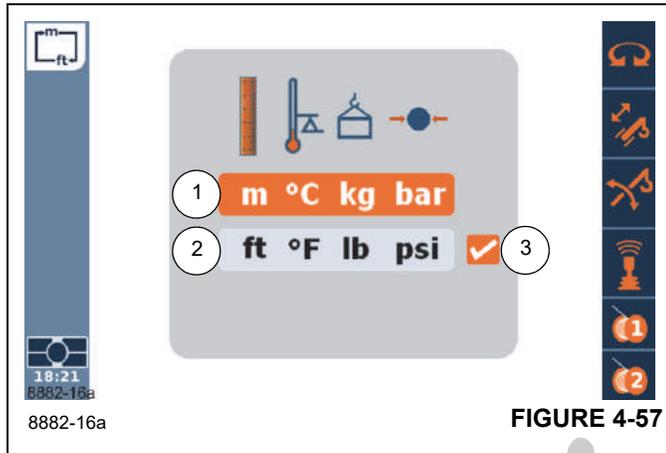


FIGURE 4-56

**Setting the Units of Measure Function**

To set the Units of Measure Function, select symbol (3), (Figure 4-57) and confirm.



**FIGURE 4-57**

Select either Metric Units of Measure or Imperial Units of Measure.

Item	Description
1	Display Metric Units:
	Meters
	Degrees Celsius
	Kilograms
2	Bar
	Display Imperial Units:
	Feet
	Degrees Fahrenheit
Pounds	
Pounds Per Square Inch	

**USING THE RATED CAPACITY LIMITER DISPLAY MODULE (RDM)**

**NOTE:** Refer to *Rated Capacity Limiter Display Module (RDM)*, page 3-33 for additional information.

The Rated Capacity Limiter (RCL) is an electro-mechanical sensing system designed to alert the crane operator when the lifted load is approaching the capacity. When an overload condition is sensed, the system provides the operator with a visual and audible warning, and locks out the controller functions to prevent raising and lowering the boom, extending the boom, or raising the main or auxiliary (optional) hoist ropes.



**DANGER**

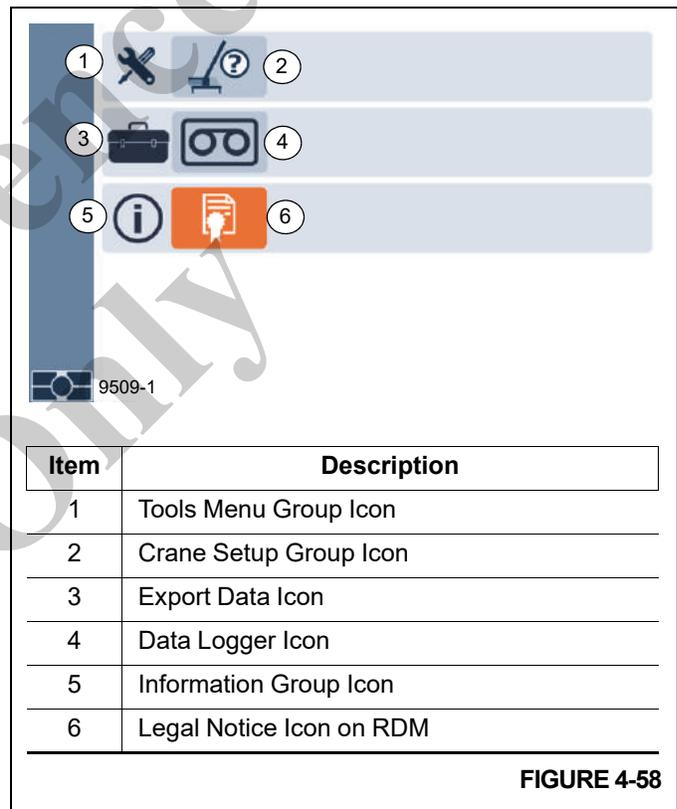
Electronic equipment on this crane is intended as an aid to the operator. Under no condition should it be relied on to replace the use of Load Charts and operating instructions.

Sole reliance on these electronic aids in place of good operating practices can cause an accident.

**Rated Capacity Limiter (RCL) Group – Menu**

The Main Menu shows symbols for further menus and symbols for current displays.

The RCL Main Menu Screen (Figure 4-58) appears on the RDM when the ignition key is set to the ON position.



**FIGURE 4-58**

**Rated Capacity Limiter (RCL) Configuration Screen**

The RCL Configuration Screen (Figure 4-59) appears on the RDM when the Crane Setup Group Icon (1), (Figure 4-59) is selected.

The operator will select (program) the data according to crane setup. Refer to Figure 4-59 to program the RCL.

RCL Configuration Screen



FIGURE 4-59

Item	Description	Explanation
1	Crane Setup Group Icon	Alert icons display in the alert bar.
2	Outrigger Deployment	Graphical representation of the outriggers deployment.
3	Counterweight	Indicates the amount of counterweight installed.
4	Load Chart Code Number	Load Chart Code Number for the programmed RCL crane configuration.
5	Swing Availability	Indicates the allowable amount of swing.
6	Boom Nose Configuration	Indicates the extensions installed, if any.
7	Active Hoist	Indicates which hoist the RCL is using to determine its limits.
8	Parts of Line for the Main Hoist	Indicates the number of parts of line programmed into the RCL for the main hoist.
9	Parts of Line for Auxiliary Hoist	Indicates the number of parts of line programmed into the RCL for the auxiliary hoist.
10	Auxiliary Boom Nose	Indicates whether the auxiliary boom nose is installed.
11	Enable/Disable Switch	Orange box indicates enabled (active). Gray box indicates not enabled (not active).
12	Boom Extension Stowed	Indicates the folding boom extension is stowed.
13	Accept Button	Select this button and press OK to accept the RCL configuration.
14	Main Hoist Selected	Orange Icon indicates Enabled (Active). Gray Icon indicates Disabled (Not Active).

Item	Description	Explanation
15	Auxiliary Hoist Selected	Orange Icon indicates Enabled (Active). Gray Icon indicates Disabled (Not Active).
16	Jog Dial Active Status Indicator	Indicates whether the ODM or RDM is Active.

### Entering a Load Chart Code Number Manually

**NOTE:** Each load chart in the *Load Chart Manual* is given a unique code number. The code number is found at the top of each load chart.

Manually program the RCL by entering the load chart code number into the RCL Setup Screen. Press the Screen Toggle Button (4), (Figure 4-22) at the Jog Dial to select the RDM screen control.

Using the Jog Dial (5), (Figure 4-22), select the code number field (4), (Figure 4-59), then press the Jog Dial (5), (Figure 4-22). The number will turn white with an orange background.

- OR -

Using the Arrow Buttons (4), (Figure 4-21) on the Navigation Control Pad at the RDM, select the code number field (4), (Figure 4-59). The box around the number will turn orange. Then press the OK Button (5), (Figure 4-21). The number will turn white with an orange background.

- Using the Jog Dial (5), (Figure 4-22) or the Up/Down Arrow Buttons (4), (Figure 4-21), select the correct code number.
- Press the Jog Dial (5), (Figure 4-22) or the OK Button (5), (Figure 4-21) on the Navigation Control Pad to accept the new number.
- Repeat Steps 1 through 3 until the complete code number is entered.
- Using the Jog Dial (5), (Figure 4-22) or the Arrow Buttons (4), (Figure 4-21), select the OK Icon (5), (Figure 4-21). The Icon will turn orange. Then press the Jog Dial (5), (Figure 4-22) or the OK Button (5), (Figure 4-21) to accept.

The RDM will display the RCL Main Screen.

### Data Logger

The Data Logger records events on change when operating the crane. It is only available on the RDM. The data can be accessed by downloading the data to a USB Drive.

The USB Connector connects to the display module to update its software or download the data logger.

Below are the steps to access the data logger:

- Select the data logger icon (4), (Figure 4-58) on the RDM.
- The data logger screen (Figure 4-60) opens.
- Insert USB drive into the USB port of RDM (Figure 3-26).

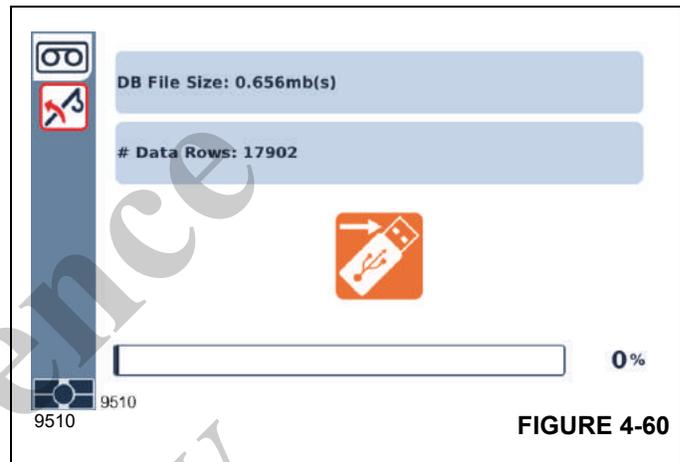
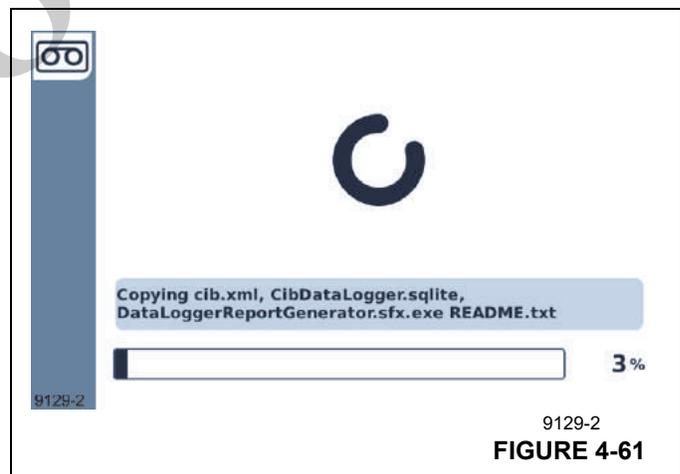


FIGURE 4-60

- Press USB Button once drive is detected to start download.

**NOTE:** When the drive is detected, the USB Icon will light up orange and the question mark will go away.



9129-2  
FIGURE 4-61

- Once writing reaches 100%, remove the USB drive and plug it into a computer, the following files will have been created:
  - CibDataLogger.sqlite

- DataLoggerReportGenerator.sfx.exe
- cib.xml

6. If running the data logger report program for the first time, select DataLoggerReportGenerator.sfx.exe and follow the setup screens to install the report generator. If the data logger report generator has been previously installed or after installing the report generator, select CibDataLogger.sqlite to generate the report.

**NOTE:** With every new release of software, the user should re-install the report generator in case updates have been made.

7. Choose the time span for the report (Figure 4-62), the default is the maximum amount of time possible. After the report is generated the disk save icon (1) will be highlighted.

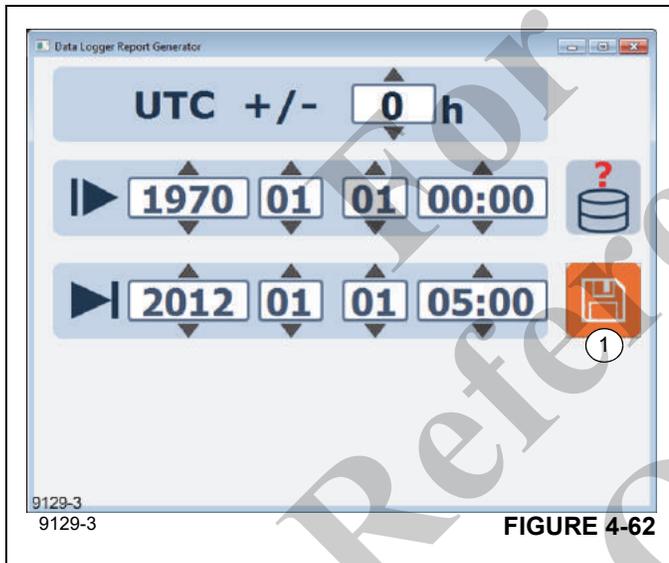


FIGURE 4-62

8. Select the save icon and choose the directory to save the report to (Figure 4-63).

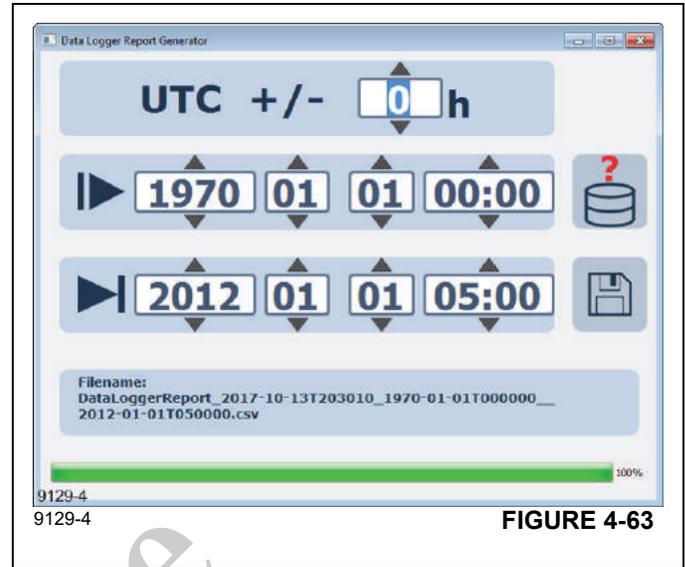


FIGURE 4-63

9. Open Microsoft Excel and import the.csv file(s) into it. There will be at least one file and possibly an additional fault codes file.

10. Open the cib.xml file to see all the possible loggable items and their descriptions.

**Legal Notice Screen**

To display the Legal Notice Screen (Figure 4-64), select the Legal Notice Icon (6), (Figure 4-58).

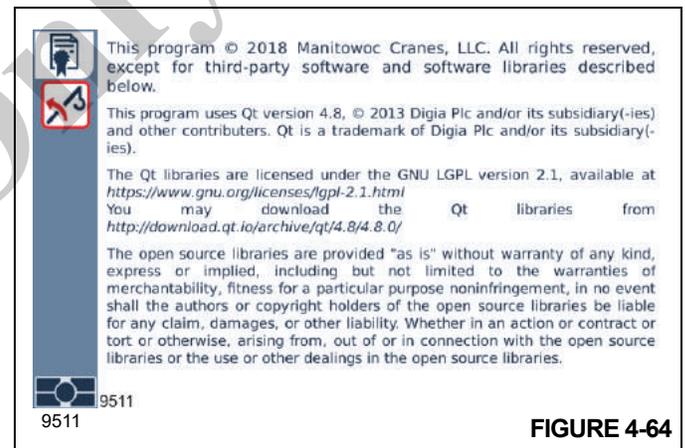


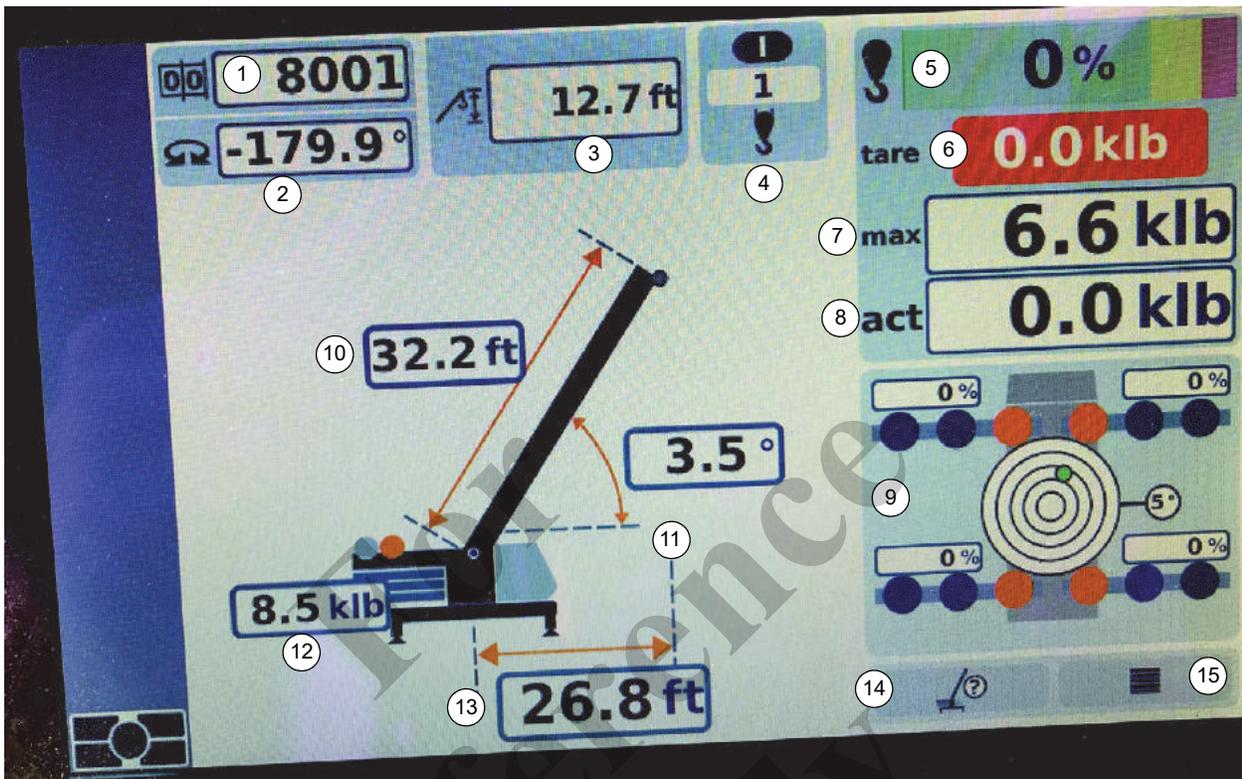
FIGURE 4-64



**Rated Capacity Limiter (RCL) Main Screen**

the lift being performed. **NOTE:** The numbers on Figure 4-65 are Example numbers ONLY.

The RCL Main Screen (Figure 4-65) example shows specific information pertaining to the current crane configuration and



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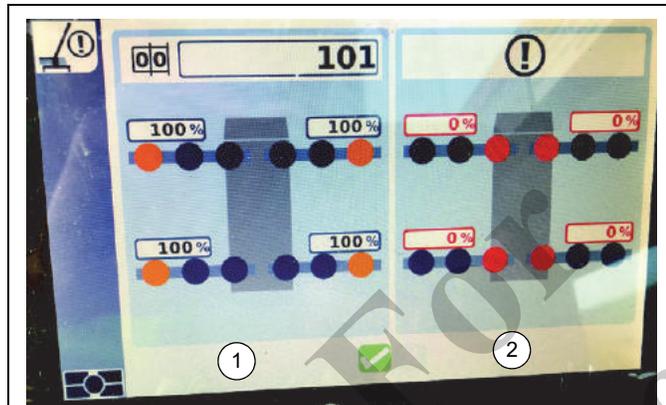
Numbers are Example Only

Item	Description	Item	Description
1	Load Chart Code	9	Outrigger Position as a Percentage (Fully Retracted = 0%, Mid-Extend = 50%, Fully Extended = 100%)
2	Swing Angle	10	Boom Length
3	Boom Tip Height	11	Boom Angle
4	Parts of Line	12	Counterweight
5	Actual Load as a Percentage of Maximum Capacity	13	Load Radius
6	Tare Load	14	Go to Crane Setup Group Screen
7	Actual Load	15	Go to Main Menu
8	Maximum Capacity (for the Current Crane Configuration/Load Chart Code Number)		

FIGURE 4-65

### Overriding the Outrigger Monitoring System

After programming the Rated Capacity Limiter (RCL), (by either manually entering a Load Chart code Number or by completing the RCL Setup Wizard) and clicking on the OK Icon (5), (Figure 4-21), an outrigger beam over-ride warning screen (2), (Figure 4-66) will appear if the outrigger beam configuration programmed by the operator does not match that which is detected by the Outrigger Monitoring System (1), (Figure 4-66). Also refer to *Navigating the Operator Display Module (ODM) and Rated Capacity Limiter (RCL) Display Module*, page 4-37.



9892-1

Example Only - Display Values May Vary

Item	Description
1	Programmed Outrigger Beam Configuration
2	OMS Detected Error Outrigger Beam Configuration

FIGURE 4-66

The operator must choose to either change the programmed outrigger beam configuration by selecting the "X" Icon (Icon will turn orange) and then pressing the Jog Dial (5), (Figure 4-22) or the OK Button (5), (Figure 4-21).

— OR —

override the OMS detected outrigger beam configuration by selecting the "check mark" Icon (Icon will turn orange) and then pressing the Jog Dial (5), (Figure 4-22) or the OK Button (5), (Figure 4-21).

### DANGER

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 limitations are required.

If the outrigger beam position is overridden, the RCL Main Screen (Figure 4-65) will appear to indicate the override.

### Limits Bypass Indicators

In an emergency situation only, the Limits Bypass Switch located in the superstructure on the overhead panel can be used to bypass the different limiter systems on the crane. Refer to the following pages for information regarding switch operation:

1. RCL Lockout - refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-82 and *RCL Bypass Switch*, page 3-30
2. WRL Lockout - refer to *Working Range Limiter (WRL) Menu Group*, page 4-48.
3. Anti- Two-Block Lockout - refer to *Limits Bypass Switch*, page 3-25 and *Hoist Bypass Switch*, page 3-25.
4. Minimum Wrap Lockout - refer to *RCL Bypass Switch*, page 3-30 and *Hoist Bypass Switch*, page 3-25.
5. RCL Bypass Switch - refer to *RCL Bypass Switch*, page 3-30.

A Limits Bypass Switch (or RCL Bridging Switch) is also located in the cab behind the operator's seat on non-CE certified cranes. Refer to *RCL Bypass Switch*, page 3-30.

6. *RCL Bypass Switch*, page 3-30; and *RCL Early Warning Indicator*, page 3-34.

When a Limits Bypass Switch is actuated, indicators on the Rated Capacity Limiter Display Module (RDM) come on to confirm that the limiters are bypassed. Refer to *Limits Bypass Switch*, page 3-25, para 4.

### Load Chart and Miscellaneous Indicators

Refer to Alert Icons, page 3-39 and Status Bar Icons, page 3-42 for a list of Indicators and their definitions that can appear on the Alert Bar (left-hand side) of the ODM Main Screen.

For  
Reference  
Only

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## SECTION 5 LUBRICATION

### SECTION CONTENTS

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### GENERAL

Following the designated lubrication procedures is important in ensuring maximum crane lifetime and utilization. The procedures and lubrication charts in this section include information on the types of lubricants used, the location of the lubrication points, the frequency of lubrication, and other information.

The service intervals specified are for normal operation where moderate temperature, humidity, and atmospheric conditions prevail. In areas of extreme conditions, the service periods and lubrication specifications should be altered to meet existing conditions. For information on extreme condition lubrication, contact your local Grove Cranes distributor or Manitowoc Crane Care.

#### CAUTION

##### Possible Equipment Damage!

Chassis grease lubricants must not be applied with air pressure devices as this lubricant is used on sealed fittings.

The multipurpose grease installed during manufacture is of a lithium base. Use of a non-compatible grease could result in damage to equipment.

### 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.

### Cummins Oil Registration List

Cummins has a program that lists engine oils that it has tested to meet its engineering specifications. Listing of recommended oils is on QuickServe® Online. Log on to quickserve.cummins.com and login with a current user name and password or create a new account by selecting “Create

an Account” under information, 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 to view the registered oils.

For  
Reference  
Only

## Standard Lubricants

Standard lubricants are used on all Grove cranes unless the crane is ordered with a cold weather package. These

standard lubricants are effective in ambient temperatures down to -9°C (15°F). Refer to TABLE 5-1: for a list of the recommended standard lubricants.

**TABLE 5-1: Standard Lubricants/Fluids [Down to -9°C (15°F)]**

Lubricant/Fluid	Grove Spec. #	Lube Spec.	Recommended Lubricant		
			Type	Grade	Classification
<b>Extreme Pressure 3% Moly Grease</b>	6829015304	M	Citgo: Lithoplex CM2 Mobil: Mobilgrease CM-P Ipiranga: IPIFLEX LI-COMP MOLY 2	NLGI Grade 2	
<b>Synthetic Gear Lube SAE 40</b>	80078954	E	Emgard MTF 7000 (BASF) Phillips 66 Triton Synthetic MTF Kendall SHP Synthetic MTF		
<b>Gear Lubricant (GL-5)</b>	6829012964	B	Century Unigear Semi-synthetic SAE 80W-90 Gear Lubricant, Product Code No. 324094 Texaco Multigear SS 80W-90 Chevron DELO Gear Lubricant 80W-90	80W-90	
<b>Engine Oil SAE</b>	6829104182	F	Conoco Fleet Supreme EC Mobil Delvac 1300 Super Mobil Delvac MX ESP	15W-40	CJ-4
<b>Hydraulic Oil</b>	6829006444	K	Exxon Mobil 424 Phillips 66 PowerTran XP	ISO grade 46/68	Must Meet John Deere Std. JDM J20c
<b>Extreme Pressure Gear Lube</b>	6829100213	H	Mobil: 600XP 150 Gear Oil Texaco: Meropa 150		
<b>Extreme Pressure Multipurpose Grease</b>	6829003477	A	Citgo: Lithoplex Red MP Grease Chevron: Starplex EP 2 Phillips 66: Multiplex Red Mobil: Mobilgrease XHP 222 Ipiranga: IPIFLEX LI-COMP EP 2	NLGI 2	
<b>Open Gear Lube</b>	6829102971	G	Fuchs Ceplattyn 300 Spray	NLGI 1-2	
<b>Anti-Seize Compound (ASC)</b>	6829003689	N	Jet Lube Kopr Kote Loctite C5-A Compound		
<b>Fully Formulated Antifreeze Coolant</b>	6829101130	C	Old World Industries, Inc. Fleet Charge SCA Caterpillar DEAC Fleetguard Compleat EG	Mix 50/50	

TABLE 5-1: Standard Lubricants/Fluids [Down to -9°C (15°F)]

Lubricant/Fluid	Grove Spec. #	Lube Spec.	Recommended Lubricant		
			Type	Grade	Classification
Liquid Coolant Conditioner	6829012858	D	Fleetguard DCA4 Fleetguard DCA2 Penray Pencool 3000		
Diesel Exhaust Fluid (DEF)	80019225	L	Fleetguard StableGuard™ Urea 32 Premix AdBlue® TerraCair Ultrapure® DEF		

For Reference Only

## Arctic Lubricants and Conditions

### Temperatures 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 in these temperatures. However, certain fluids, such as halogenated hydrocarbons, nitro hydrocarbons, and phosphate ester hydraulic fluids, may not be compatible with hydraulic system seals and wear bands. Therefore, always check with an authorized Grove distributor or Manitowoc Crane Care if in doubt of the suitability of a specific fluid or lubricant.

When operating in cold weather and regardless of the oil viscosity of the crane's lubricants, always follow the cold weather start-up and operating procedures described in this *Operator Manual* to adequate lubrication during system warm-up and proper operation of all crane functions.

### Cold Weather Lubricants

Cold weather lubricants are used on all Grove cranes when the crane is ordered with a cold weather package. The optional lubricants are effective in ambient temperatures down to -29°C (-20°F). Refer to TABLE 5-2: for a list of the recommended optional lubricants.

TABLE 5-2: Optional Lubricants/Fluids [Down to -29°C (-20°F)]

Lubricant/Fluid	Grove Spec.	Lube Spec.	Recommended Lubricant		
			Type	Grade	Classification
<b>Extreme Pressure 3% Moly Grease</b>	6829104275	M	Mobil: Mobilith SHC 220 Petro-Canada; Precision Synthetic EP1	No. 2	
<b>Synthetic Gear Lube SAE40</b>	80078954	E	Emgard MTF 7000 (BASF)		
<b>Extended Service Interval Gear Lubricant (GL-5)</b>	6829014058	B	CITGO, Syntetic Gear Lube 75W-90 Eaton, Roadranger EP75W-90 Mobil, Mobilube SHC 75W-90 Shell, Spirax® S 75W-90 Sunoco®, Duragear EP75W-90 Petro-Canada, Traxon E Synthetic 75W-90	75W-90	
<b>Engine Oil</b>	80056036	F	Shell Rotella® T6 0W-40 Mobil Delvac 1 ESP 0W-40 Caterpillar Cat DE0-ULS Cold Weather	0W-40	CJ-4
<b>Hydraulic Fluid</b>	6829006993	K	Exxon Mobil Univis HVI 26		
<b>Extreme Pressure Gear Lube</b>	6829103636	H	Mobil SHC629 Petro-Canada; Enduratex Synthetic EP 150		AGMA No. 4 EP
<b>Extreme Pressure Multipurpose Grease</b>	6829104275	A	Mobil: Mobilith SHC 220 Petro-Canada; Precision Synthetic EP1	NLGI 2	
<b>Open Gear Lube</b>	6829102971	G	Fuchs Ceplattyn 300 Spray	NLGI 1-2	
<b>Anti-Seize Compound (ASC)</b>	6829003689	N	Jet Lube Kopr Kote Loctite C5-A Compound		

TABLE 5-2: Optional Lubricants/Fluids [Down to -29°C (-20°F)]

Lubricant/Fluid	Grove Spec.	Lube Spec.	Recommended Lubricant		
			Type	Grade	Classification
<b>Fully Formulated Antifreeze Coolant</b>	6829101130	C	Old World Industries, Inc. Fleet Charge SCA Caterpillar DEAC Fleetguard Complete EG	Mix 50/50	
<b>Liquid Coolant Conditioner</b>	6829012858	D	Fleetguard DCA4 Fleetguard DCA2 Penray Pencool 3000		
<b>Diesel Exhaust Fluid (DEF)</b>	80019225	L	Fleetguard StableGuard™ Urea 32 Premix AdBlue® TerraCair Ultrapure® DEF		

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## 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 machine operating temperatures will allow hydraulic oil to warm sufficiently to penetrate these cracks and if machines are operated daily, protect the rods. Machines 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 machine is operated daily, exposed rod surfaces will corrode. Some cylinders will have rods exposed even when completely retracted. Assume all cylinders have exposed rods, as corrosion on the end of the rod can ruin the cylinder.

It is recommended that all exposed cylinder rods be protected using Boeshield® T-9 Premium Metal Protectant. Manitowoc Crane Care has Boeshield® T-9 Premium Metal Protectant available in 12 oz. aerosol cans by ordering part number 9999101803 through the Parts Department.

Cylinder operation and inclement weather will remove the Boeshield® protectant; therefore, inspect machines 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 coverage of lube points that will receive attention based on their readings. Other lubrication requirements must be made on a timely basis, such as weekly or monthly.

All oil levels are to be checked with the crane parked on a level surface in transport position, and while the oil is cold, unless otherwise specified.

On plug type check points, the oil levels are to be at the bottom edge of the check port.

On all hoists with a check plug in the drum, the fill plug shall be directly on top of the hoist, and the check plug level.

All grease fittings are SAE STANDARD unless otherwise indicated. Grease non-sealed fittings until grease is seen extruding from the fitting. 1 oz (0.28 kg) of EP-MPG equals one pump on a standard 1 lb (0.45 kg) grease gun.

Over lubrication on non-sealed fittings will not harm the fittings or components, but under lubrication will definitely lead to a shorter lifetime.

On sealed U-joints, care must be exercised to prevent rupturing seals. Fill only until expansion of the seals first becomes visible.

Unless otherwise indicated, items not equipped with grease fittings, such as linkages, pins, or levers 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 relubricate to complete lubrication of the entire wear area.

## CAUTION

The following lube intervals are to be used as a guideline only. Actual lube intervals should be formulated by the operator to correspond to actual service conditions such as continuous duty cycles and/or hazardous environments.

### Notes Listed in the Following Tables

1. Final fluid levels shall be adjusted to indicating arrows, dipstick markings, or to filler plugs.
  - a. Caution: axle fluid levels shall be adjusted to "bottom of fill plug threads". Check with crane on level ground, at normal ride height, cold or room temperature oil only!
2. Change filter when changing gear oil.
3. Capacities indicated are for a fully formulated mixture of 50% AFC and 50% water.
4. Brush lubricant on top and bottom of outrigger beams contact area.
5. The hydraulic oil shall meet or exceed ISO 4406 class 17/14 cleanliness level (ref SAE J1165).
6. Brush lubrication on I.D. of jack cylinder support tubes and wear bands before installing jack cylinders.

7.Fill radiator to bottom of filler neck per engineering specification 80029046. Run engine through (2) thermal cycles. Check level and refill as required.

8.Fill through dipstick opening.

9.Check fluid level using sight gauge on the side of the tank with boom retracted and in boom rest and all outrigger cylinders retracted.

10.Engine shall be running during lubrication to ensure equal distribution of grease.

11.Clean magnetic drain plug when changing lubricant.

12.Air conditioner - refer to applicable air conditioner manual.

13.See operator's manual when ambient temperatures are expected between +4°C (+40°F) and -62°C (-80°F).

14.Generously coat the wheel pilot or hub pads with lubricant. Do not lubricate the face of the wheel or the hub.

15.Apply lubricant during assembly and reapply lubricant whenever wheels are removed for service.

16.Clean coolant strainer after first 100 hours of use and at 2000 hrs/1 yr intervals thereafter.

17.Replace air cleaner element when indicator shows red (25" H2O).

18.Change filter at first 200 hours. Thereafter, at normal intervals. Drain with oil temperature at 65°C - 95°C (150°F - 200°F).

19.Change filter when changing gear oil.

20.Drain water trap every ten hours or daily.

21.Only use on ISL9 engine machines.

22.Service hours:

a.500 (0-55 PPM sulfur fuel)

b.400 (500-5000 \_PPM sulfur fuel)

c.250 (<5000 -PPM sulfur fuel. Not recommended.)

23.Extend boom for access through holes.

24.Spread grease on bottom plates. Top plates and side plates of boom in area that the wear pads move on.

25.One fitting per sheave.

26.Fill turntable gearbox until oil level is at middle to top of sight gauge.27.Replace the hydraulic filter element when the restriction indicator gauge on the filter head is in the red with the oil at a minimum of 100°F. When replacing the filter also replace the breather.

28. Operator must monitor the DEF level gauge and refill as necessary/indicated. Actual use rate depends on engine loading but won't be faster than fuel usage/topping off can be done at normal fueling intervals.

29. Change the oil after the first 250 hours of operation, then every 2000 hours of operation.

30. Top off when topping off fuel tank.

31. Cleanliness, environment, and usage will dictate when and if the suction strainer requires service. High vacuum pressures on the suction line may indicate that there is debris in the strainer.

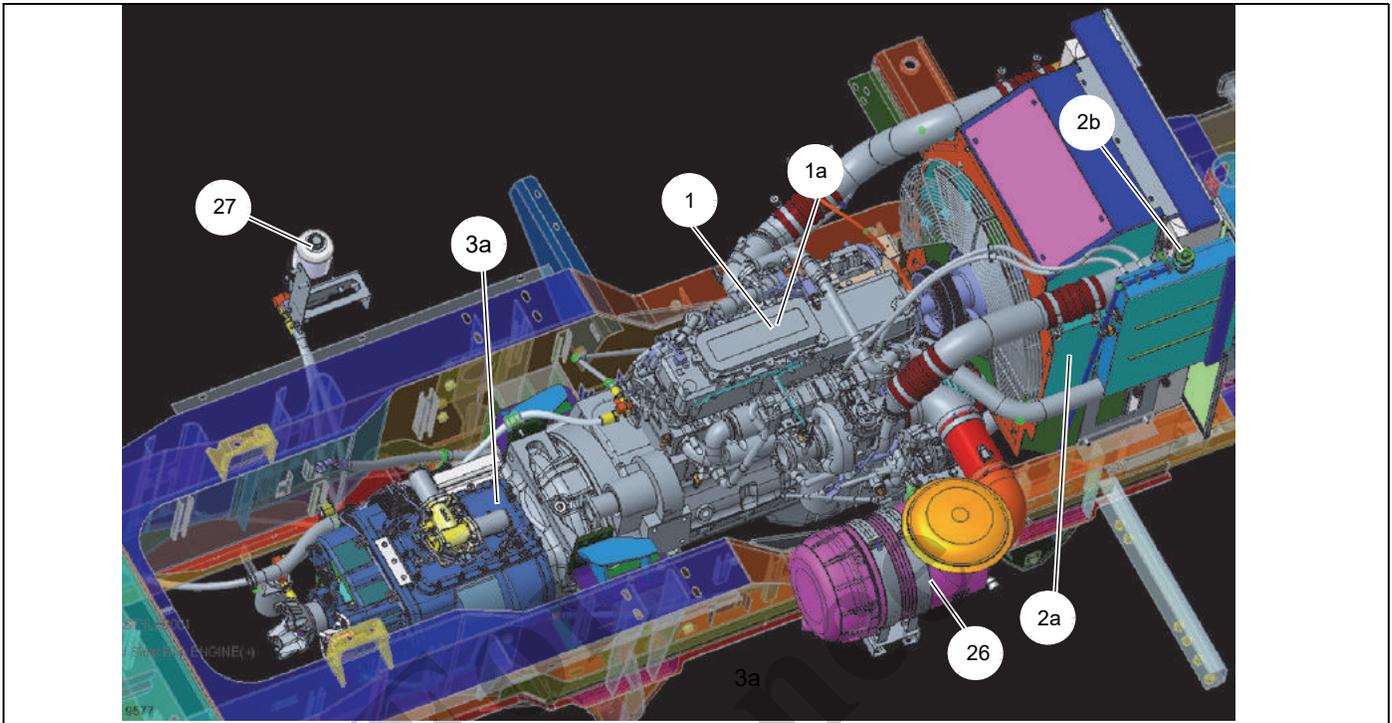
32. Drain and fill initially at 250 hours; thereafter, drain and fill every 500 hours.

The following describes the lubrication points and gives the lube type, lube interval, lube amount and application of each. Each lubrication point is numbered, and this number corresponds to the index number shown in the following figures.

Drivetrain Lubrication

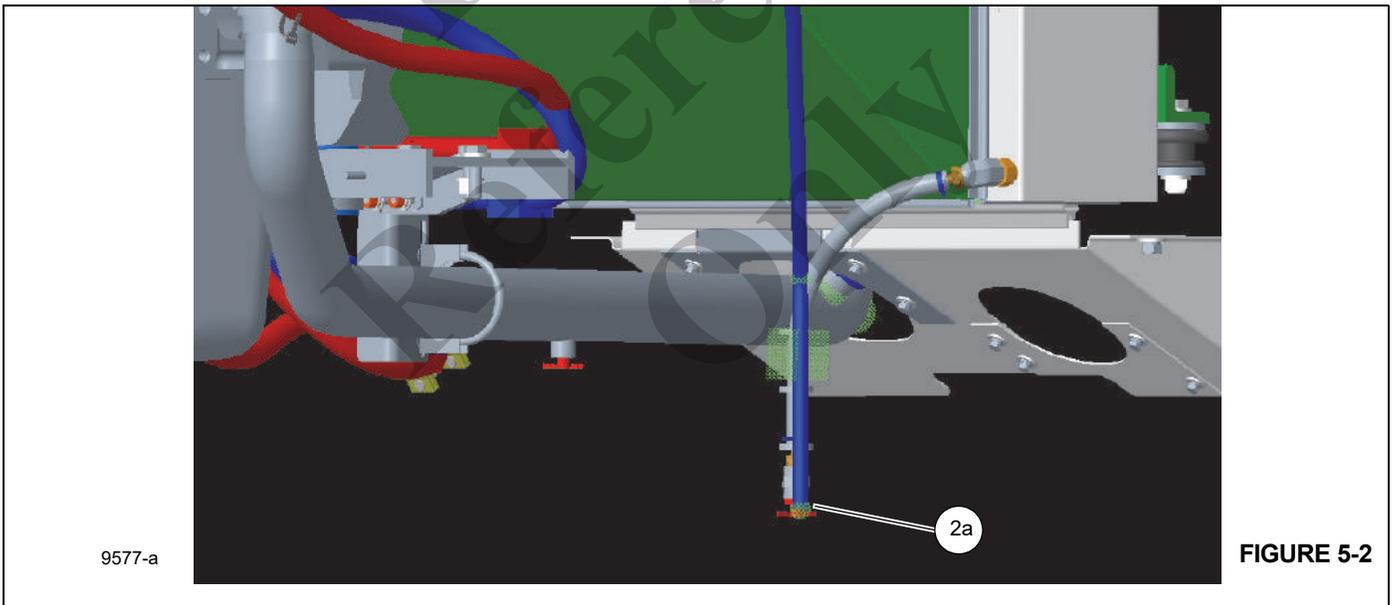
ITEM NUMBER	LOCATION NAME	APPROXIMATE CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
1	ENGINE CRANKCASE ISL9	-----	F	, 1	1	CHECK & FILL	10 HRS/DAILY
	WITH FILTER	5.0 GAL	F	1	1	DRAIN & FILL	500 HRS/6 MONTHS
1a	CRANKCASE BREATHER ELEMENT	-----	-----	-----	1A	CHANGE	60,000 MILES/2000 HRS/ 2 YEARS
2a	ENGINE COOLING SYSTEM	-----	C	3, 7	1	CHECK & FILL	500 HRS/6 MONTHS
	ENGINE COOLING SYSTEM - ISL9	67L (17.7 GAL)	C	3, 7	1	DRAIN & FILL (IF CONTAMINATED DURING CHECK)	S1000 HRS/1 YEAR
2b	ENGINE COOLING SYSTEM - ISL9	AS REQUIRED	D		1	TEST AND ADD	ENGINE 500 HRS/750 HRS
2c	COOLANT STRAINER	-----	-----	16	1	CLEAN STRAINER	2000 HRS/ 1 YR SEE NOTE 16
<b>NOTE:</b> Close shutoff valves. Remove hex plug. Clean strainer plug. Open shutoff valves.							
3a	TRANSMISSION - AUTOMATED MANUAL	-----	E	1	1	CHECK & FILL	500 HRS/9000 MI/6 MONTHS/
		16.1 L (17 QT)	E		1	DRAIN & FILL	50000 MI/2 YRS
3b	TRANSMISSION FILTER	-----	-----	1, 18	1	CHANGE FILTER	3000 HRS
4a	PUMP DRIVE SHAFT U-JOINTS	-----	A		2	LUBE	250 HRS
4b	PUMP DRIVE SHAFT SPLINE	-----	A		1	LUBE	500 HRS
5	CLUTCH THROW-OUT BEARING AND SHAFT	-----	A	10	1	LUBE	250 HRS
8	DRIVELINE SLIP	-----	A		2	LUBE	500HRS/10000 MI
26	AIR CLEANER FILTER	-----	-----	17	1	CHANGE FILTER	SEE NOTE 17
27	FUEL FILTER - PRIMARY	-----	-----	20	1	CHANGE FILTER	1000 HRS/6 MONTHS

Reference Only



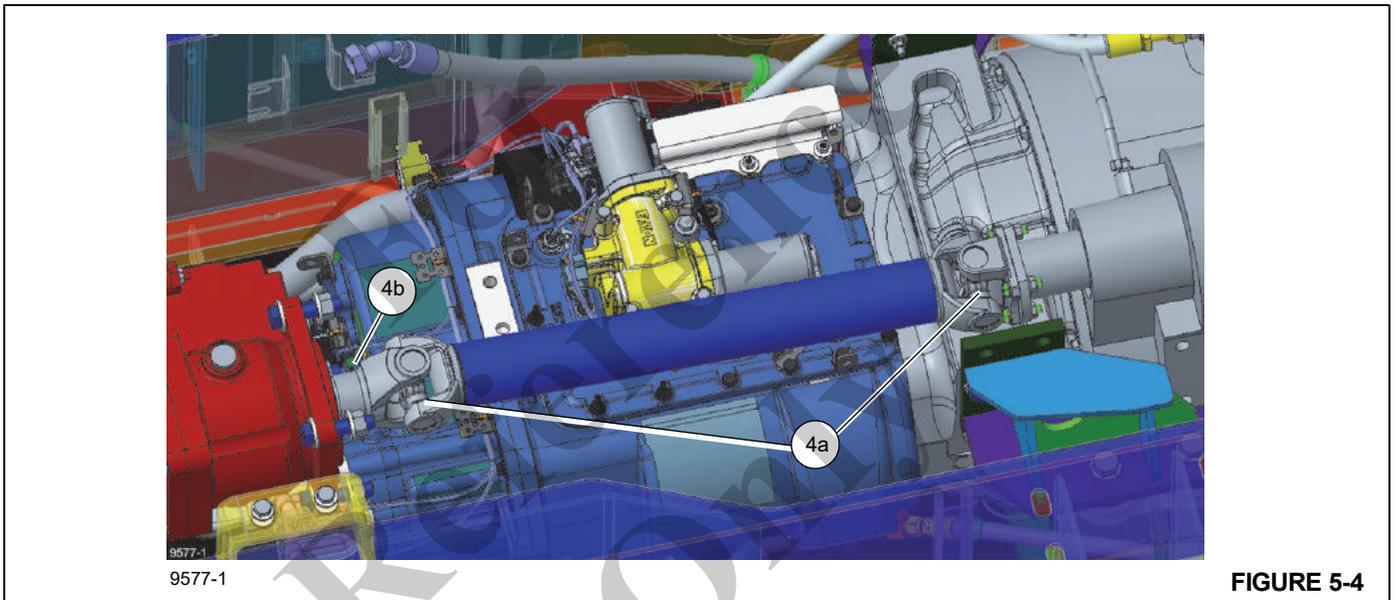
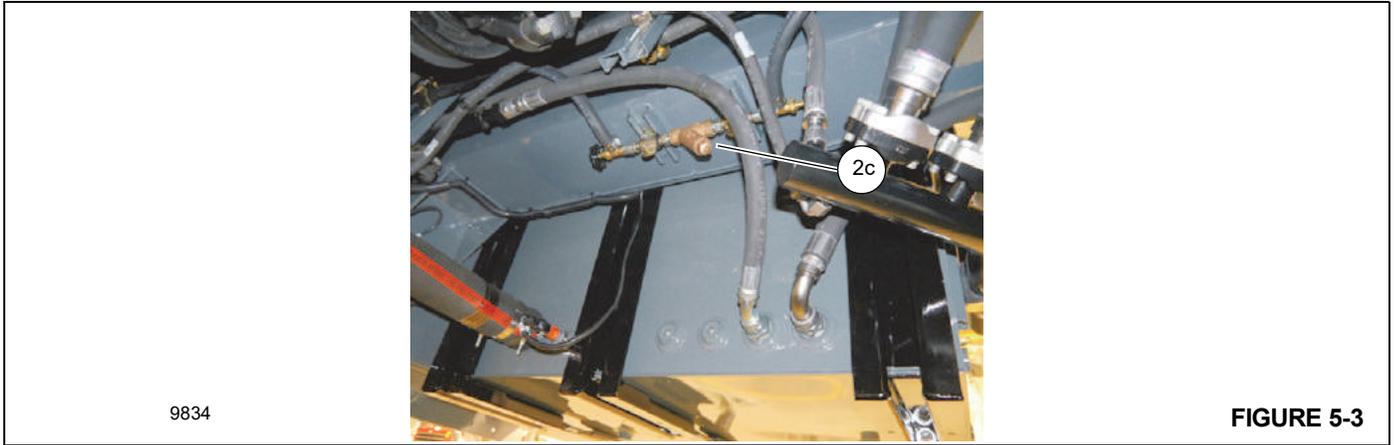
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FIGURE 5-1



9577-a

FIGURE 5-2



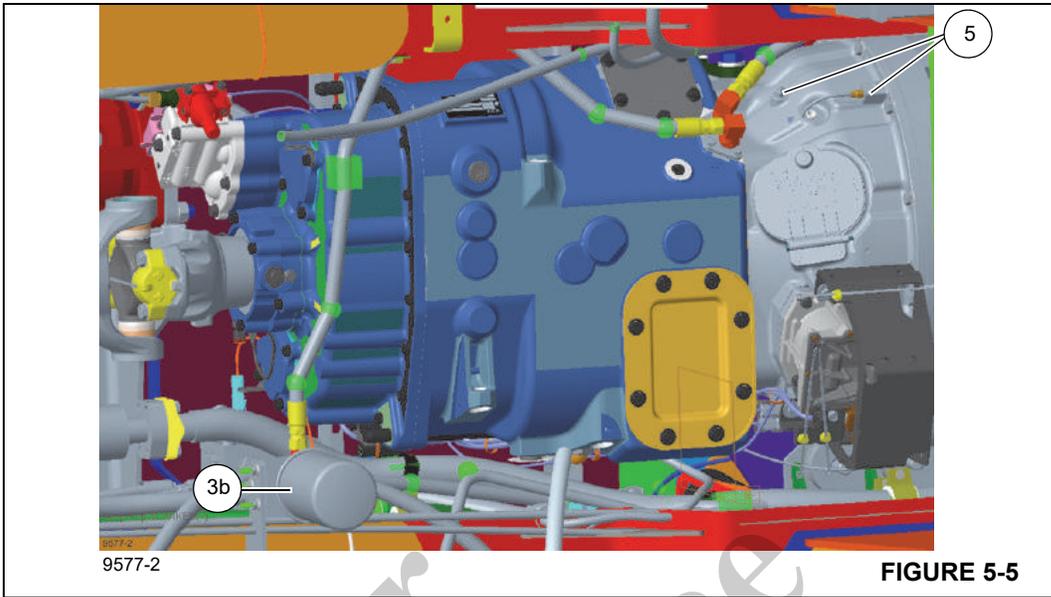


FIGURE 5-5

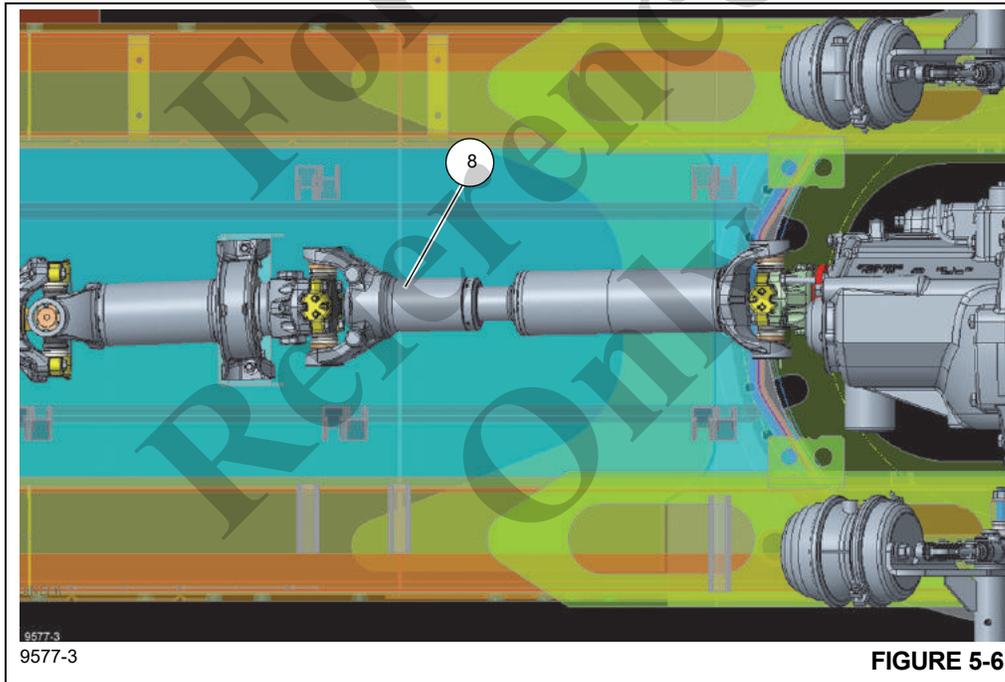
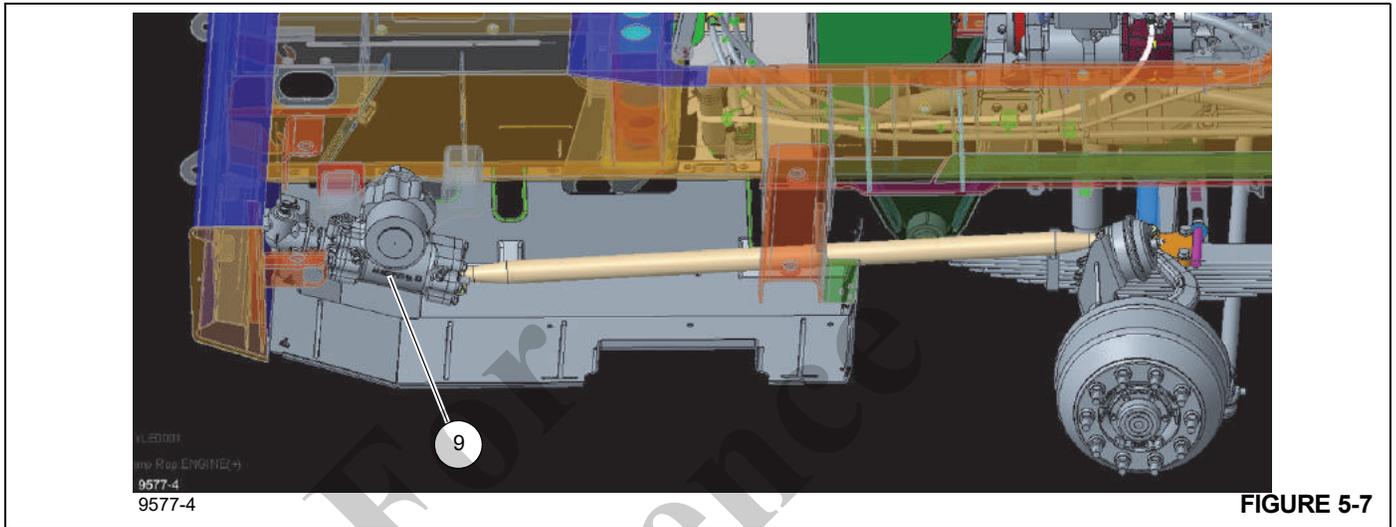


FIGURE 5-6

Steering Lubrication

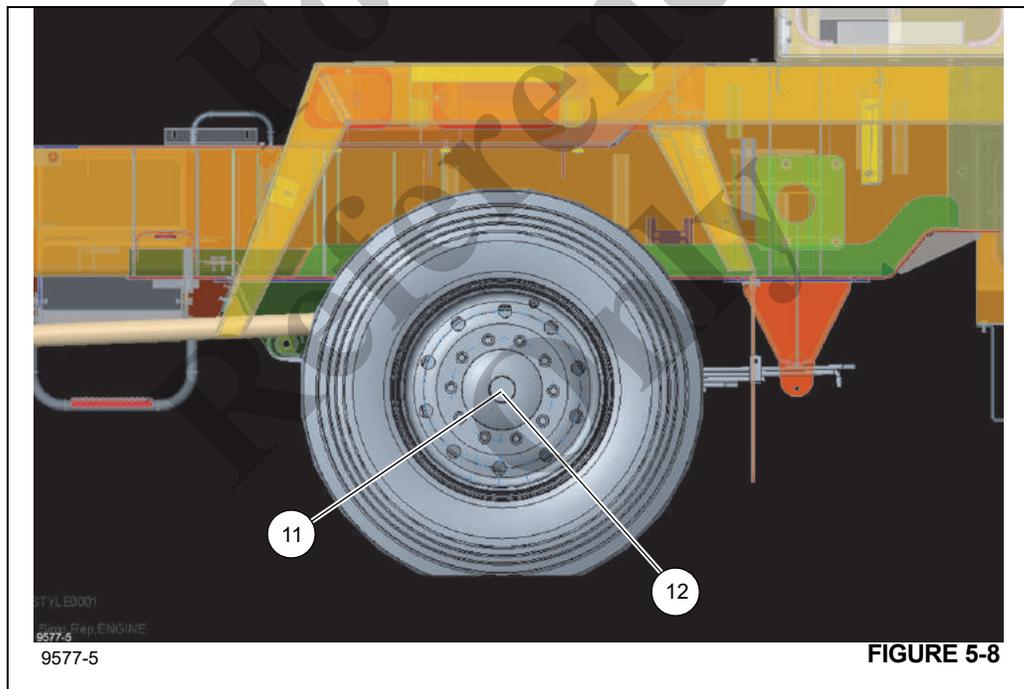
ITEM NUMBER	LOCATION NAME	APPROX. CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
9	POWER STEERING GEARBOX	-----	A		1	LUBE	1000 HRS

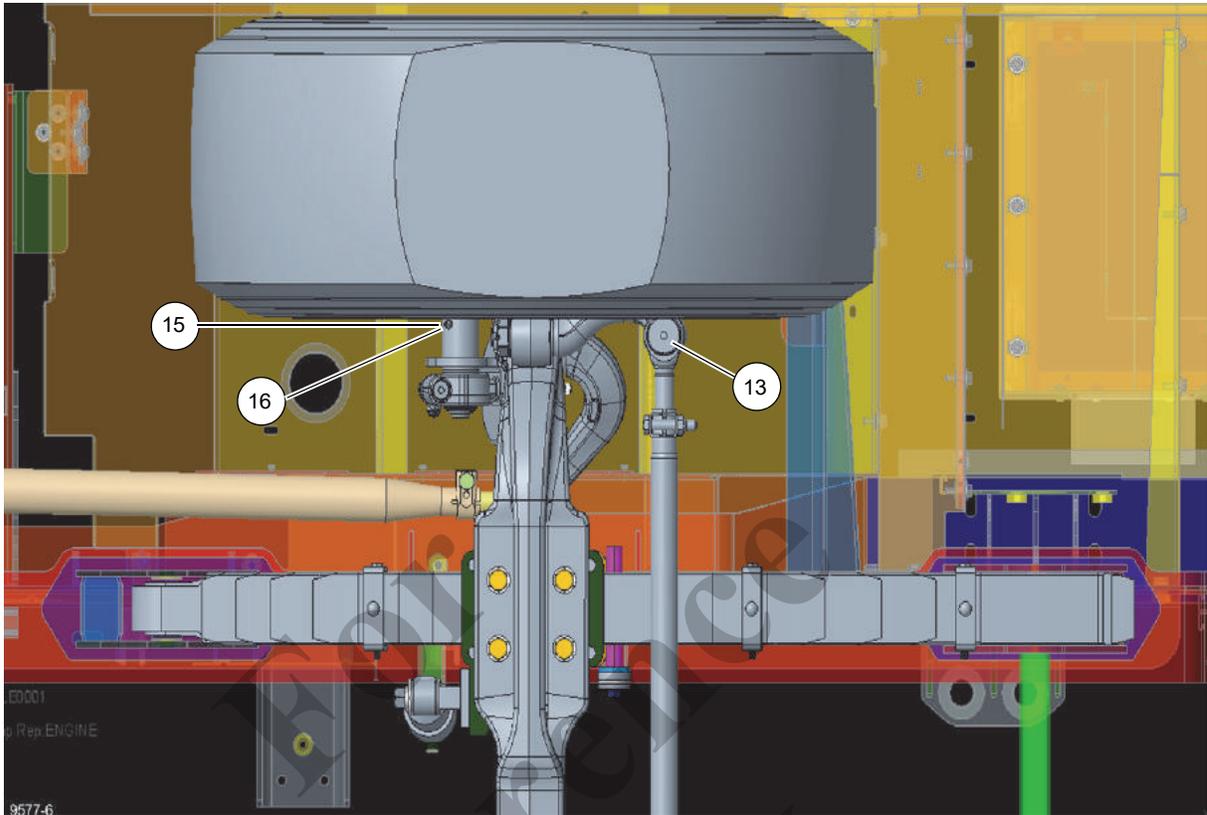


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Axle Lubrication

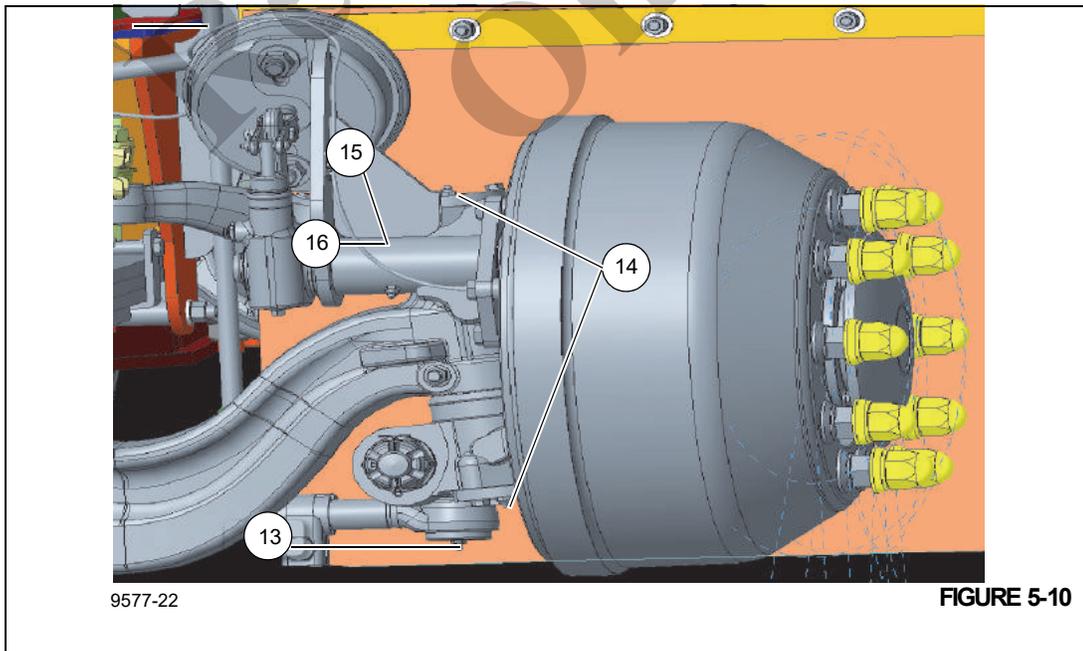
ITEM NUMBER	LOCATION NAME	APPROX. CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
11	FRONT WHEEL PILOTS	-----	N	14	2	BRUSH ON	SEE NOTE 15
12	FRONT AXLE HUBS	0.57 L (1.2 PT) EACH	B	1	2	CHECK & FILL	250 HRS
13	FRONT AXLE TIE ROD ENDS	-----	A		2	LUBE	1000 HRS
14	FRONT AXLE KING PINS	-----	A		4	LUBE	1000 HRS
15	FRONT AXLE BRAKE SLACK ADJUSTERS	-----	A		2	LUBE	1000 HRS
16	FRONT AXLE BRAKE CAMSHAFTS	-----	A		2	LUBE	1000 HRS





9577-6

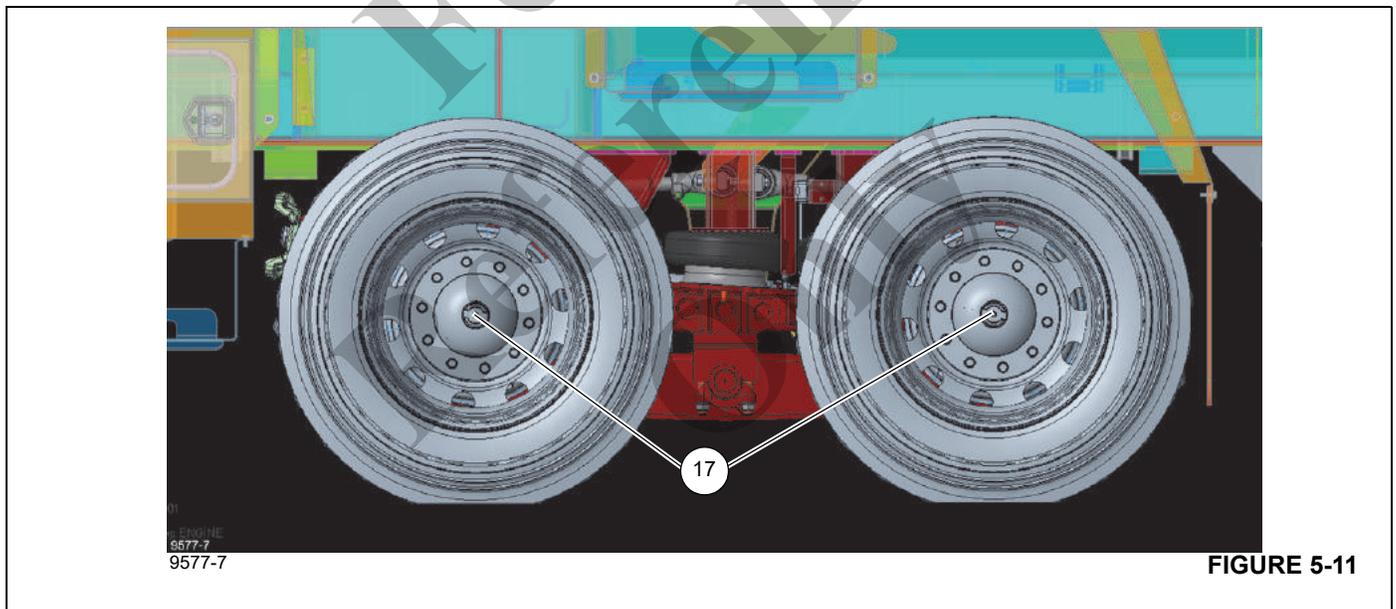
FIGURE 5-9

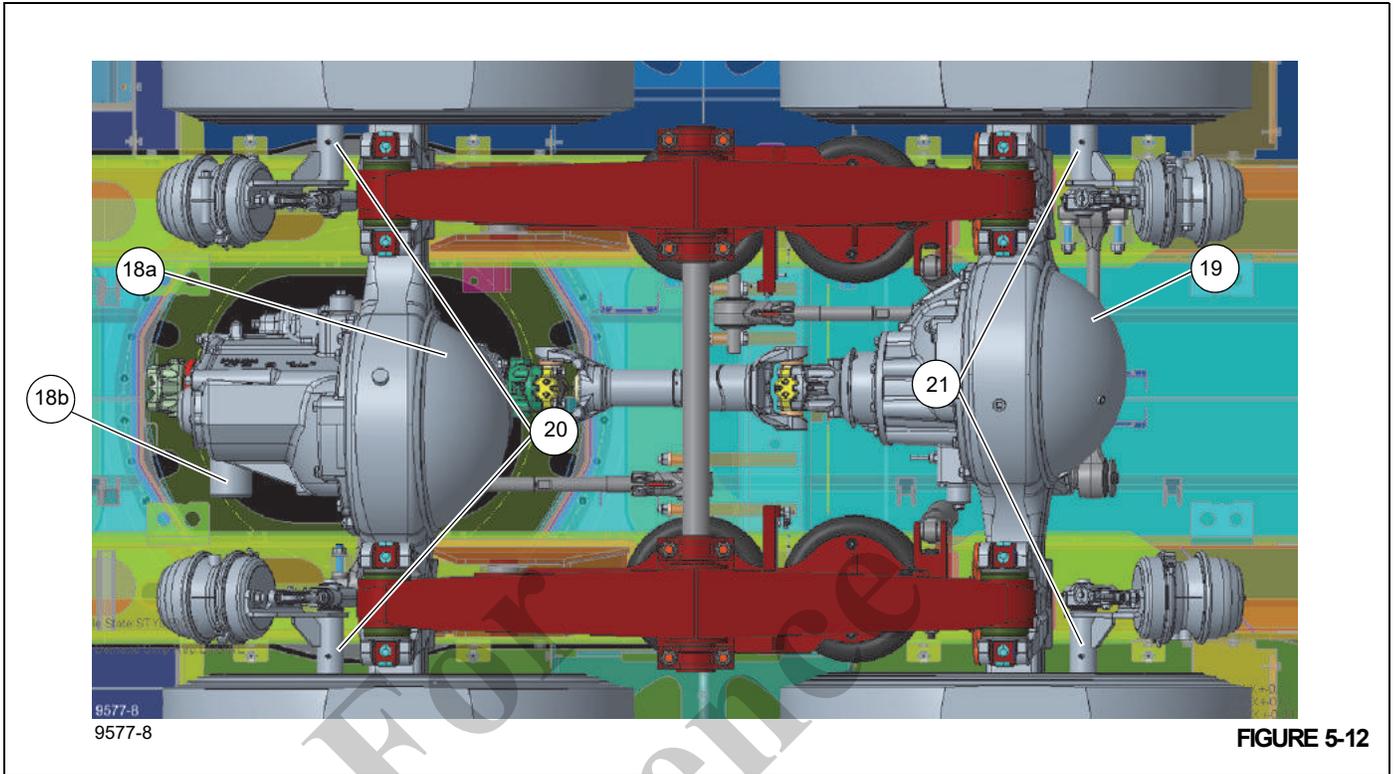


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FIGURE 5-10

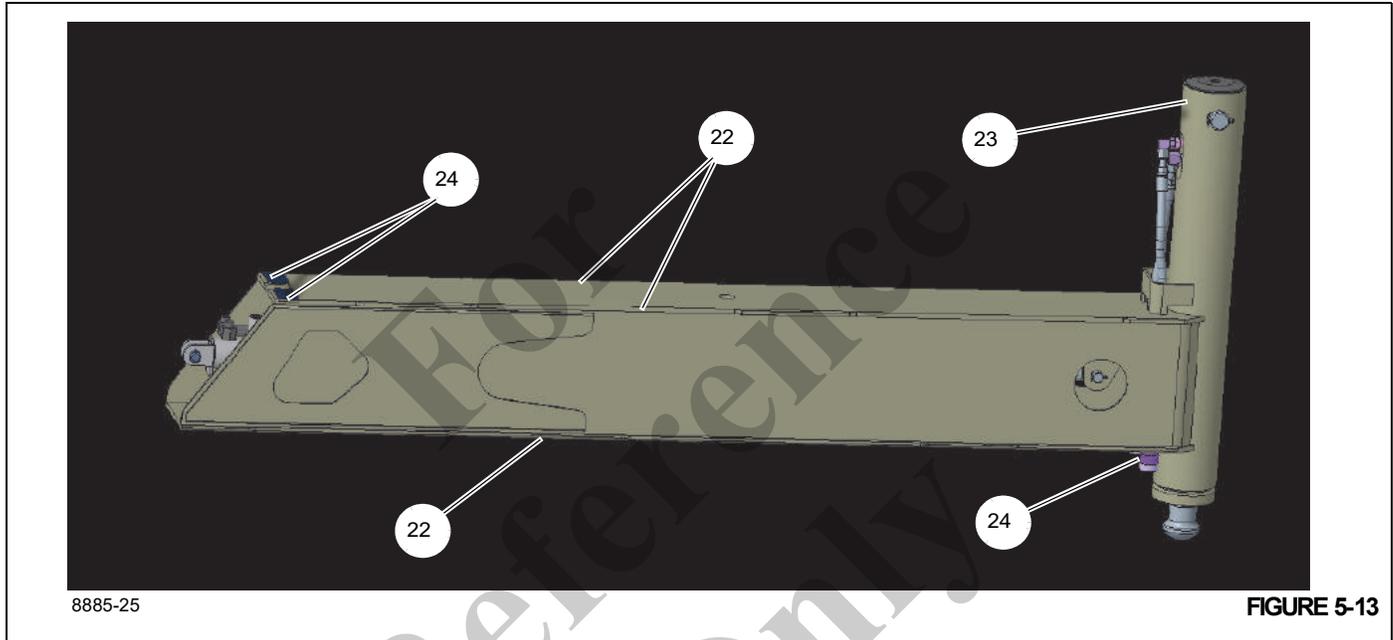
ITEM NUMBER	LOCATION NAME	APPROX. CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
17	REAR WHEEL PILOTS	-----	N	14	4	BRUSH ON	SEE NOTE 15
18a	FRONT REAR AXLE BOWL	-----	B	1	1	CHECK & FILL	250 HRS
		18.5 L (19.5 QTS)	B	1, 2, 11	1	DRAIN & FILL	50000 MI/2 YRS
18b	DIFFERENTIAL FILTER	-----	-----	19	1	CHANGE FILTER	50000 MI/2 YRS
19	REAR, REAR AXLE BOWL	-----	B	1	1	CHECK & FILL	250 HRS
		16.3 L (17.2 QTS)	B	1, 2, 11	1	DRAIN & FILL	50000 MI/2 YRS
20	REAR AXLE BRAKE SLACK ADJUSTERS	-----	A		4	LUBE	1000 HRS
21	REAR AXLE BRAKE CAMSHAFTS	-----	A		4	LUBE	1000 HRS





Outrigger Lubrication

ITEM NUMBER	LOCATION NAME	APPROX. CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
22	O/R BEAMS	-----	M	4	8	BRUSH ON	50 HRS/1 WEEK
23	JACK CYLINDER SUPPORT TUBES	-----	M	6	5	BRUSH ON	SEE NOTE 6
24	WEAR PADS	-----	M		24	BRUSH ON (Top & Bottom of Wear Pads)	50 HRS/1 WEEK

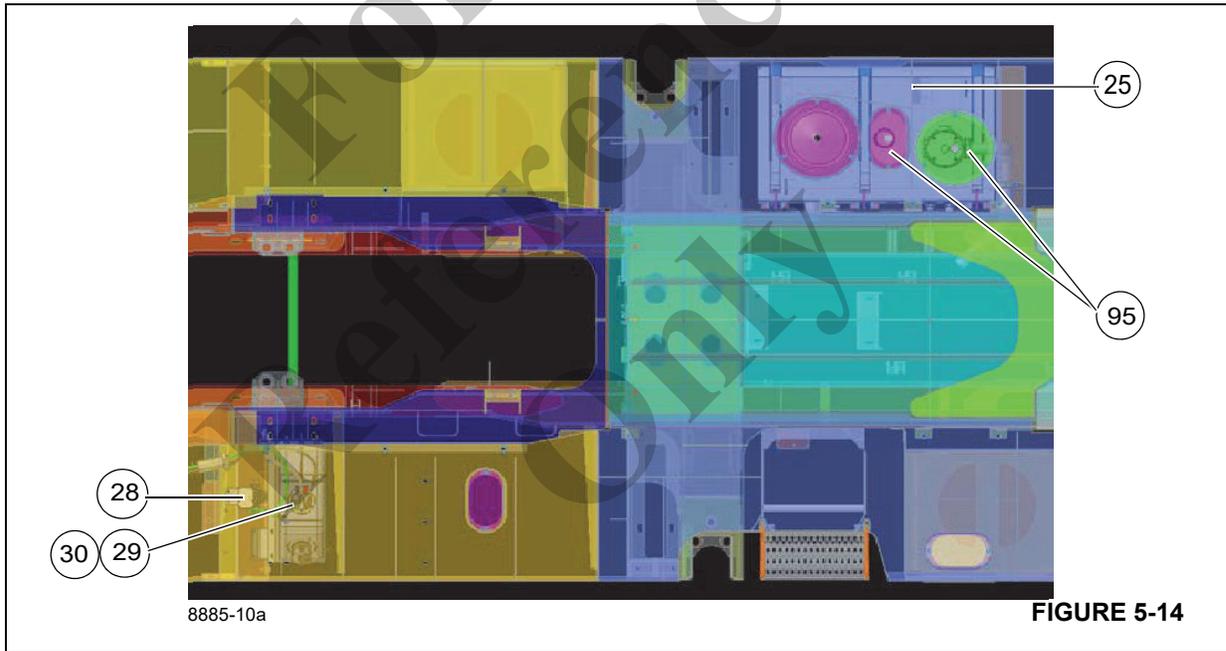


8885-25

FIGURE 5-13

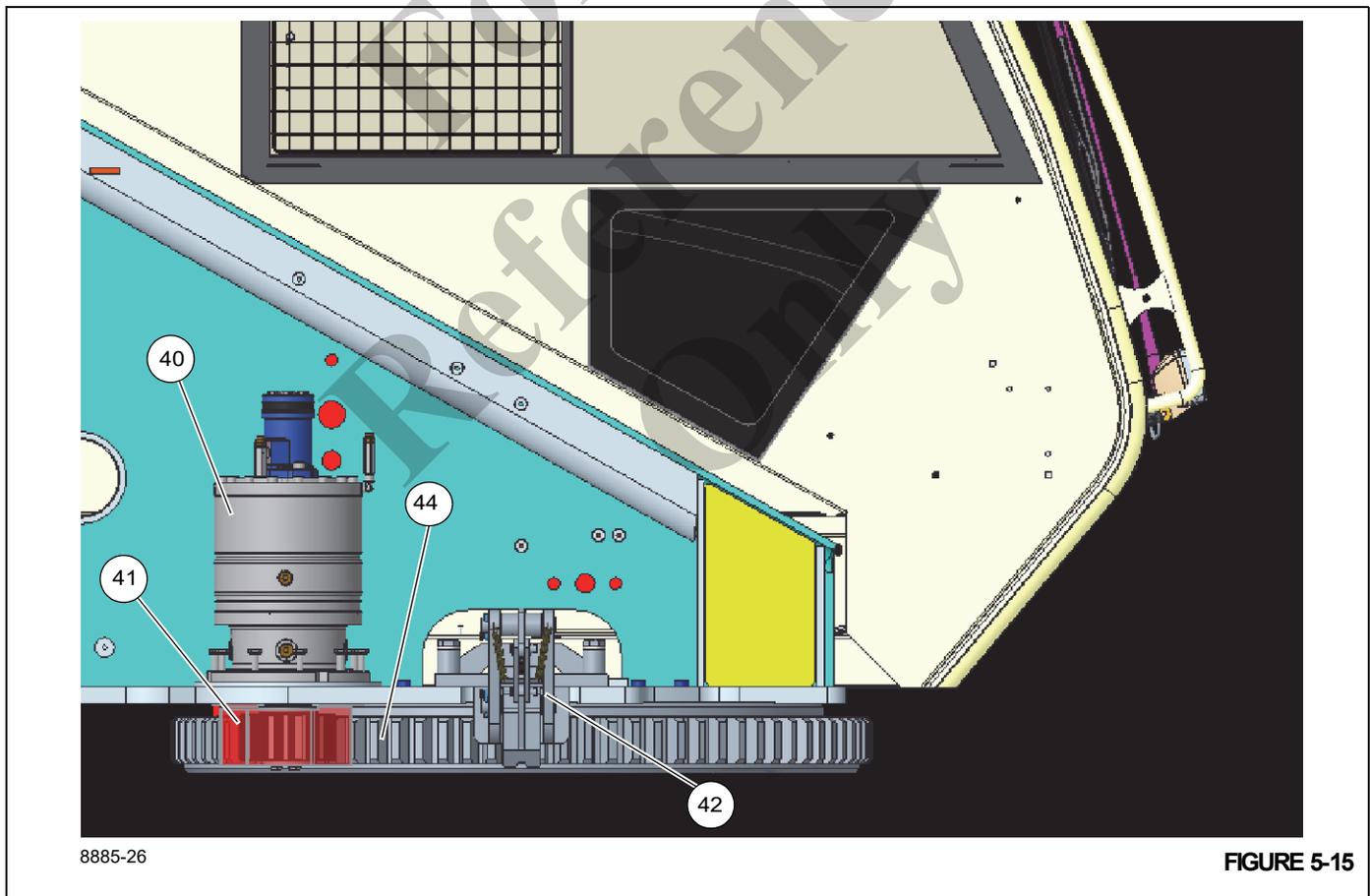
Miscellaneous Lubrication

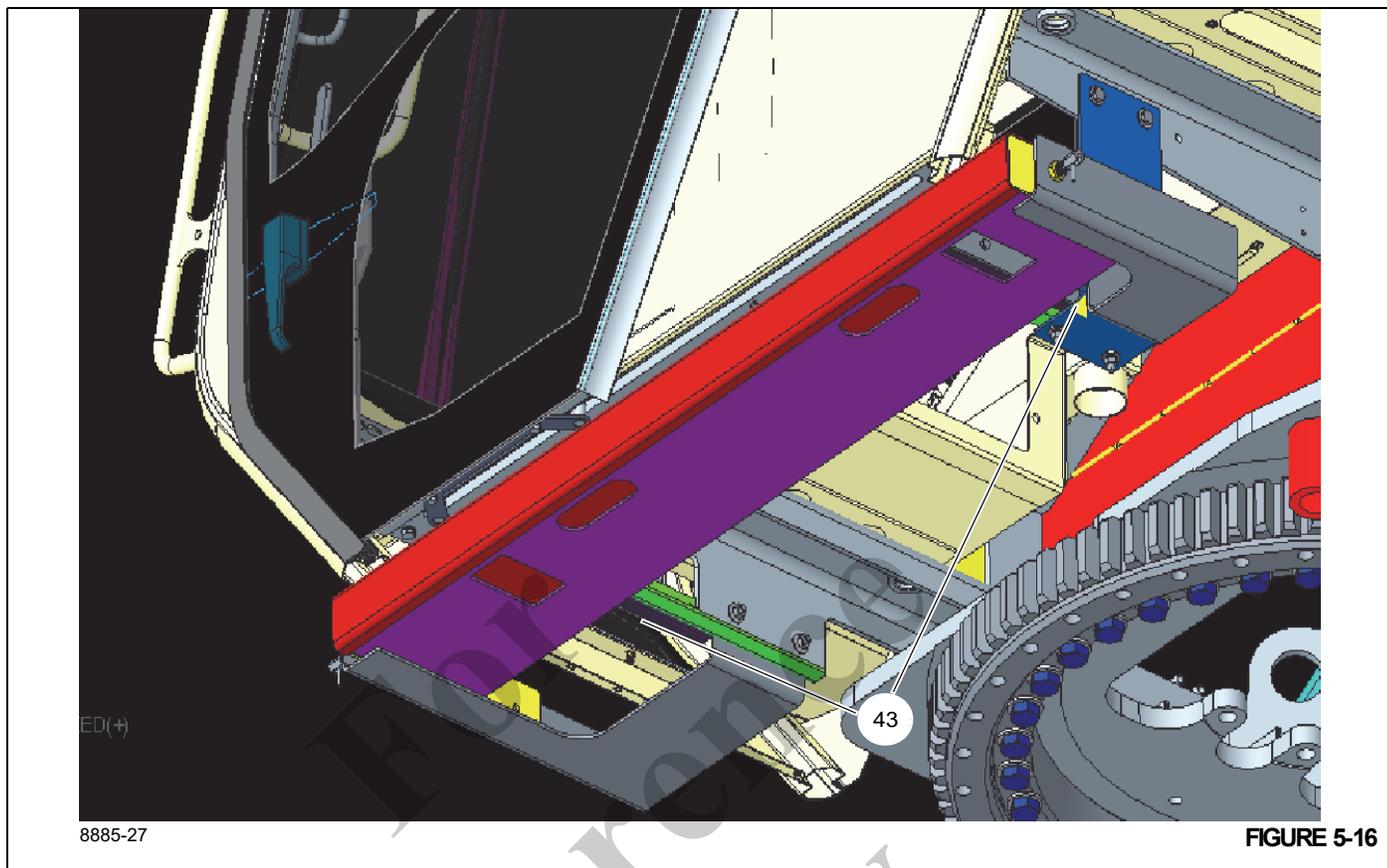
ITEM NUMBER	LOCATION NAME	APPROX. CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
25	HYDRAULIC RESERVOIR	405 L (107 GAL) (TANK ONLY)	K	5, 9	1	CHECK & FILL	10 HRS/DAILY
95	HYDRAULIC FILTER & BREATHER	-----	-----	27	1	CHANGE FILTER & BREATHER	SEE NOTE 27
28	DEF SUPPLY MODULE FILTER	-----	-----	-----	1	CHANGE FILTER	6500 HRS/ 300000 MI
29	DIESEL EXHAUST FLUID TANK	37.9 L (10 GAL) (TANK ONLY)	L	30	1	CHECK & FILL	SEE NOTE 30
30	DEF TANK STRAINER	-----	-----	31	1	CHECK FILTER	SEE NOTE 31



Turntable & Cab Platform Lubrication

ITEM NUMBER	LOCATION NAME	APPROX. CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
40	TURNTABLE GEAR BOX	4.0 L (4.25 QT)	H	1	1	CHECK & FILL	50 HRS/1 WEEK
		4.0 L (4.25 QT)	H	32	1	DRAIN & FILL	SEE NOTE 32
41	TURNTABLE GEAR & DRIVE PINION	-----	G		1	SPRAY ON	500 HRS/6 MONTHS
42	TURNTABLE SWIVEL LOCK	-----	G	1, 14	1	SPRAY ON	500 HRS/6 MONTHS
43	CAB TRACK & ROLLERS	-----	LIGHT OIL				
44	TURNTABLE BEARING INNER RACE	-----	A	1	2	LUBE	500 HRS/6 MONTHS





Hoist Lubrication

ITEM NUMBER	LOCATION NAME	APPROX. CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
46	MAIN HOIST - GEARBOX	-----	H	2, 14	1	CHECK & FILL	50 HRS / WEEKLY
		5.2 L (5.5 QTS)	H	32	1	DRAIN & FILL	SEE NOTE 32
							SAMPLE OIL
47	AUX HOIST -- GEARBOX	-----	H	2, 14	1	CHECK & FILL	50 HRS / WEEKLY
		5.2 L (5.5 QTS)	H	32	1	DRAIN & FILL	SEE NOTE 32
							SAMPLE OIL

**NOTE:** Line up the Fill/Drain Plug with the top cutout hole. Verify hoist is level side to side. Place a level along the tie rod and confirm the bubble is centered. Let hoist sit idle for 20 minutes for an accurate reading. Oil should be visible in sight glass. Level of oil is acceptable if it is at least 1.6 mm (1/16 in) down from top or up 1.6 mm (1/16 in) from the bottom of the sight glass. Hoist and oil temperature should be in the 21°C ± 7°C (70°F ± 20°F) range. If oil temperature is outside this range, allow for a higher oil level reading if hotter or a lower oil level reading if colder. Oil escaping from vent plug is an indication the hoist may be overfilled. If hoist is over filled, move the Fill/Drain Plug to the lower cutout hole and drain until oil level falls within the sight glass.

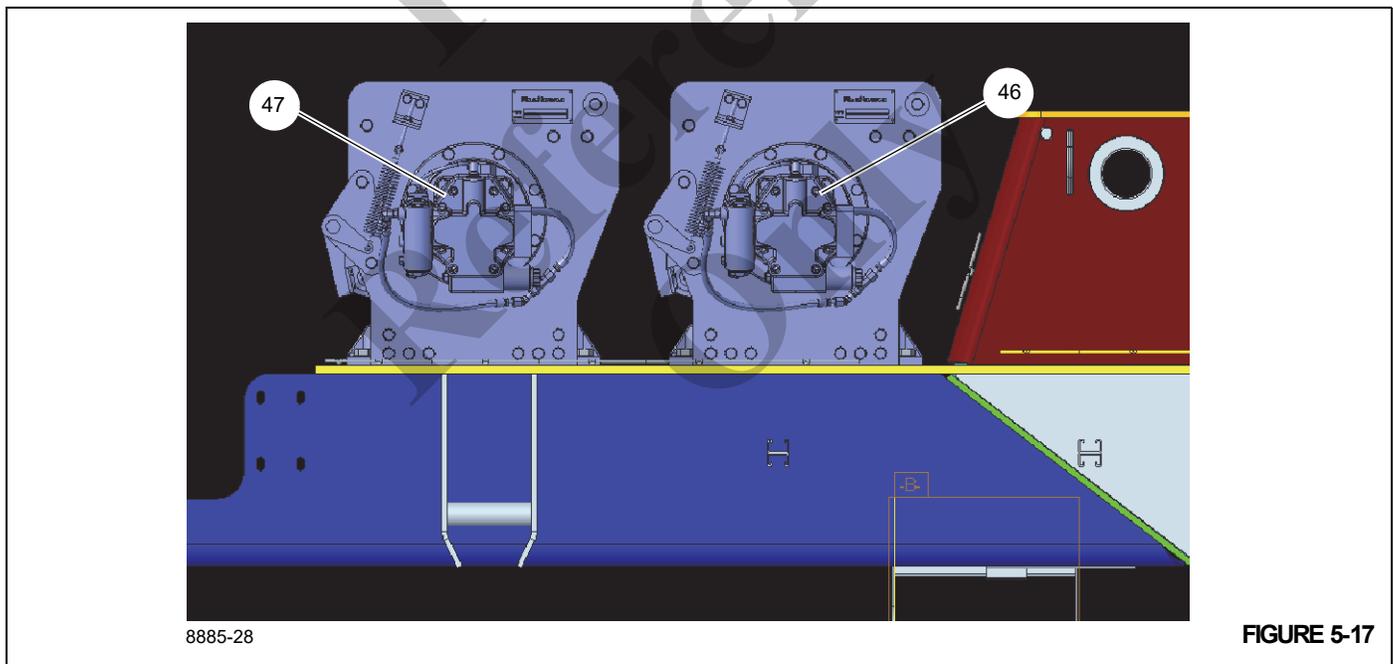
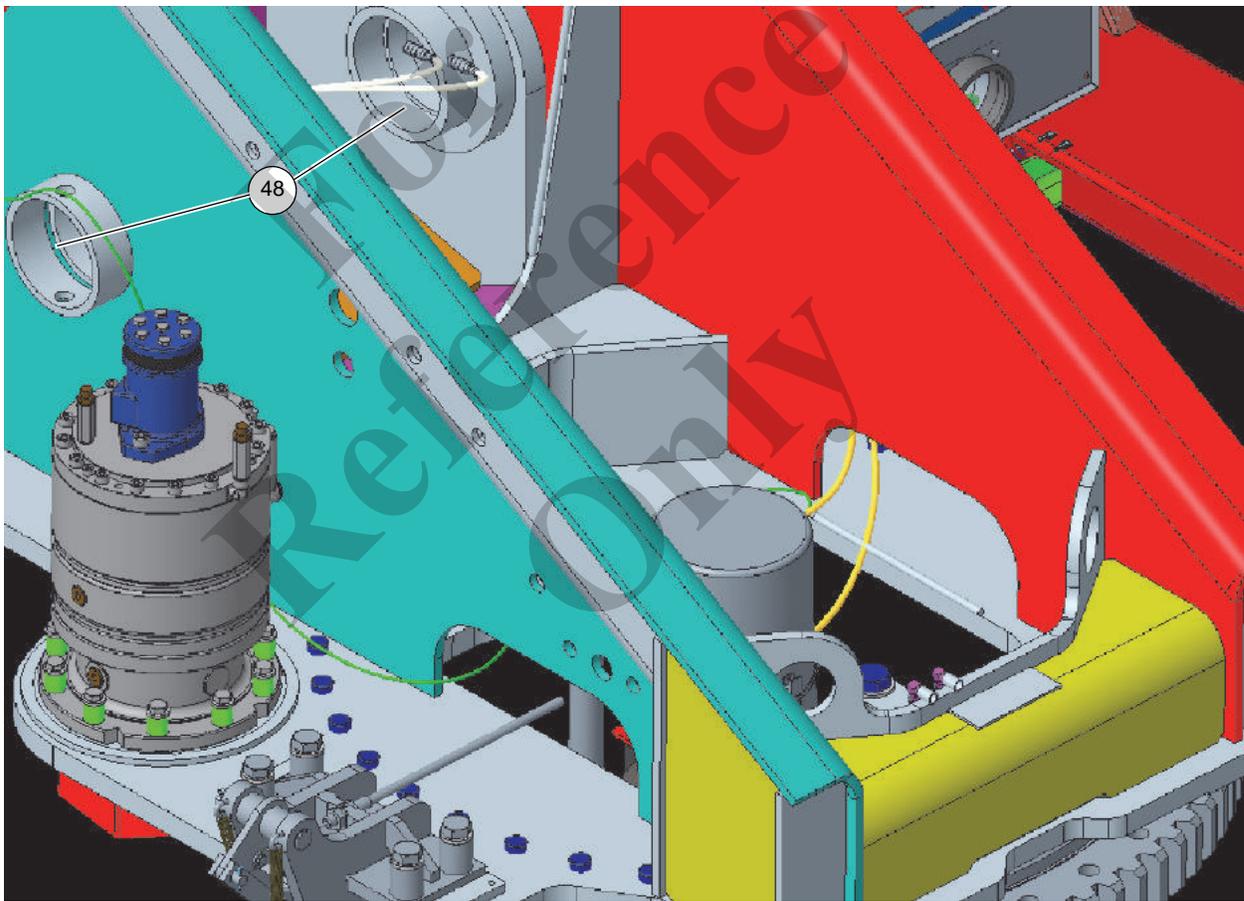


FIGURE 5-17

**Turntable Central Lubrication**

ITEM NUMBER	LOCATION NAME	APPROX. CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
<b>HOIST</b>							
48	LIFT CYLINDER	-----	M	-----	2	LUBE	500 HRS / 3 MONTHS
49	BOOM PIVOT PIN	-----	M		2	LUBE	250 HRS / 3 MONTHS
50	HOIST LOWER LIMIT SWITCH (Optional)	-----	A		2	SPRAY ON	250 HRS / 3 MONTHS
51	CABLE FOLLOWER (ARMS)		G		2	SPRAY ON	250 HRS / 3 MONTHS



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FIGURE 5-18

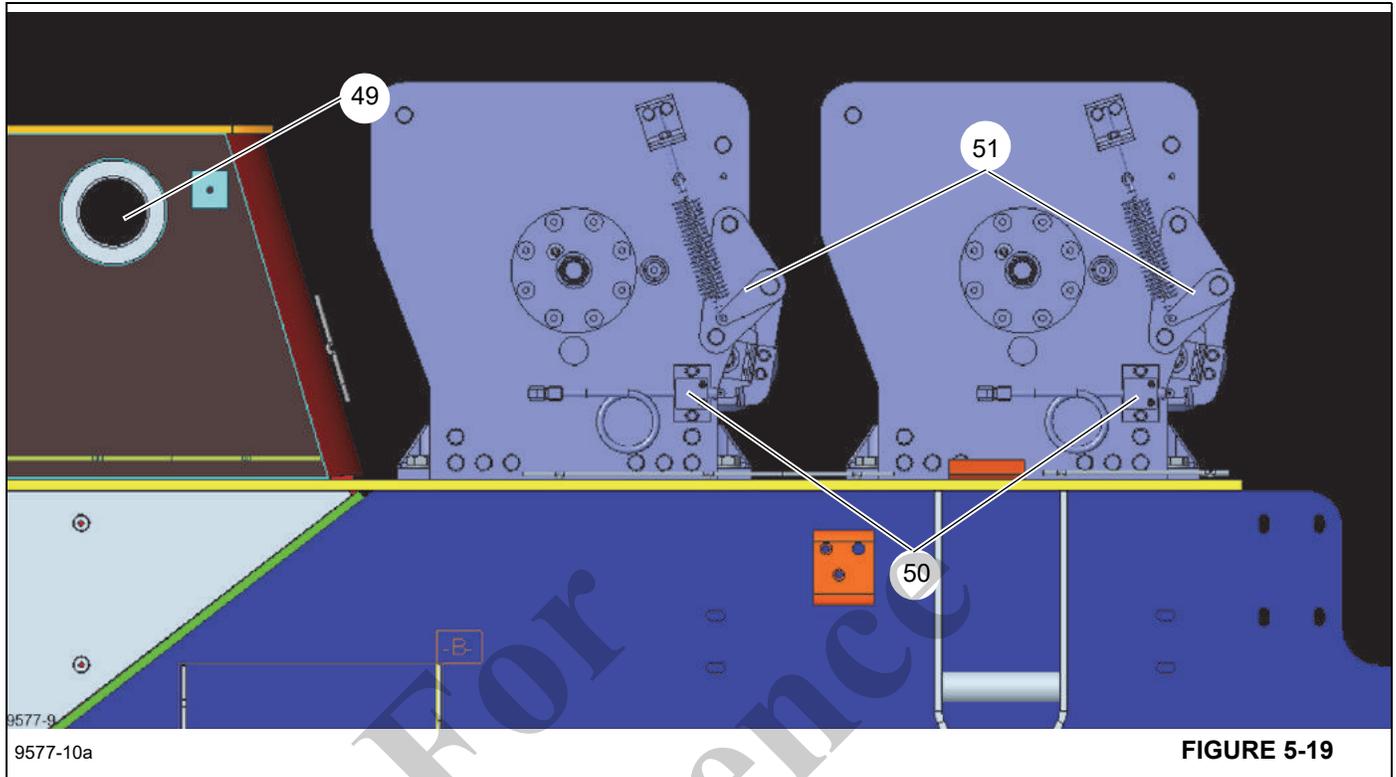


FIGURE 5-19

For Reference Only

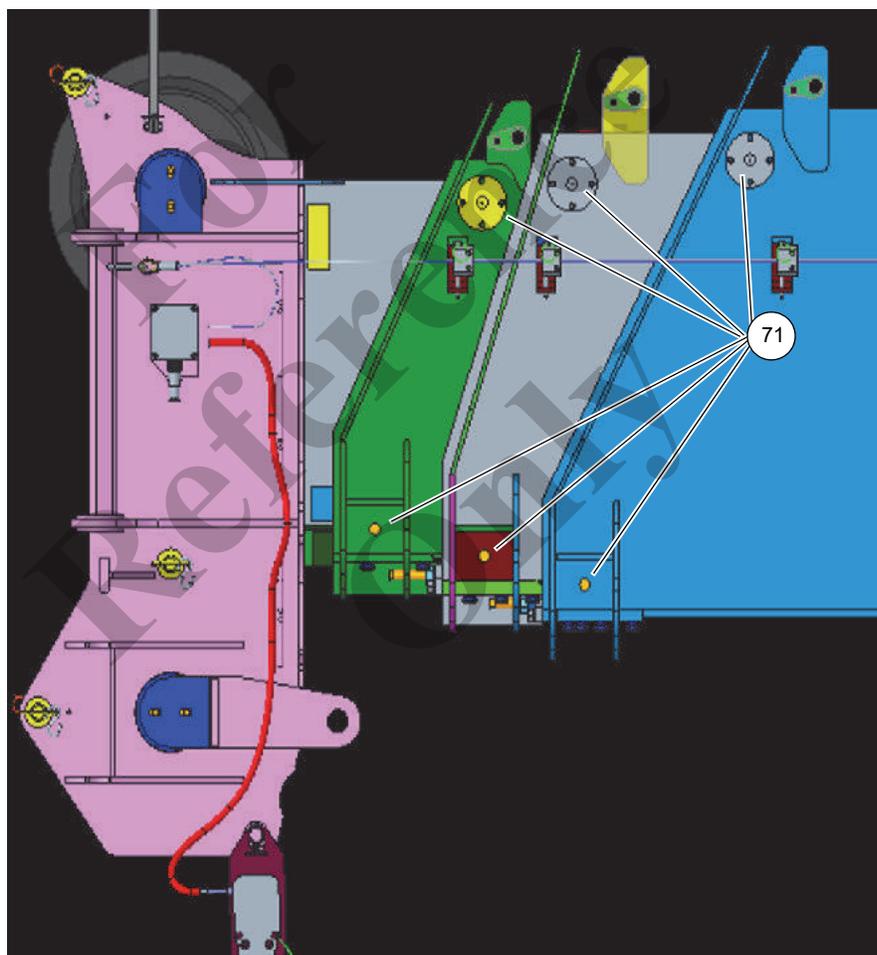
**Boom Lubrication**

**For Crane Setup:**

- Machine to be set up on firm level surface with fully extended outriggers and a minimum of 8,500LBS counterweight installed. Ensure that the crane is level.
- It is recommended to have the boom position be directly over the front and the house lock engaged.

- Set boom angle at zero degrees.
- Disable the swing function to engage the swing brakes, and engage the 360-swing lock, if applicable.
- Extend the boom until grease zerks appear in access holes. Refer to load chart for 0 degree telescoping capability.

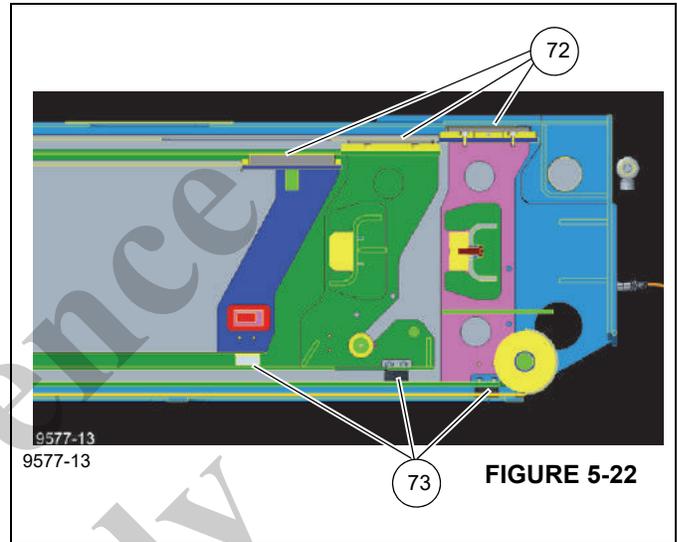
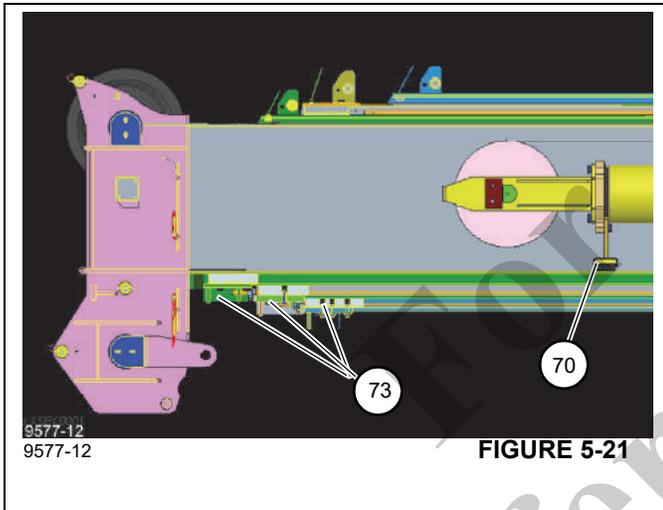
ITEM NUMBER	LOCATION NAME	APPROX. CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
71	BOOM SIDE WEAR PADS	-----	A	14, 26, 27, 29	12	BRUSH ON	250 HRS / 3 MONTHS



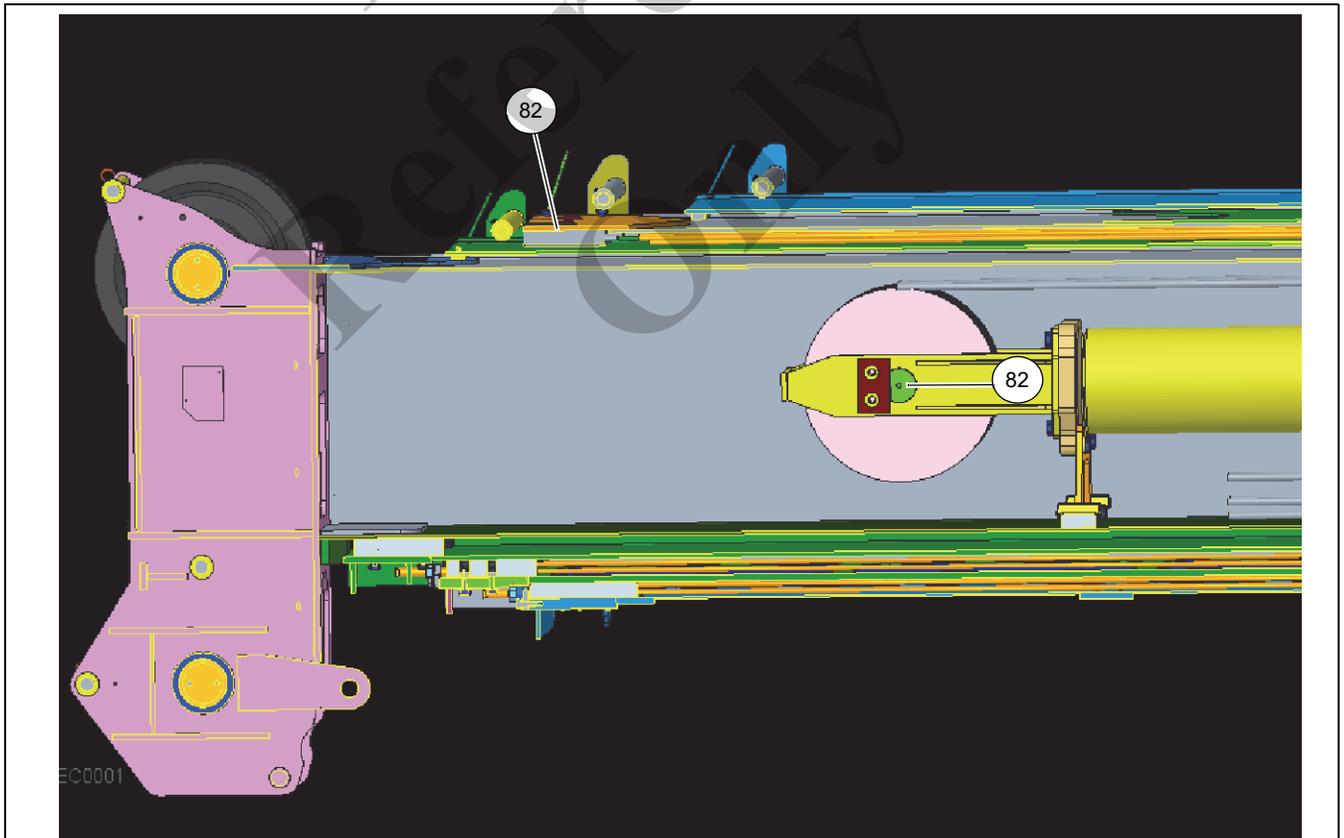
9577-11a

FIGURE 5-20

ITEM NUMBER	LOCATION NAME	APPROX. CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
70	TELE CYL WEAR PADS	-----	A	14, 26, 27, 29	2	BRUSH ON	125 HRS / 3 MONTHS
72	BOOM UPPER WEAR PADS	-----	A	14, 26, 27, 29	6	BRUSH ON	50 HRS / 1 WEEK
73	BOOM LOWER WEAR PADS	-----	A	14, 26, 27, 29	6	BRUSH ON	50 HRS / 1 WEEK



ITEM NUMBER	LOCATION NAME	APPROX. CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
<b>BOOM</b>							
82	EXTEND CABLE SHEAVES	-----	A	1, 8, 14, 26	1	LUBE	250 HRS / 3 MONTHS
83	RETRACT CABLE SHEAVES	-----	A	1, 8, 14, 26	1	LUBE	250 HRS / 3 MONTHS
84	BOOM EXTENSION SHEAVE	-----	A	1, 8, 14	1	LUBE	250 HRS / 3 MONTHS
85	MAST SHEAVE	-----	A	14, 28	1	LUBE	500 HRS / 12 MONTHS
86	BOOM NOSE SHEAVES (2 upper sheaves and 4 lower sheaves) Applies to 95' and 102' Booms.	-----	A	1, 8, 14, 28	2	LUBE	250 HRS / 3 MONTHS
87	AUX BOOM NOSE SHEAVE	-----	A	1, 8, 14	1	LUBE	250 HRS / 3 MONTHS
88	BOOM EXTENSION ROLLER	-----	A	1, 8, 14	1	LUBE	250 HRS / 3 MONTHS

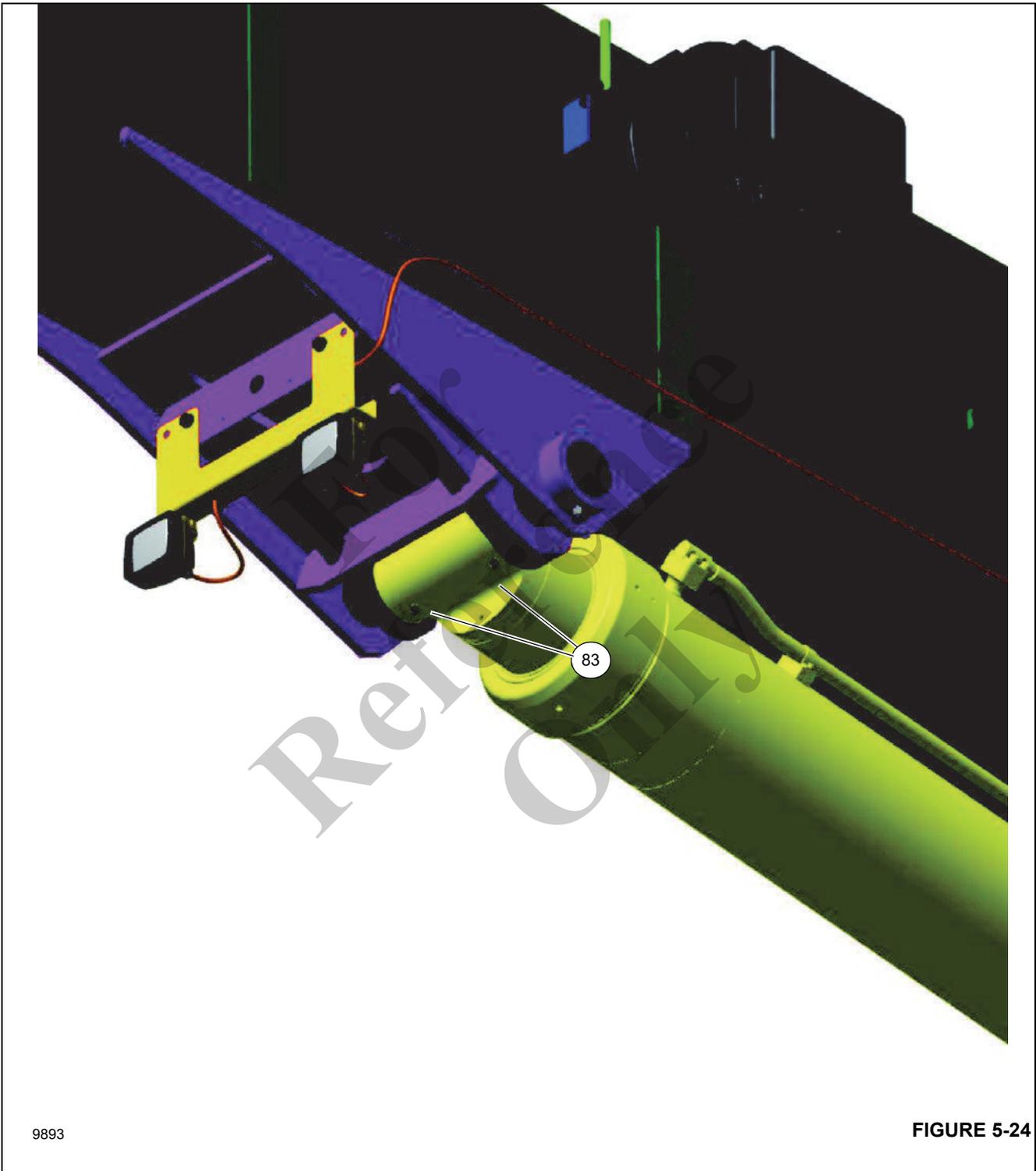


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FIGURE 5-23

**NOTE:** The Boom will need to be extended to line up the Exterior Access Holes.



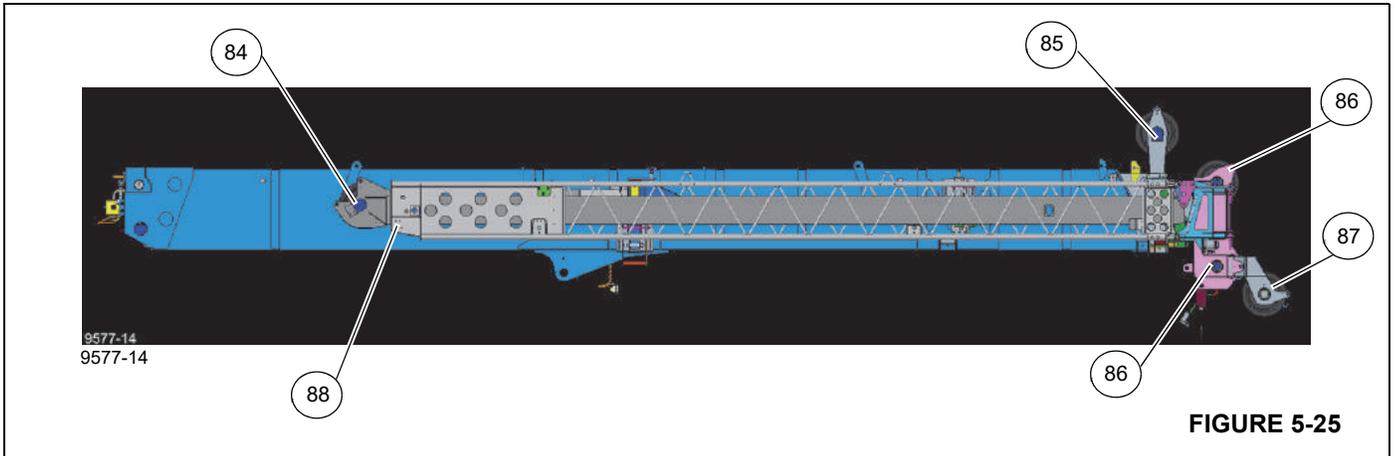
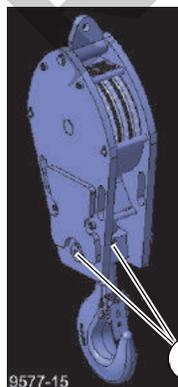
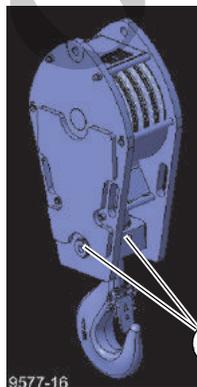


FIGURE 5-25

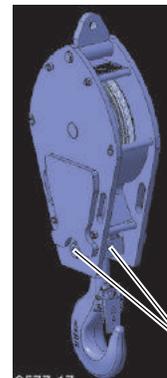
ITEM NUMBER	LOCATION NAME	APPROX. CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
91	HOOK BLOCK - 33 TON (3 SHEAVE) SWIVEL BEARING	-----	A	8, 14	3	LUBE	250 HRS / 3 MONTHS
92	HOOK BLOCK - 40 TON (4 SHEAVE) SWIVEL BEARING	-----	A	8, 14	3	LUBE	250 HRS / 3 MONTHS
93	HOOK BLOCK - 20 TON (1 SHEAVE) SWIVEL BEARING	-----	A	8, 14	3	LUBE	250 HRS / 3 MONTHS
94	OVERHAUL BALL - SWIVEL	-----	A	8, 14	1	LUBE	250 HRS / 3 MONTHS



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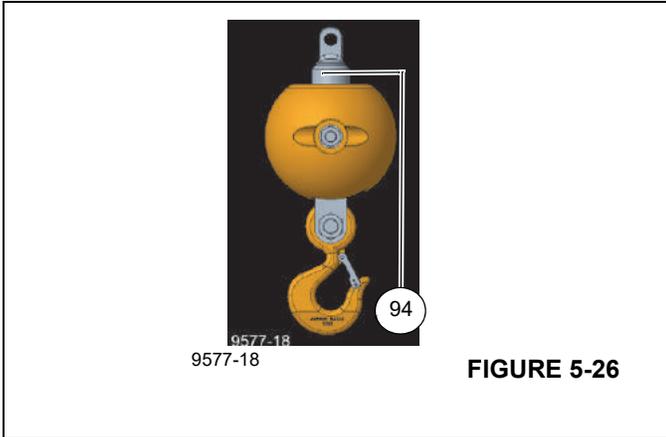


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9577-16



9577-17  
9577-17

FIGURE 5-1



- the pins for the pin connection on the lattice extension,
- the retaining pins on the return pulleys,
- the retaining pins used for fastening the lattice extension sections for transport,

**NOTE:** The lubrication interval applies to average operation. Also, lubricate the pins after high-pressure cleaning and generally at an interval that will prevent them getting dry.

## Monthly Lubrication Work

### Pins

Lubricate the following items on a monthly basis:

For Reference Only

## CARWELL® RUST INHIBITOR

### Protecting Cranes From Corrosion

Manitowoc Crane Group's 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 will be treated with a rust inhibitor called Carwell T32-CP-90. While a rust inhibitor cannot guarantee that a machine will never rust, this product will help protect against corrosion on Grove cranes that are treated with this product.

Carwell is a treatment, not a coating. It contains no silicones, solvents, CFCs or anything that would be classified as hazardous under OSHA Regulation 29CFR1910.1200. The product is a liquid blend of petroleum derivatives, rust inhibitors, water-repelling and water-displacing agents.

Special equipment is used to spray a light film onto the entire undercarriage and various other areas of each new crane prior to shipment. When applied the product has a red tint to allow applicators to view coverage during application. This red tint will turn clear on its own 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 initially 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 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 the surfaces of the crane that are easily seen have the biggest impact on the appearance of the crane, particular attention should be given to the undercarriage of the crane to minimize the harmful effects of corrosion.

Exercise special care and increase the frequency of cleaning if the crane is operated:

- on roads where large quantities of salt or calcium are applied to treat icy and snowy road surfaces;
- in areas that use dust control chemicals;
- anywhere there are increased levels of wetness - especially near salt water;
- during prolonged periods of exposure to damp conditions, for example, moisture held in mud, where certain crane parts may become corroded even though other parts remain dry; or
- in high humidity, or when temperatures are just above the freezing point.

### Cleaning Procedures

To help protect against corrosion of Grove cranes, Manitowoc Crane Care recommends washing the crane at least monthly to remove all foreign matter. More frequent cleaning may be needed when operating in harsh environmental conditions. To clean the crane, follow these guidelines:

- High pressure water or steam is effective for cleaning the crane's undercarriage and wheel housings. Keeping these areas clean will not only help retard the effects of corrosion, but will also improve the ability to identify potential issues before they grow into larger problems.



#### CAUTION

High pressure water can be forced into spaces and infiltrate beyond seals. Avoid pressure washing in the vicinity of electrical controls, panels, wiring, sensors, hydraulic hoses and fittings, or anything that can be damaged by high pressure cleaning/spraying.

- Rinse the 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 prior to washing. Do not use solvents or gasoline.
- Wash using only soaps and detergents recommended for automotive paint finishes.
- Rinse all surfaces thoroughly to prevent streaking caused by soap residue.
- Allow the crane to dry thoroughly. You can accelerate drying by using compressed air to remove excess water.

Polishing and waxing (using an automotive-type wax) is recommended to maintain the original paint finish.

### Inspection and Repair

- Immediately following cleaning, Manitowoc Crane Care recommends an inspection to detect areas that may have become damaged by stone chips or minor mishaps. A minor scratch (one that has not penetrated to the substrate surface) can be buffed with an automotive-type scratch remover. It is recommended that a good coat of automotive wax be applied to this area afterwards.
- All identified spots and/or areas that have been scratched through to the 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:

Manitowoc Crane Care recommends that a qualified body repairman prepare, prime and paint any major scratch(es) or minor damage.



#### CAUTION

To the extent any damage is structural in nature, Manitowoc Crane Care must be contacted and consulted as to what repairs may be required.

For scratches and marks in highly visible areas:

- Sand to remove the scratch and feather outward from the mark to blend the repair into the original surface. Body putty may be applied as necessary to hide the defect; then sand smooth.
- Cover all bare metal with a primer that is compatible with the original paint finish and allow to dry thoroughly.
- Prepare the surface prior to applying the finish coat of paint.
- Apply a finish coat of paint using accepted blending techniques. Use of original paint colors is recommended to insure 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 retard the effects of corrosion and enable you to do the repair at a later time 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 upon the environment in which a crane is used and/or stored, the initial factory application of Carwell T32-CP-90 should help inhibit corrosion for up to approximately 12 months.

It is recommended that the treatment be periodically reapplied by the crane owner after that time to help continue to protect 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, and/or areas where winter road salt is regularly used, reapplication of treatment is recommended sooner than 12 months, for instance, repeat treatment in 6-9 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:** Unit must be completely dry before applying treatment.

- Do not allow product to puddle or build-up on weather stripping or rubber gaskets. Unit should not have puddles or runs evident anywhere.
- To proper coverage of treatment, the product needs to be fogged on the unit.
- Use of pressure pots to apply the treatment to the unit being processed is recommended.
- Carwell treatment is available in 16 ounce spray bottles from Manitowoc Crane Care (order part number 8898904099).
- After application of the treatment is complete, wash or clean film residue from lights, windshield, grab handles, ladders/steps and all access areas to crane, as necessary.

Please contact Manitowoc Crane Care should you have any questions.

### Areas of Application

Reference Figure 5-27.

- The underside of the unit will have full coverage of the rust inhibitor. These are the only areas that a full coat of the rust inhibitor is acceptable on the painted surfaces. Areas include; valves, hose ends and fittings, swivel, pumps, axles, drivelines, transmission, swing bearing 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 ends and fittings, wire rope on hoists, roller tensioning springs on hoists,

- all unpainted fasteners and hardware, valves, swing bearing fasteners and all bare metal surfaces.
- Boom applications areas are; pivot pins, hose ends 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.

For  
Reference  
Only



Item	Description
1	Hoist Hose Connections
2	Boom Extension Pins, Clips
3	Valve Bank
4	Hose Connections inside Turntable
5	Boom Extension Hanger Hardware
6	Boom Nose Pins, Clips
7	Hook block Tiedown Cable
8	Overhaul Ball/Hook Block
9	Mirror Mounting Hardware
10	O/R Hose Connections
11	All Hardware, Clips, Pins, Hose Connections not painted O/R Pins, Clips

Item	Description
12	Powertrain Hardware inside Compartment
13	Entire underside of Unit
14	Turntable Bearing Fasteners
15	Wire Rope
16	Tension Springs
17	Pivot Shaft
18	Outrigger Beam Wear Pad Adjustment Hardware

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Reference  
Only

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Reference  
Only

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## SECTION 6 SET-UP AND INSTALLATION

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### GENERAL

This section provides procedures for the setup of crane before and after transporting, installing the hoist rope on the hoist drum, cable reeving, and erecting and stowing the boom extension.

### SETUP OF CRANE BEFORE AND AFTER TRANSPORTING

Before transporting the crane, place the following components into their transport positions. After transporting the crane, place these same components into their working positions:

- Hoist Mirrors (at hoists)

- Hoist Camera (Optional)
- Hoist Mirror (at cab)
- RCL Light Tower (Optional)
- Carrier Cab Beacon Light (Optional)
- Superstructure Cab Beacon Light (Optional)
- Boom Nose Position Indicator (Optional) and Anemometer (Optional)
- Front and Rear Access Ladders

**HOIST PLATFORM**

The hoist platform (1), (Figure 6-1) is provided to allow for inspection and maintenance activities to be performed at the hoist area (2), (Figure 6-1).

Use the ladder (1) to access the hoists (2), hoist camera (3), and hoist mirror(s) (4) as shown in (Figure 6-1).

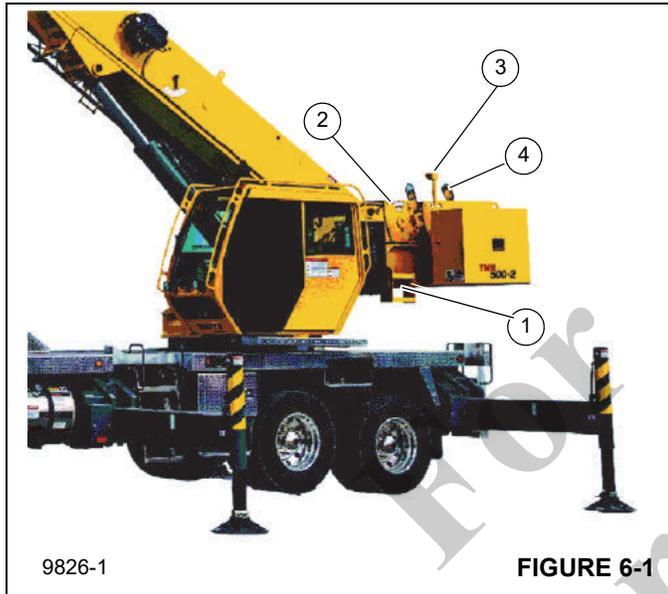


FIGURE 6-1

**! 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.

**INSTALLING CABLE ON THE HOIST**

**CAUTION**

If cable is wound from the storage drum, the reel should be rotated in the same direction as the hoist.

**NOTE:** The cable should preferably be straightened before installation on the hoist drum.

Install cable on the hoist drum in accordance with the following procedure:

1. Position the cable over the boom nose sheave and route to the hoist drum.
2. Position the hoist drum with the cable anchor slot on top.

3. Insert the cable through the slot and position around the anchor wedge (1), (Figure 6-2).

**NOTE:** The end of the cable should be even with the bottom of the slot for the anchor wedge.

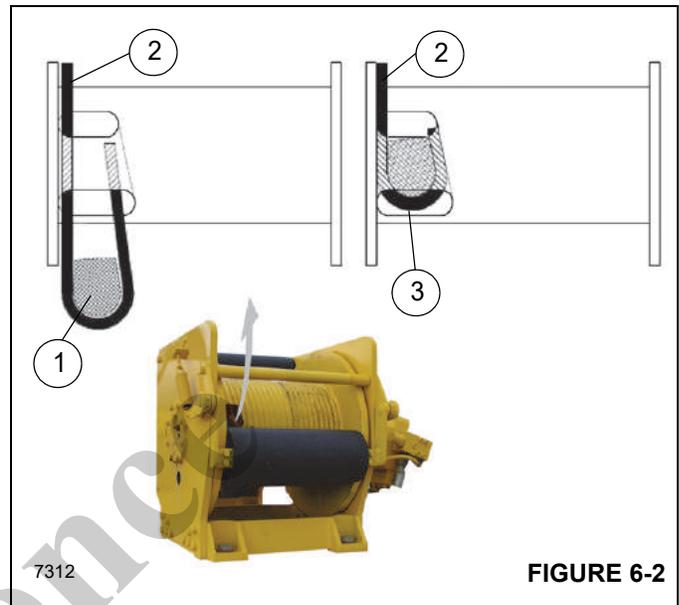


FIGURE 6-2

4. Position the anchor wedge in the drum slot; pull firmly on the free end (2), (Figure 6-8) of the cable to secure the wedge.

**NOTE:** If the wedge does not seat securely in the slot, carefully tap (3), (Figure 6-2) the top of the wedge with a mallet.



5. Slowly rotate the drum, ensuring the first layer of cable is evenly wound onto the drum.
6. Install the remainder of the cable, as applicable.

**ANTI- TWO-BLOCK (A2B) SWITCH**

An Anti- two-block (A2B) Switch is a device that, when activated, disengages all crane functions whose movement can cause two-blocking.

It is important that an A2B Switch is properly installed at each location where a hoist rope is reeved.

**NOTE:** If an A2B Switch is installed and connected to the system with no cable reeved, it can be locked.

If a hoist rope has been reeved and two A2B switches are installed, the unused A2B switch must be locked (disabled) to allow all crane operations.

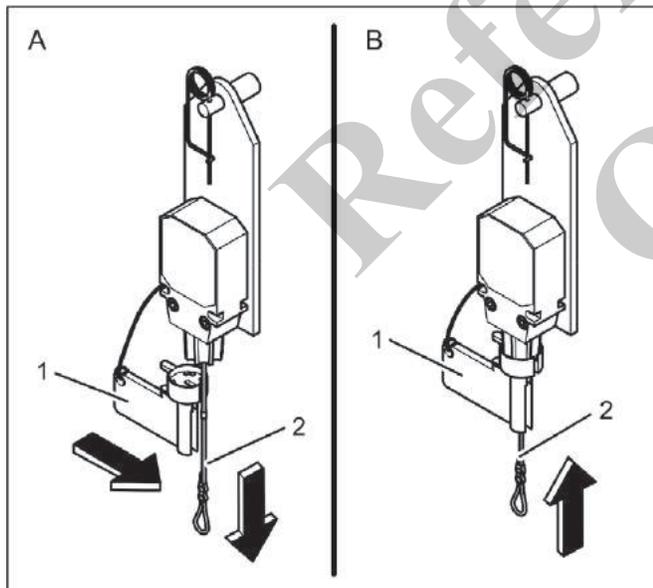
An Anti- two-block device is also incorporated into the system to prevent the hook block or overhaul ball from coming into contact with the boom nose or boom extension. This condition will also cause a lockout of hoist up, boom down, and telescope out, and also provides a visual and an audible alarm.

**Locking A2B Switch**

**CAUTION**

If the A2B switch is locked (disabled), the hook block could hit the main boom nose or extension, resulting in damage to the hook block, main boom nose or extension, and hoist rope. Never lock an A2B switch with a switch weight attached.

1. Remove A2B weight.
2. Remove cap (1) from switch as shown in Step A, (Figure 6-3).
3. Pull lanyard (2) down.
4. Secure lanyard (2) in this position using cap (1) as shown in Step B, (Figure 6-3). A2B switch is locked (disabled).

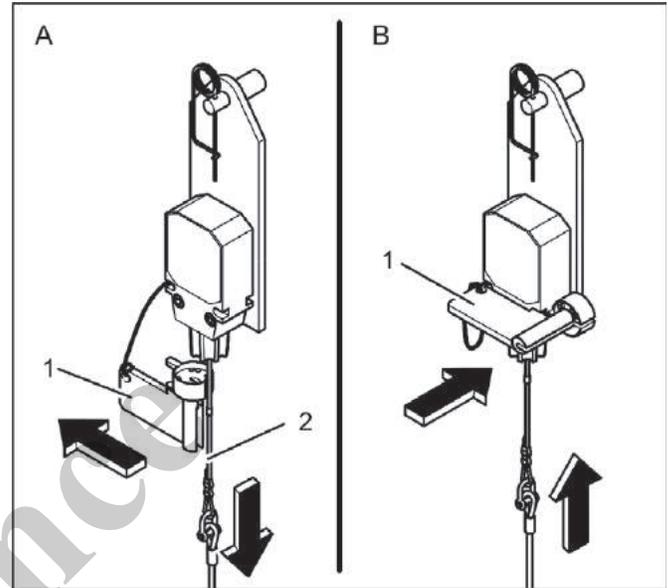


8684-1 **FIGURE 6-3**

**Unlocking A2B Switch**

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

1. Pull down lanyard (2) and remove cap (1) as shown in Step A, (Figure 6-4). Switch is unlocked (enabled).
2. Install cap (1) on A2B switch as shown in Step B (Figure 6-4).



8684-2 **FIGURE 6-4**

**Before Operation Check**

Check the following electrical connections before operating the crane to make sure the 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 extension, no additional connections are necessary. If the crane is operated with a main boom extension, the connecting cable must be mounted between the electrical socket on the extension and the socket 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. An A2B Switch must be installed and connected at each location where hoist rope is reeved.

**Cranes with Main and Auxiliary Hoists**

If the main boom extension is not used, then the bridging plug must be plugged into the electrical socket 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 electrical socket on the boom extension and the electrical socket on the main boom. In addition, weights must be fitted to both the A2B switch of the main boom and the A2B switch of boom extension.

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. See (Figure 6-5). Also refer to *Locking A2B Switch*, page 6-3.

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.

If the crane is operated with an auxiliary boom nose, then the connecting cable must be mounted between the electrical socket on the auxiliary boom nose and the electrical socket on the main boom. In addition, weights must be fitted to both the A2B switches on the main boom and the auxiliary boom nose. Always secure the A2B switch(es) (Figure 6-5) before moving the crane. Also refer to *Boom Extension Anti- Two-Block Switch*, page 6-22.

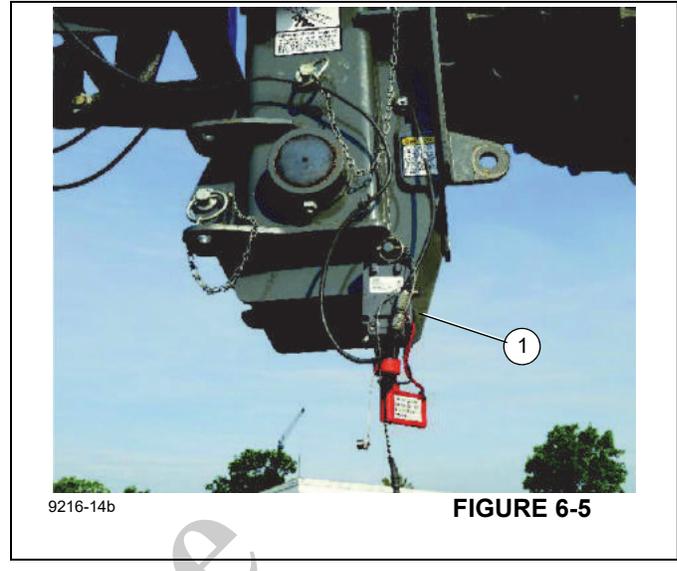


FIGURE 6-5



## WARNING

The following tests must be performed with care to prevent personnel injury or crane damage. Proper functioning of the A2B requires successful completion of these tests before starting work.

If the operator cannot see the hook block approaching the main boom nose, this task must be assigned to an assistant.

The crane operator must be prepared to stop the crane immediately if the A2B 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 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 A2B switch warning should display (see *Operator Display Module and Rated Capacity Limiter Display Module*, page 3-33).
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 switch warning 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 hoist limit situation. As soon as the hook block raises the weight, the acoustic alarm should sound, the A2B switch warning should display, and the boom lower function

should switch off. Lower the hook block slightly to eliminate this condition.

- Slowly extend (telescope out) the boom to bring about a potential hoist limit situation. As soon as the hook block raises the weight, the acoustic alarm should sound, the A2B switch warning 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.

- If crane is equipped with a boom extension, the inspection procedure must be repeated for the A2B switch of the extension.

**NOTE:** If the crane is equipped with an auxiliary hoist, the procedure needs to be repeated for each A2B Switch location.

### HOIST ROPE REEVING

Within the limits of the load and range charts and permissible line pull, multi-part lines allow the operator to raise a greater load than can be raised with a single part line. Various cable reeving (parts of line) is possible with the boom nose and hook block (Figure 6-11). This reeving should be accomplished by a qualified rigger using standard rigging procedures.

To quick reeve the hook block without removing the wedge socket on the end of the cable, remove the rods (1) (Figure 6-6) and route the wedge socket under the sheave.

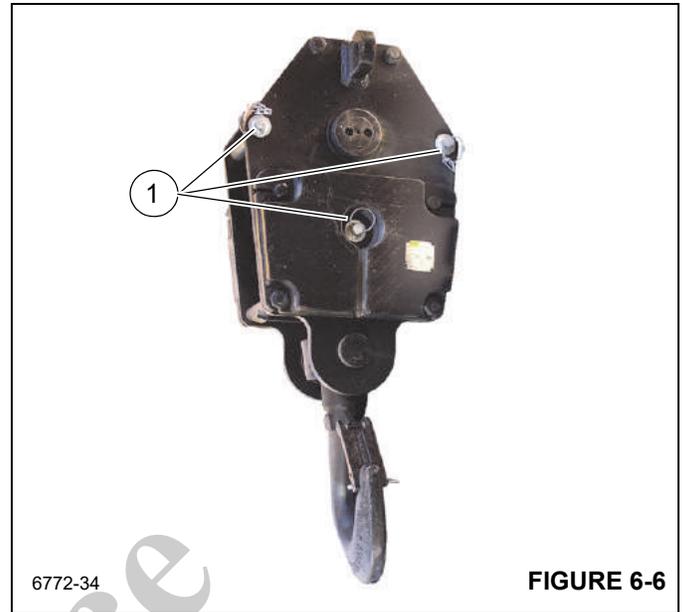


FIGURE 6-6

### Positioning/Removing the Hoist Cable

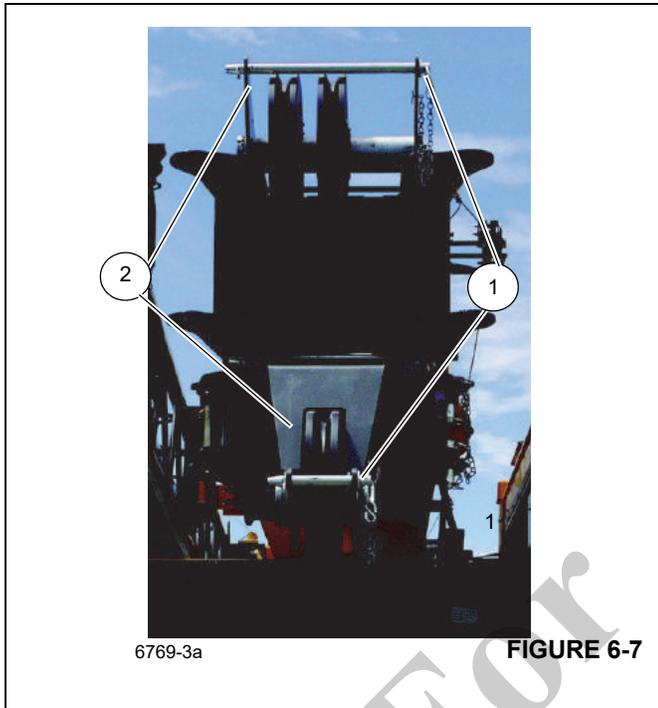


### CAUTION

#### Falling Objects Hazard!

Always make sure rods that secure the hoist rope are secured with clips. This prevents components from coming loose, falling and causing injury.

- Remove the upper and lower retaining rods (1), (Figure 6-7).
- Guide the rope over the upper and lower boom nose sheaves (2), (Figure 6-7).
- Reinstall the upper retaining and lower retaining rods and secure with retaining clips (1), (Figure 6-7).
- Install the overhaul ball or the hook block. The rope may now be reeved.
- Reinstall the lower retaining rod and secure with retaining clip.



### Unreeving the Hoist Rope

1. Unreeve the hook block or disconnect the overhaul ball.
2. Remove the upper and lower retaining rods (1), (Figure 6-7).
3. Take the wire rope off the upper and lower boom nose sheave (2), (Figure 6-7) and place it on the ground on the left side of the boom.
4. Replace all retaining rods and secure them with retaining clips (1), (Figure 6-7).

### Reeving Hoist Rope Over the Boom

**NOTE:** The load bearing capacity of the TMS500-2 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 hook block or a heavier hook block should be used.

### DEAD-END RIGGING/WEDGE SOCKETS

Wedge socket assemblies are popular rigging accessories and have been successfully used for decades to terminate wire ropes on mobile cranes. A wedge socket assembly is easily installed and dismantled but it must be installed and used correctly. It is essential to use only a wedge and socket of the correct size for the rope fitted. Failure to do so may result in the rope pulling through the fitting.

Since state and local laws may vary, alternate attachment methods may be necessary depending upon work conditions. If alternate methods are selected, the user is responsible and should proceed in compliance with the regulations in force. If there are any questions, contact your local Grove Distributor or Manitowoc Crane Care.

Do not mix components from different manufacturers. The selection, installation and use of a wedge socket assembly must be in accordance with the requirements of the wedge socket manufacturer and the wire rope manufacturer upon whose wire rope the wedge socket assembly will be used.

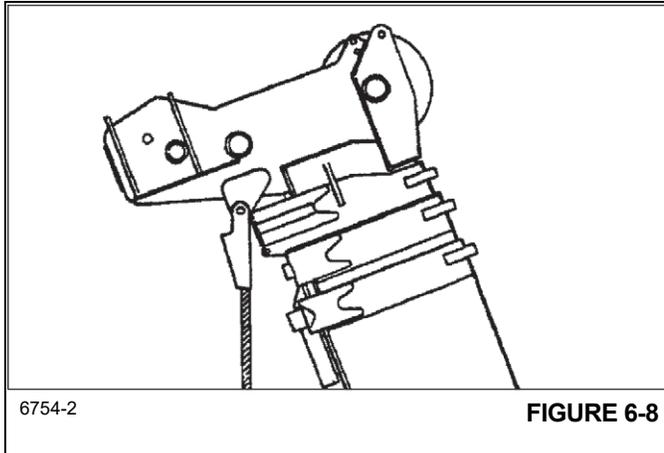
Grove Crane specifies the size, type, class and line pulls for wire rope, predominately rotation resistant wire rope, and rigging accessories such as overhaul balls and hook blocks for use with each new crane that it manufactures. Other wire ropes and rigging accessories are available from various vendors. Different wire rope manufacturers have differing requirements for the construction, handling, cutting, seizing, installation, termination, inspection and replacement of the wire ropes they produce. Their advice should be sought for each specific type of wire rope a crane user intends to install on a mobile crane.

When assembly is complete, raise the boom to a working position with a load suspended to firmly seat the wedge and rope into the socket before the crane is used operationally.

### CAUTION

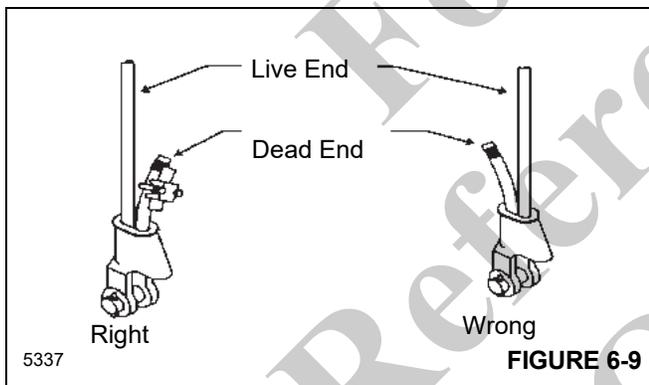
If the socket is not positioned with the flat face toward the boom sections, structural damage will occur.

When anchoring the socket to the boom, make sure the flat face of the socket is toward the boom sections, as shown in (Figure 6-8)



### Installing Wedge and Socket

1. Inspect the wedge and socket. Remove any rough edges and burrs.
2. For rotation resistant rope, the end needs to remain welded.



3. Make sure the live-loaded side (Figure 6-9) of the rope is directly in-line with the ears of the socket and the direction of pull to which the rope will be subjected. If the rope is loaded into the socket incorrectly, under a load the rope will bend as it leaves the socket, and the edge of the socket will wear into the rope causing damage to the rope and eventual failure.
4. Insert wire rope end in socket, form a loop in the rope, and route the rope back through the socket allowing the "dead" end (Figure 6-9) to protrude from the socket. Make sure the dead end of the rope is long enough to apply end treatment to the dead end after the wedge has been seated. See below for minimum length of dead end.

5. Insert the wedge into the loop and pull the live end of the rope until the wedge and rope are snug inside the socket. It is recommended that the wedge be seated inside the socket to properly secure the wire rope by using the crane's hoist to first apply a light load to the live line.
6. After final pin connections are made, increase the loads gradually until the wedge is properly seated.
7. The wire rope and wedge must be properly secured inside the socket before placing the crane into lifting service. It is the wedge that secures the wire rope inside the socket whereas the dead-end treatment is used to restrain the wedge from becoming dislodged from the socket should the rope suddenly become unloaded from the overhaul ball or hook block striking the ground.

Sketches A through F (Figure 6-10) illustrate various methods for treating the dead-ends of wire ropes which exit a wedge socket assembly. While use of the loop-back method is acceptable, care must be exercised to avoid the loop becoming entangled with tree branches and other components during crane transport and with the anti-two block system and other components during use of the crane.

Of the methods shown below, Grove prefers that Method A or F be used on Grove cranes, that is, clipping a short piece of wire rope to the dead-end or using a commercially available specialty wedge. It is required that the tail length of the dead-end should be a minimum of 6 rope diameters but not less than 15.2 cm (6 in) for standard 6 to 8 strand ropes and 20 rope diameters but not less than 15.2 cm (6 in) for rotation resistant wire ropes.

When using Method A, place a wire rope clip around the dead end by clamping a short extra piece of rope to the rope dead end. **DO NOT CLAMP THE LIVE END.** The U-bolt should bear against the dead end. The saddle of the clip should bear against the short extra piece. Torque the U-bolts according to the figures listed in the chart titled Wire Rope Clip Torque Values (Table 6-1).

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) B30.5 applies to cableways, cranes, derricks, hoists, hooks, jacks, and slings. It states, in section 5-1.7.3, "(c) Swagged, 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 the Wire Rope Users Manual, latest revised.

Table 6-1

WIRE ROPE CLIP TORQUE VALUES			
Clip Sizes		*Torque	
mm	Inches	Nm	Ft-Lbs
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

WIRE ROPE CLIP TORQUE VALUES			
Clip Sizes		*Torque	
mm	Inches	Nm	Ft-Lbs
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

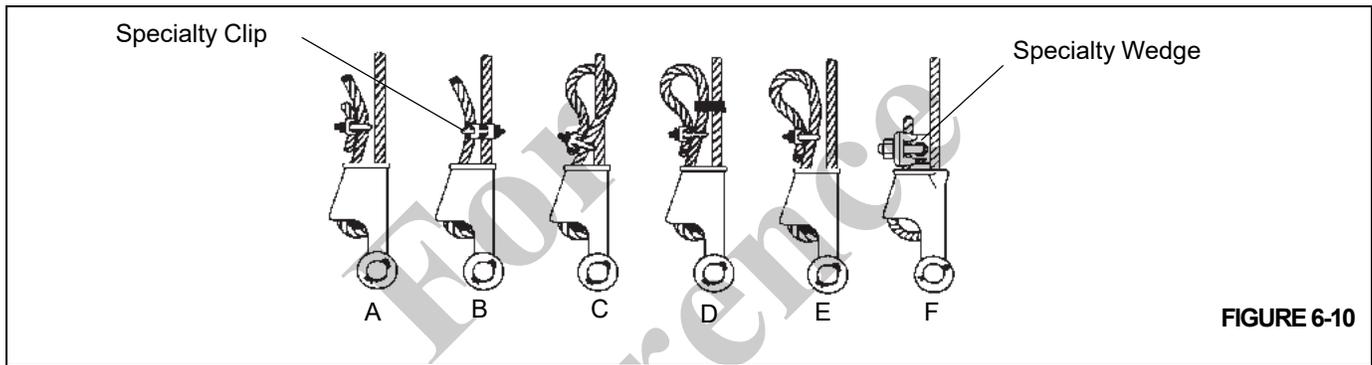
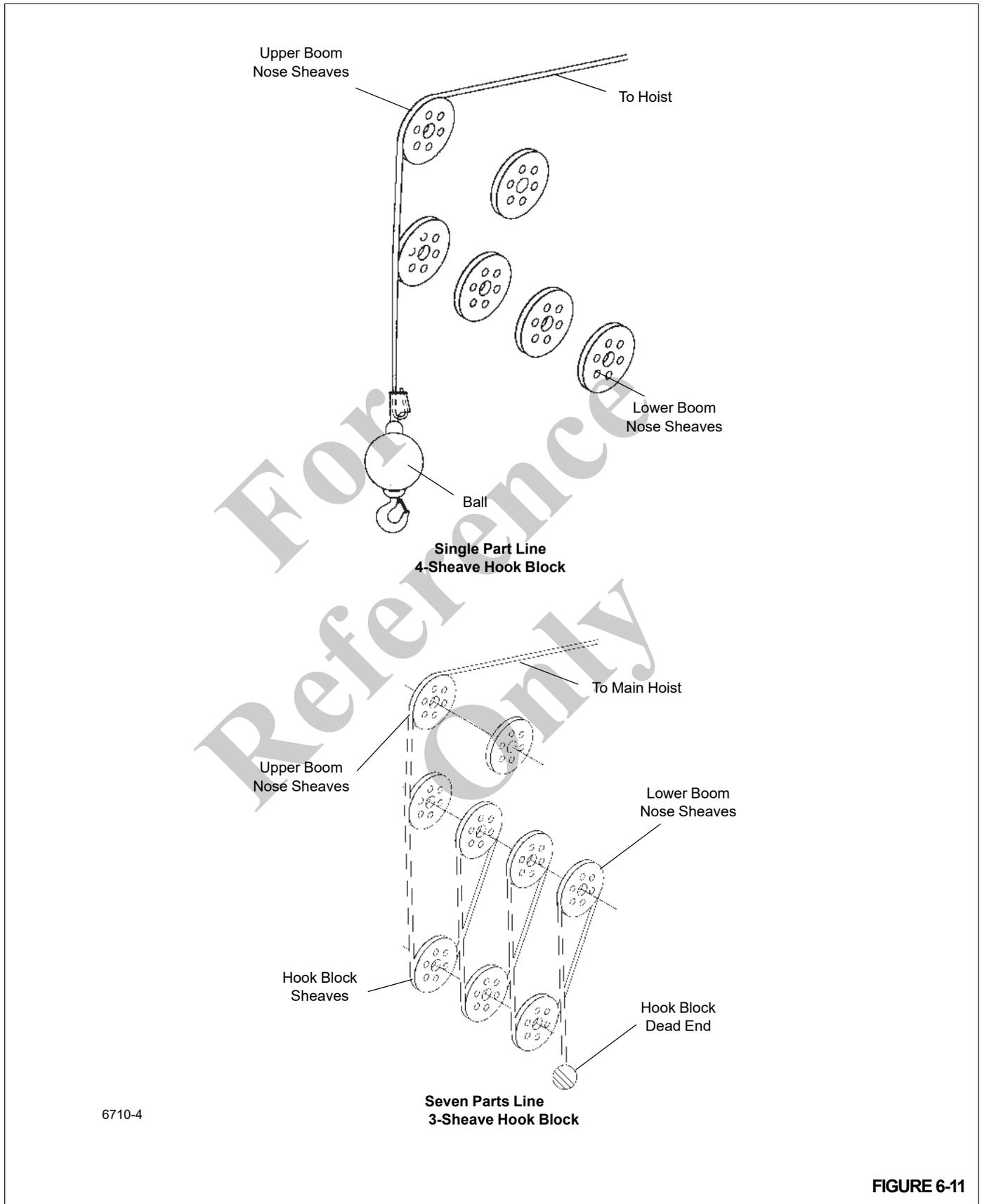


FIGURE 6-10



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FIGURE 6-11

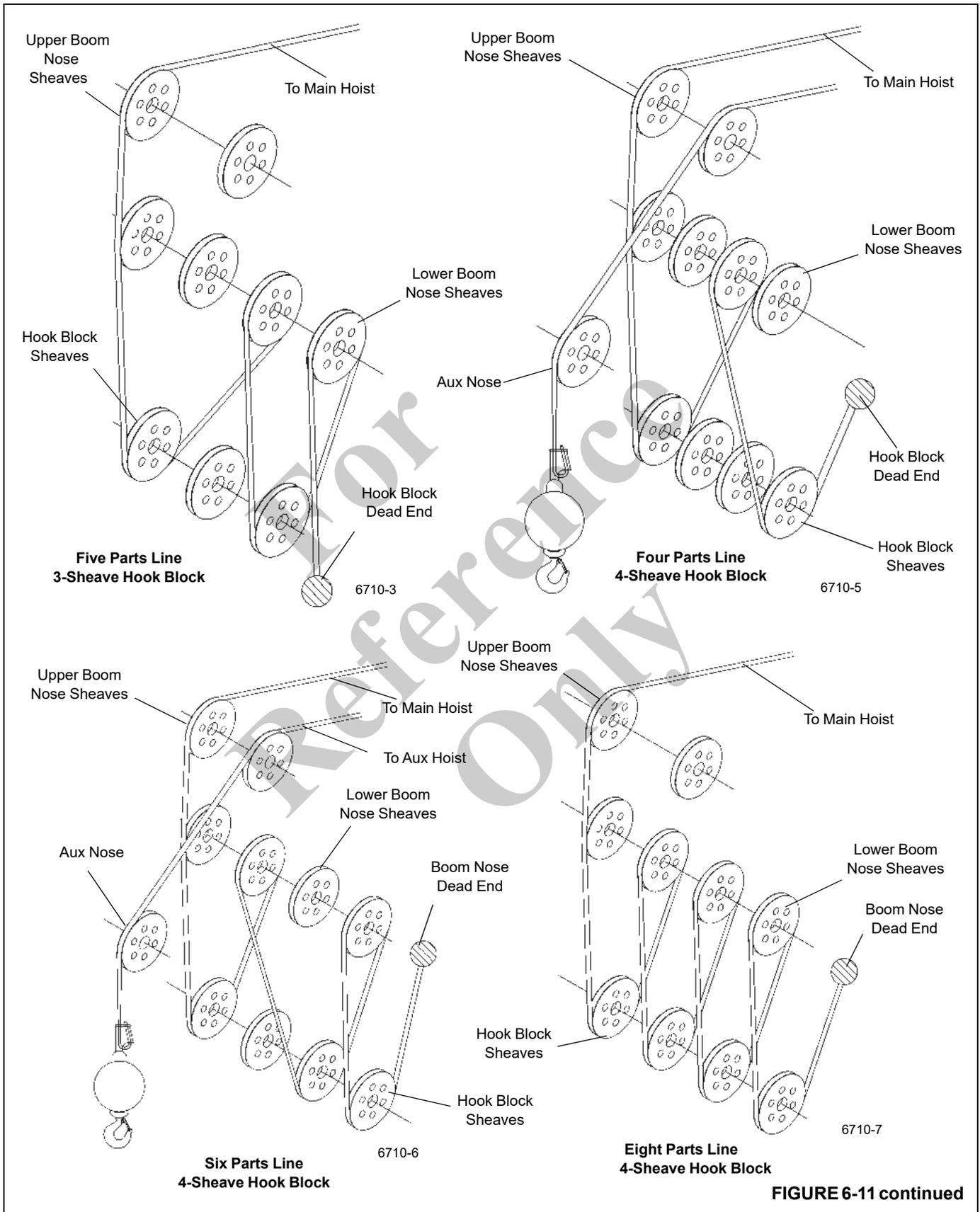
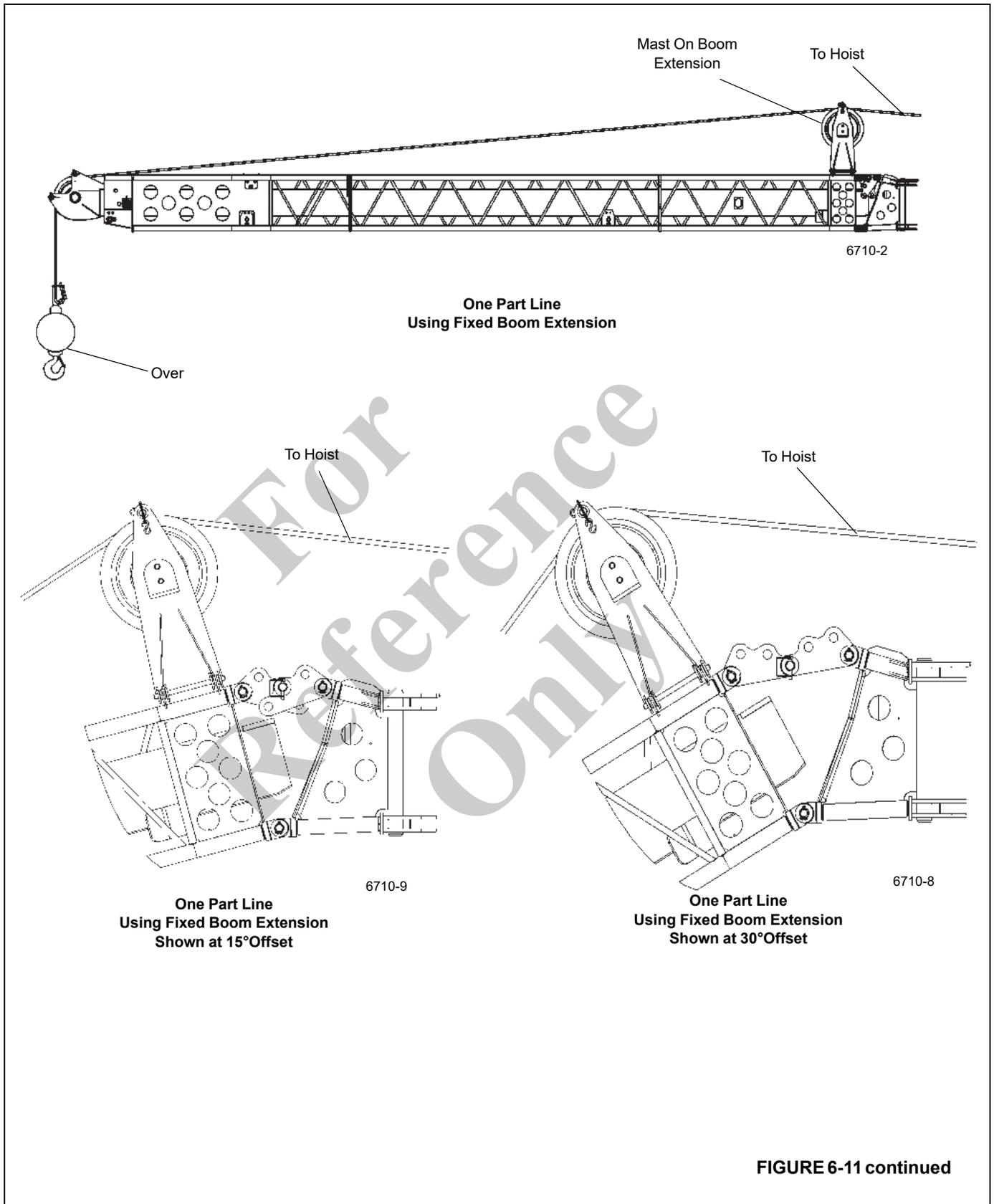


FIGURE 6-11 continued



## COUNTERWEIGHTS

Configurations for counterweights follows below.

### **Fixed Counterweight Description**

The Standard Counterweight is a 2268 kg (5000 lb) box attached to the Superstructure. An optional Heavy Counterweight package adds two 794 kg (1750 lb) weight blocks to the box for a total of 3856 kg (8500 lb). (Refer to the *Fixed Counterweight Description*, page 6-12).

Both weight blocks must be used together. An optional Zero Counterweights configuration can be utilized by removing the box. (Refer to the *Fixed Counterweight Removal*, page 6-12).

All three configurations can be used with the 95' boom length. The 102' boom length must be used with the Heavy Counterweight option only. For cranes without an auxiliary hoist, a 351 kg (773 lb) counterweight is bolted to the hoist mount in place of the auxiliary hoist. Counterweight Removal

### **Fixed Counterweight Removal**



### **DANGER**

Death or serious injury could result from being crushed by a falling counterweight.

Ensure the retainer pin is properly installed to secure the counterweight mounting pin.

**NOTE:** Use of a forklift to remove/install the fixed counterweight is not recommended.

1. Fully extend and set the outriggers.

**NOTE:** The counterweight weighs approximately 2268 kg (5000 lb) or 3856 kg (8500 lb.) if Heavy Counterweight Package blocks are installed.

2. Lower and fully retract the boom.
3. Shut down crane.
4. Attach an adequate lifting device to the counterweight.
5. Ensure the four counterweight leveling capscrews are set for maximum clearance with the turntable.
6. Slowly raise counterweight until pin assembly can be removed by pushing and turning the pin.
7. Remove pin assembly from opposite side.
8. Lower counterweight until attaching lugs are clear of the turntable.
9. Back counterweight away from turntable until it is clear of crane.

10. Replace pin assembly in turntable counterweight mounting lugs.
11. Move counterweight far enough from crane to allow the turntable/superstructure to clear during repositioning.

### **Fixed Counterweight Installation**

1. Fully extend and set the outriggers.
2. Lower and fully retract the boom.
3. Shut down crane.

## **CAUTION**

When lifting/handling the counterweight, keep the chains/straps vertical to minimize side pull on the lifting lugs.

**NOTE:** The counterweight weighs approximately 2268 kg (5000 lb) or 3856 kg (8500 lb.) if Heavy Counterweight Package blocks are installed.

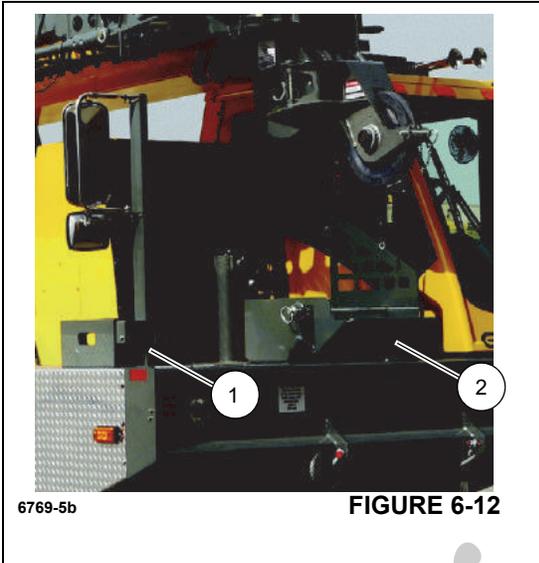
Use of a forklift to remove/install the fixed counterweight is NOT recommended.

4. Attach an adequate lifting device to the counterweight and lift the counterweight into place on the superstructure, aligning the mounting holes on the counterweight to the holes in the superstructure.
5. Install the counterweight mounting pins and secure them in place with hitch pin retainers.
6. Remove the lifting device from the counterweight.
7. Using the four counterweight leveling bolts, level the counterweight and eliminate any relative movement between the counterweight and turntable. Maximum width of counterweight shall not exceed 6.0 mm (0.25 in) out of level with the turntable bearing when measured from either counterweight outer edge.

## **RIGGING WORK ON THE MAIN BOOM**

### **Overhaul Ball Stowage**

The hook block or overhaul ball can also be stowed in trays next to the carrier cab or stowed behind the boom rest. If using the stowage area behind the boom rest, the operator will need to supply the appropriate tie-down straps. The overhaul ball stowage tray is shown in (1), (Figure 6-12) and the hook block tray (2) in (Figure 6-12).



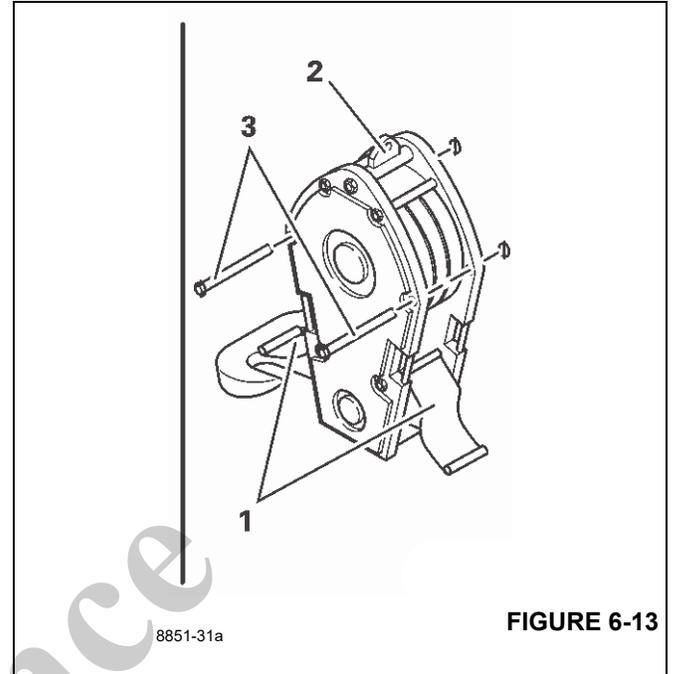
### Picking up and Removing the Hook Block from Stowed Position

**NOTE:** The Main boom should be raised to a position where the boom tip is directly over the hookblock/overhaul ball so that the weight is supported and it does not swing when released for picking up and removing the hookblock from the stowed position.

1. The main boom must be fully retracted.
2. Enter the current rigging mode on the RCL.
3. Slacken the hoist rope and lower the main boom at the same time.
4. Detach the hook block or overhaul ball from the retaining cable.

### Attaching the Hook Block

1. Pull out the rods (2), (Figure 6-13).
2. Fold down the plates (1), (Figure 6-13).



### Securing the Hoist Rope

1. Insert the rods (1), (Figure 6-13).
2. Secure all the rods.

### Closing the Hook Block

1. Fold up the plates (3) on both sides (Figure 6-13).
2. Insert the rods (3), (Figure 6-13) and secure them.

**CAMERA GROUP FOR CRANE OPERATION (OPTIONAL)**

There is an optional group camera package which consists of four cameras (Figure 6-14) and also noted individually in

(Figure 6-14) thru (Figure 6-18): one on the right front-side of the crane (1); one on the superstructure (right back-side) (2); one on the hoist (3); and one rear backup camera (4).



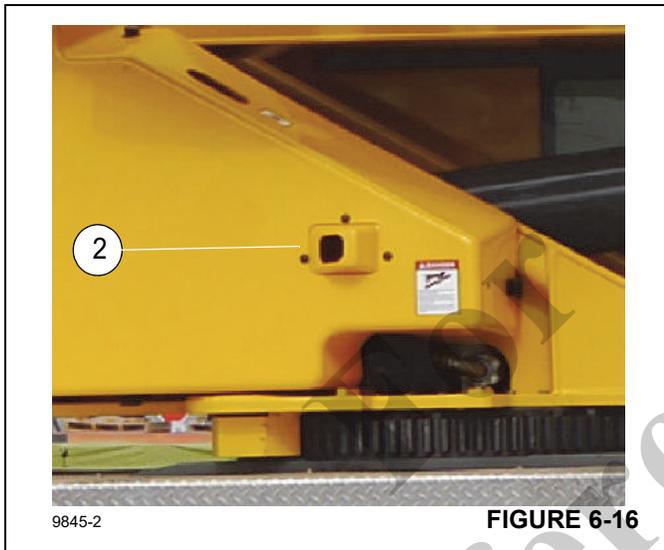
**Right Front-Side Camera (Optional)**

The Right Front-Side Camera (Optional) is located at the right front of the crane and shows the right-side view of the crane as shown in (1), (Figure 6-14) and (1), (Figure 6-15).



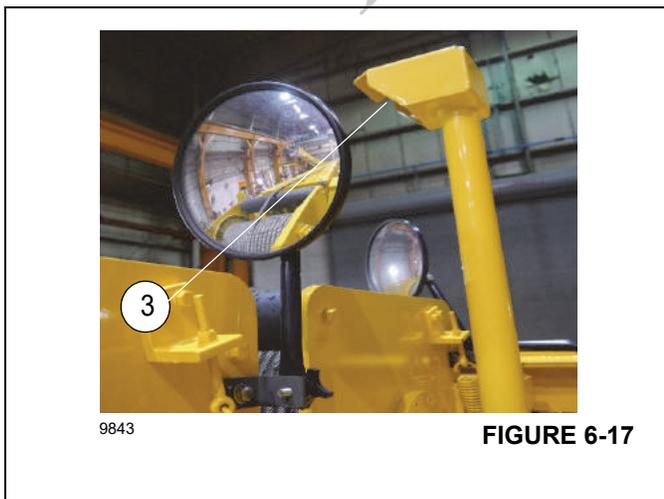
### Superstructure Camera (Optional)

The Superstructure Camera (Optional) shows the area to the right, rear of the crane. This view is mirrored to simulate a right-side rear-view mirror and is located on the right side of the Superstructure toward the rear of the crane (2) as shown in (Figure 6-14) and (2), (Figure 6-16). The Superstructure Camera image is shown on the Camera Display Screen on the ODM in the Superstructure operator cab. Refer to *Camera Group (Optional) Display on ODM*, page 6-15.



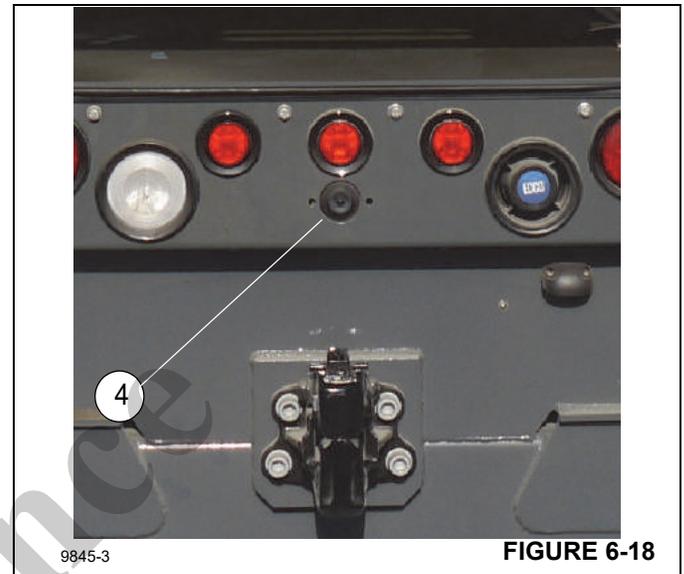
### Hoist Camera (Optional)

The Hoist Camera (optional) shows the remaining rope on the hoist as shown in (3), (Figure 6-14) and (Figure 6-17). The Hoist Camera image is shown on the camera display Screen on the ODM in Superstructure operator cab. Refer to *Camera Group (Optional) Display on ODM*, page 6-15



### Back-up Camera (Optional)

The Back-up Camera view shows the rear view area of the crane as shown in (4), (Figure 6-14) and (4), (Figure 6-18). The image will be displayed in the carrier cab.



### CAUTION

#### Machine Damage!

Always lower the hoist camera before driving. When the camera is extended, the overall height specified for on-road driving is exceeded.

### Camera Group (Optional) Display on ODM

A camera (if equipped) transmits an image of the main and auxiliary hoists to the display in the crane cab.

The Camera Group is made up of three camera function icons (Figure 6-19):

- Camera View 1 (Main Hoist and Auxiliary Hoist (if equipped)).
- Camera View 2 (Superstructure).
- Camera Views 1 and 2 (Hoist and Superstructure).

These camera function icons are used to set which camera view is displayed on the Main Screen of the ODM.

- Select and confirm a symbol (Figure 6-19) to switch over between the cameras.



Icon	Description
	Camera View 1 icon - not selected
	Camera View 1 icon - selected
	Camera View 2 icon - not selected
	Camera View 2 icon - selected
	Camera Views 1 and 2 icon - not selected
	Camera Views 1 and 2 icon - selected

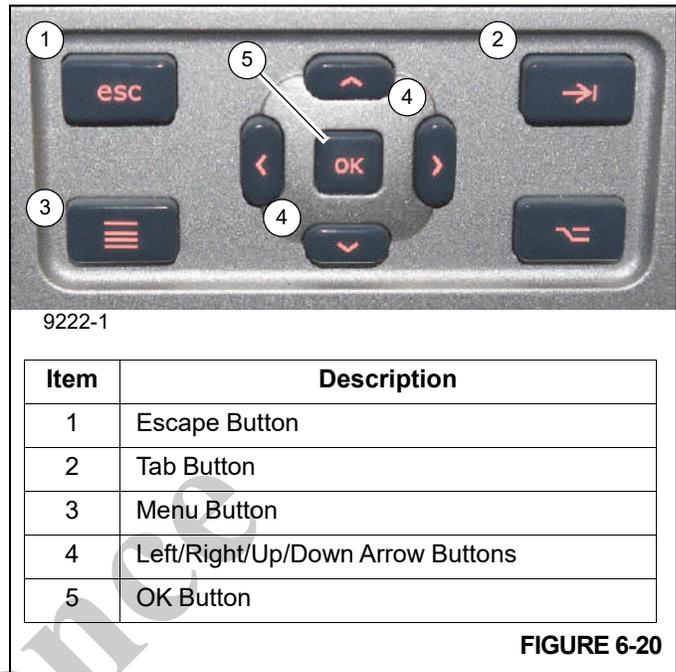
**Selecting a Camera View**

Select a Camera function Icon by doing one of the following:

- Press the Screen Toggle Button (4), (Figure 6-21) at the Jog Dial to select the ODM screen control.  
Press the Menu Button (3), (Figure 6-21) to go to the Menu Screen.  
Using the Jog Dial (5), (Figure 6-21), select one of the Camera Group Function Icons. (Icon will turn orange) (Figure 6-19), then press the OK Button (6), (Figure 6-21) to make the camera view active.
- OR -
- Press the Menu Button (3) (Figure 6-20) on the Navigation Control Pad at the ODM to go to the Menu Screen.

Using the Arrow Buttons (4), select one of the Camera Group Function Icons. (Icon will turn orange) (Figure 6-

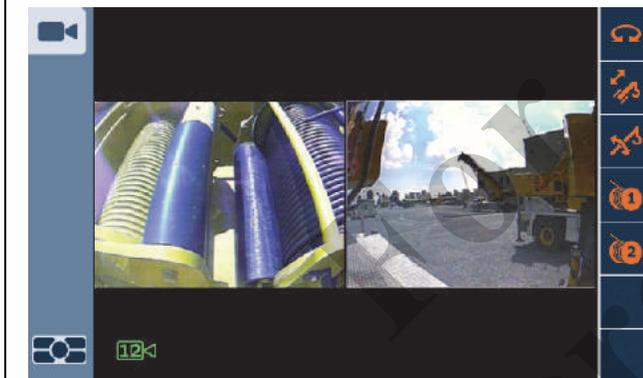
20), then press the OK Button (5), (Figure 6-20) to make the camera view active.



Upon selecting a camera view from the Menu Screen and pressing the Jog Dial or OK Button, the ODM will switch to the corresponding Camera View Screen (Figure 6-22).



9219 Example: Camera View 1 Screen Active



9219 Example: Camera Views 1 and 2 Screens Active

**FIGURE 6-22**

The active camera view is also displayed on the Main Screen of the ODM (Figure 6-23).



9219 Example: Camera View 1 Displayed on Main Screen



9219 Example: Camera Views 1 and 2 Displayed on Main Screen

**FIGURE 6-23**

**Exiting the Camera View Screen**

Perform one of the following procedures to exit the Camera View Screen and navigate to the Main Screen or Menu Screen:

- Press the Screen Toggle Button (4), (Figure 6-21) at the Jog Dial to select the ODM screen control, then press the Escape Button (1), (Figure 6-21) for the Main Screen or the Menu Button (3), (Figure 6-21) for the Menu Screen.

**- OR -**

- Press the Escape Button (1), (Figure 6-20), on the Navigation Control Pad at the ODM, for the Main Screen or the Menu Button (3), (Figure 6-20) for the Menu Screen.

## ERECTING AND STOWING THE BOOM EXTENSION

### Description

A 7.92 m to 13.7 m (26 ft to 45 ft) telescopic, manual off-settable boom extension provides additional boom reach. The boom extension weighs approximately 745 kg (1,642 lb).

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.

### General Warnings

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 the 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

To prevent serious injury or death, always wear personal protective equipment; such as a hard hat, eye protection, gloves and metatarsal boots.



### DANGER

Boom angles are used to control speed at which extensions swing during erecting and stowage. Improper boom angles will cause uncontrollable swing speeds of extension.

Tag line used in these procedures is to control the movement of the boom extension.



### DANGER

Before attempting to erect or stow the boom extension; read and strictly adhere to all danger decals installed on the boom/boom nose, boom extension, and stowage brackets to prevent serious injury or death.

Controlling the boom extension during erecting and stowing procedures is accomplished by raising or lowering the boom. Failure to control the boom extension could cause serious injury or death.

### Securing the Boom Extension with Tag Line (Rope)

**NOTE:** A tag line attached to the tip of the extension is used to control the movement of the boom extension.



### DANGER

Always secure the boom extension with a tag line (rope) on the main boom before removing any connections. This will prevent the extension from swinging around and knocking you off the carrier or injuring other persons in the swing range. Refer to Figure 6-24.

The boom extension may swing out on its own accord when you remove the last connection that held the extension at the side of the main boom.

Always secure the boom extension before you begin the erection procedure.

Secure the boom extension as follows:

- Attach a tag line (rope) at the front of the boom extension. Refer to Figure 6-24.
- Have a helper hold the tag line (rope) tight while you are removing the last connection.

**NOTE:** If you are alone, secure the other end of the tag line (rope) onto the crane; for example, on the steps of the access ladder or to the superstructure. Leave enough play in the tag line that it is tight only when you swing the boom extension towards the main boom nose later in the procedure.

### Erecting the Boom Extension



### DANGER

To prevent serious injury or death, do not stand on crane decking unless boom extension is secure.

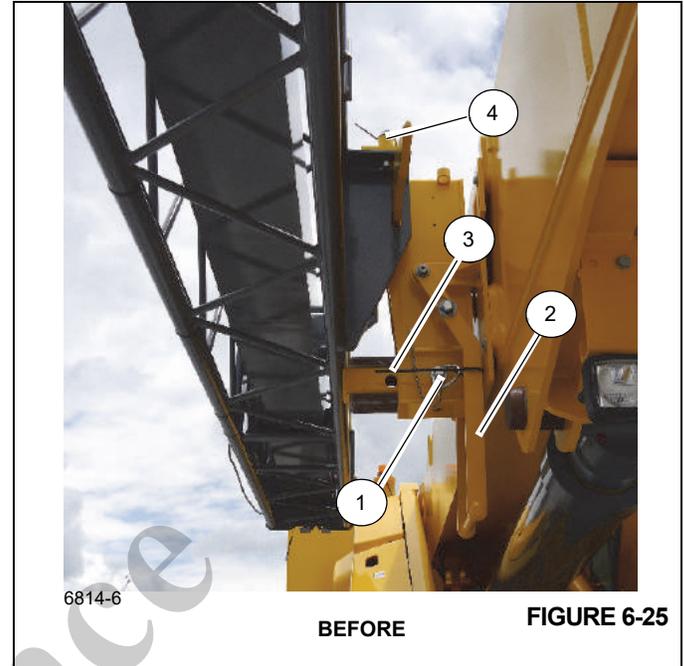


**DANGER**

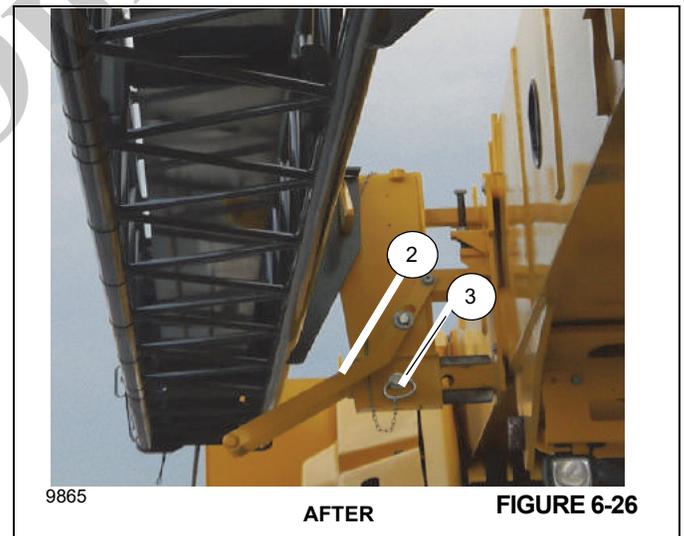
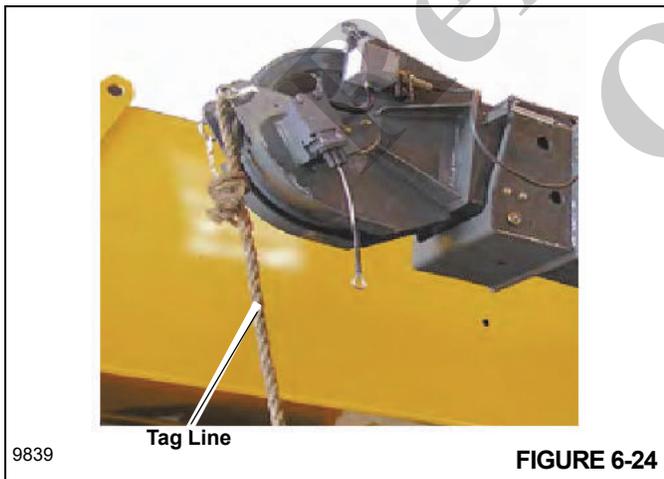
**Boom Extension Hazard!**

To avoid death or serious injury, follow procedures in Load Chart, Safety, and Operation Manuals during erection, stowage and use of the boom extension. Install and secure all pins properly and control the boom extension movement at all times.

1. Visually check to ensure that the extension is secured and that all pins are installed.
2. Fully extend and set the outriggers using normal setup procedures. Refer to *Using the Outriggers*, page 4-26.
  - a. If extended, fully retract all of the boom sections.
  - b. Lower the boom to horizontal position for erecting over the rear of the crane. The auxiliary boom nose (rooster sheave) does not have to be removed. However, if reeved, the hoist rope must be removed from the sheave before the boom extension is secured to the boom nose.
3. Rig either the main hoist or auxiliary hoist rope for single part line with only the wedge socket on the end of the hoist rope. Refer to *Hoist Rope Reeving*, page 6-5 and *Dead-End Rigging/Wedge Sockets*, page 6-6 in this section.
4. Attach a length of rope (tag line) (Figure 6-24) to the boom extension tip to aid in swinging the boom extension into place ahead of the boom nose.

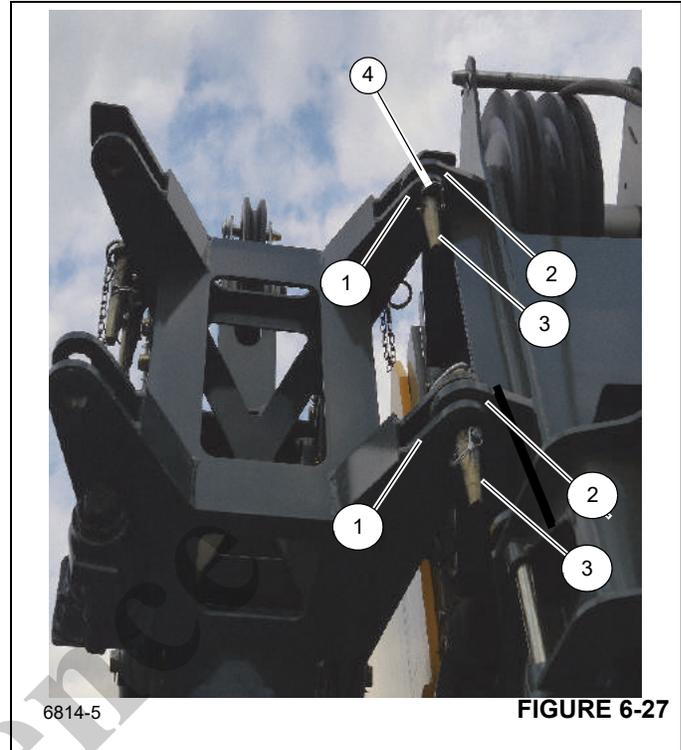


5. Remove the cross pin (1), (Figure 6-25) that secures the boom extension to the rear stowage bracket. Pull the lever (2), (Figure 6-25) outward. Releasing the lever outward aligns the boom extension anchor fittings with the boom nose attachment holes. Place the cross pin (1), (Figure 6-25) into the stowage hole (3), (Figure 6-25) and secure the cross pin. BEFORE is shown in (Figure 6-25) and AFTER is shown in (Figure 6-26).



6. Attach the boom extension base section to the boom nose by installing the right side attachment pins (3), (Figure 6-27) through the anchor fittings (1), (Figure 6-27) and attachment lugs (2), (Figure 6-27). Make sure the attachment pins (3), (Figure 6-27) are fully engaged. Install retaining pin into attachment pin (4), (Figure 6-27)

7. Make sure the boom extension has been securely attached to the boom nose. Then remove the hitch pin (4), (Figure 6-25).
8. If the cable is reeved over the boom nose, remove the top cross pin (1), (Figure 6-29) so that the cable can be moved away from the boom nose before attaching the boom extension. Then replace the cross pin
9. Raise the boom to a positive angle to prevent loss of control of boom extension. Extend boom approximately 51 to 64 cm (20" to 25") or 1.7 ft. to 2.0 ft. Slightly raise and/or lower the boom to help control the boom extension. Using the tagline (Figure 6-24) attached to the tip of the boom extension (Figure 6-28), manually swing the extension into place ahead of the boom nose, engaging the right side lugs (2), (Figure 6-27) with the anchor fittings (1), (Figure 6-27) on the left side of the boom nose.
10. Attach the boom extension base section to the boom nose by aligning the top left side anchor fittings (1), (Figure 6-30) with the attachment lug (2), (Figure 6-30). Secure with the attachment pin (3), (Figure 6-30). Install retaining pin/clip.



6814-5

FIGURE 6-27

**DANGER****Boom Extension Fall Hazard**

An unsecured boom extension may fall resulting in death or serious injury.

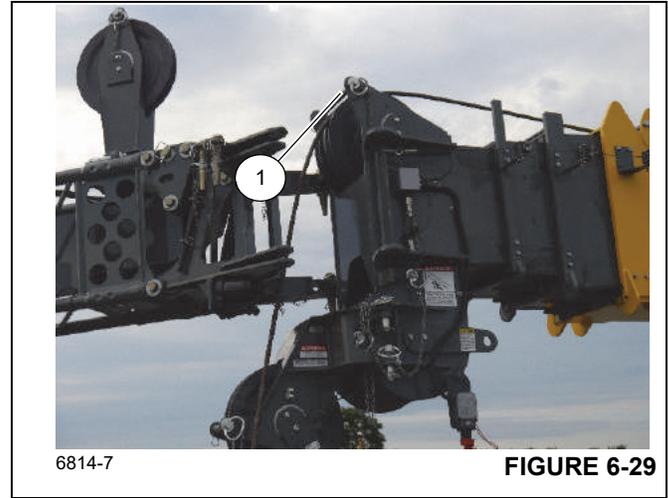
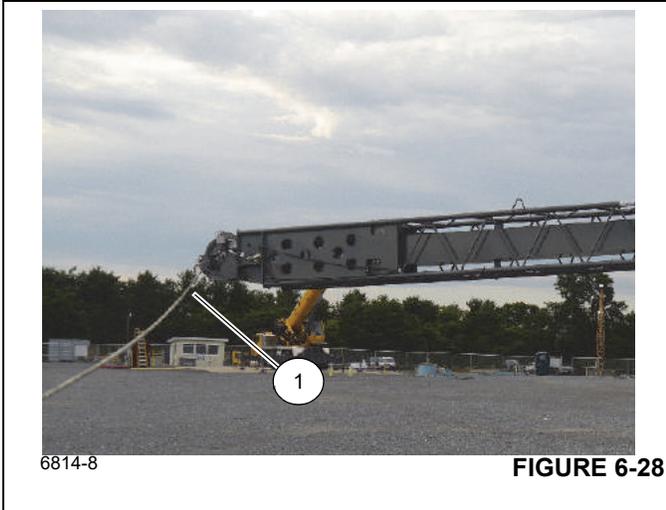
Do not remove the hitch pin (4), (Figure 6-25) unless the boom extension is securely attached to the boom nose.

**DANGER**

When erecting the boom extension, make sure that all personnel and equipment are kept clear of the swing path.

**DANGER**

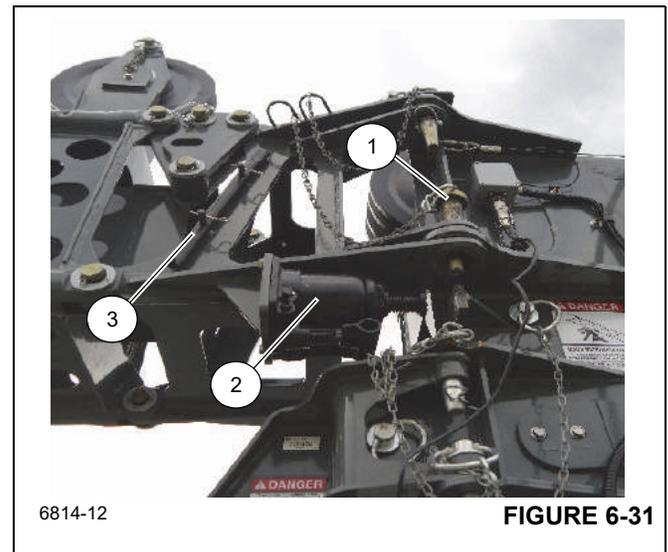
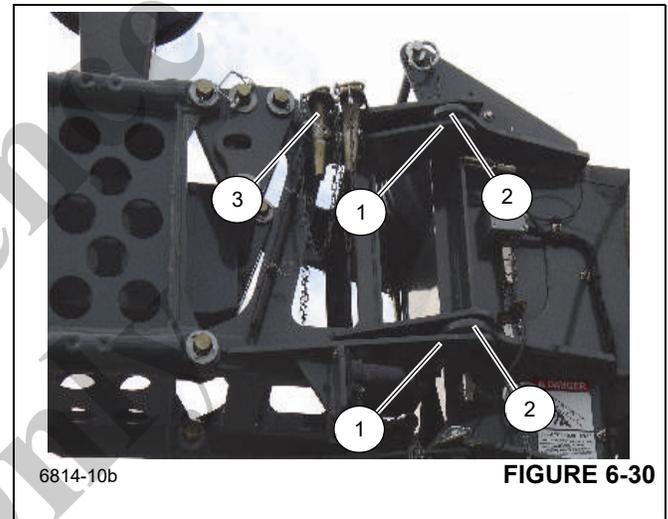
Do not modify the attachment points to permit the installation of the attachment pins.



**CAUTION**

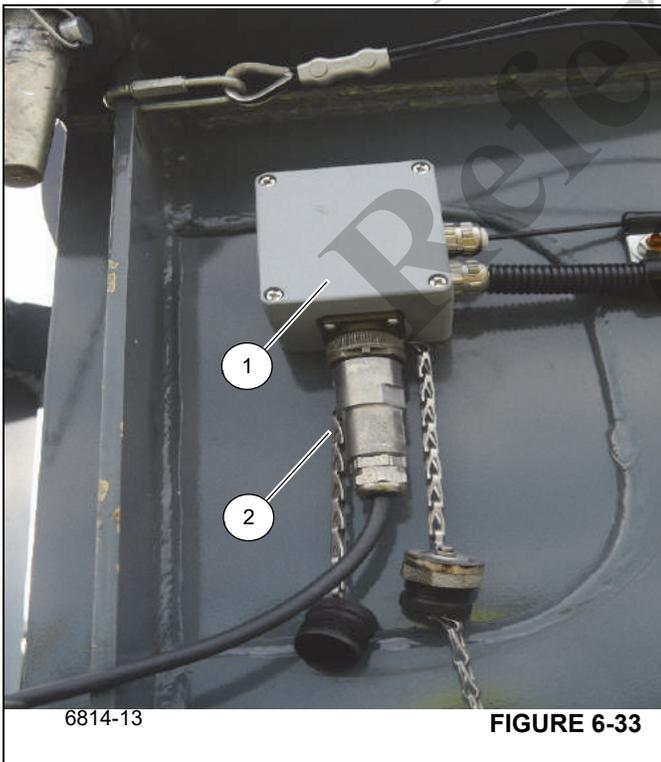
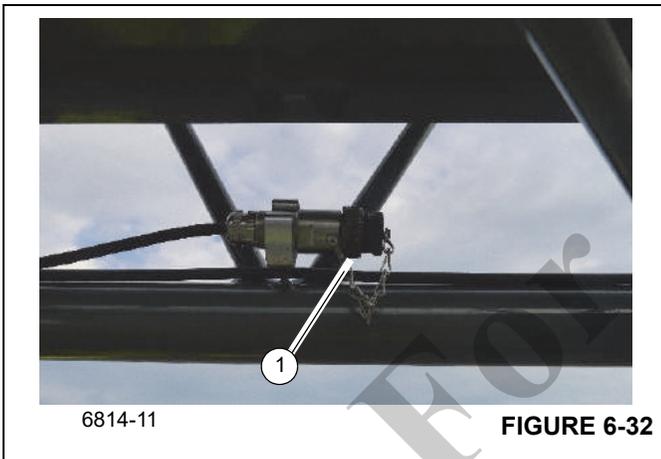
To prevent possible damage to the sheave wheel, do not place blocking under the boom extension sheave wheel.

11. Use the bottle jack (2) and handle (3), (Figure 6-31) to install the bottom pin (1), (Figure 6-31) into the anchor fitting. Install retaining pins/clips. Release pressure and retract the bottle jack. Stow the handle on the adapter.



## Boom Extension Anti- Two-Block Switch

1. Connect Anti-Two-block Cables. Remove the Anti-Two Block cable end connector (1), (Figure 6-32) from the stowage clip on the boom extension. Route the cable through the boom extension and over to the Electrical Socket (1), (Figure 6-33) connection box on the Main Boom. Remove the auxiliary nose Anti- two block cable and plug into the Anti- two-block wire from the Boom Extension (2), (Figure 6-33).



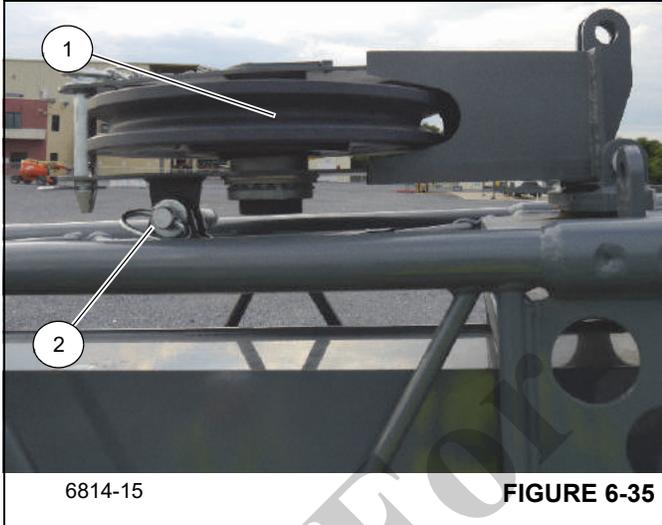
2. If the main boom nose is not reeved with cable, manually override the A2B Switch on the boom nose using the red flag device (1) as shown in (Figure 6-34).
3. If the boom extension stinger section is not to be erected, connect the boom extension base section anti-two-block cable end connector to the anti- two-block switch at the nose of the boom extension stinger section.
4. Lower the boom and remove the tag line (1), (Figure 6-28) from the tip of the boom extension.
5. Lower the boom to minimum elevation and remove the hoist rope retaining pins from the tip of the boom extension.
6. Remove the upper boom nose hoist rope retaining pin to prevent the hoist rope from rubbing on the pin.

## Installing the Mast and Reeving Rope

1. Raise the mast sheave assembly by doing the following:
  - a. Remove the attachment pin (2), (Figure 6-35) that secures the mast sheave in the stowed position.
  - c. Lift the mast sheave (1). (Figure 6-35) to its raised position (4), (Figure 6-36) by rotating it clockwise 90°.
  - d. Install the attachment pin (2), (Figure 6-35) and secure with retaining clip.

**CAUTION**

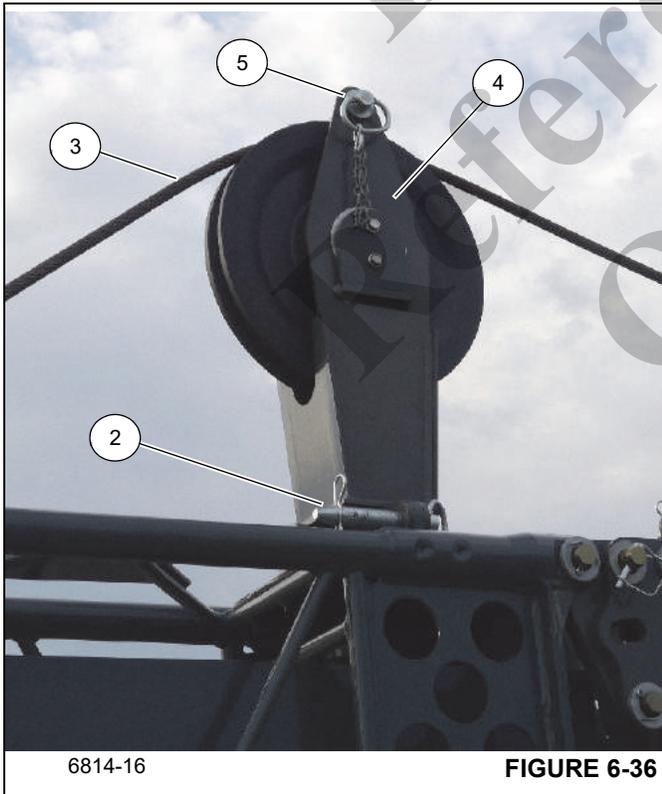
To prevent possible damage to the sheave wheel, do not place blocking under the boom extension sheave wheel.



6814-15

**FIGURE 6-35**

2.



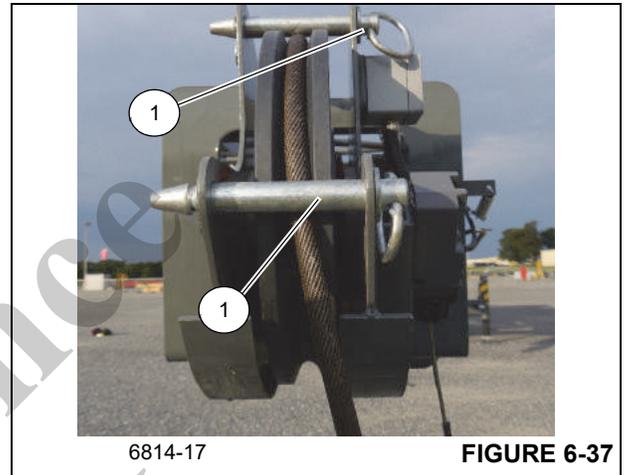
6814-16

**FIGURE 6-36**

Reeve the hoist rope (3), (Figure 6-36) over the mast sheave by removing the retaining pin (5), (Figure 6-36), and routing the hoist rope over the mast sheave. Reinstall the hoist rope retaining pin (5), (Figure 6-36)

and secure with retaining clip (5), (Figure 6-36). Refer to *Hoist Rope Reeving*, page 6-5 in this section.

3. Remove the hoist rope retaining pins (1), (Figure 6-37) from the boom extension sheave and route the hoist rope over the sheave. Reinstall the hoist rope retaining pins (1) and secure with retaining clip.
4. Rig the hoist rope.
5. If required, set the boom extension offset to 15" or 30". Refer to *Setting the Offset*, page 6-25.



6814-17

**FIGURE 6-37**

6. Install the A2B weight on the A2B switch and remove the red flags that were installed in (1), , page 6-22). Refer to *Camera Group for Crane Operation (Optional)*, page 6-14.

## Stowing the Boom Extension

**NOTE:** The boom extension must be set at the minimum offset and, if used, the telescoping section must be fully retracted. Refer to *Setting the Offset*, page 6-25.



### DANGER

When stowing the boom extension, make sure that all personnel and equipment are kept clear of the swing path.

1. With crane set up on outriggers, fully retract the boom and swing to over-the-rear.
2. Lower the boom to minimum elevation.
3. Attach a tag line to the nose of the boom extension (Figure 6-24). Have a helper hold the tag line to prevent the boom extension from moving.
4. Remove the cable retainer pin from the boom extension tip and the mast assembly. Remove the hoist rope from the sheaves. Install the cable retainer pins.
5. Remove the mast assembly retainer pin and the pin securing the mast assembly in the upright position (2), (Figure 6-35). Lay the mast assembly over to the stowed position. Insert the pins securing the mast to the base section (Figure 6-35). Disconnect Anti-Two-Block cable:
  - a. Remove connector from junction box on boom nose.
  - b. If the auxiliary boom nose is installed, then install the Auxiliary-nose Anti- Two-Block dummy plug into the junction box if the auxiliary boom nose is not being used.
  - c. Route cable to and attach to boom extension. Stow plug on boom extension (1), (Figure 6-32).
6. Raise the boom to horizontal.
7. Extend the boom approximately 51 to 64 cm (20 to 25 in) or (1.7 ft. to 2.0 ft.). Make sure the attachment pin (4), (Figure 6-25) is removed from the rear stowage bracket.
8. Extend the boom extension alignment jack (2), (Figure 6-25) until the lower attachment pin (1), (Figure 6-31) is free. Remove the lower boom extension attachment pin and stow the pin on the adapter of the boom extension.
9. Release pressure on the boom extension alignment jack. Completely retract the jack and stow the handle.
10. Remove the top left side attachment pin (1), (Figure 6-30) and clip pin from the upper anchor and attachment

fittings of the boom nose and stow the pin on the adapter of the boom extension. Stow left side attachment pins and clips in outside attachment fitting on swingaway.



### DANGER

When stowing the boom extension, make sure that all personnel and equipment are kept clear of the swing path.

### CAUTION

Do not allow the boom extension to slam into the stowage bracket when swinging into the stowed position.

11. Sufficient momentum is needed to swing and engage the boom extension to the front stowage bracket. Using the tag line attached to the tip of the boom extension, manually swing the extension to the side of the boom.
12. Make certain that the boom extension stowage lugs will line up in front of the guide pins and ramp (4), (Figure 6-25) on the stowage brackets when the boom extension is positioned to the side of the boom. Align the stowage lugs on the boom extension with the guide pins and ramp on the stowage brackets (Figure 6-25) and (Figure 6-26) and fully retract the boom.
13. Install the attachment pin (4), (Figure 6-25) and clip pin securing the boom extension to the rear stowage bracket.



### DANGER

Do not remove attachment pins (3), (Figure 6-25) unless the boom extension is secured at the rear stowage bracket by the hitch pin and on the guide pins at the front mount.

14. Remove the attachment pins (4), (Figure 6-27) and clip pins from the anchor and attachment fittings on the right side of the boom nose and stow them in the base of the boom extension.
15. On the rear stowage bracket, remove the pin (3), (Figure 6-25) securing the sliding support in the "OUT" position. Push in on the handle (2), (Figure 6-26) to push the swingaway against the rear of the boom. Install the pin (1), (Figure 6-25) securing the sliding support in the "IN" position.
16. Rig the boom nose and hoist rope as desired and operate the crane using normal operating procedures.

Setting the Offset

**CAUTION**

The mast assembly must be positioned on top of the base section before attempting to offset the swingaway to 15 or 30 degrees. Failure to do so can cause damage to the mast and/or swingaway adapter.

Extend and set the outriggers. Swing the boom over the rear of the crane.

To set the offset from zero degrees (0°) to fifteen degrees (15°), perform the following:

**CAUTION**

Do not overload the swingaway or the attachment points when lowering the boom.

1. Slowly lower the boom until the tip of the swingaway is on the ground and the pressure on the offset pin is relieved.
2. Remove the lock pin, two washers, and offset pin (1), (Figure 6-38).

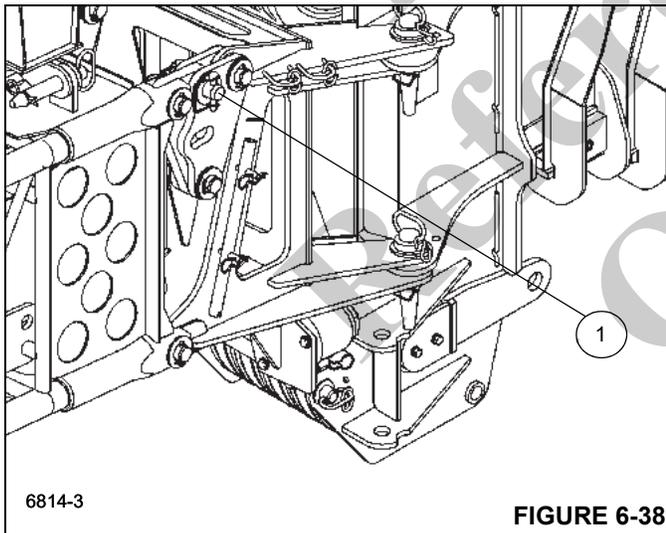


FIGURE 6-38

3. Slowly elevate and telescope the boom at the same time until the center holes (1), (Figure 6-39) align and two washers, offset pin and lock pin can be installed.
4. Raise the boom until the offset pin takes the full load of the swingaway.

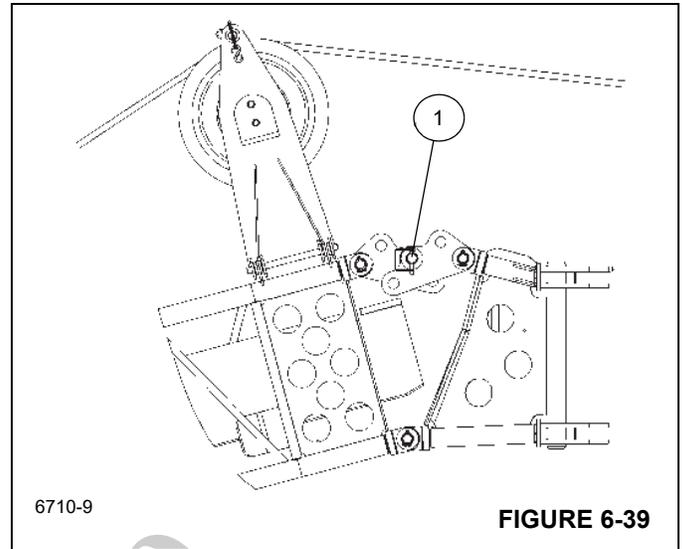


FIGURE 6-39

To set the offset from zero degrees (0°) to thirty degrees (30°), perform the following:

**CAUTION**

Do not overload the swingaway or the attachment points when lowering the boom.

1. Extend and set the outriggers. Swing the boom over the rear of the crane.
2. Slowly lower the boom until the tip of the swingaway is on the ground and the pressure on the offset pin is relieved.
3. Remove the lock pin, two washers, and offset pin (1), (Figure 6-38).

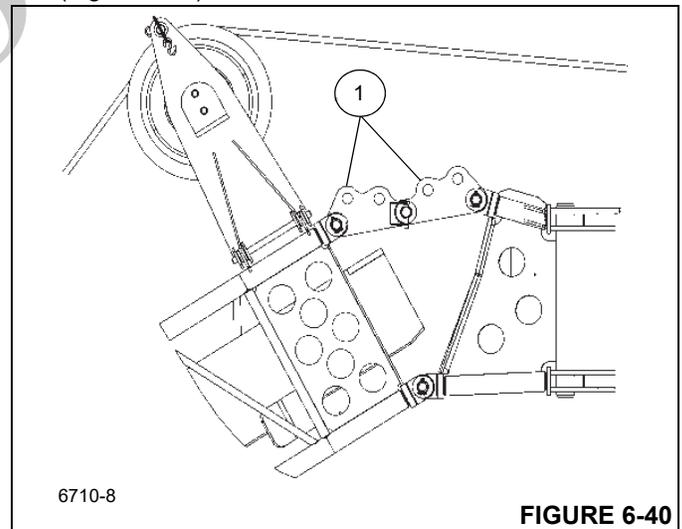


FIGURE 6-40

4. Slowly elevate and telescope the boom at the same time until the offset brackets (1),(Figure 6-40) are fully extended.

5. Raise the boom until the offset pin takes the full load of the swingaway.

To set the offset from fifteen degrees (15°) or thirty degrees (30°) to zero degrees (0°), perform the following:

1. Slowly lower the boom until the tip of the swingaway is on the ground and the offset pin can be removed.
2. Continue lowering the boom until the top holes align and the lock pin, two washers, and offset pin can be installed (1), (Figure 6-38).

### Extending and Stowing the Telescoping Boom Extension Fly Section

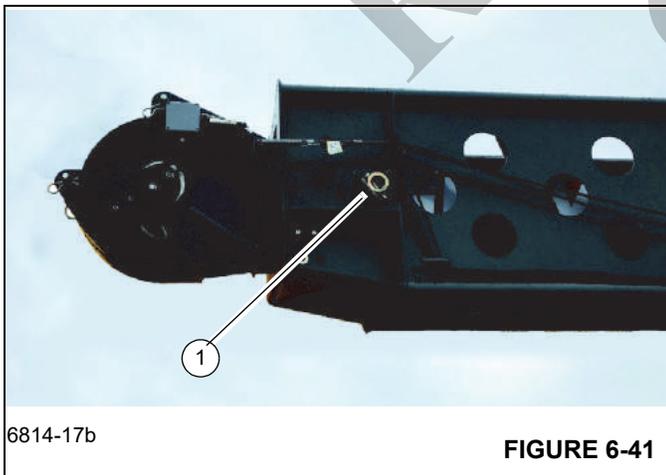
#### Extending

1. Extend and set the outriggers and swing the boom to over the rear.
2. Lower the boom to below horizontal.
3. Unwind the A2B cable from side of boom extension base section before pulling the stinger out.

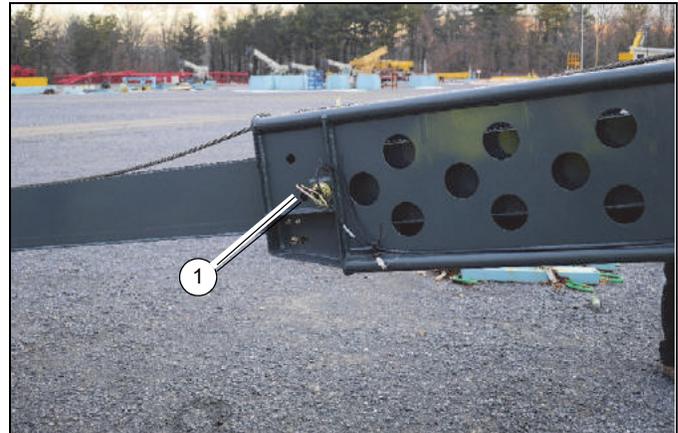
**CAUTION**  
**A2B CABLE HAZARD**

Unwind the A2B cable from side of Boom Extension base section prior to pulling out the stinger.

4. Pull the telescoping section out of the base section until the holes in the rear of the telescoping section align with the holes in the tip of the base section.
5. Remove the pin (1), (Figure 6-41) securing the telescoping section to the base section.



6. Pull the telescoping section out of the base section until the holes in the rear of the telescoping section align with the holes in the tip of the base section.
7. Reinstall the pin and retaining clip (1), (Figure 6-42).



8. Unwind the A2B cable from the side of the boom extension base section before pulling the stinger out.

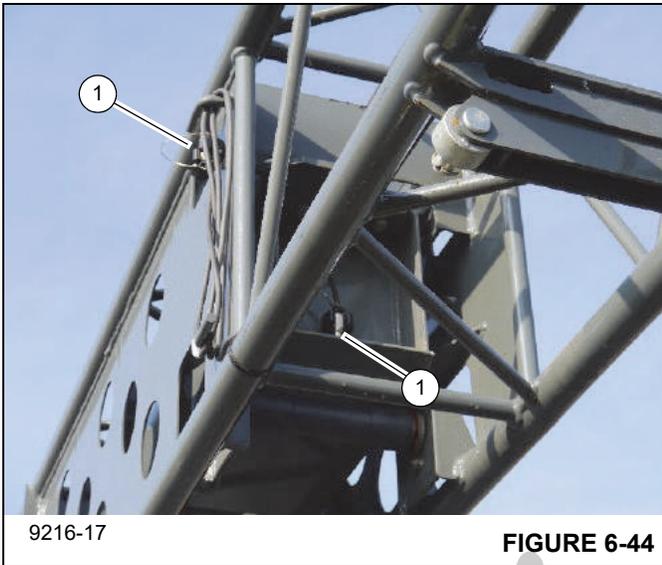
**NOTE:** If this has not yet been done, connect the A2B plug to the junction box at the end of the telescoping section (1), (Figure 6-43).

9. Install the A2B weight.

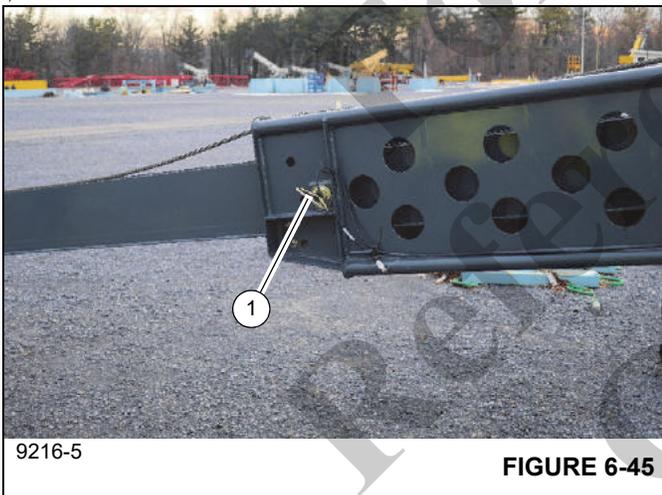


#### Retracting

1. Extend and set the outriggers and swing the boom over the front of the crane.
2. Lower the boom to below horizontal.

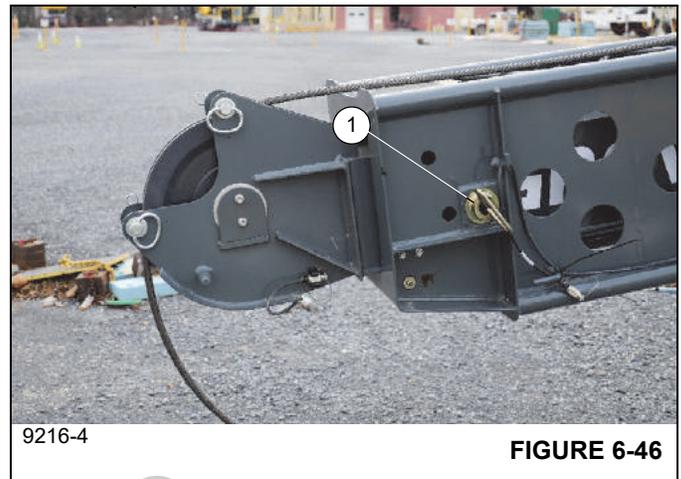


3. Remove the pin (1), (Figure 6-45) securing the telescoping section to the base section.



4. Using two people, slide the telescoping section into the base section until the holes in the front of the telescoping

section align with the holes in the tip of the base section. Reinstall the pin and retaining clip (1), (Figure 6-46).



5. Connect the boom extension stinger section anti-two block cable end connector to the anti-two block switch at the nose of the boom extension stinger section. Stow A2B cable.

**AUXILIARY SINGLE-SHEAVE BOOM NOSE (OPTIONAL EQUIPMENT)**

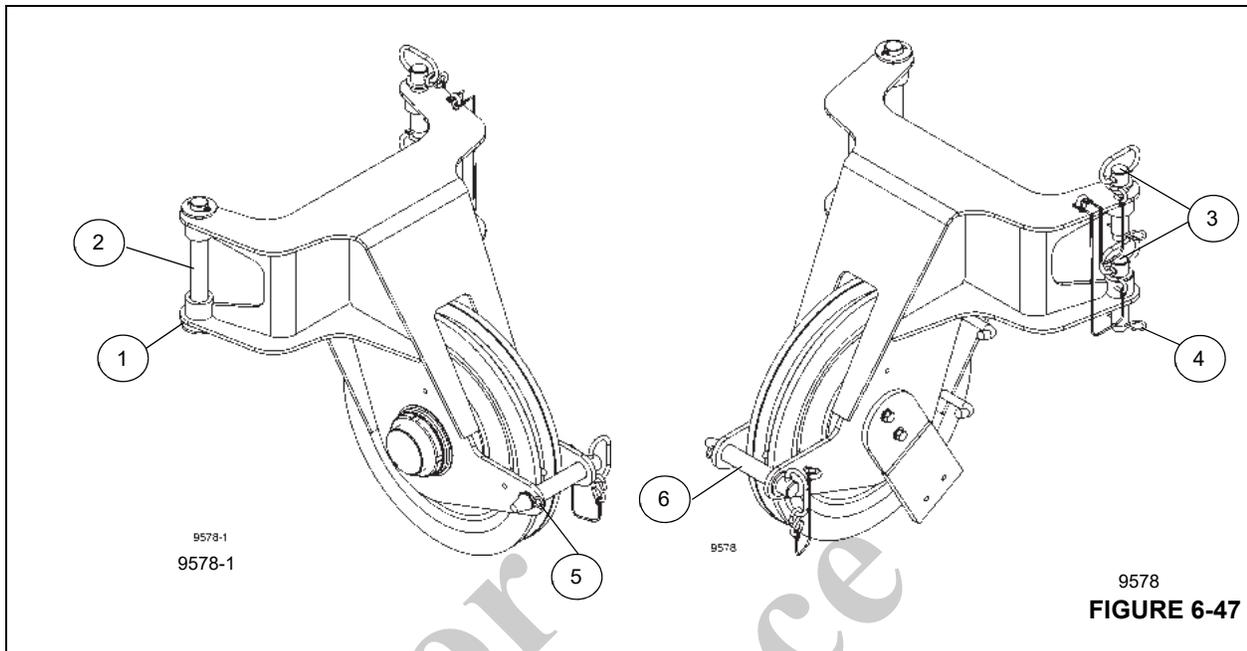
**Identification**

The auxiliary single-sheave boom nose is calibrated for the crane it was delivered with.

**CAUTION**

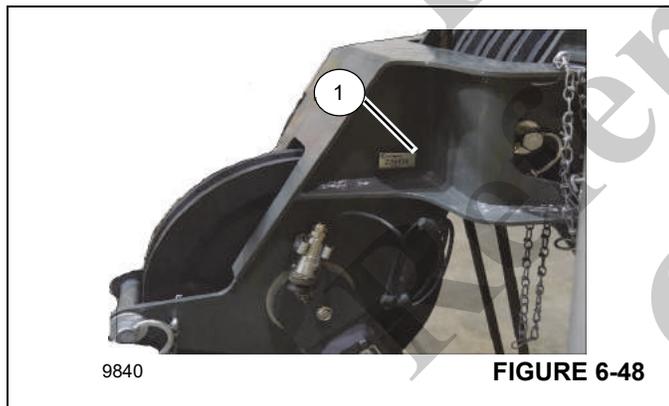
Operate the crane only with the auxiliary single-sheave boom nose that has the identical serial number.

If you wish to use the auxiliary single-sheave boom nose on several Grove cranes, contact Manitowoc Crane Care.



The serial number (1), (Figure 6-48) is on a plate, on the auxiliary single-sheave boom nose.

If the crane is transported with the auxiliary nose installed, it needs to be in the working position or removed and securely stowed.



**Installing Auxiliary Single-Sheave Boom Nose**

1. Remove the lower cotter pin (1), (Figure 6-47) from the attachment pin (2), (Figure 6-47) and remove the pin from the attachment lugs.
2. Attach a lifting device to assist with attachment of the auxiliary single-sheave boom nose to the front of the main boom nose.

**NOTE:** The auxiliary boom nose weighs approximately 45 kg (100 lbs).

Align the auxiliary single-sheave boom nose so that the attachment lugs line up to the boom nose attachment lugs.

3. Secure the auxiliary single-sheave boom nose to the main boom nose using pins (3), (Figure 6-47). Install a retaining pin into the attachment pin on the right side and install pin (2) and the pin (1), (Figure 6-47).
4. Secure the pins (3) with retaining clips (4), (Figure 6-47).

**Removing the Auxiliary Single-Sheave Boom Nose**

1. Attach a lifting device to assist with removal of the auxiliary boom nose from the crane.

**NOTE:** The auxiliary boom nose weighs approximately 45 kg (100 lbs).

2. Remove the retaining clips (4) and remove the pins (3), (Figure 6-47) from lugs.

**Installing/Removing Auxiliary Single-Sheave Boom Nose**

**! DANGER**  
Crushing Hazard!

During installation and removal, always use the proper equipment with sufficient load bearing capacities.

In the working position, the auxiliary single-sheave boom nose is positioned in front of the main boom nose and is fastened with pins.

3. Remove the cotter pin (1) from the attachment pin (2), (Figure 6-47).
4. Remove the attachment pin from the lugs.
5. Lift the auxiliary single-sheave boom nose from the head of the main boom and securely stow for transport.

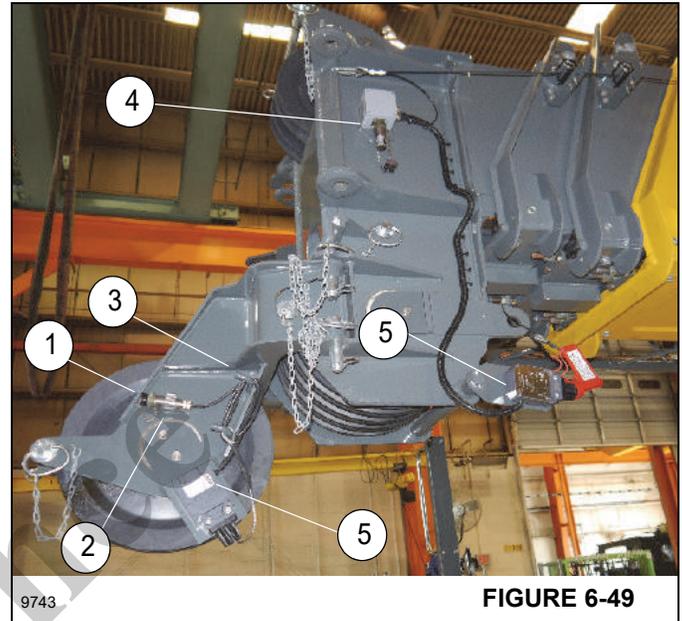
### Attaching and Removing Hoist Rope

1. Remove the hoist rope retaining pins from the tip of the main boom and from the auxiliary single-sheave boom nose (6), (Figure 6-47).
2. When reeving the auxiliary boom nose, guide the hoist rope over the left hand upper sheave of the boom nose. Insert the hoist rope retaining pins into the auxiliary single-sheave boom nose and secure the pins with the corresponding retaining clips.
3. Fasten the cable end clamp on the overhaul ball or the hook block.

Reverse the sequence of operations to remove the hoist rope before removing the auxiliary boom nose for transporting.

### Auxiliary Boom Nose and Anti- Two-Block Switch

#### In Operation



1. Pull the plug (1) of the connecting cable from the storage clip (2), (Figure 6-49)
2. Unwind the connecting cable from the holders (3), (Figure 6-49).
3. Remove the dummy plug and insert the plug of the connecting cable into the socket on the main boom nose junction box (4), (Figure 6-49).
4. Guide the hoist rope through the anti-two block switch weight (5), (Figure 6-49) (not shown).

#### During Transport

1. Disconnect cable from the boom nose junction box. Install the dummy plug and connector cap.
2. Wind the connecting cable onto the holders (3), (Figure 6-49).
3. Insert the plug of the connecting cable into the storage clip (2), (Figure 6-49).

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