

# Grove TMS875-2/ TMS800-2 Operator Manual



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 **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**

Product Support 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.

Product Support 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.



1565 Buchanan Trail East PO Box 21  
Shady Grove, PA 17256-0021 T  
717 597 8121 F 717 593 5999  
www.manitowoc.com

## 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

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

## TMS875-2/TMS800-2

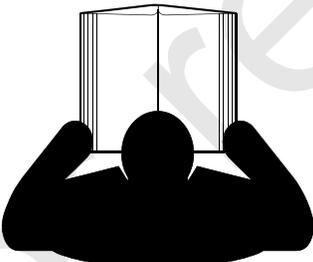
This Manual is divided into the following sections:

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

### NOTICE

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

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

	<h2> DANGER</h2> <p><b>An untrained operator subjects himself and others to death or serious injury. You must not operate this crane unless:</b></p> <ul style="list-style-type: none"><li>• You have been trained in the safe operation of this machine.</li><li>• 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.</li><li>• You are sure the machine is operating properly and has been inspected and maintained in accordance with the manufacturer's manuals</li><li>• You are sure all safety signs, guards, and other safety features are in place and in proper condition.</li></ul> <p><b>Avoid Electrocution, tipping, two-blocking, and other operational hazards.</b></p>
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For reference only

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## SECTION 1 INTRODUCTION

### SECTION CONTENTS

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### GENERAL

This manual provides important information for the operator of the Model TMS875-2/TMS800-2 Grove Crane.

Throughout this Operator Manual, reference is made to left, right, front, and rear when describing locations. These reference locations are to be considered as those viewed from the operator seat with the Superstructure facing forward over the front of the carrier frame. The basic nomenclature is shown in (Figure 1-1).

The mobile crane carrier incorporates an all welded steel frame. The 8 x 4 x 4 carrier utilizes two drive axles and two steer axles. 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 manual or optional automatic transmission.

Hydraulic, two-stage double box telescopic beam with jack cylinder outriggers are integral with the carrier frame. The outriggers are utilized in four positions; fully extended, mid-extended, partial extended, and fully retracted (100%, 77%, 54% and 0%). The carrier is also equipped with a center front stabilizer with a permanently installed pad.

The superstructure is capable of 360° rotation in either direction. All crane functions are controlled from the fully enclosed cab. The crane is equipped with a 12 m to 39 m (39.3 ft to 128.0 ft) four-section boom.

Lifting is provided by a main and auxiliary hoist. Bi-fold swingaway hydraulically offsetable and manually offsetable boom extensions are available.

### Ambient Operation Temperature

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

### Customer Support

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

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

### New Owners

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

Go to: <https://www.manitowoccranes.com/en/services/crane-care/service-and-tech-support/Change-of-Ownership-Form> and complete the form.

**SERIAL NUMBER LOCATION**

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

Serial numbers are located at in various spots:

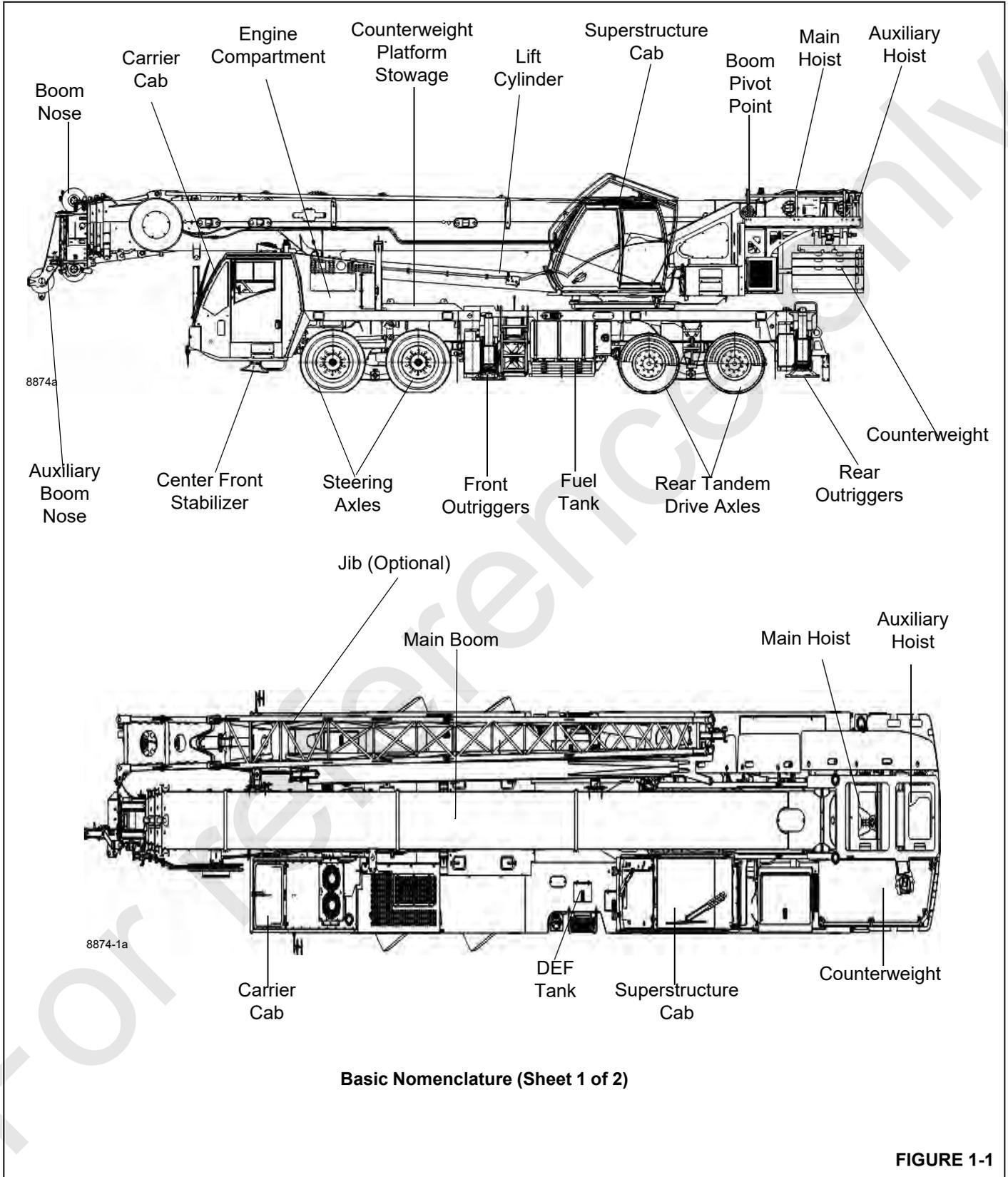
1. Stamped on Frame on the front bumper.
2. Data plate inside the cab,
3. Operator Manual cover.

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

For reference only

TMS875-2/TMS800-2 CRANE COMPONENTS

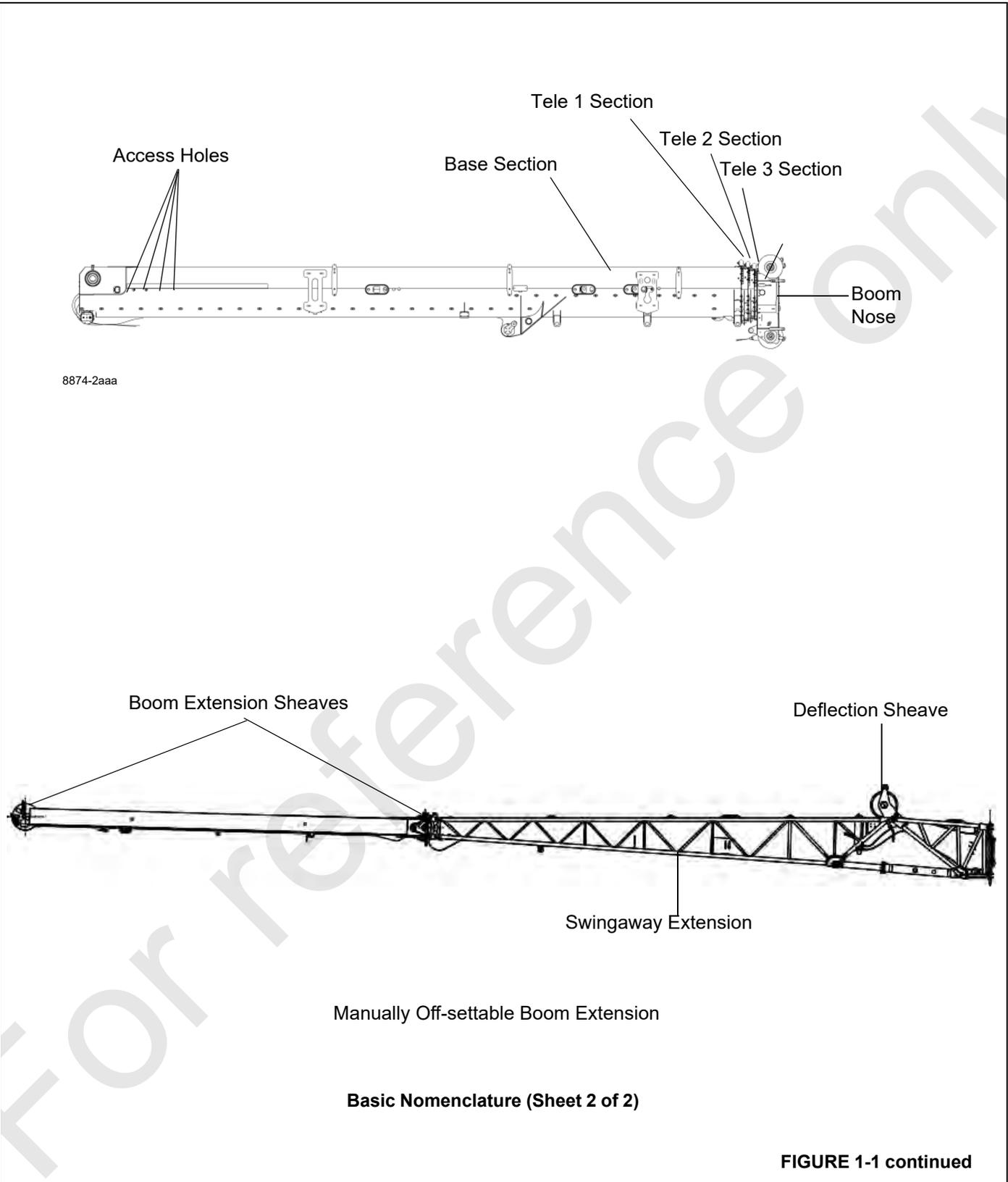
1



Basic Nomenclature (Sheet 1 of 2)

FIGURE 1-1

TMS875/TMS800-2 CRANE COMPONENTS (Cont)



8874-2aaa

Manually Off-settable Boom Extension

Basic Nomenclature (Sheet 2 of 2)

FIGURE 1-1 continued

**LIST OF SPECIFICATIONS**

**General**

Model	TMS875-2/TMS800-2 Series
Rated Capacity	See <i>Load Chart</i> in cab
Drive	8 x 4 x 4
Gross Weight	
No CWT	36791 kg (81110 lb)
Full CWT	49532 kg (109198 lb)

**Dimensions**

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

Wheelbase	5613 mm (221 in)
Overall Crane Length	14318 mm (564 in)
Overall Crane Width (Over Fenders)	2540 mm (100 in)
Overall Crane Height	3596 mm (142 in)
Tail-Swing	4259 mm (168 in)
Outrigger Spread	
Retracted	2320 mm (91 in)
Mid Extend	54% - 5000 mm (197 in)
Mid Extend	77% - 6500 mm (256 in)
Fully Extended	7300 mm (287 in)

**Capacities**

Fuel Tank	386 liters (102 gal)
Coolant System	70 L (18.5 gal)
Engine Lubrication System	See Engine Specifications
Hydraulic Tank (Reservoir Capacity)	
Total	625 liters (165 gal)
at Full Level	556 liters (147 gal)
at Add Level	515 liters (136 gal)
Expansion Space	69 liters (18.3 gal)
Hoist (Each)	4.9 liters (5.2 qt)
Swing Gearbox	0.9 liters (0.95 qt)
Front Axle Hubs	0.56 liters (0.6 qt)
Front Rear Axle Differentials	20.8 liters (22 qt)
Rear Rear Axle Differentials	20.8 liters (22 qt)
Transmission	16.1 liters (17 qt)

**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 X12-2023**

Bore	132 mm (5.2 in)
Stroke	144 mm (5.67 in)
Displacement	11.8 liters (720 cu in)
Firing Order	1-5-3-6-2-4
Lube Amount	47.3 liters (12.5 gal)

**Suspension**

Front	Air
Rear	Air

**Axles**

**Front**

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

**Rear**

Type	Single reduction tandem
Ratio	4.56:1

**Brakes**

**Front**

Type	Air operated S-Cam
Size	419 x 178 mm (16.5 x 7.0 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	445/65R22.5
Rear	315/80R22.5

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

**Swing Gearbox**

Reduction Ratio	33.8:1
-----------------	--------

**Boom**

Length	12 m to 39 m (39.3 ft to 128 ft)
Power	4 Section, MEGAFORM™
Pinning	TWIN-LOCK™ Boom Pinning
Max Tip Height without Extension	42 m (138 ft)
Elevation	-3° to +81°
Boom Extensions (Optional)	
Manual Bi-Fold Lattice Swingaway	
Length	10 m to 17 m (32.8 ft to 55.8 ft)
Manual Offsets at	0°, 20°, and 45°
Maximum Tip Height	59.1 m (194 ft)
Hydraulic Bi-Fold Lattice Swingaway	
Length	10 m to 17 m (32.8 ft to 55.8 ft)
Hydraulic Offsets from	0° to 45°
Boom Extension Insert	8 m (26 ft)
Max Tip Height with Boom Extension and Insert	67 m (220 ft)

**Hoists**

**MTW19-78-243**

Drum Dimensions

Diameter .....378 mm (14.8 in)  
 Length .....541 mm (21.3 in)

Cable, Main, 35x7 Steel

Diameter .....19 mm (0.75 in)  
 Length .....199 m (652 ft)

Max Permissible

Line Pull .....7784 kg (17,160 lb)

Cable, Aux., 35x7 Steel

Diameter .....19 mm (0.75 in)

Length ..... 128 m (420 ft)

Max. Permissible

Line Pull .....7784 kg (17,160 lb)

Max. Single Line Speed at: 121 m/min (398 ft/min)

Max. Hoist Line Pull on Top Usable Layer

.....78 kN (17,535 lb)

Motor Displacement .....90 cc (5.49 cu. in.)

For reference only

## SECTION 2

### SAFETY INFORMATION

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## SAFETY MESSAGES

### General

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

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

### Safety Alert Symbol



This safety alert symbol means **ATTENTION!** Become alert - **your safety is involved!** Obey all safety messages that follow this symbol to avoid possible death or injury.

### Signal Words



#### DANGER

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



#### WARNING

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



#### CAUTION

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

#### CAUTION

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

**NOTE:** Emphasizes operation or maintenance procedures.

## GENERAL

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

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

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

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

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

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

### 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 Grove Product Support.

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

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

1565 East Buchanan Trail  
Shady Grove, PA 17256-0021

Phone: 888-777-3378 (888-PSR.DEPT)

717-597-8121

Fax: 717-593-5152

E-mail: product.safety@grove.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.

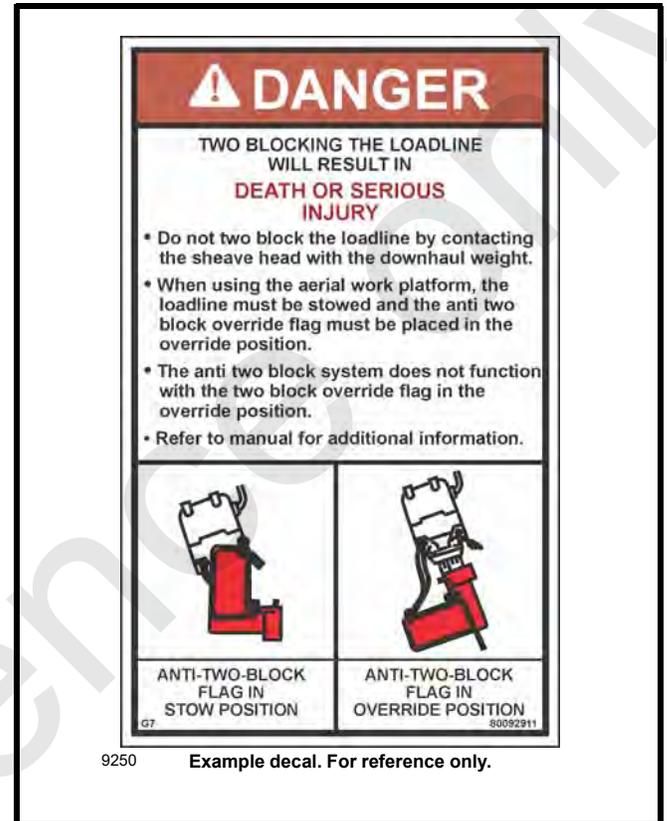
Two-blocking is more likely to occur when both the main and auxiliary hoist lines are reeved over the main boom nose and boom extension nose respectively. An operator, concentrating on the specific line being used, may telescope or lower the boom allowing the other hoist line attachment to contact the 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.



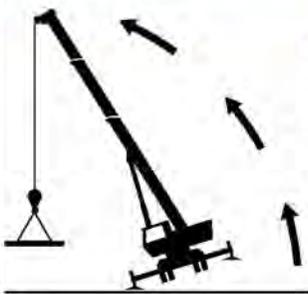
9250 Example decal. For reference only.

### Working Area Limiter (If Equipped)

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

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

**! DANGER**



**TIPPING HAZARD**

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

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

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

**TO AVOID DEATH OR SERIOUS INJURY:**

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

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

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

**NEVER** get on or off a moving crane.

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



**TWO-BLOCKING HAZARD**

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

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

**DO NOT PASS LOADS OR BOOM OVER GROUND PERSONNEL.**

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

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

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

**FOLLOW INSTRUCTIONS IN OPERATOR'S AND SAFETY HANDBOOK.**

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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:

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

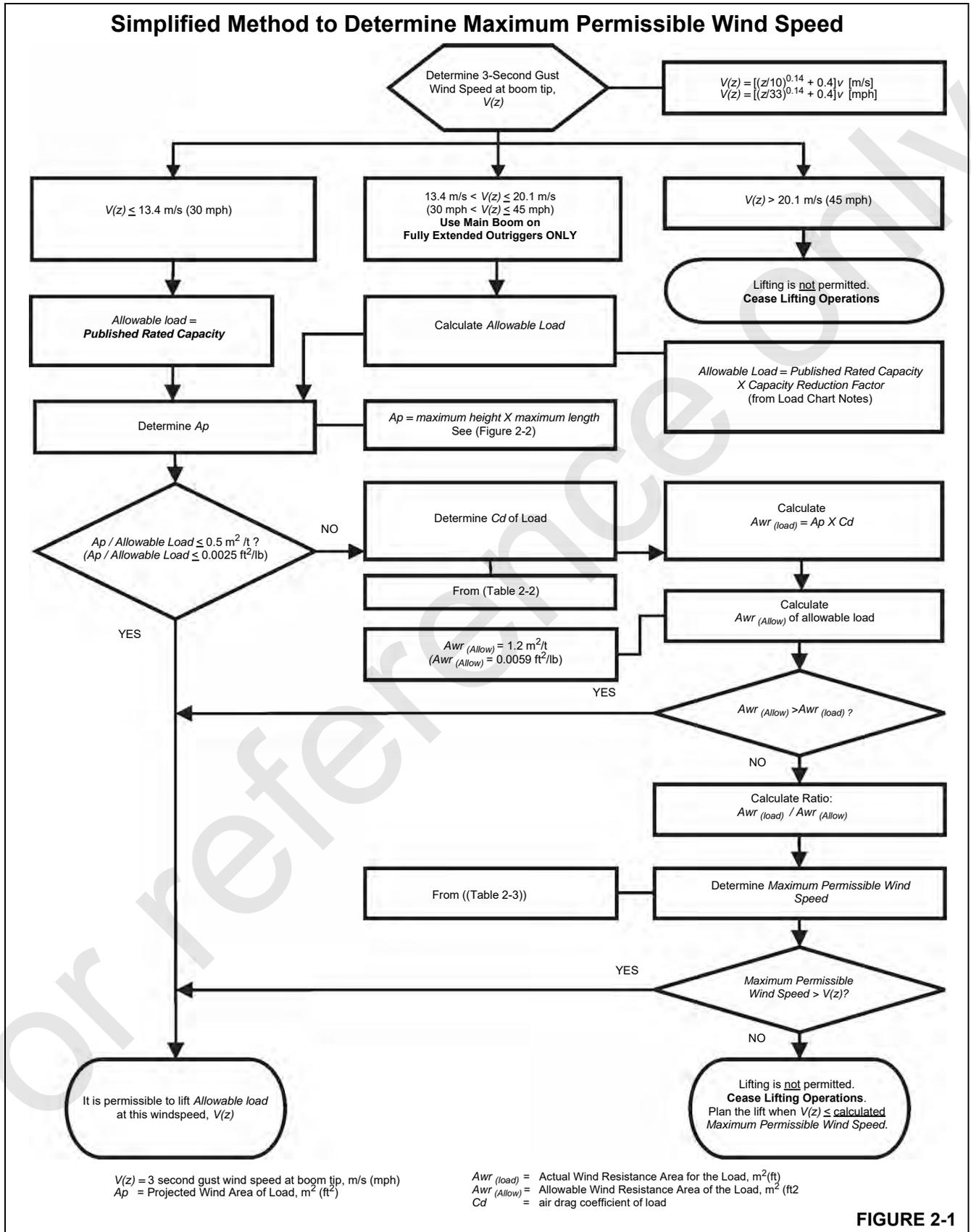
**NOTE:** This condition is limited to operation with the main boom on fully extended outriggers only.

- 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.



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

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

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

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

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

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

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

where:

$V$  [m/s] [mph] - Mean wind speed at 10 m (33 ft) elevation (upper limit of Beaufort scale)

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

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

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

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

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  $\leq 13.4 \text{ m/s (30 mph)}$ , 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

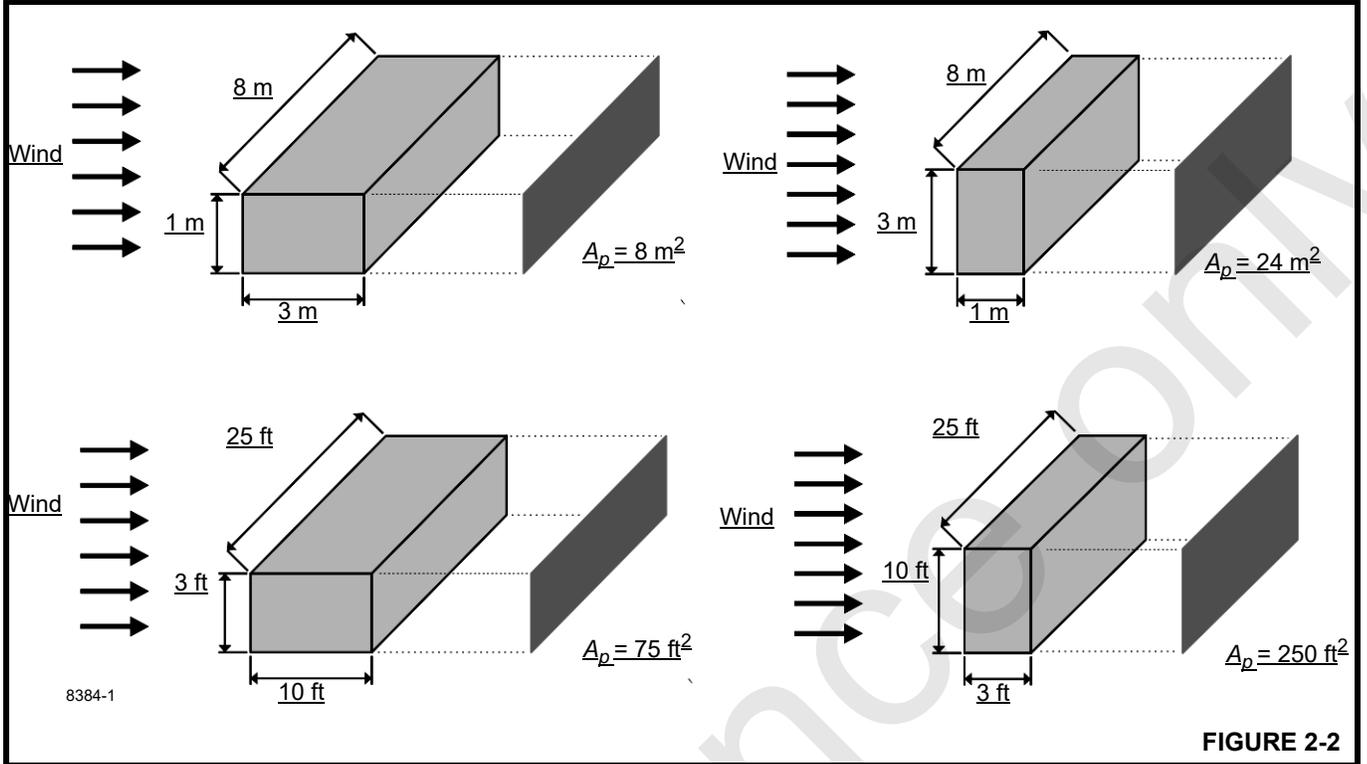
$$Awr_{(allow)} = 0.0012 \times m_{(load)} \quad (2.4)$$

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 ( $A_p$ ):



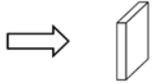
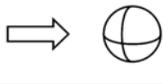
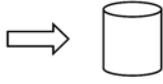
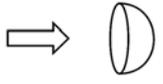
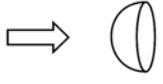
**Determining Wind Drag Coefficient ( $C_d$ )**

(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

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

Rated Load Chart Example - Metric

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

Radius in Meters	#001								
	Main Boom Length in Meters								
	10.9	12.2	15.2	**18.4	21.3	24.4	27.4	30.5	33.5
3	+60,000 (69.5)	40,950 (72)	40,950 (76)						
3.5	53,000 (66.5)	40,950 (69.5)	40,950 (74)	28,350 (78)					
4	47,450 (63.5)	40,950 (66.5)	40,950 (72)	28,350 (75.5)	*18,225 (78)				
4.5	42,875 (60.5)	40,950 (64)	40,950 (70)	28,350 (73.5)	18,225 (76)				
5	39,050 (57.5)	39,025 (61.5)	38,300 (67.5)	28,350 (72)	18,225 (75)	*18,225 (78)			
6	32,950 (50.5)	32,925 (55.5)	32,825 (63.5)	28,350 (68.5)	18,225 (72)	18,225 (75)	*18,225 (78)		
7	28,325 (42.5)	28,300 (49)	28,225 (59)	26,250 (65)	18,225 (69)	18,225 (71)	18,225 (74.5)	*16,725 (78)	*11,400 (78)
8	24,150 (32.5)	24,150 (42)	23,975 (54.5)	23,275 (60)	18,225 (69.5)	18,225 (72)	16,575 (72)	15,250 (74.5)	11,400 (76)
9	20,600 (18.5)	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)	17,175 (41)	17,125 (54)	17,325 (60)	15,125 (66)	13,725 (67.5)	12,700 (70.5)	11,400 (72.5)
12			15,075 (38)	15,025 (45.5)	12,575 (53.5)	12,175 (63)	11,600 (63)	10,725 (66.5)	10,050 (69)
14				9,000 (35)	9,360 (46)	9,730 (53.5)	9,955 (58.5)	9,205 (62)	8,620 (65)
16				6,750 (19)	7,110 (37.5)	7,475 (47)	7,920 (53)	7,980 (57.5)	7,470 (61.5)
18					5,960 (42)	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)	4,545 (48.5)
24								3,435 (23.5)	3,780 (43.5)
26									2,975 (28)
28									2,400 (16)
30									2,135 (22)
Minimum boom angle (°) for indicated length (no load)									0
Maximum boom length (m) at 0° boom angle (no load)									33.5

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

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

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

FIGURE 2-3

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

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

For wind speed  $V(z)$  (3-second gust speed at boom tip height)  $V(z) > 13.4 \text{ m/s} \leq 20.1 \text{ m/s}$ , the Reduced Capacity shall be calculated by multiplying the Published Rated Capacity by the following factors:

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

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

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

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

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

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

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

**Example and Sample Calculations (metric)**

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

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

**NOTE:** Not all crane models allow lifting operations 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:

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

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

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

- Maximum load 15,050 kg
- Maximum wind resistance area of load 18.06  $\text{m}^2$

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 **Ap** = 15.25 m<sup>2</sup>,
- Wind Drag Coefficient **Cd** = 1.3

the wind resistance area of load can be estimated as

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

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

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

- Is **Awr<sub>(load)</sub>** less than **Awr<sub>(allow)</sub>**?  
19.83 m<sup>2</sup> ≤ 14.45 m<sup>2</sup> NO

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

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

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

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

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 (36.5)	56,600 (45)	56,350 (56)	53,650 (63)	40,200 (67)	40,200 (70.5)	37,950 (73)	34,900 (75)	*25,150 (78)
30	43,500 (11.5)	44,300 (32)	43,950 (48.5)	43,650 (57.5)	40,200 (62.5)	37,050 (66)	32,750 (69.5)	30,200 (74)	25,150 (74)
35			33,550 (40)	33,700 (51.5)	34,700 (58)	33,550 (62)	33,550 (66)	26,400 (69)	24,700 (71.5)
40			25,800 (28)	26,150 (44.5)	26,300 (52.5)	27,300 (58.5)	25,200 (62.5)	23,300 (66)	21,800 (68.5)
45				20,300 (36.5)	20,450 (47)	22,300 (54)	22,400 (59)	20,700 (62.5)	19,400 (65.5)
50				15,500 (52)	17,400 (41)	18,200 (49.5)	19,100 (55)	18,550 (59.5)	17,350 (62.5)
55					14,300 (33.5)	15,500 (44)	16,000 (51)	16,400 (56)	15,600 (60)
60					11,500 (23.5)	12,700 (38)	13,550 (46.5)	13,950 (52.5)	14,100 (56.5)
65						10,000 (31.5)	11,550 (41.5)	11,950 (48.5)	12,300 (53.5)
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)

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

8382-1

FIGURE 2-4

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

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

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

Wind Speed $Vz > 30$ $\leq 45$ mph	Main Boom Length in Feet								
	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 in  $[ft^2]$ ,  $Awr_{(allow)} = 0.0059 \times$  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  $\text{ft}^2 \leq$  119  $\text{ft}^2$  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.**



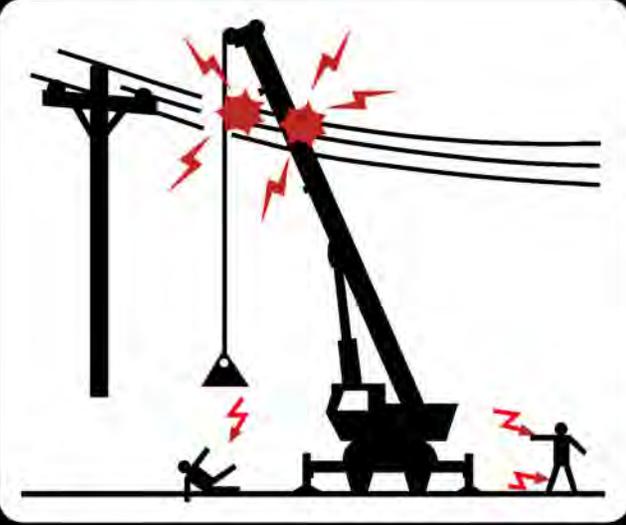
**DANGER**

### 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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80037260

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

Before operating this crane in the vicinity of electrical power lines or equipment, notify the power utility company. Obtain positive and absolute assurance that the power has been turned off.

This crane is **not insulated**. Always consider all parts of the load and the crane, including the hoist rope, wire rope, pendant cables, and tag lines, as conductors. You, the operator, are responsible for alerting all personnel of dangers associated with electrical power lines and equipment. Do not allow unnecessary personnel in the vicinity of the crane while operating. Permit no one to lean against or touch the crane. Permit no one, including riggers and load handlers, to hold the load, load lines, tag lines, or rigging gear.

If the load, hoist rope, boom, or any portion of the crane contacts or comes too close to an electrical power source, everyone in, on, and around the crane can be seriously injured or killed.

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

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

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

It is not always necessary to contact a power line or power source to become electrocuted. Electricity, depending on magnitude, can arc or jump to any part of the load, load line, or crane boom if it comes too close to an electrical power source. Low voltages can also be dangerous.

### Set-Up and Operation

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

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

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

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

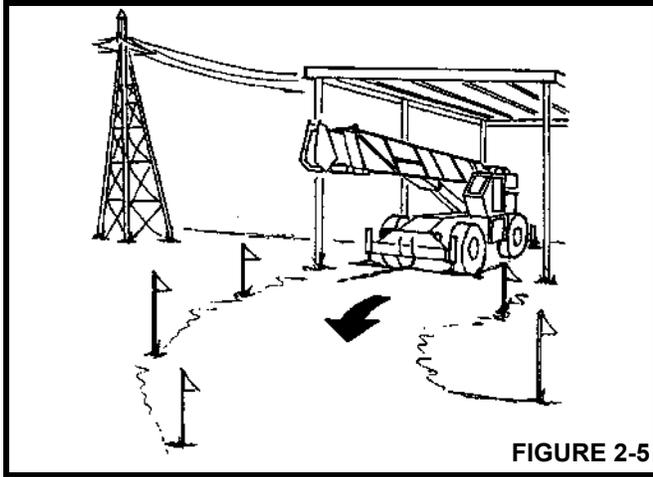


FIGURE 2-5

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

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

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

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

## Electrocution Hazard Devices

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

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

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

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

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

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

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

Some variables you must know and understand are:

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

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

## Electrical Contact

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

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

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

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

### Special Operating Conditions and Equipment

Never operate the crane during an electrical thunderstorm.

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

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

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

### Grounding the Crane

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



### WARNING

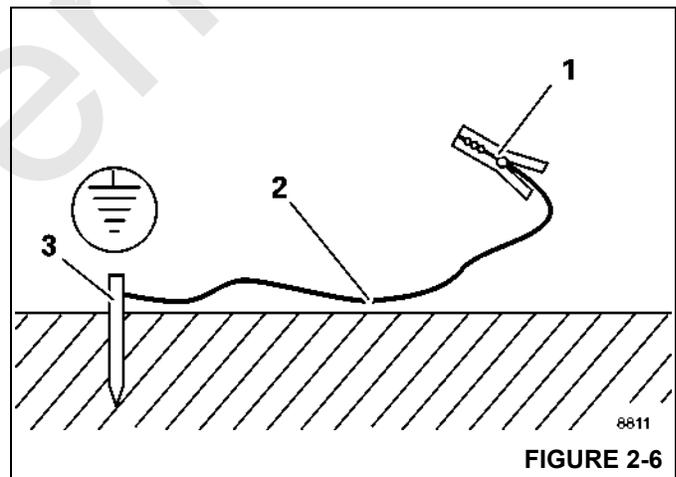
#### Risk of accidents due to electric shock!

Ground the crane before you start to work with it

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

Use electrically conducting material for grounding.

1. Hammer a metal rod (3, (Figure 2-6)) (length of approximately 2.0 m (6.6 ft)) at least 1.5 m (5 ft) into the ground.
2. Moisten the soil around the metal rod (3) for better conductivity.
3. Clamp an insulated cable (2) to the metal rod (3), cross-section of at least 16 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.



### 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 Grove Product Support to determine if load testing is required after a structural repair is performed.

#### Lubrication

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

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

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

#### Tires



### WARNING

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

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

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

Make sure that all lug nuts are properly torqued.

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

## HOIST ROPE

### Synthetic Hoist Rope

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

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

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

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

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

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

**NOTE:** Hoist rope may be purchased by contacting Grove Product Support.

### Wire Rope

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

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

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

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

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

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

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

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

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

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

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

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

#### Installing a new rope

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

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

#### When using a wedge socket

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

#### Sheaves

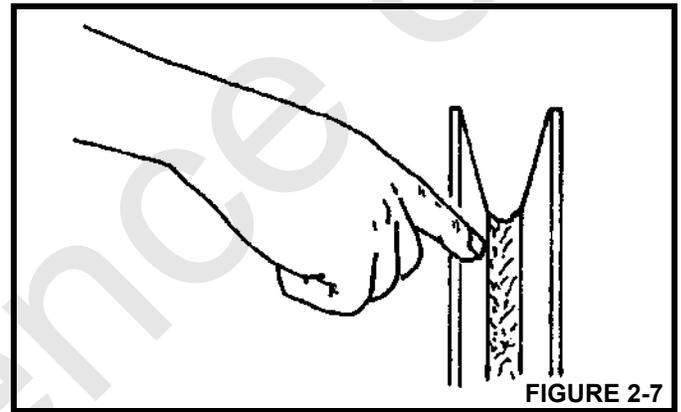


FIGURE 2-7

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.

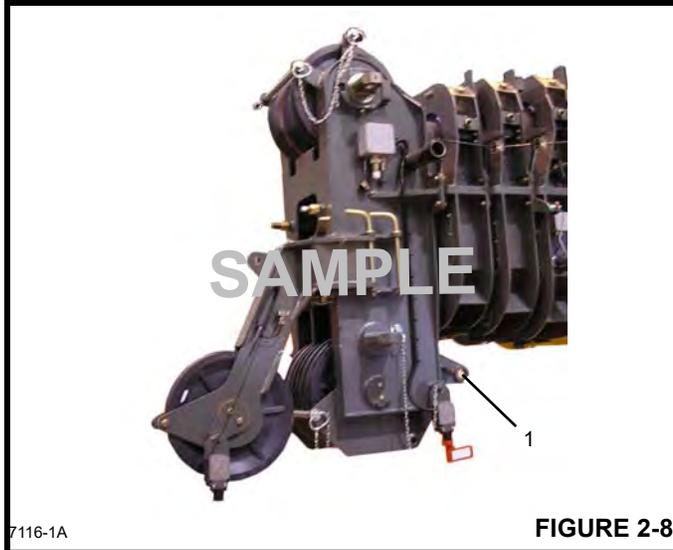
Check load limits of bridges on the travel route, and make sure that they are greater than the combined weight of the crane and transporting vehicle.

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 and resting on the tires only. Do not

extend outrigger jacks onto transport vehicle. Consult with Grove Product Support if you are going to transport with the tires removed.

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.



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.

 <p>SUPERSTRUCTURE ROTATION</p>	<p><b>⚠ DANGER</b></p> <p><b>CRUSHING HAZARD</b></p> <ul style="list-style-type: none"> <li>• DEATH OR SERIOUS INJURY COULD RESULT FROM BEING CRUSHED BY MOVING MACHINERY.</li> <li>• CLEAR ALL PERSONNEL FROM THE COUNTERWEIGHT AND SUPERSTRUCTURE AREA BEFORE REMOVING THE COUNTERWEIGHT OR ROTATING THE SUPERSTRUCTURE.</li> <li>• FOLLOW THE INSTRUCTIONS IN OPERATOR'S AND SAFETY HANDBOOK.</li> </ul>
 <p>COUNTERWEIGHT REMOVAL</p>	

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.

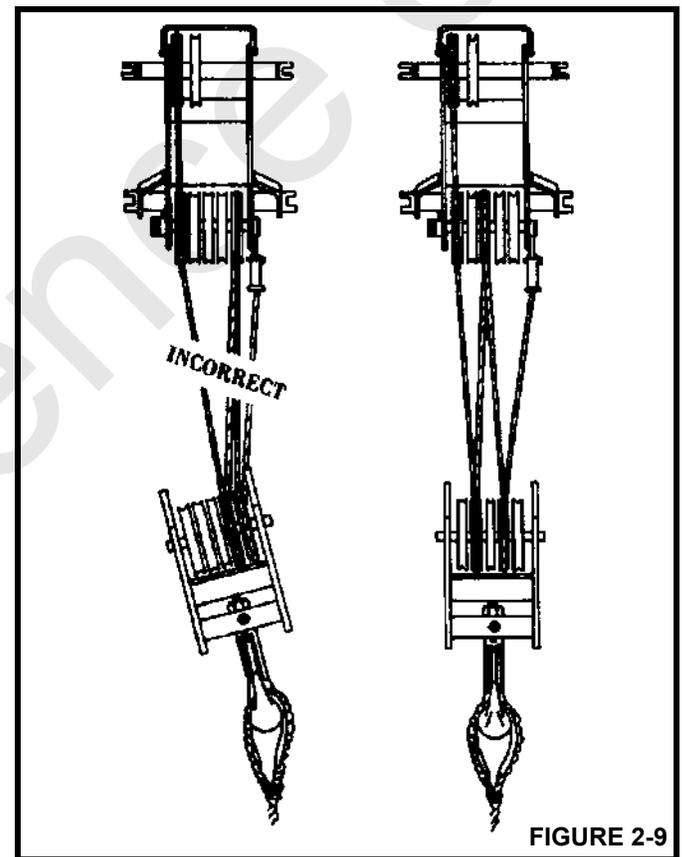


FIGURE 2-9

**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.

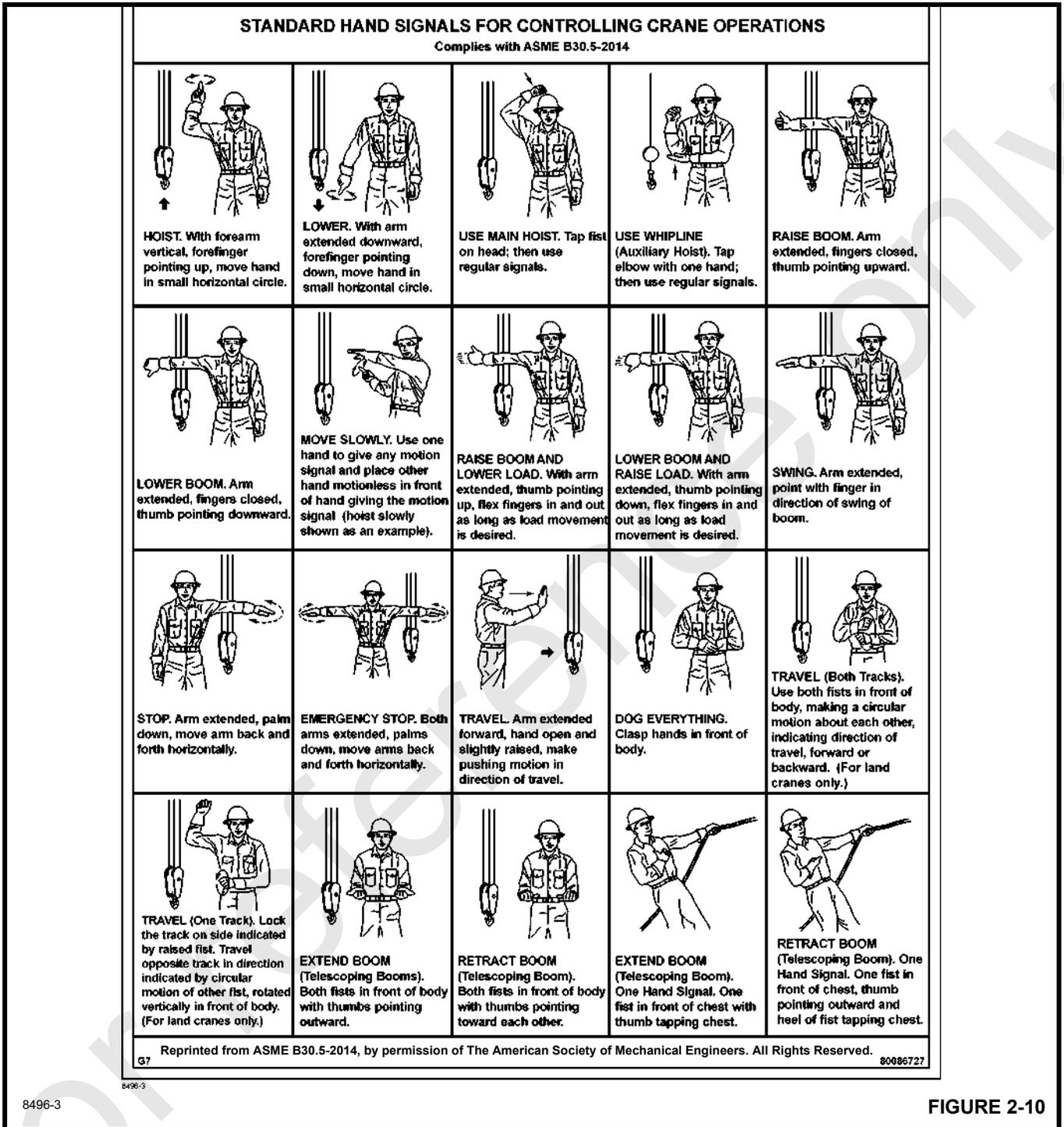


FIGURE 2-10

## 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

## 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 Grove Product Support must be contacted for corrective action.

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

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

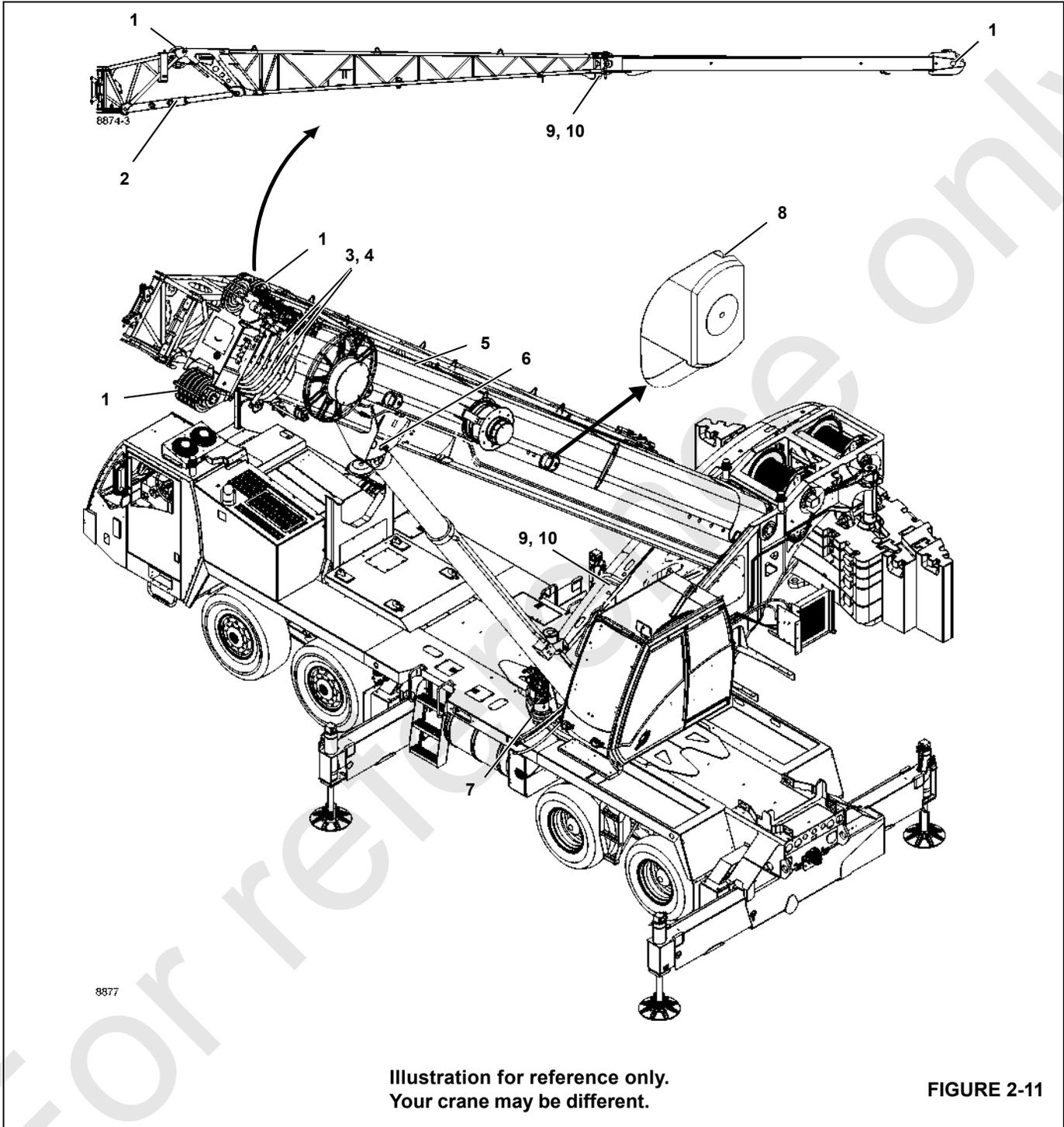
To avoid an accident caused by overload damage to your crane:

- Perform the inspections outlined in this publication for overloads up to 50%.
  - Stop operating the crane and contact your Local Distributor or Grove Product Support immediately for overloads of 50% and higher.
- 

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

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

Boom Inspection



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

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

Superstructure Inspection

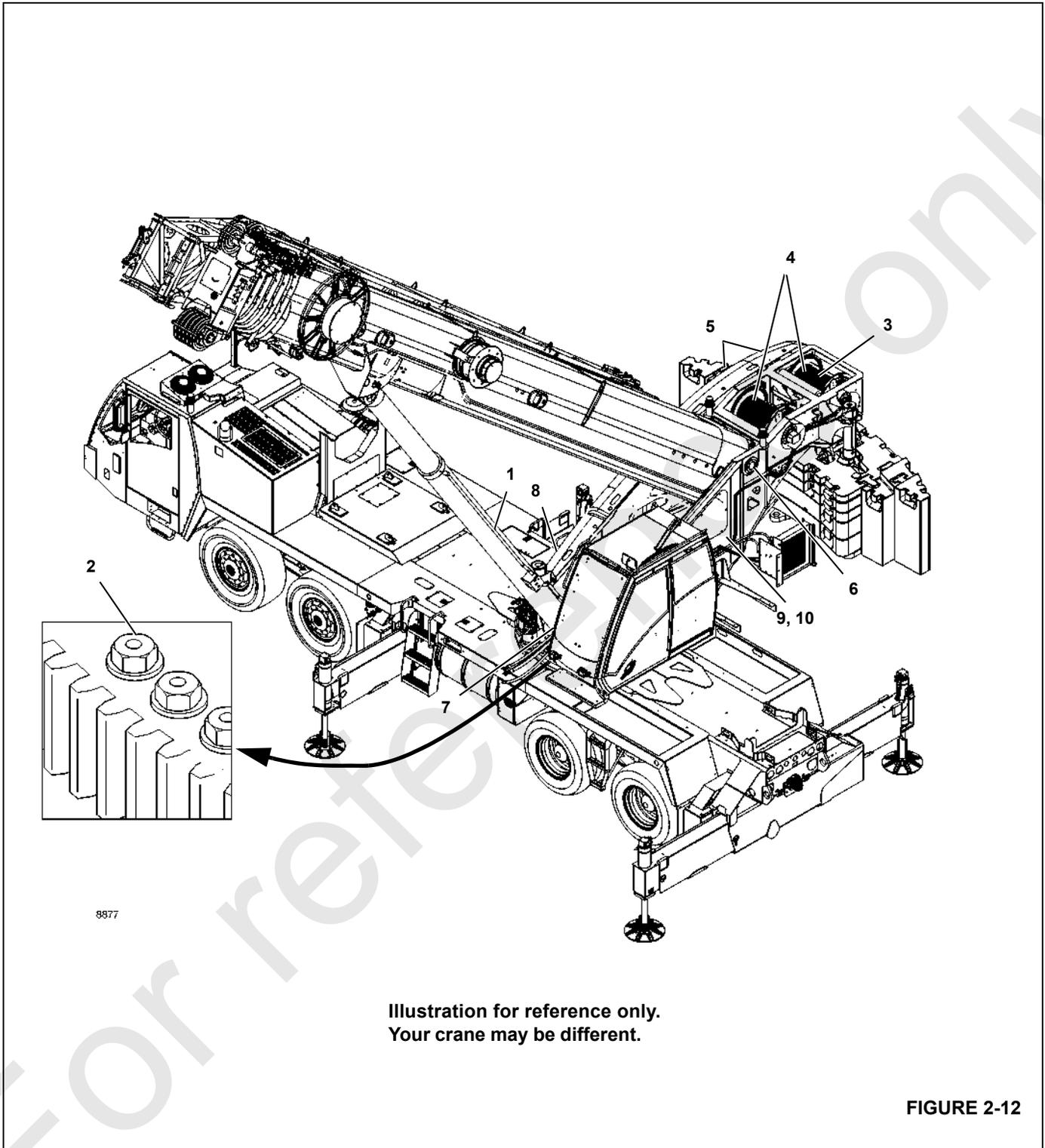


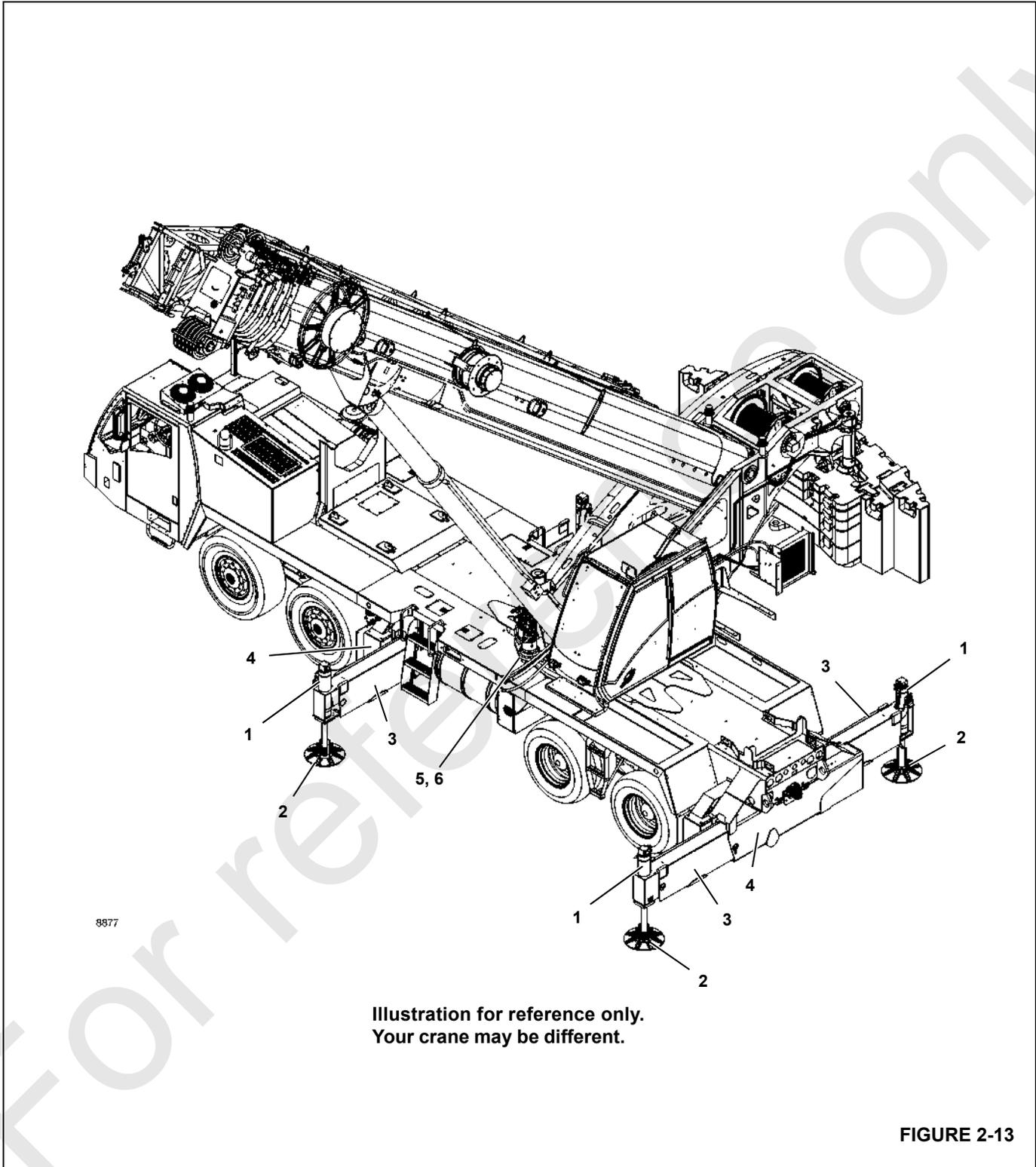
Illustration for reference only.  
Your crane may be different.

FIGURE 2-12

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

<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



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

<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 FEATURES

### SECTION CONTENTS

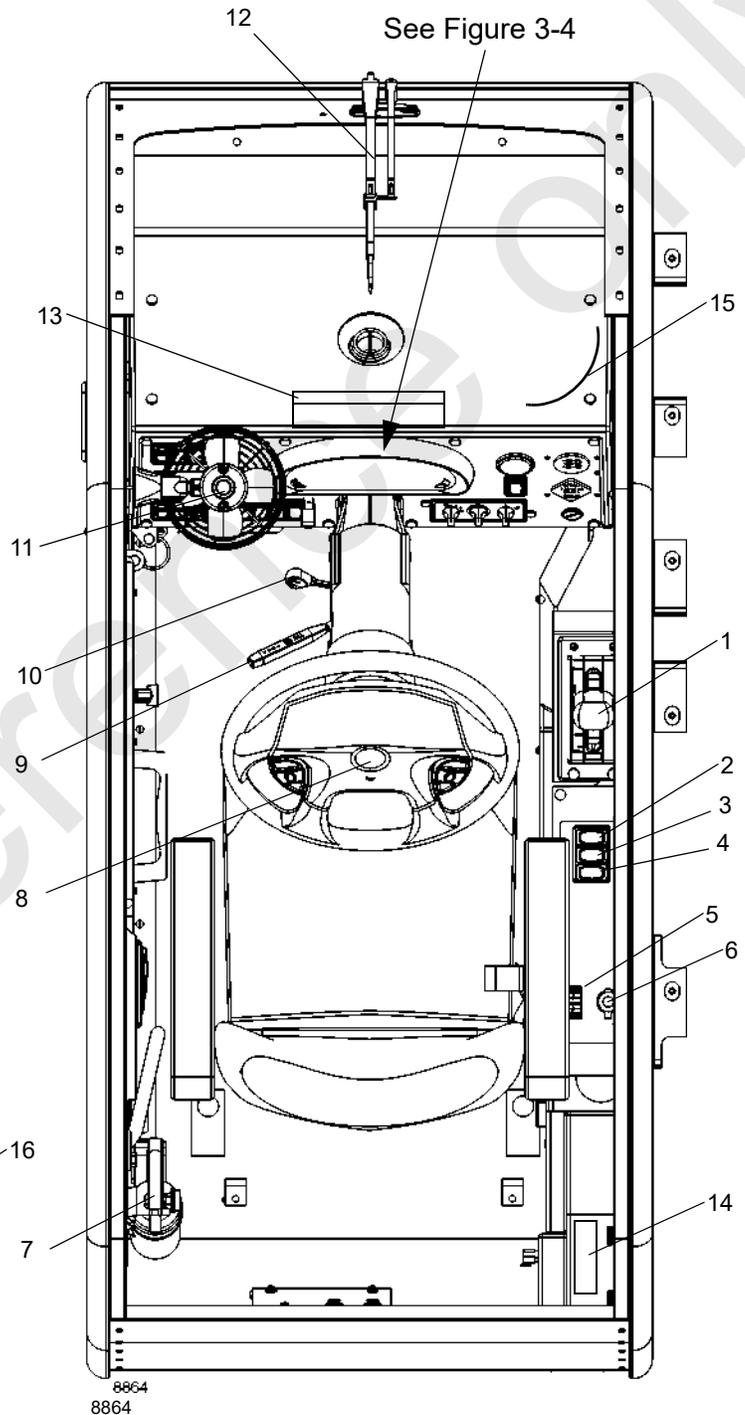
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**CARRIER CAB CONTROLS AND INDICATORS**

Item	Description
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	Steering Column Tilt / Telescope Adjustment Lever
11	Cab Circulating Fan
12	Windshield Wiper / Washer
13	Camera Display
14	Dome Light / Switch
15	Air Horn Control
16	Throttle Pedal
17	Brake Pedal
18	Clutch Pedal (Manual Transmission Only)



**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 *Shifting Gears - Manual Transmission*, page 4-23 and *Automatic Transmission (Optional)*, page 4-26 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

The USB Ports (5), (Figure 3-1) located in the carrier cab right hand armrest, are used for charging devices. Software cannot be downloaded with it. **Note:** The USB ports located in the Superstructure cab are for downloading software functionality information from the data logger.

### 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. Depressing 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.

### Steering Column Tilt/Telescope Lever

The Steering Column Tilt/Telescope Lever (10), (Figure 3-1) is located on the steering column behind the turn signal lever. Pulling back on the lever allows the steering column to be tilted to seven positions. Pushing the lever allows the steering column to be telescoped.

### 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 (12), (Figure 3-1) removes moisture from the windshield. The washer applies a liquid to the windshield so the wiper can clean it. Controls for the Windshield Wiper and Washer are located on the steering wheel.

### Carrier Camera Display and Setup

The Carrier Camera Display (13), (Figure 3-1) can be configured to display either the back up camera or the right turn camera or both, see *Camera Menu Group*, page 4-130.



FIGURE 3-2

3

Item	Description
1	Camera Selection Button
2	Auto LCD Back-light Control Day/Night Settings Button
3	Setting the Contrast* Button
4	Setting the Brightness* Button *Combine 3 and 4 = Setting Color Saturation
5	Option / Previous Button
6	Minus (Go to the Next Menu Option)
7	Plus (Go to the Previous Menu Option)
8	Enter (Select or Enable the Chosen Option)

**Dome Light**

The Dome Light (14), (Figure 3-1) with integral switch 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 or decrease the engine speed.

**Brake Pedal**

The Brake Pedal (17), (Figure 3-1) is located on the right side of the cab floor and is used to apply the service brakes.

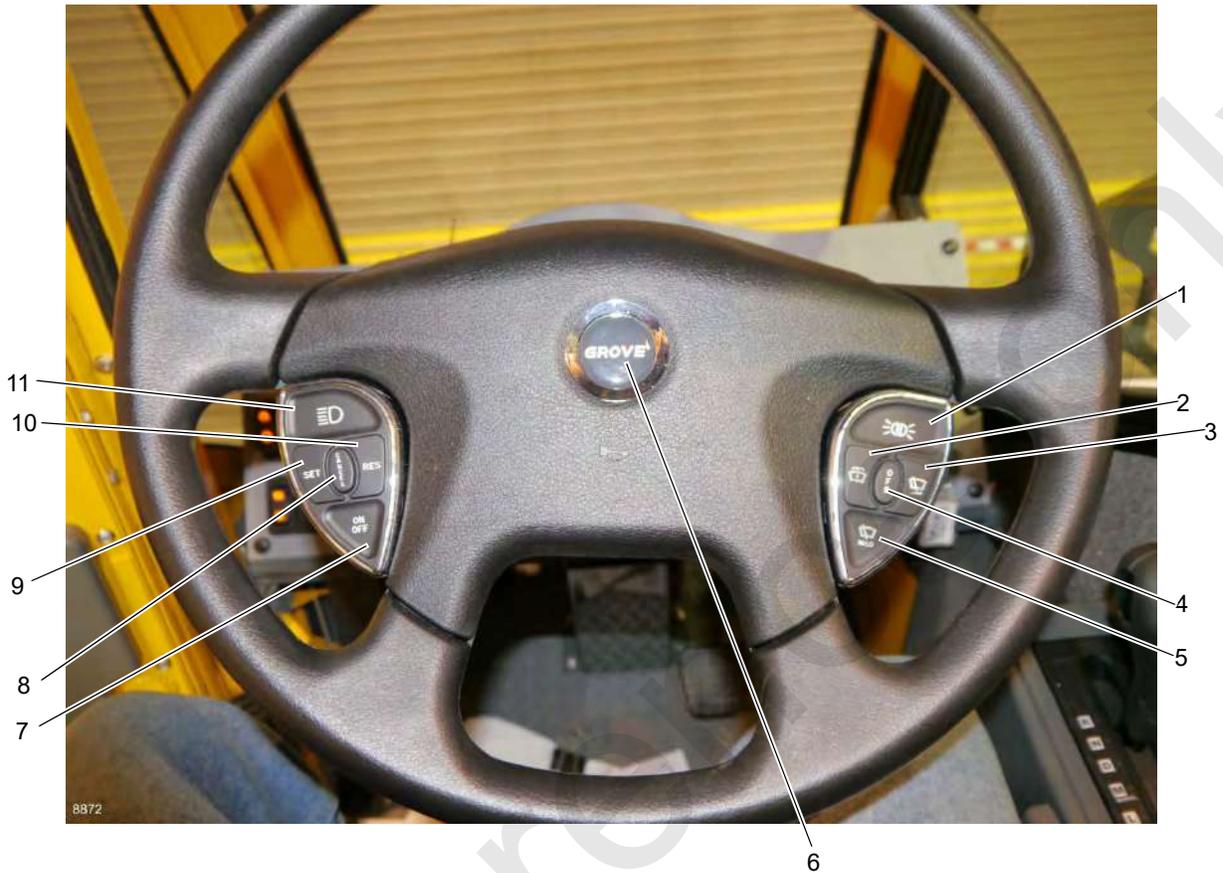
**Clutch Pedal**

The Clutch Pedal (18), (Figure 3-1) manual transmission only, is located on the left side of the cab floor and is used to disengage and engage the engine with the transmission.

**Steering Wheel**

The Steering Wheel (Figure 3-3) 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. To sound the horn press the center of the steering wheel.

**STEERING WHEEL**



Item	Description	Item	Description
1	Flash Marker Lights Switch	7	Cruise Control ON/OFF Switch
2	Windshield Washer Switch	8	Cancel Set Speed Switch
3	Intermittent Wiper Speed Control Switch	9	Set Speed/Coast Switch
4	Windshield Wiper OFF Switch	10	Resume Set Speed/Accelerate Switch
5	Hi/Low Constant Speed Control Switch	11	Flash Headlights Switch
6	Horn Switch		

**FIGURE 3-3**

**Flash Marker Lights Switch**

The Flash Marker Light Switch (1), (Figure 3-3) 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 Wiper and Washer Switches**

The Windshield Washer (2), Intermittent Wiper Speed Control (3), Windshield Wiper OFF (4) and the High/Low

Wiper Speed Control switches (5), are located on the steering wheel (Figure 3-3).

**Windshield Washer Switch**

The Windshield Washer Switch (2), (Figure 3-3) is located on the right side of the steering wheel. Push the switch to apply a liquid to the windshield so the wiper can clean it. The windshield wiper removes moisture from the windshield.

### Intermittent Wiper Speed Control Switch

The Intermittent Wiper Speed Control Switch (3), (Figure 3-3) allows a faster or slower speed and allows the wipers to stop momentarily between each wipe. Four speeds are available in the Intermittent Mode.

### Horn Switch

The Horn Switch (6), (Figure 3-3) is located in the middle of the steering wheel and is an audible 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 3-3) is located on the steering wheel. Cruise Control is a system that automatically controls the speed of the vehicle. Also, refer to *Cruise Control Indicator*, page 3-15

### Cancel Set Speed Switch

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

### Set Speed/Coast Switch

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

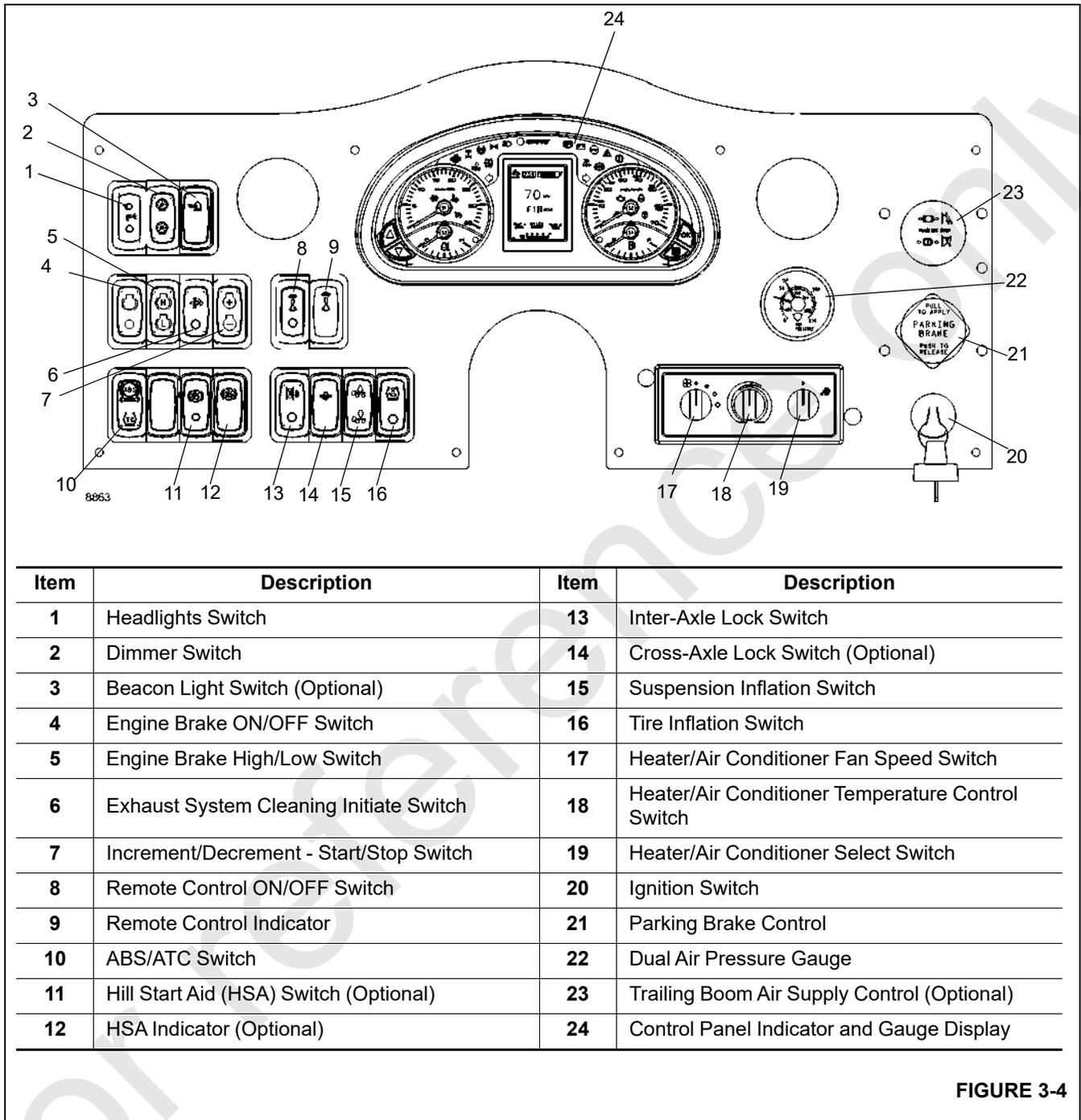
### Resume Set Speed/Accelerate Switch

The Resume Set Speed/Accelerate Switch (10), (Figure 3-3) 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 3-3) 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.

**CARRIER CAB DASHBOARD PANEL**



**FIGURE 3-4**

The Carrier Cab Dashboard Panel (Figure 3-4) is a panel extending across the interior of the vehicle below the windshield that contains instruments and controls.

**Headlights Switch**

The Headlights Switch (1), (Figure 3-4) is located on the top left side of the front console.

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

Push the bottom of the switch to cause the headlights, marker lights, and taillights to go OFF. Set the rocker switch to center position to cause the marker and taillights to come ON. Push the top of the switch to cause the headlights on the

front and back of the crane to come ON, in addition to the marker lights and tail lights.

### Dimmer Switch

The Dimmer Switch (2), (Figure 3-4) is located on the left top side of the front console. The switch controls the brightness of the dual air pressure gauge and automated transmission shift lever back lighting.

The Control Panel Indicator and Gauge Display (24), (Figure 3-4) back lighting brightness is not controlled by this switch. The back lighting controls for it can be accessed by selecting the menu button located on the Control Panel and Gauge Display. See Item (22), (Figure 3-5) for the location of the Menu Button.

**NOTE:** The Headlight Switch (1), (Figure 3-4) must be in the center or top position before the dual air pressure gauge and automated transmission shift lever back lighting will be illuminated and the dimmer switch becomes functional.

### Beacon Light Switch (Optional)

The Beacon Light Switch (3), (Figure 3-4) is a two-position, toggle ON/OFF Switch located on the left side of the front console that controls the beacon light on the top of the carrier cab and both superstructure beacon lights. Push down on the toggle switch to turn ON and push the opposite end to turn OFF. Also, refer to *Strobe Light or Beacon Lights (Optional)*, page 5-2.

### Engine Brake ON/OFF Switch

The Engine Brake ON/OFF Switch (4), (Figure 3-4) is located on the left side of the front console. The two-position (ON/OFF) Switch energizes the engine brake. When the top of the switch is pushed, the switch is in the ON position. Push the opposite end of the switch to turn OFF.

### Engine Brake High/Low Switch

The Engine Brake High/Low Switch (5), (Figure 3-4) is located on the left side of the front console. The two-position Engine Brake High/Low Switch controls the amount of engine braking. When the top of the switch is pushed, the switch is in the HIGH position.

### Exhaust System Cleaning Initiate Switch

The Exhaust System Cleaning Initiate Switch (6), (Figure 3-4) is located on the left side of the front console in the carrier cab. The Exhaust System Cleaning Initiate Switch is used to initiate a stationary exhaust system cleaning. The switch must be cycled ON and OFF to initiate cleaning. The Exhaust System Cleaning Initiate Switch is a maintained ON switch.

The brake and throttle pedals (and clutch pedal for cranes with a manual transmission) must also be released. The engine will automatically change speed as needed. The cycle will take approximately 20 minutes.

### Engine Idle Increment/Decrement Start/Stop Switch

The Engine Idle Increment/Decrement Start/Stop Switch (7), (Figure 3-4) is located on the left side of the front console and is used to set the engine idle operating speed. Each push of the top of the switch (+) increases the engine idle speed by 25 rpm to a maximum of 800 rpm. Each push of the bottom of the switch (-) decreases the engine idle speed by 25 rpm to a minimum of 600 rpm. Idle speed will revert to the factory setting two minutes after shutting the engine down.

The Engine Idle Increment/Decrement Start/Stop Switch in the Carrier Cab does not act as a start/stop switch. Only the switch in the Superstructure Cab works as a start/stop switch.

### Remote Control ON/OFF Switch

The Remote Control ON/OFF Switch (8), (Figure 3-4) is on the left side of the console. Push the top of the switch to enable the hand-held remote control.

### Remote Control Indicator

The Remote Control Indicator (amber) (9), (Figure 3-4) will illuminate solid when the remote control switch is ON and permissions for enabling have been met. It will flash if the switch is ON but all permissions have not been met.

### ABS/ATC Switch

The Anti-Lock Braking System/Automatic Traction Control (ABS/ATC) Switch (10), (Figure 3-4) 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 4-11 or *Automatic Traction Control (ATC) Functional Overview*, page 4-13 for more information on the operation of these switches.

### Hill Start Aid (HSA) Switch (Optional)

The Hill Start Aid (HSA) Switch (11), (Figure 3-4) 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) (Optional)*, page 4-29.

**NOTE:** The HSA Switch and Indicator are for the Automated Transmission.

### Hill Start Aid (HSA) Indicator (Optional)

The Hill Start Aid (HSA) Indicator (12), (Figure 3-4) illuminates amber when the HSA system is inactive.

### Inter-Axle Lock Switch

The Inter-Axle Differential Lock Switch (13), (Figure 3-4) is located on the left side of the front console. Push the two-position toggle switch to operate. 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.

---

#### CAUTION

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

---

### Cross-Axle Lock Switch (Optional)

The Cross-Axle Lock Switch (14), (Figure 3-4) 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 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.

---

#### 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.

---

### Suspension Inflation Switch

The Suspension Inflation Control Switch (15), (Figure 3-4) is located on the left side of the 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 3-4) 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 in the

Carrier Cab Control Panel Indicator and Gauge Display will illuminate and a warning buzzer will sound when the switch is in the ON position.

### Heater/Air Conditioner Fan Speed Switch

The Heater/Air Conditioner Fan Speed Switch (17), (Figure 3-4) is located on the right of the console. The rotary switch controls the fan speed and volume of heated or cooled air output. Settings are OFF, low speed, medium speed, and high speed.

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

### Heater/Air Conditioner Temperature Control Switch

The Heater/Air Conditioner Temperature Control Switch (18), (Figure 3-4) is located on the right side of the console. Turn the knob fully clockwise for maximum heat and turn the knob fully counterclockwise for maximum cooling.

### Heater/Air Conditioner Select Switch

The Heater/Air Conditioner Select Switch (19), (Figure 3-4) is located on the right side of the console. Turn the switch to the vertical position for heater or to the right for air conditioner.

### Ignition Switch

The Ignition Switch (20), (Figure 3-4) 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 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 (21), (Figure 3-4) 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 (22), (Figure 3-4) is located on the right side of the front console. The gauge is a direct reading pressure gauge with two indicating pointers, red for the primary system and green 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.

### Trailing Boom Air Supply Control (Optional)

The Trailing Boom Air Supply (Trailer Emergency) brake control (23), (Figure 3-4) is a push-pull type air valve located on the right side of the front console. The control is used to set and release the brakes on the trailing boom dolly. Push the control to release the brakes, pull the control out to apply the brakes.

### Control Panel Indicator and Gauge Display

The Control Panel Indicator and Gauge Display (24), (Figure 3-4) and detailed in (Figure 3-5) 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.

**CARRIER CAB 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, also called IGN.

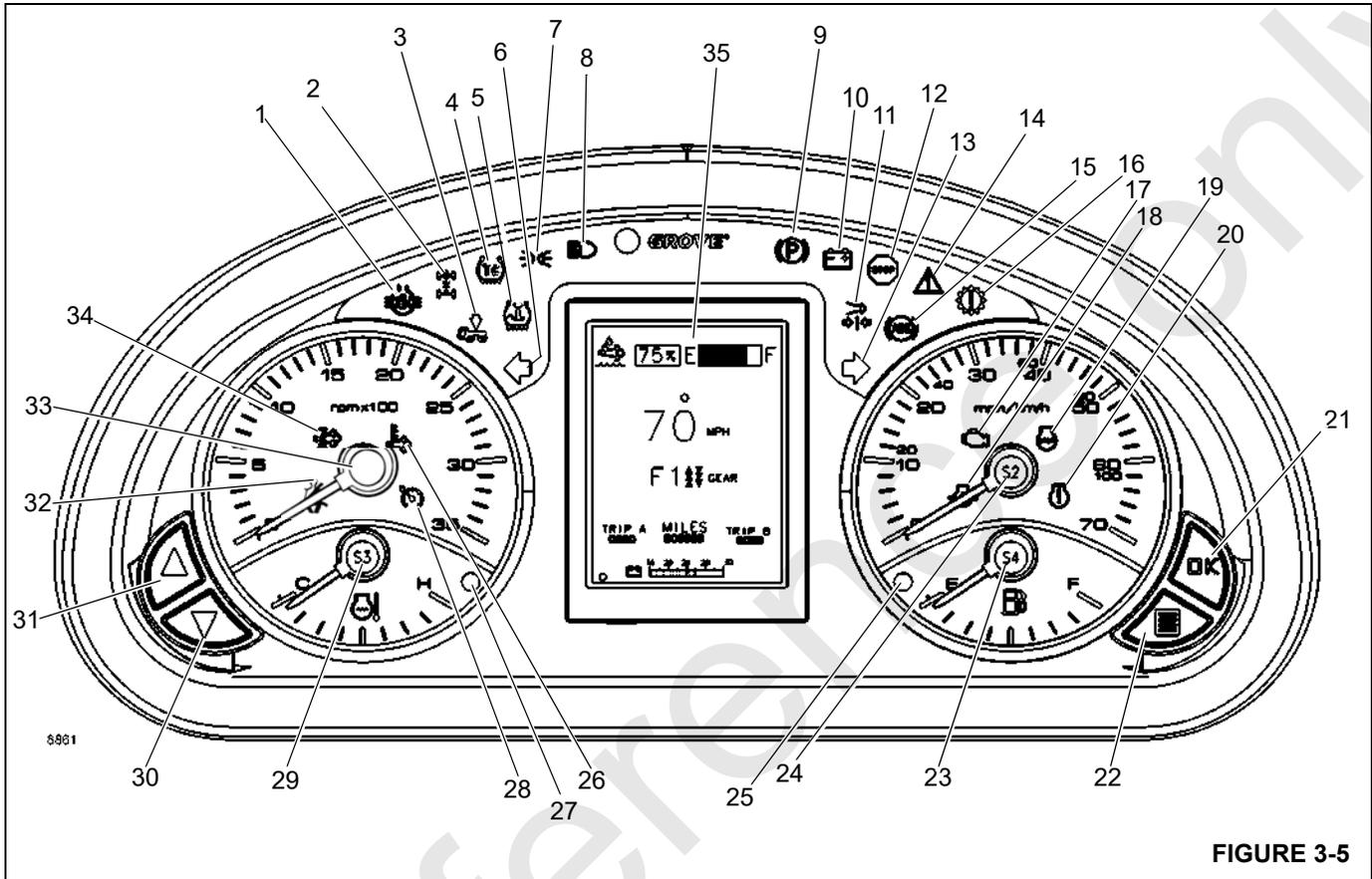


FIGURE 3-5

ITEM	DESCRIPTION	INDICATOR COLOR
1	Cross-Axle Locked Indicator / Differential Locked Indicator	AMBER
2	Inter-axle Locked Indicator	AMBER
3	Suspension Deflated Indicator	AMBER
4	Traction Control Indicator	AMBER
5	Tire Inflation ON Indicator	AMBER
6	Left Turn Signal Indicator	GREEN
7	Lights ON Indicator	GREEN
8	High Beam Indicator	BLUE
9	Park Brake Engaged Indicator	RED
10	Battery Charge Indicator	RED
11	Low Air Pressure Indicator	AMBER
12	Emergency Stop Indicator	RED
13	Right Turn Signal Indicator	GREEN
14	System Fault Indicator	AMBER
15	Anti-lock Braking System (ABS) Indicator	AMBER
16	Check Transmission Indicator	RED

ITEM	DESCRIPTION	INDICATOR COLOR
17	Malfunction Indicator Lamp (MIL)	AMBER
18	Low Oil Pressure Indicator	RED
19	Engine Stop Indicator	RED
20	Engine Warning Indicator	AMBER
21	OK Button	NONE
22	Menu Button	NONE
23	Fuel Level Gauge Indicator	NONE
24	Speedometer	NONE
25	Low Fuel Level Indicator	AMBER
26	High Exhaust System Temperature Indicator	AMBER
27	Engine Temperature Indicator	RED
28	Cruise Control Indicator	AMBER
29	Engine Coolant Temperature Gauge	AMBER
30	Down Button	NONE
31	Up Button	NONE
32	Seat Belt Unfastened Indicator	RED
33	Tachometer	RED at 2600 rpm
34	Exhaust System Cleaning Needed Indicator	AMBER
35	LCD Display	

### Cross-Axle Locked Indicator (Optional)

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

### Inter-Axle Locked Indicator

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

### 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.

### Traction Control Indicator

The Traction Control Indicator Lamp (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 ON Indicator

The Tire Inflation ON Indicator (5), (Figure 3-5) is located on the left side of the gauge cluster. The indicator illuminates Amber when the pressure switch in 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. It is a Green indicator light that flashes when the turn signal lever or hazard switch is activated.

### Lights ON Indicator

The Lights ON Indicator (7), (Figure 3-5) is located on the left side of the gauge cluster. It illuminates Green 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 indicator illuminates Blue 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 indicator illuminates Red 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) will illuminate Red when any of the following conditions are met, key switch is OFF but the headlights or turn signals are left on, the key switch is turned to the IGNITION position, the engine is running and the alternator charge signal is missing, or the system battery voltage or engine ECM voltage falls below 18V or goes above 30V. If both the carrier and superstructure key switches are OFF this light will not be on.

### Low Air Pressure Indicator

The Low Air Pressure Indicator (11), (Figure 3-5) is located on the right side of the gauge cluster. It illuminates Red when the pressure in the air brake system 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. It illuminates Red when an Emergency Stop Switch is pushed in (refer to Emergency Stop Indicator, page 3-14) 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. It is a Green indicator light that flashes when the turn signal lever or hazard switch is activated.

### System Fault Indicator

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

### Anti-Lock Braking System (ABS) Indicator

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

- The ABS lamp illuminates steadily for a two second lamp check whenever the ignition is switched ON. The lamp will remain ON until the brake pedal has been pressed and the system senses the activation.
- If the 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 (Automated Transmission Only)

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

### Malfunction Indicator Lamp (MIL)

The Malfunction Indicator Lamp (MIL) (17), (Figure 3-5) illuminates Amber 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. It illuminates Red as commanded by the engine ECM via SAE J1939 serial communications.

### Engine Stop Indicator

The Engine Stop Indicator (19), (Figure 3-5) is located in the speedometer. The indicator illuminates Red when energized by a signal from the engine 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. This code will be a SAE J1939 SPN, accompanied with an engine manufacturer FMI (Failure Mode Identifier) value. With these two values the exact engine fault code may be looked up through engine manufacturer documentation or by contacting Grove Product Support.

### Engine Warning Indicator

The Engine Warning Indicator (20), (Figure 3-5) is located in the speedometer. It illuminates Amber when energized by a signal from the engine 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 display.

## Menu Button

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

## Fuel Level Gauge Indicator

The Fuel Level Gauge Indicator (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 ECM via SAE J1939 serial communications.

### CAUTION

#### Engine Damage Hazard!

Ultra low sulfur diesel fuel is 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 Amber when the fuel level goes below 45 L (12 gal). This is based on calculated fuel level from engine ECM

## High Exhaust System Temperature Indicator

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



### WARNING

#### Extreme Heat Hazard!

During exhaust system cleaning, exhaust temperatures may reach 800°C (1500°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.

During cleaning it is possible for the engine exhaust to reach temperatures exceeding 649°C (1200°F). The HEST indicator will illuminate red to warn the operator of when

temperatures reach 640°C (1184°F) and will stay on until the temperature falls below 625°C (1157°F).

For more information on the cleaning process, refer to *Exhaust System Cleaning Indicator*, page 3-15

## Engine Temperature Indicator

The Engine Temperature Indicator (27), (Figure 3-5) is located in the temperature gauge. The indicator illuminates red when the cooling system water temperature reaches 107°C (225°F). This indicator is controlled by a multiplexed message from the engine ECM.

## Cruise Control Indicator

The Cruise Control Indicator (28), (Figure 3-5) is located in the tachometer. The indicator illuminates Amber 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 (TEMP) Gauge (29), (Figure 3-5) is located on the lower left of the gauge cluster. The gauge illuminates Amber and indicates the engine coolant temperature on a scale from cold (C) to hot (H). The gauge is controlled by a multiplexed message from the engine ECM.

## Down Button

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

## Up Button

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

## Seat Belt Unfastened Indicator

The Seat Belt Unfastened Indicator (32), (Figure 3-5) is located in the tachometer. The indicator illuminates Red when the ignition is on and the seat belt is not fastened. A buzzer will sound until the seat belt is fastened.

## Tachometer

The Tachometer (33), (Figure 3-5) is located on the left side of the gauge cluster. The Tachometer is calibrated in RPM x 100 with a range of zero (0) to 35. The gauge is controlled by a multiplexed message from the engine ECM and illuminates Red at 2600.

## Exhaust System Cleaning Indicator

The Exhaust System Cleaning Needed Indicator (34), (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 illuminated 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 (20), (Figure 3-5) will illuminate in addition to the Cleaning 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 (1500°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 detail on these.

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 Exhaust System Cleaning Initiate Switch (6), (Figure 3-4) is momentarily placed in the manual cleaning position, manual cleaning is initiated.

## LCD (Display)

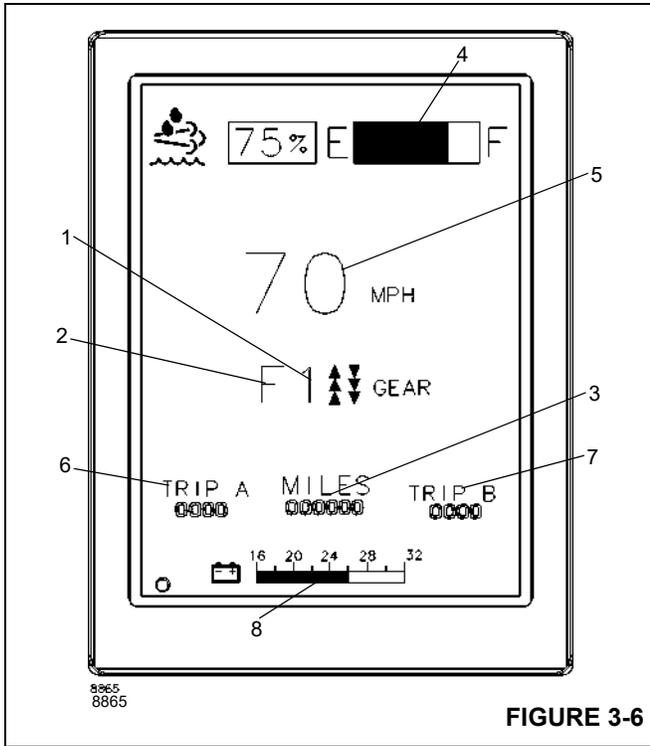
The LCD (Display) (35), (Figure 3-5) includes the following:

- Diesel Exhaust Fluid (DEF) percent/gauge
- Vehicle speed
- Transmission gear (automatic transmission only)
- Battery voltage level

- 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 SW Version. The software version will be displayed as four individual numbers.



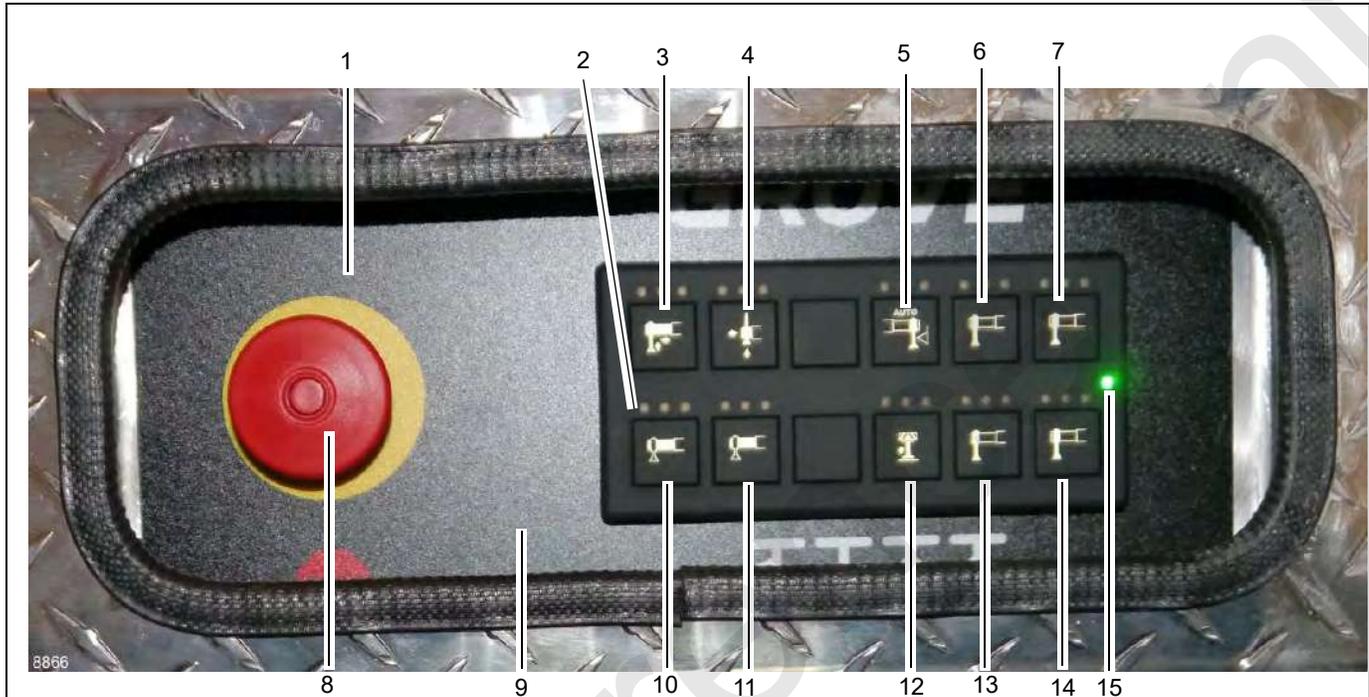
Item	Description
3	Odometer, Engine Hours, Reset Trip A, Reset Trip B, Units of Measure, Brightness of Display, Master Software Version
4	DEF Level/Gauge
5	Speedometer
6	Trip A Odometer
7	Trip B Odometer
8	Voltmeter

Item	Description
1	Transmission Gear (Auto Transmission Only)
2	Forward or Reverse, Transmission (Auto Transmission Only)

**CONTROLS AND FEATURES EXTERNAL TO THE CAB**

**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 in each paragraph represents the index number from the outrigger panel illustration (Figure 3-7).



Item	Description	Item	Description
1	Outrigger Control Panel	9	Bubble-Level Indicator (Not Shown)
2	Outrigger Operation Indicator Lights (Green, Yellow, Red)	10	Outrigger Front Beam Selector Push Button
3	Extend Push Button	11	Outrigger Rear Beam Selector Push Button
4	Retract Push Button	12	Center Front Stabilizer (CFS) Push Button
5	Auto-Level Push Button	13	Jack Selector Front Left Push Button
6	Jack Selector Front Right Push Button	14	Jack Selector Rear Left Push Button
7	Jack Selector Rear Right Push Button	15	Keypad Power Indicator Light
8	Emergency Stop Switch		

**FIGURE 3-7**

**Outrigger Control Panel**

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.

The Green LED (15), (Figure 3-7) illuminated is the keypad “Power” LED meaning that the keypad is properly powered (power and ground).

**NOTE:** The two carrier outrigger control panels **ONLY** operate when the carrier ignition is ON and the parking brake is set. The operator can only operate the outrigger beams on the side he/she is operating from. The jacks can be operated from either side.

Each control panel contains push buttons 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 push button for raising and lowering the center front stabilizer.

A push button emergency stop switch (8), (Figure 3-7) is installed on the panel.

A bubble level indicator (not shown) (9), (Figure 3-7) is installed at the bottom of the outrigger panel.

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

### **Outrigger Operation Indicator Lights**

Each button on the Outrigger Control Panel has three (3) LED lights (2), (Figure 3-7) above it: (one Green; one Yellow; and one Red).

- The Green LED will illuminate when the button is activated and the function is not blocked or no error for that function is active.
- The Yellow LED will illuminate if the button pushed is associated with an output and that output has an error that is active (STB = Short to Battery; STG = Short to Ground; and Over-current OR Open Load/Cable Break).
- The Red LED will illuminate if that button function is blocked or locked out. **NOTE:** There are many different combinations to this blocked or lock-out list.

### **Extend Push Button**

The Extend Push Button (3), (Figure 3-7) will operate both the outrigger beams or the jacks. While depressing the desired combination of selector buttons, pushing the Extend Push Button will move the selected component in the extend direction.

**NOTE:** More than one selector button may be operated concurrently, and the selector button must be depressed and held while the Extend Push Button is depressed.

### **Retract Push Button**

The Retract Push Button (4), (Figure 3-7) will operate both the outrigger beams or the jacks. While depressing the desired combination of selector push buttons, pushing the Retract Push Button will move the selected component in the retract direction.

**NOTE:** More than one selector button may be operated concurrently, and the selector button must be depressed and held while the Retract Push Button is depressed. The center front stabilizer will **NOT** automatically retract when any other main jack is retracted when Cribbing Mode is active.

### **Auto-Level Push Button**

The Auto-Level Push Button (5), (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 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 the ground. If any of the tires have made contact with the ground, consider adding cribbing under the outriggers, or leveling the crane manually.

Also refer to *Setting the Outriggers Using the Auto-Level Feature*, page 4-47.

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

### **Jack Selector Push Buttons (Front/Rear)**

The Jack Selector (Front/Rear) Left and Right Push Buttons (6, 7, 13, and 14), (Figure 3-7) selects which jack is to be operated.

### **Emergency Stop Switch**

The Emergency Stop Switch (8), (Figure 3-7) is located on the left center side of the 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.

### **Bubble-Level Indicator (Not Shown)**

The Bubble-Level Indicator (9), (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 4-40.

### **Outrigger Beam Selector Push Buttons (Front/Rear)**

The Outrigger Beam Selector Push Buttons (Front and Rear) (10 and 11), (Figure 3-7) are used to select the desired operation of the front or rear outrigger beams for the side of the unit the control panel is on.

### **Center Front Stabilizer (CFS) Push Button**



## **DANGER**

### **Tip Over Hazard**

When Cribbing Mode is **NOT** active, the Center Front Stabilizer will retract automatically when any main outrigger jack is retracted. Continued operation without resetting the center front stabilizer could result in loss of stability.

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

The Center Front Stabilizer Push Button (12), (Figure 3-7) is located in the center of the outrigger control panel. It must be used in conjunction with the Extend (3), (Figure 3-7) and Retract (4), (Figure 3-7) Push Buttons to control the operation of the Center Front Stabilizer. The Center Front Stabilizer will **NOT** retract automatically when in the Cribbing Mode. For additional information on Cribbing Mode, refer to *Activating Cribbing Mode*, page 4-43 and/or *Activating Cribbing Mode*, page 4-43.

If any of the other four jacks are retracted, it must be reset if lifting is to be continued. Refer to *Activating Cribbing Mode*, page 4-43; and *Activating from Outrigger Keypads*, page 4-43; and/or *Activating Cribbing Mode from Superstructure Cab ODM*, page 4-45.

### **Outrigger Keypad Power Indicator Light**

The Power Indicator (15), (Figure 3-7) illuminates green when power is available to the control panel.

## **Cribbing Mode**

Under normal outrigger operations, the Center Front Stabilizer (CFS), (12), (Figure 3-36) will automatically retract upon any of the outrigger jacks being retracted. Cribbing mode allows the CFS to remain extended while retracting the front outrigger jacks, allowing for additional cribbing. Refer to *Activating Cribbing Mode*, page 4-43 and *Activating from Outrigger Keypads*, page 4-43.

### **Two Methods for Activating Cribbing Mode**

There are two methods for activating the Cribbing Mode:

1. Using the Carrier Outrigger Keypad Center Front Stabilizer (CFS) Push Buttons.

**OR**

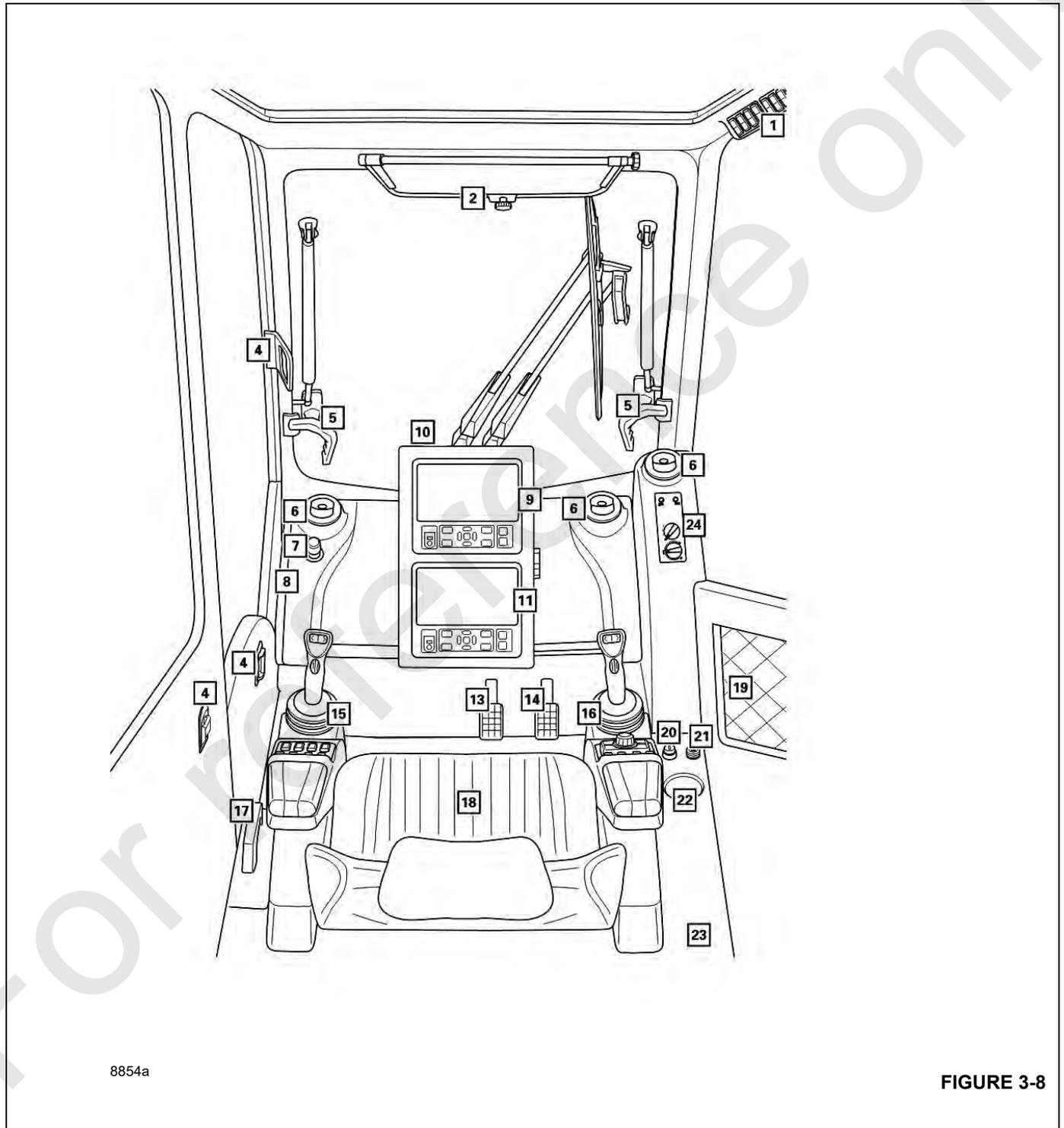
2. Navigating the Superstructure Cab ODM Outrigger Screen and selecting the Cribbing Mode Icon.

For additional information on the Cribbing Mode and the two Methods for Activating Cribbing Mode, refer to *Activating Cribbing Mode*, page 4-43.

**Superstructure Cab**

This section shows the position and designations of the controls and indicators that are used to operate and monitor crane functions found inside the Superstructure Cab. 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.



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**FIGURE 3-8**

**3**

Item	Description	Refer to	Item	Description	Refer to
1	Superstructure Right Side Overhead Control Panel	page 3-28	13	Swing Brake Pedal	page 3-24
2	Sun Visor	page 3-22	14	Throttle Pedal	page 3-24
3	Not Used		15	Left-Hand Armrest Controls	page 3-34
4	Superstructure Cab Door	page 3-22	16	Right-Hand Armrest Controls	page 3-38
5	Lock/Unlock Windows	page 3-23	17	Grab Handles	page 3-24
6	Air Vents	page 3-24	18	Superstructure Cab Seat with Seat Contact Switch	page 3-24
7	Emergency Stop Switch	page 3-14	19	Stowage Pouch	page 3-26
8	Windshield Washer Fluid Reservoir	page 3-4	20	Superstructure Ignition Switch	page 3-26
9	Rated Capacity Limiter Display Module (RDM)	page 3-24	21	24-Volt Outlet	page 3-27
10	Adjusting the RDM/ODM Panels	page 3-24	22	Ashtray	page 3-27
11	Operator Display Module (ODM)	page 3-24	23	Superstructure Cab, Rear View	page 3-32
12	Not Used		24	Air Conditioning System Controls	page 3-27

**SUPERSTRUCTURE RIGHT SIDE OVERHEAD CONTROL PANEL**

The Superstructure Right Side Overhead Control Panel (1), (Figure 3-8) is located at the top right side of the superstructure cab.

**Sun Visor**

The Sun Visor (2), (Figure 3-8) is located at the front of the cab toward the top of the windshield.

The sun visor can be folded down to reduce sunlight coming into the cab through the front windshield.

The sun visor can be rotated 90° to reduce sunlight coming into the cab through the door.

**Superstructure Cab Door Operation**

The superstructure cab door is located on the left side of the cab (4), (Figure 3-8).

**Superstructure Cab Door**

**From Outside**

**Unlock**

- Turn the key in direction A (Figure 3-9).

**Lock**

- Turn the key in direction B.

**Open/Close**

- Pull the handle (1).
- Slide the door until it latches in the open or closed position

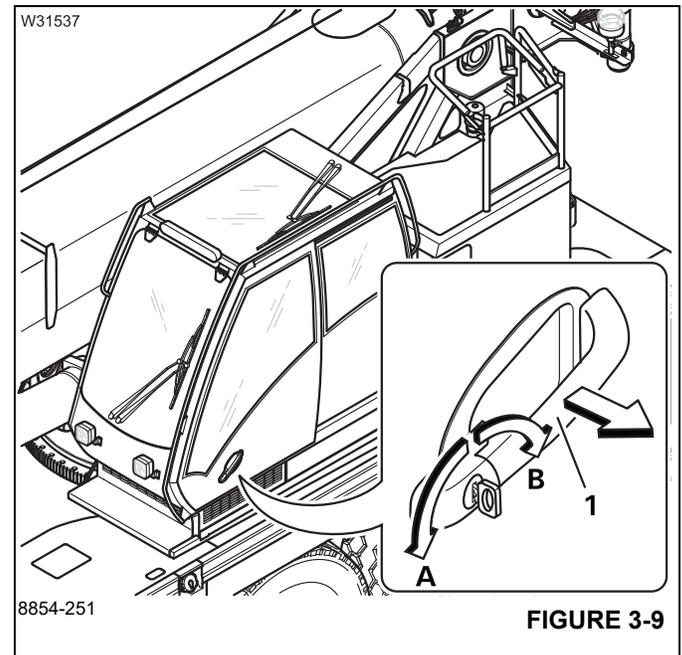


FIGURE 3-9

**Superstructure Cab Door Operation**

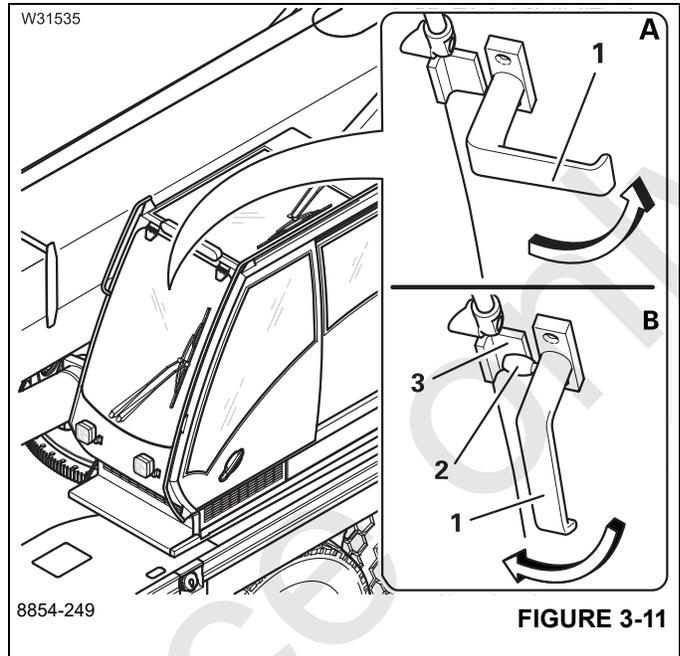
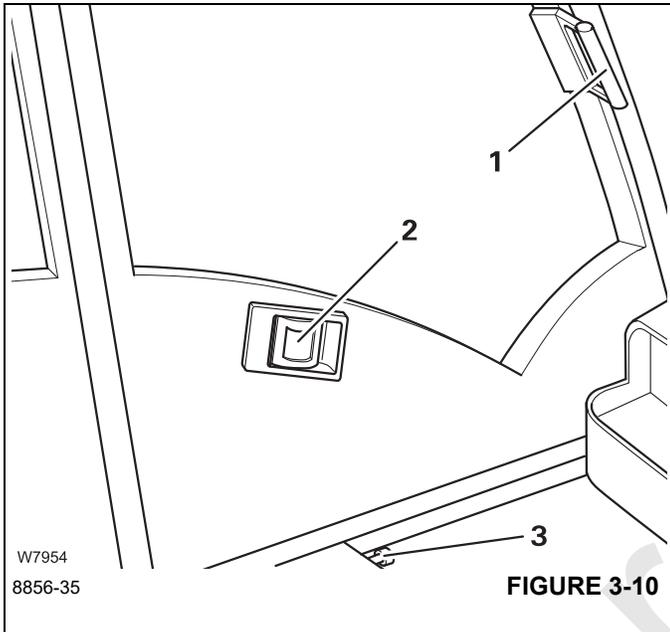
**Closing**

Pull unlocking lever (3), (Figure 3-10), push door forwards by handle (1) – until it latches.

Locking from inside not possible.

**Opening**

Pull unlocking lever (2), pull door back by handle (1) – until it latches.



**Rear Window**

**Opening**

- Raise the handle (1), (Figure 3-12).
- Push window outwards.

**Closing**

- Pull in window.
- Push down handle (1).

**Lock/Unlock Windows**

The handles on the windshield and the rear window have the same function.

**Front and Rear Windows**

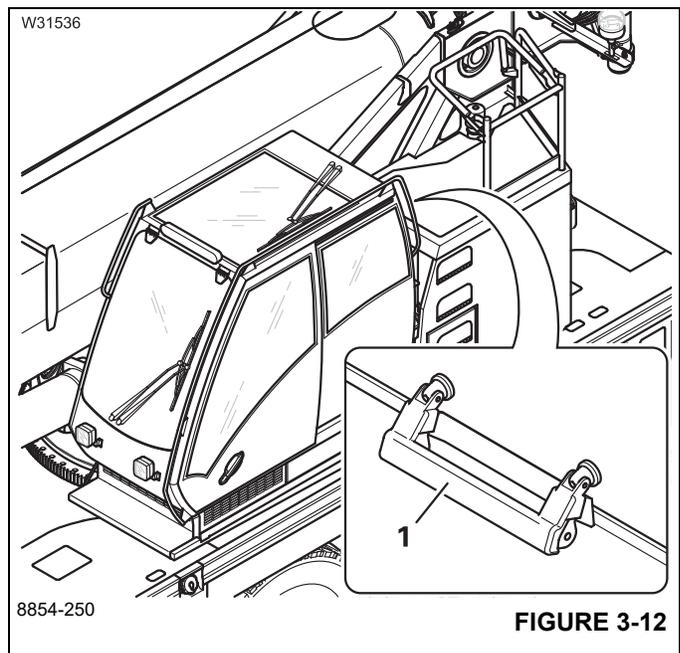
The handles on the windshield and the rear window have the same function.

**Open Window (A)**

- Turn both handles (1), (Figure 3-11) inward.
- Push the window forward.

**Close Window (B)**

- Pull the window closed.
- Turn both handles down – pegs (2) located behind the holder (3).



**Air Vents**

The air vents (6), (Figure 3-8), are located in the front right dashboard of the superstructure cab. Refer to *All Air Vents*, page 4-33.

**Emergency Stop Switch**

The Emergency Stop Switch (7), (Figure 3-8) is located in the Superstructure Cab on the left-hand side of the dash below the Air Vent. When the switch is pushed in a warning buzzer will sound.

**Rated Capacity Limiter Display Module (RDM)**

The Rated Capacity Limiter Display Module (RDM) (9), (Figure 3-8) allows the operator to easily program and monitor the RCL by entering a code number from the *Load Chart Manual* or by using the RCL setup screen.

Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-196 for more information regarding the use of the module in the operation of the crane.

**Adjusting the RDM/ODM Panels**

To adjust the RDM/ODM panels, refer to *Adjusting the RDM/ODM Panels*, page 4-38.

**Operator Display Module (ODM)**

The Operator Display Module (ODM) (11), (Figure 3-8) allows the operator to do the following actions:

- Monitor performance of crane systems
- Select the camera views displayed on the ODM
- Telescope the boom (semi-automatic and manual modes)
- Extend/retract the outriggers
- Operate the 360° superstructure lock mechanism
- Operate the boom extension stowage pins
- Set the working range limits (WRL)
- View engine, transmission, and crane fault codes
- View software versions and hours of operation for each crane function
- Set controller curves and maximum speeds, engage/disengage ECO mode, and inhibit operation of the engine cleaning system
- Set units of measure (metric/imperial), screen display brightness, and time (24 hour or AM/PM)

Refer to *Using the Operator Display Module (ODM)*, page 4-105 for more information regarding the use of the module in the operation of the crane.

**Swing Brake Pedal**

The Swing Brake Pedal (13), (Figure 3-8) is located on the left side of the cab floor.

Push Swing Brake Pedal to slow and stop the swing motion.

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

**Throttle Pedal**

The Throttle Pedal (14), (Figure 3-8) is located on the right side of the floor.

Push Throttle Pedal to increase engine speed.

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

**Left-Hand Armrest Controls**

The left-hand armrest controls (15), (Figure 3-8) are located on the left side seat armrest. Refer to *Left-Hand Armrest Controls*, page 3-24.

**Right-Hand Armrest Controls**

The right-hand armrest controls (16), (Figure 3-8) are located on the right side armrest. Refer to *Superstructure Right-Hand Armrest Controls*, page 3-38.

**Grab Handles**

Grab Handles (17), (Figure 3-8) are located around the entrance to the cab to help with entering and exiting the cab.

Always maintain a three-point contact with the crane when entering and exiting.

**Superstructure Cab Seat with Seat Contact Switch**

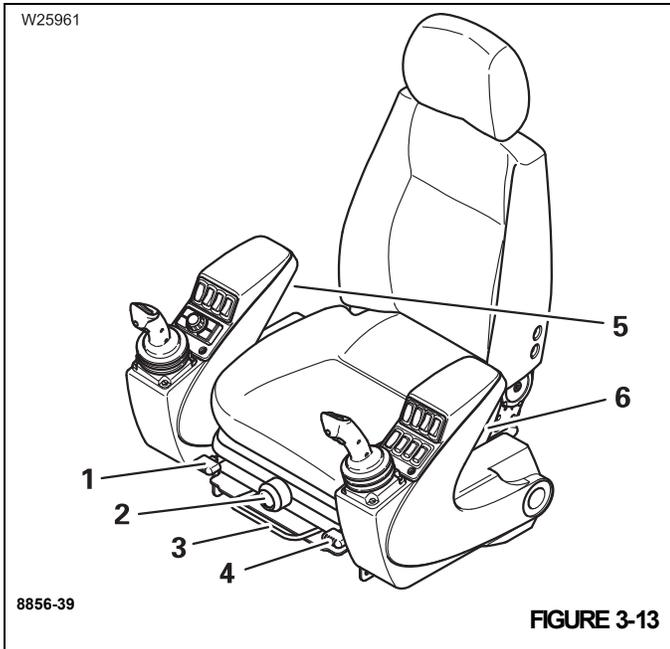
The superstructure cab seat with seat contact switch is very sensitive. The Seat Contact Switch (18), (Figure 3-8) is located within the seat. The operator must be sitting in the seat, enabling the switch, before any crane functions can be operated.

It is recommended that you also press the dead man's switch in order to avoid unintentional lockout.

**Adjusting the Superstructure Crane Seat and Front Control Panel**

You can adjust the crane cab seat to your preference. Refer to (Figure 3-13).

1. Adjust angle of seat back and lower seat cushion by pushing or pulling on control (1) in desired direction.
2. Adjust height of seat by pushing or pulling control (2) in desired direction.
3. Adjust the distance to the control panels by pulling up on control (3).
4. Adjust angle of seat back by pushing or pulling on control (4) control in desired direction.
5. Adjust angle of control panels by pushing button on rear (underneath) of the right hand armrest (5) and (6) to provide ease of entrance to the seat.



1	Seat-Tilt Adjustment Switch Without Control Panels
2	Seat-Height Adjustment Switch
3	Seat-Length Adjustment Switch With Control Panels
4	Back-Rest Adjustment Switch – Angle
5	Right Armrest Adjustment Switch
6	Left Armrest Adjustment Switch

**Seat-Tilt Adjustment Switch**

The Seat-Tilt Adjustment Switch (1), (Figure 3-13) is located on the right front lower side of the seat base. Adjust the switch to tilt the seat forward or backward.

**Seat-Height Adjustment Switch**

The Seat-Height Adjustment Switch (2), (Figure 3-13) is located in the middle lower side of the seat base. Turn the switch to adjust the seat height.

**Seat-Length Adjustment Switch**

The Seat-Length Adjustment Switch (3), (Figure 3-13) is located on the middle front seat base. Adjust the seat length by holding the switch and pulling forward in the seat or holding the switch and pushing backward in the seat.

**Back-Rest Adjustment Switch**

The Back-Rest Adjustment Switch (4), (Figure 3-13) is located on the left front lower side of the seat base. Push down on the switch to adjust the angle.

**Right Armrest Adjustment Switch**

The Right Armrest Adjustment Switch (5), (Figure 3-13), can be angled forward. Push the button located under the armrest and adjust the angle.

**Left Armrest Adjustment Switch**

The Left Armrest Adjustment Switch (6), (Figure 3-13), can be angled forward. Push the button located under the armrest and adjust the angle.

**Deadman Switches**

The Deadman Switches (1), (Figure 3-16) (Optional) are located on the front of both controllers. Either Deadman Switch can be used to keep the crane functions active when the operator stands up out of the seat (causing the seat switch to open and stop craning functions).

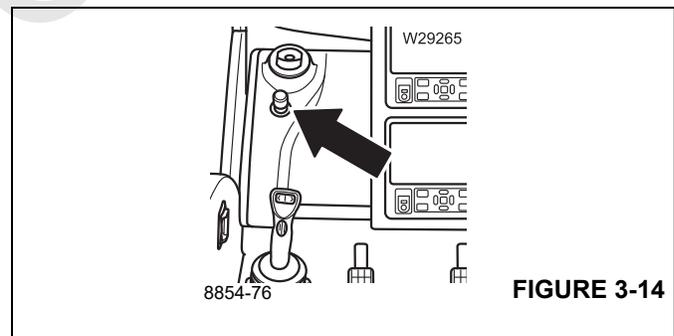
**NOTE:** The seat contact switch and the dead-man switch are for enabling crane functions.

**Emergency Stop Switch**

The emergency stop switch is provided as a means to shut off the engine and stop crane functions in the case of an emergency (Figure 3-14).

Press the switch until it latches (Figure 3-14), the engine will shut off and all crane functions will stop.

Turn the latched switch clockwise (Figure 3-14) to enable engine start and crane functions.



**To Switch Displays**

The symbol (3), (Figure 3-15) will appear at the bottom left hand corner of the active display, no symbol will be displayed on the inactive display. Use button (5), (Figure 3-15) of the jog dial or control panel to switch between screens.

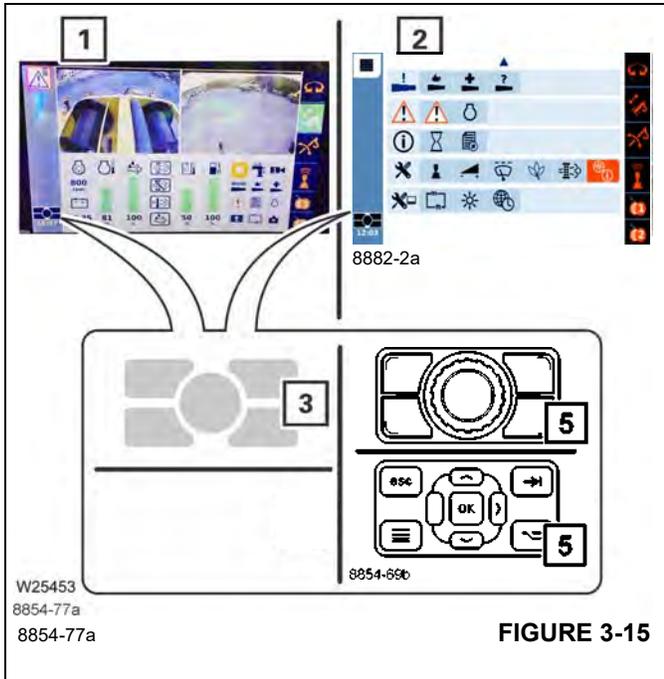


FIGURE 3-15

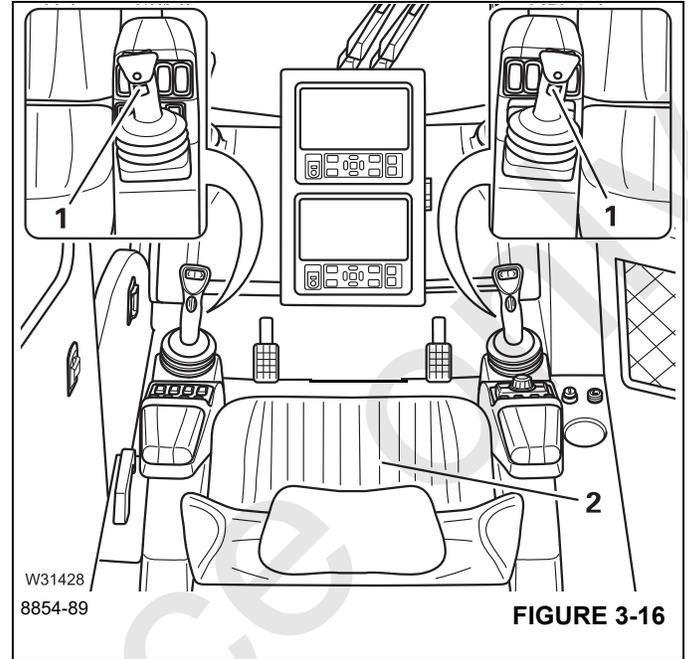


FIGURE 3-16

**Seat Switch**

The Seat Switch (18), (Figure 3-8) is located within the seat. The operator must be sitting in the seat, enabling the switch, before any crane functions can be operated.

**Enabling Crane Functions**

- Activate the rocker switch of the desired crane function(s).

**AND**

- Activate either dead-man switch (1), (Figure 3-16) or seat switch (2), (Figure 3-16).

**Disabling Crane Functions**

- Activate the rocker switch of the desired crane function(s) a second time.

**OR**

- De-activate seat switch and dead-man switches.

All operating elements for crane functions in the superstructure cab are locked.

Any crane movements are slowed down to standstill within 3 seconds and then locked.

**! DANGER**  
**Crush Hazard!**

Never operate the controls unless seated properly at the control station. Operation of the controls from outside the cab could result in being struck by the moving superstructure causing death or serious injury.

**Stowage Pouch (Document Holder)**

A stowage pouch (19), (Figure 3-8) or document holder is located to the right-hand side wall area.

**Superstructure Ignition Switch**

The Superstructure Ignition Switch (20), (Figure 3-8) is located on the right-hand side panel near the right-hand armrest.

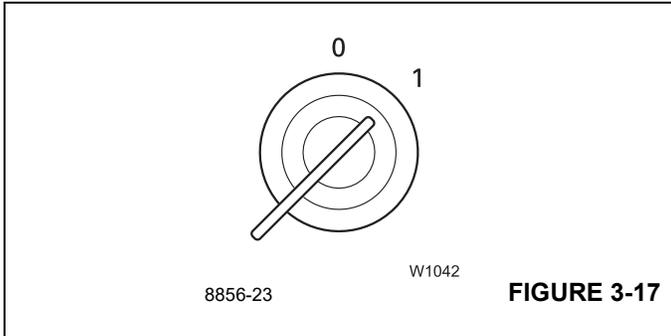
To start the engine from the superstructure cab:

1. Turn the ignition key to position 1 (ON), (Figure 3-17). Then,
2. Press and hold the top of the Engine Idle Increment/Decrement Switch (Figure 3-18).

To stop the engine from the superstructure cab:

1. Turn the ignition key to position 0 (OFF), **OR**
2. Press and hold the bottom of the Increment/Decrement Switch.

0	Ignition OFF, key off, key can be removed (Figure 3-17)
1	Ignition ON and power supply on for: instrument lighting, CCS, engine control system, RCL (Figure 3-17)



**FIGURE 3-17**

**NOTE:** The superstructure ignition switch does not depend on the carrier ignition key. It will turn the engine ON

or OFF with the carrier key in either position. Turning the carrier key from ON to OFF will stop the engine no matter what position the superstructure key is in.

**24-Volt Outlet**

The 24-Volt Outlet (21), (Figure 3-8) is located to the right of the Superstructure Ignition Switch.

**Ashtray**

An Ashtray (22), (Figure 3-8) is located directly behind the Ignition Switch and 24-Volt Outlet.

**Air Conditioning System Controls**

You can use the air-conditioning system controls (24), (Figure 3-8) to cool and dry the air in the superstructure cab when the engine is running. Also refer to *Air Conditioning System*, page 4-36.

### Superstructure Right Side Overhead Control Panel

The Superstructure Right Side Overhead Control Panel (Figure 3-18) is located inside the cab, top right-hand side above your head.

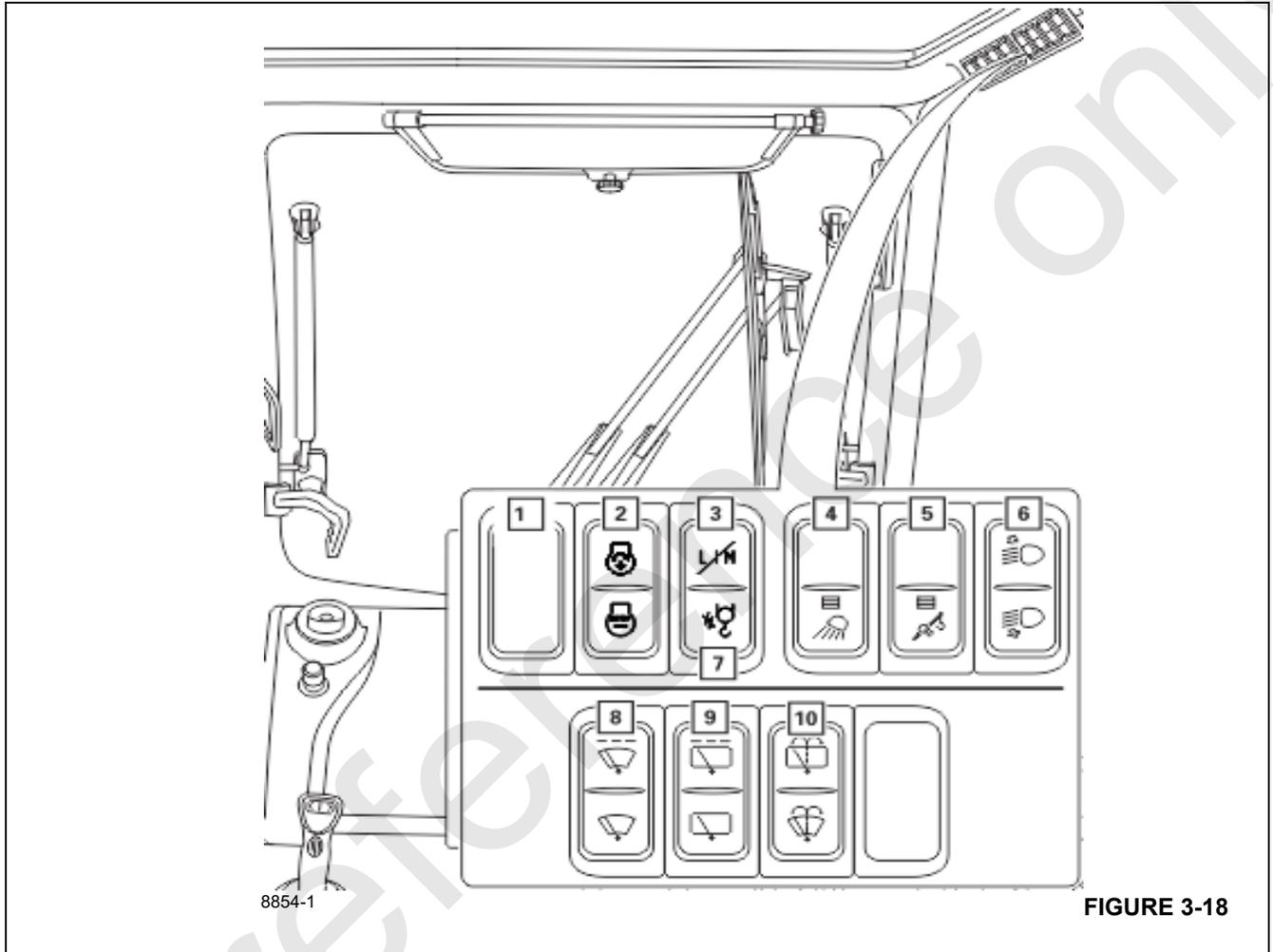


FIGURE 3-18

Item	Description	Refer to	Item	Description	Refer to
1	Not Used		7	Hoist Limits Override <sup>3)</sup>	page 3-55
2	Engine Idle Increment/Decrement Start/Stop Switch	page 3-29	8	Windshield Wiper ON/OFF	page 3-4
3	Limits Bypass/Override <sup>1)</sup>	page 3-29	9	Skylight Wiper ON/OFF	page 3-30
4	Superstructure Cab Work Lights	page 3-30	10	Windshield and Skylight Washer	page 3-31
5	Boom Lights	page 3-30	11	Heater Control Panel (located at the Rear of these switches)	page 3-10
6	Boom Light Rotation Control <sup>2)</sup>	page 3-30			

1) RCL lockout, WRL lockout, Carrier Avoidance, Counterweight too Low Lockout, Boom Extension Stowage

Lockout, Anti Two-Block Lockout, Minimum Wrap Lockout.

2) Optional equipment

3) Anti Two-Block Lockout, Minimum Wrap Lockout

### Increment/Decrement – Start/Stop Switch

The Increment/Decrement – Start/Stop Switch (2), (Figure 3-18) is located on the right overhead control panel.

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

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

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

With engine speed at low idle, push and hold bottom of switch until engine stops. To restart engine, push and hold top of switch until engine starts. Unlike the Ignition Switch, the Increment/Decrement – Start/Stop Switch can be used to stop the engine without disconnecting power to the electrical systems. Thus, using this switch to start and stop the engine during short breaks in craning operation saves time, as the ODM and RDM remain fully powered and programmed. The Increment/Decrement – Start/Stop Switch is also used to set the engine speed when using the Economy (ECO) Mode feature. Refer to *Economy (ECO) Mode*, page 4-189 for details of its operation.

### Limit Bypass Set-Up Switch



The Limit Bypass Switch prevents the function lockouts from activating.

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

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

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

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

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

The Limit Bypass Set-up Switch (3), (Figure 3-18) is a three-position, momentary type rocker switch located on the right overhead control panel.

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

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

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

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

- Anti-Two-Block Indicator is flashing
- 3rd Wrap Indicator is flashing

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

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

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

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

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

- Bypass 1 Pressed Indicator is on
- RCL Bypass Active Indicator is on
- RCL Shutdown Warning Indicator is flashing
- Working Range Limiter (WRL) Indicator is on
- Low Boom Angle Indicator is flashing

If RCL has not been programmed and the top of the limit bypass rocker switch is pushed and released, the swing left/right, boom up/down, hoist up/down, and telescope extend/retract functions operate at normal speeds when actuated.

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

- Bypass 1 Pressed Indicator is on

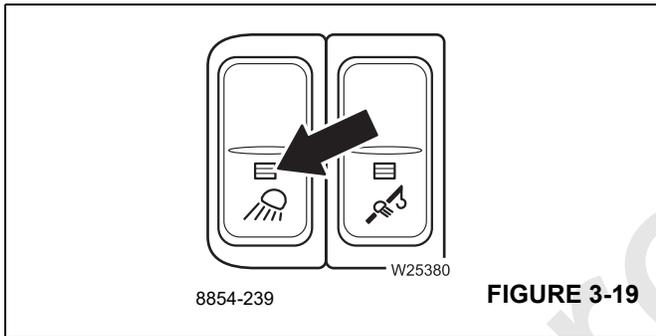
- RCL Bypass Active Indicator is on
- RCL Shutdown Warning Indicator is flashing
- Working Range Limiter (WRL) Indicator is on
- Low Boom Angle Indicator is flashing

All craning functions locked out are bypassed until one of the following occurs:

- Top of the Limit Bypass Switch is again pushed and released while the controllers are in the neutral position
- Controllers are in the neutral position for 10 seconds

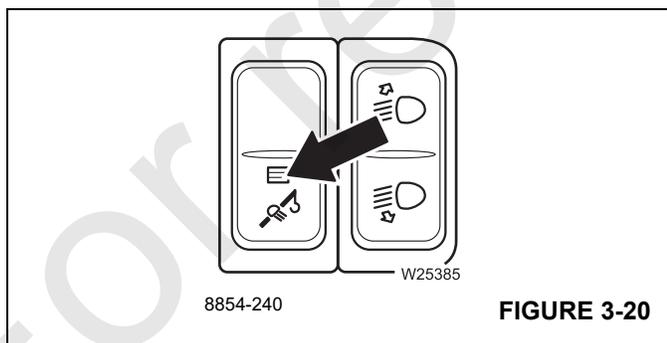
**Superstructure Cab Work Lights ON/OFF**

To Enable:	Push down – lamp in the button on (Figure 3-19)
To Disable:	Push up – lamp in the button off



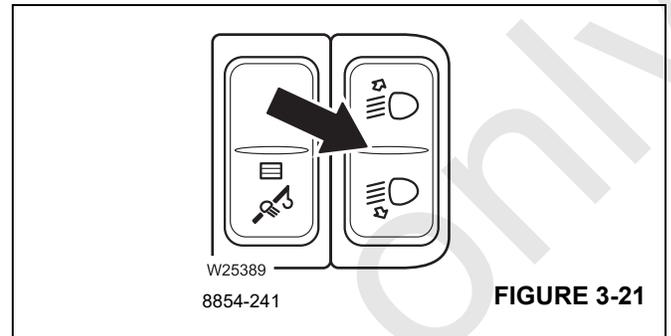
**Boom Lights**

To Enable	Push down – lamp in the button ON (Figure 3-20)
To Disable:	Push up – lamp in the button OFF



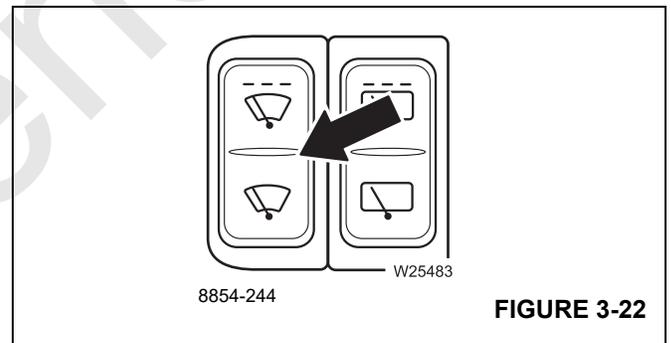
**Rotating Boom Lights Control**

Down:	Push down (Figure 3-21)
Up:	Push up



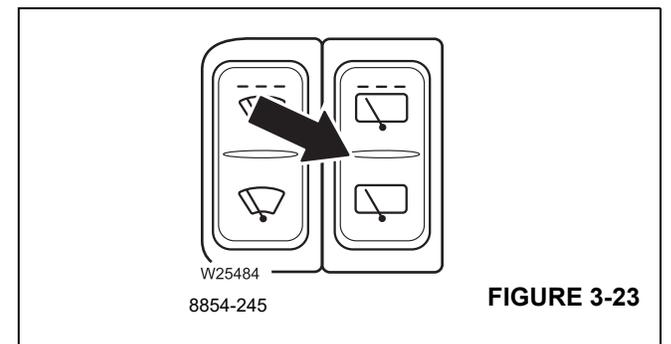
**Windshield Wiper ON/OFF**

OFF:	Middle position (Figure 3-22)
Intermittent:	Push up (speeds are adjusted in ODM)
Continuous operation:	Push down



**Skylight Wiper ON/OFF**

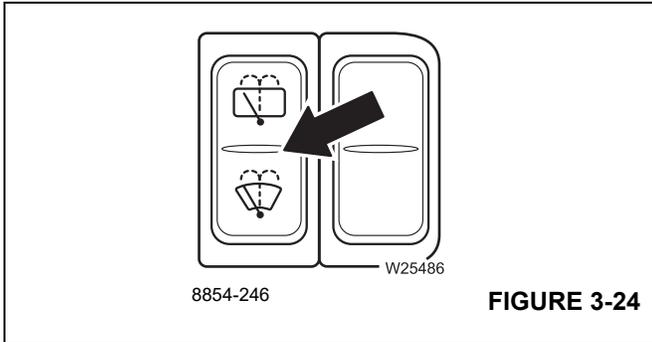
OFF:	Middle position (Figure 3-23)
Intermittent:	Push up (speeds are adjusted in ODM)
Continuous operation:	Push down



**Windshield/Skylight Washer System**

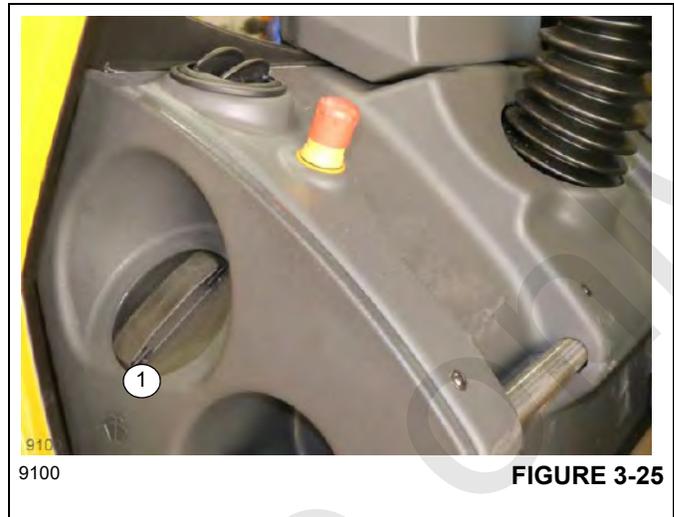
Windshield:	Push down (Figure 3-24)
Skylight:	Push up

Press the appropriate wiper on/off button to spray and remove washing fluid,



**Windshield Washing Fluid Tank**

The windshield washer fluid tank (1), (Figure 3-25) is located on the left side of the instrument panel. Remove the cap to fill the tank.



**RCL Bypass Switch**

The RCL Bypass Switch is located on the right front of the Superstructure cab. For additional information, refer to *RCL Override*, page 4-218.

SUPERSTRUCTURE CAB - REAR

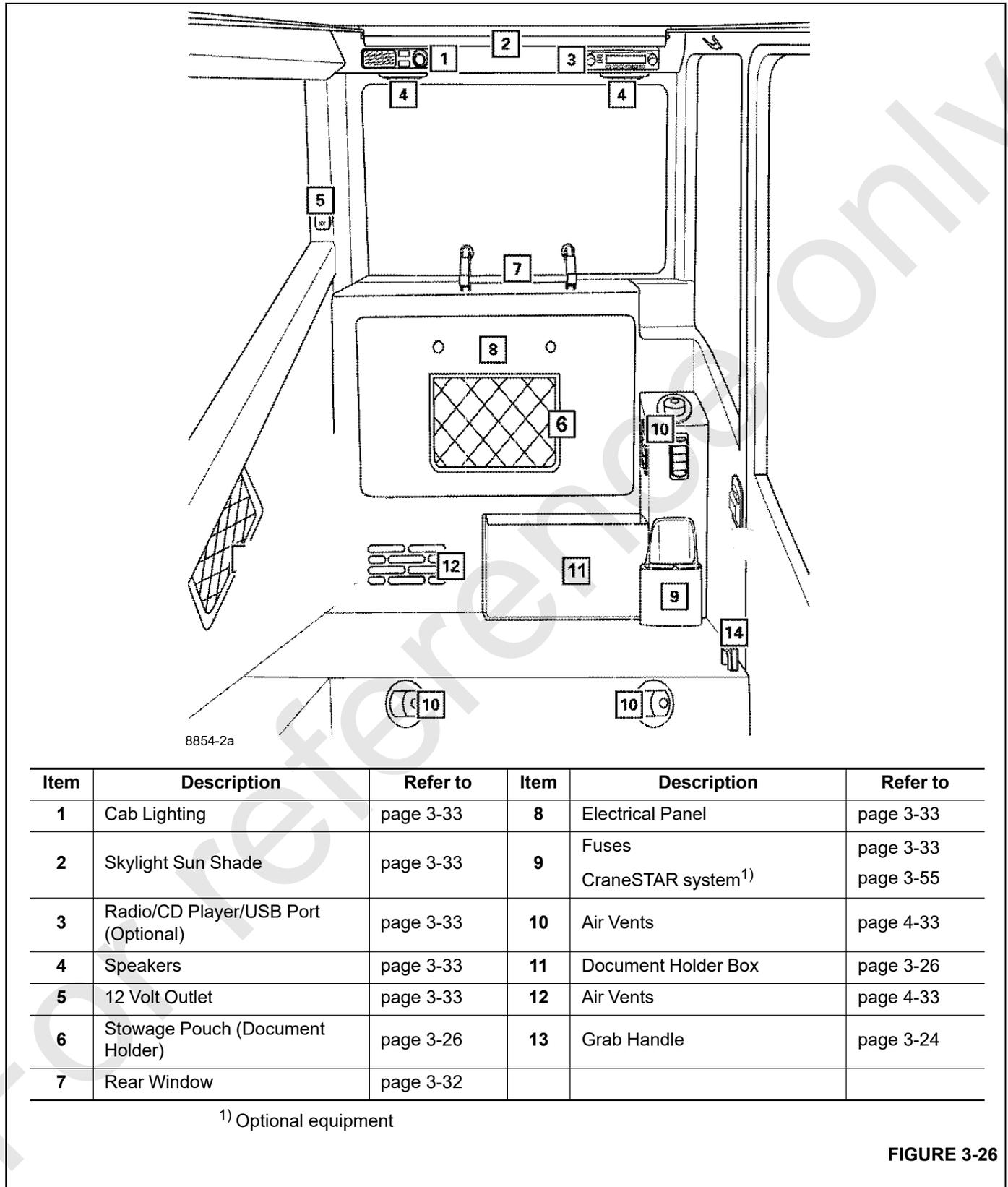
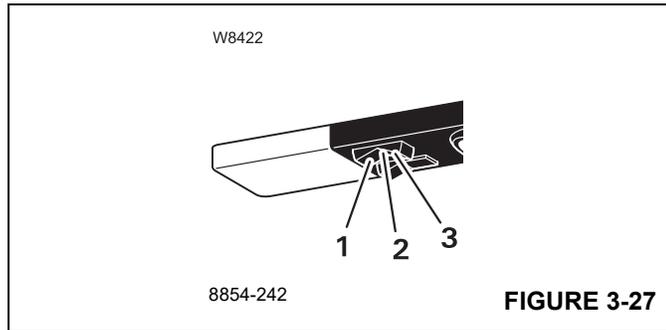


FIGURE 3-26

**Cab Lighting**

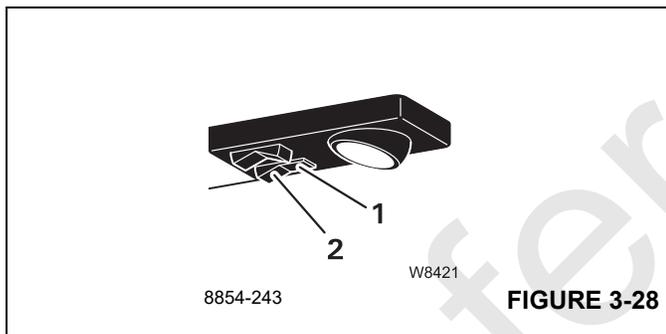
1	Always ON (Figure 3-27)
2	Always OFF
3	ON/OFF via door contact

Cab Lighting (1), (Figure 3-26) is located at the rear ceiling of the cab.



**Reading Lamp**

1	ON (Figure 3-28)
2	OFF



**Skylight Sun Shade**

The Skylight Sun Shade (2), (Figure 3-26) reduces direct sunlight coming into the cab.

**Radio, CD Player, USB Port (Optional)**

A Radio, CD Player and USB port (optional) (3), (Figure 3-26) is located behind the seat at the Rear Window

(7) and plays radio, audio compact discs and has a USB port.

**Speakers**

Speakers (4), (Figure 3-26) are located at the rear of the cab below the Radio, CD Player and USB port as well as the cab lighting (1), (Figure 3-26).

**12-Volt Outlet**

A 12-Volt Outlet (5), (Figure 3-26) is located to rear of the cab.

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

**Stowage Pouch**

A Stowage Pouch (6), (Figure 3-26) is located to the rear of the cab.

**Rear Window**

The Rear Window (7), (Figure 3-26) is located to the rear of the cab.

**Electrical Panel**

The Electrical Panel (8), (Figure 3-26) is located to the rear of the cab.

**Fuses (CraneSTAR System)**

Fuses (CraneSTAR System) (9), (Figure 3-26) are located below the right-side window of the cab.

**Air Vents**

The Air Vents (10) and (12), (Figure 3-26) are located to the front of the cab.

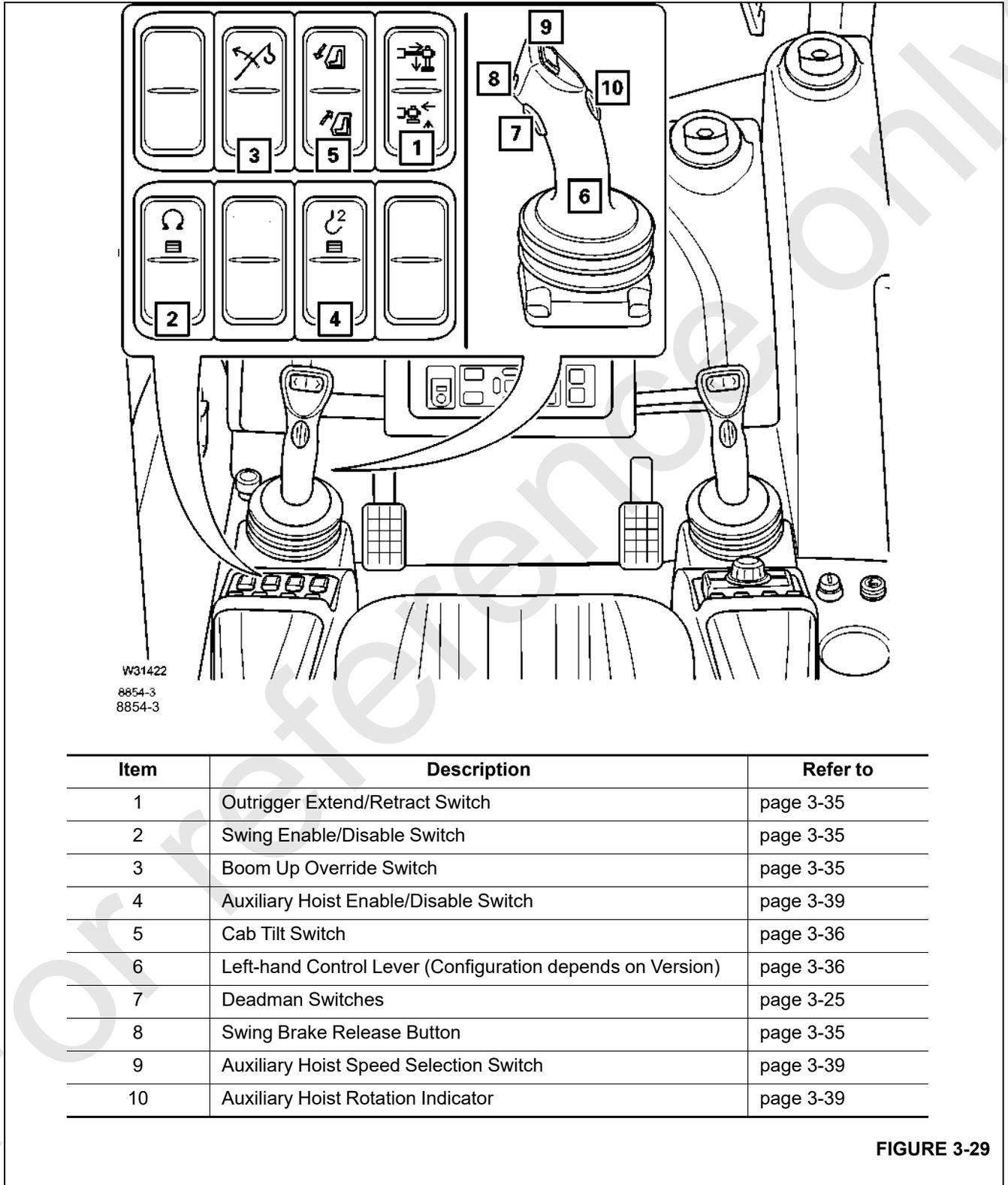
**Document Holder Box**

A Document Holder Box (11), (Figure 3-26) is located behind the seat toward the rear of the cab.

**Grab Handle**

The Grab Handle (13), (Figure 3-26) is located on the door.

**SUPERSTRUCTURE LEFT-HAND ARMREST CONTROLS**



Item	Description	Refer to
1	Outrigger Extend/Retract Switch	page 3-35
2	Swing Enable/Disable Switch	page 3-35
3	Boom Up Override Switch	page 3-35
4	Auxiliary Hoist Enable/Disable Switch	page 3-39
5	Cab Tilt Switch	page 3-36
6	Left-hand Control Lever (Configuration depends on Version)	page 3-36
7	Deadman Switches	page 3-25
8	Swing Brake Release Button	page 3-35
9	Auxiliary Hoist Speed Selection Switch	page 3-39
10	Auxiliary Hoist Rotation Indicator	page 3-39

FIGURE 3-29

### Outrigger Extend/Retract Switch

The Outrigger Extend/Retract Switch (1), (Figure 3-29) is a three-position momentary switch that is located on the left armrest.

Use Outrigger Extend/Retract Switch in combination with the buttons on the Jog Dial or Navigation Control Pad, and the Outrigger Extend/Retract Function Screen on the Operator Display Module (ODM) to extend and retract the outrigger beams and jacks.

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

1	Press button:	Extend pre-selection (Figure 3-30)
2	Press button:	Retract pre-selection

The movement stops after the button is released or when an end position is reached.

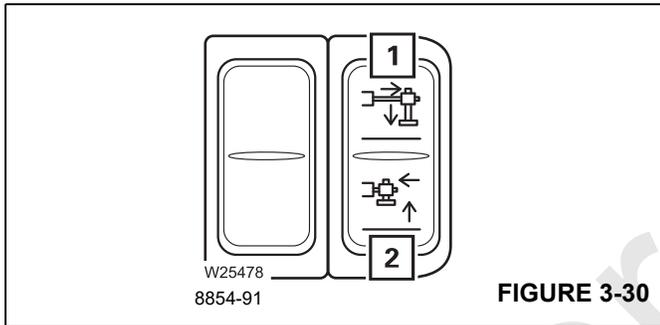


FIGURE 3-30

### Swing Enable/Disable Switch

The Swing Enable/Disable Switch (2), (Figure 3-29) is a momentary switch that is located on the left armrest.

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

The Swing Enable/Disable Indicator shows green in the Status Bar (*Status Bar*, page 4-123) of the Operator Display Module (ODM) when the swing function is enabled. The indicator goes off when the swing function is disabled.

Enabling one craning function (hoist, lift, telescope, or swing) using its related Enable/Disable Switch will cause the engine speed to increase to 950 rpm. Disabling all craning functions will cause the engine speed to decrease to 800 rpm. Also see (Figure 3-31).

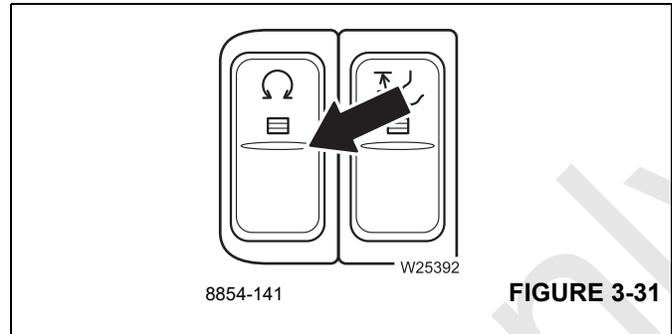


FIGURE 3-31

### Swing Brake Release Button

To Enable:	Press and hold the button on the joystick (Figure 3-32) to release the swing brake.
To Disable:	Release the button – to apply the swing brake.

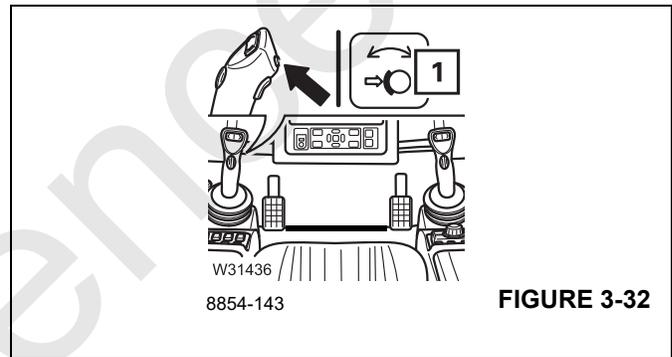


FIGURE 3-32

### Boom Up Override Switch

When overloaded, pressing and holding the switch allows the operator to boom up even though the RCL normally blocks that motion. This reduces the radius which usually increases the allowed load.

ON:	Lockout overridden (Figure 3-33)
OFF:	Lockout not overridden

The button is located on the left armrest control panel.

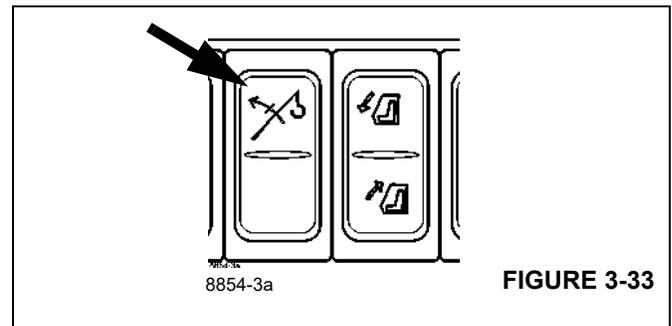


FIGURE 3-33

### Boom Up Bypass Switch

The Boom Up Bypass Switch is a two-position momentary rocker switch that is located on the Left-hand Armrest Controls.

While boom lift function is enabled and in an RCL lockout condition, push and release the Boom Up Bypass Switch to enable boom lift up.

The following indicators come on to indicate the limiter is bypassed:

- Bypass 2 Pressed Indicator is on constant (only when switch is pushed)
- RCL Bypass Active Indicator is on constant
- RCL Shutdown Warning Indicator is on constant when crane capacity is greater than 100%

For CE certified cranes only, the speed of the boom up function is reduced by 50% when actuated. For non-CE Certified cranes, the boom up function operates at normal speed when actuated.

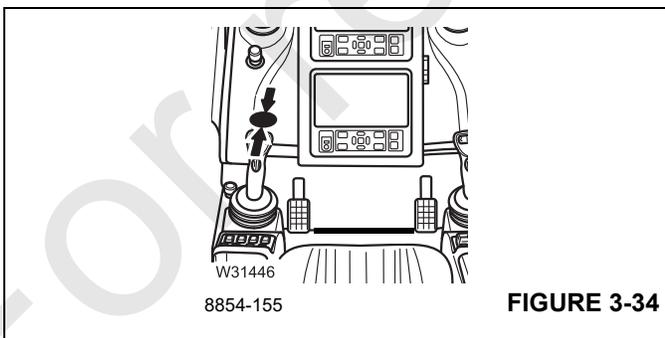
The boom up function lockout is bypassed until one of the following occurs:

- Boom Up Bypass Switch is again pushed and released while controllers are in neutral position
- Boom up controller is in neutral position for 10 seconds, and load is greater than 90% crane capacity and less than or equal to 100% crane capacity
- Load is reduced to less than 90% of crane capacity.

### Left Control Lever - Optional

Control lever configuration when the crane is not equipped with an auxiliary hoist.

Back	Retract (Figure 3-34)
Forward	Extend



The right control lever will be used for boom lift/lower and luffing boom extension raise and lower.

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

*Hoist Control (Main and Auxiliary)*, page 4-94.

The auxiliary hoist uses the same icons as the main hoist and the left control lever actuates the auxiliary hoist. Refer to *Main Hoist Controller*, page 3-39.

The Auxiliary Hoist Enable/Disable Switch (4), (Figure 3-29) is a two-position momentary switch located on the left armrest.

Push switch one time to enable the auxiliary hoist function. Push switch again to disable the auxiliary hoist function.

Quickly push the switch two times to enable the auxiliary hoist function at high speed. Pushing and holding the switch for approximately 2 seconds will also enable the auxiliary hoist function at high speed.

The Auxiliary Hoist Enable/Disable Indicator (10), (Figure 3-29) shows green in the Status Bar (*Status Bar*, page 4-123) of the Operator Display Module (ODM) when the auxiliary hoist function is enabled. The Indicator goes off when the auxiliary hoist function is disabled.

The Auxiliary Hoist High Speed Indicator in the Status Bar comes on when the high speed function is enabled.

Enabling one craning function (hoist, lift, telescope, or swing) using its related Enable/Disable Switch will cause the engine speed to increase to 950 rpm. Disabling all craning functions will cause the engine speed to decrease to 800 rpm.

### Cab Tilt Switch

The Cab Tilt Switch (5), (Figure 3-29) is located on the left armrest.

The switch is a three-position, momentary rocker switch that is used to tilt the cab up for easy viewing of an elevated boom and load.

Push and hold rear of switch to tilt the cab up (Figure 3-35). Push and hold front of switch to tilt the cab down (Figure 3-35). Release switch when cab is tilted to the desired position.

When cab is tilted up, the Cab Not Fully Lowered Alert in the *Alerts Area*, page 4-107 of the Operating Display Module (ODM) comes on (amber).

**NOTE:** Cab must be in the fully lowered position for the drive functions to be enabled.

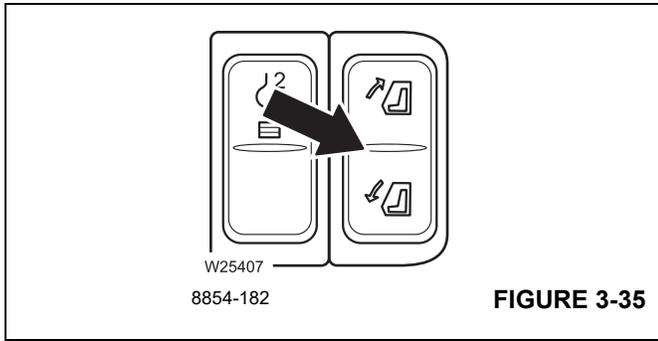


FIGURE 3-35

### Deadman Switches (Optional) (Dual Axis)

Deadman Switches (7), (Figure 3-29) (Optional) (Dual Axis) are located on the front of both controllers.

Either Deadman Switch can be used to keep the crane functions active when the operator stands up out of the seat

(causing the seat switch to open and stop craning functions). Refer to *Seat Switch*, page 3-26.

### Swing Brake Release Button

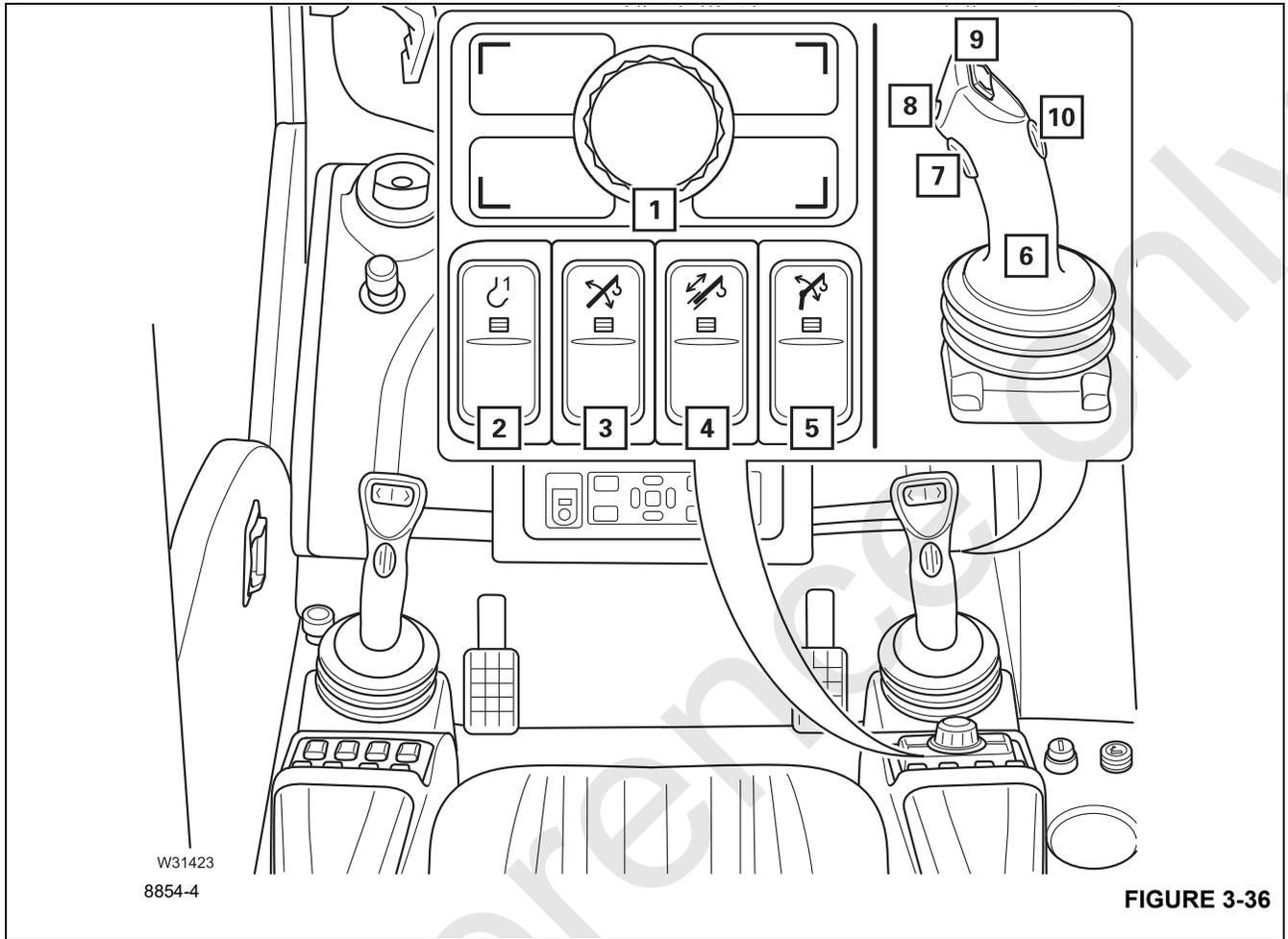
The Swing Brake Release Button (8), (Figure 3-29) is located on the upper front of the left controller.

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

Push and hold Swing Brake Release Button to release the swing brake. While swing brake is released, slowly reel in hoist until boom centers itself over the load. Release button to re-apply the swing brake.

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

Superstructure Right-Hand Armrest Controls



W31423  
8854-4

FIGURE 3-36

Item	Description	Refer to
1	Jog Dial	page 3-46
2	Main (Auxiliary) Hoist Enable/Disable Switch	page 3-36
3	Boom Lift/Lower Enable Switch	page 3-36
4	Telescoping Enable/Disable Switch	page 3-40
5	Hydraulic Offsetable Boom Extension Enable/Disable Switch <sup>1), 2)</sup>	

Item	Description	Refer to
6	Right-hand Control Lever (Configuration depends on Version)	page 3-39
7	Deadman Switch	page 3-25
8	Horn Button	page 3-4
9	Main Hoist High-Speed Mode ON/OFF	page 3-39
10	Main Hoist Rotation Indicator	page 3-39

1) Optional equipment

2) Setting an Angle between 0° and 45°

### Main Hoist Controller

The Main Hoist Controller (9), (Figure 3-36) is located on the right armrest.

Push controller forward to lower the hoist rope. Pull controller rearward to raise the hoist rope.

#### Right Control Lever

Back:	Main hoist raise (Figure 3-37)
Forward:	Main hoist lower

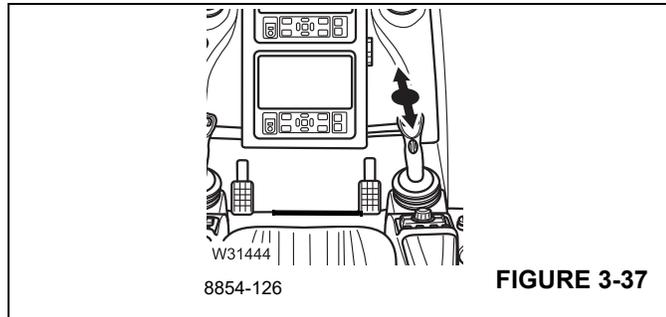


FIGURE 3-37

#### Hoist High-Speed Mode ON/OFF

Left:	High-speed mode on, off when released (Figure 3-38)
Once to the right:	High-speed mode on – continuous operation
Once to right or once to left:	High-speed mode off

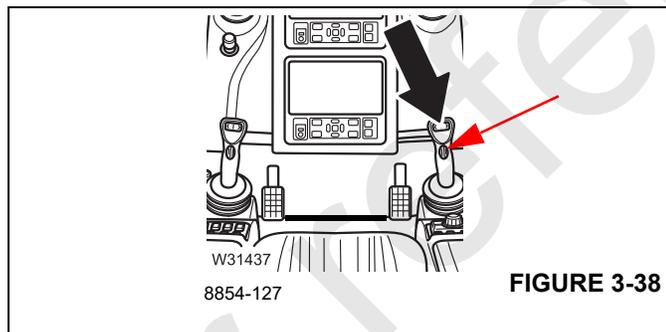


FIGURE 3-38

#### Hoist Speed Range Selection

For dual axis joysticks use the following:

- Press and hold the thumb toggle switch to the side towards the seat. High speed is ON when pressed, turns OFF when released.

- Press and release the thumb toggle switch away from the seat. High speed status is toggled each time it is pressed (on with 1st press, off with 2nd)
- Do a long press (about 2 seconds) when enabling hoist with the armrest switches. High speed will be enabled. Disabling hoist with the armrest switch disables high speed.
- Do a double press when enabling hoist with the armrest switches (within about 1 second). High speed will be enabled. Disabling hoist with the armrest switch disables high speed.

#### Hoist Rotation Indicator

The Hoist Rotation Indicators for the auxiliary and main hoist are located on the controller. The high speed switch is at the top of the controller (9), (Figure 3-36). The rotation indicators are on the back face of the controller as shown by the red arrow or vertical oval below the high speed switch (Figure 3-38). Each indicator is electronically driven by an input signal from a sensor attached to its related hoist and an output signal from a control module. The Hoist Rotation Indicator pulses on the auxiliary or main hoist controller when its related hoist is operating.

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

The Hoist Rotation Indicator also makes an audible click when it pulses.

The frequency of the pulses and clicks increases and decreases as the hoist speed increases and decreases.

#### Boom Lifting/Lowering Mechanism ON/OFF

Press once:	Boom Lifting/lowering mechanism ON (Figure 3-39), press the switch again to turn OFF.
-------------	---

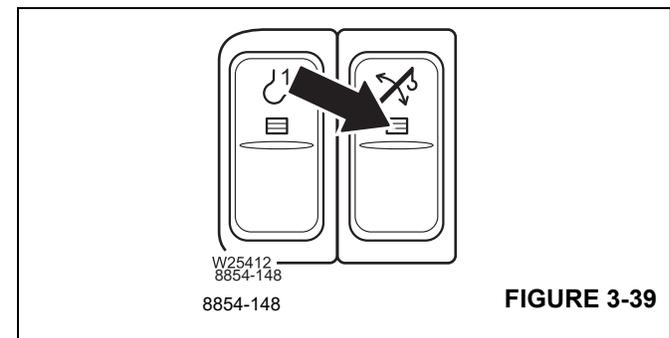
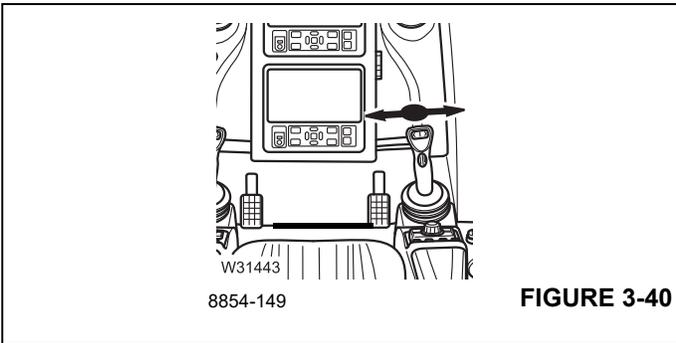


FIGURE 3-39

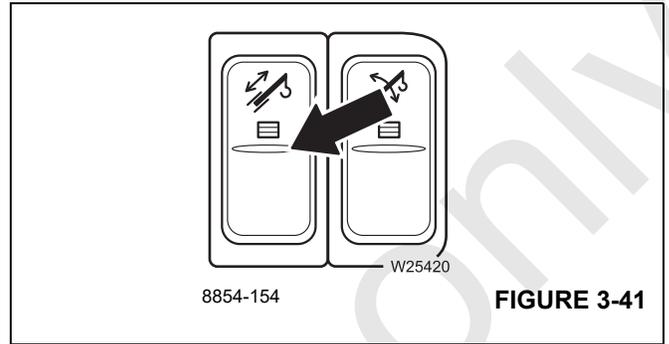
**Right Control Lever**

To the left:	Raise – lift main boom (Figure 3-40)
To the right:	Lower – lower main boom



**Telescoping Enable Switch**

The button (Figure 3-41) is used to enable the telescoping mechanism.



Superstructure Left/Right Control Levers

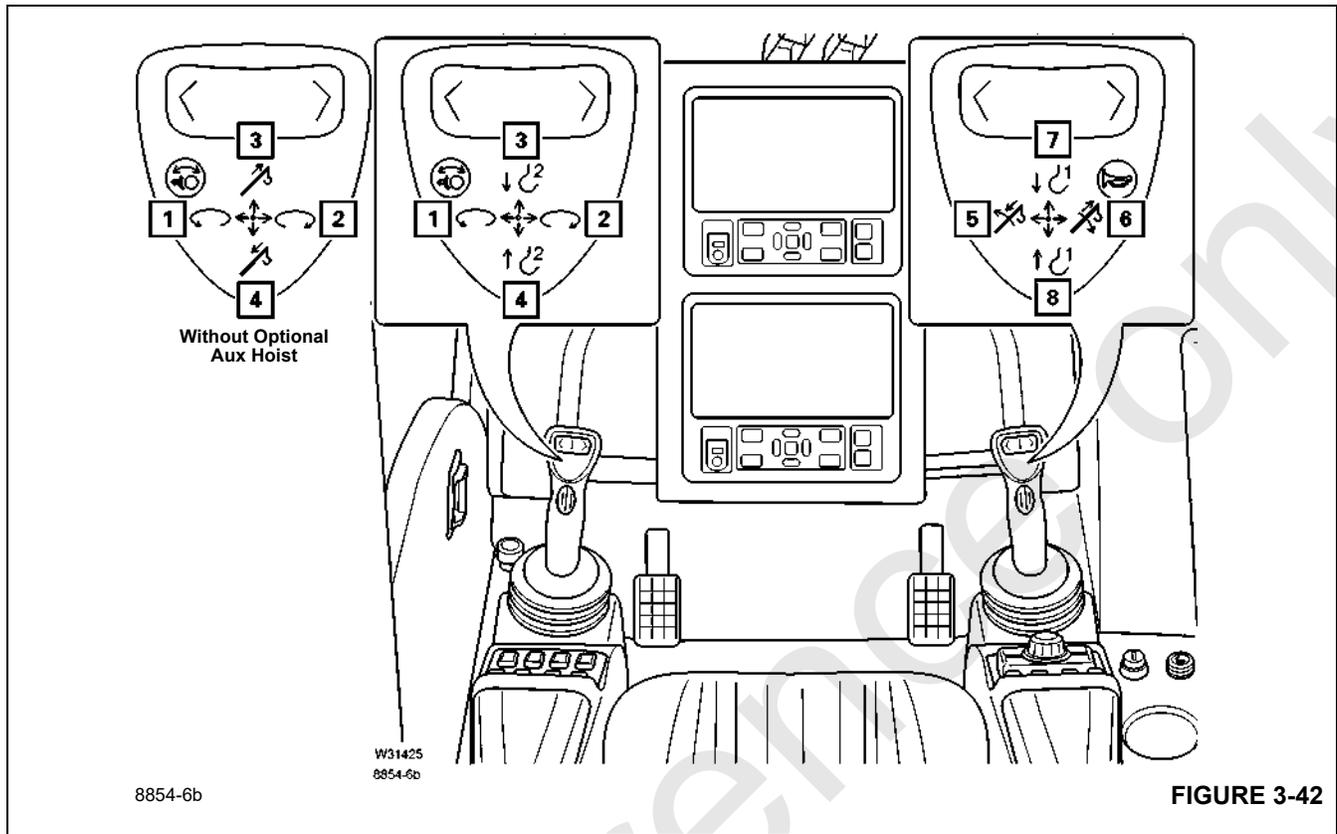
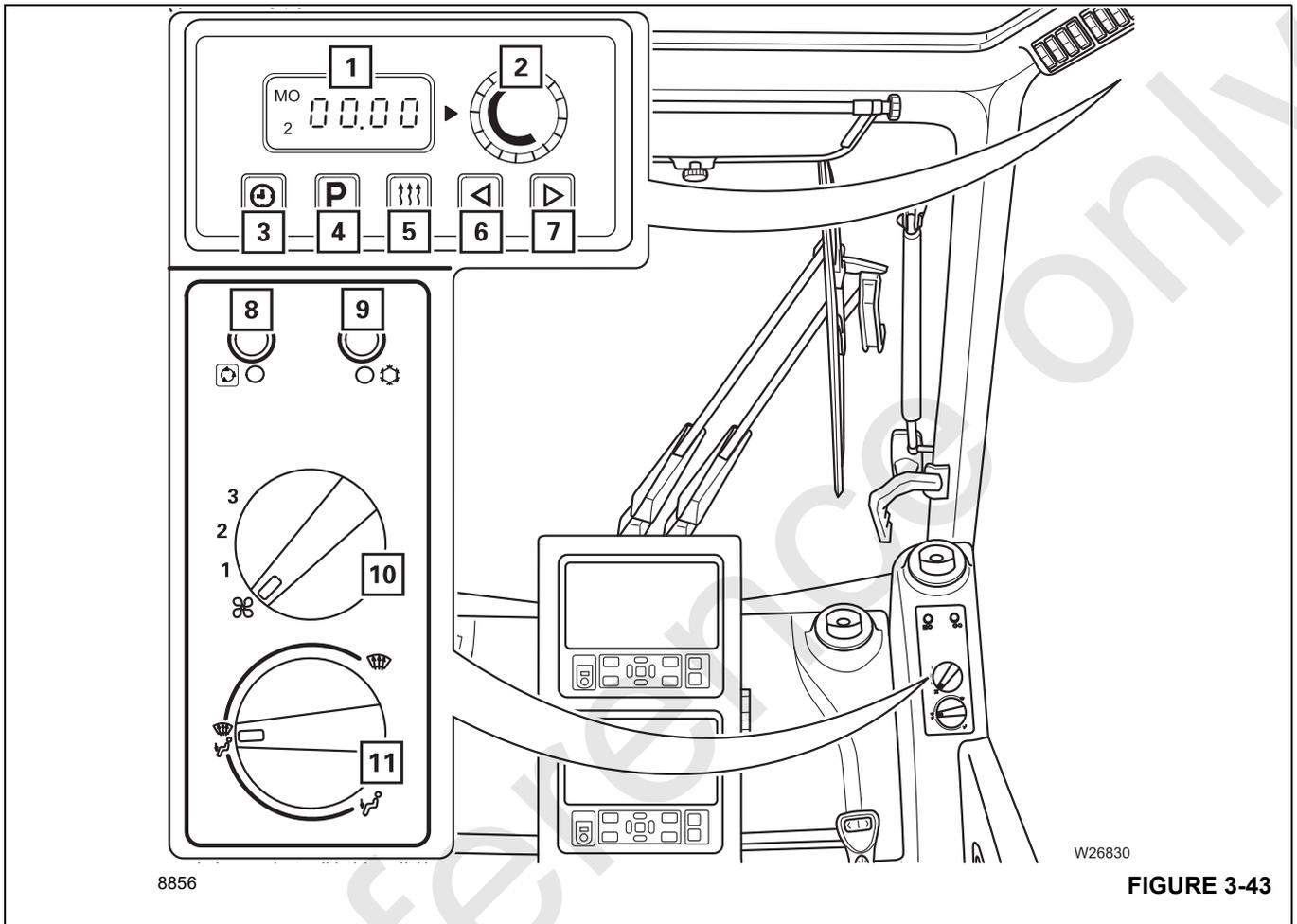


FIGURE 3-42

Left Control Lever		Right Control Lever	
1	Swing Left	5	Boom Raise (If Boom Function is Enabled) Telescope Retract (If Telescope is Enabled and Aux Hoist is Installed)
2	Swing Right	6	Boom Lower (If Boom Function is Enabled). Telescope Extend (If Telescope is Enabled and Aux Hoist is Installed)
3	Auxiliary Hoist Lower (if aux hoist is installed) <sup>1)</sup> or Telescope Extend	7	Main Hoist Lower
4	Auxiliary Hoist Raise (if aux hoist is installed) <sup>1)</sup> or Telescope Retract	8	Main Hoist Raise

<sup>1)</sup> Optional equipment

**SUPERSTRUCTURE HEATING AND AIR  
CONDITIONING SYSTEM**



8856

W26830

**FIGURE 3-43**

Item	Description
1	Heating System Display
2	Regulating Temperature Switch
3	Setting Time/Day
4	Retrieving Storage Locations
5	Heating System ON/OFF Switch
6	Input -
7	Input +
8	Fresh Air/Recirculated Air Switch
9	Air Conditioning ON/OFF
10	Fan Speed Control Switch
11	Air Distribution Switch

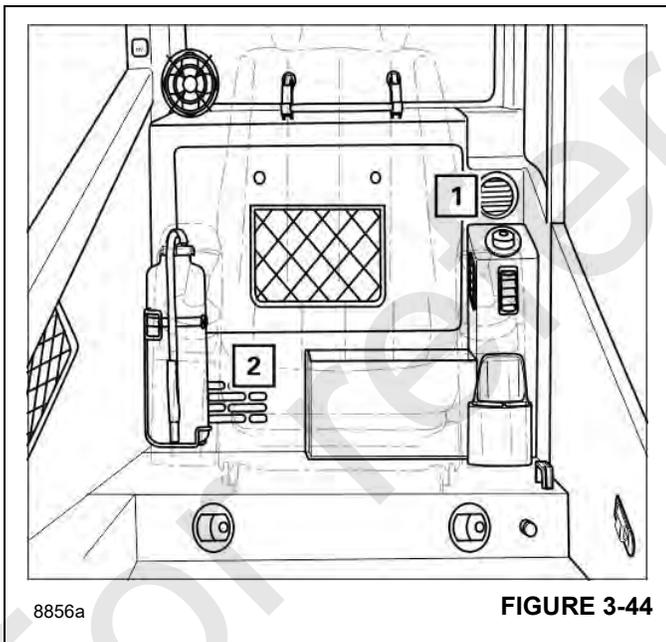
## Heating System Display

The Heating System Display (1), (Figure 3-43) features a control mode for delivering 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 grilles (1) and (2), (Figure 3-44) 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:** Check whether the auxiliary air heater is allowed to be operated at the current site of the truck crane before switching it on. Find out whether there are any possible sources of danger that could result in an explosion.



## Regulating Temperature Switch

The Regulating Temperature Switch (2), (Figure 3-43) regulates air flow into the cab. Turn the knob to desired air flow.

## Time/Day Setting

The Time/Day Setting Switch (3), (Figure 3-43) allows the operator to set the weekday and time.

## Retrieving Storage Locations

The Retrieving Storage Locations Switch (4), (Figure 3-43) allows the operator to program with the left input switch (6), (Figure 3-43) and right input switch (7), (Figure 3-43) the desired locations for air flow to be distributed.

## Heating System ON/OFF Switch

The Heating System ON/OFF Switch (5), (Figure 3-43) turns the heat on or off. There are three level settings (10), (Figure 3-43).

## Left Input Switch

The Left Input Switch (6), (Figure 3-43) allows the operator to input data as desired.

## Right Input Switch

The Right Input Switch (7), (Figure 3-43) allows the operator to input data as desired.

## Fresh Air/Recirculated Air Switch

The Fresh Air/Recirculated Air Switch (8), (Figure 3-43) allows for fresh air or recirculate air.

## Air Conditioning ON/OFF

The Air Conditioning ON/OFF Switch (9), (Figure 3-43) allows the operator to turn the air conditioning on or off. Then adjust the desired air level.

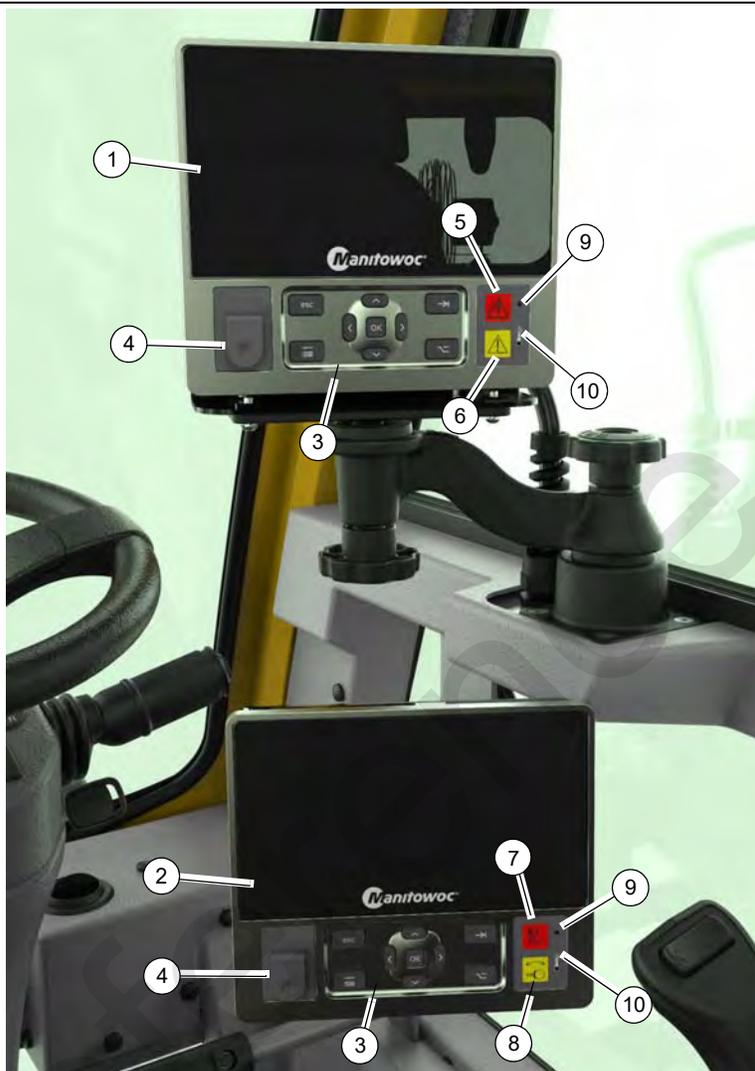
## Fan Speed Control Switch

The Fan Speed Control Switch (10), (Figure 3-43) allows the operator to choose the desired level of air flow from one to three. When heating is switched on, the fan runs at least at level 1, even if the switch is in off position.

## Air Distribution Switch

The Air Distribution Switch (11), (Figure 3-43) allows the operator to set the desired air distribution with the switch.

Rated Capacity Limiter Display Module (RDM) and Operator Display Module (ODM)



9838-10

Item	Description	Page	Item	Description	Page
1	Rated Capacity Limiter Display Module (RDM)	<a href="#">page 3-24</a>	6	RCL Early Warning Indicator	<a href="#">page 3-44</a>
2	Operator Display Module (ODM)	<a href="#">page 3-45</a>	7	Anti-Two-Block (A2B) Indicator	<a href="#">page 3-46</a>
3	Navigation Control Pad	<a href="#">page 3-45</a>	8	Swing Brake Engaged Indicator	<a href="#">page 3-46</a>
4	USB Diagnostic Connector <sup>1)</sup>	<a href="#">page 3-44</a>	9	Brightness Sensor	<a href="#">page 3-44</a>
5	RCL Shutdown Warning Indicator (Non-CE Certified Cranes)	<a href="#">page 3-44</a>	10	Internal Temperature Warning Indicator	<a href="#">page 3-44</a>
5	RCL Shutdown Warning Indicator (CE Certified Cranes)	<a href="#">page 3-44</a>			

<sup>1)</sup>For Service personnel only, not suitable for external devices, e.g. mobile phone.

FIGURE 3-45

### RATED CAPACITY LIMITER DISPLAY MODULE (RDM) AND OPERATOR DISPLAY MODULE (ODM)

The Rated Capacity Limiter Display Module (RDM) and Operator Display Module (ODM) (Figure 3-45) are located inside and to the center of the Superstructure Cab.

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

#### Rated Capacity Limiter Display Module (RDM)

The RDM (1), (Figure 3-45) allows the operator to easily program the Rated Capacity Limiter (RCL) by entering a code number from the load chart or by following the RCL setup wizard. Enter Rigging Code, page 4-198 and Operation of the Rated Capacity Limiter, page 4-195.

#### Operator Display Module (ODM)

The Operator Display Module (ODM) (2), (Figure 3-45) allows the operator to do the following actions:

- Monitor crane performance.
- Telescope the boom (semi-automatic and manual modes).
- Extend/retract the outriggers.
- Remove/install the counterweight.
- Operate the 360° superstructure lock mechanism
- Operate the boom extension stowage actuators
- 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 controller curves and maximum speeds, engage/disengage ECO Mode, and inhibit operation of the engine cleaning system.
- Set the screen display brightness, units of measure (metric/imperial), and controller settings, and turn the ECO Mode ON/OFF.

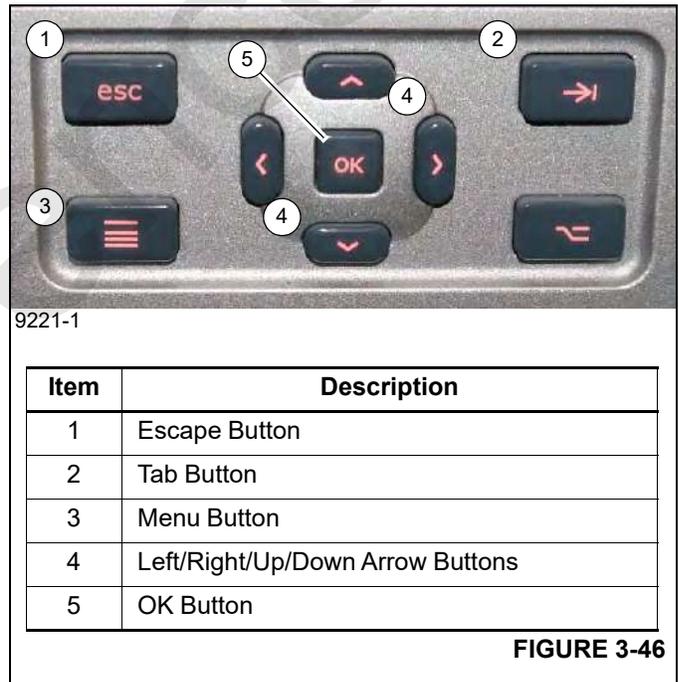
- View the engine/transmission fault codes, crane fault codes, software versions installed, and hours of operation for each function.

Refer to Using the *Using the Operator Display Module (ODM)*, page 4-105 for more information regarding the module's use in *Checks Before Operating the Crane*, page 4-217. Also refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-196.

#### Navigation Control Pad

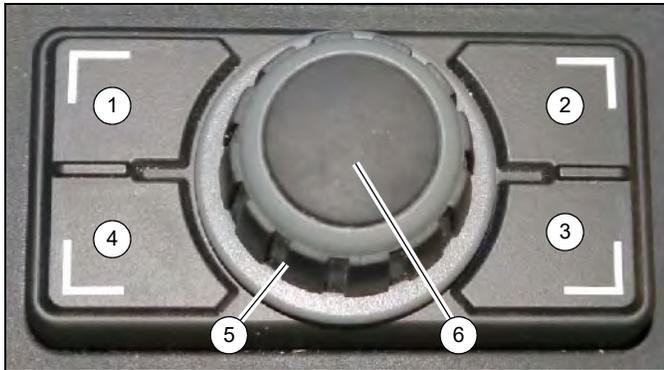
The Navigation Control Pads (3), (Figure 3-45) on the RDM and ODM (Figure 3-46) allow the operator to navigate through the function screens of the related module. The control buttons on the two Navigation Control Pads are identical in configuration and perform the same navigation functions.

The Tab Button (2), (Figure 3-46) on the Navigation Control Pad of the ODM and RDM can be pushed to temporarily silence active audible alarms.



The Jog Dial (Figure 3-47), mounted on the right armrest can be used to navigate the two modules in a similar manner as the Navigation Control Pads.





9221-2

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

FIGURE 3-47

Refer to *Navigating the Operator Display Module and Rated Capacity Limiter Display Module*, page 4-103 for information on how the Navigational Controls Pads and Jog Dial are used in the operation of the crane.

**USB Diagnostic Connector**

The RDM and ODM each have a USB Diagnostic Connector (4), (Figure 3-45) located to the left of each of its related display module screens.

The USB Connectors allow a service technician to connect to the display modules and update its software or download the data logger from the RDM/ODM, which records certain events that can occur when operating the crane.

**NOTE:** These USB Connectors are not powered and will not charge a phone or tablet.

**RCL Shutdown Warning Indicator (Non-CE Certified Cranes)**

The RCL Shutdown Warning Indicator (5), (Figure 3-45) is located immediately below and to the right of the RDM screen.

The RCL Shutdown Warning Indicator comes on (red) when the RCL senses a lift that is between 100% to 110% of crane capacity for the programmed configuration.

When the RCL senses a lift between 100% to 110% of crane capacity, the crane control system will lock out the boom up/

down, telescope extend, and hoist up crane functions, which would worsen the overload condition.

**RCL Shutdown Warning Indicator (CE Certified Cranes)**

The RCL Shutdown Warning Indicator (5), (Figure 3-45) is located immediately below and to the right of the RDM screen.

The RCL Shutdown Warning Indicator comes on (red) when the RCL senses a lift that is between 100% to 110% of crane capacity for the programmed configuration.

When the RCL senses a lift between 100% to 110% of crane capacity, the crane control system will lock out the boom up/down, telescope extend, and hoist up crane functions, which would worsen the overload condition.

**RCL Early Warning Indicator**

The RCL Early Warning Indicator (6), (Figure 3-45) is located immediately below and to the right of the RDM screen.

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

**Anti-Two-Block (A2B) Indicator**

The Anti-Two-Block Indicator (7), (Figure 3-45) is located immediately below and to the right of the ODM screen.

The A2B Indicator comes on (red) when a two-block condition occurs.

When a two-block condition occurs, the crane control system will lock out the hoist up, boom down, and telescope out crane functions, which would worsen the two-block condition if operated.

**Swing Brake Engaged Indicator**

The Swing Brake Engaged Indicator (8), (Figure 3-45) is located immediately below and to the right of the ODM screen.

The swing brake engaged indicator comes on (amber) when the swing brake is applied. The indicator goes off when the swing brake is released.

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

**Brightness Sensor**

A Brightness Sensor (9), (Figure 3-45) is located immediately below and to the right of the RDM screen and ODM screen.

The Brightness Sensor senses the amount of light in the operator cab. As the amount of light inside the cab changes, the RDM screen and the ODM screen will brighten and darken automatically, making the screens easier for the operator to see.

**Internal Temperature Warning Indicator**

An Internal Temperature Warning Indicator (10), (Figure 3-45) is located immediately below and to the right of the RDM screen and ODM screen.

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

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

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

**Crane Operation with RDM/ODM**



**WARNING**

**An Untrained Operator Subjects Him/Herself 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’s Manual and Load Chart are in the holder provided on crane.

**Definition of Direction 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 left 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 3-48), which means that:

1	Front	2	Right
3	Rear	4	Left

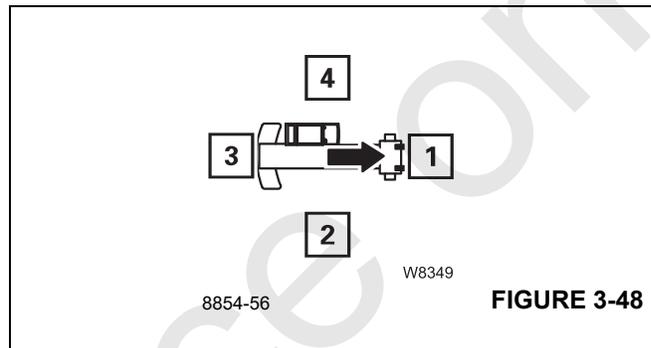


FIGURE 3-48

**General Rules for Buttons and Symbols on the Display**

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

Symbols can be shown in different colors (Figure 3-49). The color of the symbol indicates the current switching state of the relevant power unit:

1	Grey:	e.g. main hoist – Disabled
2	Green:	e.g. auxiliary hoist – Enabled

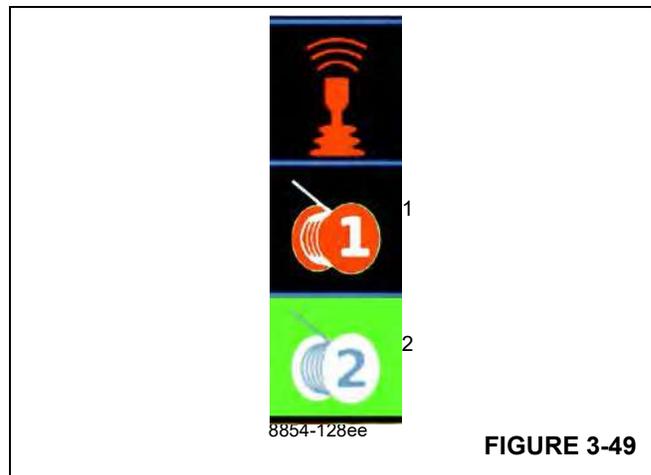


FIGURE 3-49

For the ODM crane function status column as shown, the possibilities are:

- Not enabled: Blue background, orange icon (this is at 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)

In these operating instructions, we always refer to colors in terms of “The symbol is red”, for instance.

Regardless of whether the background (1), (Figure 3-50) of a symbol is red or whether only parts (2), (Figure 3-50) of a symbol are red. This applies to all symbols and all colors.

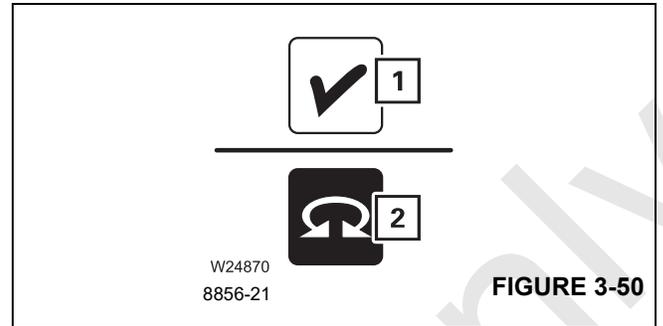


FIGURE 3-50

If the instruction given in this section is to “Press the button once...”, for instance, this always refers to the button (1), (Figure 3-51) also known as the Jog Dial or (2), (Figure 3-51). This is the case if a menu is opened or a function is to be carried out.

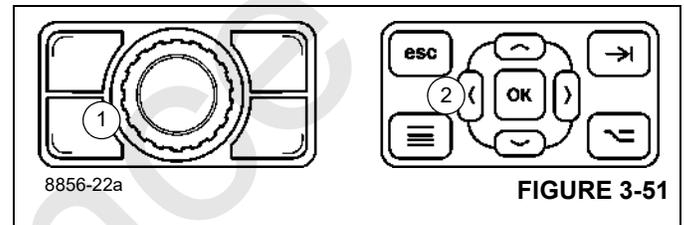


FIGURE 3-51

**Changing Menus**

Buttons (1), (Figure 3-51) and (2), (Figure 3-51) denote that the active menu can change displays by either using the Jog Dial (1), (Figure 3-51) or by using the lower left Button on EITHER display (Figure 3-51).

## REMOTE CONTROL UNIT

For operating information regarding the Remote Control Unit, refer to *Using the Remote Control Unit*, page 4-84.

### Overview



FIGURE 3-52

The Remote Control Unit (Figure 3-52) is a rechargeable, hand-held device.

**Use the Remote Control Unit only during crane set up.** The Remote Control Unit is not intended to operate the crane during normal crane operations.

The Remote Control Unit operates the following crane functions:

- Outrigger Beams
- Outrigger Jacks
- Hoist (Main)
- Hoist (Auxiliary)
- Boom Lift
- Swing
- 360° Swing Lock
- Horn
- Engine Start/Stop
- Engine Throttle Control
- Hydraulic Luffing Boom Extension (Optional)
- Boom Extension Stowage Actuators

- Counterweight Cylinders

When using the Remote Control Unit, all limiters and their crane function lockouts are inoperable, to include the following:

- RCL System (boom up/down, telescope extend, hoist up)
- Anti- Two-Block System (boom up/down, telescope extend, hoist up)
- 3rd Wrap Limiter System (hoist down)
- Working Range Limiter (WRL) System
- Carrier Avoidance System
- -29°C Temperature Limiter System (Optional)

The Remote Control Unit has the following operating conditions:

Working Range	Approximately 30 m (100 ft)
Operating Temperature	-20°C to 70°C (-7°F to 158°F)
Storage Temperature	-40°C to 75°C (-40°F to 167°F)
Rechargeable Battery Life	Approximately 10 hours

### Storage and Charging

The Remote Control Unit is powered by a 3.2 Ah lithium rechargeable battery pack, which provides approximately 10 hours of operation.

Two battery packs are provided – one battery pack is to be installed in the Remote Control Unit, while the other is to be kept in the charger.

For short-term storage, store the Remote Control Unit in the pocket on the inside of the carrier cab door (Figure 3-52). The battery charger is mounted on the cab wall behind the driver’s seat and is always on and will charge the battery pack whether the engine is operating or not.

The charger is equipped with the following indicator lights to show the battery pack state of charge:

Status	Description
Four red lights	Battery pack is charging
Three green lights	Battery pack is fully charged

Controls and Features



FIGURE 3-53

Item	Description	Page	Item	Description	Page
1	Programming Port	<a href="#">page 3-51</a>	11	Boom Lift Button	<a href="#">page 3-52</a>
2	Power Button	<a href="#">page 3-51</a>	12	Swing Button	<a href="#">page 3-52</a>
3	Color Display	<a href="#">page 3-51</a>	13	Option Button	<a href="#">page 3-52</a>
4	Left Side Motion Button	<a href="#">page 3-51</a>	14	Engine Button	<a href="#">page 3-52</a>
5	Right Side Motion Button	<a href="#">page 3-51</a>	15	Horn Button	<a href="#">page 3-52</a>
6	Enable Buttons (left and right)	<a href="#">page 3-51</a>	16	Information Button	<a href="#">page 3-52</a>
7	Emergency Stop (E-Stop) Button	<a href="#">page 3-51</a>	17	Escape Button	<a href="#">page 3-53</a>
8	Outrigger Beam Button	<a href="#">page 3-52</a>	18	Status Indicator	<a href="#">page 3-53</a>
9	Outrigger Jack Button	<a href="#">page 3-52</a>	19	Battery Pack (Not Shown)	<a href="#">page 3-53</a>
10	Hoist Button	<a href="#">page 3-52</a>			

### **Programming Port**

The Programming Port (1), (Figure 3-53) is for Grove factory authorized use only.

### **Power Button**

The Power Button (2), (Figure 3-53) is a push button switch that switches the Remote Control Unit on and off.

Push the button one time to cause remote to come on. Push the button again to cause remote to go off.

### **Color Display**

The Color Display (3), (Figure 3-53) shows the function screen for the selected crane function being operated.

Refer to *Display Components*, page 3-54 for an example of a function screen and its related indicators.

### **Left Side Motion Button**

The Left Motion Button (4), (Figure 3-53) is a proportional push button switch.

Push the button to cause the selected crane function to move in the direction indicated on the display screen.

The speed of the crane function operation is controlled by how far down the push button switch is pushed.

For the crane function to operate, the left or right side Enable Button (6), (Figure 3-53) must also be pushed at the same time that the Left Motion Button is pushed.

### **Right Side Motion Button**

The Right Motion Button (5), (Figure 3-53) is a proportional push button switch.

Push the button to cause the selected crane function to move in the direction indicated on the display screen.

The speed of the crane function operation is controlled by how far down the push button switch is pushed.

For the crane function to operate, the left or right side Enable Button (6), (Figure 3-53) must also be pushed at the same time that the Right Motion Button is pushed.

### **Enable Buttons**

The Enable Buttons (6,) (Figure 3-53) are two-position push button switches.

Either the left or right side Enable Button must be pushed at the same time that the Left or Right Motion Button is pushed for the selected crane function to operate in the desired direction.

### **Emergency Stop Button**

The Emergency Stop Button (7), (Figure 3-53) is located at the bottom of the Remote Control Unit.

Push the red button to stop engine and all crane functions.

When the Emergency Stop Button is pushed, the Emergency Stop Indicator (Figure 3-54) in the Remote Control Unit display comes on (red).

Pull out the red button to allow engine to be re-started and normal operation resumed.

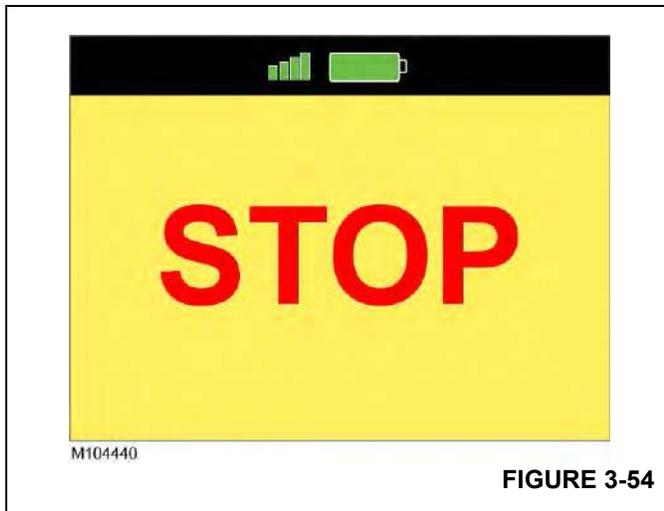


FIGURE 3-54

When the Remote Control Unit is enabled, the Emergency Stop Button in the cab and the optional Emergency Stop Buttons on the left and right sides of the carrier continue to operate normally.

#### **Outrigger Beam Button**

The Outrigger Beam Button (8), (Figure 3-53) is a momentary push button switch.

Push the button to cause the outrigger beam function screen to appear in the Remote Control Unit display.

From this function screen, the outrigger beams can be extended and retracted.

#### **Outrigger Jack Button**

The Outrigger Jack Button (9), (Figure 3-53) is a momentary push button switch.

Push the button to cause the outrigger jack function screen to appear in the Remote Control Unit display.

From this function screen, the outrigger jacks can be extended and retracted.

#### **Hoist Button**

The Hoist Button (10), (Figure 3-53) is a momentary push button switch.

Push the button to cause the hoist function screen to appear in the Remote Control Unit display.

From this function screen, the hoist rope can be reeled in or out on the main and auxiliary hoists.

#### **Boom Lift Button**

The Boom Lift Button (11), (Figure 3-53) is a momentary push button switch.

Push the button to cause the boom lift function screen to appear in the Remote Control Unit display.

From this function screen, the boom can be raised and lowered.

#### **Swing Button**

The Swing Button (12), (Figure 3-53) is a momentary push button switch. Push the button to cause the swing function screen to appear in the Remote Control Unit display.

From this function screen, the boom and superstructure can be swung left and right.

#### **Option (OPT) Button**

The Option (OPT) Button (13), (Figure 3-53) is a momentary push button switch.

Push the Option Button several times to cause the luffing boom extension offset, boom extension stowage, and counterweight load/unload function screens to cycle through the Remote Control Unit display.

From these function screens, the following functions can be performed:

- Set boom extension offset
- Deploy and stow boom extension
- Remove and install counterweight

#### **Engine Button**

The Engine Button (14), (Figure 3-53) is a momentary push button switch.

Push the button once to cause the engine start/stop function screen to appear in the Remote Control Unit display.

From this function screen, the engine can be started or stopped.

Quickly push the button two times to cause the engine throttle function screen to appear.

From the engine throttle function screen, the engine speed can be increased and decreased.

The throttle pedal and the Increment/Decrement – Start/Stop Switch in the cab will not operate when the Remote Control Unit is enabled.

#### **Horn Button**

The Horn Button (15), (Figure 3-53) is a momentary push button switch.

Push button to operate the horn.

The horn button in the cab will continue to operate when the Remote Control Unit is enabled.

#### **Information (INFO) Button**

The Information (INFO) Button (16), (Figure 3-53) is a momentary push button switch.

Push button to cause the information screen to appear in the Remote Control Unit display.

The information screen shows the Remote Control Unit software version and the crane serial number.

The serial number shown on the Remote Control Unit must match the serial number of the crane, as the two are paired with one another.

**Escape (ESC) Button**

The Escape (ESC) Button (17), (Figure 3-53) is a momentary push button switch.

Push the button to cause the crane function screen, that currently appears in the display, to change back to the main screen.

**Status Indicator LED**

The Status Indicator LED (18), (Figure 3-53) is a bi-colored LED that indicates the status of the Remote Control Unit.

The following statuses are possible:

Green (Slow flash)	Radio frequency communication is Okay
Red (Slow flash)	E-Stop Button is pushed in or wireless communication stopped
Red (Fast flash)	Battery pack has low charge
Red (Constant)	Remote controlling system error

**Battery Pack**

The Battery Pack (19), (Figure 3-53) is installed into the back of the Remote Control Unit.



**WARNING**

**Tipping/Overload Hazard!**

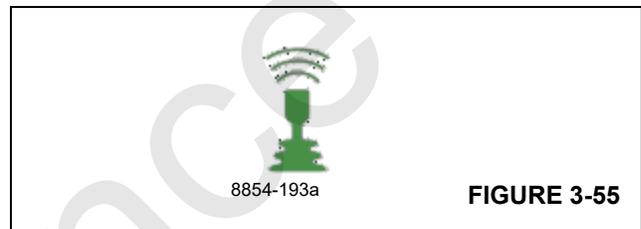
RCL lockouts and limiters are not functional when remote control is used.

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

Read the Operator Manual.

**Remote Control Icon**

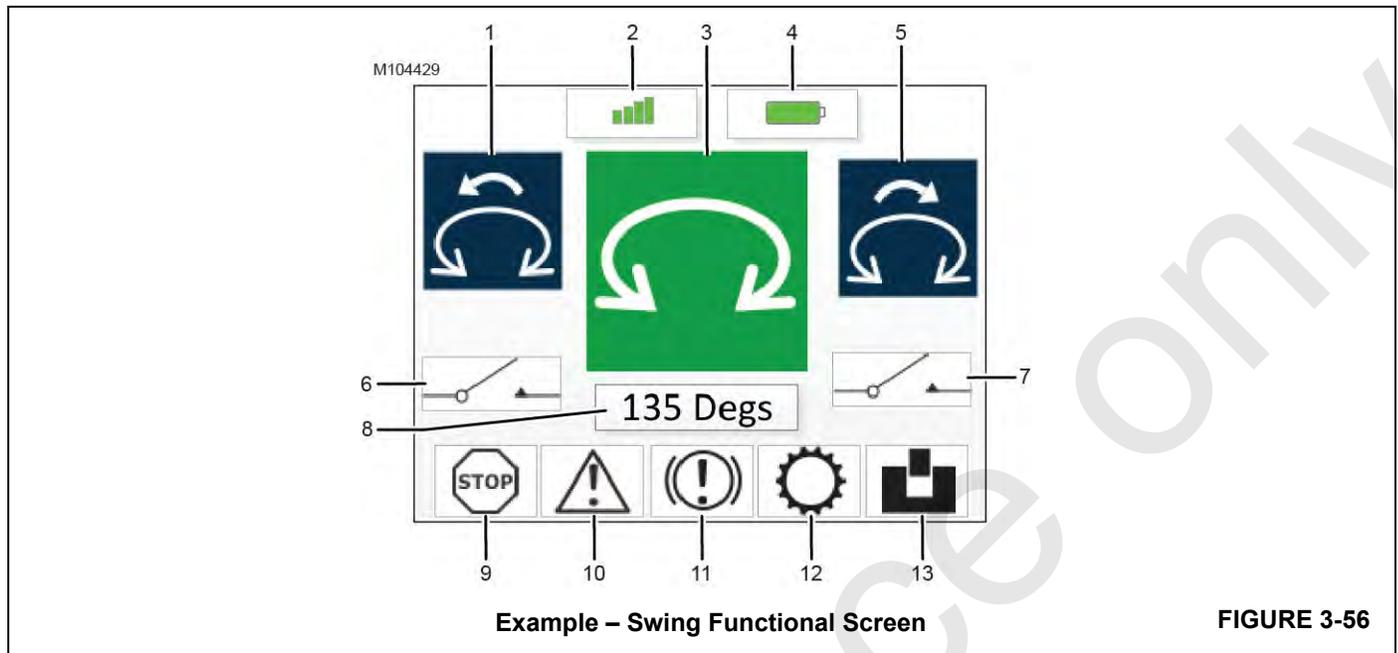
With remote control switched on, crane operation from the superstructure cab is blocked. Icon (Figure 3-55) is shown green on all menus.



**Table 3-10 Remote Control Operating Conditions**

<b>Working Range</b>	Approximately 30 m (100 ft) depending on obstructions and environment
<b>Battery Operating Time</b>	Approximately 10 hours
<b>Operating Temperature</b>	-20°C to 70°C (-4°F to 158°F)
<b>Storage Temperature</b>	-40°C to 75°C (-40°F to 167°F)

Display Components



Example – Swing Functional Screen

FIGURE 3-56

Table 3-11 Display Components

Item	Component (Figure 3-56)	Description
1	Left Motion Command Indicator	Depicts the operation that is controlled by the left motion command button
2	Transmission Strength Indicator	More bars = greater strength, and vice versa
3	Function Screen Indicator	Depicts the function that is being operated (swing in this example)
4	Battery Pack Power Indicator	Green = full charged Amber = discharging
5	Right Motion Command Indicator	Depicts the operation that is controlled by the right motion command button
6	Left Enable Indicator	White = enable button is not pushed (function cannot be operated)
7	Right Enable Indicator	Green = enable button is pushed (function can be operated)
8	DEG or RPM Indicator	When applicable, shows the position of the superstructure in degrees or the rotational speed of the selected motion.
9	E-Stop Indicator	White = E-Stop button pulled out (operation is allowed) Red = E-Stop button pushed in (operation is not allowed)
10	Crane Fault Indicator	White = no active crane fault exists (operation is allowed) Red = active crane fault exists (operation is not allowed)
11	Parking Brake Indicator	White = parking brake is applied (operation is allowed) Red = parking brake is released (operation is not allowed)
12	Transmission Indicator	White = transmission is in neutral (operation is allowed) Red = transmission is in gear (operation is not allowed)
13	360° Swing Lock Indicator (Optional)	White = swing lock is engaged Red = swing lock is not engaged

**Limits Override**

Switch (1), (Figure 3-57) for overriding the following lockouts:

- RCL Lockout
- WRL Lockout
- Carrier Avoidance Lockout
- Counterweight too low Lockout
- Boom Extension Stowage Lockout
- Anti Two-Block Lockout
- Minimum wrap Lockout

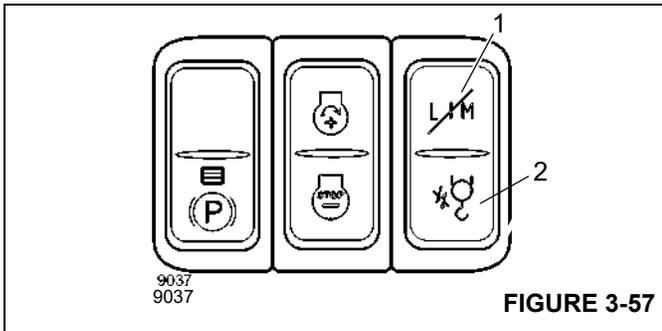


FIGURE 3-57

**Hoist Limits Override**

Switch (2), (Figure 3-57) for overriding the following lockouts:

- Anti Two-Block Lockout
- Minimum Wrap Lockout

**External Limit Bypass Switch**

There is a limits bypass key switch on the outside of the cab, under the right hand bottom corner of the front windshield. Turn the key to override the RCL lockout for 30 minutes.

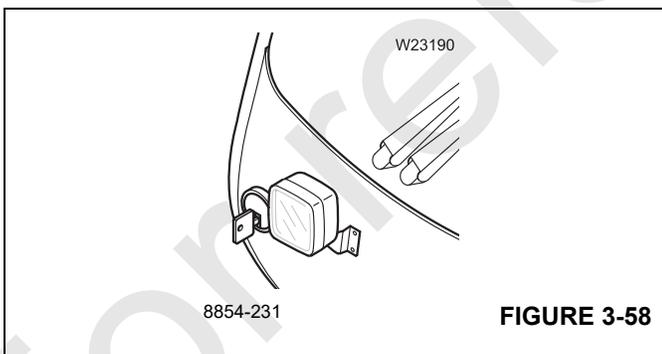


FIGURE 3-58

The Limit Override Switch (Figure 3-58) is a two-position, momentary type key switch. In an emergency situation only, turn switch clockwise and hold to override the different limiter systems on the crane. The override will last for 30 minutes or until the engine is stopped.

Turn key switch clockwise and hold to override the following limiter systems and their craning function lockouts:

- Anti Two-Block System (boom up/down, telescope extend, hoist up).
- Minimum wrap limiter system (hoist down).
- RCL system (boom up/down, telescope extend, hoist up).
- Working range limiter (WRL) system.
- Carrier avoidance system.

**External Displays**

**Status Display**

To inform people in the danger area of the truck crane.

1	Loudspeaker (warning signal) (Figure 3-59)
2	Lamp, green
3	Lamp, yellow
4	Lamp, red

The displays light up or flash depending on

- the current degree of utilization,
- RCL lockout/early warning,
- RCL override.

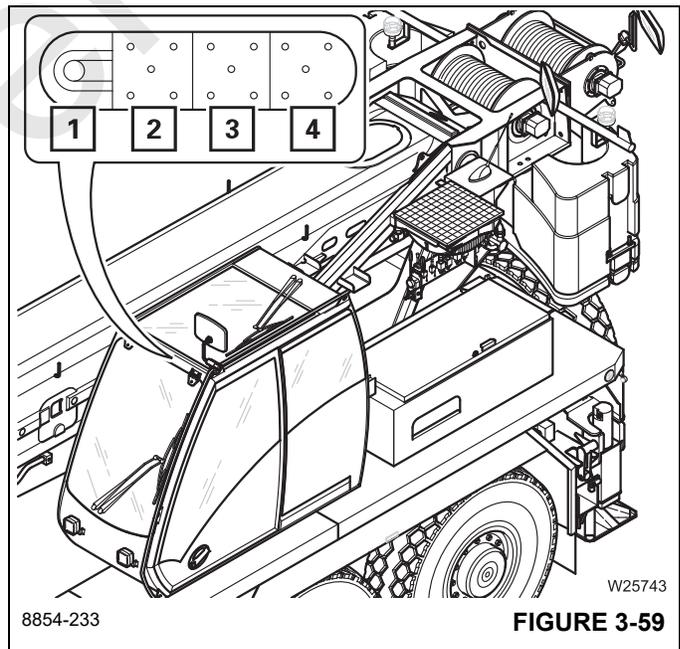


FIGURE 3-59

**CRANESTAR® SYSTEM (OPTIONAL)**

**Overview**

Your truck crane maybe equipped with the optional CraneSTAR system.

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For reference only

## SECTION 4 OPERATING PROCEDURES

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## BREAKING-IN A NEW CRANE

Your new Grove crane has been thoroughly tested, adjusted, lubricated, and inspected prior to delivery. For detailed engine conditioning, refer to the applicable engine manual.

Some important rules to follow to establish conditions for long service life are listed below.

- Operate as much as possible in half to three-quarters throttle or load range.
- Avoid long periods of operation at engine idle speeds or at continuous maximum horsepower levels.
- Observe instruments often and shut down at the first indication of an abnormal reading.
- Operate to a power requirement that allows acceleration to governed speed when conditions require more power.
- Check all components frequently for proper operation, unusual noises, or excessive heating.
- Check the engine oil and the coolant levels frequently.

These rules should not be considered as limitations in putting your equipment to work at maximum capacity, but rather to serve as a guide to familiarization and development of good operating habits.

## 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 specifically for the operator's benefit to make sure the crane is prepared for starting the day's work.

### Fuel Supply

Make sure the fuel tank is full and the cap is on tight.

Use only approved fuels. The X12 engine requires the use of Ultra Low Sulfur Diesel (ULSD) fuel.



### WARNING

Never mix gasoline, alcohol, or gasohol with diesel fuel. This mixture can cause an explosion.

### CAUTION

In X12 engines, use only ultra low sulfur diesel fuel. Failure to do so may cause damage to the exhaust catalyst.

## Engine Oil

### CAUTION

DO NOT OVERFILL the engine crankcase. Damage to engine components will result.

Check the oil level in the crankcase; fill to the FULL mark on the dipstick. Do not overfill.

### DEF Fluid Level

Check the DEF fluid level in the DEF tank; fill to the proper level. An engine derate will occur when the fluid level is low.



### WARNING

#### Inhalation/Irritation Hazard!

Ammonia vapors can irritate mucous membranes, skin and eyes.

Use caution when opening the DEF tank in high ambient temperatures as ammonia vapor can be released. Avoid breathing vapors or allowing vapors to contact face and skin.

### CAUTION

#### Machine Damage!

DEF can cause corrosion of these surfaces. Clean up spilled DEF with water immediately.

## Engine Coolant

Check the coolant level in the radiator; fill to the proper level. Do not overfill. Check the surge tank cap for security.

## Batteries

Some cranes use maintenance-free type batteries. When applicable, check the state-of-charge indicator on these type batteries. On cranes not using the maintenance-free batteries, check each cell for the correct electrolyte level. Add only clean, distilled water. Do not overfill. On either type battery, make sure that the cables and clamps are tight and not corroded.

## Hydraulic Reservoir and Filter

Check the hydraulic level sight gauge and filter condition indicator on the hydraulic tank. Hydraulic fluid should be at normal operating temperature and the boom and outriggers in a retracted position. Check breather for cleanliness and security.

## Hoist Rope

Inspect the 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 the safety latch is free and aligned.

## Seats and Mirrors

Adjust seat and mirrors for clear vision and safe driving.

## Cameras

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

## Seat Belts

### *Seat Belt Maintenance*

Seat belt assemblies are maintenance-free; however, they should be periodically inspected to make sure that they have not become damaged and they remain in proper operating condition, particularly if they have been subjected to severe stress.

### *Cleaning Seat Belt Webbing*

To clean the webbing, wash with any mild soap or detergent. Do not clean seat belts with commercial solvents. Also, bleaching or re-dyeing the webbing is not recommended because of possible loss of webbing strength.

## Floor Mat

Make sure that the floor mat is correctly in place and does not interfere with the operation of the foot pedals.

## Signal and Running Lights

Check all signal and running lights for proper operation. Replace burned out lamps with those of the same number, or equivalent.

## Service and Parking Brakes

Check for proper operation.

## Tires

Check for severe cuts, foreign objects embedded in treads, and for correct inflation pressures. A tire inflation chart,

providing the correct air pressures, is located in the *Load Chart Manual* in the crane cab. Check pressure and condition of all tires before starting.

**NOTE:** For tire inflation pressures, refer to the Tire Inflation Decal on the crane.

## Wheels

Maintain proper torque on wheel lugs and check for proper wheel mounting. If equipped with steel or aluminum wheels, re-torque wheels 300 hours after initial installation or any time tires and wheels are removed. Doing this re-seats the lug nuts. Check lug nuts for proper torque every 500 hours thereafter.

## Safety Equipment

Check all lights, windshield wipers, washers, washer liquid supply, horn, instruments, signaling devices, etc. to be sure each is in proper working condition.

## Daily Lubrication

Make sure that all components requiring daily lubrication have been serviced. (Refer to the Section on "Maintenance and Lubrication" on page 6-1).

## Boom

Before extending the boom, make sure the access covers on top of the boom base section and on the face of the boom nose are installed.

## COLD WEATHER OPERATION

**NOTE:** This crane is equipped with a Cold-Weather Starting Ether System. The operator should crank the engine normally in all temperatures.

The correct grade of oil for the prevailing temperature should be used in the crankcase to prevent hard cranking. Diesel fuel should have a pour point of 5°C (10°F) less than the lowest expected temperature.



### WARNING

The cold start system on the engine operates automatically. If the engine does not start immediately, do not use cold starting fluid which could result in a minor explosion.

When the engine is cold, the symbol (Figure 4-1) goes out as soon as the engine is preheated (duration of up to 20 seconds).



FIGURE 4-1

Start the engine within the next 30 seconds; otherwise, you must switch on the ignition again and wait until the symbol (Figure 4-1) goes out.

To start the engine, position the ignition switch to START. If the engine does not start within 30 seconds, allow the starter to cool at least two minutes and repeat the procedure.

The following recommendations are for operating Grove cranes in regions with ambient temperatures below  $-9^{\circ}\text{C}$  ( $15^{\circ}\text{F}$ ) which are considered arctic.

**NOTE:** Additional information regarding cold weather operation is available through your Cummins dealer/service center under Service Bulletin 3379009.

Use particular care to ensure that cranes being operated in very cold temperatures are operated and maintained in accordance with the procedures as provided by Grove. Always make sure there is adequate lubrication during system warm-up. Regardless of crane lubricant viscosity, always follow cold weather warm-up procedures described in the section *Crane Warm-Up Procedures*, page 4-10. For proper cold weather lubricants, refer to the section *Arctic Conditions Below  $-18^{\circ}\text{C}$  ( $0^{\circ}\text{F}$ )*, page 6-2.

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. If in doubt of suitability for a specific fluid or lubricant, check with an authorized Grove distributor or Manitowoc Product Support. Cranes should have appropriate hydraulic oil, lubricants, and other auxiliary items required for operation in arctic temperatures.

Operation of cranes at full rated capacities in temperatures between  $-18^{\circ}\text{C}$  ( $0^{\circ}\text{F}$ ) and  $-29^{\circ}\text{C}$  ( $-20^{\circ}\text{F}$ ) or lower should be accomplished only by competent operators who possess the skill, experience, and dexterity to ensure smooth operation. Shock loading shall be avoided. Refer to the following paragraphs for cold weather operation of cranes down to  $-40^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$ ).

### Derated Capacities for Each $^{\circ}\text{F}$ Below $-40^{\circ}\text{F}$

Derate the rated load shown on the capacity charts 2 percent for each degree Fahrenheit below  $-40^{\circ}\text{F}$ .

**NOTE:** Contact your local distributor or Grove Product Support to determine requirements and lift solution for operation down to  $-40^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$ ).

### Derated Capacities for Each $^{\circ}\text{C}$ Below $-40^{\circ}\text{C}$

Derate the rated load shown on the capacity charts 3.67 percent for each degree Celsius below  $-40^{\circ}\text{C}$ .

Grove recommends the crane be equipped with the following cold weather accessories:

#### Down to $-29^{\circ}\text{C}$ ( $-20^{\circ}\text{F}$ ) Package

- Battery heater
- Transmission heater
- In-line Fuel heater
- Engine hood insulation
- Fan clutch
- Radiator air shutters
- Air diverter
- Diesel fired cab heater
- Cold weather alternator
- Fluids suitable to  $-29^{\circ}\text{C}$  ( $-20^{\circ}\text{F}$ )

#### Down to $-40^{\circ}\text{C}$ ( $-40^{\circ}\text{F}$ ) Package

- Coolant heater (to circulate warm coolant through heaters and engine)
- Transmission heater
- Hydraulic Swivel heater
- Battery heater
- In-line Fuel heater
- Engine hood insulation
- Fan clutch
- Radiator shutters
- Air diverter
- Diesel fired cab heater
- Cold weather alternator
- Super-capacitor starting system
- Fluids suitable to  $-40^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$ )

Individual crane functions should be operated to make sure that they are sufficiently warmed prior to performing a lift. Allow at least 30 minutes of engine run time for warm up. Follow the warm-up procedures found in section *Crane Warm-Up Procedures*, page 4-10.

For crane operation below -40°C (-40°F), derate load chart capacities by 6.60% for each degree Celsius or by 3.67% for each degree Fahrenheit below -40°C (-40°F).

Operation of cranes at full rated capacities in ambient temperatures below -9°C (15°F) should be accomplished only by competent operators who possess the skill, experience, and dexterity to ensure smooth operation. Shock loading shall be avoided.

## 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

**NOTE:** This crane is equipped with a Cold-Weather Starting Ether System. The operator should crank the engine normally in all temperatures.



### CAUTION

Before starting the engine, ensure the transmission is in neutral and the parking brake is applied.

### CAUTION

Never crank the engine for more than 30 seconds during an attempted start. If the engine fails to start after 30 seconds, allow the starter motor to cool for approximately two minutes before attempting another start.

If the engine fails to start after four attempts, correct the malfunction before attempting another start.



### DANGER

Diesel engine exhaust can be harmful to your health. Only operate engine in a well ventilated area or vent exhaust outside.

1. Apply the parking brake, and position the transmission to neutral.

**NOTE:** The engine will not crank unless the transmission shift lever is in neutral.

2. There are different procedures for the Carrier versus the Superstructure:

3. **Carrier:**

- Turn the ignition switch to IGN.
  - The Engine Warning Indicator and the Engine Stop Indicator are located on the front console display in the carrier cab and in the Alerts Area (1), (Figure 4-150) of the Operator Display Module (ODM) will come on and go off in sequence after approximately two seconds (as a check). Also refer to (Figure 3-14).
  - If the Engine Warning Indicator or the Engine Stop Indicator remains ON, correct the malfunction before cranking the engine.
4. Turn Ignition Switch to START and release immediately when the engine starts.
  5. **For the Superstructure:**
    - Turn key switch to ON
    - The Engine Warning Indicator and the Engine Stop Indicator are located in the ODM (Figure 4-1) of the Operator Display Module (ODM) will come on and go off in sequence after approximately two seconds (as a check).
    - If the Engine Warning Indicator or the Engine Stop Indicator remains ON, correct the malfunction before cranking the engine.
  6. Press the Increment side of the Increment/Decrement switch in the Panel and release immediately when the engine starts.
  7. When starting has been accomplished, check the engine instruments for proper indications.



### WARNING

Make sure that both air system pressures are in the normal operating range prior to disengaging the parking brake.

### CAUTION

If oil pressure and/or temperature indicator(s) do not display the proper readings, shut down the engine and correct the malfunction before resuming operation.

8. Allow the engine to warm up one minute before applying a load. If not yet within recommended operating temperature range, apply loads gently. Do not race the engine for a faster warm up.

**NOTE:** The Ignition Switch has an anti-restart feature. After a failed attempt to start the engine, the crane control system prevents the engine from cranking again for approximately six seconds.

Warm up engine and all crane components following the procedures under *Crane Warm-Up Procedures*, page 4-10.

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### CAUTION

If the Engine Warning Indicator or the Engine Stop Indicator is ON, immediately stop the engine and correct the malfunction.

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### Jump Starting Hazard

Do not attempt to jump start the crane.

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### CAUTION

Do not jump start the crane with a different vehicle, portable power pack, or other power source. The surge of power from these sources can damage the crane electronic controls and computer systems. Jump starting the crane batteries with a different vehicle while the engine is running can also damage the donor vehicle electronics.

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This crane has multiple computer systems (crane control, RCL, engine & transmission control) that are highly susceptible to voltage/amperage surges in the electrical system.

The batteries should be completely disconnected from the crane electrical system and charged using a battery charger of appropriate voltage level or replace the batteries with fully charged batteries. Refer to *Charging the Batteries*, page 4-8.

### Charging the Batteries

When charging the batteries, do not turn on the battery charger until the charging leads have been connected to the battery(s). Also, if the battery(s) are frozen, do not attempt to charge them. Remove the battery(s) from the crane, allow them to thaw, and then charge the battery(s) to full capacity.

“Slow charging” is preferred to “fast charging”. Fast charging saves time but risks overheating the battery(s). Slow charging at six (6) amps or less develops less heat inside the battery and breaks up the sulfate on the battery plates more efficiently to bring the battery up to full charge. The use of a “smart charger” that automatically adjusts the charging amperage rate is recommended.

### Idling the Engine

Idling the engine unnecessarily for long periods of time wastes fuel and fouls injector nozzles. Unburned fuel causes carbon formation; oil dilution; formation of lacquer or gummy deposits on the valves, pistons and rings; and rapid accumulation of sludge in the engine.

**NOTE:** If prolonged idling is required and the engine falls below the desired operating temperature, the

engine will increase idle speed to generate more heat. Activation of any input will return the engine to idle speed.

### Particulate Filter Maintenance at Idle — Unexpected Idle Speed Increase

If the engine is left at idle for significant periods of time without reaching the minimum exhaust operating temperatures, the engine will automatically increase the engine idle speed to 760 rpm for 10 minutes to maintain the condition of the particulate filter. Unexpected idle speed increase will occur if the crane’s speed is zero, the clutch, brake and throttle pedals are released, the transmission is out of gear and after four continuous idle hours with exhaust temperature less than 120°C (248°F) or after eight continuous idle hours with exhaust temperature less than 250°C (482°F).

**NOTE:** The standard idle speed is 800 rpm, so unexpected idle speed increase is only an issue if the operator intentionally lowered the idle speed to a setting below 760 rpm.

### Racing the Engine

DO NOT race engine during warm-up period or operate beyond governed speed (as might occur in downhill operation or down-shifting). Engine bearings, pistons, and valves may be damaged if these precautions are not taken.

### Exhaust System Cleaning

For more information, refer to *Exhaust System Cleaning Indicator*, page 3-15.

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### 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.

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The exhaust system cleaning process can take place in three different modes:

- **Passive:** Exhaust is hot enough during normal working operation to burn off the hydrocarbon (soot) accumulation

**Active:** Active cleaning occurs when there is insufficient heat in the exhaust system to convert all the hydrocarbon being collected in the exhaust system. Exhaust temperatures are raised by injecting a small amount of fuel. The resulting chemical reaction raises exhaust gas temperatures high enough to oxidize the hydrocarbon system. This is done without operator input.

Exhaust system cleaning is automatic and can occur while parked or driving. Engine speed will increase and possibly reach between 1000 and 1500 rpm.

The exhaust system cleaning inhibit mode should be used if the crane cannot be parked in safe area regarding exhaust temperatures. Return the switch to the neutral position as soon as it is safe to do so.

- **Manual:** Manual, or stationary, cleaning is the same as active cleaning but takes place when crane is not being operated. It allows the operator to perform cleaning outside of the normal duty cycle.

If the exhaust system begins to clog and needs cleaned, the Engine Exhaust Cleaning Required Indicator comes on and is located in the front console display area in the carrier cab and also in the Alerts Area of the ODM Main Screen (refer to *Alerts Area*, page 4-107).

These above conditions can only occur if cleaning has been inhibited or a manual cleaning was interrupted.

When the Engine Exhaust Cleaning Required Indicator is on constant or flashing, start the manual cleaning process at the next opportune time. Refer to section titled *Exhaust System*

*Cleaning*, page 4-191 for procedures to manually clean the exhaust. Also refer to the Carrier and Superstructure Sections for Exhaust Cleaning.

If the exhaust system continues to clog, the Engine Warning Indicator in the Alerts Area comes on in addition to the Exhaust Cleaning Required Indicator and a severe engine derate will occur.



**WARNING**

**Burn Hazard!**

During exhaust system cleaning, exhaust temperatures may reach 800°C (1500°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.

**Faults on the DEF System**

Malfunction	Icon	Cause	Solution
Lights up Flashes		DEF level in tank at reserve level DEF tank empty	Refuel DEF.
Lights up		DEF reservoir sensor faulty Error in the DEF dosing unit DEF lines blocked Temperature sensor faulty Cable break in DEF system Exhaust gas sensor faulty	Have the exhaust system checked by your local distributor or Grove Product Support, an authorized GROVE retailer or an authorized specialized workshop.

**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. **Carrier:** Turn ignition switch to the OFF position.  
**Superstructure:** Turn the key switch to the OFF position or press the Decrement side of the Increment/Decrement Switch in the right-hand overhead panel.
3. Drain fuel filter-water separator.
4. If crane is to be inactive for more than 24 hours, disconnect the batteries using the battery disconnect switch

To avoid possible engine fault codes and undesirable operation, make sure the key switch has been OFF for 2 minutes before disconnecting the batteries.

**WARNING**

If an overheating condition necessitates an emergency shutdown, use caution when checking the radiator coolant. When loosening the radiator cap to relieve pressure, use a heavy cloth or gloves. Allow the engine to cool before removing the cap from the radiator.

**CAUTION**

Correct the problem that caused the emergency shutdown before attempting a restart of the engine.

**CRANE WARM-UP PROCEDURES**

The following procedures detail the actions that must be taken to properly warm the different crane components before operating the crane.

**NOTE:** For temperatures below -9°C (15°F) refer to arctic lubricants and conditions in the Operator and Service Manuals.

Before starting the crane, ensure the appropriate lubricants are used to provide lubrication for the prevailing ambient temperatures in which the crane will operate in (a list of lubricants and their temperature ranges can be found in the Maintenance and Lubrication Section of this crane's *Operator Manual*, by contacting your local Manitowoc distributor, or by contacting Grove Product Support directly).

**CAUTION****Crane Damage Hazard!**

Operating the crane with the incorrect lubricants and fluids for the prevailing ambient temperature and/or failing to adequately warm the crane prior to cold weather operation can lead to a failure of a crane component or system.

Always use Manitowoc recommended lubricants and fluids for the prevailing ambient temperature and properly start and warm the crane using the cold weather procedures found in this Operator's Manual and supplement before operating the crane at full load.

**Engine****Warm-up Procedures for All Temperature Ranges:**

1. Upon startup, allow the engine to idle for 3 to 5 minutes before operating with a load.
2. If below desired temperature, the engine will increase the engine speed to provide adequate lubrication to the bearings and to allow the oil pressure to stabilize.

**Transmission**

Operating the transmission with a sump temperature below normal operating temperature is limited to:

- operating in the neutral gear or
- driving with an unloaded crane while not exceeding 1500 engine RPM and not exceeding half throttle.

**Warm-up Procedures for Truck Mount (TM/TMS) Cranes:**

1. Setup the crane on outriggers. Ensure that all tires are free of the ground.
2. Warm-up operation of 4-wheel drive transmission engaged in 2-wheel drive only could cause transmission damage.
3. Engage the transmission and allow crane to run at idle until the temperature of the transmission sump reaches normal operating temperature.
4. Push traction control button 5 times before putting transmission in gear.
5. Once operating temperature is reached, push traction control button 3 times before driving machine.

**Hoist**

Performing a warm-up procedure is recommended at every startup and is required at ambient temperatures below 4°C (40°F).

**Warm-up Procedures - Standard Hydraulic Oil:**

1. Without operating the hoist function, warm the hydraulic oil (see Hydraulic Oil System Section).
2. Once the hydraulic system is warm, operate the unloaded hoist, in both directions, at low speeds several times to prime all hydraulic lines with warm hydraulic oil and to circulate gear lubricant through the planetary gear sets.

**Warm-up Procedures - Cold Weather Hydraulic Oil:**

1. Operate the unloaded hoist, in both directions, at low speeds several times to circulate gear lubricant through the planetary gear sets.

**Swing Drive and Turntable Bearing****Warm-up Procedures for Temperatures Above -7°C (20°F):**

1. Setup the crane on fully extended outriggers, with the boom fully retracted and near maximum lift angle with no load applied.
2. Rotate the superstructure at a speed of less than one RPM for at least one complete revolution in one direction, then rotate the superstructure at a speed of less than one RPM for at least one complete revolution in the opposite direction.

**Warm-up Procedures for Temperatures Below -7°C (20°F):**

1. Ensure the boom is fully retracted and near maximum lift angle with no load applied.
2. Rotate the superstructure at a speed of less than one-half RPM for at least two complete revolutions in one direction, then rotate the 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 the crane on outriggers. Ensure all tires are free of the ground.
2. Engage the transmission and allow crane to run at idle until the temperature of the transmission sump reaches normal operating temperature.
3. Follow steps for warming up the transmission ("Transmission" on page 4-10 above).

**Hydraulic Oil System****Operating Limits and Warm-up Procedures:**

**NOTE:** Ambient temperatures between -10°C and -40°C (15°F and -40°F) require the use of a cold weather hydraulic oil (refer to cold weather lubricants in the section *Cold Weather Lubricants*, page 6-5). With cold weather hydraulic oil installed, warming the hydraulic oil before operating the crane is not required.

- **Hydraulic Oil Temperatures from 4°C to -10°C (40°F to 15°F):** Crane operation without a load is allowed with medium engine RPM and medium function speed

(controller position) until the 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 the 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 the 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 the crane's hydraulic oil cool by running the engine at idle with no functions actuated.

**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. Due to system constraints, only axles 2, 3 and 4 are monitored. The first steer axle has sensors installed but they are not connected. The sensors transmit information to the ABS 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 4-2) 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 4-2) is used to diagnose system problems along with blink codes displayed on the ABS indicator, see the *Service Manual* for more information.

**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.

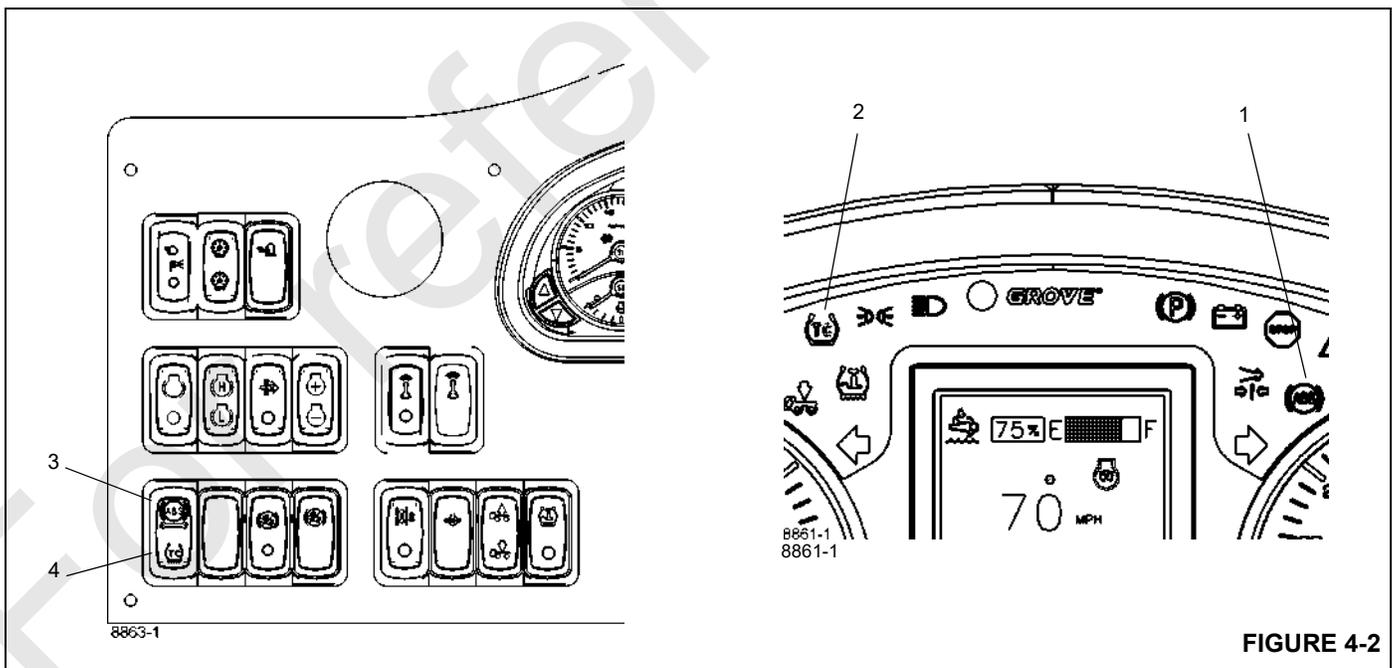


FIGURE 4-2

## 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 switch (4), (Figure 4-2) allows greater wheel spin (more torque) when activated. It is intended for adverse conditions, usually off-highway. The switch turns on ATC 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 4-2) 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 4-2) 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 4-2) 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.

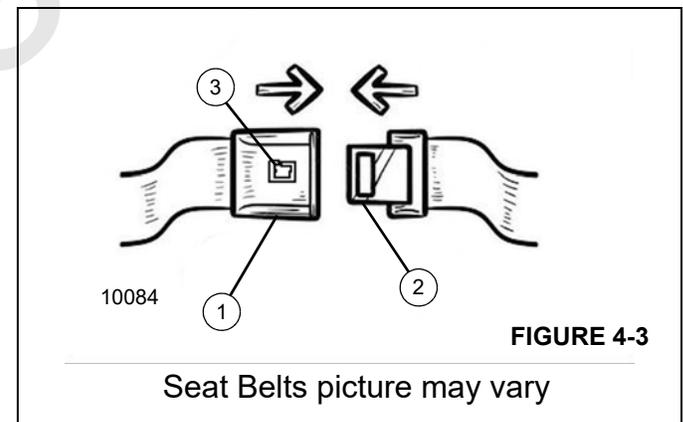
Pushing the switch again will turn off the ATC off-road mode.

### 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.

## DRIVING THE CRANE

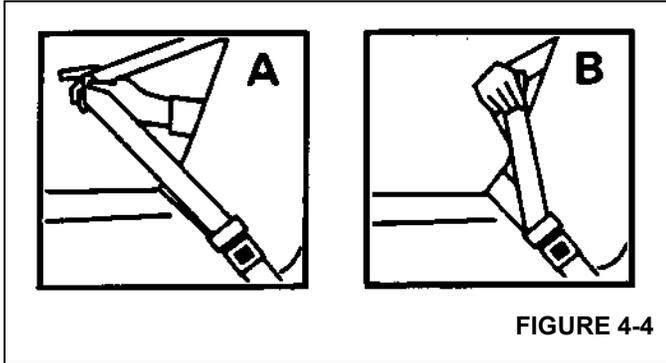
### Seat Belts



1. Before fastening the seat belt, always adjust driver's seat to position in which you will drive.
2. Pull belt across your lap and push latch plate (2), (Figure 4-3) into buckle (1), (Figure 4-3) until it clicks.
3. To reduce risk of sliding under belt during a collision, position the belt across your lap as low on your hips as possible and pull it toward door to a snug fit.

**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), (Figure 4-4) at least 130 mm (5 in) so that when it is let go, it returns to your chest.
  - b. Then pull down on the shoulder belt (B), (Figure 4-4) 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 4a (above).

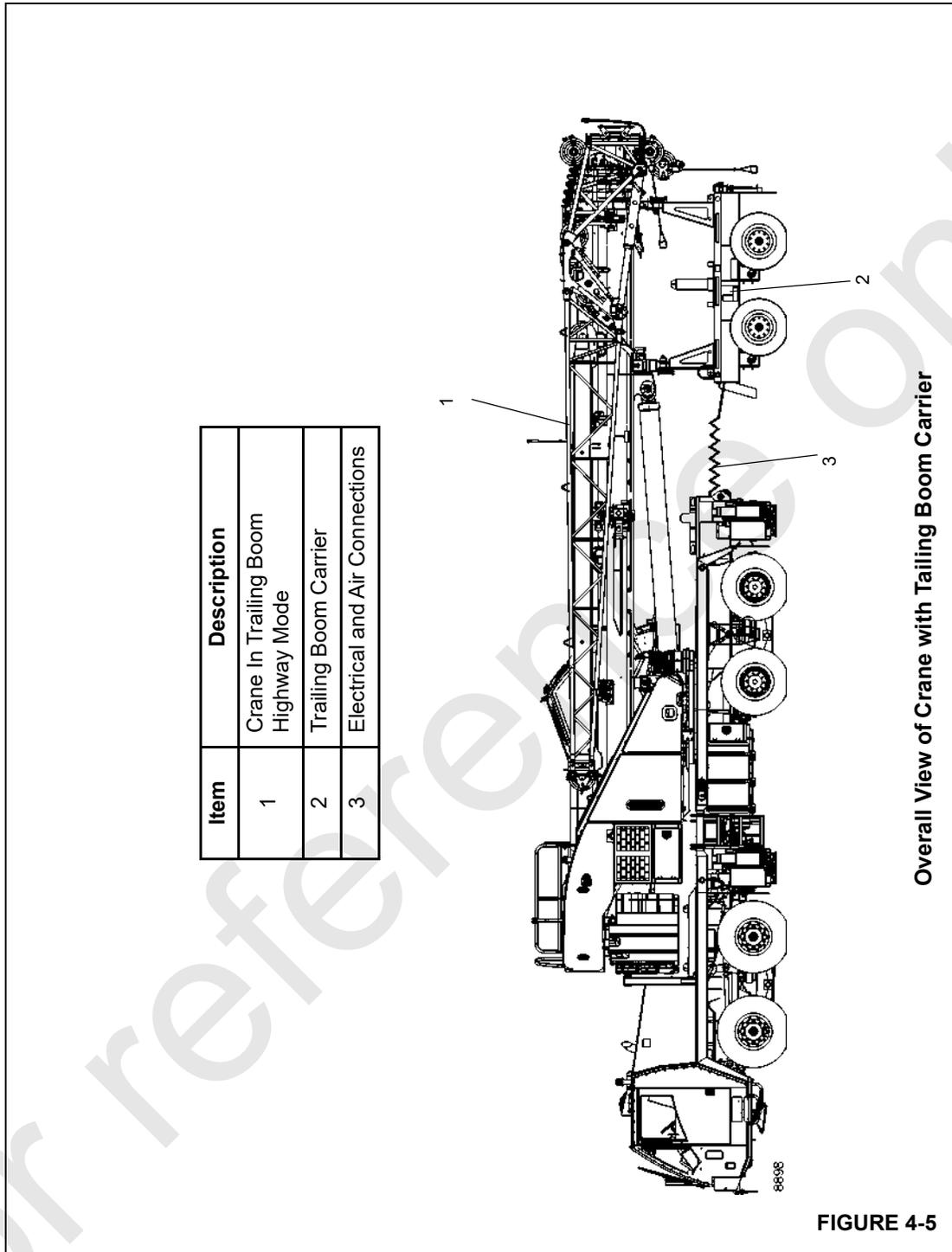
**DANGER**

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.

6. 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 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.
7. To release seat belt, push the push button (3), (Figure 4-3) at the buckle (1), (Figure 4-3).

**Trailing Boom Carrier (Optional)****Description**

The trailing boom carrier provides a means of distributing the cranes total travel weight over a greater area and more axles to allow for reduced individual axle loads for highway travel. The components include a trailer, swing brake release valve assembly and a lift cylinder relief valve.



**Preparation for Highway Travel**

1. Determine the highway route to be taken, the states to be crossed and the allowable axle weights for the crane with trailing boom and carrier. Consult with your local Grove Cranes distributor or Grove Product Support for

weight distribution with or without removable components. Obtain the necessary permits.

2. Configure the crane to achieve allowable axle weight distribution with trailing boom and boom carrier installed.
3. Swing the boom over the rear.

4. Make sure that the Trailer Air Supply Control in the crane carrier cab is applied. Refer to *Trailing Boom Air Supply Control (Optional)*, page 3-11.
5. Make sure that the Air Locking Pin Valve knob at the rear of the trailing boom carrier is turned to the RETRACT position. Refer to (Figure 4-6).

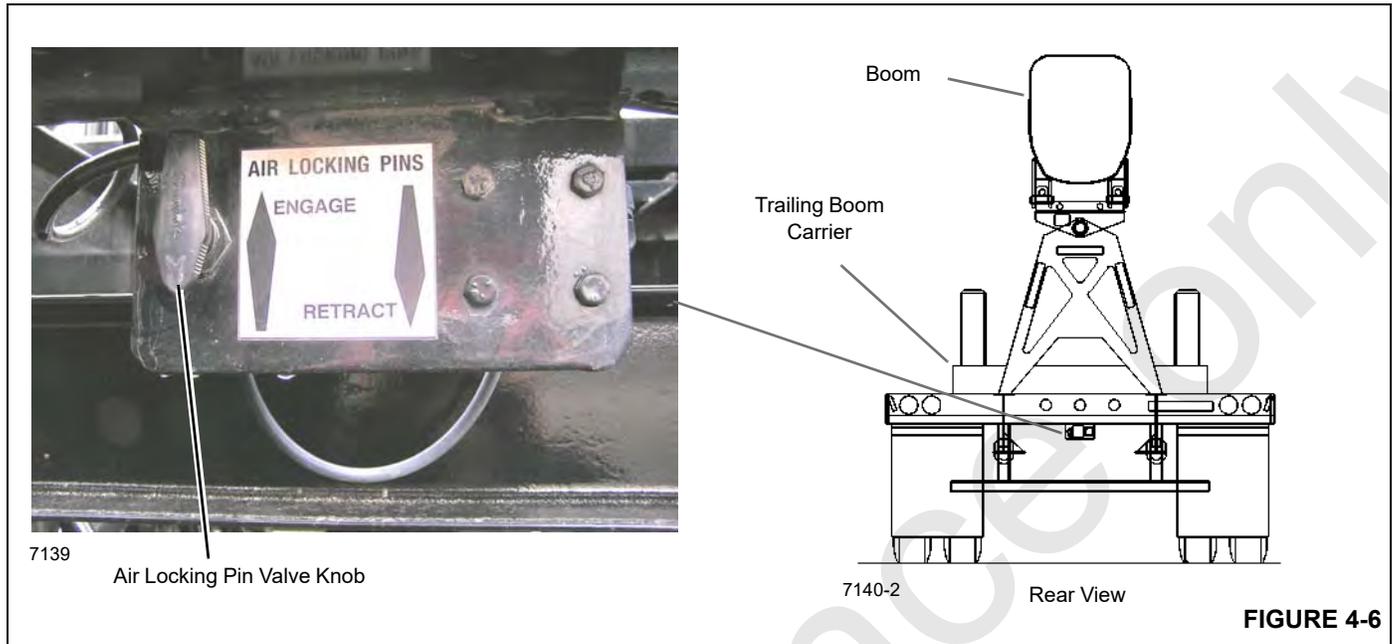


FIGURE 4-6

6. Visually check locking pins to make sure that they are retracted.

**NOTE:** When the air cylinders are extended, the locking pins are disengaged. When the air cylinders are retracted, the locking pins are engaged. Refer to (Figure 4-7).

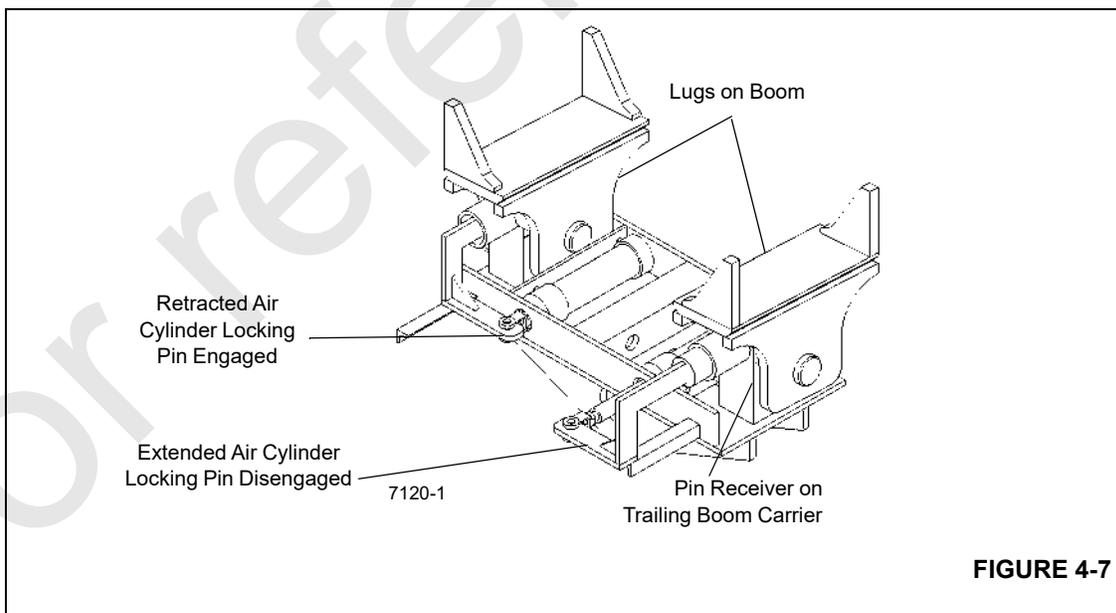


FIGURE 4-7



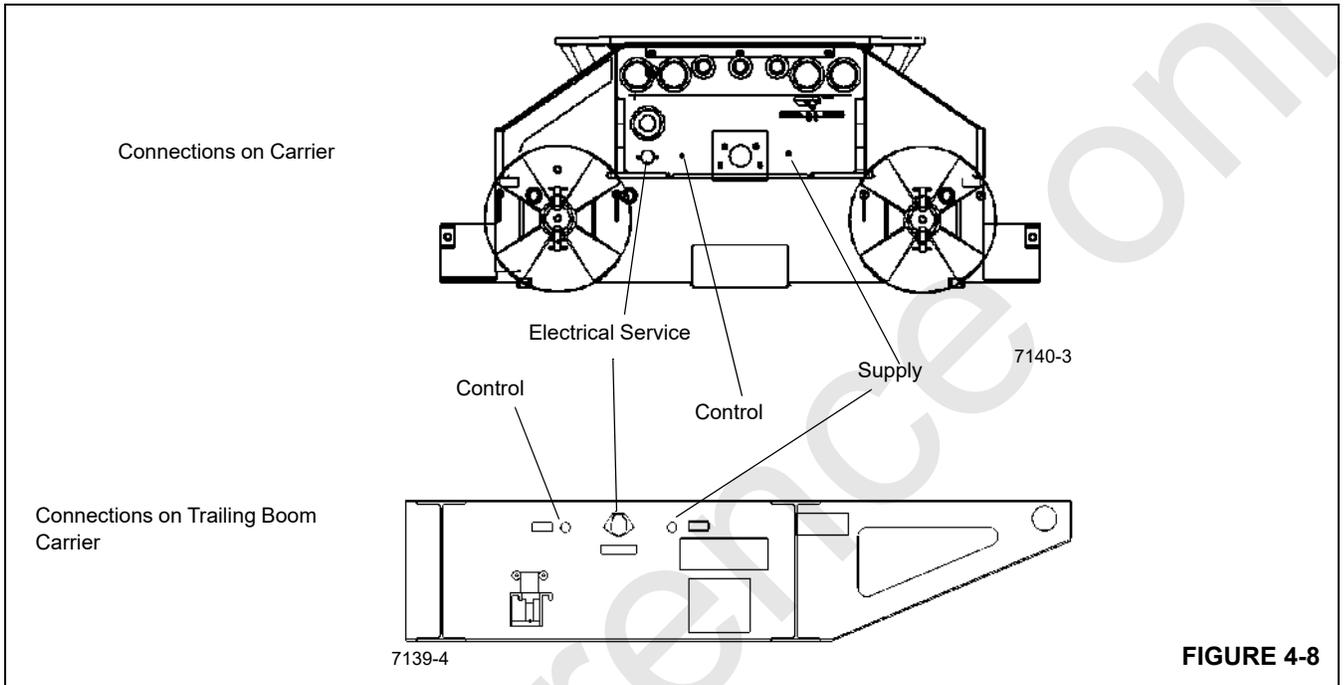
**WARNING**

Prior to moving the crane and trailing carrier, make sure that all four of the two-inch diameter pins are engaged or the trailing carrier can separate from the boom.

7. Lower the boom onto the trailing carrier until lugs on boom seat into pin receivers on the trailing carrier as shown in (Figure 4-8).

**NOTE:** Chock the wheels of the trailing carrier.

8. Connect the air and electrical lines between the crane carrier and the trailing carrier as shown in (Figure 4-8).



**FIGURE 4-8**

9. Turn the Locking Pin Air Valve knob to the ENGAGE position.
10. Visually check locking pins to ensure all four pins are engaged.

11. Turn the lift cylinder float valves counterclockwise to open them for trailing boom operation as shown in (Figure 4-9).

12. Release the turntable swing brakes by pushing in on the knobs. Secure the knobs in the released position with the padlocks.

13. Verify the 360° swing lock is disengaged. Refer to *Switching the 360° Lock ON/OFF (Optional)*, page 4-50 and *Releasing the 360° Lock*, page 4-50.

14. Install flags and oversize load placards as required.



**WARNING**

The superstructure is free to swing when the trailing boom swing brake release valve is released.

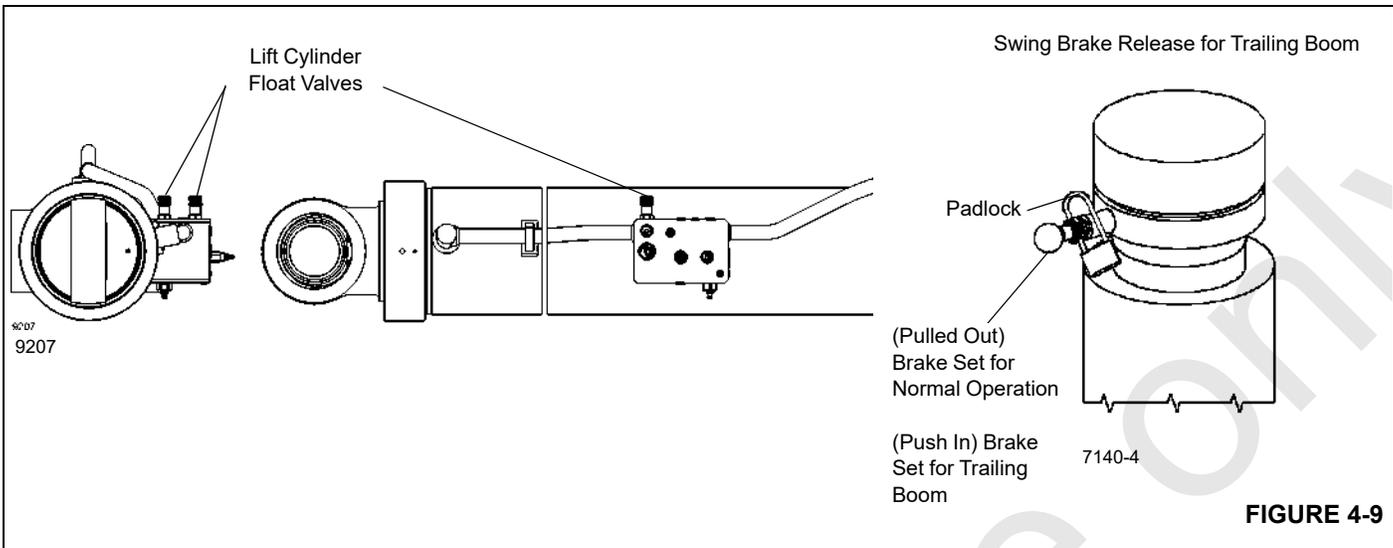


FIGURE 4-9

### Travel Precautions

**NOTE:** The following paragraphs list several important travel precautions which must be taken into consideration when traveling with the crane in the trailing boom configuration.

- Use of the trailing boom feature may require reducing travel speeds. Adjust travel speed to suit driving conditions (i.e. traffic, highway, weather).
- The crane boom and trailer combination requires a wide turning radius. When turning during driving, allow extra space on both the left and right sides of the carrier.
- The superstructure will rotate and stick out past the side of the carrier that is opposite the direction the carrier is being steered/turned when traveling.
- Reduce travel speed to avoid undesired weight transfer between the carrier and the boom trailer at abrupt crests and undulating terrain.

### Returning to Normal Crane Operation

1. Position the crane and trailing boom carrier on a firm level surface with the boom carrier directly behind the crane.
2. Block the wheels and apply the parking brakes.
3. Turn the lift cylinder float valves clockwise to the normally closed position.
4. Pull out the knobs on the swing brakes to set for normal brake operation and padlock.

5. Turn air locking pin valve knob to the RETRACT position. Visually check locking pins to ensure they are disengaged.
6. Raise the boom from the trailing boom carrier.
7. Disconnect all air and electrical lines from the rear of the crane.

### Parking the Trailing Boom Carrier



### WARNING

The superstructure is free to swing when the trailing boom swing brake release valve is released.

Use the following procedure when parking the trailing boom carrier.

1. Apply the emergency/parking brake in the carrier cab. Refer to *Trailing Boom Air Supply Control (Optional)*, page 3-11.
2. Chock the tires on the trailing boom carrier.

**NOTE:** The trailing boom carrier brakes are air pressure applied and may bleed off.

Disconnect the boom from the trailing boom carrier as described under *Returning to Normal Crane Operation*, page 4-18.

## Traveling - General

### 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.

Owner/lessee must take appropriate measures to make sure all persons operating or working with affected models are in compliance with Grove U.S. L.L.C. recommendations. Operator of the crane assumes responsibility for determining suitability of traveling conditions. Traveling under controlled conditions, specified in these guidelines, must be conducted with the utmost diligence and care to make sure safety of all personnel performing the operation and/or working around the crane.

When driving on roadways, the operator must follow all applicable regulations and/or restrictions.



### DANGER

#### Tipping Hazard!

Avoid holes, rocks, extremely soft surfaces, and any other obstacles which might subject crane to undue stresses or possible overturn.

Fully retract boom. Make sure swingaway boom extension is properly stowed and secured.

### CAUTION

#### Machine Damage Hazard!

Do not travel with an empty hook in a position where it can swing freely (except where noted). Remove hook block and/or overhaul ball from hoist rope and stow securely or make sure hook block or overhaul ball is properly secured to tie down provided for that purpose.

Do not drive crane with lift cylinder fully retracted. At a minimum, position boom to horizontal.

Fully retract outrigger beams and jacks and properly stow pads.

Disengage pumps (if applicable) for extended traveling.

Do not move the crane until the superstructure has been secured as outlined below:

- Make sure that the axles and/or suspension are not overloaded. Refer to *Axle Weight Distribution Table*, page 4-21.

- Make 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.
- If equipped, engage the optional 360° swing lock, except for trailing boom mode.
- Make sure that the swingaway boom extension, if so equipped, is properly stowed and secured.
- Remove the hook block or overhaul ball from the hoist cable(s) and stow securely before traveling or make sure the hook block or overhaul ball is properly secured to the tie down provided for that purpose.
- Make sure that the outrigger jacks and outrigger beams are fully retracted and the floats are removed. Install outrigger beams locking stirrups for retracted position.
- Make sure that the jack floats are properly stowed in their holding racks.
- Make sure that the center front stabilizer is fully retracted.
- Make sure that the cover doors on the battery box, and sling box are closed.
- Close all superstructure cab windows and door.

Requirements and recommendations regarding operation and use of Grove Cranes are stated on decals and in this Operator Manual and other manuals provided with each specific model machine.

The crane owner must 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.

## Traveling with Boom Extension Erected

**NOTE: Travel with the 8.05 m (26') Insert Erected is NOT Permitted.**

### 10.5 m (34 ft), 17.6 m (58 ft with stinger) Extensions

Travel is permissible under the following conditions:

1. The boom extension shall be erected at minimum offset. If traveling with just the 10.5 m (34 ft) extension, the stinger must be removed or stowed on the boom base section, not on the extension base section.
2. Jobsite travel only on firm, level surface.

- 3. Main boom shall be fully retracted, directly over the front or rear (see table).
- 4. Maximum travel speed: 4 km/h (2.5 mph).
- 5. Auxiliary hoist (with rope) or IPO Counterweight must be installed.
- 6. Hookblock must be removed from main boom nose.
- 7. Headache ball may be reeved over boom extension, hanging 0.9 m (3 feet) below sheave.
- 8. Suspension air bags shall be inflated.
- 9. The tires shall be properly inflated.
- 10. Allowable extension, counterweight, slew position and boom elevation configurations are shown in the following table:

<b>ALLOWABLE TRAVEL WITH EXTENSION CONDITIONS (UNLESS NOTED)</b>			
<b>Extension</b>	<b>Counterweight</b>	<b>Boom Over Front Main Boom Elevation</b>	<b>Boom Over Rear Main Boom Elevation</b>
<b>10.5 m (34 ft)</b> - stinger removed or stowed on boom base section	0-28K lb	0-40°	0-40°
<b>17.6 m (58 ft)</b>	None	0-30°	<b>NOT PERMITTED</b>
	8K-28K lb	0-30°	0-40°

**NOTE:** When Travel with the Extension is completed, the proper routing of the hoist cable must be verified **BEFORE** lifting any loads.

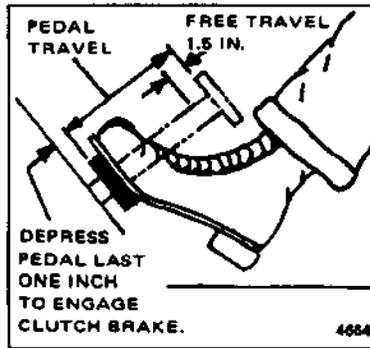
## Axle Weight Distribution Table

Description	CG To CL Rear Bogie cm (in)		Weight kg (lb)		Front Axle kg (lb)		Rear Axle kg (lb)	
Maximum Tire & Wheel Loads Allowed					23224	(51200)	27216	(60000)
Maximum Axle Loads Allowed					23224	(51200)	27216	(60000)
Standard Carrier Assy (8x4x4)	299.21	(117.80)	18878	(41619)	10045	(22146)	8833	(19473)
Superstructure Assy with main & aux hoists and cables	-52.27	(-20.58)	6042	(13320)	-562	(-1238)	6603	(14558)
Boom Assy w/pivot pins	477.01	(187.80)	7622	(16803)	6466	(14254)	1156	(2549)
Lift Cylinder and lower pin	372.82	(146.86)	1114	(2456)	738	(1628)	376	(828)
Complete Basic Machine: Carrier Assy, S/S Assy, 12.2 m - 39.0 m (39.4 ft - 128.0 ft) 4-Section Boom, Cummins X12 Engine, 445/65R22.5 Michelin Front Tires, 315/80R22.5 Michelin Rear Tires, Full Fuel and Hydraulic Oil, cable on both hoists	278.82	(109.77)	33656	(74198)	16688	(36791)	16968	(37407)
<b>Boom Extensions</b>								
10.5 - 17.6 m (34.5 - 57.6 ft) Manual Bi-fold Boom Extension	672.92	(264.93)	1488	(3280)	1780	(3925)	-293	(-645)
10.5 - 17.6 m (34.5 - 57.6 ft) Hydraulic Bi-fold Boom Extension	680.72	(268.00)	1511	(3331)	1829	(4032)	-318	(-701)
Boom Extension Carrier Brackets	478.71	(188.47)	203	(448)	173	(381)	30	(67)
Luffing Extension Hydraulic Components	842.80	(331.81)	123	(272)	185	(408)	-62	(-136)
Aux Boom Nose - Installed	1138.53	(448.24)	88	(194)	178	(393)	-90	(-199)
<b>Counterweights</b>								
2000 lb counterweight (pin on with pins) on S/S	-246.18	(-96.92)	917	(2022)	-401	(-885)	1319	(2907)
3000 lb counterweight (pin on with pins) on S/S	-246.18	(-96.92)	1371	(3022)	-600	(-1323)	1971	(4345)
5000 lb counterweight (pin on with pins) on S/S	-246.18	(-96.92)	2278	(5022)	-997	(-2199)	3275	(7221)
5000 lb counterweight (pin on with pins) on S/S	-246.18	(-96.92)	2278	(5022)	-997	(-2199)	3275	(7221)
2000 lb counterweight (pin on with pins) on carrier deck	481.99	(189.76)	917	(2022)	786	(1733)	131	(289)
3000 lb counterweight (pin on with pins) on carrier deck	481.99	(189.76)	1371	(3022)	1175	(2590)	196	(432)
3000 lb counterweight (tray) on carrier deck	481.99	(189.76)	1361	(3000)	1167	(2572)	194	(428)

Description	CG To CL Rear Bogie cm (in)		Weight kg (lb)		Front Axle kg (lb)		Rear Axle kg (lb)	
5000 lb counterweight (pin on with pins) on carrier deck	481.99	(189.76)	2278	(5022)	1953	(4305)	325	(717)
10,000 lb counterweight (non pin on) on carrier deck	481.99	(189.76)	4536	(10000)	3888	(8572)	648	(1428)
<b>Rigging Equipment</b>								
11 t (12 USt) Overhaul Weight - in stowage tray	830.58	(327.00)	294	(648)	435	(958)	-140	(-309)
9 t (10 USt) Overhaul Ball - tied to front bumper	942.34	(371.00)	310	(683)	519	(1145)	-210	(-462)
26 t (29 USt) Hookblock (1 sheave) - tied to front bumper	955.04	(376.00)	535	(1179)	908	(2002)	-373	(-823)
45 t (50 USt) Hookblock (3 sheave) - tied to front bumper	955.04	(376.00)	560	(1235)	952	(2098)	-391	(-863)
75 t (83 USt) Hookblock (5 sheave) - tied to front bumper	955.04	(376.00)	722	(1592)	1227	(2704)	-504	(-1112)
Cribbing storage compartments - carrier and carrier cab	271.81	(107.00)	78	(173)	38	(84)	40	(89)
Cribbing pads - 1"	256.54	(101.00)	191	(420)	87	(192)	103	(228)
Cribbing pads - 2"	259.08	(102.00)	176	(388)	81	(179)	95	(209)
Cribbing (in rear troughs)	-35.56	(-14.00)	181	(400)	-11	(-25)	193	(425)
Rigging	170.18	(67.00)	45	(100)	14	(30)	32	(70)
<b>Optional Equipment</b>								
Driver	762.00	(300.00)	113	(250)	154	(339)	-40	(-89)
Rear Frame Counterweight Mount	-165.10	(-65.00)	39	(87)	-12	(-26)	51	(113)
Trailing Boom - Carrier Components	-88.90	(-35.00)	29	(64)	-5	(-10)	34	(74)
Rear Step	-208.28	(-82.00)	27	(60)	-10	(-22)	37	(82)
360° Swing Lock	117.91	(46.42)	40	(88)	8	(18)	32	(70)
<b>Substitutions and Removals</b>								
REM: Main Hoist Cable (653' of 3/4" 35x7)	-176.89	(-69.64)	-384	(-847)	121	(266)	-505	(-1113)
REM: Aux Hoist Cable (420' of 3/4" 35x7)	-271.88	(-107.04)	-247	(-545)	120	(264)	-367	(-809)
SUB: Main Hoist only (replace aux hoist & cable with IPO cwt)	-270.71	(-106.58)	-315	(-694)	152	(334)	-466	(-1028)

## Manual Transmission Clutch Operation

Clutch pedal adjustment (Figure 4-10) provides for approximately 38.1 mm (1.5 in) for free travel movement of the pedal after the first free travel of 12.7 mm (0.5 in) is passed before engaging the release bearing fully. It is important that this free travel be maintained to avoid possible excessive wear on the bearing and/or clutch slippage. Approximately the last 25 mm (one inch) of downward clutch pedal travel engages the clutch brake which overcomes the tendency of the clutch to rotate at high speed when the clutch is disengaged. A slight but definite resistance to clutch pedal downward movement will be felt at the last 25 mm (1.0 in) of travel.



Clutch Travel  
FIGURE 4-10

The clutch brake is particularly useful for initial gear engagement in the lower gears when going uphill, when the road speed drops off more quickly than the engine speed, requiring rapid shifts. The clutch brake **MUST NOT BE USED** when making a downshift.

### CAUTION

Never fully depress the clutch pedal before the transmission is put in neutral. If the clutch brake is applied with the transmission still in gear, a reverse load will be put on the gears making it difficult to get the transmission out of gear. At the same time, it will have the effect of trying to stop or decelerate the crane with the clutch brake, with resultant rapid wear and generation of excessive heat, necessitating frequent replacement of the brake friction discs.

Clutch engagement should always be made smoothly while synchronizing accelerator movement necessary to move the crane.

Double clutching is a means of bringing the speed of the transmission gears into synchronization so the shift can be made without clash. The engine is used to speed up the countershaft for a downshift and to slow it down for an upshift. Double clutching operation is accomplished as follows.

1. Depress the clutch (do not engage clutch brake) and shift into neutral.
2. Release clutch pedal and accelerate the engine (when making downshift) or allow the engine to slow down

(when upshifting) until engine speed approximately corresponds to road speed of the gear ratio selected.

3. Depress the clutch pedal (do not engage clutch brake) and shift into gear.
4. Release the clutch pedal. Always use the double clutching technique.

**NOTE:** Never allow your foot to ride the clutch pedal when the clutch is engaged. This causes premature release bearing failure and short clutch disc life.

## Shifting Gears - Manual Transmission

Next to concern for safety, good shifting habits are probably the most important capability a driver can have. Knowing how and when to shift can return savings in trip time and operating expense.

In the early stage of moving the crane, keep the engine speed down to the actual power requirement but anticipate the next shift demand and do not cause the engine to labor with the next shift. Start the crane in the lowest gear necessary and with the first few shifts, develop only the engine speed (RPM) needed to get rolling. Then as you upshift, increase crane speed in each gear with a progressive increase in engine speed. It should seldom be necessary to go to governed engine speed in the lower gears except in a peak load situation, such as starting up a grade.

The biggest task when climbing a grade generally will be maintaining a reasonable rate of speed. When possible, pre-plan the climb and probable shift requirements according to traffic conditions and grade to be climbed.

When approaching a hill, gradually move the throttle all the way down, if necessary, to maintain governed engine speed (RPM) and remain at full throttle as the crane starts up the grade. If there is sufficient power to maintain satisfactory road speed without the engine laboring, remain in that gear for the entire grade. Whenever a grade proves too great for the gear that you are in and the engine begins to labor, ease off the throttle as necessary and allow speed to drop off to the next lower shift point before downshifting to the next gear. Speed usually drops off quickly while shifting so the shift should be made rapidly. Additional downshifting should be performed in the same way, as necessary. By riding each gear down to the next shift point, you will get over your grades in the best possible time with minimum shifts.

On downhill operation, the engine provides most efficient braking when run at or near top engine speed in the operating range, **BUT REMEMBER**, the governor has no control over the engine speed when it is being pushed by a heavy crane. When the engine exceeds the rated governed engine speed while descending a grade or downshifting at the high end of the operating range, engine overspeed can result in serious damage. On downhill operation, use the vehicle brakes and gears in combination to keep crane

speed under control and the engine below rated governed engine speed.

The transmission has 11 forward speeds and three reverse, consisting of a five speed front section and a three speed auxiliary section. The auxiliary section contains low and high range ratios, plus three deep reduction gears. The three lowest (LL1, LO, LL2) gear sets are used for road speed control and are not intended to be used as progressive shifts. The other four ratios are used twice, once in low (LO) range and once in high (HI) range.

As with any transmission gearing, shifting depends on proper synchronization. Never try to force the gear lever. During regular shifts, when moving the gear lever into the next gear position for engagement, the lever should be held lightly against the gear to be engaged. If gears are synchronized, engagement will be made immediately. If not synchronized, the flat gear teeth will rotate against each other until synchronization is reached. Do not jerk the shift lever into the next gear position or try to force gear engagement. If gears are out of synchronization, no amount of force is going to make the engagement before synchronization.

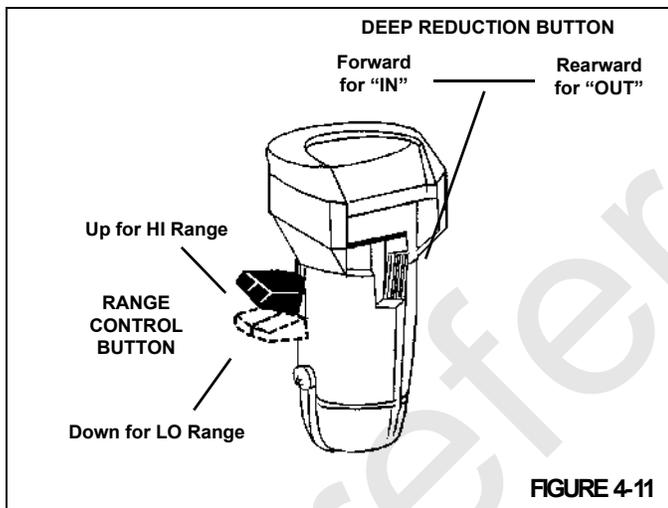


FIGURE 4-11

All shifts are made with one lever and a Range Control Button (Figure 4-11) which is used only once during an upshift sequence, and only once during a downshift sequence. Always preselect the range shift. After preselection, the transmission will automatically make the synchronizer range shift as the shift lever passes through neutral.

In the following instructions, it is assumed that the driver is familiar with motor trucks and tractors, and that he can coordinate the necessary movements of the shift lever and clutch pedal to make progressive and selective gear engagements in either direction, up or down.

**Initial Start-Up**

**CAUTION**

Before moving the crane, make sure you understand the shift pattern configuration (Figure 4-12).

1. Make sure that the shift lever is in neutral and the parking brake is set.
2. Start the engine.
3. Allow air pressure to build up.
4. Apply the service brakes.

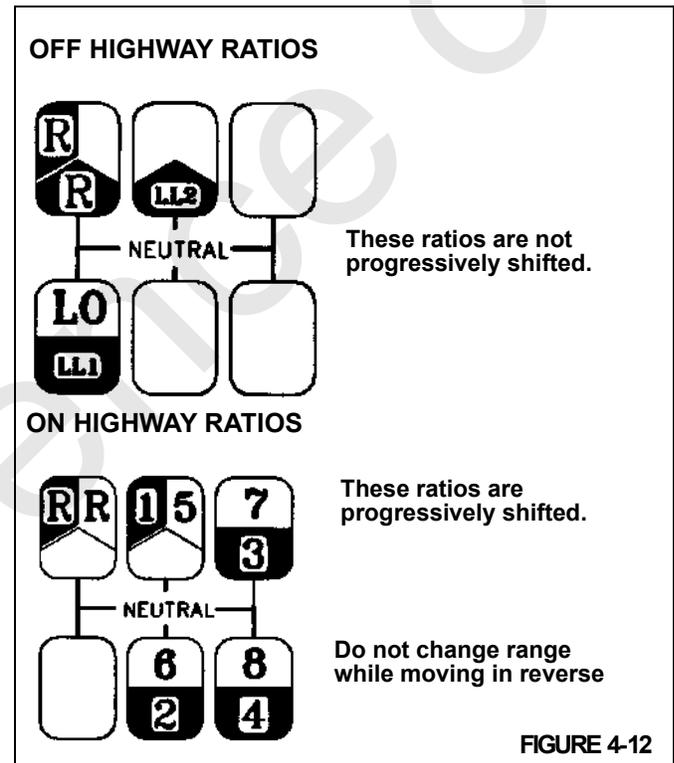


FIGURE 4-12

5. Make sure that the range button is down in the LO position.
6. If the crane is to be started in deep reduction (LL2 or LL1), move the deep reduction button forward to IN.
7. Depress the clutch pedal to the floor.
8. Move the shift lever to the desired initial gear.
9. Release the parking brakes.
10. Slowly release the clutch pedal and depress the foot throttle pedal.

**Up-Shifting**

Refer to (Figure 4-13).

**CAUTION**

Never move the deep reduction button or the range button with the shift lever in neutral while the crane is moving.

To make a deep reduction button shift from LL2 to 1st, proceed as follows:

1. Just before making the upshift, move the deep reduction button rearward to OUT while maintaining foot throttle position.
2. Immediately release the foot throttle pedal, depress the clutch pedal once to brake torque, release the pedal to engage the clutch, allow the engine to decelerate until the shift is complete. Continue driving or up-shifting. The transmission shifts from LL2 to 1st when synchronous is reached.
3. To shift in LO range, proceed as follows.

Move the shift lever, double clutching, to the next desired gear position (1st to 2nd to 3rd to 4th).

4. To shift from LO (4th) to HI (5th) range, proceed as follows.

When in the last gear position for LO range and ready for the next upshift, pull the range button up to HI and move the shift lever, double clutching, to the next higher gear position. As the shift lever passes through neutral, the transmission will automatically shift from LO to HI range.

**CAUTION**

Never move the shift lever to the lower speed gear position after HI range preselection, or anytime the transmission is in HI range.

5. To shift in HI range, proceed as follows.

Move the shift lever, double clutching, to the next desired gear position (5th to 6th to 7th to 8th).

**Down-Shifting**

Refer to (Figure 4-13).

1. To shift in HI range, proceed as follows.

Move the shift lever, double clutching, to the next desired gear position (8th to 7th to 6th to 5th).

2. To shift from HI (5th) to LO (4th) range, proceed as follows.

When in the 5th gear position for HI range and ready for the next downshift, push the range button down to LO and move the shift lever, double clutching, to the next lower gear position. As the shift lever passes through

neutral, the transmission will automatically shift from HI to LO range.

3. To shift in LO range, proceed as follows.

Move the shift lever, double clutching, to the next desired gear position (4th to 3rd to 2nd to 1st).

4. To make a deep reduction button shift from 1st to LL2, proceed as follows:

- a. Just before making the downshift, move the deep reduction button forward to IN while maintaining foot throttle position.

- b. Immediately release the foot throttle pedal, depress the clutch pedal once to brake torque, release the pedal to engage the clutch, and depress the foot throttle pedal. The transmission shifts from 1st to LL2 when synchronous is reached.

**Shifting to Reverse****CAUTION**

Never make a range shift or deep reduction shift while moving in reverse.

1. With the transmission in neutral, determine which reverse range is to be used. Move the range control button up for HI reverse or down for LO reverse.
2. Move the shift lever to the reverse position.
3. To engage deep low reverse, position the range control button in the down (LO) position. Move the deep reduction button to the forward (IN) position.
4. Carefully release the clutch, making sure deep reverse is fully engaged.

**Driving Tips**

- For a smooth start, always select an initial starting gear that will provide sufficient reduction for the load and terrain.
- On later model cranes, do not progressively shift the road control ratios.
- Always use normal double clutching procedures when making lever shifts.
- Never slam or jerk the shift lever to complete gear engagement.
- Never coast with the gear shift lever in the neutral position.
- Never move the Deep Reduction Button or the Range Control Button with the gear shift lever in the neutral position while the vehicle is moving.
- Never make a range shift while operating in reverse.

- Never downshift at too high of a road speed.
- When slowing down, the proficient operator can downshift through all the individual gear speeds to prolong the life of the brakes.
- In most cases, depending on the engine and axle ratios, fuel can be saved by operating the crane at less than governed RPM while cruising in 8th gear.

**Automatic Transmission (Optional)**

The optional automatic transmission has eleven speeds forward and three speeds reverse. The shift lever (Figure 4-13) has five positions; Reverse, Neutral, Drive, Manual, and Low. The unlock trigger must be pressed to shift the lever. It has an upshift/downshift button to be used when in the manual or reverse modes.

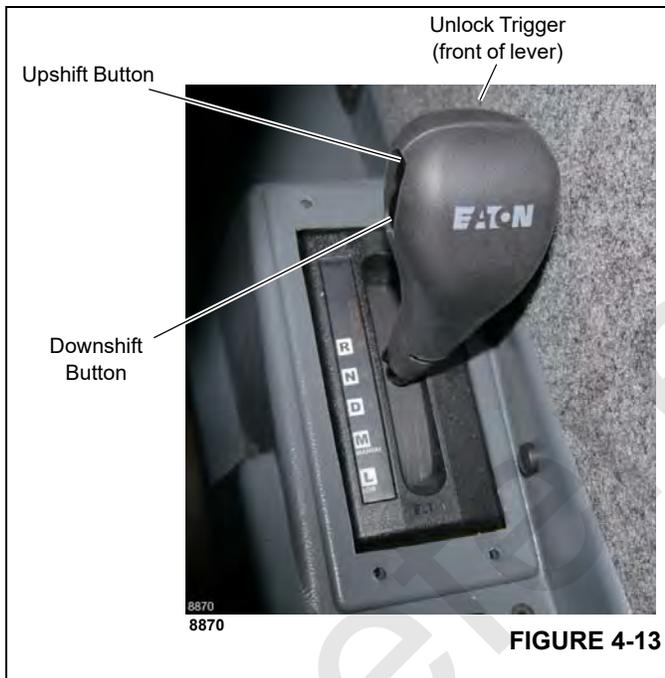


FIGURE 4-13



**WARNING**

Do not release the parking brake or attempt to select a gear until the air pressure is at the correct level

**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 upshift or downshift the gear display may momentarily flash the target gear position (Figure 4-14).

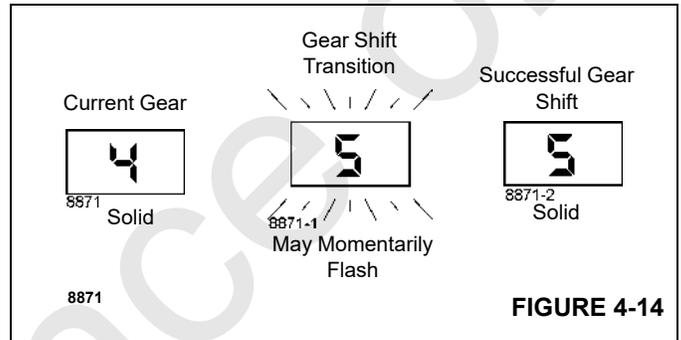


FIGURE 4-14

The “DASH” (Figure 4-15) indicates the transmission may be torque locked in gear. See Service Manual for more information.

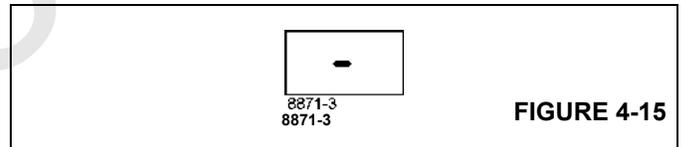


FIGURE 4-15

“CA” will appear in the gear display if a clutch abuse event is occurring (Figure 4-16).

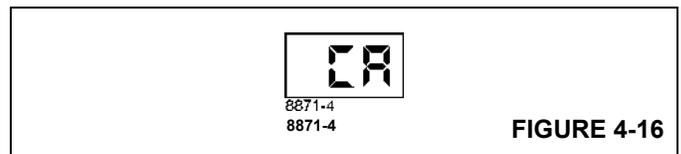


FIGURE 4-16

“AN” will appear in the gear display if the transmission goes into Auto Neutral (Figure 4-17).

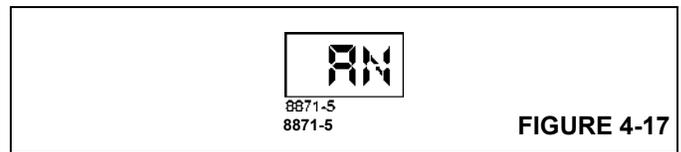


FIGURE 4-17

“F” will appear in the gear display if the transmission experiences a fault (Figure 4-18).

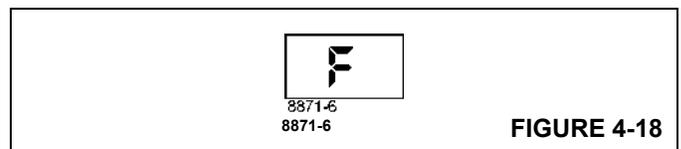


FIGURE 4-18

**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 down-shifts 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 ensure 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 (i.e. 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 upshifts from MANUAL and LOW for engine over speed protection. Some engines do not use the Eaton engine overspeed protection.

- The system will automatically shift or inhibit shifts to prevent over-speed or under-speed 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 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 upshift.

- 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 upshift (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 upshift.

### CAUTION

The transmission initiates upshifts 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) (Optional)****(Only Available with Automatic Transmission)**

Prevents vehicle from rolling in an unintended direction for up to 3 seconds when launching vehicle on a grade.

Hill Start Aid 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) Switch (Optional)" on page 3-9.

When stopped on an incline, the Bendix system will apply the brakes on the rear axles. When you begin to pull away again, it will keep the brakes applied until the transmission tells the Bendix system to release them. The transmission won't tell Bendix 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.

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 UNLOCK.

The Cross-Axle Control Switch is used to control the locking capability between the right and left wheels in the tandem set. The switch has two positions, LOCK and UNLOCK.

**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 UNLOCKED position while maintaining slow speed.
2. Let up momentarily on the accelerator to allow the shift.
3. Resume driving at a safe speed.

**Brakes****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.

**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 all four 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 310 kPa (45 psi), 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.

## Engine Brake

**NOTE:** Do not keep a foot lightly on the throttle pedal. This will cause the engine brake not to come on.

Pressing the clutch pedal will disable the engine brake.

By energizing the engine brake, 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 engine speed for a desired vehicle 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. Make sure that 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, i.e., drain water from the fuel filter/water separator, refueling, etc.
6. Close all windows.
7. Remove the keys from the crane.
8. Lock up the crane. Install vandal guards, 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. **NOTE: RECOMMENDATION TO RETRACT ALL CYLINDERS unless circumstances require them to be left extended.** Make a thorough walk around inspection to ensure 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.

**Unattended Crane**



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

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

The configuration in which the crane should be left while unattended shall be determined by a qualified, designated individual familiar with the job site, configuration, conditions, and limitations.

**SUPERSTRUCTURE CAB PLATFORM**

To pull out the cab platform, pull a retaining pin (1), (Figure 4-19) out on one end of the platform while pulling on the lip of the platform. Do the same on the other end of the platform. Now use both hands to fully pull out the platform. **Note:** Ensure that the spring-loaded pins have engaged with the holes in the cab platform.



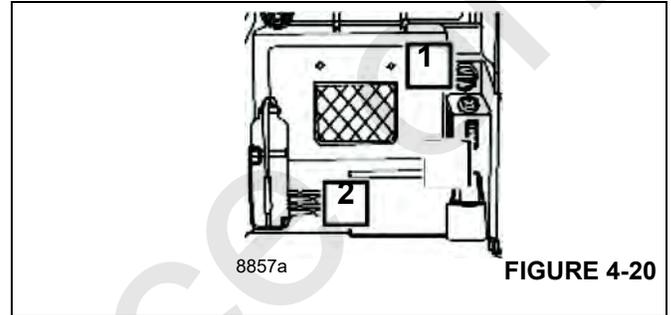
FIGURE 4-19

**HEATING AND VENTILATING**

The superstructure cab is heated and cooled by a heater and air conditioner. There are vents to direct the air and grilles that return the air to the heater/air conditioner. Refer to (Figure 4-20).

Do not cover the grilles (1) and (2), (Figure 4-20).

- Air is drawn in through grilles (1) and (2).
- The grille (1) is used to ventilate the electronics.



**Heating System**

The heating system can be operated when the engine is switched off or running.

The heater fuel tank must be adequately filled in order to operate the heater. **Note:** Diesel fuel is the same as engine fuel.

**CAUTION**

**Accelerated Discharging of Battery When the Engine is Switched OFF!**

The batteries will run down if you operate the heater with the engine switched off. The batteries will need to be recharged more frequently.

**Switching ON**

Before switching on the heating system, check whether it is allowed to be operated at the current site of the truck crane. Find out whether there are any possible sources of danger that could result in an explosion.

**! DANGER**  
**Explosion Hazard!**

The diesel heater includes a flame. Operation where flammable/explosive fumes are present may result in fire/explosion.

The heating system may not be operated:

- At service stations and tank farms
- At places where flammable gases or vapors can be found or formed (e.g. at places where fuel is stored and in chemical factories)
- At locations where explosive dust is found or can be formed (e.g. coal dust, wood dust, grain dust).

**! DANGER**  
**Suffocation Hazard!**

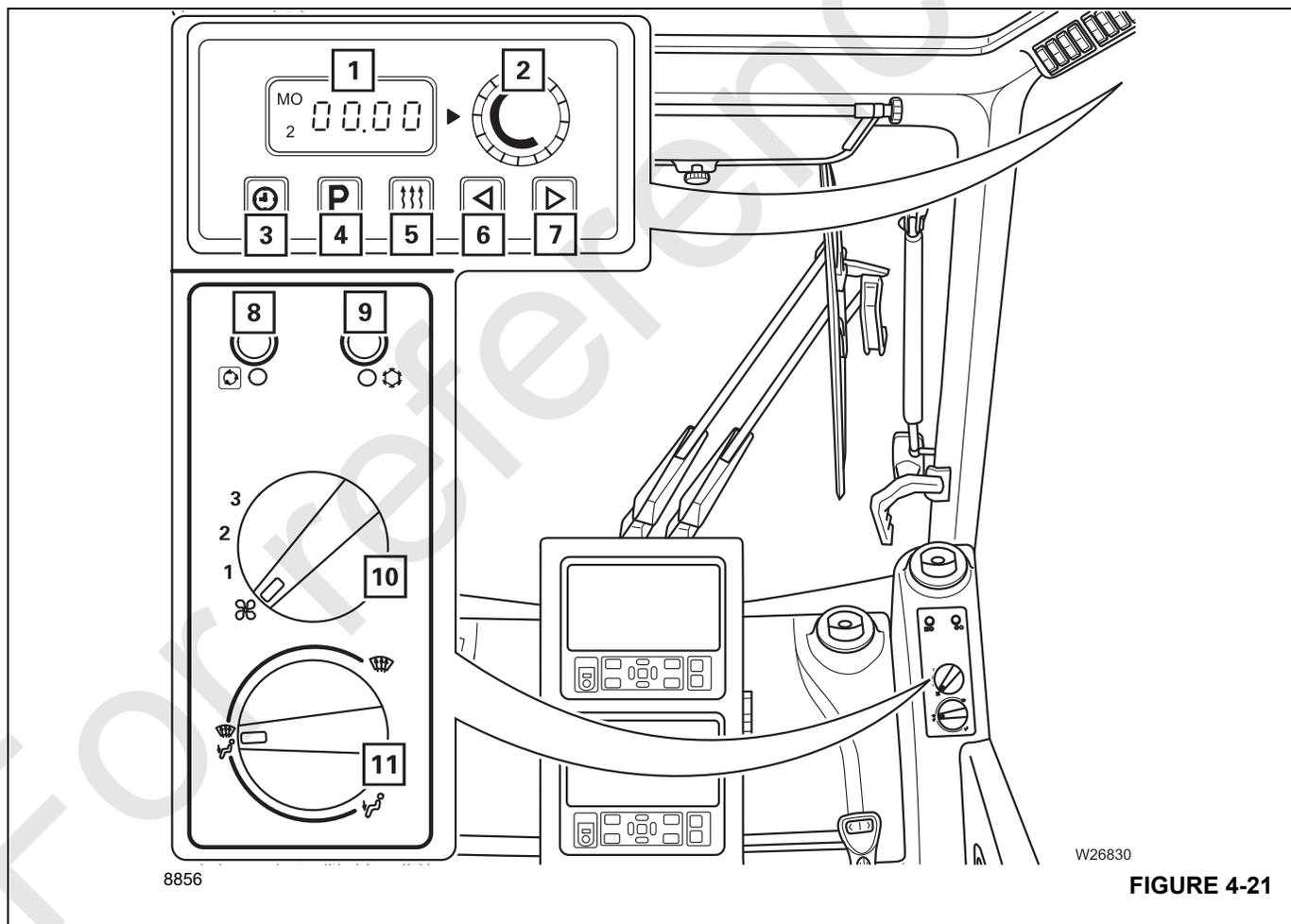
Carbon monoxide fumes from the heater exhaust can cause suffocation in an enclosed area (e.g. garages). Good ventilation is very important when operating the heater.

**Heating System Manual Operation**

**NOTE:** This section describes how to operate the heater manually. The heater can also be switched on automatically.

- Turn on the ignition.
- Press the button (5), (Figure 4-21) once.

The heater switches itself on and the control field(1), (Figure 4-21) lights up.



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**FIGURE 4-21**

The fan also switches on with the heater in order to avoid overheating.

### Temperature

You can preselect a temperature. The preselected temperature is automatically set and maintained.

#### To Increase the Temperature

Turn the knob (2), (Figure 4-21) clockwise.

#### To Reduce the Temperature

Turn the knob (2), (Figure 4-21) counterclockwise.

### Fan

You can set the air volume that is delivered to the superstructure cab.

#### Increasing the Air Volume

Turn the switch (10), (Figure 4-21) clockwise.

The switch engages in three different positions.

#### Reducing the Air Volume

Turn the switch (10), (Figure 4-21) counterclockwise.

When the heater is switched on the fan comes on at slow speed.

### Fresh Air/Recirculated Air

You can set which air is sucked in by the heating system.

#### Fresh Air

Press the button (8), (Figure 4-21) – lamp goes out.

#### Recirculated Air

Press the button again – lamp illuminates. Only the superstructure cab air is extracted.

### Air Distribution

You can distribute the heating air flow from the different air vents.

#### Air Vents on the Windshield and in the Center

Turn the switch (11), (Figure 4-21) clockwise.

### Air Vents on the Cab Floor

Turn the switch counterclockwise.

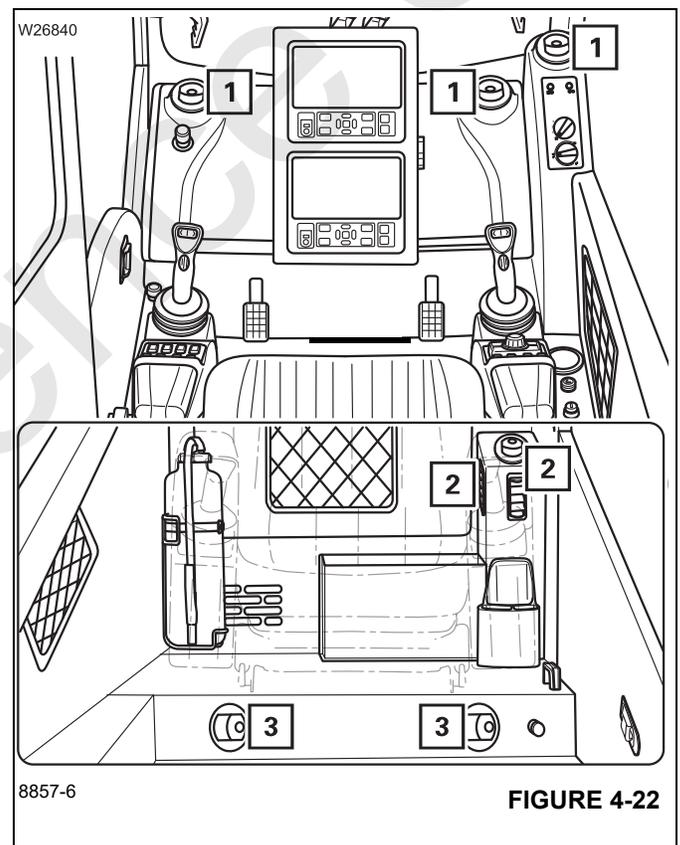
### All Air Vents

Turn the switch as shown. Refer to (Figure 4-22).

The heated air blows out at the following positions

- Windscreen and middle from the air vents (1), (Figure 4-22).
- Foot area from the air vents (3).
- All air vents (1) to (3).

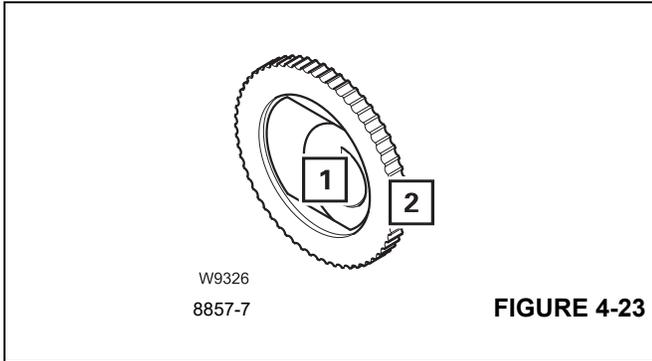
You can additionally set the direction of the air flow on the air vents (1) and (3).



**Adjusting the Air Vents**

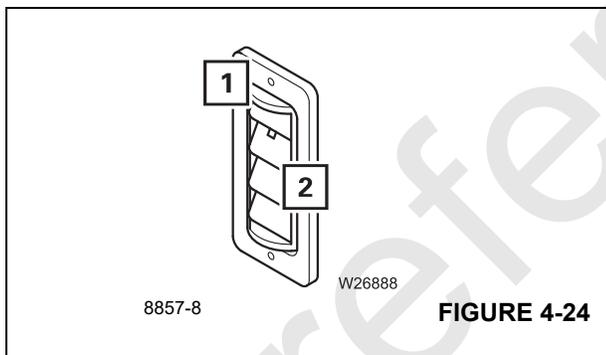
**Round Vents**

To open the vent:	Press the fins (1), (Figure 4-23) down and set them lengthwise
To direct the air flow:	Turn the ring (2), adjust fins
To close the vent:	Fold fins (1) to the side



**Rectangular Vents**

To open the vent:	Raise the fins (2), (Figure 4-24)
To direct the air flow:	Turn the ring (1), adjust fins
To close the vent:	Lower the fins (2)



**Heating System Automatic Operation**

**Setting the Day and Time**

Always set the current time and current day of the week. These settings are required for the correct activation point of the automatic start.

If the power supply is interrupted, all symbols in the display will flash and you must set the time and day again.

Press the button (3), (Figure 4-21) for longer than 2 seconds.

The displayed time flashes.

Set the current time on the flashing display, e.g. 14:00 – button (6) or (7).

Wait for 5 seconds. The new time is saved and then the weekday flashes, e.g. MO for Monday (Figure 4-25).



Set the current weekday on the flashing display – button (6), (Figure 4-21) or (7), (Figure 4-21).

After 5 seconds, the display stops flashing and the current time is displayed. The weekday goes out.

The time and weekday have now been set.

**Storing the Heating Start**

Heating is started automatically on schedule only if the time and the day of the week have been correctly set. Refer to *Time Set*, page 4-193.

You can set three different automatic heating starts – up to seven days in advance.

**NOTE:** If you call up values in order to change them during the following setting process, they flash for 5 seconds. The entry must be made within this period. The value stops flashing after 5 seconds and is saved as the new value.

To retrieve a storage location, press the button (4), (Figure 4-21) once.

The following flash:

- the retrieved storage location, e.g. 2 (Figure 4-26).
- the last saved heating start, e.g. 6:00.

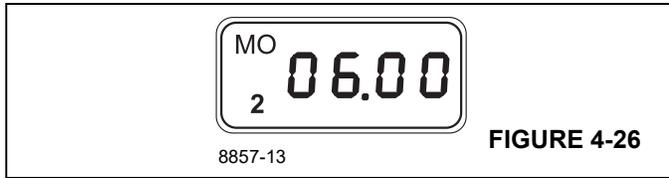


FIGURE 4-26

Set the time for the desired heating start e.g. 8:00 – button (6), (Figure 4-21) or (7), (Figure 4-21).

Wait for approx. 5 seconds until the weekday for the heating start flashes, e.g. MO for Monday (Figure 4-27).



FIGURE 4-27

Set the weekday for the desired heating start – button (6), (Figure 4-21) or (7), (Figure 4-21).

Wait for approximately 5 seconds until the current time is displayed, e.g. 14:00 (Figure 4-28).

Now, the new heating start has been saved and switched on.

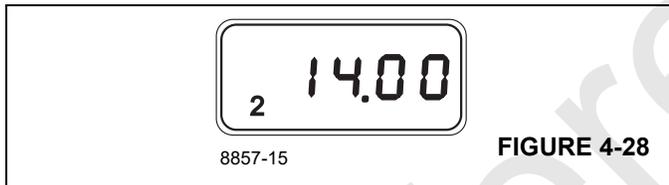


FIGURE 4-28

**NOTE:** If you wish to store one or two more heating starts, retrieve a new storage location using the button (3) and repeat the procedure. Refer to (Figure 4-21).

After you have saved the heating start, you can also set the heating period, by doing the following procedure.

**Setting the Heating Period**

After an automatic start, the heating system will disable automatically as soon as the set heating period has elapsed.

The heating period applies to all saved heating starts.

Disable the heating system using the button (5), (Figure 4-21).

Press the button (6) for longer than 3 seconds.

The last set heating period, e.g. 27 minutes (Figure 4-29), now flashes for 5 seconds in the display field.



FIGURE 4-29

Set the desired heating period with the buttons (6) and (7), (Figure 4-21). You can set a heating period of 10 to 120 minutes.

Wait for approximately 5 seconds until the current time is displayed.

A new heating period has now been set.

**Switching the Heating Start ON and OFF**

To switch on an automatic heating start, you must retrieve the corresponding storage location.

To retrieve a storage location, press the button (1), (Figure 4-21) once.

The display field flashes for 5 seconds and a storage location is shown (e.g. 2) (Figure 4-30). The heating start at this storage location is now switched on.

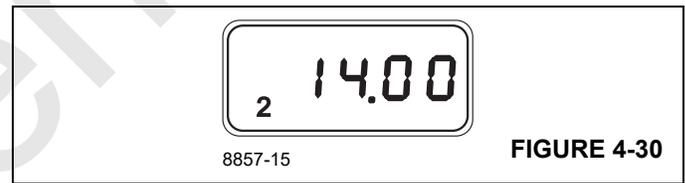


FIGURE 4-30

To switch on a different heating start, press the button (6), (Figure 4-21) repeatedly until the desired storage location is displayed. This heating start is switched on as soon as the display stops flashing.

To disable the automatic heating start, press the button (6), (Figure 4-21) repeatedly until a storage location is no longer displayed.

**Turning off the Heat**

This section only describes how to disable the heater manually. If the heater is switched on automatically, it switches off after the set heating period has elapsed, refer to the procedure above.

To switch off, press the button (5), (Figure 4-21) once. The heater goes off immediately.

**NOTE:** If you turn off the ignition while the heater is in operation, the heater will continue running for a certain period. You can set this remaining time by performing the following procedure.

### Setting the Remaining Time

If the ignition is turned off with the heater turned on, the heater will remain switched on for the remaining time.

Enable the heating system using button (4), (Figure 4-21).

Switch off the ignition.

The heating system will continue to run and the last set remaining time will flash, e.g. 48 minutes (Figure 4-31).



Set the desired remaining heating period with the buttons (6), (Figure 4-21) and (7) in the flashing display. You can set a remaining time of 1 to 120 minutes.

Wait for 5 seconds until the current time is displayed.

The remaining time is now set.

### Air Conditioning System

You can use the air-conditioning system to cool and dry the air in the superstructure cab when the engine is running.

#### Switching ON

At the heating/air conditioning control panel:

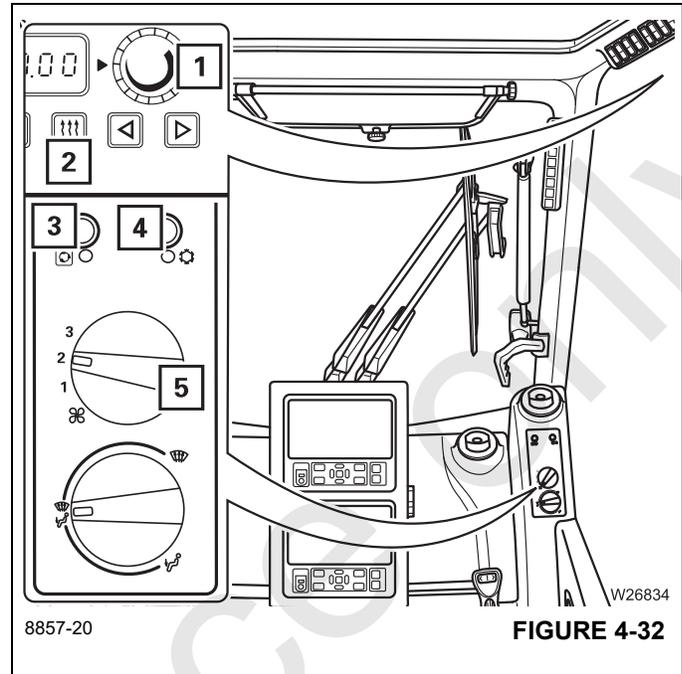
Press button (2), (Figure 4-32) once, heating off

Turn the knob (1) as far as it will go to cold position,

Turn the fan switch (5) to the required level.

For faster cooling, press button (3) for recirculation.

Switch the air conditioning on – press button (4).



Set the air distribution and ventilation nozzles.

#### Operation

Adjust the temperature and air flow as preferred by the operator.

If the truck crane has been exposed to strong sunlight for a long period of time, for example, the air conditioning system should initially be operated at the highest blower level with the engine running.

The door or at least the windows should be left open for a short while to air thoroughly. The cooling-down procedure can be accelerated by increasing the engine speed.

If the air-conditioning system is operated continuously, close the windows and the door to ensure sufficient cooling.

Set the fan to a lower level once the inside temperature has reached the desired temperature.

#### Drying the Air

You can dry the air in the superstructure Cab.

Switch the air conditioning on – press button (4), (Figure 4-32) – the button will illuminate.

At the heater control panel:

- Press button (2) once, heating on,
- Switch (1) as far as it will go to warm.
- Turn the switch (5) to the required level.
- Button (3) on the Recirculated air symbol – lamp on.

When drying, the air conditioning system and the heating system work against each other. After drying, switch off the device that you do not require.

### Switching OFF

Switch the air-conditioning system off:

Press the button (4), (Figure 4-32) – button lamp goes out,

If you do not wish air to be circulated, turn the switch (5) to the off position.

### Settings and Displays for Crane Operation

This section only describes settings and displays needed during crane operation. Operating elements that can be assigned to other procedures are described with the corresponding procedures.

#### Inclining the Crane Cab

With the appropriate equipment, you can incline the crane cab in order to attain a better sitting position when working at heights.

**NOTE:** Prior to inclining the cab, make sure the door is latched into position and that all loose items are secured.

#### (A) – Raise the Cab (See Figure 4-33)

- Close the crane cab door.
- Push the button (1) down.

#### (B) – Lower the Cab (See Figure 4-33)

- Close the crane cab door.
- Push the button (1) up.

The crane cab will tilt as long as you hold the button down or until its end position is reached.

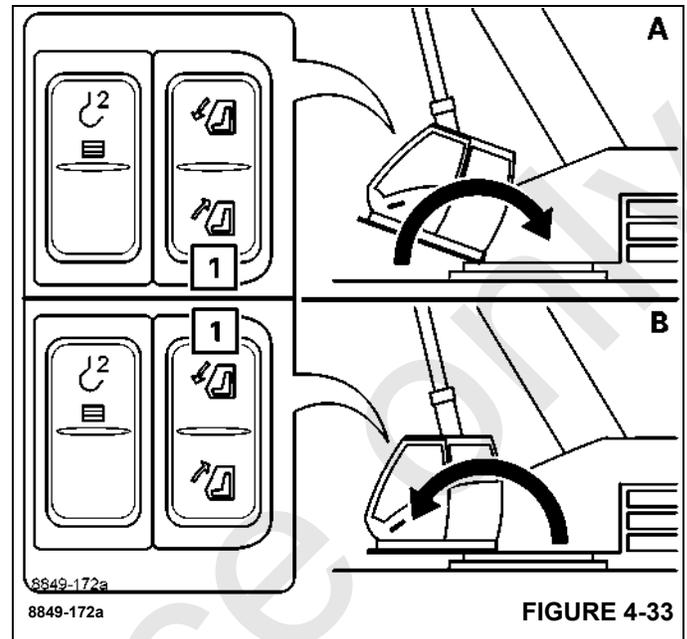


FIGURE 4-33

## CRANE OPERATION CHECKS

### Daily Checks While Stationary

1. Sit down.
2. Enable control lever functions.
3. Exit the seat.
4. Do not press either Dead Man's Switch (1), (Figure 4-34).
5. Function both control levers in all directions.

No functions should operate if any control malfunctions. Have the problem diagnosed.

### Dead-Man's Switch Test

- For the following tests, a crane function will need to be enabled.
- Do not sit down on the crane cab seat.
- Press and hold the right dead man's switch (1), (Figure 4-34) and slowly lift the hook block.

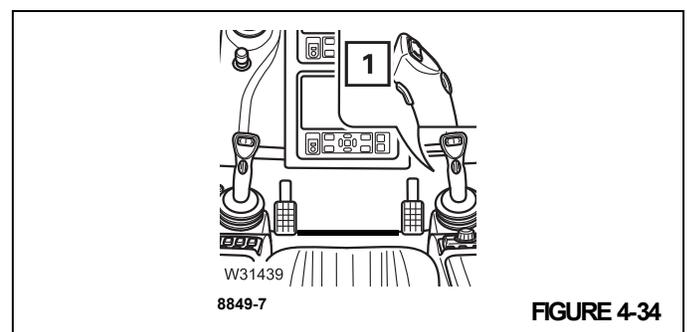


FIGURE 4-34

- With the control lever actuated, let go of the right dead man's switch and check whether the crane movement comes to a standstill within approximately 3 seconds.
- Repeat the check with the dead man's switch on the left control lever.

If the dead man's switch system is not working correctly, do not start work with the crane but notify your local distributor or Grove Product Support.

## Before Operating the Crane

**NOTE:** This procedure only applies to working with a rigged truck crane (supported and rigged with counterweight). If the truck crane is not yet rigged refer to *Set-up and Installation*, page 5-1.

Perform the inspections as outlined in *Pre-Starting Checks*, page 4-4.

1. Inspect the truck crane, looking out in particular for any leaking fluids (oil, fuel or water).

### CAUTION

#### Environmental Hazard!

Fluid spills can result in environmental damage. Immediately repair all oil, fuel and coolant leaks detected during inspection.

2. Adjust crane cab seat and front panel, refer to *Adjusting the Superstructure Crane Seat and Front Control Panel*, page 3-24.
3. Enable the cameras for the operation of the crane, refer to *Cameras for Crane Operation*, page 5-37.
4. Adjust the slewable spotlights if necessary.
5. Start the engine for crane operation.

Check the operation of all crane functions. If any malfunctions are noted, do not use the crane until the issues are corrected.

6. Check the position of the hoist ropes, refer to *Checking the Position of the Hoist Ropes*, page 5-3.
7. Compare current rigging mode to display on RCL – enter current rigging mode, if necessary, refer to *Enter Rigging Code*, page 4-198.
8. Compare current reeving of hoist used against the display on the RCL – enter current reeving, if necessary, refer to *Selecting the Hoist and Entering the Reeving*, page 4-206.
9. Check telescoping, refer to *Inspections Prior to Starting Operations*, page 4-60.

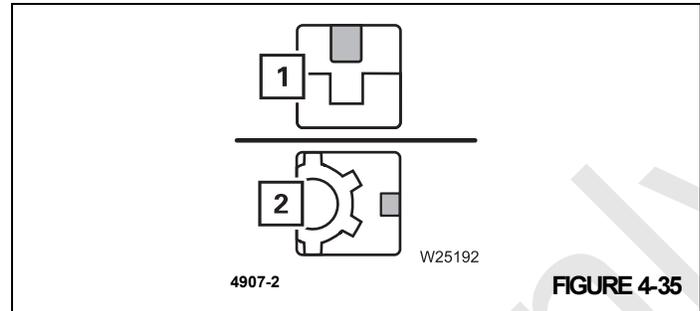


FIGURE 4-35

10. Check the electrical system for correct operation, refer to *Checking the Electrical System*, page 4-38.
11. Check hydraulic oil temperature.
12. Adjust the brightness of the CCS displays as required.

**NOTE:** See additional information on inspections during crane operation, on permissible working positions and on how to operate the individual power units, refer to *Crane Operation with Main Boom*, page 4-221.

### Checking the Electrical System

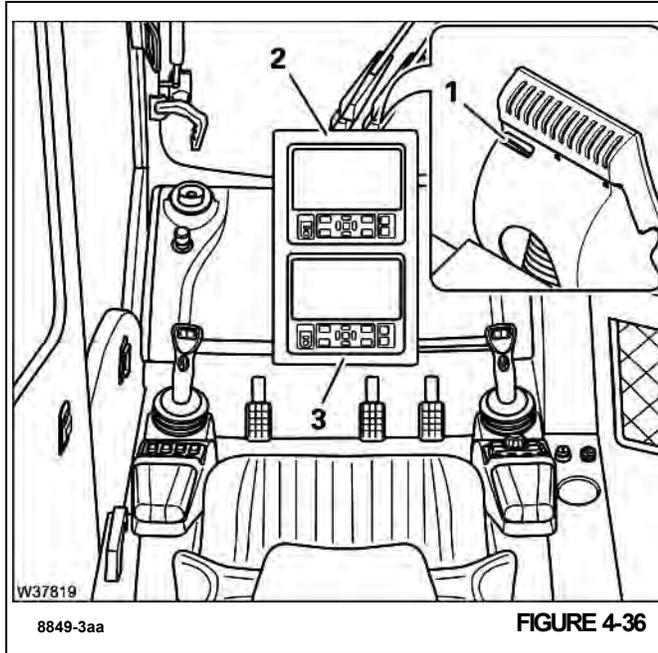
Check the following functions and have faulty parts repaired.

- Working area spotlight.
- Boom position indicator light, rotating beacons.
- Windshield wipers, windshield washing system.
- Horn.

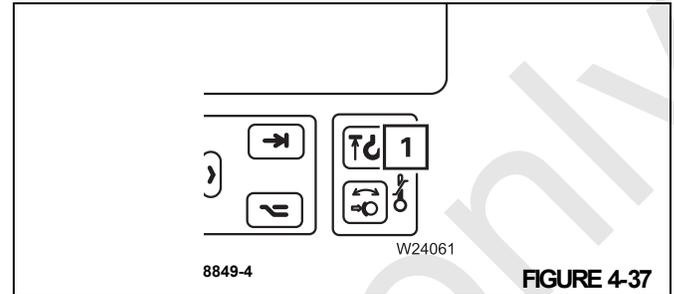
### Adjusting the RDM/ODM Panels

You can adjust the height, inclination, and clearance of the seat to the RDM/ODM panels.

- Pull and hold the handle (1), (Figure 4-36).
- Adjust the front panel to suit your requirement.
- Release the handle (1), (Figure 4-36).
- To adjust the inclination of the display, press either (2), (Figure 4-36) or (3), (Figure 4-36).



**NOTE:** Anti Two-Block switches on auxiliary boom nose or boom extension (if installed) also need to be checked in a similar manner.



If the anti-two-block switch is not working correctly, do not start work with the crane, but notify your local distributor or Grove Product Support. Refer to *Anti-Two-Blocking Device*, page 2-5.

**Emergency Stop Switch**

- Set down the hook block and let go of both control levers.
- Press the emergency stop switch (Figure 4-38) so that it engages.

**Checking Operator Aids**

**Rated Capacity Limiter**

- Turn on the ignition to start the rated capacity limiter (RCL). Do all of the checks and enter the current rigging mode. Refer to *Switching ON the RCL*, page 4-195.
- The RCL is working correctly at this point in time if no error message is pending and if crane movements have been enabled.

If the RCL is not working correctly, do not start work with the crane but notify your local distributor or Grove Product Support. Refer to *Rated Capacity Limiter (RCL) Systems*, page 2-4.

**Anti Two-Block Switch**

- Raise the main boom until the hook block is lifted off the ground.
- Hoist up slowly until the hook block lifts the Anti Two-Block Switch weight.
- Make sure that hoist up, boom lower and tele extend are locked out, the hoist limit indication (1), (Figure 4-46) is illuminated, and the operator display buzzer is on. If so, the anti-two-block switch is determined to be functioning properly.
- Make sure that hoist lower, boom raise and tele retract are still operational.



- Check whether the engine stops.
- Turn the emergency stop switch until it disengages again.
- Repeat the checks with the emergency stop switches in both outrigger control panels.

If the emergency stop switch is not working correctly, do not start work with the crane but notify your local distributor or Grove Product Support.

## CRANING FUNCTIONS

### Controller Operation

The controller operation for crane functions is proportional – that is, the closer the lever is to neutral (center), the slower the system responds.

**NOTE:** Always operate controllers with slow, even pressure.

### Proper Crane Leveling

The load capacity chart developed in accordance with ASME B30.5 is based upon the crane being level to within 1% of grade. If the crane is not level to 1% of grade, the capacity will be reduced. Therefore, whether lifting on rubber or outriggers, it is essential that the crane is level to within 1% of grade. The bubble level that is 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, fully lowered to horizontal and fully retracted (for cranes fitted with a boom rest, the boom shall be stowed onto the boom rest). Raise and level the crane using the outriggers; refer to *Setting the Outriggers*, page 4-42.

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 (for cranes fitted with a boom rest, the boom shall be stowed onto the boom rest). If necessary, re-level the crane using the procedures under *Setting the Outriggers*, page 4-42.

### Bubble-Level Indicator Adjustment

**NOTE:** To check and adjust the auto level, refer to the *Setting the Outriggers Using the Auto-Level Feature*, page 4-47.

There are two Bubble-Level Indicators on the carrier. One by each remote control panel which 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 the process, if necessary, on opposite side.

### Using the Outriggers

Besides the remote control and superstructure cab, the carrier is equipped with remote mounted outrigger panels on each side of the carrier to allow the outriggers to be operated from the ground. For additional information on the Outrigger Controls and Indicators, refer to *Setting the Outriggers*, page 4-42.



#### DANGER

To prevent serious injury or death, keep clear of moving outrigger beams/jacks

---



#### WARNING

The Parking Brake must be engaged to run the Outriggers.

---



#### WARNING

The outriggers and the center front stabilizer must be properly extended and set before any other operation of the crane is attempted. The center front stabilizer must be checked and properly set after any main jack is extended or retracted.

**NOTE:** The center front stabilizer will automatically retract when any main jack is retracted and the Cribbing Mode is not active.

---



#### DANGER

Death or serious injury could result from improper crane setup on outriggers.

---

**WARNING**

Be sure the outriggers are properly extended and set, and the crane is level for operation on outriggers.

All four outrigger beams must be equally set to the fully retracted position, mid position vertical stripe, or fully extended position before beginning operation. Mid extended outriggers must be pinned (locked) in position.

**WARNING**

When operating the crane on outriggers, the outriggers should always be extended and set in the proper position corresponding to the load capacity chart to be used.

**Engaging the Outrigger Mid-Extend Lock Pin**

**NOTE:** It may be necessary to jog the Outrigger Extend/Retract Switch slightly to get proper pin engagement.

**WARNING**

All four outrigger beam lock pins must be engaged before operating from the partial extend- or mid-extend position.

The operator must select the proper load chart and RCL program for the outrigger position selected.

Partial extend positions can be located at 54% or 77% position (Figure 4-39).

1. With the outriggers fully retracted, disengage the locking stirrup from its stowed position, refer to (Figure 4-39).
2. Slowly extend the outriggers to the partial extend position until the outer extension beam and inner extension beam holes align (Figure 4-39).
3. Remove locking pin from stowage bracket located next to the frame (Figure 4-40).
4. Insert locking pin into Partial/Mid Extension locking holes. If pin will not freely slip into the hole, slowly extend or retract the outrigger beam to allow the locking pin to engage into the holes.
5. Rotate pin until retention pin aligns with slot in locking hole of outrigger beam.

**NOTE:** Rotate handle on the lock pin until lug is pointing downward to lock pin in secured position.

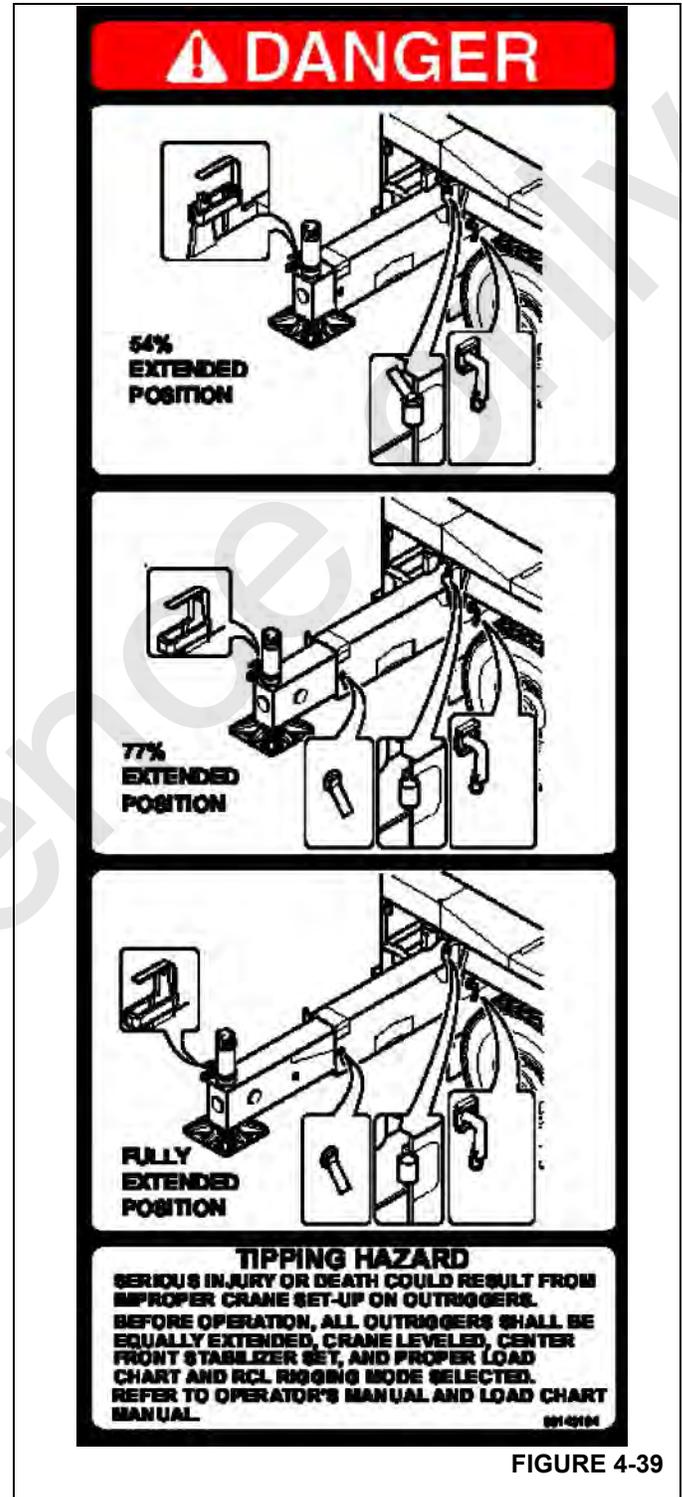
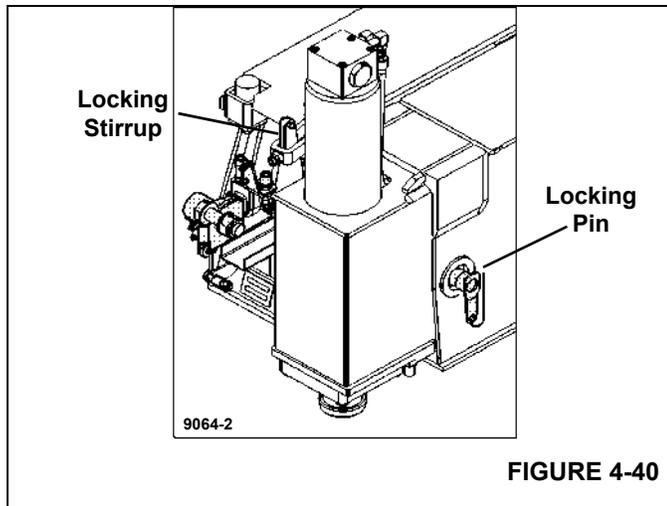


FIGURE 4-39



### Setting the Outriggers

1. Set the parking brake before operating the outriggers.

**NOTE:** The two ground outrigger control panels **ONLY** operate when the carrier ignition is ON and the parking brake is set. The operator can only operate the outrigger beams on the side s/he is operating from. The jacks can be operated from either side.

Make sure the air suspension is deflated before raising machine on outriggers.

2. Position the outrigger floats directly out from each outrigger to where the outriggers will be properly extended.
3. Push the appropriate outrigger selector push button to operate the preferred main outrigger beam and push the outrigger extension/retraction push button to extend. The appropriate outrigger beam should begin to extend. Refer to *Extend/Retract Outrigger Beams*, page 4-46 if the crane is to be operated with the outriggers at one of the mid-extend positions.
4. If required, extend the outrigger beams to the mid-extend or fully extended position using the Outrigger Extend/Retract Switch and/or the Operator Display Module (Refer to *Extending/Retracting the Outriggers Beams/Jacks*, page 4-139).

Refer to *Engaging the Outrigger Mid-Extend Lock Pin*, page 4-41 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 four 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 4 (above) for each outrigger after a multi-outrigger extension.

5. After all four outrigger beams have been fully extended, position the appropriate outrigger selector push button to FRONT JACK or REAR JACK and position the outrigger extension/retraction button to EXTEND.

### **DANGER** Tipping Hazard!

The mid-extend outrigger beam lock pin must be engaged before operating on any beam from the mid-extend position.

Operator must select the proper rigging code from the load chart and RCL program for the outrigger position selected. The Outrigger Monitoring System (OMS) will NOT change the rigging code to match the existing outrigger position.

6. Pick up outrigger float and slide onto the stud end of jack cylinder. Extend the jack cylinder to the ground. Insert both locking pins into the holes provided.
7. Extend all four main jacks until the crane is level with all the wheels off the ground, push the front outrigger selector buttons to FRONT JACK and push the extension/retraction button to EXTEND. Extend the front jacks approximately 76 to 102 mm (3 to 4 in).
8. Push the rear outrigger selector button to REAR JACK and push the extension/retraction button to EXTEND. Extend the rear jacks approximately 76 to 102 mm (3 to 4 in).
9. Repeat the procedures in Steps 6 and 7 (above) until all wheels are clear of the ground and the crane is level, as indicated by the bubble-level indicator located at the bottom of each outrigger control box. If suspected that the bubble level indicator is out of adjustment, refer to *Bubble-Level Indicator Adjustment*, page 4-40.

- 10. Then lower the center front stabilizer until it just contacts ground.
- 11. **OPTIONAL STEP:** If additional cribbing is required to obtain necessary ground clearance, use the Cribbing Mode, "Activating Cribbing Mode" on page 4-43 (below).

**Running Outriggers from the Superstructure Cab ODM**

Select the appropriate icon on the Outrigger Control Display to perform the function as noted in the table below (Figure 4-41).

Exiting the Menu:	Select symbol (1), (Figure 4-41) and confirm
Outrigger Beam:	Select symbol (2), (Figure 4-41) and confirm
Outrigger Jack:	Select symbol (3), (Figure 4-41) and confirm
Auto Level	Select symbol (4), (Figure 4-41) and confirm
Center Front Stabilizer (CFS)	Select symbol (5), (Figure 4-41) and confirm
Front Left	Select symbol (6), (Figure 4-41) and confirm
Front Right	Select symbol (7), (Figure 4-41) and confirm
Rear Left	Select symbol (8), (Figure 4-41) and confirm
Rear Right	Select symbol (9), (Figure 4-41) and confirm
Center Front	Select symbol (10), (Figure 4-41) and confirm

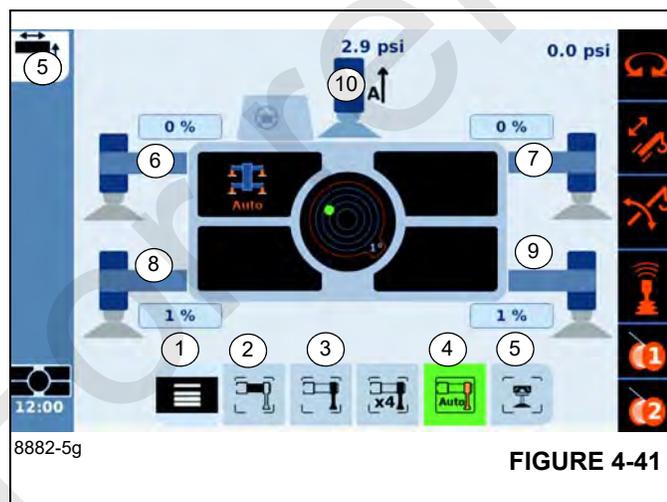


FIGURE 4-41

**Additional Cribbing Needed to Increase Ground Clearance**

Cribbing Mode is an outrigger mode that will allow the center front stabilizer (CFS) to be locked in position while the front jacks are raised to allow for additional cribbing to be inserted.

**Prior to Entering Cribbing Mode**

Before entering the Cribbing Mode, set the crane up by following Steps 1 thru 5 under Section, *Engaging the Outrigger Mid-Extend Lock Pin*, page 4-41.

**Activating Cribbing Mode**

**NOTE:** The Remote Control does **NOT** have a Cribbing Mode Icon/Setting to activate Cribbing Mode.

There are two methods for activating Cribbing Mode:

1. Using the Carrier Outrigger Keypad Center Front Stabilizer (CFS) Push Buttons.

**OR**

2. Navigating the Superstructure Cab ODM Outrigger Screen and selecting the Cribbing Mode Icon. See (1), (Figure 4-44).

The following are required for the Cribbing Mode to be activated:

- Boom must be directly over the front or over the rear (slew angle at 0 +/-2 degrees or 180 +/- 2 degrees).
- Boom to be elevated as needed to make sure that the load on the CFS is less than 4,500 psi. **NOTE:** The pressure indicator is presented on the ODM Outrigger Menu. On the Carrier, the pressure indicator is shown on the status of the CFS LED. Flashing RED LED indicates CFS pressure > 4500 psi (Solid RED LED for 1000 - 4500 psi).
- The Swing Brake must also be applied for Cribbing Mode to be active. **NOTE:** This occurs when Swing is disabled **OR** the operator has not slewed in the past 7 seconds (secures automatically). On the ODM Outrigger Screen, a flashing red "swing brake" Icon will appear to indicate when the swing brake is not engaged.

**Activating from Outrigger Keypads**

On the Outrigger Keypad(s), to activate or deactivate Cribbing Mode (Figure 4-42), push the Center Front Stabilizer (CFS) push button twice.

**NOTE:** The red LEDs (1 thru 4), (Figure 4-43) over the Center Front Stabilizer (CFS), Auto-Level, and both rear jack push buttons are on when the Cribbing Mode is active because the CFS motion is blocked. These LEDs also light if the pressure limit is reached in the CFS.

For additional information on the Outrigger Panel, refer to *Outrigger Controls and Indicators*, page 3-18 and the *Outrigger Control Panel*, page 3-18 and (Figure 3-7).

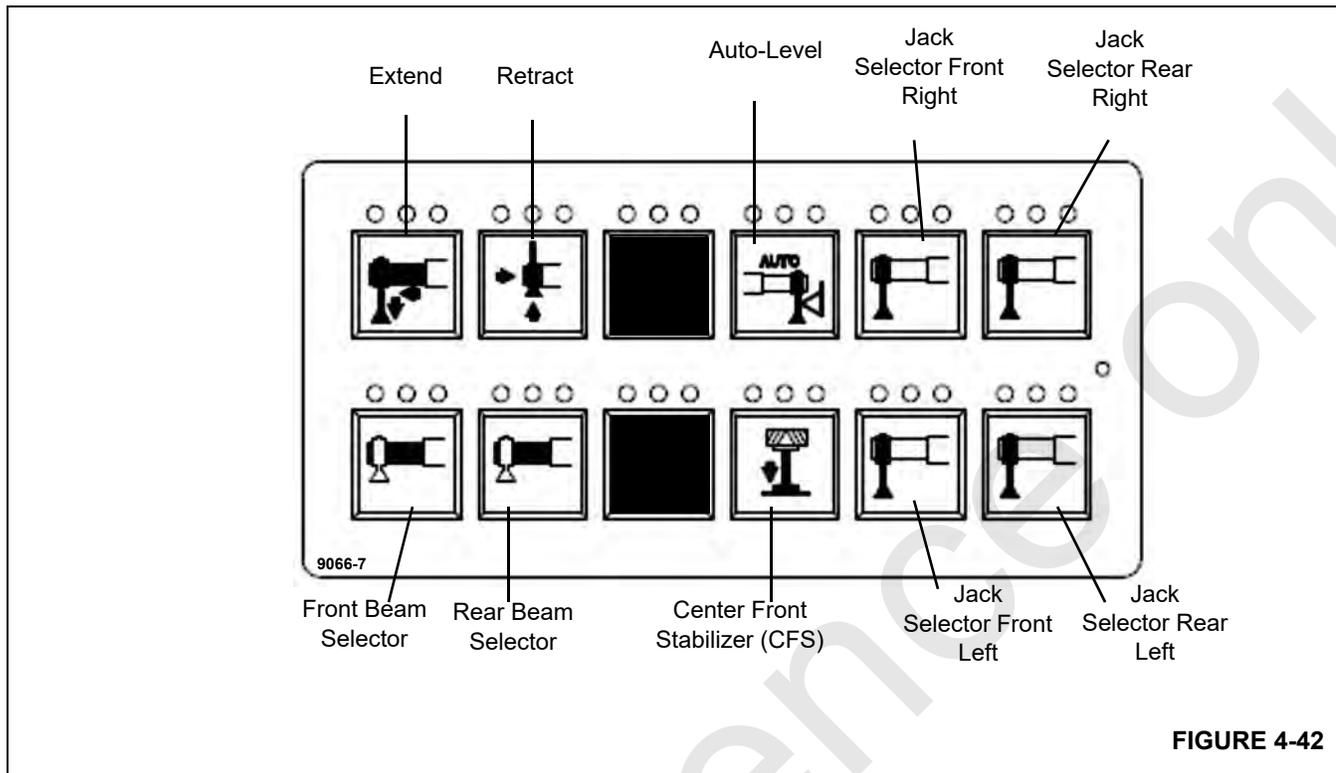


FIGURE 4-42

### Enter Cribbing Mode from Outrigger Keypads

Use either side of the Outrigger Keypads.

1. Park the crane and lock the swing brake and the parking brake. Extend outrigger beams to the desired position.
2. Fully extend the four outrigger jacks and level the crane.
3. Place cribbing beneath the Center Front Stabilizer (CFS).
4. Extend CFS until movement ceases.
5. Enter Cribbing Mode by quickly pressing the **Center Front Stabilizer** (Figure 4-43) push button twice. Cribbing Mode is now activated.

**NOTE:** During the course of operation on the Outrigger Panels, you will see the function colors during the operation. These are the Outrigger Operation Indicator Lights: **Green, Yellow and Red**. Refer to *Outrigger Operation Indicator Lights*, page 3-19. Red indicates something is wrong, STOP (Prohibited). Yellow indicates an electrical issue and Green indicates Normal Operation.

**NOTE:** Cribbing Mode will automatically time out after 30 seconds if no jack operation is performed. If Cribbing Mode becomes disabled during this

procedure, simply re-enable it by starting with Step 5.

6. Retract the main front outrigger jacks off the ground. by pushing the **Retract** push button and the **Jack Selector** push buttons together to move the main front outrigger jacks off the ground (Figure 4-42).

**NOTE:** If you are locked out of the Cribbing Mode due to over pressurization of the CFS, re-level the crane on the outriggers and rearrange your counterweight configuration or raise the boom.

7. Add cribbing under the main front outriggers.
8. Extend the main front outrigger jacks so that the Center Front Stabilizer (CFS) is unloaded and comes off the ground/cribbing by pressing the Extend push button and both the Left and Right Front Jack Selector push buttons together (Figure 4-42).
9. Exit Cribbing Mode by double-tapping the CFS Button or let the Cribbing Mode time out.
10. Level the crane. Refer to *Proper Crane Leveling*, page 4-40 and proceed with crane setup.
11. Extend the CFS until movement ceases by pressing the Extend push button and the Center Front Stabilizer push buttons together (Figure 4-42).

**CFS Overload Condition Alert**



**WARNING**  
**CFS Over Pressure Hazard!**

If at any time during this operation, the CFS is greater than 1000 psi, you will get a CFS overloaded ALERT (solid RED).

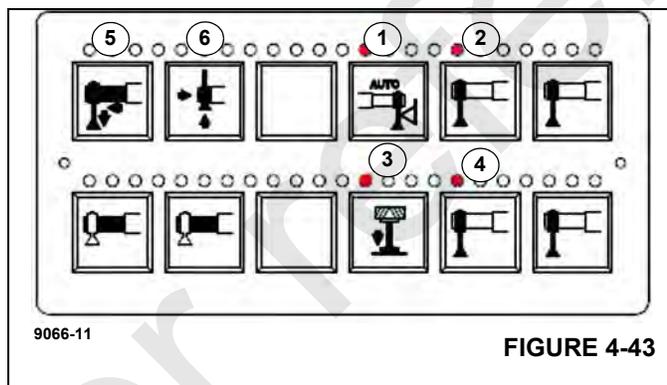
If the LEDs on the control panel illuminate, an alert will be given to indicate that there is a CFS overload condition.

**NOTE:** Flashing RED LED indicates CFS pressure > 4500 psi (Solid RED LED for 1000 - 4500 psi).

The LED's on the control panel will illuminate to indicate that the Center Front Stabilizer (CFS) is greater than 1000 psi.

1. If not pressing Outrigger Extend or Retract - red LEDs above the CFS and Auto Level will illuminate as shown in (1) and (3), (Figure 4-43).
2. If pressing Outrigger Extend - red LEDs above the CFS, Auto Level and both rear jacks will illuminate (same as with the Cribbing Mode Active Indicator) as shown in (Figure 4-43). Extending the front main jacks or retracting the rear main jacks will reduce CFS pressure.
3. If pressing Outrigger Retract - red LEDs above the CFS, Auto Level and both front jacks will illuminate (Figure 4-43). STOP, raise the CFS to adjust.

**NOTE:** An operator must be pressing either Extend or Retract for conditions in Steps 2 and 3 above.



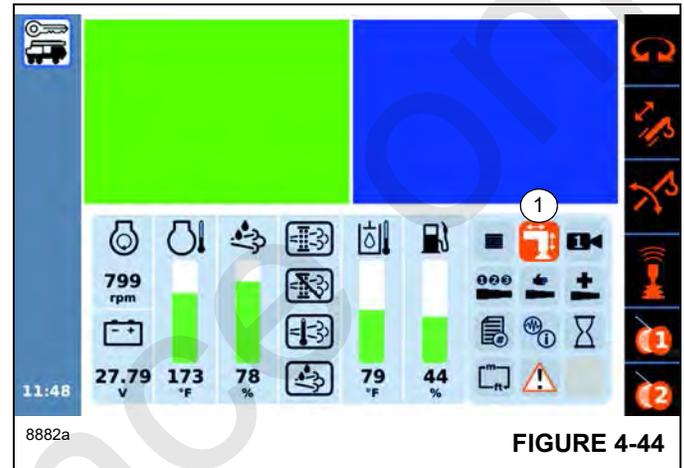
**FIGURE 4-43**

**Activating Cribbing Mode from Superstructure Cab ODM**

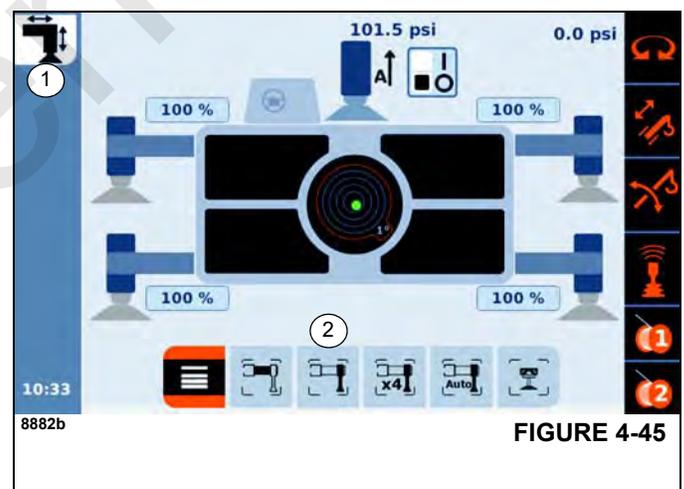
To activate Cribbing Mode from the Superstructure Cab ODM, select the Outrigger Menu (1), (Figure 4-44), select the Outrigger Jack (2), (Figure 4-45), and then toggle the Cribbing Mode Switch, that appears next to the Center Front

Stabilizer (CFS) to the ON position (2), (Figure 4-46). For additional information on the Outrigger Menu, refer to *Outrigger Keypad Power Indicator Light*, page 3-20.

**NOTE:** Cribbing Mode will automatically time out after 30 seconds if no jack operation is performed. If Cribbing Mode becomes disabled during this procedure, simply re-enable it by starting with Step 6 below.



**FIGURE 4-44**



**FIGURE 4-45**

1. Start the engine from the Superstructure cab.
2. Go to the ODM, CCS Home Screen, Main Menu. Scroll to the Outrigger Icon (1), (Figure 4-44).
3. Open the Outrigger Screen (1), (Figure 4-45), scroll to, and select the Outrigger Jack Select (2), (Figure 4-45) from the Radio Buttons across the bottom of the Screen.
4. The Cribbing Mode Enable Switch (2), (Figure 4-46) will now appear next to the Center Front Stabilizer (CFS) at the top of the screen.



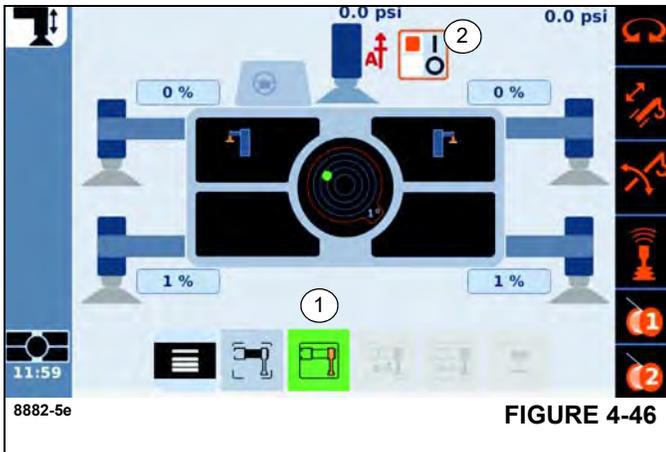


FIGURE 4-46

5. Fully extend all outrigger beams until the ODM reads 100% (1), (Figure 4-45). Fully extend the four outrigger jacks and level the crane.
6. Press the Center Front Stabilizer (CFS) (1), (Figure 4-47) to extend the CFS into place. Place cribbing beneath the CFS.
7. Extend CFS until movement ceases. **NOTE:** You will also see an increase in the CFS pressure (Figure 4-50).
8. Activate Cribbing Mode by using the Cribbing Mode Enable Switch:
  - **Cribbing Mode Enable Switch:** Toggle the Cribbing Mode Enable Switch (2), (Figure 4-46) to the ON position (Orange indicates ON position), then press the Cribbing Mode on the ODM (1), (Figure 4-47).

Cribbing Mode is now activated.

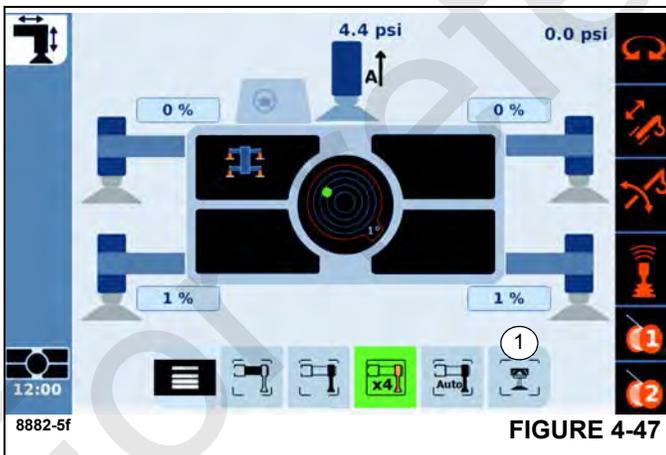


FIGURE 4-47

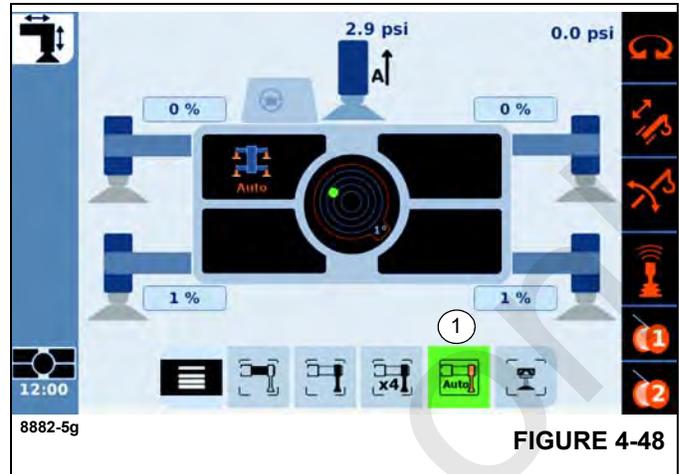


FIGURE 4-48

9. Retract the main front outrigger jacks off the ground by selecting the Retract push button and the Jack Selector (1), (Figure 4-46) push buttons together to raise the main front outrigger jacks off the ground.
10. Add cribbing under the main front outriggers.
11. Extend the main front outrigger jacks so that the Center Front Stabilizer (CFS) is unloaded and comes off the ground/cribbing by pressing the Extend push button and the Jack Selector push buttons together (Figure 4-46).
12. Level the crane. Refer to *Proper Crane Leveling*, page 4-40 and proceed with crane setup.
13. Extend the CFS until movement ceases by pressing the Extend push button and the Center Front Stabilizer push buttons together (Figure 4-47).

### Extend/Retract Outrigger Beams

1. To extend or retract an outrigger beam or jack, select the beam/jack with the jog dial or control panel. (Left rear beam is selected and beam icon is green, meaning it is active).
2. Press and hold the outrigger beam/jack extend/retract pre-select switch (1), (Figure 4-49) on the left hand armrest control panel.
3. Release the switch when the extension/retraction is reached.

For additional information refer to: *Extend/Retract Outrigger Beams*, page 4-46.



FIGURE 4-49

### Extend/Retract Outrigger Jack Cylinders

To extend or retract the outrigger jack cylinder, refer to (Figure 4-48) and Table function.

### CFS Overload Alert

1. The ODM Outrigger Screen will indicate that the CFS is overloaded. Extending the front main jacks or retracting the rear main jacks will reduce CFS pressure.
2. The ODM CFS Overloaded ALERT will be on solid RED when the CFS is greater than 1000 psi (1), (Figure 4-50). The ALERT will be ON Flashing when the pressure is greater than 4500 psi and the ODM not on outrigger screen. Operator should reduce CFS pressure using means described in Step 1 above.
3. The Outrigger Circuit Supply Pressure value shows the pressure of the entire circuit (beams and jacks of all outriggers, including the CFS) and will be shown on the Outrigger Screen as shown in (2), (Figure 4-50).
4. The Center Front Stabilizer (CFS) pressure value will also be shown on the Outrigger Screen.

**NOTE:** Cribbing Mode may be canceled by the user at any time by scrolling the selection to (1), (Figure 4-50) and pressing OK. Cribbing Mode reverts to inactive when the user exits the outrigger operating screen.

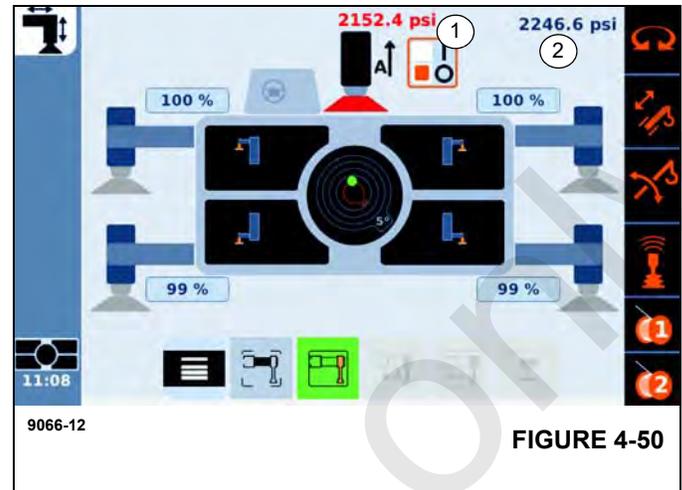


FIGURE 4-50

### Exiting Cribbing Mode

Exiting the Cribbing Mode may be accomplished by allowing the Cribbing Mode to automatically time out. Time out happens approximately 30 seconds after no outrigger functioning; OR simply by turning **OFF** on the ODM.

### Setting the Outriggers Using the Auto-Level Feature

To activate auto-level from either the Carrier or the Superstructure ODM, press and hold the auto-level button and the 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 the ground. If any of the tires are still in 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 outrigger jack. Verify visually that the center front outrigger jack has made contact with the ground or outrigger mat. Also refer to *Auto-Level Push Button*, page 3-19.

Start with outrigger beams and jacks retracted.

**NOTE:** ECO mode does not work when operating the outriggers.

1. Enable the outrigger functions by doing the following:
  - Shift transmission to neutral
  - Engage the parking brake.
  - Disable all crane functions
  - Fully lower cab
1. Position the outrigger beams to the desired length and make sure that the pads are properly installed.
2. Fully extend all four main jacks.

3. **A.** From either the Carrier outrigger keypad, press and hold the auto-level button (1), (Figure 4-43) and either extend/retract (5), (6), (Figure 4-43) keys,

- OR -

**B.** From the Superstructure Cab ODM, select the auto-level button (1), (Figure 4-48). The crane will:

- a. Briefly extend all 4 jacks.
- b. Briefly retract all 4 jacks.
- c. Begin adjusting by lowering 2 jacks at once until level position is reached.
- d. There may be several long pauses after lowering for the level sensor to stabilize – keep holding the buttons through these.

4. Leveling is complete when out-of-level by less than 0.1 degrees. And, on the outrigger control panels, green and yellow LED's will alternate - this is intended as a reminder to proceed to set the center front stabilizer.

**NOTE:** After using auto level, the center front stabilizer must be lowered.

5. Extend the Center Front Stabilizer (CFS) as shown in (4), (Figure 4-43). Refer to *Activating Cribbing Mode from Superstructure Cab ODM*, page 4-45

### Outrigger Monitoring System (OMS)



#### DANGER

##### Tipping Hazard!

The crane can overturn, causing death or serious injury or sustain serious damage from operating the crane from outrigger positions other than the position specified on the selected load chart.

The OMS is an operator's aid only, measurements from the OMS system are not used by the crane control system. The operator must select the proper rigging code.

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 four pre-defined locations, including fully retracted, partial extend, mid-extend, and fully extended.

Outrigger setup is the same for cranes equipped with OMS. Refer to *Engaging the Outrigger Mid-Extend Lock Pin*, page 4-41 or *Setting the Outriggers Using the Auto-Level Feature*, page 4-47. The CCS only indicates the horizontal position of the outrigger beam and should not be used to confirm proper crane setup.

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 (OMS), an outrigger beam over-ride warning screen will appear. 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.

When an outrigger is not properly deployed the outrigger symbol will light up red and the operator will need to properly deploy the outriggers for the rigging code selected.

If an outrigger symbol and its associated distance number does not display, then that sensor is not properly calibrated or has failed.

### Stowing the Outriggers

Also, refer to *Activating Cribbing Mode from Superstructure Cab ODM*, page 4-45.

**NOTE:** Park the crane. Lock the swing brake and the parking brake.

1. Push the center front stabilizer control button to ACTIVATE and retract the center front stabilizer.
2. Press both the left rear jack button and the right rear jack button, plus the retract button until the rear jacks have retracted several inches.
3. Press both the left front jack button and the right front jack button, plus the retract button until the front jacks have retracted several inches.
4. Repeat steps 2 and 3 until the crane is resting on all wheels and the jack floats are several inches off the ground.



#### CAUTION

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

5. Release the locking pins and allow the floats to drop to the ground.
6. Continue to retract the jacks until fully retracted.
7. Refer to “Stowing the Outrigger Partial/Mid Extension Lock Pin” on page 4-49 if the crane was operated at the partial or mid-extend position. Push the appropriate outrigger selector button to FRONT EXTENSION or REAR EXTENSION and push the Extension/Retraction Switch to RETRACT to retract each outrigger beam.

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

8. Stow the outrigger floats.

### Stowage of Outriggers Using Cribbing Mode

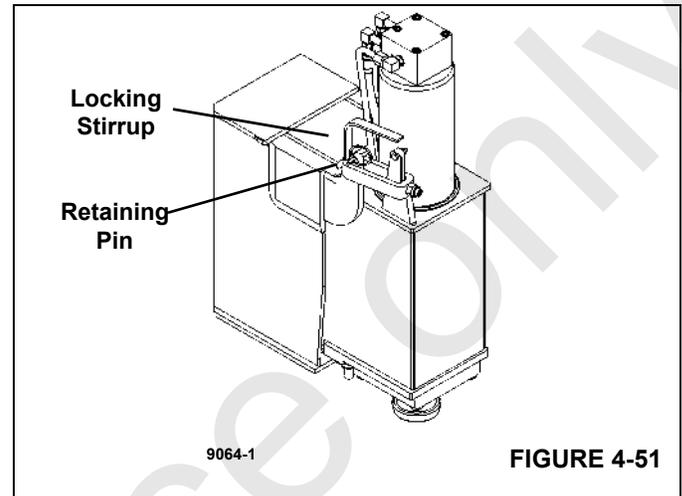
1. Start with the crane properly supported on all outriggers on cribbing which requires the use of Cribbing Mode.
2. Retract all jacks normally (the CFS retracts completely), and as much as possible.
3. Extend the front jacks a minimal amount (1-2") to allow room to create clearance once the center front stabilizer is extended in the next step.
4. Extend the center front stabilizer until movement ceases.
5. Enter the Cribbing Mode. Refer to *Activating Cribbing Mode*, page 4-43.
6. Retract the main front outrigger jacks off the cribbing (this uses the allowance created in Step #3 above).
7. Remove the cribbing from the main front outriggers.
8. Extend the main front outrigger jacks so that the center front stabilizer is unloaded and comes off the ground/cribbing.
9. Exit Cribbing Mode, then fully retract all jacks.

### Stowing the Outrigger Partial/Mid Extension Lock Pin

**NOTE:** If the lock pin is wedged in the hole in the outrigger beam, it may be necessary to jog the outrigger Extension/Retraction pushbutton slightly while pulling on the pin.

1. Rotate handle of lock pin to align guide pin with slot in hole while pulling on pin and return pin to stowed position.
2. Remove locking pins from side of the outrigger beam. If the pin will not freely disengage from the hole, slowly extend or retract the outrigger beam to allow the locking pin to disengage from the holes.
3. Fully retract outriggers.
4. Install the locking stirrup over the retainer lug and install retaining pin. Refer to (Figure 4-51).

5. Stow locking pin in the pin stowage bracket located at the frame.
6. Install travel locking pin in outrigger box before traveling to prevent beam creep.



**NOTE:** It may be necessary to jog the outrigger extension/retraction switch slightly to ensure proper pin engagement.

### Stowing the Center Front Stabilizer



## WARNING

### CFS Over Pressure Hazard!

Except for operation of the CFS during Cribbing Mode, never operate the center front stabilizer unless the boom is retracted and in the boom rest position. Always retract the center front stabilizer before retracting the main jacks and outriggers. The center front stabilizer is a vital factor in the stability of the crane.

1. **From the Carrier:** Position the center front stabilizer control switch to ACTIVATE and position the outrigger extension/retraction switch to RETRACT.
  - **From the ODM:** HOLD Retract and hit the center front stabilizer Icon as shown in green in (Figure 4-52). Also, refer to the Retract Switch in the Left-Hand Armrest.

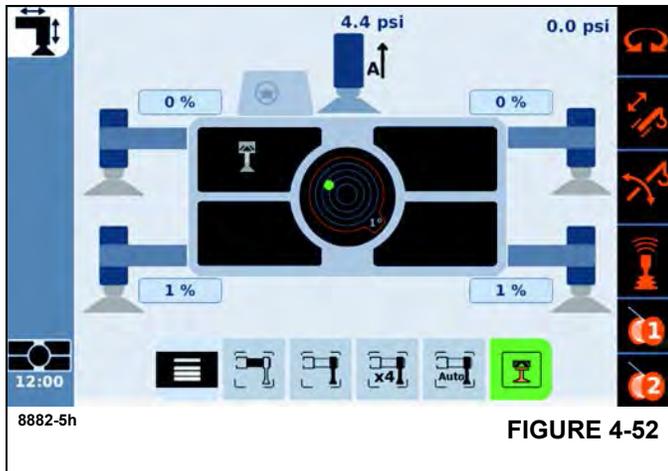


FIGURE 4-52

- Retract the center front stabilizer until the jack is fully retracted.

**Using the Swing System**

Set the swing gear to a maximum speed of 30%, refer to *Switching ON the Swing Gear*, page 4-78.

Lock the turntable, refer to *Switching the 360° Lock ON/OFF (Optional)*, page 4-50 below.

Depress the swing brake pedal.

Perform the crane function, swing against the swing brake.

The hydraulic oil is preheated when the display (1), (Figure 4-53) shows a temperature of at least 10 °C (50 °F).



FIGURE 4-53

**Switching the 360° Lock ON/OFF (Optional)**

The turntable can be locked in the entire swing range. For locking, a pin extends and blocks the swing gear.

**Applying the 360° Lock**

- To apply the 360° lock, use the jog dial to highlight (3), (Figure 4-54) and press Enter. Item (4), (Figure 4-54) should change from showing unlocked to locked (3). Item (5), (Figure 4-54) should change state when the 360 Lock is engaged.

**NOTE:** At any key on, it always goes to the rigging code selection screen.

It might be necessary to swing the crane very slightly and slowly due to friction of the locking gear teeth against the swing gear teeth.

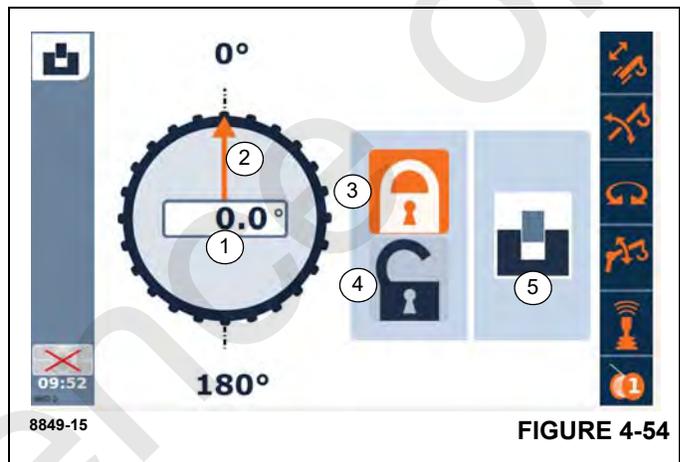


FIGURE 4-54

**Releasing the 360° Lock**

Check that the swing gear is disabled. If it is not disabled, switch it OFF. Refer to *Swing*, page 4-78.

**CAUTION**

**Machine Damage!**

Always disable the swing gear before you operate the 360° lock. The system will be damaged if the superstructure is rotated during the locking procedure.

The control system will prompt with a swing command symbol if small movements of the superstructure are necessary to engage or disengage the 360° locking mechanism.

- Select the symbol (4), (Figure 4-54).

Press the Enter button until the symbol (5), (Figure 4-54) is displayed with the pin out.

### Switching the Boom Position Indicator Light ON and OFF

To Enable:	Select symbol (1), (Figure 4-55) and confirm – symbol ON is displayed
To Disable:	Select symbol (2), (Figure 4-55) and confirm – symbol OFF is displayed

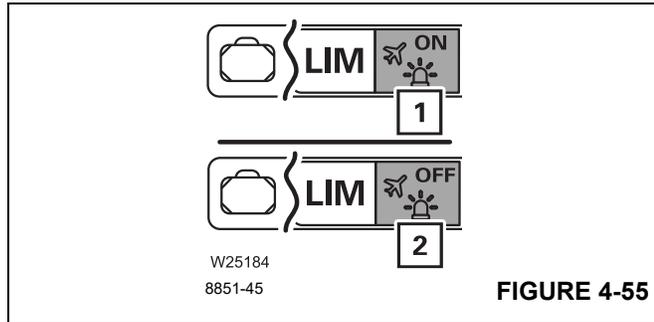


FIGURE 4-55

### Swinging the Boom and Superstructure

**! DANGER**  
**Crushing Hazard!**

Death or serious injury could result from being crushed by moving machinery. Before activating swing, sound the horn and verify all personnel are clear of rotating and moving parts.

Make sure the area around the boom, turntable and counterweights are clear of all obstructions and personnel before swinging.

**NOTE:** The swing brake automatically disengages when the swing controller is moved from the center (neutral) position and it re-engages when the controller is returned to the center position.

The Swing Brake Engaged Indicator (Figure 4-56) on the Operator Display Module (ODM) comes on (amber) when the swing brake is engaged and goes off when the swing brake is disengaged.

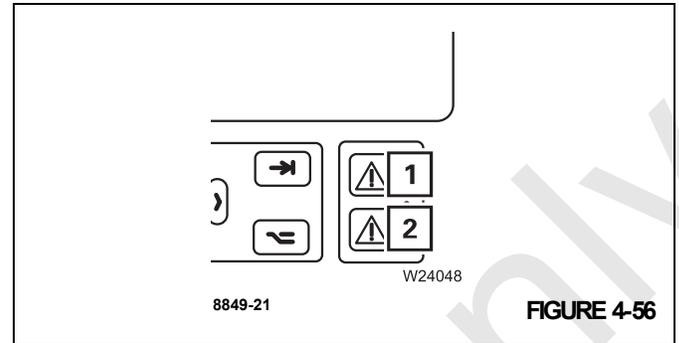


FIGURE 4-56

**NOTE:** Always operate controller with a slow, even pressure.

**NOTE:** Swing Controller can be pushed through neutral and toward opposite direction of swing to help slow and stop the swing motion.

#### Dual Axis Controllers

1. Press the Swing Enable/Disable Switch on left armrest to enable the swing function.

The Swing Enable Indicator in the Status Bar area (Figure 4-57) of the Operator Display Module (ODM) will come on (green).

2. Push controller on left armrest to the right and hold to swing right (rotates turntable clockwise) or push controller to the left and hold to swing left (rotates turntable counterclockwise).
3. To stop swinging, let swing controller return to the center (neutral) position and apply the swing brake with the Swing Brake Pedal (refer to *Swing Brake Pedal*, page 3-24).

#### Single Axis Controller (Optional)

1. Press the Swing Enable/Disable Switch on left armrest to enable the swing function.

The Swing Enable Indicator will come on green (Figure 4-57).

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).

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

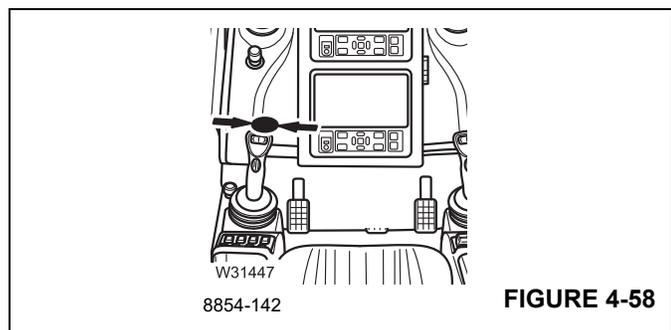
There is an icon on the right side of the display.

Green:	Swing ON (Figure 4-57)
Red:	Swing OFF



**Left Control Lever**

Push the control lever to the left:	Swing the superstructure to the left (Figure 4-58)
Push the control lever to the right:	Swing the superstructure to the right



**Raising and Lowering the Boom**

**Raising the Boom**

**! DANGER**  
**Crushing Hazard!**

Keep area above and below boom clear of all obstructions and personnel when elevating the boom.



Dual Axis Controllers

1. Press the Boom Lift Enable/Disable Switch on right armrest to enable the boom lift function.

The Boom Lift Enable Indicator in the Status Bar area (Figure 4-155) of the Operator Display Module (ODM) will come on (green).

2. Push controller on right armrest to the left and hold to raise the boom.
3. When boom angle gets to the desired elevation, let controller return to the center (neutral) position to stop boom lift function.

Single Axis Controller (Optional)

1. Press the Boom Lift Enable/Disable Switch on right armrest to enable the boom lift function.

The Boom Lift Enable Indicator will come on (green).

2. Pull inner controller on right armrest rearward and hold to raise the boom.
3. When boom angle gets to the desired elevation, let controller return to the center (neutral) position to stop boom lift function.

## Lowering the Boom



### DANGER

#### Crushing and/or Tipping Hazard!

Keep area beneath boom clear of all obstructions and personnel when lowering boom.

Long cantilever booms can create a tipping condition, even when unloaded in an extended, lowered position.



### DANGER

#### Two-Block Hazard!

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

When lowering boom, simultaneously let out hoist rope to prevent two-blocking the boom nose and the hook block.

The closer the load is carried to the boom nose, the more important it becomes to simultaneously let out hoist rope as boom is lowered.

### Dual Axis Controllers

1. Press the Boom Lift Enable/Disable Switch on right armrest to enable the boom lift function.

The Boom Lift Enable Indicator in the Status Bar area (Figure 4-155) of the Operator Display Module (ODM) will come on (green).

2. Push controller on right armrest to the right and hold to lower the boom.
3. When boom angle gets to the desired elevation, let controller return to the center (neutral) position to stop boom lower function.

### Single Axis Controller (Optional)

1. Press the Boom Lift Enable/Disable Switch on right armrest to enable the boom lift function.

The Boom Lift Enable Indicator will come on (green).

2. Push inner controller on right armrest forward and hold to lower the boom.
3. When boom angle gets to the desired elevation, let controller return to the center (neutral) position to stop boom lower function.

## Telescoping the Boom

The TMS875-2/TMS800-2 is equipped with a four-section boom. It has three telescoping sections that can be extended or retracted independently from one another. Each telescoping section has locking positions at 0%, 50% (T1), 51% (T2 and T3), 90%, and 100% of extension.

Within the boom there is a single-stage hydraulic cylinder. It can be extended or retracted by enabling the telescoping function and commanding motion using the controller. See sections on *Extending the Boom* or *Retracting the Boom* for operational information.

There are three interfaces provided for telescoping in normal operation the operator can select from: *Semi-Automatic Telescope Mode*, page 4-67 or *Manual Telescoping*, page 4-55. If necessary, the *Emergency Telescope Mode*, page 4-171 can be used to perform maintenance on the boom or correct problems with the telescoping operation.

### Descriptions of the telescoping modes

- *Semi-Automatic Telescope Mode*, page 4-67 is the preferred method for telescoping because it requires the least effort from the operator. The operator inputs the telescoping sequence, or “tele picture” into the Operator Display Module (ODM) by entering the locking position for each of the three telescoping sections. The Crane Control System (CCS) determines the order of operations required to achieve the entered telescoping sequence. To increase the boom length, the user moves the controller in the extend direction. To decrease the boom length the user moves the controller in the retract direction. When the boom sections are moving, the speed is controlled proportionally to the command given by the user. The CCS slows telescoping motion when the boom section is nearing the target locking position.

**NOTE:** Some movements of the telescoping cylinder are automated by the CCS. When CCS is controlling the movement of the telescoping cylinder, a moving series of dots is displayed on the ODM.

- *Manual Telescoping*, page 4-61 is a method of telescoping preferred by some operators because it gives them more control over the telescoping process. In this mode, it is not necessary to enter the target telescoping sequence prior to starting the process. Rather, the operator can unlock the telescoping cylinder and position the telescoping cylinder within the boom using the controller. When the telescope cylinder is within range to engage a boom section, the symbol for locking the cylinder appears. The operator moves the telescoping cylinder to the desired boom section and then selects the symbol for locking the telescope cylinder. The CCS locks the telescoping mechanism to the boom section and then automatically unlocks the boom section from the neighboring boom section so it can be moved. The operator can then extend the boom section by moving the controller in the extend direction

or retract it by moving the controller in the retract direction. As the boom section nears the 0%, 50% (T1), 51% (T2 and T3), 90%, and 100% locking positions, it automatically slows down. When the boom section is at a locking position, the icon to lock appears. If the operator selects Lock, the CCS will lock and “set down” the boom section. After the boom section has been locked, the symbol to unlock cylinder appears. If the operator selects the symbol to unlock the telescoping cylinder, it will disengage the boom section and move to the next boom section. When it arrives at the next boom section, it will lock the cylinder to the section and then unlock the boom section from the neighboring boom section automatically.

- *Emergency Telescope Mode*, page 4-171 is used to move the telescoping system for maintenance and service work, as well as when a problem occurs that affects the other telescoping modes. The *Emergency Mode* has two levels of access. The first level is the basic emergency mode, which is to be used to service or repair the pinning head. The basic emergency mode can only be used to extend a fully retracted boom for the purpose of aligning the pinning head with the hole in the base section. Moving the boom for all other reasons must be done in the extended emergency mode, which requires a special access code. In the *Emergency Mode* the operator has control over the locking and unlocking functions of the telescoping cylinder. The operator can also retract or extend the telescoping cylinder. The operator or technician may also see the sensor information for the complete telescoping system.

The operator must use the telescope controller with the automatic and manual telescope modes in the ODM to telescope the boom.

### **Switching OFF the Telescoping Mechanism**

If the telescoping mechanism is not required, it should be switched OFF to avoid unintentional use.

- Push the Boom Telescope Enable/Disable Switch on right armrest to disable the boom lift function.
- The Boom Telescope Enable Indicator in the Status Bar area (Figure 4-155) of the Operator Display Module (ODM) will change from green to blue.

### **Extending the Boom**



#### **DANGER**

#### **Crushing Hazard!**

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

#### **DANGER**

#### **Two-Block Hazard**

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

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

#### Dual Axis Controller

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

The Telescope Enable Indicator in the Status Bar area (Figure 4-155) of the Operator Display Module (ODM) will come on (green).

2. Push controller on right armrest to the right and hold to extend the boom.
3. When boom gets to the desired length, let controller return to the center (neutral) position to stop extending the boom.

#### Single Axis Controller (Optional)

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

The Telescope Enable Indicator in the Status Bar area (Figure 4-155) of the Operator Display Module (ODM) will come on (green).

2. Push inner controller on right armrest forward and hold to extend the boom.
3. When boom gets to the desired length, let controller return to the center (neutral) position to stop extending the boom.

## Retracting the Boom



### **DANGER** **Crushing Hazard!**

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

#### Dual Axis Controller

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

The Telescope Enable Indicator in the Status Bar area (Figure 4-155) of the Operator Display Module (ODM) will come on (green).

2. Push controller on right armrest to the left and hold to retract the boom.
3. When boom gets to the desired length, let controller return to the center (neutral) position to stop retracting the boom.

#### Single Axis Controller (Optional)

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

The Telescope Enable Indicator in the Status Bar area (Figure 4-155) of the Operator Display Module (ODM) will come on (green).

2. Push inner controller on right armrest rearward and hold to retract the boom.
3. When boom gets to the desired length, let controller return to the center (neutral) position to stop retracting the boom.

## Telescoping - Theory of Operation

The following section describes the internal operation of a pinning boom.

The telescoping process requires locking and unlocking processes in the main boom. You can telescope the main boom in different ways.

### **Manual Telescoping**

For manual telescoping, the operator must initiate some locking and unlocking processes at the right time. Refer to Manual Telescoping, page 4-61.

### **Semi-Automatic Telescoping**

When telescoping with semi-automation, the operator enters a telescoping sequence or “tele-picture” and the Crane Control System (CCS) controls all the locking and unlocking processes automatically. This mode can also be used for intermediate lengths.

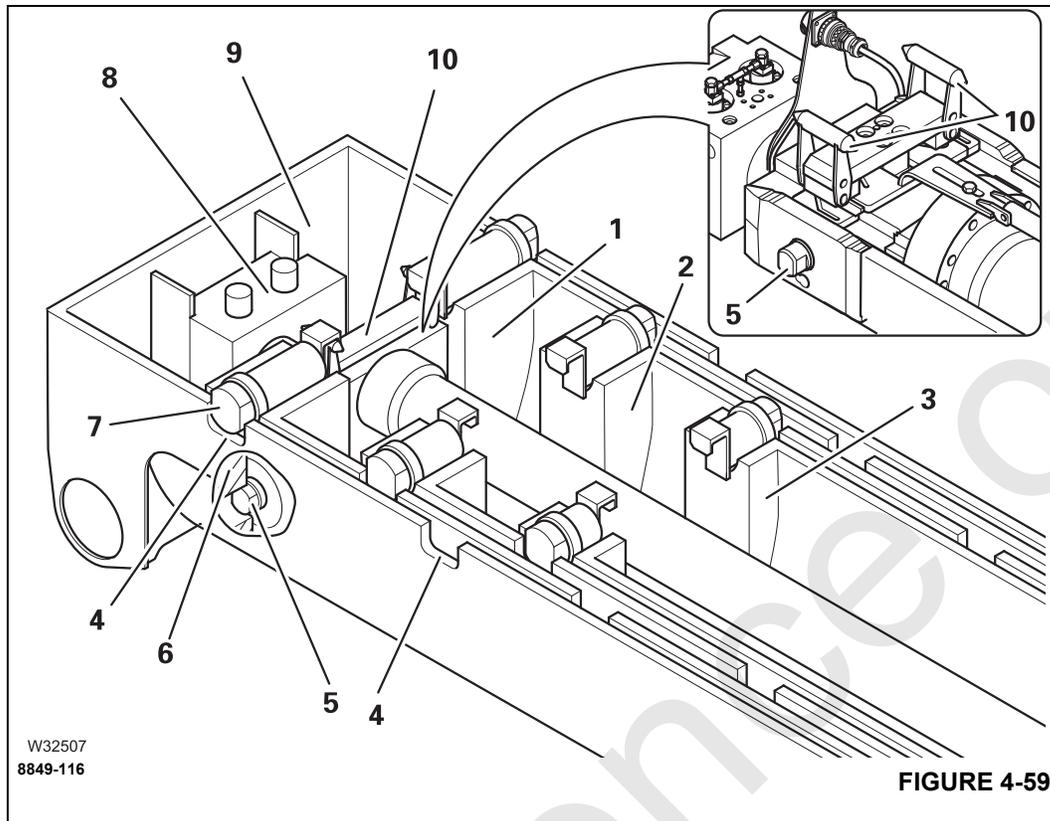
**NOTE:** For more information on telescoping with semi-automation, refer to *Semi-Automatic Telescope Mode*, page 4-67.

### **Extending with the Main Boom Configuration**

The CCS displays various sectional views of the main boom. To become more familiar with these representations more quickly, the following section begins with an overview of the telescoping mechanism and telescoping process.

### **Overview**

The illustration (Figure 4-59) shows the completely retracted main boom with the base section (9) and the three telescopic sections I to III (1) to (3).



Each telescopic section is equipped with two-section locking pins (7) which are extended by spring force. Refer to (Figure 4-59).

The section locking pins (7) are pushed into the cutouts (4) of the telescopic section at the locking points – the telescopic section is locked.

The telescoping cylinder is attached to the base section (9) with the piston rod (8). The telescoping cylinder has two cylinder locking pins (5) at the bottom and a mechanism at the top (10).

When the telescoping cylinder is positioned at a locking point:

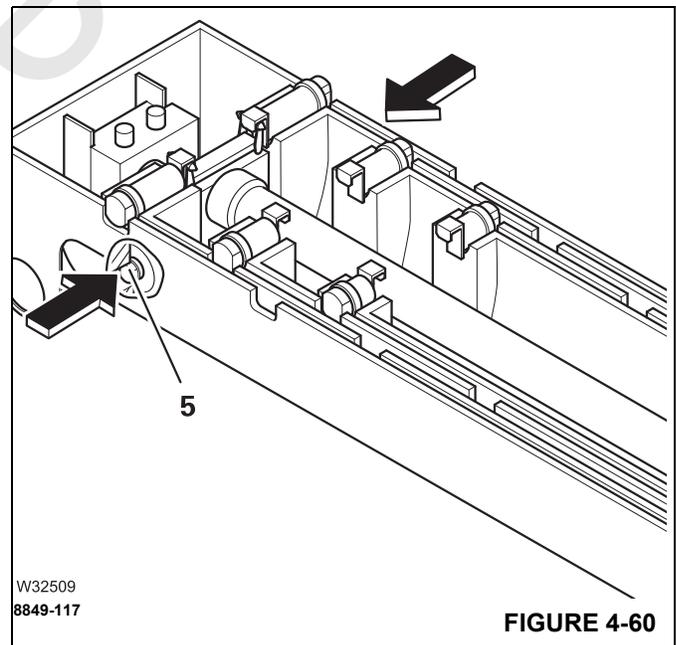
- The locking pins (5) can be extended into the cutouts (6) – the telescoping cylinder is locked.
- The mechanism (10) engages into the locking pins (7) and can retract them – the telescopic section is unlocked.

**Telescoping Process**

The state shown in (Figure 4-60) should be the starting point for a telescoping process. The telescoping processes consist of 4 Steps:

1. Unlocking the telescoping cylinder.

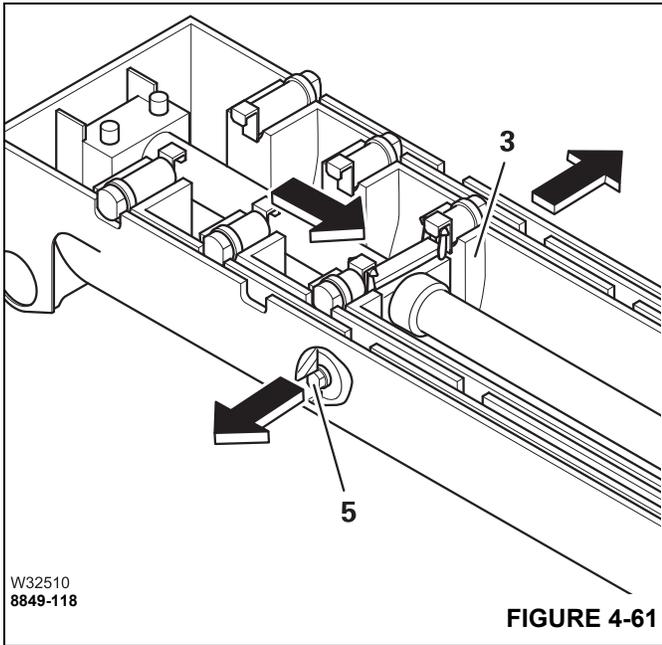
The locking pins (5), (Figure 4-60) retract – the telescoping cylinder is unlocked.



2. Moving and locking the telescoping cylinder.

The telescoping cylinder moves into the section to be telescoped, e.g. telescopic section III (3), (Figure 4-61).

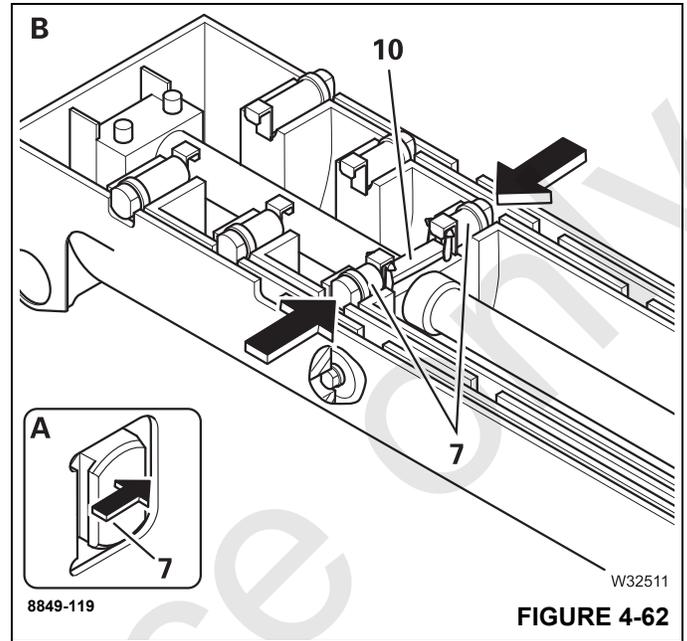
The cylinder locking pins (5), (Figure 4-61) extend – the telescoping cylinder is locked.



3. Unlocking the telescopic section.

(A), (Figure 4-62) – When a telescope section is locked at the 50/51%, 90% or 100% position, the telescoping cylinder extends until the locking pins (7), (Figure 4-62) are clear. When a section is fully retracted and locked at the 0% position, there is no lift-off process. The boom section is supported at the front of the section by the stop blocks instead of by the locking pins. Because of this, the 0% locking holes are oversized, and the locking pin never touches the bottom of the hole.

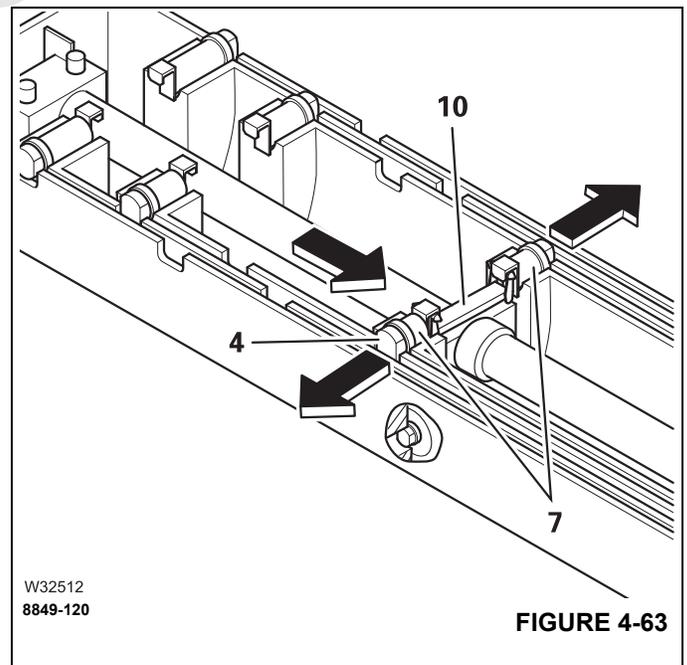
(B), (Figure 4-62) - The mechanism (10) retracts the locking pins (7) – the telescopic section is unlocked.



4. Telescoping, locking, and setting down a telescopic section.

The telescoping cylinder pushes the telescopic section to a locking point.

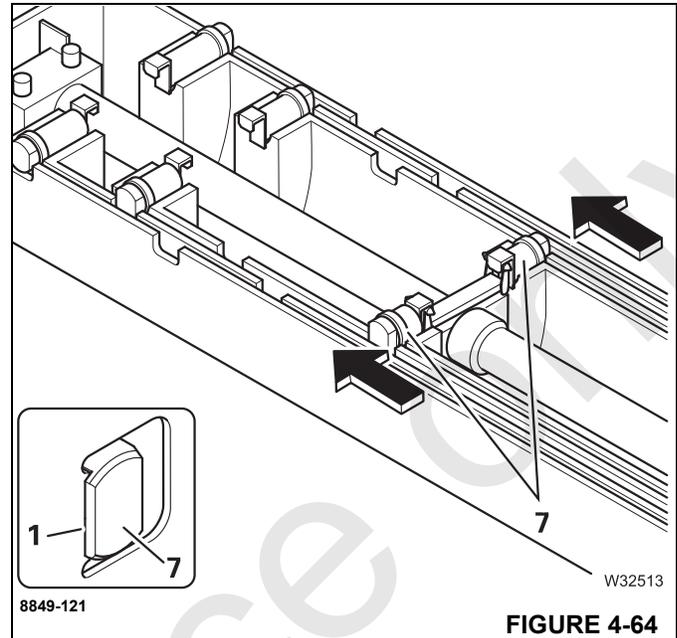
The weight is taken off the mechanism (10), (Figure 4-62). The locking pins (7), (Figure 4-63) extend into the cutouts (4), (Figure 4-63).



The telescopic section is automatically set down.

The telescoping cylinder retracts until the locking pins (7), (Figure 4-64) are positioned on the above telescopic section (1), (Figure 4-64).

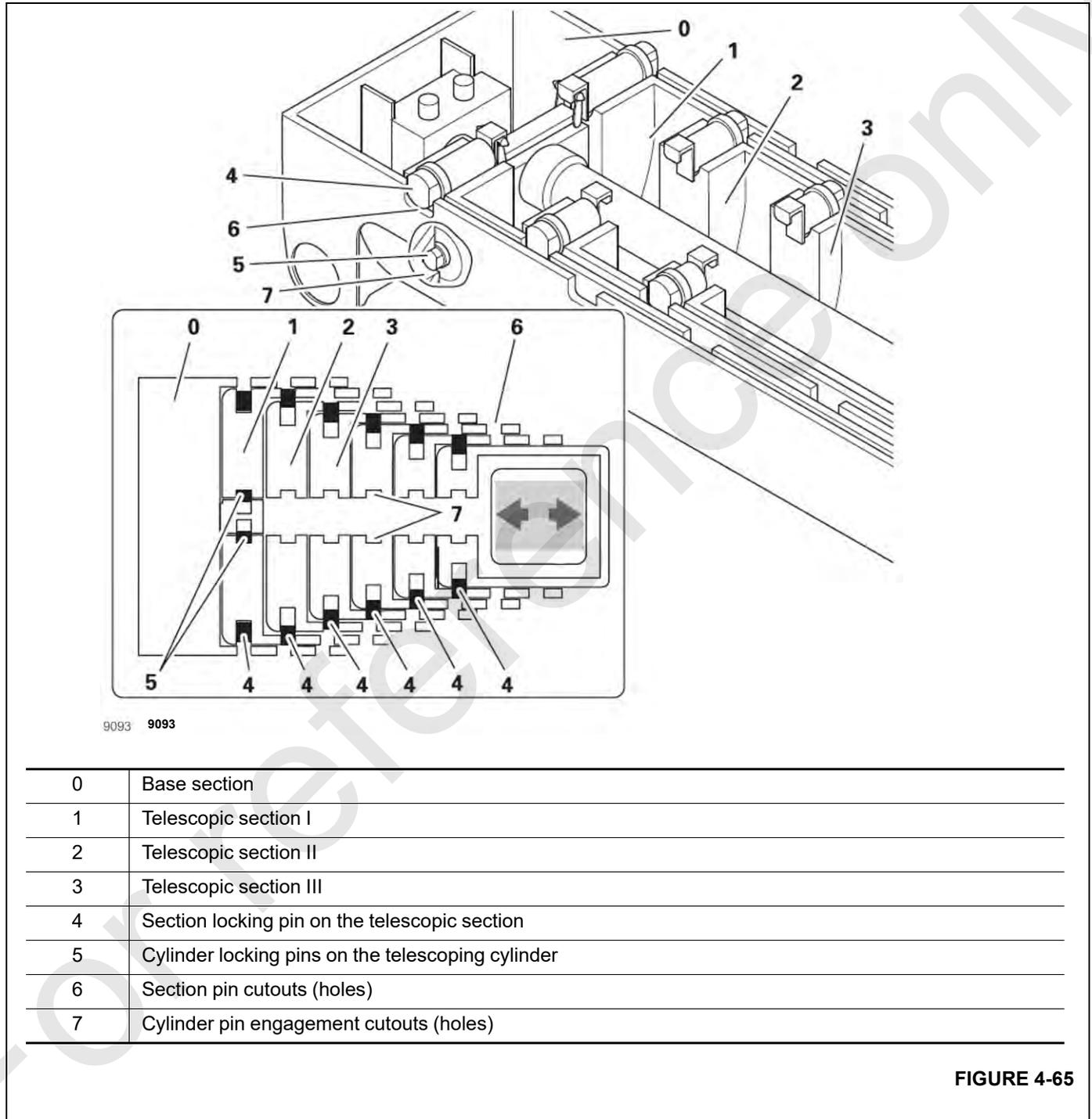
The weight of the load is now on the telescopic sections and not on the telescoping cylinder.



**Assignment for Display**

The CCS display shows a sectional view of the main boom in the menus.

The following elements are displayed (Figure 4-65):



0	Base section
1	Telescopic section I
2	Telescopic section II
3	Telescopic section III
4	Section locking pin on the telescopic section
5	Cylinder locking pins on the telescoping cylinder
6	Section pin cutouts (holes)
7	Cylinder pin engagement cutouts (holes)

**FIGURE 4-65**

**Fixed Length and Intermediate Length**

There are lifting capacity tables for main boom fixed lengths, main boom intermediate lengths, and main boom telescoping lengths.

The lengths are automatically detected by the Rated Capacity Limiter (RCL), and the corresponding lifting capacities according to the Lifting Capacity Table are enabled and displayed automatically.

**Main Boom Fixed Length**

Main boom fixed lengths have the greatest lifting capacities. A main boom fixed length is reached if:

- All telescopic sections are locked to a fixed length.
- All telescopic sections are set down.

**Main Boom Intermediate Length**

A main boom intermediate length is reached if not all telescopic sections are locked to fixed lengths. The size of the load that can be telescoped depends on the angle of inclination and on the degree of lubrication of the main boom.

Extend the main boom to the required length before hoisting the load.

**Telescoping**

The position of the telescopic sections, i.e. which telescopic section is extended to what extent, is referred to as the telescoping sequence or the actual telescope picture.

This section only deals with the displays on the RCL. The telescoping is also shown on the Operator Display Module (ODM). Refer to *Telescoping the Tele Section*, page 4-65.

The RCL displays main boom fixed lengths and main boom intermediate/telescoping lengths in different ways.

**Telescoping Sequence**

The telescopic sections can only be telescoped individually, one after the other.

When extending, the operator must always extend the telescopic section with the highest numbering first, then the telescopic section with the second highest numbering, etc. (e.g. III, II, I).

The telescopic sections are always retracted in the reverse order of extending.

**Inspections Prior to Starting Operations**

When the ignition is turned ON, CCS registers the displayed telescoping status from the current status of the telescoping mechanism and the previously saved locking and unlocking procedures.

Normally, CCS detects differences between the current and the displayed telescoping and displays the corresponding error message.

If a malfunction results in saved values being deleted, CCS can no longer calculate the current telescoping and may not issue an error message.

**CAUTION****Telescope Mechanism Damage!**

If the telescope system position is different from the current telescoping shown on the display, damage could occur during operation of the Telescope system.

Make sure that the actual indicated telescope status matches the current telescope position.

**NOTE:** Before the first telescoping, compare the telescoping indicated on the ODM with the current telescoping.

**Function of the Controller**

This section only describes the function of the control lever. Before telescoping, a number of prerequisites need to be fulfilled as well.

**WARNING****Risk of Accidents Due to Unexpected Crane Movements!**

In the case of multiple configurations of a controller, check whether the control lever function Telescoping is switched on before you move the control lever.

This prevents accidents caused by unexpected lifting/lowering.

The right-hand controller side to side motion will function as either Boom Lift, Boom Telescope or Hydraulic extension luffing, depending on which function is enabled.

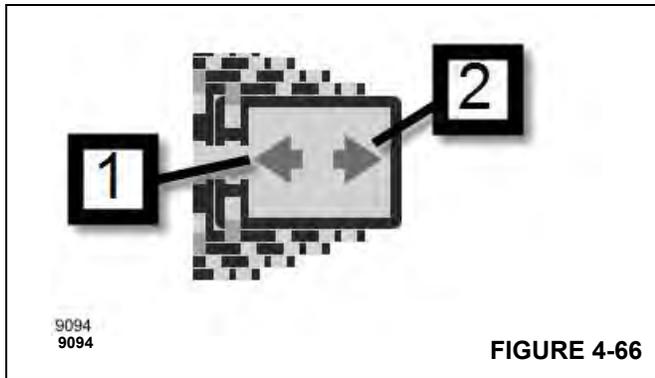
The distance between the hook block and the boom nose changes during telescoping. Make sure that the hook block does not trigger the anti-two block switch or touch the ground.

• To prevent two-blocking or slack rope conditions, perform the following functions as required:

- Lower hoist when extending
- Lift hoist when retracting.

The control lever movements for telescoping vary depending on the configuration. Refer to *Raising the Boom*, page 4-52 and *Lowering the Boom*, page 4-53.

Telescoping will only start if left arrow for retracting (1), (Figure 4-66) or right arrow for extending (2), (Figure 4-66) is shown in the indicated location of the operating display screen (either the semi-automation or manual telescoping screen).



You can regulate the speed by moving the control lever or changing the engine speed.

**NOTE:** With certain telescoping states, the RCL will switch telescoping OFF, e.g. when you leave the telescoping lengths or when the working range limit has been reached. Refer to *RCL Shutdown*, page 4-217.

**Manual Telescoping**

To telescope manually, you must initiate all locking and unlocking processes. The locking and unlocking processes are carried out automatically.

The following sections describe the operating procedures:

- Checking the initial position.
- Unlocking the telescoping cylinder. Refer to *Unlocking the Telescoping Cylinder*, page 4-62.
- Extending/retracting the telescoping cylinder (without telescopic section). Refer to *Extending/Retracting the Telescoping Cylinder*, page 4-63.
- Locking the telescoping cylinder. Refer to *Locking the Telescoping Cylinder*, page 4-64.
- Unlocking the telescopic section. Refer to *Unlocking the Telescopic Section*, page 4-64.
- Telescoping the telescopic section. Refer to *Telescoping the Tele Section*, page 4-65.
- Locking the telescopic section. Refer to *Locking the Tele Section*, page 4-66.

**NOTE:** The operating order depends on the current initial position. For an overview of a telescoping process

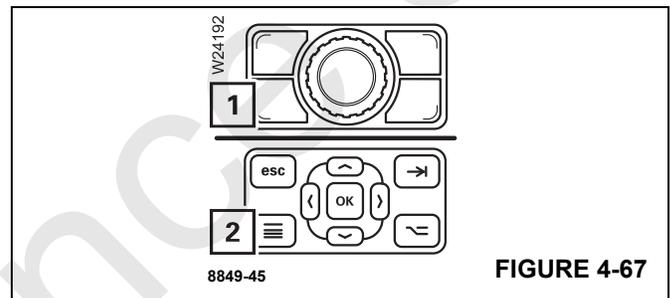
(example), refer to *Telescoping Process*, page 4-56.

**NOTE:** The lengths given in the following illustrations are purely sample values, and may differ from the current display.

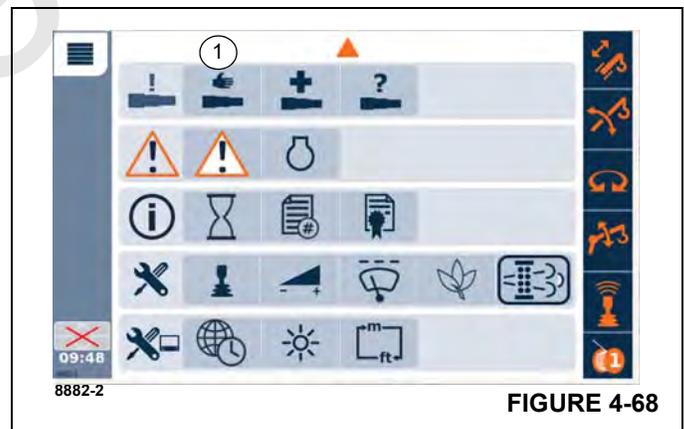
**Checking the Initial Position**

Before telescoping, you must check the following:

- Current telescope status,
  - Position of the telescoping cylinder,
  - Position of the locking pins.
- To do so, open the ODM main menu and press the button (1), (Figure 4-67) or (2), (Figure 4-67) once.



Open the Manual Telescoping Menu (1), (Figure 4-68).



**Current Telescoping**

The display (1), (Figure 4-69) shows how far the telescoping cylinder is extended, e.g. 0%.

The display (2), (Figure 4-69) shows the current main boom length.

The display (3), (Figure 4-69) shows the corresponding telescopic section, e.g. telescopic section 1.

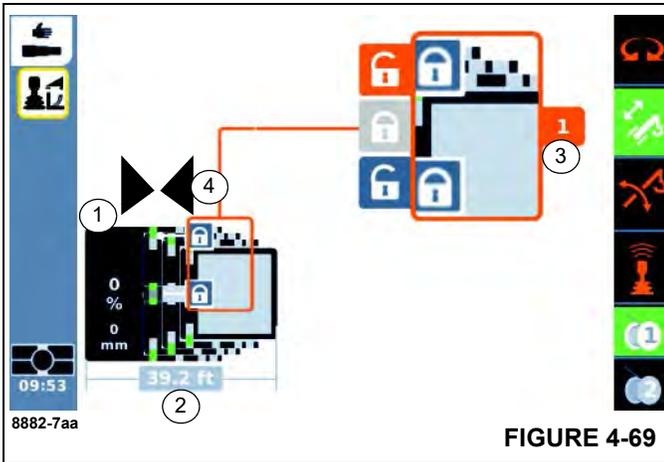


FIGURE 4-69

**Position of the Telescoping Cylinder**

The display (1), (Figure 4-70) shows the position of the telescoping cylinder (example, 11 mm) within the boom (millimeters), as well as a percentage of boom section travel (when the cylinder is locked to a boom section).

If the telescoping cylinder is near a locking point:

- The display (3), (Figure 4-70) shows the corresponding telescopic section, e.g. telescopic section 1.
- The display (4), (Figure 4-70) shows two green arrows, depending on the distance to the locking point.

**Position of the Locking Pins**

The current positions of the locking pins are (Figure 4-70):

1	on the telescopic section
2	on the telescoping cylinder

Item (5), (Figure 4-70) shows an enlarged cut-out.

The current settings are shown in different colors.

Red:	Unlocked
Green:	Locked
Yellow:	Intermediate position

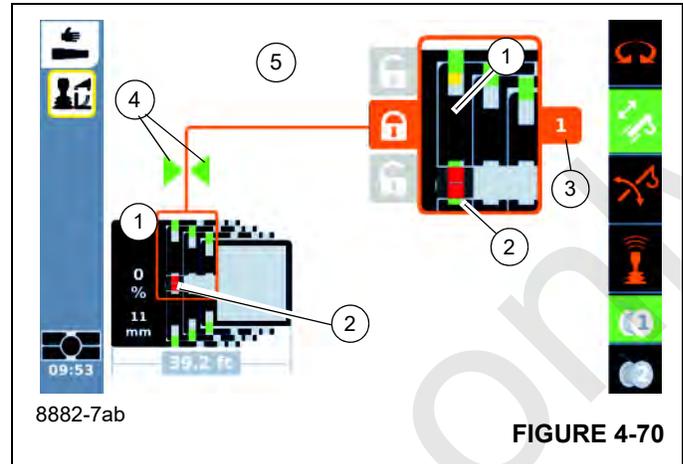


FIGURE 4-70

**Unlocking the Telescoping Cylinder**

Unlocking the telescoping cylinder is required for the telescoping cylinder to be moved separately (without telescopic section).

The telescoping cylinder and the telescopic section cannot be unlocked simultaneously.

**Prerequisites:**

- Telescoping mechanism ON – symbol (3), (Figure 4-71) green.
- Telescoping cylinder locked – symbol (2), (Figure 4-71) green.
- Telescopic section locked – symbol (1), (Figure 4-71) green.

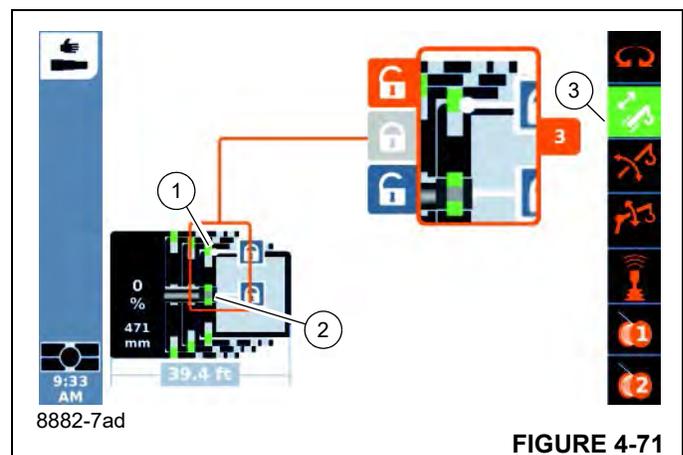


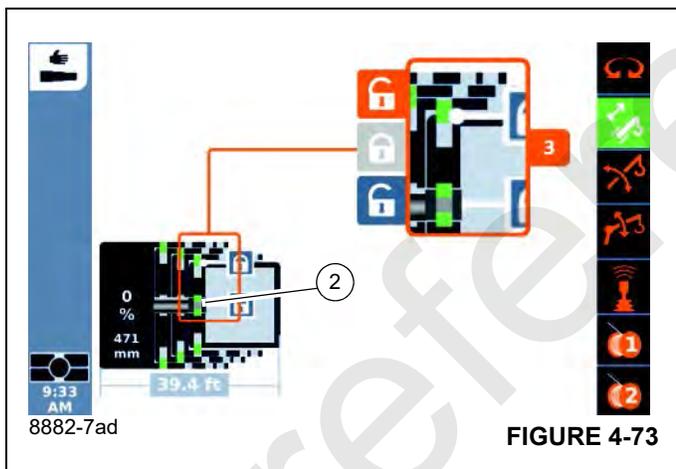
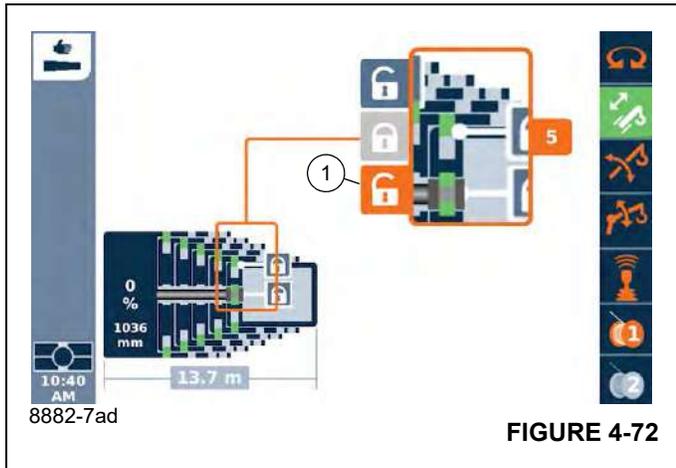
FIGURE 4-71

**Unlock**

Select the symbol (1), (Figure 4-72).

Confirm the selection – the telescope cylinder locking pins (2), (Figure 4-73) will retract.

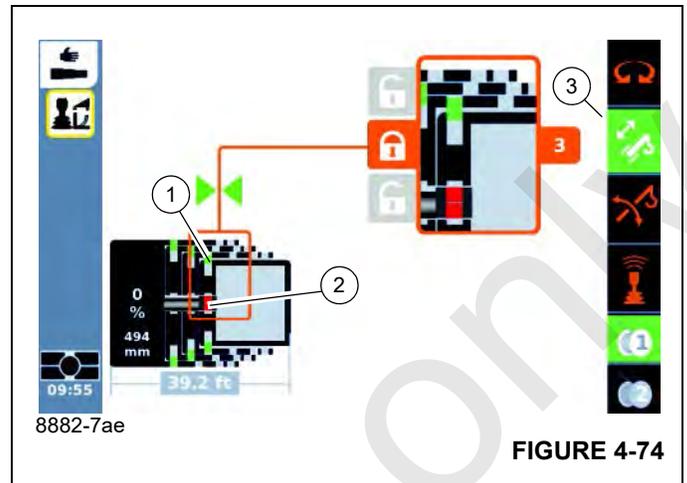
Yellow:	Intermediate position
Red:	Unlocked



**Extending/Retracting the Telescoping Cylinder**

**Prerequisites:**

- Telescoping function enabled – symbol (3), (Figure 4-74) green.
- Telescopic section locked – symbol (1), (Figure 4-74) green.
- Telescoping cylinder unlocked – symbol (2), (Figure 4-74) red.

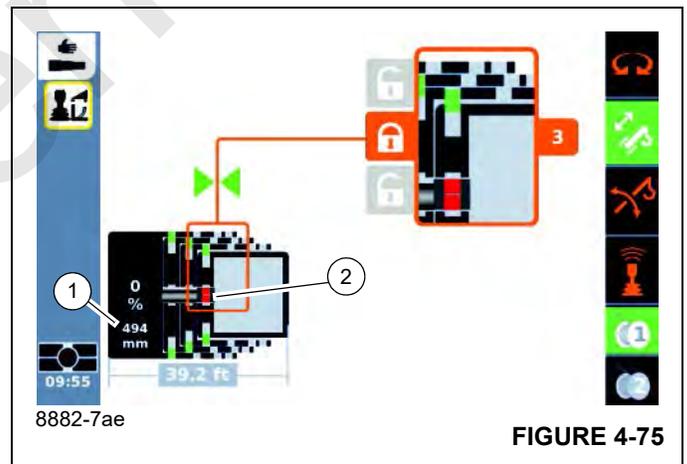


**Extending/Retracting**

Move the control lever in the corresponding telescoping direction:

The telescoping cylinder (2), (Figure 4-75) extends/retracts.

The display (1), (Figure 4-75) shows the length, in millimeters, that the telescope cylinder is extended to.



Near a locking point, the symbols (3), (Figure 4-76) show:

The direction of travel to the locking point (Figure 4-76):

1	Continue Extending
2	Continue Retracting
3	At the locking point

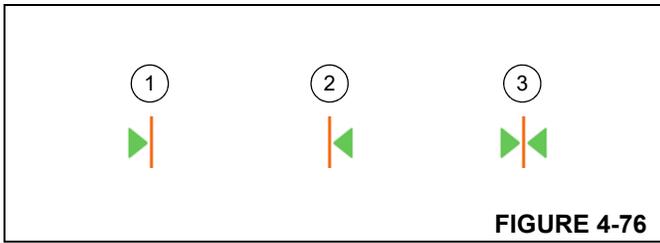


FIGURE 4-76

**CAUTION**

**Boom System Damage!**

If extending and retracting several times does not lead to the lock being released, you must **NOT** telescope any further against the stop.

If removing the load does not cause the lock to be released, you must lock the telescoping cylinder and then restart unlocking.

**Locking the Telescoping Cylinder**

The telescoping cylinder must be locked to a telescopic section so that the telescopic section can be telescoped.

**Prerequisites:**

- Telescoping mechanism ON – symbol (3), (Figure 4-77) green.
- Telescopic section locked – symbol (1), (Figure 4-77) green.

**NOTE:** Lock command available – symbol (4), (Figure 4-77) orange.

Telescoping cylinder unlocked – symbol (2), (Figure 4-77) red.

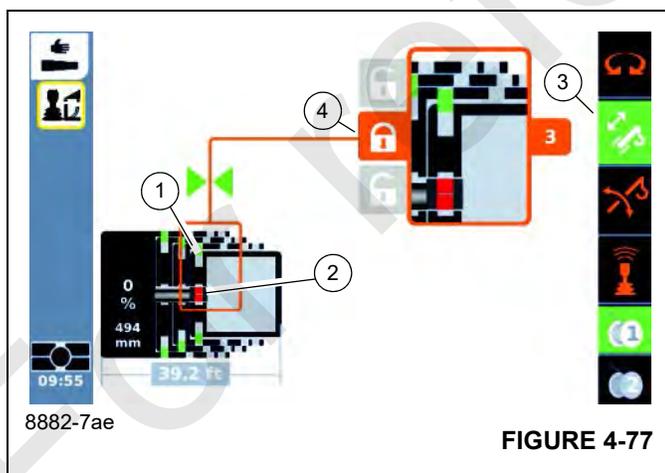


FIGURE 4-77

**Lock**

- Move the telescoping cylinder to the desired locking point, e. g. to telescopic section (1), (Figure 4-78). Wait until the display:

- shows the desired telescopic section (1), (Figure 4-78);
- and
- the symbols (2) are shown.
  - Select the symbol (3).
  - Confirm the selection – the locking pins (2) will extend – symbol (4) green.

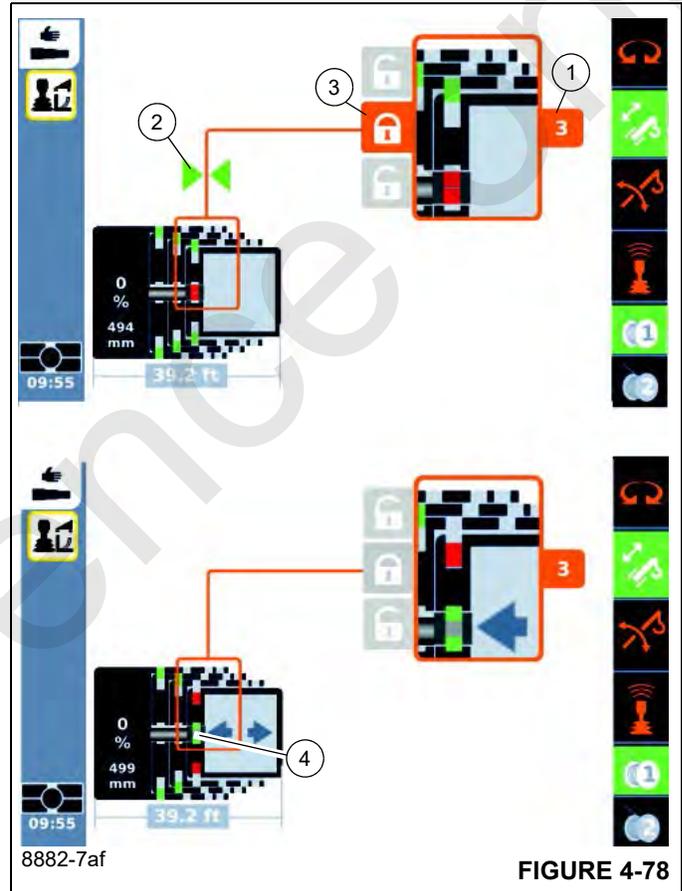


FIGURE 4-78

**Unlocking the Telescopic Section**

Unlocking a telescopic section is required for the telescopic section to be telescoped.

**NOTE:** The telescoping cylinder and the telescopic section cannot be unlocked simultaneously.

**Prerequisites:**

- Telescoping mechanism enabled – symbol (3), (Figure 4-79) green.
- Telescopic section locked – symbol (1), (Figure 4-79) green.
- Telescoping cylinder locked – symbol (2), (Figure 4-79) green.

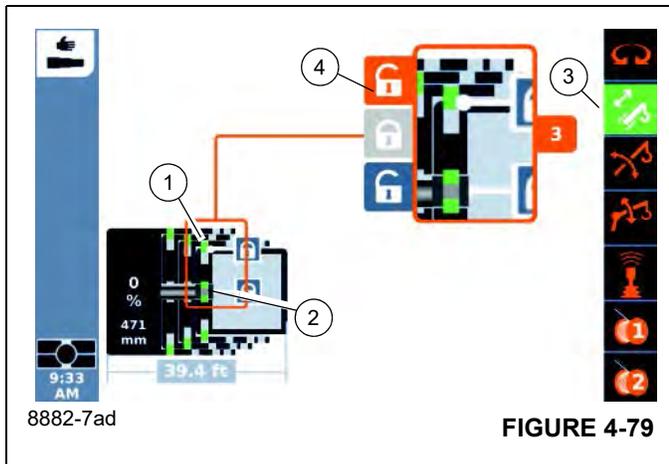


FIGURE 4-79

**Unlock**

Select the symbol (4), (Figure 4-79).

Confirm the selection – the section locking pins will retract. Symbol (2), (Figure 4-80) red.

If symbol (2), (Figure 4-80) is not red after approximately 10 seconds, this means that the locking pins are under load.

To relieve the load, carefully retract and extend a little.

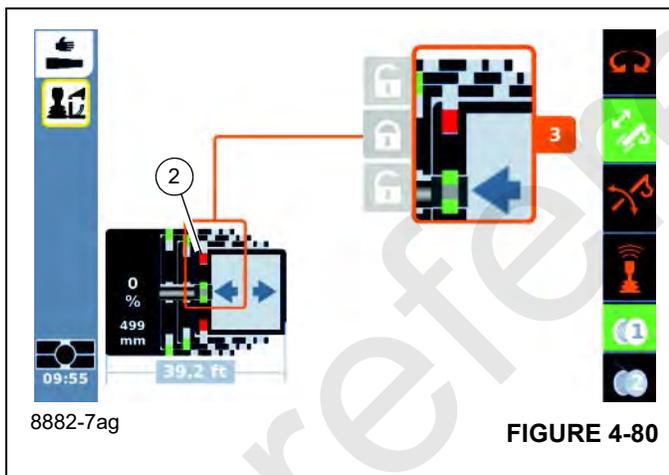


FIGURE 4-80

**CAUTION**  
**Boom System Damage!**  
 If extending and retracting several times does not lead to the lock being released, you must not telescope any further against the stop.

If removing the load does not cause unlocking, you must lock the Telescopic Section. Refer to *Locking Telescopic Sections*, page 4-179 and restart unlocking.

**Telescoping the Tele Section**

The Tele Section can be telescoped once it is unlocked.

**Prerequisites:**

- Refer to (Figure 4-81).
- Telescoping mechanism ON – symbol (3), (Figure 4-81) green.
- Telescoping cylinder locked – symbol (2) green.
- Telescopic section unlocked – symbol (1) red.

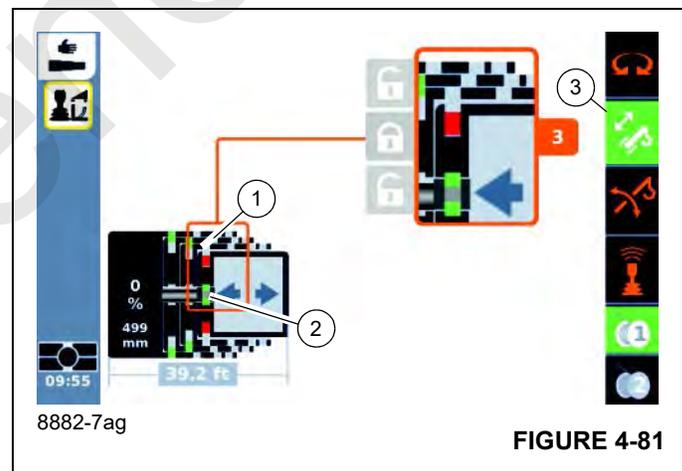


FIGURE 4-81

**Telescoping**

Refer to (Figure 4-82).

If the requirements for telescoping are met, the symbol (2) is shown.

- Move the control lever in the desired telescoping direction.

The display (1) shows the current boom extended length.

4

The current telescope diagram on the display (2) will change continually.

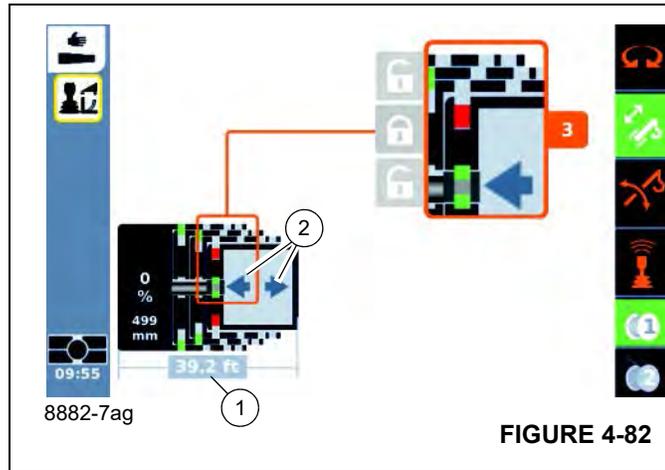


FIGURE 4-82

**Locking the Tele Section**

Every telescopic section can be locked at the fixed lengths. Refer to *Fixed Length and Intermediate Length*, page 4-60.

**Prerequisites:**

- Telescoping mechanism ON – symbol (3), (Figure 4-83) green.
- Telescopic section unlocked – symbol (1) red.
- Telescoping cylinder locked – symbol (2) green.

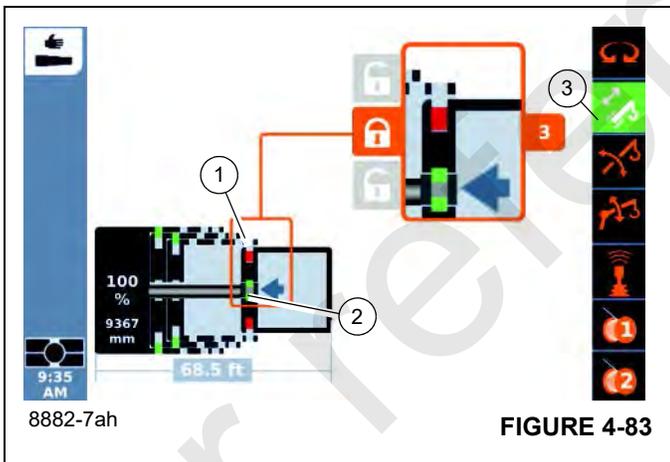


FIGURE 4-83

**Lock**

- Refer to (Figure 4-84).
- Telescope to the desired fixed length, e. g. telescopic section (3) 1 to 100%.

If the symbol (3) is orange, the telescopic section can be locked.

- Select the symbol (3).

- Confirm the selection – the locking pins will extend – symbol (2) green.

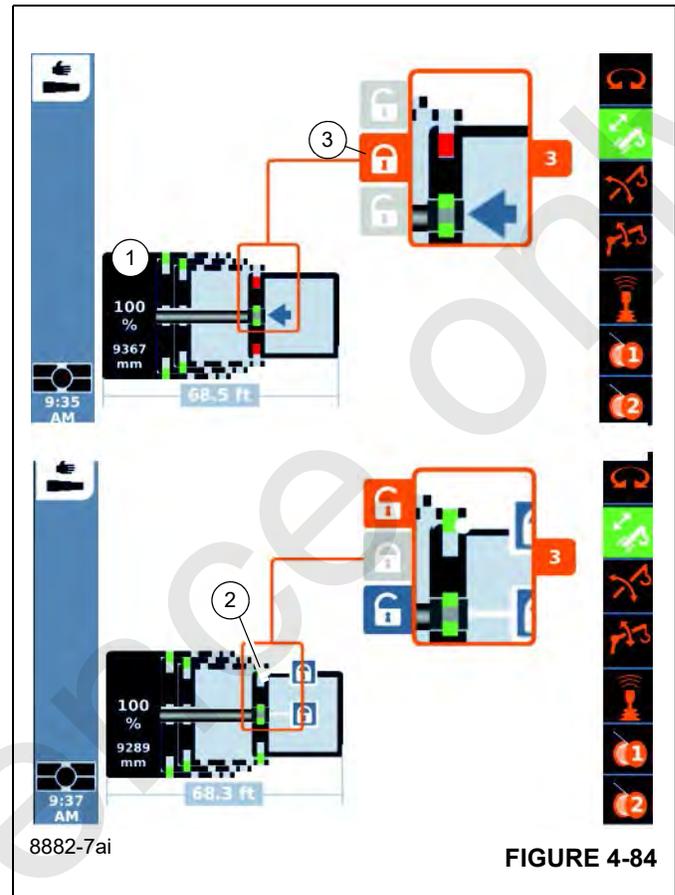


FIGURE 4-84

**Locking the Telescopic Section for On-Road Driving**

Once you have retracted the main boom, you might lock the telescoping cylinder in telescopic section I to achieve the proper axle loads.

**Telescoping with Semi-Automation**

When telescoping with semi-automation (or the semi-auto mode), the operator enters, on the Operator Display Module (ODM), the pinning location for each of the boom sections (a target or requested “tele picture”). If this pinning configuration is accepted by CCS, then the controller is used to move the boom sections to the pre-determined configuration. The telescoping cylinder moves between the boom sections automatically as needed.

**NOTE:** The entered boom configuration (“tele picture”) does not have to be completed for normal operation of the boom. For instance, if the requested boom configuration is 100-100-0, and just the T2 section is locked at 100% (T1 section still at 0%), then the boom can be operated as if the configuration 0-100 was entered. The operator can just stop the telescoping function with the boom at 0-100-0.

If the boom is desired to be fully or partially retracted after just reaching 0-100-0 (and when 100-100-0 had originally been entered), the operator can just reverse the direction of the controller and the boom will retract. That is, it is not necessary to enter a boom configuration of 0-0-0 to retract the boom. The entered boom configuration (target or requested “tele picture”) is ALWAYS only a final destination or configuration.

The controller is ALWAYS used to indicate extending or retracting the boom itself, NEVER to indicate the extending or retracting of the telescoping cylinder. The allowed motion for the boom with the controller is indicated by arrows shown on the display. The telescoping direction arrow to the right is always extending the boom. The telescoping arrow to the left is always retracting the boom.

**CAUTION**

**Boom Damage!**

When a boom section is first unlocked, the boom section may automatically extend 50 mm (2 inches). The operator must be aware of this motion and have the crane in a position to anticipate this motion and prevent contact with nearby objects.

**NOTE:** Enable the telescoping mechanism. Refer to *Function of the Controller*, page 4-60.

**NOTE:** Open the Telescoping Semi-Automation Menu (1), (Figure 4-85).

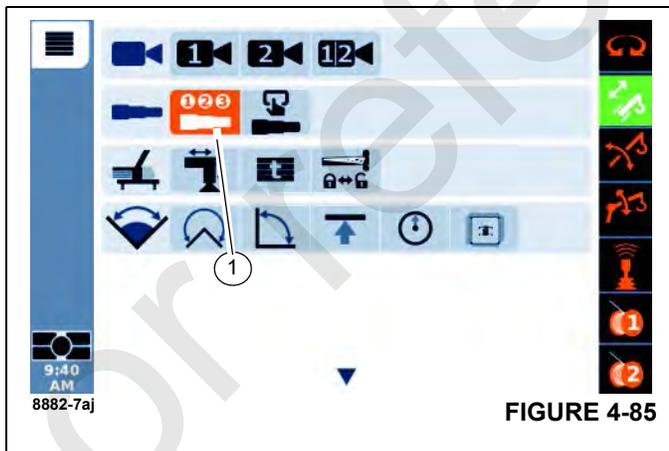


FIGURE 4-85

**Semi-Automatic Telescope Mode**

**Introduction**

The Semi-auto Mode is typically the standard method for telescoping the pinned boom.

It is important to understand that a pinned boom has a telescoping cylinder that can disconnect and reconnect (unlock/lock) to boom sections, as well as disconnect and connect (unlock/lock) boom sections to each other. This is accomplished by a pinning mechanism or pinning “head” at the near end of the barrel of the telescoping cylinder (the rod is fixed to the base section and the barrel extends within the boom). This pinning mechanism has a set of sensors and an electronic module to communicate with the crane control system. Using these sensors, as well as a precision length sensor for the location of the telescoping cylinder within the boom, the crane control system commands the pinning mechanism to perform the locking operations. The Semi-Auto Mode is the simplest approach to operating the pinned boom, since it automatically handles the most complicated aspects of the pinning.

It is important to realize that the control system is performing automated motions within the boom at some points in the telescoping process. At other times the operator is able to move the boom components. Then the automated motions can occur once again after the operator has indicated the appropriate next action for telescoping the boom.

The Semi-Auto screen of the operating display (refer to Figure 4-86) shows a graphic schematic near the bottom of the screen that indicates the current status of the boom computed by the control system (however the operator must continue to monitor the status of the physical boom to compare with this schematic).

In (Figure 4-86), there is a 100% (1) shown for the position of the telescoping cylinder (above the 9339 mm distance value). The graphical representation of the telescoping cylinder rod protrudes horizontally from the left end of the schematic (near item 1). The end of the graphical representation of the rod at the T2 boom section which is at the 100% pinning location. The slightly larger rectangular entity at the right end of the telescoping cylinder rod represents the pinning mechanism.

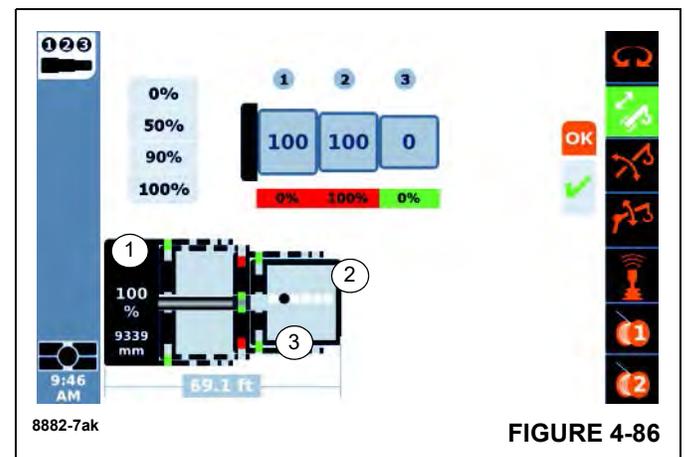


FIGURE 4-86

The example in (Figure 4-86) shows the value of 9339 mm for the extension of the telescoping cylinder within the boom.

This is the value from the precision length sensor. The example also shows a value of 69.1 ft as the overall boom length. The example shows the T3 boom section still at 0% with respect to T2, and T1 has not yet been extended.

As mentioned earlier, there are times when the control system is performing automated motions. The example in (Figure 4-86) shows some dots (2) at the end of the schematic graphic. These dots, as well as the one dark dot cycling back and forth to the left and right (3), indicates that automated motions are occurring.

(Figure 4-87) shows the same screen when the operator is able to control motions of the boom sections. In this case, there is a left and/or right pointing arrow (instead of the dots shown in (2), (Figure 4-86)). As is consistent with the schematic's orientation, the left arrow indicates retracting the boom, the right arrow indicates extending the boom. The control device (typically the joystick in the standard joystick option) would be moved to the left to retract the boom, and it would be moved to the right to extend the boom (while keeping in mind that only one boom section - the boom section the telescoping cylinder is locked to - would be moving).

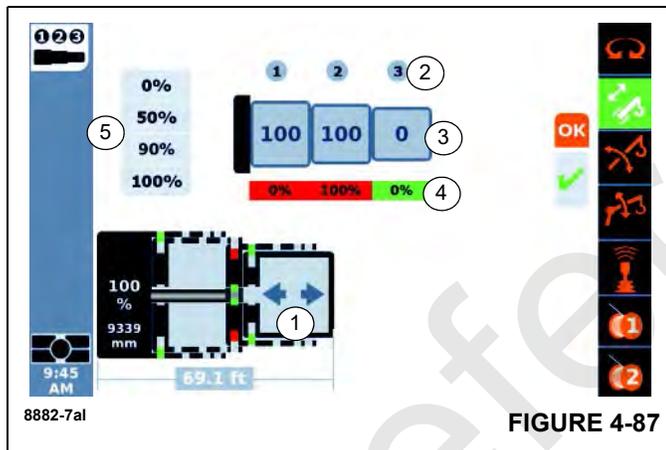


FIGURE 4-87

The arrows (1), (Figure 4-87), at some point in the telescoping process, will blink. The blinking is an indication that an unlocking or locking event will occur if the operator holds the joystick in the direction of that arrow for at least 1 second. If this event begins, then the screen will change to the dots (as described for (Figure 4-86)) so that the operator knows that an automated motion or action is again occurring.

The RCL must be configured and activated in order to have automated motions or to have operator control of the telescoping function. If the Enter Rigging Mode screen on the RCL display is used (accessed with the '?' Icon on the RCL display), then the telescoping action is paused. When the check-mark is used on the RCL display to re-activate the RCL, then the telescoping action resumes (whether automated motion or operator control).

As seen in (Figure 4-87), there are sets of numerical values at the top portion of the screen above the graphical schematic of the boom. First, there is a set of values in a top row with values of 1 to 3 in circles (2), (Figure 4-87). The 1 to 3 in the circles indicate the telescoping boom sections (or "tele sections"). The 1 is for the boom section that is the largest and closest to the base section. This is referred to as T1. This then proceeds from T2 to T3 for the 2 to 3 values.

The values under these boom section indication numbers represent the requested final boom configuration (or "target tele picture"). (Figure 4-87) shows this set of values as 100-100-0 (3). This means that T1 is to be extended to its 100% pinning location, T2 is to be extended to its 100% pinning location, and T3 remains fully retracted, 0%, pinning locations. It is vital that the operator understand that this requested final boom configuration is the first step in operating the pinned boom in the Semi-Auto Mode. Everything the control system performs with the Semi-Auto Mode is dependent on this requested final boom configuration.

Second, there is a set of percentage values shown under the requested final boom configuration values. In (Figure 4-87), these are shown as 0%-100%-0% (4). This represents the control system's currently computed actual boom configuration (or "actual tele picture"). This can be understood as what the boom likes "now" (but as mentioned above the operator must be aware of the physical boom to compare to these values). As the boom is operated, this computed boom configuration will change (just as the schematic graphic for the boom system will change on the display). But the operator should realize that the requested final boom configuration will not be changing as the boom is operated (it is the final destination for the boom motion).

Third, there is a list of percentages on the left (0%, 50%, 90%, 100%) (5), (Figure 4-87). These percentages are the available pinning locations for the boom sections. They represent an extent of the distance along the next larger boom section where the boom section can be pinned - i.e. locked to the next larger and encompassing boom section. The 100% is not the extreme end of the next larger boom section, but the farthest available pinning location (there will always be some overlap between boom sections). The list of percentages are command buttons in the control system interface; a value can be highlighted, and then an Enter button used to actually select the value in the list. When an Enter button is used in this manner, it sets all the values for the boom sections for the requested final boom configuration to that value. For example, if Enter is used on the 50% button, then all the values in the top row of the display will be near 50 (thus requesting the final boom configuration of 50-51-51).

**Semi-Auto Mode Basic Operating Procedures**

The following steps would be expected for extending the boom in Semi-Auto Mode:

- Enter the Semi-Auto screen on the operating display. The icon for this screen is (1), (Figure 4-88).

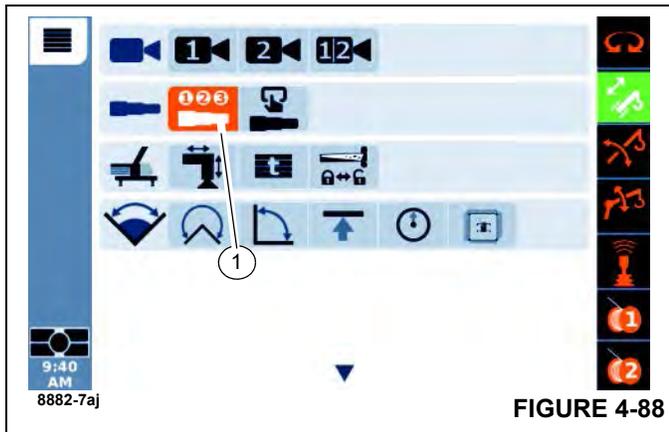


FIGURE 4-88

- Verify that the telescoping function is enabled. This is confirmed by the green background for the icon for the telescoping function in the right margin area of the operating display. Refer to (Figure 4-89).

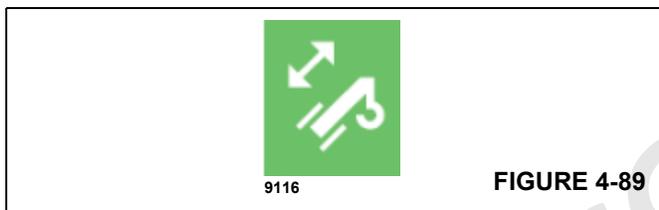


FIGURE 4-89

- Using the operating display, enter the values for the requested final boom configuration (such as 100-100-0).
- Using the operating display, the Enter button is used for the OK shown on the screen. This sends the requested data to the control system. If this configuration is considered acceptable, a check-mark will be shown below the OK (as is seen in (Figure 4-87)). If the configuration is not considered acceptable, a red X will be shown instead of the check-mark. As an example, a requested final boom configuration of 50-0-50 is not allowed (the T2 section was “skipped” for having a non-0% pinning location).
- Depending on the current location of the telescoping cylinder, the cylinder may need to move to a different boom section. If this is needed, the automated motions will immediately occur.
- Once the telescoping cylinder is considered locked to the boom section that is to be first moved (T2 in the current example) by the control system, the boom section will be unlocked (this is an automated action).
- Once the boom section is unlocked, the telescoping direction arrows, as shown in (Figure 4-87), will appear.
- With the arrows present, the operator can telescope the first boom section to be moved (T2 in this example).

- The operator uses the joystick (or other control device) to extend the boom section. The boom motion will automatically be stopped at the 100% pinning location and the right arrow will be blinking. If the joystick is used in the extend direction for at least 1 second after the arrow is blinking, then the boom section will be locked at this pinning location. If the joystick is not used in this time interval, then the boom section can remain at that location and not locked (note that the boom section could also now be retracted and the boom fully retracted, if desired, without changing the target tele picture / requested final boom configuration).
- Assuming that the boom section is requested to be locked, it is important to know that there are a few phases to the automated motion to lock the boom section. In particular, (Figure 4-90) shows that there is a “lip” on the boom section pins (pointed to by the arrow in figure). The first phase for boom section locking is to release/extend the pins into the hole/cutout in the encompassing boom section. If this is successful, then there is a second phase of automated motion to set down the boom section on the proper flat surface of the pins that is next to the lip. In a final phase, the pin is confirmed to be engaged and the boom section locked by the control system command the telescoping cylinder to retract and then checking for no boom motion. If there is no motion, then it is confirmed as locked.

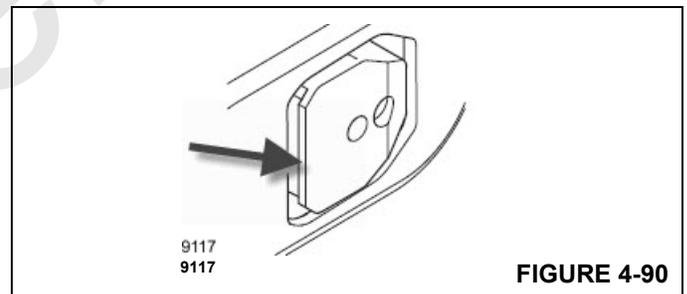


FIGURE 4-90

- After the boom section is locked, the left AND right arrows are shown blinking. This indicates to the operator that the boom can be retracted or extended, and that in either case, there will be automated motions and to be aware that it will take some time (the blinking is an indication to the operator that this time will be needed).
- Assuming the boom is to continue to be extended, the operator would use the joystick (or other control device) in the extend direction for at least 1 second. This is interpreted as the indication to change to extending the next boom section (T1 in this example). Therefore, the telescoping cylinder will automatically unlock from the T2 boom section, retract to the T1 boom section, lock to the T1 boom section, and then unlock the T1 boom section.

- When the T1 boom section is unlocked, the left and right telescoping direction arrows will appear again (as is shown in Figure 4-87).
- The operator can telescope the next boom section (T1).
- The T1 boom section operating process is the same as for the T2 boom section described above. When the T1 boom section is at its 100% pinning location, then it can be locked in the same manner (using the extend direction of the joystick for at least 1 second when the right arrow is blinking).
- With the T1 boom section at its requested final location, only the left arrow would be blinking. This is indicating that it is impossible to telescope the boom any further (the boom has arrived at its final configuration as requested).

The following steps would be expected for fully retracting the boom in Semi-auto Mode:

- DO NOT ENTER a new boom configuration or “target tele picture” (such as 0-0-0) just to be able to fully retract the boom.
- At any point in the boom extending procedure (described above), when the left arrow is shown, the joystick (or other control device) can be used in the retract direction to retract the boom (partially or fully).
- Using the previous example for extending the boom, the boom motion would end at the boom configuration of 100-100-0. And, the left arrow would be blinking.
- The operator can use the joystick in the retract direction for at least 1 second, and then the automated motion to unlock the boom section (T1 in the example) will start. It is important to know that there are two phases for unlocking a boom section. As mentioned previously, and shown in (Figure 4-90), there is a lip on the boom section pins. Therefore, the first phase of the automated motion is to lift up the boom section to have clearance from this lip. After the lift up is completed, then the pins are retracted. The boom section is now able to be retracted.
- The operator can retract the first boom section to move (T1). But note that the retract and extend arrows are again shown. It is possible for the operator to change direction once again and return to extending the boom, if desired.
- Assuming the boom is to be fully retracted, the operator would retract the first section. The boom section will slow down near the 0% pinning location. If the operator continues to retract the boom section to the 0% pinning location, the boom motion stops. The left arrow is shown blinking.

- The operator can command the retract direction for at least 1 second, and then the boom section will lock at 0%.
- The left and right arrows would be shown blinking.
- The operator can continue to command the retract direction for at least 1 second, and then the telescoping cylinder will automatically unlock from the boom section, extend to the next boom section to be retracted, and lock to that boom section. Then the automated motion to unlock the boom section will be used (now for boom section T2 in this example). When unlocked, the left and right arrows will appear again.
- The operator can continue to command the retract direction and the second boom section to move will be retracted. And, as before, it can be locked at its 0% pinning location.

**NOTE:** When the boom is fully retracted, the telescoping cylinder does not automatically move to another boom section (such as automatically moving to the T1 boom section). The telescoping cylinder will remain at the boom section that was the last to be retracted. However, this cylinder can be moved to another boom section with the Semi-Auto Mode. Refer to the section (below) *Semi-Auto Mode for Shifting Cylinder Within Fully Retracted Boom*, page 4-70.

#### ***Semi-Auto Mode for Shifting Cylinder Within Fully Retracted Boom***

It may be desirable to have the telescoping cylinder locked to a particular boom section while the boom is fully retracted. This might be particularly useful for weight distribution changes for roading the crane.

The following procedure can be used:

- Enter the Semi-auto screen of the operating display.
- Verify that the telescoping function is enabled.
- Enter a requested final boom configuration with 0% for each of the boom sections, EXCEPT for the boom section where the tele cylinder is desired to be locked to. For this one boom section, enter 50%. For example, if the telescoping cylinder is desired to be locked to the T1 boom section (and it is not located there currently), then 50-0-0 would be entered.
- If the telescoping cylinder is not at the boom section desired, it will shift to that boom section.
- When the telescoping cylinder is locked to the desired boom section, that boom section will be automatically unlocked (as if it is to be operated).
- Use the joystick (or other control device) to retract for at least 1 second. The boom section will re-lock, and the boom should still be fully retracted and locked, and the

telescoping cylinder will be in the position desired (such as locked to T1 boom section).

### Semi-Auto Mode Requiring Boom to be Retracted

It is important to understand that a new requested final boom configuration (“target tele picture”) may require the boom to be retracted first. For example, if the requested final boom configuration is currently 100-100-0, and the boom is extended to this configuration, and then a new requested final boom configuration (such as 0-100-100) is entered, it is impossible to use the new configuration unless the existing boom sections are retracted first. When this condition arises, only the left telescoping direction arrow (1), (Figure 4-91) will be shown on the display. When the boom is fully retracted, then the automated motions should proceed to the new configuration. That is, for the example, when T2 is locked at 0% (after using the joystick to retract everything), then telescoping cylinder can move to the T3 boom section to be unlocked (since it is the first boom section to move for the new final boom configuration of 0-100-100).

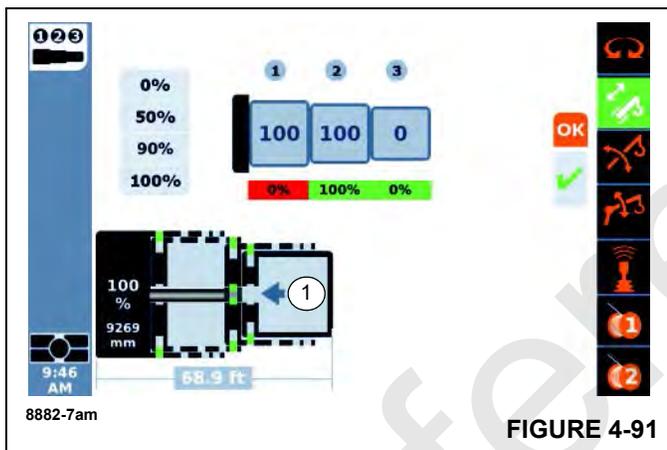


FIGURE 4-91

### Semi-Auto Mode Screen Refresh

When the Semi-auto screen of the operating display is entered, the final boom configuration (“target tele picture”) that is shown is the one most recently ACCEPTED and is actually being used to control/operate the boom. If the screen is exited and re-entered, what is shown may not be the most recently REQUESTED final boom configuration.

As noted in the section of the document 'Semi-auto Mode Requiring Boom to be Retracted', there are cases where a newly requested final boom configuration can not be accepted until the current boom configuration is completed to have the boom fully retracted. If the Semi-auto Mode is currently requiring the boom to be retracted, and the Escape (ESC) Button is used to leave the Semi-auto screen, and then Semi-auto screen is entered again, the values shown for boom sections will revert to the original boom configuration, the ACCEPTED boom configuration (until the boom is fully retracted and the control system can then “shift” to the new REQUESTED final boom configuration).

### Semi-Auto Mode Warning Indications

The control system manages a fault indication system. This is characterized by a set of error codes or fault codes. When a fault condition is noted by the control system, the icon in (Figure 4-92) is seen (at least in the left margin of the operating display). There is also a screen of the operating display that uses this icon, and that screen will show the fault codes.



FIGURE 4-92

For the pinned boom control (such as in Semi-Auto Mode), a fault may be noted that is momentary. For instance, there is a calculation of the difference between the calculated boom length (based on the calculated boom section positions in the control system) and the measured boom length (from the boom outer cable reel sensor). If this difference is too large, there is a fault condition. However, if the cable on the outer cable reel sensor is just moved momentarily by something near the boom, the cable may suddenly move and then return to the proper tension. In this case, the fault condition can appear momentarily. This fault code could be viewed on the operating display, but it does not cause the telescoping function to shut-down, and the fault code can be cleared.

For the proximity switches that sense the position of the telescoping cylinder components and pinning mechanism, similar momentary conditions may appear. There may also be fault codes that appear when automated motions take longer than expected, but the control system automatically recovers from the condition.

For these momentary and warning conditions, the telescoping function will continue to be available. If the left and/or right arrows appear, then the boom can be moved in the directions indicated by the arrows. The momentary or warning conditions might also be helpful in diagnosing faults that eventually cause the telescoping function to shut-down (Refer to the section *Semi-Auto Mode Telescoping Function Shut-Down*, page 4-72).

There are sensors in the telescoping cylinder that detect elevated pressure conditions for extending the boom (particularly for telescoping with significant hook loads). If the pressure is beyond a threshold (depending on the distance the telescoping cylinder has been extended), then the extend motion is slowed down. If the pressure approaches another threshold, then the extend motion is stopped. When these conditions are apparent, the icon shown in (Figure 4-93) will be shown in the left margin of the operating display (ODM).



FIGURE 4-93

**Semi-Auto Mode Telescoping Function Shut-Down**

If the control system detects a fault that is not momentary and not a warning indication, then the telescoping function will be shut-down. In this case, the error icon (as seen in (Figure 4-94)) will appear in the graphical schematic for the boom (instead of the dots or the direction arrows described previously).

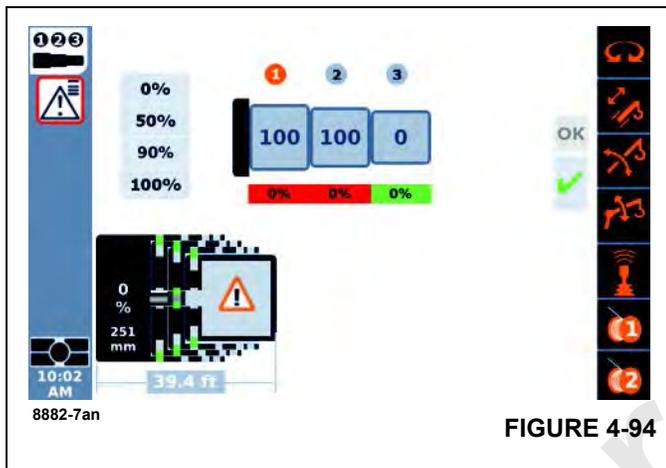


FIGURE 4-94

Typically shut-down condition indicates a failure in the components of the control system (such as sensors or modules or communications). If the only indication of faults is for the telescoping function, then the following steps can be used:

Cycle the power for the control system. When the power is restored, the control system will attempt to repeat the same procedure or automated motion that was interrupted by the fault condition. If the fault condition was not permanent, this may correct the condition, and if the error icon does not appear again, then the telescoping function can continue to be used.

If cycling the power for the control system is not effective, and there is a load on the hook while the control system is attempting an automated action or motion (such as unlocking the telescoping cylinder or a boom section), then lower the load, if possible. Without the load on the hook, cycle the power again to attempt the automated action or motion.

If the telescoping function is still not operable, then the manual telescoping mode can be attempted. In this mode, it is possible to command slight telescoping cylinder motions to assist with locking or unlocking.

If telescoping function is still not operable, then the fault can be assumed to be in the control system components, and control system diagnostic procedures should be utilized.

**Semi-Auto Mode Lost Boom Configuration**

The Semi-Auto Mode is expected to continuously monitor and record the positions of the telescoping boom sections. If this process is interrupted, perhaps by communication interruption or repairing a component in the control system, then this recorded boom configuration (or “tele picture”) may be lost. The control system will not find components in the expected position. When this occurs, a question mark icon will appear in the screen as shown in (Figure 4-95).

The operator can attempt to correct this condition by the procedure in the section (below) *Telescope Recovery Mode/Resetting Telescope Configuration*, page 4-72.

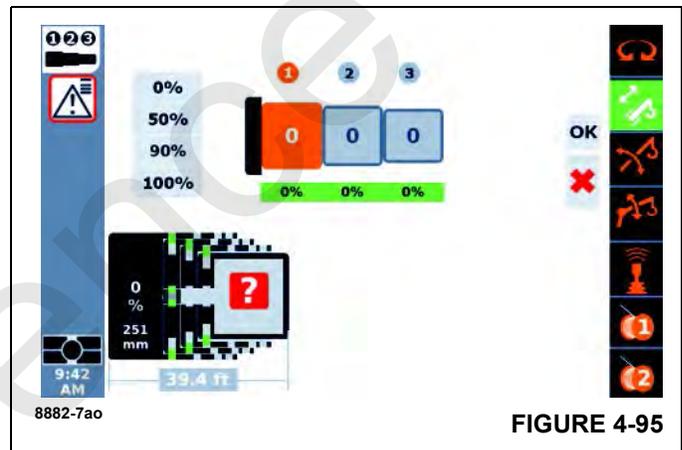


FIGURE 4-95

**Telescope Recovery Mode/Resetting Telescope Configuration**

CCS no longer displays the current telescoping if

- you telescoped in emergency mode,
- **OR**
- the power supply was interrupted in the course of saving data.

If the actual boom configuration (or “actual tele picture”) is no longer considered valid by the control system, the question mark icon (Figure 4-96) appears in the Semi-Auto screen, then the following procedure can be used to reset (or “teach”) the telescoping configuration:

When entering the new values for these positions for each boom section, you can select from the display values such as 0%, 50%, 92%, and 100%. If one boom section is unlocked (locked to the tele cylinder and that boom section is able to be extended/retracted), then the display buttons or jog-dial can be used to select “less than” 0% and then an unlock symbol appears. This unlock symbol is the proper

selection for the boom section that can be extended/retracted.

- Enter the request reset telescoping screen on the Operator Display Module (ODM). (Figure 4-96) shows the icon for this screen.



FIGURE 4-96

The request reset telescoping screen appears as shown in (Figure 4-97). This screen is for entering a confirmation code. The confirmation code is L-O-S-T. When these letters are entered on the screen, then an Enter button can be used on the OK (Figure 4-97) shown on the screen. If this is the correct code, then the reset telescoping screen appears as shown in Figure 4-98.

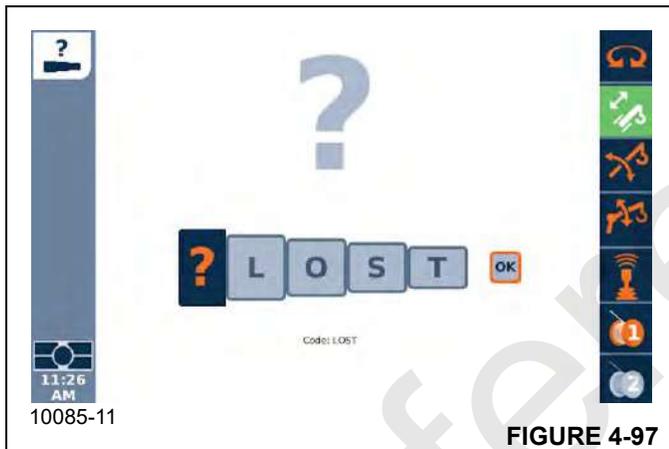


FIGURE 4-97

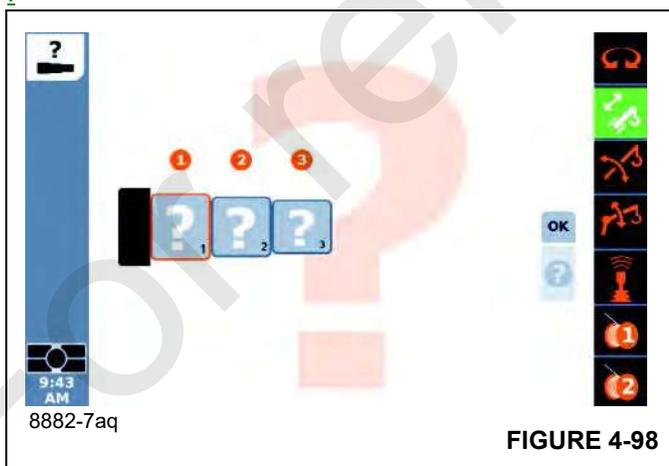


FIGURE 4-98

- In the reset telescoping screen, as shown in Figure 4-98, the operator can indicate the current boom configuration (“actual tele picture”). It is seen that there are 3 available boxes (for the 3 telescoping boom sections). Each of these spin boxes can be used to change to one of the following:

- 0%
- 50%, 51%
- 90%
- 100%
- Unlock icon (appears when the 0% value is shown and then the jog dial or operating display arrow button is used to get a value below 0%).

- Each of the spin boxes needs to be set to a value or indication of the current actual configuration of the boom. If a boom section is locked at a 50/51% location, then that boom section spin box is to be set to the 50/51%. If a boom section is unlocked (and able to be operated by the telescoping cylinder), then that boom section spin box is to be set to the Unlock icon.

- When each of the spin boxes is set to the correct value or indication, then an Enter button can be used on the OK in the screen. If the control system confirms this boom configuration, then a check-mark appears below the OK (as in (Figure 4-99). Otherwise, the question mark shown under the OK (as in (Figure 4-100) will remain; in this case, the operator should repeat an attempt to enter the actual boom configuration.

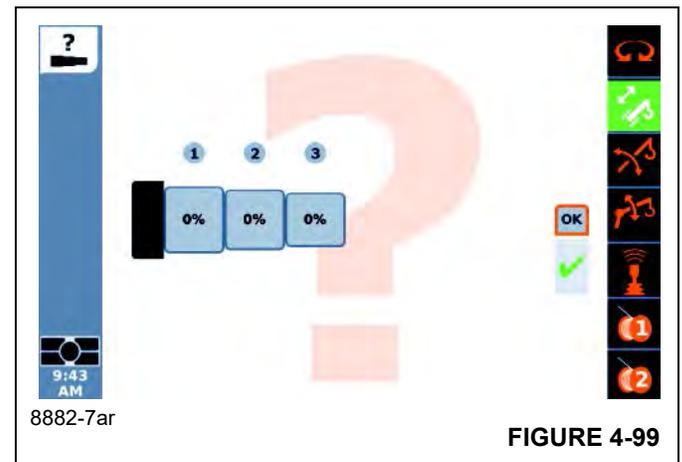


FIGURE 4-99

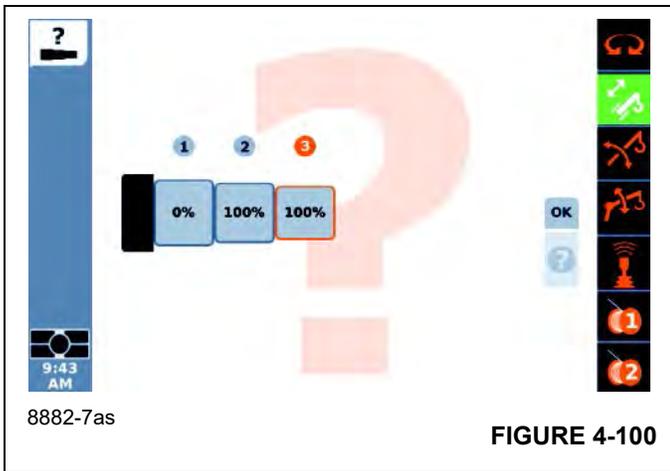


FIGURE 4-100

**CAUTION**

**Risk of Damage Due to Incorrect Input!**

Before working with the crane, check whether CCS indicates the current telescoping and correct if this is not the case. This is indicated by the standard error symbol (exclamation point in a triangle) shown in the normal telescoping control screens. The error symbol should not be shown.

Entering incorrect values can cause malfunctions and may result in damage to the telescoping mechanism.

**Semi-Auto Mode vs. Manual Mode**

The pinned boom can also be controlled with a Manual Mode. Although the Manual Mode allows some additional capabilities, the Manual Mode still requires some automated motions. The Manual Mode screen includes the same schematic graphical representation of the boom, and it uses the same dots indication for automated motions (as shown in Figure 4-86), as well as the telescoping direction arrows for operator control (as shown in Figure 4-87).

The following outlines differences between the Semi-auto Mode and the Manual Mode:

- The Manual Mode screen does not show the final boom configuration values (“target tele picture” or “actual tele picture”). In Manual Mode, the operator requests lock and unlock procedures and telescopes boom sections to desired pinning locations without an initial indication of the final destination. However, the control system internally still creates such a final boom configuration for the instance where the operator changes to the Semi-auto Mode after using the Manual Mode. The control system sets the final destination for all boom sections not yet moved to 100%. Thus, when changing from Semi-auto Mode (where the operator may have entered 50-50-50) to Manual Mode (where only boom sections

T2 and T3 were operated), and then changing back to Semi-Auto Mode, the Semi-auto screen can show 100-50-50 (thus the control system automatically changed the destination of T1 from 50% to 100%). This is expected behavior. The operator can use the Semi-auto screen to change the 100% back to 50%, and in some cases, the boom can continue to be operated (but in other cases, the boom may have to be fully retracted first).

- The Manual Mode shows an expanded view of the telescoping cylinder pinning mechanism with the same unlock icons and a lock icon, as seen in (Figure 4-101) (instead of the requested final boom configuration values for the Semi-auto Mode). When one of the unlock or lock icons becomes available to be selected (changes from the basic gray color to the focus color), then the operator can request the unlock command or the lock command. The top unlock icon is for the boom section unlocking, and at the proper time the lock icon would be used to again lock the boom section (the lock icon will become available as a command when the control system allows it). The bottom unlock icon is for the telescoping cylinder unlocking, and again at the proper time the lock icon would be used to again lock the telescoping cylinder (again the lock icon will become available as a command when the control system allows it). There is only one lock icon since the pinning mechanism is designed to either unlock the boom section or the telescoping cylinder (but not both at the same time). In this manner, the boom configuration and pinning locations are “built up” by the operator as the boom is operated.

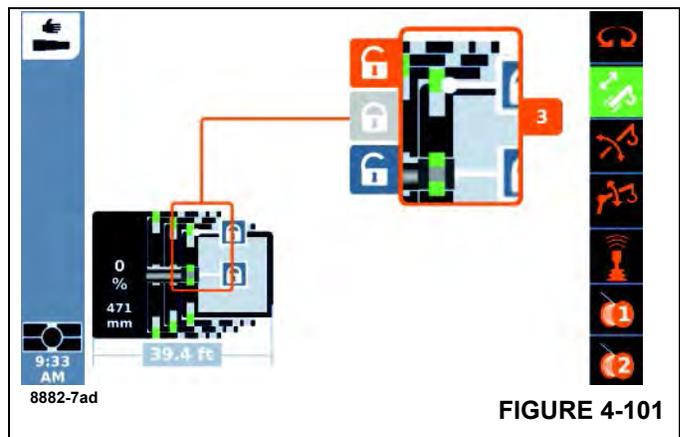
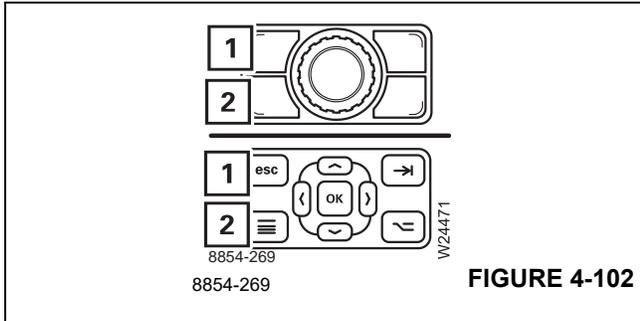


FIGURE 4-101

- In the Semi-Auto Mode, the unlocking of the telescoping cylinder and boom sections is entirely automated. And when locking is completed in the Semi-auto Mode, the joystick (or other control device) does not affect the position of the telescoping cylinder (the joystick is used to confirm the next command when there is a blinking arrow). In the Manual Mode, the command buttons indicate the unlocking and locking, and the joystick can

affect the position of the telescoping cylinder; however, with the components already in a locked condition, the position of the cylinder can only be slightly affected. But, making slight adjustments to the position of the cylinder can assist with the unlocking process.

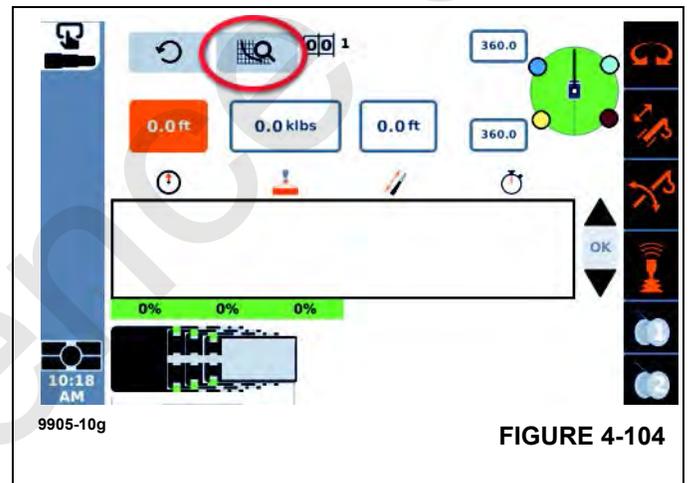
You can cancel the entry at any time using the (1), (Figure 4-102) or (2) buttons.



**Boom Configurator**

There are many boom or pinning configurations available. The Boom Configurator can assist with previewing these boom configurations and making an appropriate selection. This screen is used when the boom is fully retracted. Enable the telescoping mechanism, refer to *Function of the Controller*, page 4-60.

The Boom Configurator is selected from the menu system on the ODM as shown in Figure 4-103. Once selected, the Boom Configurator screen is shown (refer to Figure 4-104). This screen allows lift plan information such as hook radius, hook load, and boom length to be entered. The screen will then present a table of possible boom configurations to select from. The table will show the load chart based information for the configurations, as well as an approximate time (in seconds) to complete the telescoping to the boom configuration. Note that the boom configurations shown are dependent on the rigging information already entered on the RCL display, so be certain to set this rigging information correctly. If the rigging information is changed, all the selections on the Boom Configurator and data on the Boom Configurator may change. When the Boom Configurator data is updating (a waiting circle is shown on the screen), do not interact with the screen/display; wait until the data is completely updated before selecting the next action (although ESC can be used at any time to cancel the operation).



After a table of boom configurations is displayed, the arrow icons on the right side of the screen can be used to highlight a particular row in the table. For this highlighted row, the details of the boom configuration (“tele picture”) is shown below the table. If the OK button is pressed with a particular row highlighted, then the boom configuration is sent directly to the Semi-auto screen and the control system begins to work that selection and can begin unlocking the boom as long as the tele function is enabled and the engine is running.

As an example, the RCL rigging information can be set to utilize Rigging Code 201 as follows (including using the check-mark to activate this selection):

- Outriggers at 100% extension.
- Counterweight of 18,000 lb.
- 2 parts of line on main hoist (no aux nose).
- Boom extension stowed.

1. Enter the Boom Configurator screen (should appear similar to (Figure 4-104)).
2. Highlight the first selection box at the top of the screen (for radius), and select Enter.  
The value in the box can now be changed. Increase the value until 75.0 ft is shown, and select Enter.
3. Use Enter on the Search Icon (highlighted in Figure 4-104).  
After a few moments, the boom configurations are searched and sorted and then shown in the table similar to (Figure 4-105).

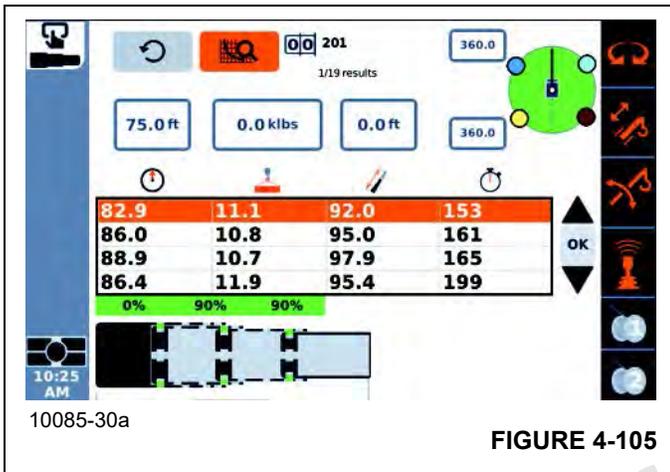


FIGURE 4-105

4. Highlight the second selection box (for hook load), and select Enter.  
The value in the box can now be changed. Increase the value until 12.0 klb is shown, and select Enter.
5. Use Enter on the Search Icon (highlighted in Figure 4-104).  
The boom configurations are now a shorter list (since now matching for both radius and load).

Figure 4-106 shows the expected typical boom configurations for the criteria that have been entered. Note that the fourth row has the radius and hook load highlighted in green. These green values indicate the maximum radius and maximum load values in those columns. For the column with the approximate time to extend the boom (the fourth column), the green highlighted value is actually the minimum value (since a shorter time is expected to be the most desirable). Also, note that the orange color for highlighting/selecting a row can “hide” the green color, but the italics is also used to try to distinguish these items. Use the up and

down arrow icons at the right side of the screen to change the highlighted row and then see all the green colored items.

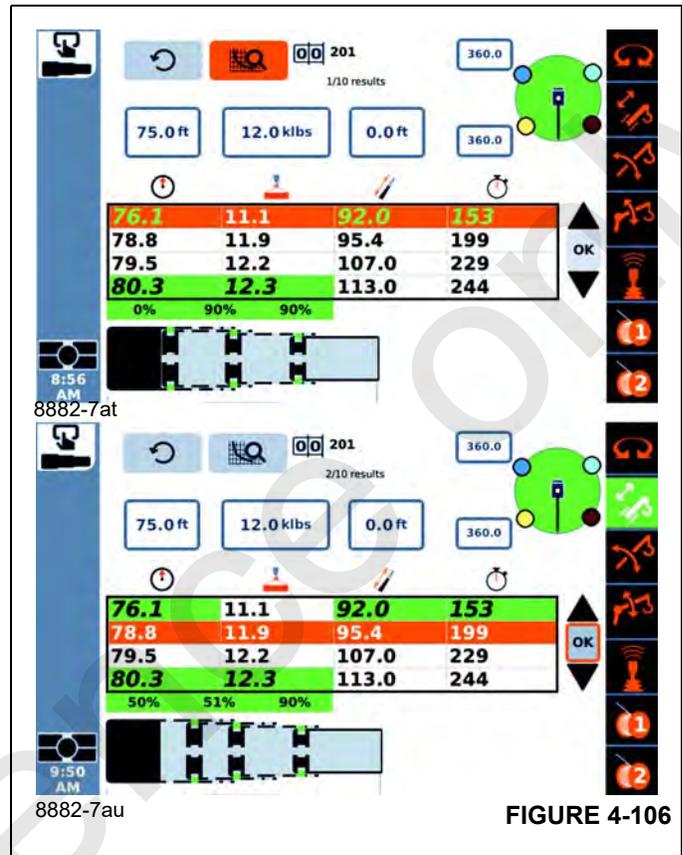


FIGURE 4-106

Again referring to Figure 4-106, the second row could be highlighted using the up and down arrows at the right side of the screen. This would be pinning combination 50-51-90 (as seen in the values below the table of values and the graphic of the boom sections). Once a selection is made, the OK button can be used (if the telescoping function has been enabled) to proceed to use the boom configuration in the Semi-auto mode. Another option is to change the rigging information as explained next.

The rigging information on the Rated Capacity Display Module (RDM) can be changed, for example, as follows:

- 10 parts of line on main hoist (no aux nose)
- Use the check-mark to activate new rigging.

If the Boom Configurator screen is still shown on the ODM, then the table of values should update.

After a new table of available boom configurations appears, a new selection can be made and sent to the Semi-auto telescoping mode.

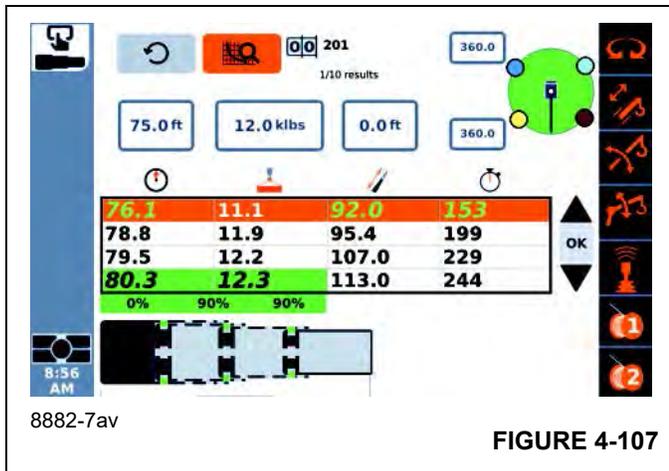


FIGURE 4-107

Finally, if it is desired to keep lifts within a criterion such as 75% of the maximum values for the load chart data, then the search can be based on a modified hook load. The modified hook load value would be the hook load divided by the decimal value for the desired limitation such as the following:

$$P_{\text{modified}} = P / 0.75$$

For example, if hook load is 10,000 lbs, and 0.75 is the modification desired, then the value to enter on the Boom Configurator screen would be the following:

$$P_{\text{modified}} = 10,000 / 0.75$$

$$P_{\text{modified}} = 13,333$$

Thus, enter the value of 13.5 klbs for the Boom Configurator.

### High-Speed Mode Operation

**NOTE:** The telescoping mechanism cannot be operated at high speed. Swing cannot be operated at high speed.

#### Hoists

Hoist speeds can also be changed with the Enable/Disable switches in the armrest.

### CAUTION Machine Damage!

Operation in high speed mode with a large number of parts of line and/or very light loads could result in the cable becoming slack causing mis-spooling and damage to the rope.

#### To Switch on High Speed Mode Momentarily

- Press the button (1), (Figure 4-108). High-speed mode will be active until you release the button.

#### Continuous Operation

- Press the button (2), (Figure 4-108). High-speed mode will be enabled until you press the button again.

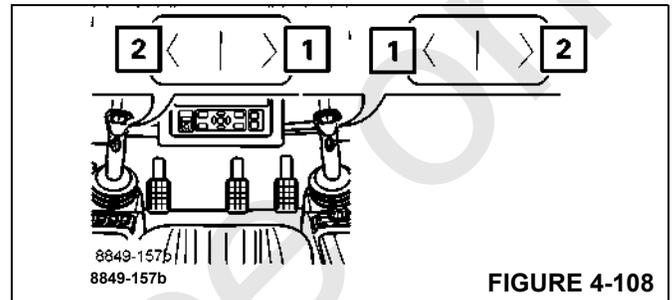


FIGURE 4-108

The icon indicates the current status:

<b>ON:</b>	(1), (Figure 4-109) High-speed mode switched ON
<b>OFF:</b>	(2), (Figure 4-109) High-speed mode switched OFF



FIGURE 4-109

#### Warning for Lowering Limit Switch Lockout

Icon shown:	Lowering limit switch triggered – main hoist stop (Figure 4-110). <b>NOTE:</b> This icon is in Warning Area of the ODM.
No icon:	Lowering limit switch not triggered



FIGURE 4-110

**Hoist Lifting Limit Lockout Indication**

ON:	Hoisting is locked out due to Anti Two-Block condition (Figure 4-111). <b>NOTE:</b> Minimum wrap condition is not indicated in this figure.
Flashing:	Hoist Limit Lockout Override Active
OFF:	Anti Two-Block switch not triggered

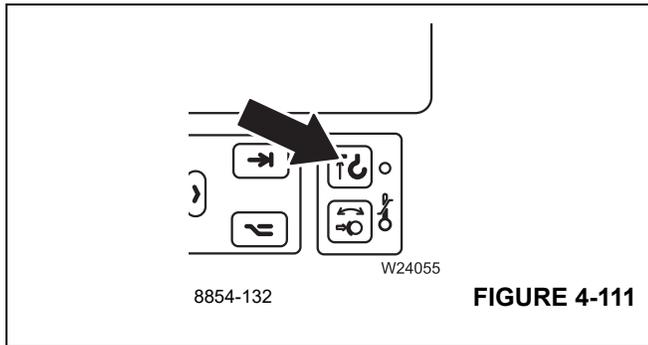


FIGURE 4-111

**Swing**

**WARNING**  
**Tip Over Hazard!**

Always check before swing whether swing is permitted in the truck crane's current rigging mode (counterweight, outrigger span, working radius).

Correct the rigging mode if necessary. Refer to *Swinging with Rigged Counterweight*, page 5-29.

**Swing Brake**

The swing gear is braked with the brake pedal.

**Switching ON the Swing Gear**

After the ignition is switched on, all of the power units will be switched off and the lamps in the corresponding buttons will light up only dimly.

- Press the button (1), (Figure 4-112) once.
  - Symbol (2), (Figure 4-112) is green if the swing gear is switched on.

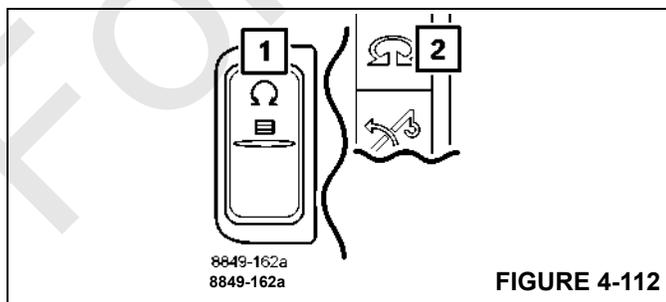


FIGURE 4-112

**Releasing the Swing Brake**

- When releasing the swing brake with the brake pedal function:  
 The swing brake is released when you enable the swing gear.

Lamp (1), (Figure 4-113) will extinguish if the swing brake has been released.

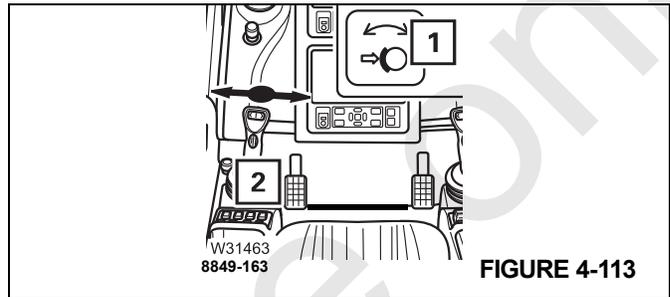


FIGURE 4-113

**Applying the Swing Brake**

**NOTE:** The swing brake is applied when you disable the swing gear. Refer to *Switching OFF the Swing Gear*, page 4-80.

The lamp (1), (Figure 4-114) will light up if the swing brake has been applied.

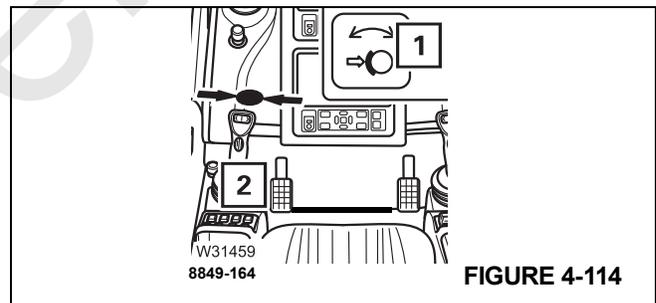


FIGURE 4-114

**Swing**

The following requirements must be fulfilled before swinging:

- The 360 Lock must be disengaged. Refer to *Releasing the 360° Lock*, page 4-50.
- Swing must be permissible with the current rigging mode.
- The current rigging mode must have been entered on the RCL display.

**Releasing Locked Swing Gear**

You can unlock the swing gear if it has been locked.

Press and hold the button (1), (Figure 4-115) – the swing gear is unlocked. The speed will then be reduced to 10%.

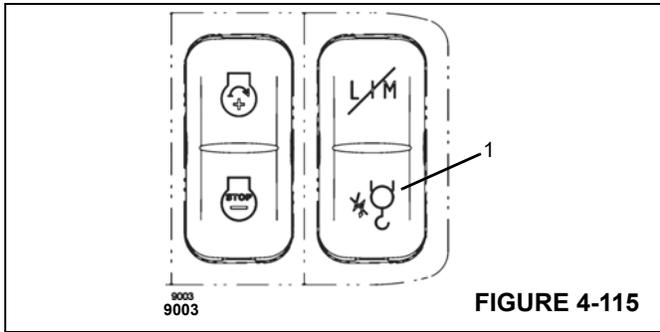


FIGURE 4-115

The anti two-block does not bypass the swing brake. It does bypass the swing lockout where swing is not permitted because of:

- Counterweight cylinder position,

OR

- Carrier avoidance (boom low enough and close enough to hit the carrier cab or exhaust stack).



**WARNING**

**Tip Over Hazard!**

Before swinging, always check whether the RCL code is valid for the current rigging mode displayed.

This prevents swing operations from being enabled within the impermissible ranges, which would cause the truck crane to overturn.



**DANGER**

**Crush Hazard!**

Death or Serious Injury could occur if struck by moving machinery.

You can adjust the sensitivity of the control levers to suit the operating conditions. Refer to *Controller Speed Function*, page 4-187.

**NOTE:** Swing movements are not braked automatically. If you let go of the control lever or move it to initial position, the swing movement will gradually slow down. Refer to *Braking the Swing Movement*, page 4-79.

You can limit the maximum swing speed (1), (Figure 4-116). Refer to *Controller Speed Function*, page 4-187.

To swing to the left:	• Push the control lever to the left (Figure 4-116).
To swing to the right:	• Push the control lever to the right (Figure 4-116).

You can regulate the speed by moving the control lever or changing the engine speed.

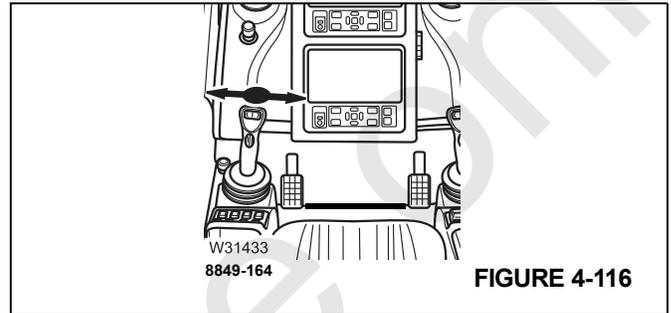


FIGURE 4-116

0° means that the superstructure is positioned with the boom over the rear (Figure 4-117).

- Angles in the left semi-circle are displayed as positive values (0° to +180.0°).
- Angles in the right semicircle will be shown as negative (0° to -179.9°).

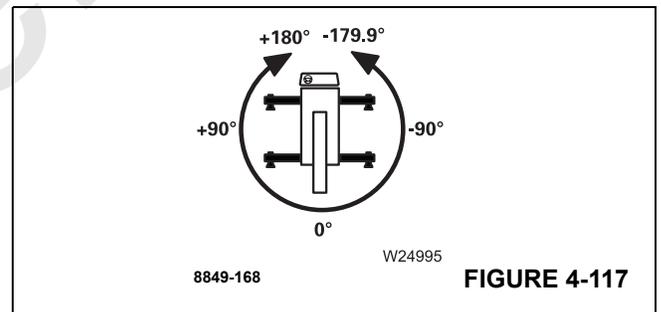


FIGURE 4-117

**Braking the Swing Movement**

You may only brake the swing movement with the swing gear brake.



**WARNING**

**Boom Damage Hazard!**

Switching off the swing drive will activate the swing brake immediately. If the crane is swinging, abrupt stopping will create a shock load that could result in damage or buckling of the boom. Death or Serious injury may occur.

- Depress the brake pedal (1), (Figure 4-118). Do not brake to such a degree that the load starts swinging.

If you only move the control lever to initial position, the swing movement will slowly run down.

will be shown in the left margin of the operating display (ODM).

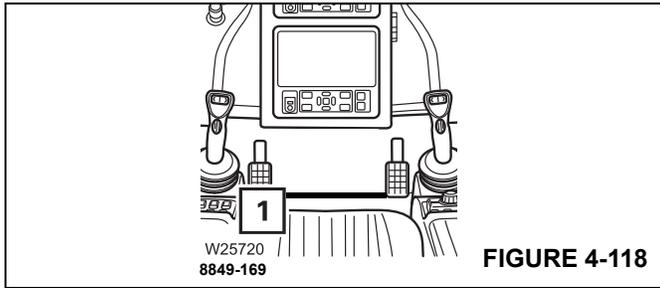


FIGURE 4-118

At the initial position, the swing movement will be stopped. At the same time the swing gear hydraulic brake will be applied.



FIGURE 4-119

**Free Swing Mode**

In free swing mode, the swing brake and swing drive are released and the crane can swing freely when external forces act upon the load or boom. To activate free swing mode:

- Enable the swing gear. The swing gear brake is released – lamp (1), (Figure 4-120) lights up.
- Shift the control lever (2), (Figure 4-120) to its initial position.
- Press the button (3), (Figure 4-120). The swing gear hydraulic brake is released.

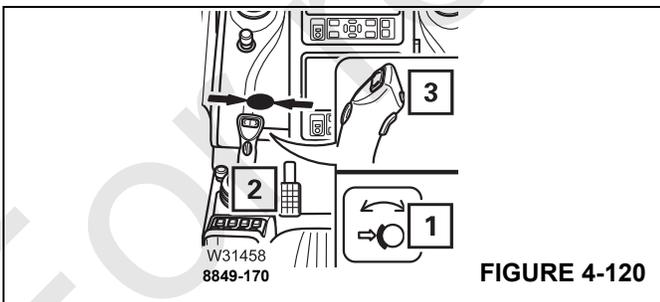


FIGURE 4-120

- When the free swing mode is active, the icon shown in (Figure 4-121) (swing function icon with yellow border)



FIGURE 4-121

**Switching OFF the Swing Gear**

If the swing gear is not required, it should be switched OFF to avoid unintentional use.



**WARNING**

**Boom Damage Hazard!**

Switching off the swing drive will activate the swing brake immediately. If the crane is swinging, abrupt stopping will create a shock load that could result in damage or buckling of the boom. Death or Serious injury may occur.

- Press the button (1), (Figure 4-122) once.
  - The lamp in the button (1), (Figure 4-122) will light up dimly.
  - Symbol (2), (Figure 4-122) will turn red if the swing gear is switched off.
  - The swing gear brake is applied – lamp (3), (Figure 4-122) lights up.

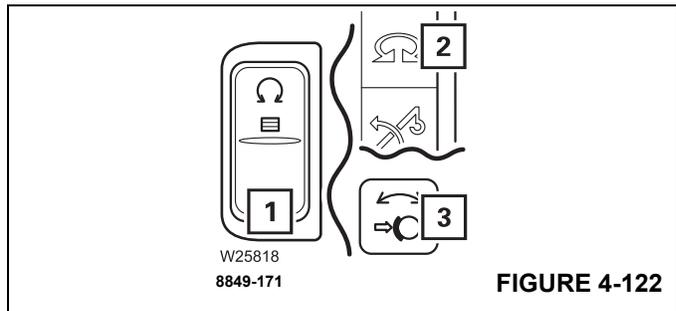


FIGURE 4-122

**Possible Movement Combinations**

- The main hoist, telescoping mechanism, lifting/lowering mechanism and swing gear can be operated in almost any combination simultaneously. Restrictions are specified for the specific power units.
- The auxiliary power units – Superstructure lock, tilt crane cab, counterweight lifting unit – cannot be operated with the Telescoping movement. Moving the auxiliary power units in combination with other power units can result in reductions of speed.

- Lattice extension lifting/lowering mechanism. The lattice extension lifting/lowering mechanism cannot be operated in combination with the Extending movement.

**Lowering and Raising the Main Hoist Rope**

**! DANGER**  
**Crushing Hazard!**

Keep area beneath load clear of all obstructions and personnel when lowering or raising rope (load).

**! DANGER**  
**Crushing Hazard!**

Do not jerk controller when starting or stopping hoist. Jerking controller causes load to bounce, which could result in possible damage to the crane.

When load is stopped at desired height, the automatic brake will engage and hold the load as long as the controller remains in neutral.

The symbols show the direction of rotation of the hoist (Figure 4-123):

1	Lifting the load
2	Lowering the load



**FIGURE 4-123**

**NOTE:** The speed of the hoists will only be significantly increased by switching to high-speed mode if you have moved the control lever by more than 70%.

**Lowering the Main Hoist Rope**

Dual Axis Controllers

1. Press the Main Hoist Enable/Disable Switch on right armrest to enable the main hoist function.

The Main Hoist Enable Indicator in the Status Bar area (Figure 4-155) of the ODM will come on (green).

2. Push controller on right armrest forward and hold to lower the main hoist rope.

3. When hook block/overhaul ball gets to the desired height, let controller return to the center (neutral) position to stop lowering the main hoist rope.

**NOTE:** When the main hoist controller is pushed forward to lower the rope, the Hoist Rotation Indicator pulses and the Main Hoist Lower Indicator (Figure 4-155) comes on to indicate to the operator that the main hoist is operating.

Single Axis Controller (Optional)

1. Press the Main Hoist Enable/Disable Switch on right armrest to enable the main hoist function.

The Main Hoist Enable Indicator in the Status Bar area (Figure 4-155) of the ODM will come on (green).

2. Push outer controller on right armrest forward and hold to lower the main hoist rope.

3. When hook block/overhaul ball gets to the desired height, let controller return to the center (neutral) position to stop lowering the main hoist rope.

**NOTE:** When the main hoist controller is pushed forward to lower the rope, the Hoist Rotation Indicator pulses and the Main Hoist Lower Indicator (Figure 4-155) comes on to indicate to the operator that the main hoist is operating.

**Raising the Main Hoist Rope**

**! DANGER**  
**Two-Block Hazard!**

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

Dual Axis Controllers

1. Press the Main Hoist Enable/Disable Switch on right armrest to enable the main hoist function.

The Main Hoist Enable Indicator in the Status Bar area (Figure 4-155) of the ODM will come on (green).

2. Pull controller on right armrest rearward and hold to raise the main hoist rope.

3. When hook block/overhaul ball gets to the desired height, let controller return to the center (neutral) position to stop raising the main hoist rope.

**NOTE:** When the main hoist controller is pulled rearward to raise the rope, the Hoist Rotation Indicator pulses and the Main Hoist Raise Indicator (Figure 4-155) comes on to indicate to the operator that the main hoist is operating.

Single Axis Controller (Optional)

1. Press the Main Hoist Enable/Disable Switch on right armrest to enable the main hoist function.

The Main Hoist Enable Indicator in the Status Bar area (Figure 4-155) of the ODM will come on (green).

2. Pull outer controller on right armrest rearward and hold to raise the main hoist rope.
3. When hook block/overhaul ball gets to the desired height, let controller return to the center (neutral) position to stop raising the main hoist rope.

**NOTE:** When the main hoist controller is pulled rearward to raise the rope, the Hoist Rotation Indicator pulses and the Main Hoist Raise Indicator (Figure 4-155) comes on to indicate to the operator that the main hoist is operating.

**Lowering and Raising the Auxiliary Hoist Rope**

 **DANGER**  
**Crushing Hazard!**

Keep area beneath load clear of all obstructions and personnel when lowering or raising rope (load).

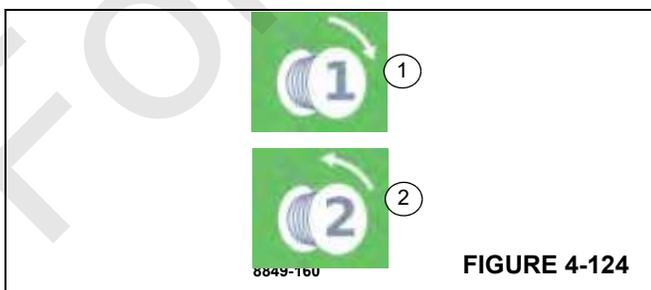
 **DANGER**  
**Crushing Hazard!**

Do not jerk controller when starting or stopping hoist. Jerking controller causes load to bounce, which could result in possible damage to the crane.

**NOTE:** When load is stopped at desired height, the automatic brake will engage and hold the load as long as the controller remains in neutral.

The symbols show the direction of rotation of the hoist (Figure 4-124):

1	Lifting the load
2	Lowering the load



**NOTE:** The speed of the hoists will only be significantly increased by switching to high-speed mode if you have moved the control lever by more than 70%.

**Lowering the Auxiliary Hoist Rope**

Dual Axis Controllers

1. Press the Auxiliary Hoist Enable/Disable Switch on left armrest to enable the auxiliary hoist function.

The Auxiliary Hoist Enable Indicator in the Status Bar area (Figure 4-155) of the ODM will come on (green).

2. Push controller on left armrest forward and hold to lower the auxiliary hoist rope.
3. When hook block/overhaul ball gets to the desired height, let controller return to the center (neutral) position to stop lowering the auxiliary hoist rope.

**NOTE:** When the auxiliary hoist controller is pushed forward to lower the rope, the Hoist Rotation Indicator pulses and the Auxiliary Hoist Lower Indicator (Figure 4-155) in the Status Bar area of the ODM comes on to indicate to the operator that the auxiliary hoist is operating.

Single Axis Controller (Optional)

1. Press the Auxiliary Hoist Enable/Disable Switch on left armrest to enable the auxiliary hoist function.

The Auxiliary Hoist Enable Indicator in the Status Bar area (Figure 4-155) of the ODM will come on (green).

2. Push inner controller on left armrest forward and hold to lower the auxiliary hoist rope.
3. When hook block/overhaul ball gets to the desired height, let controller return to the center (neutral) position to stop lowering the auxiliary hoist rope.

**NOTE:** When the auxiliary hoist controller is pushed forward to lower the rope, the Hoist Rotation Indicator pulses and the Auxiliary Hoist Lower Indicator (Figure 4-155) in the Status Bar area of the ODM comes on to indicate to the operator that the auxiliary hoist is operating.

**Raising the Auxiliary Hoist Rope**

 **DANGER**  
**Two-Block Hazard!**

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

Dual Axis Controllers

1. Press the Auxiliary Hoist Enable/Disable Switch on left armrest to enable the auxiliary hoist function.

The Auxiliary Hoist Enable Indicator in the Status Bar area (Figure 4-155) of the ODM will come on (green).

2. Pull controller on left armrest rearward and hold to raise the auxiliary hoist rope.
3. When hook block/overhaul ball gets to the desired height, let controller return to the center (neutral) position to stop raising the auxiliary hoist rope.

**NOTE:** When the auxiliary hoist controller is pulled rearward to raise the rope, the Hoist Rotation Indicator pulses and the Auxiliary Hoist Raise Indicator (Figure 4-155) in the Status Bar area of the ODM comes on to indicate to the operator that the auxiliary hoist is operating.

#### Single Axis Controller (Optional)

1. Press the Auxiliary Hoist Enable/Disable Switch on left armrest to enable the auxiliary hoist function.

The Auxiliary Hoist Enable Indicator in the Status Bar area (Figure 4-155) of the ODM will come on (green).

2. Pull inner controller on left armrest rearward and hold to raise the auxiliary hoist rope.
3. When hook block/overhaul ball gets to the desired height, let controller return to the center (neutral) position to stop raising the auxiliary hoist rope.

**NOTE:** When the auxiliary hoist controller is pulled rearward to raise the rope, the Hoist Rotation Indicator pulses and the Auxiliary Hoist Raise Indicator (Figure 4-155) in the Status Bar area of the ODM comes on to indicate to the operator that the auxiliary hoist is operating.

## Selecting the Hoist Speed Range

### CAUTION

Do not change speeds while hoist is operating.

On dual axis controllers and single axis controllers (optional), the high speed hoist function can be enabled by doing one of the following:

- With the main hoist function disabled, hold the Main Hoist Enable/Disable Switch on right armrest for 1.5 seconds to enable the main hoist function at high speed.
- With the auxiliary hoist function disabled, hold the Auxiliary Hoist Enable/Disable Switch on left armrest for 1.5 seconds to enable the auxiliary hoist function at high speed.

- OR -

- With the main hoist function disabled, double-click the Main Hoist Enable/Disable Switch to enable the main hoist function at high speed.
- With the auxiliary hoist function disabled, double-click the Auxiliary Hoist Enable/Disable Switch to enable the auxiliary hoist function at high speed.

**NOTE:** When the main or auxiliary hoist function is enabled at high speed, the respective Main Hoist High Speed Indicator or Auxiliary Hoist High Speed Indicator in the Status Bar area (Figure 4-155) of the ODM will come on.

On dual axis controllers only, press 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. Press and release the outside (farthest from operator) of the switch to enable high speed (maintained state).

**USING THE REMOTE CONTROL UNIT**

For an overview of the remote control unit's controls and features, and storage and charging information, refer to *Remote Control Unit*, page 3-49.

The hand-held Remote Control Unit is provided to operate the needed crane functions during crane set-up only. The Remote Control Unit is not intended to operate crane functions during normal crane operation.

When operating the crane using the Remote Control Unit, all limiters and their crane function lockouts are inoperable, to include the following:

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

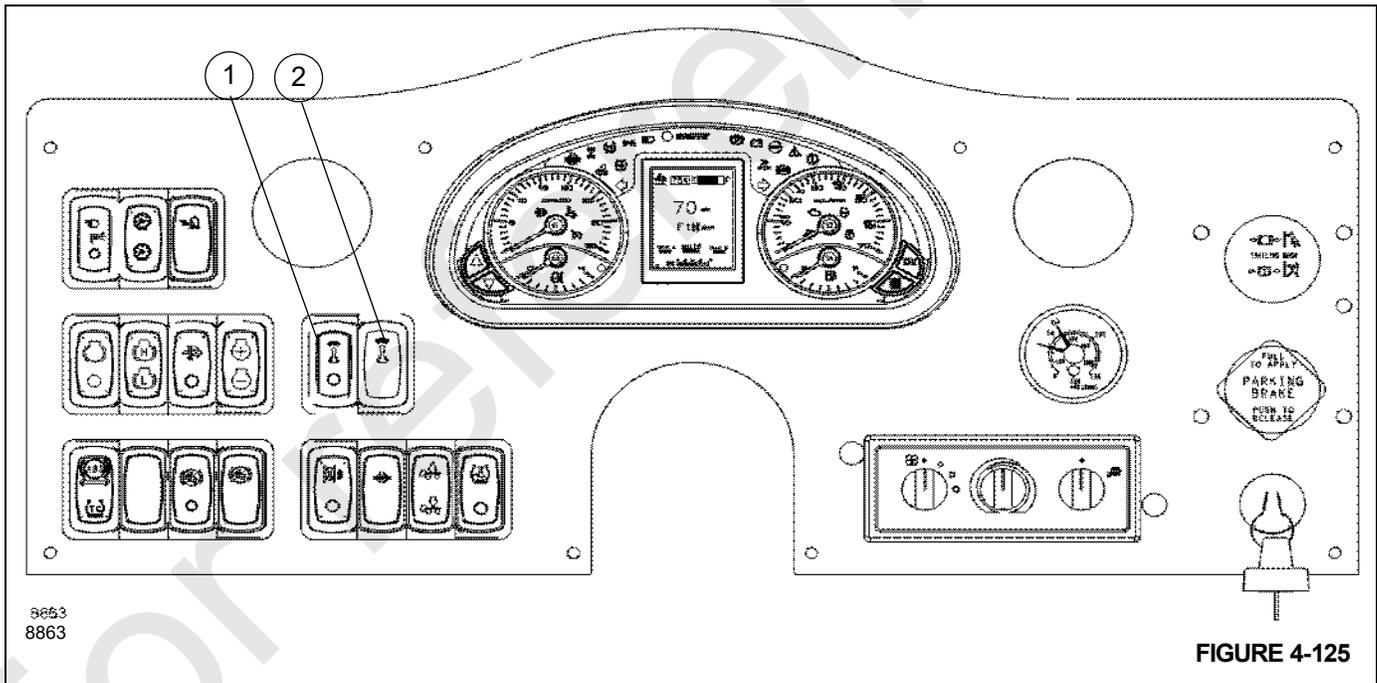
- Carrier Avoidance System
- -29°C Temperature Limiter System (optional)

**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 RUN position.
6. Set the remote control switch (1), (Figure 4-125) on the carrier control console to ON.

**NOTE:** Note: 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.

1	Remote Control ON/OFF Switch
2	Remote Control Indicator



8653  
8863

FIGURE 4-125



FIGURE 4-126

7. The amber remote control indicator (2), (Figure 4-126) next to remote control switch (1), (Figure 4-126), indicates the following:

- Amber ON = remote control has control of crane functions
- Amber OFF = remote control is 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 (1), (Figure 4-126) button on the top of the remote control.

- b. Make sure the E-stop button on the remote control is pulled out (7), (Figure 4-126)
- c. Set the Remote Control Unit to ON by pressing the Power Button (2), (Figure 4-126).

**NOTE:** When the remote is enabled, power is supplied to the remote module and the E-Stop relay (in remote module) then is added in series to the E-Stop electrical circuit.

- d. The SPLASH (Figure 4-127) screen will appear for a few seconds, followed by the WARNING screen.
- e. Press the ESC (17), (Figure 4-126) button on the remote control to acknowledge that you have read the warning and to bring up the MAIN Screen (Figure 4-128).
- f. Press the engine (14), (Figure 4-126) button on the remote control. The engine screen appears in the display.

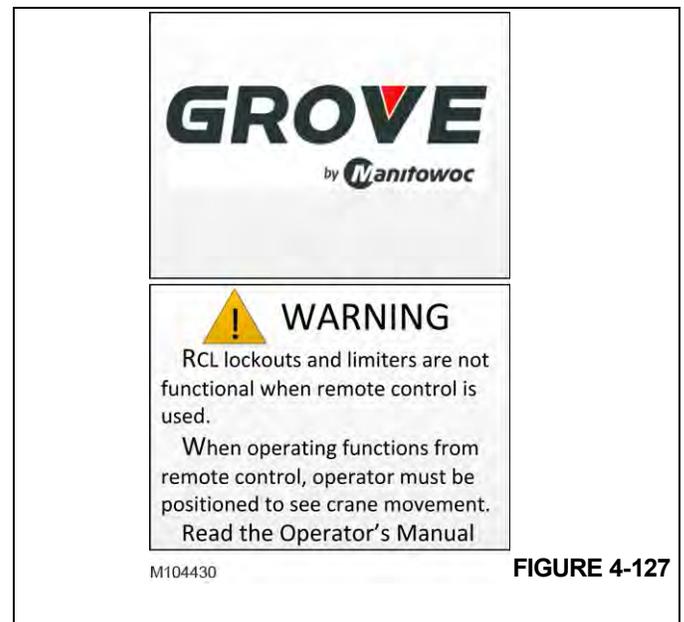
The operator must start the engine from the remote control. See *Engine Start/Stop/Throttle*, page 4-88.

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.

**NOTE:** If no buttons are pressed on the remote control for 5 minutes while a function screen is active, the remote control will timeout and go back to the Main Screen (Figure 4-128).



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FIGURE 4-127



FIGURE 4-128

9. Set the Remote Control to OFF by doing the following:
- If desired, stop the engine with the remote control. See *Engine Start/Stop/Throttle*, page 4-88.
  - Turn OFF the remote control by pressing the power button (2), (Figure 4-126) on the top of the remote control.
  - Set the remote control switch on the carrier control console (Figure 4-125) to OFF.
  - If you want to keep the engine running:
    - First, set the remote control switch on the carrier control console (Figure 4-125) to OFF.
    - Then, turn OFF the remote control (2), (Figure 4-126) by pressing the power button on the top of the remote control.

**NOTE:** If you fail to perform this step “D”, the remote control will remain ON (not operable) and its battery will discharge.

### Operating Remote Control

#### Superstructure Horn

Press and hold the horn button  on the remote control to sound the superstructure horn. The superstructure horn button can also be used to sound the horn.

### Emergency Stop

Pushing in the E-Stop (7), (Figure 4-126) button causes the following to occur:

- The engine stops
- ALL crane functions operating are stopped
- The STOP (Figure 4-129) screen appears.

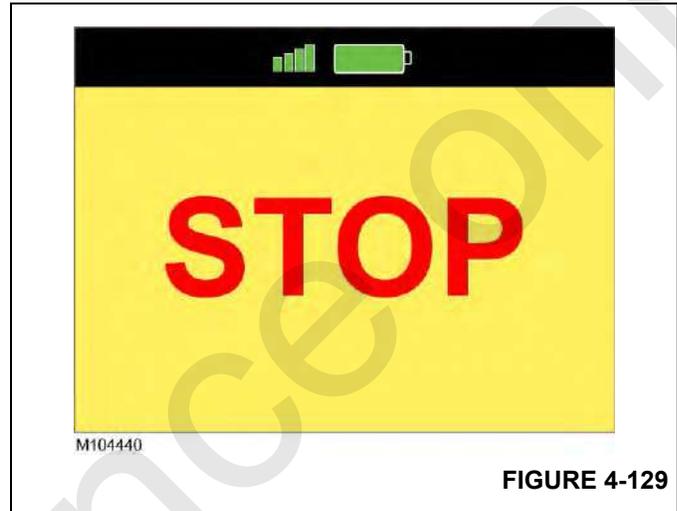


FIGURE 4-129

To restart the engine, the E-Stop (7), (Figure 4-126) button must be pulled out.

For more information on the Engine Start/Stop/Throttle Function Screen, refer to Table 4-1 on page 88 and (Figure 4-130).

Engine Start/Stop/Throttle Function Screen

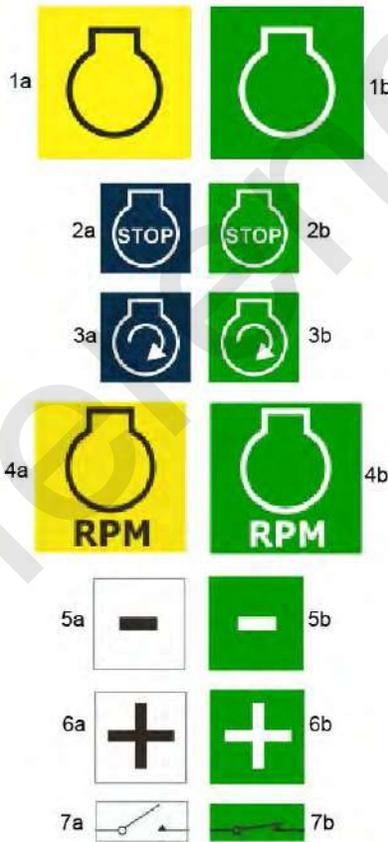
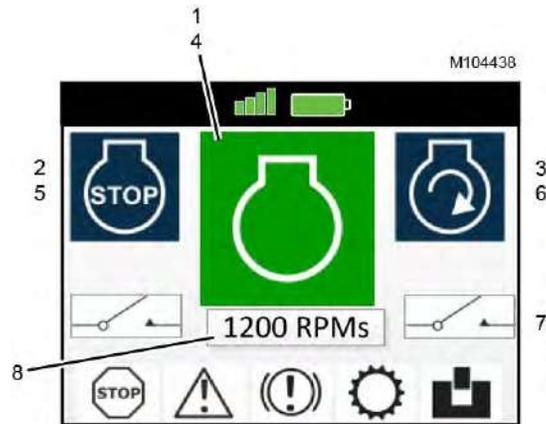


FIGURE 4-130

Table 4-1 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 Speed Function	4a - Yellow = engine speed cannot be changed due to a crane fault 4b - Green = engine speed can be changed
5	Decrease Speed	5a - White = engine speed cannot be decreased until either enable button is held down 5b - Green = engine speed can be decreased with left motion button
6	Increase Speed	6a - White = engine speed cannot be increased until either enable button is held down 6b - Green = engine speed can be increased with right motion button
7	Enable Button Status	7a - White = both enable buttons released (operation disabled) 7b - Green = either enable button held down (operation enabled)
8	RPM Screen	Shows the engine speed

### Engine Start/Stop/Throttle

See (Figure 4-130).

#### Starting/Stopping Engine

1. Press the engine button  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  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).

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  on the remote control. The Main Screen appears.

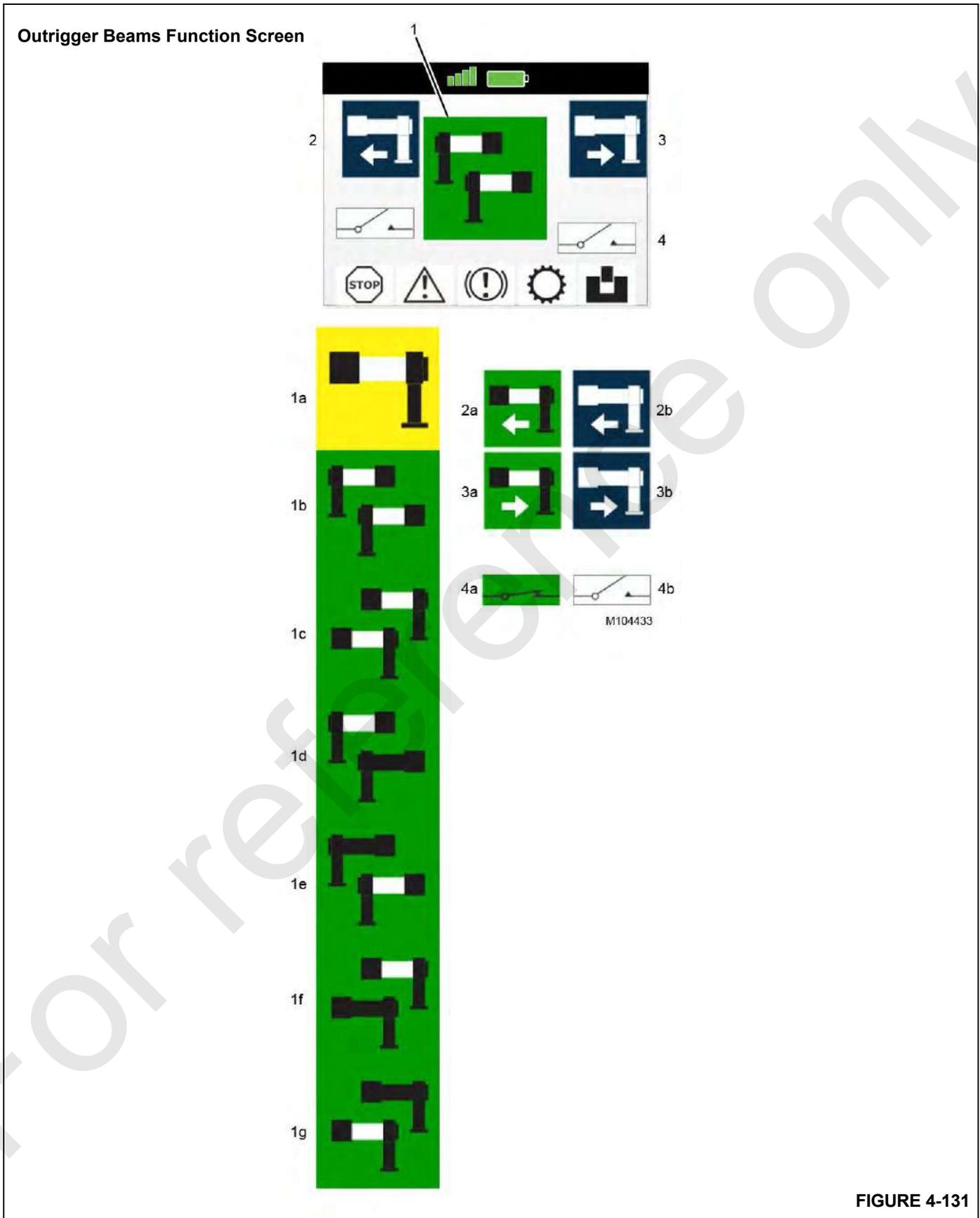


FIGURE 4-131

Table 4-2 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 outriggers are to be deployed with the boom in the boom rest. In this configuration, the direction the operator is facing is considered the front of the crane.

The top of the remote control unit corresponds to the front of the crane. The terms left and right correspond to the operator's left and right sides when looking forward from the front of the crane.

**Outrigger Beams**

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

See (Figure 4-131).

1. Press the outrigger beams button  on the remote control as many times as needed until the desired beam screen (1) appears.
2. To RETRACT the selected beams, hold down either enable button and the left motion button at the same time. Release both buttons to stop the beams at the desired position.
3. To EXTEND the selected beams, hold down either enable button and the right motion button at the same time. Release both buttons to stop the beams at the desired position.
4. To exit this screen, press the ESC button  on the remote control. The Main Screen appears.

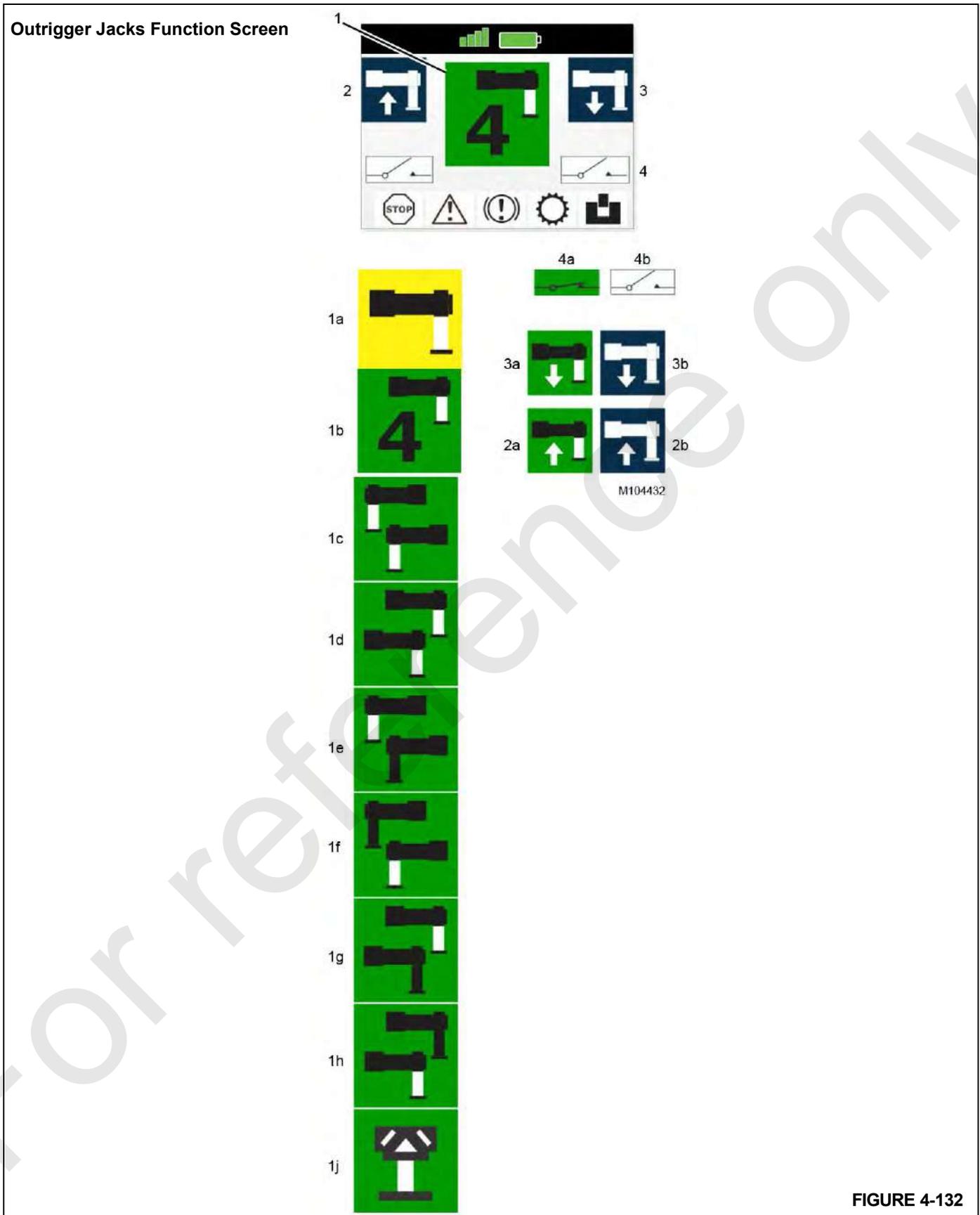


FIGURE 4-132

Table 4-3 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.

**NOTE:** The Cribbing Mode is only available from the cab; **NOT** through the remote control.

**Outrigger Jacks**

See (Figure 4-132).

1. Press the outrigger jacks button  on the remote control as many times as needed until the desired jack screen (1) appears.
2. To RETRACT the selected jacks, hold down either enable button and the left motion button at the same

time. Release both buttons to stop the jacks at the desired position.

**NOTE:** The front outrigger 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  on the remote control. The Main Screen appears.

Hoist Control (Main and Auxiliary Hoist) Function Screen



FIGURE 4-133

Table 4-4 Main/Auxiliary 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	Reel 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	Auxiliary Hoist Function	4a - Yellow = aux hoist cannot be operated due to a crane fault 4b - Green = aux hoist can be operated
5	Reel 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 Auxiliary)**

See (Figure 4-133).

1. Press the hoist button  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 is the default.

Speed in either direction is proportional to how far the motion button is depressed.

3. To PAY 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 HAUL 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  on the remote control. The Main Screen appears.

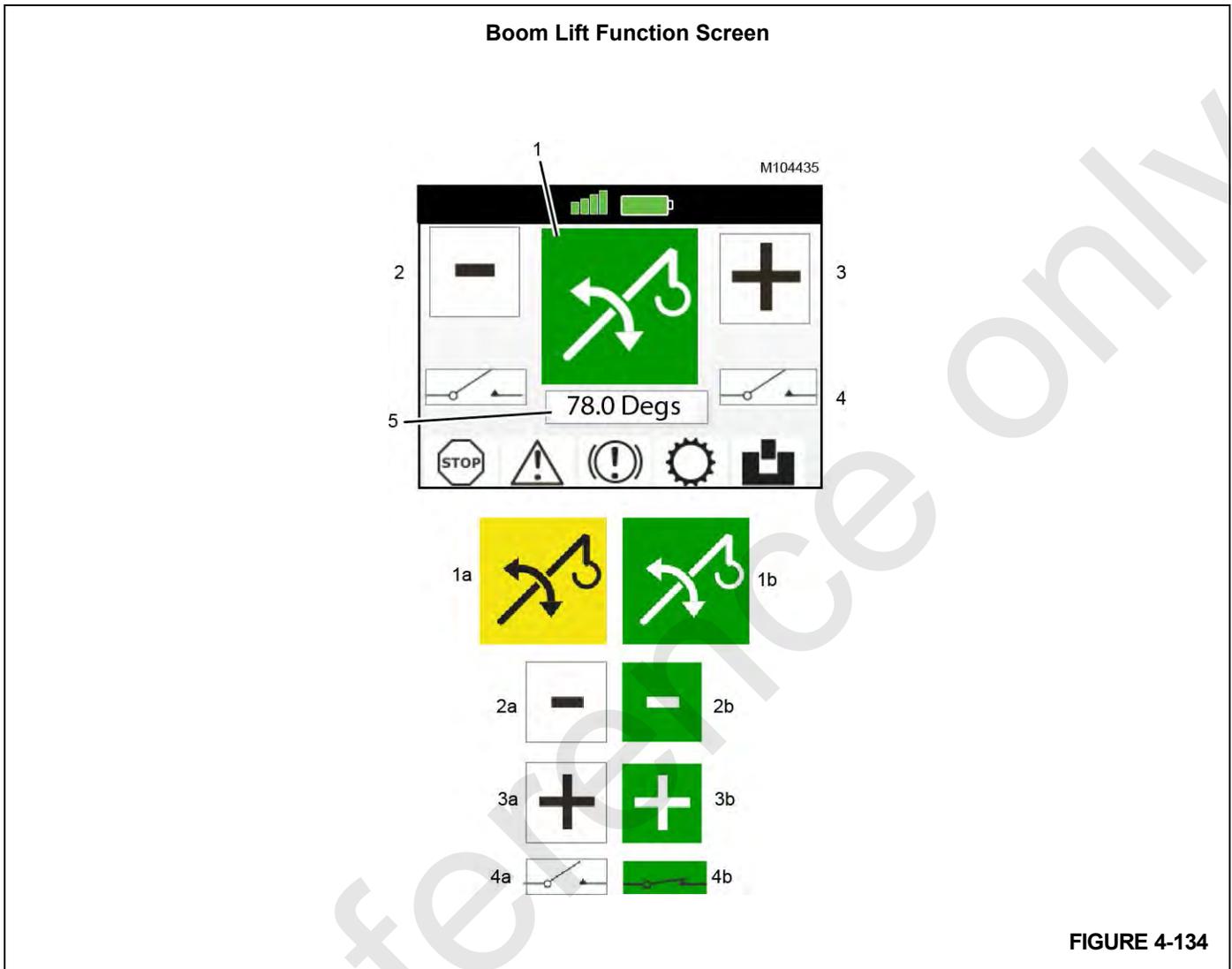


FIGURE 4-134

Table 4-5 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	4a - White = both enable buttons released (operation disabled) 4b - Green = either enable button held down (operation enabled)
5	DEG Screen	Shows the boom angle in degrees

**Boom Lift**

See (Figure 4-134).

1. Press the boom lift button  on the remote control. The boom lift screen (1) appears.

**NOTE:** Speed in either direction is proportional to how far the motion button is depressed.

2. To LOWER the boom, hold down either enable button and the left motion button at the same time. Release both buttons to stop the boom.

3. To RAISE the boom, hold down either enable button and the right motion button at the same time. Release both buttons to stop the boom.

4. The boom's angle is shown in the DEG screen (5).

5. To exit this screen, press the ESC button  on the remote control. The Main Screen appears.

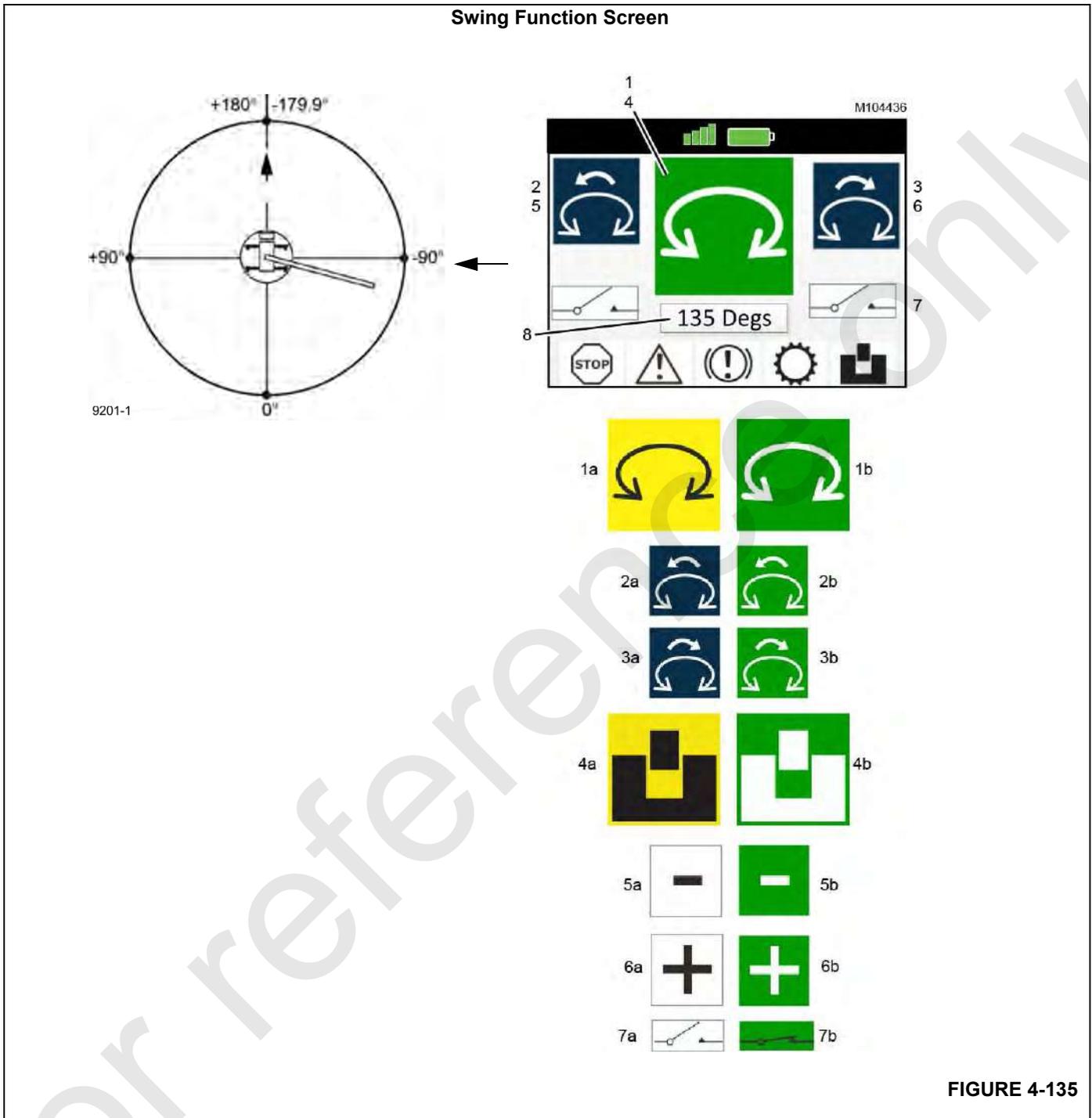


Table 4-6 Swing Function Screen

Item	Indicator Name	Description
1	Swing Function	1a - Yellow = swing cannot be operated due to a crane fault 1b - Green = swing can be operated
2	Swing Left	2a - Blue = cannot swing left until either enable button is held down 2b - Green = can swing left with left motion button
3	Swing Right	3a - Blue = cannot swing right until either enable button is held down 3b - Green = can swing right with right motion button
4	360° Swing Lock Function	4a - Yellow = swing lock cannot be operated due to a crane fault 4b - Green = swing lock can be operated
5	Lock	5a - White = cannot engage swing lock until either enable button is held down 5b - Green = can engage swing lock with left motion button
6	Unlock	6a - White = cannot disengage swing lock until either enable button is held down 6b - Green = can disengage swing lock with right motion button
7	Enable Button Status	7a - White = both enable buttons released (operation disabled) 7b - Green = either enable button held down (operation enabled)
8	DEG Screen	Shows the swing angle in degrees

**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.

**Swing and 360° Swing Lock**

See (Figure 4-135).

**Swinging**

1. Press the swing button  on the remote control ONCE. The swing screen (1) appears.

**NOTE:** Speed in either direction is proportional to how far the motion button is depressed.

2. To swing LEFT, hold down either enable button and the left motion button at the same time.
3. To swing RIGHT, hold down either enable button and the right motion button at the same time.

4. The swing angle is shown in the DEG screen (8).

**Operating 360° Swing Lock**

1. Press the swing button  on the remote control ONCE if already at the swing screen or TWICE if at the Main Screen. The 360° swing lock screen (4) appears.
2. To LOCK the 360° swing lock, hold down either enable button and the left motion button at the same time.
3. To UNLOCK the 360° swing lock, hold down either enable button and the right motion button at the same time.

**Exiting Swing/360° Swing Lock Screen**

To exit this screen, press the ESC button  on the remote control. The Main Screen appears.

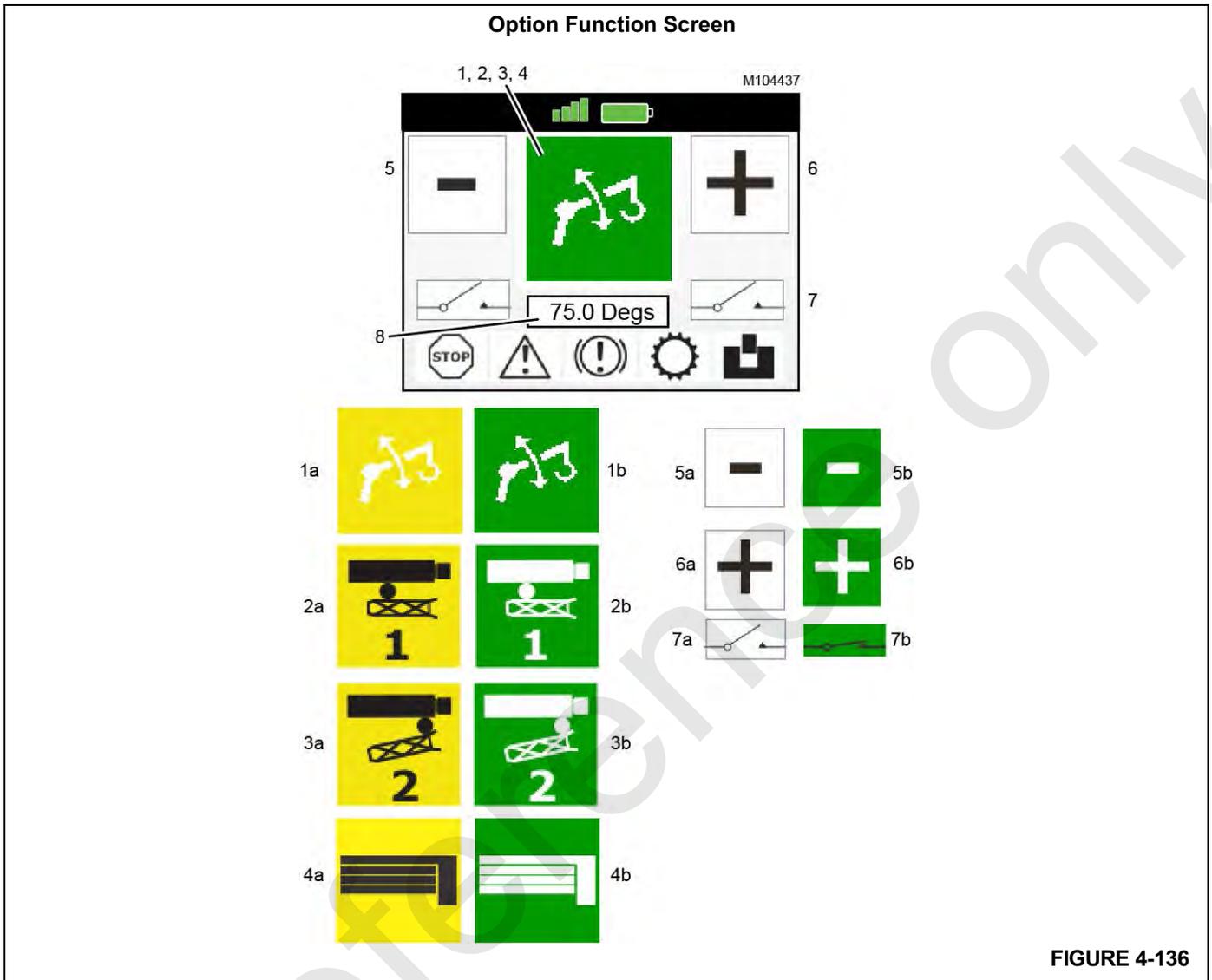


FIGURE 4-136

Table 4-7 Option Function Screen

Item	Indicator Name	Description
1	Luffing Boom Extension Function	a - Yellow = function cannot be operated due to a crane fault b - Green = function can be operated
2	Rear Boom Extension Stowage Actuator Function	
3	Front Boom Extension Stowage Actuator Function	
4	Counterweight (Cwt) Function	
5	Retract Actuator Lower Cwt Cylinders Lower Boom Extension	5a - White = operation cannot be performed until either enable button is held down 5b - Green = operation can be performed with left motion button

6	Extend Actuator Raise Cwt Cylinders Raise Boom Extension	6a - White = operation cannot be performed until either enable button is held down 6b - Green = operation can be performed with right motion button
7	Enable Button Status	7a - White = both enable buttons released (operation disabled) 7b - Green = either enable button held down (operation enabled)
8	DEG Screen	Shows the boom extension angle in degrees

**OPT (Options)**

See (Figure 4-136).

The options function screen controls the following optional crane functions:

- Luffing boom extension
- Boom Extension assist
- Counterweight

**Luffing Boom Extension Offset**

Refer to *Setting the Offset Angle with an Auxiliary Crane*, page 5-79 for more information.

1. Press the option button **OPT** on the remote control as many times as needed to access the luffing boom extension screen (1).
2. To LOWER the luffing boom extension, hold down either enable button and the left motion button at the same time.
3. To RAISE the luffing boom extension, hold down either enable button and the right motion button at the same time.

**NOTE:** Speed in either direction is proportional to how far the motion button is depressed.

4. The boom extension angle is shown in the DEG screen (8).

**Boom Extension Stowage Actuators**

The boom extension stowage feature has two actuators to assist the operator in deploying and stowing the boom extension option.

1. Press the option button **OPT** on the remote control (Figure 4-137), as many times as needed to access the rear boom extension stowage actuator screen (2). See (Figure 4-71).



**FIGURE 4-137**

2. To RETRACT the rear actuator, hold down either enable button and the left motion button at the same time.
3. To EXTEND the rear actuator, hold down either enable button and the right motion button at the same time.

**NOTE:** Speed in either direction is proportional to how far the motion button is depressed.

4. Repeat the above steps for the front boom extension stowage actuator screen (3).

**Counterweight Loading/Unloading Cylinders**

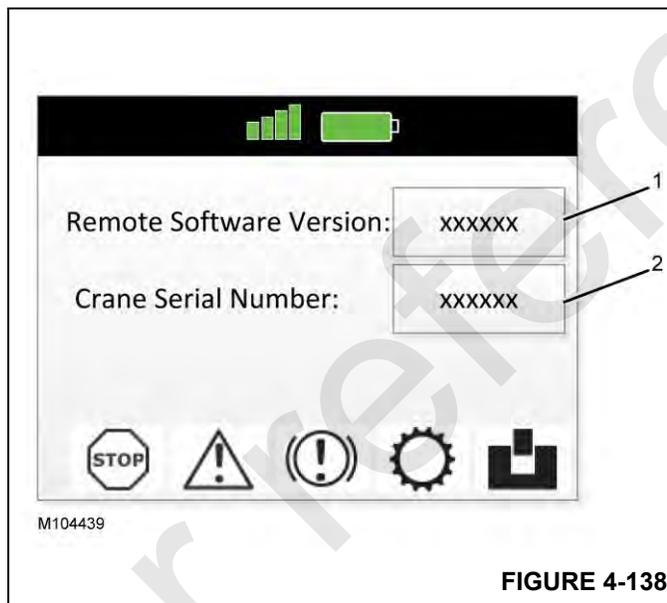
Refer to *Removable Counterweight*, page 5-16.

1. Press the option button **OPT** on the remote control unit as many times as needed to access the counterweight screen (4).
2. To LOWER the counterweight, hold down either enable button and the left motion button at the same time.
3. To RAISE the counterweight cylinders, hold down either enable button and the right motion button at the same time.

**NOTE:** The counterweight cylinders can be raised at any swing position outside of -3.9 to +3.9 degrees, or at 0.0 degrees. They can only be lowered at -4.0 degrees and +4.0 degrees if no counterweight is mounted, or at 0 degrees if a counterweight is mounted.

**Exiting OPT Screen**

To exit this screen, press the ESC button **ESC** on the remote control unit. The Main Screen appears.



**FIGURE 4-138**

**Information**

To access the information screen, press the info button **INFO** on the remote control unit.

See Figure 4-138

The information screen shows the following:

- Remote control unit's software version (1)

You will need to know the software version when communicating with your Grove dealer or Grove Product Support.

- Crane Serial Number (2)

The remote control must remain with the crane it was supplied with. The serial number in the information screen must match the serial number on the crane.

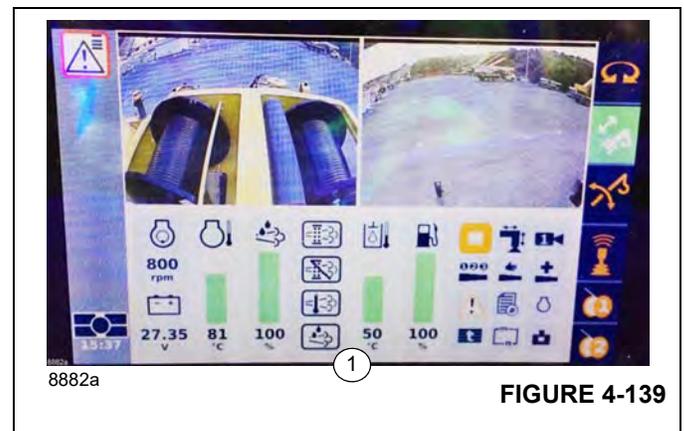
**Crane Control System Overview**

The Crane Control System (CCS) consists of a machine vision system, usually a monitor-system (RDM and ODM) that displays precise and reliable crane operations. It also contains a remote radio console that allows the operator to run the crane.

Manitowoc's Crane Control System (CCS) is a standardized operating platform integrated across a diverse range of equipment. CCS offers a user-friendly interface, two full graphic displays (RDM at the top with ODM at the bottom), and jog dial. Also refer to *Crane Operation with RDM/ODM*, page 3-47.

After turning the Crane Control System (CCS) Display on, the Main Screen appears after switching on the ignition (1), (Figure 4-139). For additional information, refer to *Using the Operator Display Module (ODM)*, page 4-105.

After pressing a button on the ODM, the menu screen (2), (Figure 4-140) appears.



**FIGURE 4-139**

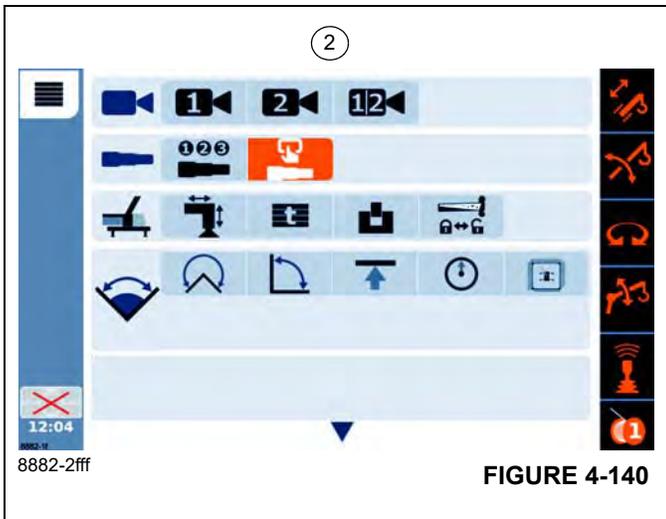


FIGURE 4-140

**Warning Message/Error Message Display Area**

Error messages will appear on the left side of the display (5), (Figure 4-141) 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

**Open Error Menu**

When an error message appears, go to error message menu on the second page of the main menu and select the appropriate sub menu based on the error being displayed. Select symbol (Figure 4-141) and confirm:

3	For engine
4	For Crane control

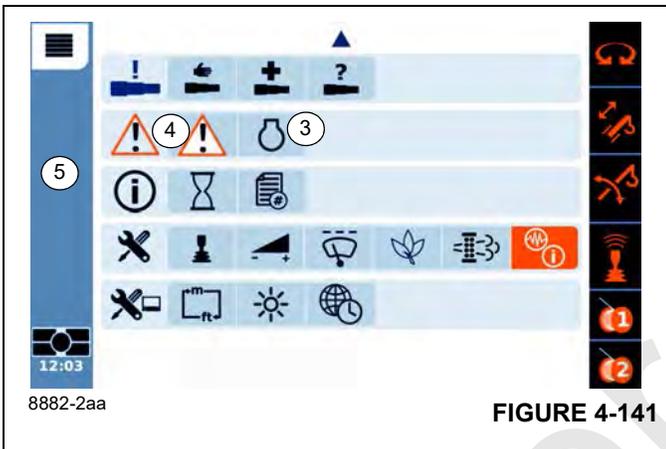


FIGURE 4-141

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

For a description the Operator Display Module and Rated Capacity Limiter Display Module (ODM and RDM), refer to *RATED CAPACITY LIMITER DISPLAY MODULE (RDM) AND OPERATOR DISPLAY MODULE (ODM)*, page 3-45.

The ODM and RDM each have an integral Navigation Control Pad (Figure 4-142) which allows the operator to navigate through the function screens for that module. The buttons on the two Navigation Control Pads are identical in configuration and perform the same navigational functions.



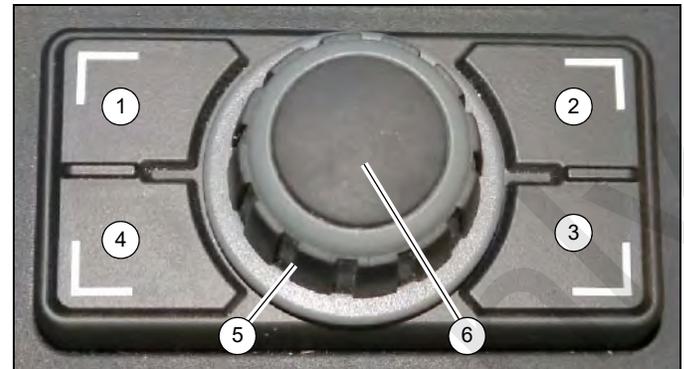
9221-1

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

FIGURE 4-142

The Jog Dial (Figure 4-143), mounted on the right armrest, can also be used to navigate the ODM and the RDM in a similar manner:

- Rotating the Jog Dial performs the same function as pressing the Left/Right/Up/Down Arrow Buttons on the Navigational Control Pads.
- Pressing the Jog Dial performs the same function as pressing the OK Button on the Navigation Control Pads.
- Pressing one of the four buttons surrounding the Jog Dial performs the same function as pressing the respective button surrounding the Arrow and OK Buttons on the Navigational Control Pads.



9221-2

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

FIGURE 4-143

The Jog Dial can control one display module at a time. A Jog Dial Status Indicator (2), (Figure 4-149) 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 4-143) 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 4-142) and (1), (Figure 4-143) or return to the Menu Screen by pressing the Menu Button (3), (Figure 4-142) and (4), (Figure 4-143).

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 4-142) and (1), (Figure 4-143) or return to the Menu Screen by pressing the Menu Button (3), (Figure 4-142) and (4), (Figure 4-143).

**NOTE:** When setting the outriggers using the Outrigger Extend/Retract function screen, the Escape Button and Menu Button are used to perform outrigger functions (refer to *Outrigger Extend/Retract Screen*, page 4-137).

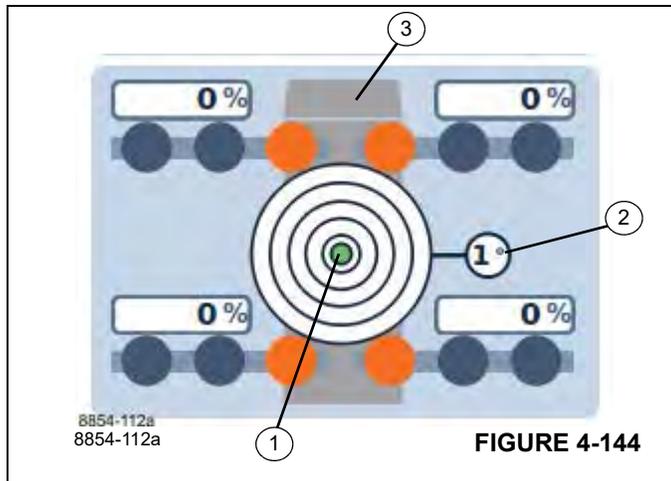
Rotating the Jog Dial or pressing the Arrow Buttons allow the operator to select the different function icons that are found on the Main Screens and Menu Screens of the ODM and RDM. When a function icon is selected, the Icon will turn orange in color.

The Tab Button (2), (Figure 4-142) on the ODM and RDM Navigation Control Pads can be pressed to temporarily silence active audible alarms.

**Inclination Indicator**

On the RCL Monitoring Screen:

1	Inclination indicator (Figure 4-144)
2	Measuring range display
3	Directional indicator

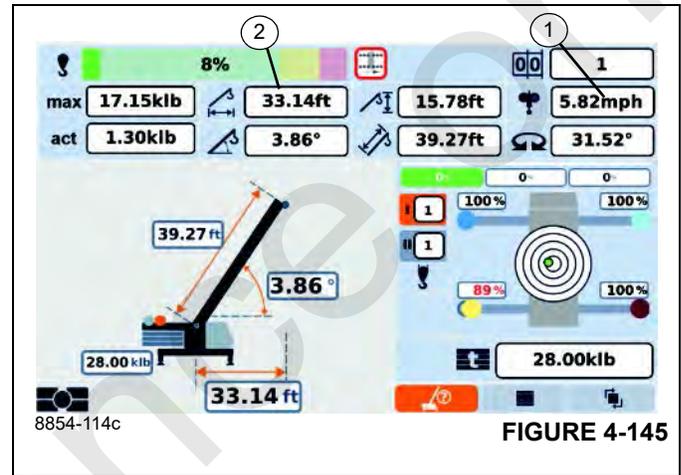


**Anemometer Display (Optional)**

When the anemometer is connected it will display on the RCL Monitoring Screen. Wind speed (1), (Figure 4-145) is shown in top right in mph.

$V_{max}$  = maximum permissible/reduced wind speed as shown in the lifting capacity table

2	Display in meters per second (m/sec) or feet per second (ft/sec) as shown in (Figure 4-145)
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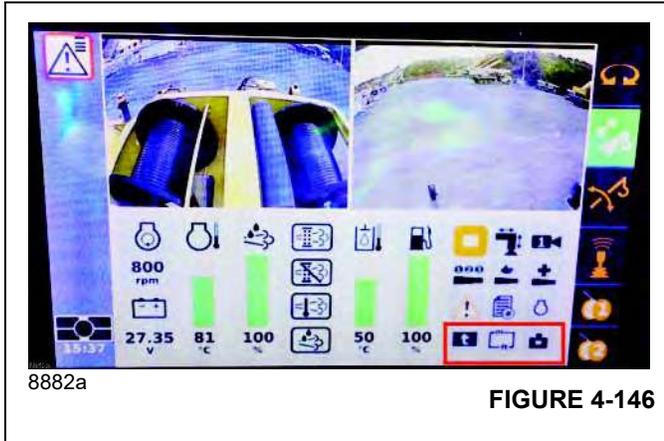


### USING THE OPERATOR DISPLAY MODULE (ODM)

**NOTE:** Refer to *Operator Display Module (ODM)*, page 3-45 for additional information.

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

**1. Main Screen (Figure 4-146)**



For detailed information on the Main Screen of the ODM, refer to the section titled *Main Screen*, page 4-106.

**2. 2. Menu Screen (Figure 4-147)**



For detailed information on the Menu Screen of the ODM, refer to the section titles *Menu Screen*, page 4-127.

**Main Screen**

The Main Screen (Figure 4-149) appears on the ODM (lower screen) when the key switch is initially set to the ON position.

Navigating back to the Main Screen can be accomplished by doing one of the following procedures:

- Press the Screen Toggle Button (1), (Figure 4-148) at the Jog Dial to select the ODM screen control, then press the Escape Button (2), (Figure 4-148).

- OR -

- Press the Escape Button (3), (Figure 4-148) on the Navigation Control Pad at the ODM.

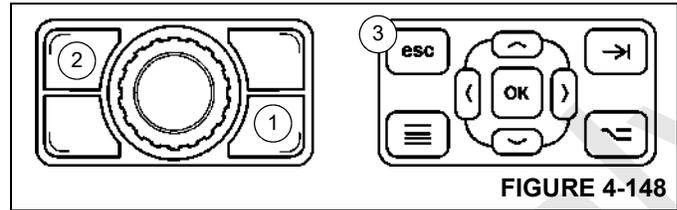


FIGURE 4-148

The Main Screen is separated into seven areas as shown in (Figure 4-149).



FIGURE 4-149

**Alerts Area**

The Alerts Area of the ODM Main Screen shows caution and warning alerts when a crane system is not operating normally. The following list identifies all possible alerts that can appear in the Alerts Area (1), (Figure 4-150).

An alert can show with one of three outline colors to emphasize its importance:

- Blue - Limit/Status
- Yellow - Non Critical
- Red - Critical

At the same time, the alert can show constant ON or flashing to indicate an additional level of importance.

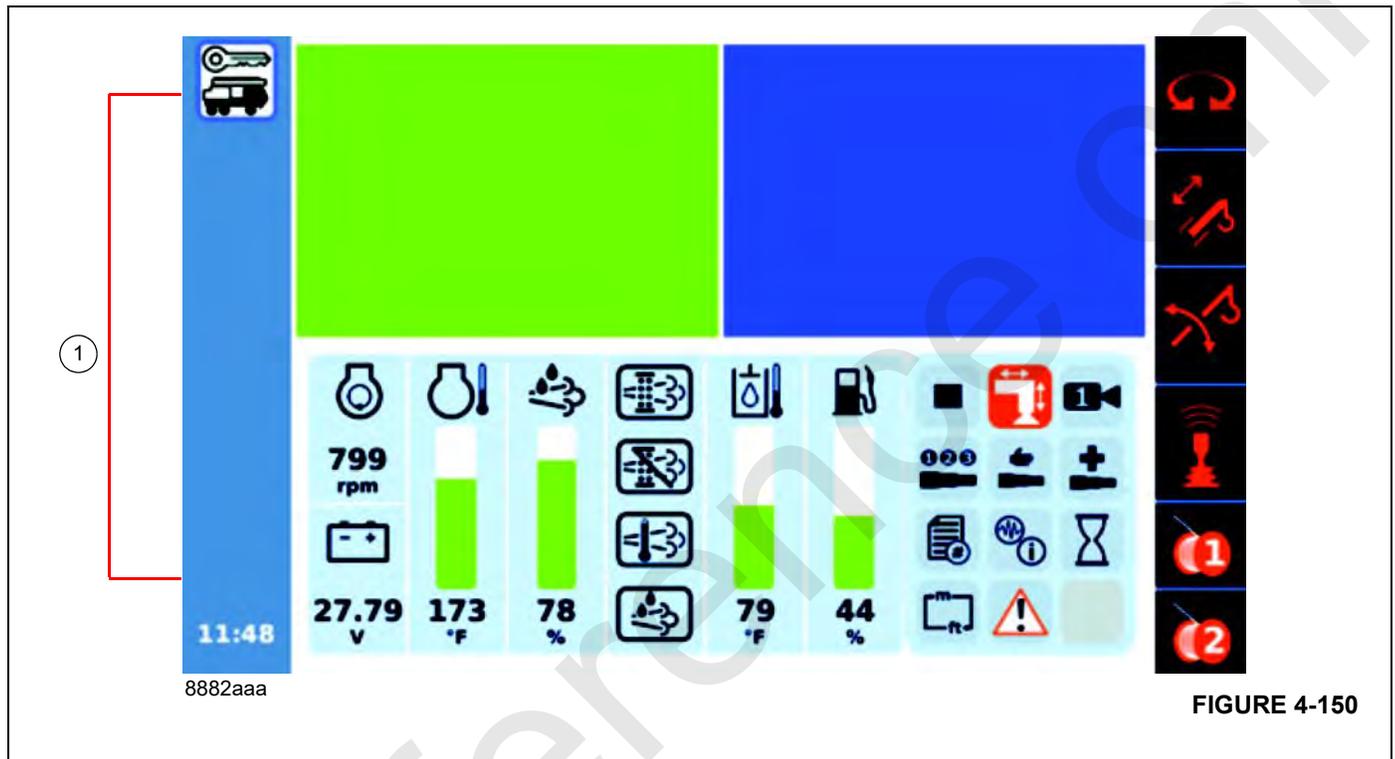


FIGURE 4-150

Name	Symbol	Description
Crane Fault Active Alert		Indicates there is at least one active crane fault that has been viewed.
New Crane Fault Active Alert		Indicates there is at least one active crane fault that has not been viewed.
Low Fuel Level Alert		Indicates the fuel level is low.
Hydraulic Oil Temperature Warning Alert		Indicates the hydraulic oil temperature is too high. Safely stop crane operation and let hydraulic oil cool by running the engine at idle with no functions actuated.
Hydraulic Oil Temperature Invalid Alert		Indicates the hydraulic oil temperature input to the crane control system is invalid.

Name	Symbol	Description
<b>Transmission Oil Temperature Warning Alert</b>		Indicates the transmission oil temperature is too high. When safe to do so, move the crane to a location where it can be parked and secured, then let the transmission cool by running the engine at idle.
<b>Transmission Oil Temperature Invalid Alert</b>		Indicates the transmission oil temperature input to the crane control system is invalid.
<b>Engine Coolant Temperature Warning Alert</b>		Indicates the engine coolant temperature is too high. Safely stop the lifting operations, land and secure any load being lifted. If possible retract and lower boom. Shut down and secure crane.
<b>Engine Coolant Temperature Invalid Alert</b>		Indicates the engine coolant temperature input from the engine ECM is invalid.
<b>Engine Oil Pressure Warning Alert</b>		Indicates the engine oil pressure is too low. Safely stop the lifting operations, land and secure any load being lifted. If possible retract and lower boom. Shut down and secure crane.
<b>Engine Fault Active Alert</b>		Indicates there is at least one active engine fault that has been viewed.
<b>New Engine Fault Active Alert</b>		Indicates there is at least one active engine fault that has not been viewed.
<b>Engine Speed Warning Alert</b>		Indicates the engine speed is too fast, or the operator is attempting to raise or lower the suspension while the engine is OFF. Apply the service brake to reduce travel speed and RPM, or shift to a higher gear.
<b>Engine Data Not Valid Alert</b>		Indicates the crane control system is not receiving the expected data from the engine ECM.
<b>Cab Not Fully Lowered Alert</b>		Constant ON – Indicates the cab is not in the fully lowered position. Flashing – Indicates one of the following has occurred: <ul style="list-style-type: none"> <li>- Operator is trying to tilt the cab while the parking brake is not applied, the transmission is not in neutral, or the seat switch is not active (operator is not sitting in the seat).</li> <li>- Engine is started while the parking brake is not applied and the cab is not fully lowered.</li> <li>- Operator is trying to operate the outriggers while the cab is not fully lowered.</li> </ul> Drive functions are disabled when this indicator is ON.
<b>-29°C (-20°F) Temperature Alert (Optional)</b>		Indicates the ambient temperature is below -29°C (-20°F). All crane functions are locked out.

Name	Symbol	Description
Third Wrap Alert - Main Hoist		Indicates the minimum number of wraps of rope required has been reached on the main hoist. When the indicator comes on (red), the warning buzzer will sound. The crane system will lock-out the hoist down and telescope out crane functions.
Third Wrap Alert - Auxiliary Hoist		Indicates the minimum number of wraps of rope required has been reached on the auxiliary hoist. When the indicator comes on (red), the warning buzzer will sound. The crane system will lock-out the hoist down and telescope out crane functions.
Engine Wait-To-Start Alert		Indicates the outside ambient temperature is low and preheating of the air inside the air-intake manifold is required. Do not start engine until indicator goes OFF.
Transmission Not-In-Neutral Alert		Indicates the operator is trying to perform an operation that requires the transmission to be in neutral, to include the following operations: <ul style="list-style-type: none"> <li>- Shifting the transmission between two-wheel drive (high range) and four-wheel drive (low range).</li> <li>- Starting the engine.</li> <li>- Tilting the cab.</li> <li>- Shifting the transmission to forward or reverse gear while the cab is not fully lowered, the brake pedal is not pressed, or the RCL is programmed with a non-travel rigging code.</li> <li>- Switching the steering direction using the Steering Reversal Switch.</li> </ul> Operator must first shift the transmission to neutral, then try the operation again.
Emergency Stop Active Alert		Indicates the Emergency Stop Switch is pushed in. When the indicator comes on, the warning buzzer will sound
Low Boom Angle Alert		Constant ON – Indicates the boom has reached the carrier avoidance area. When the indicator comes on, the warning buzzer will sound. The crane system will lock out the boom down and swing left or right crane functions. Flashing – Indicates the carrier avoidance area system and its lock outs (boom down and swing left and right) are actively bypassed by one of the Limit Bypass Switches.
Engine Stop Alert		Indicates there is one or more active engine faults. When the indicator comes on, the warning buzzer will sound. Safely stop the lifting operations, land and secure any load being lifted. If possible, retract and lower the boom. Shut down and secure the crane. Access the fault codes through the Menu Screen of the ODM
Engine Warning Alert		Indicates there is one or more active engine faults. Access the fault codes through the Menu Screen of the ODM. Correct malfunction as soon as possible.

Name	Symbol	Description
<p><b>Parking Brake Alert</b></p>		<p>Indicates the operator is trying to do one of the following operations:</p> <ul style="list-style-type: none"> <li>- Tilting the cab while the parking brake is released.</li> <li>- Starting the engine while the parking brake is released.</li> <li>- Shifting the transmission to forward or reverse while the parking brake is engaged.</li> <li>- Operating the outrigger function while the parking brake is released.</li> <li>- Releasing the parking brake while rigging code 9810 (Stationary ON Rubber) is active in the RCL.</li> </ul>
<p><b>Alternator charge error</b></p>		<p>The engine is running but the alternator is not charging –OR– the engine is not running but the alternator is charging.</p>
<p><b>Alternator charge low or high</b></p>		<p>The battery voltage is too low (about 22V or less) or too high (30V or more).</p>
<p><b>Carrier key on</b></p>		<p>The carrier cab key is in the ON or START position.</p>
<p><b>Center stabilizer overload</b></p>		<p>The pressure in the center front stabilizer cylinder is too high.</p>
<p><b>Counterweight blocking swing</b></p>		<p>The counterweight is blocking swinging because the cylinders are not fully up.</p>
<p><b>Settings speed or Speed adjust</b></p>		<p>The speed settings or joystick curves are not at their default value (100% or linear joystick).</p>
<p><b>Boom extension too low</b></p>		<p>The boom is near the driving cab and motion is blocked.</p>
<p><b>Forbidden zone blocking range</b></p>		<p>The boom is near the driving cab and motion is blocked.</p>
<p><b>Forbidden zone bypassed</b></p>		<p>The boom is near the driving cab and motion would be blocked but the bypass switch is allowing motion.</p>

Name	Symbol	Description
<b>Auto-level Sensor Warning Alert</b>		Indicates the operator is trying to auto-level the crane and there is a malfunction with sensor.
<b>Tele Cylinder At Boom Nose Alert</b>		Indicates the telescoping cylinder has extended too far and reached the boom nose. Tele extension is locked out.
<b>Controller Speed/Curve Not Set To Factory Default Alert</b>		Indicates one or more of the controller functions are not set to the factory default setting.
<b>Free Swing Active Alert</b>		Indicates the swing brake is released and the boom is free to swing.
<b>Tele Extend Pressure Too High Alert</b>		Indicates the pressure in the telescope extend circuit is too high for the given boom length. The crane control system will reduce the system pressure and eventually stop the telescope extend function to protect boom components. If the boom is not fully extended, the load must be relieved from the crane before continuing to extend the boom.
<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>System voltage</b>		The supply voltage measured at the main control module is less than 22V or more than 30V.
<b>Service Brake Pedal Not Pushed Alert</b>		Indicates the service brake pedal is not pushed while doing one of the following operations: <ul style="list-style-type: none"> <li>- Shifting the transmission between two-wheel drive (high range) and four-wheel drive (low range).</li> <li>- Shifting the transmission from neutral to forward or reverse.</li> <li>- Switching the steering direction using the Steering Reversal Switch while the parking brake is released.</li> </ul>
<b>High Exhaust System Temperature Alert</b>		Indicates the exhaust temperature is above 800°C (1472°F) during the active exhaust system cleaning process. Indicator remains on until the temperatures falls below 350°C (662°F). Indicator also is on constant during the manual exhaust system cleaning process.

Name	Symbol	Description
<b>Exhaust System Clogged Alert</b>		<p>Constant ON – Indicates the exhaust system requires cleaning. When possible, stop and perform a manual exhaust system cleaning.</p> <p>Constant ON while Engine Warning Indicator is on constant – Indicates the exhaust system requires cleaning or the engine will begin to derate. Immediately stop and perform a manual exhaust system cleaning.</p> <p>Flashing – Indicates the manual exhaust system cleaning is active or there is a communication loss with the engine ECM.</p>
<b>Inhibit Exhaust System Cleaning Alert</b>		<p>Constant ON – Indicates the Exhaust System Cleaning Switch is set to the Inhibit Cleaning position, which prevents the exhaust cleaning process from automatically occurring.</p> <p>Flashing – Indicates there is a communication loss with the engine ECM.</p>
<b>Swing Caution Alert</b>		<p>Indicates the counterweight cylinders are not fully raised, thus the crane control system has reduced the speed of the swing function.</p>
<b>Low DEF Level Alert</b>		<p>Indicates the DEF level is low.</p>

**Active Screen Indicator Area**

The following indicator can appear in the Active Screen Indicator Area (1), (Figure 4-151) of the ODM Main Screen:

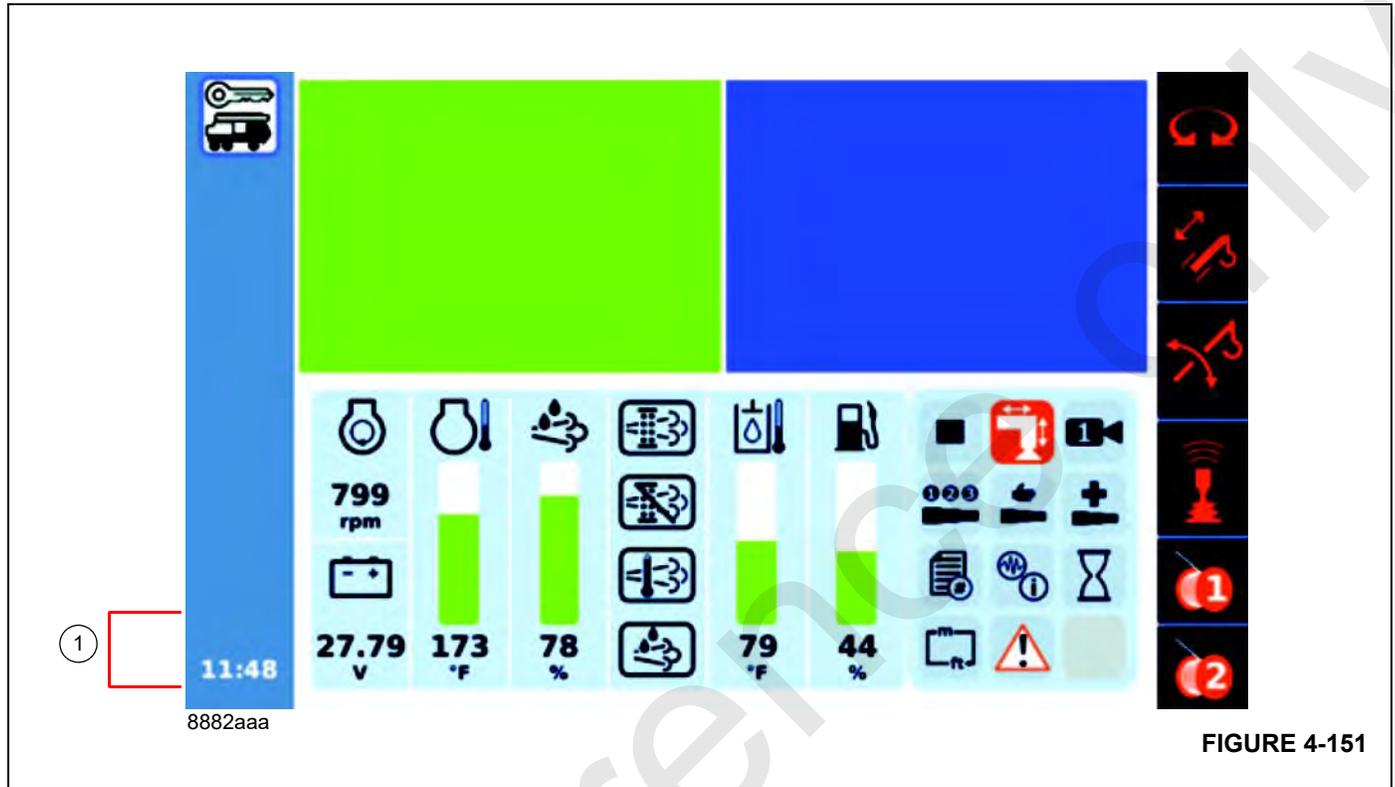


FIGURE 4-151

Name	Symbol	Description
Active Screen Indicator		Indicates the ODM screen is being controlled by the Jog Dial. Refer to <i>Navigating the Operator Display Module and Rated Capacity Limiter Display Module</i> , page 4-103.

**Crane Information Area**

The following indicators make up the Crane Information Area (Figure 4-152) of the ODM Main Screen.

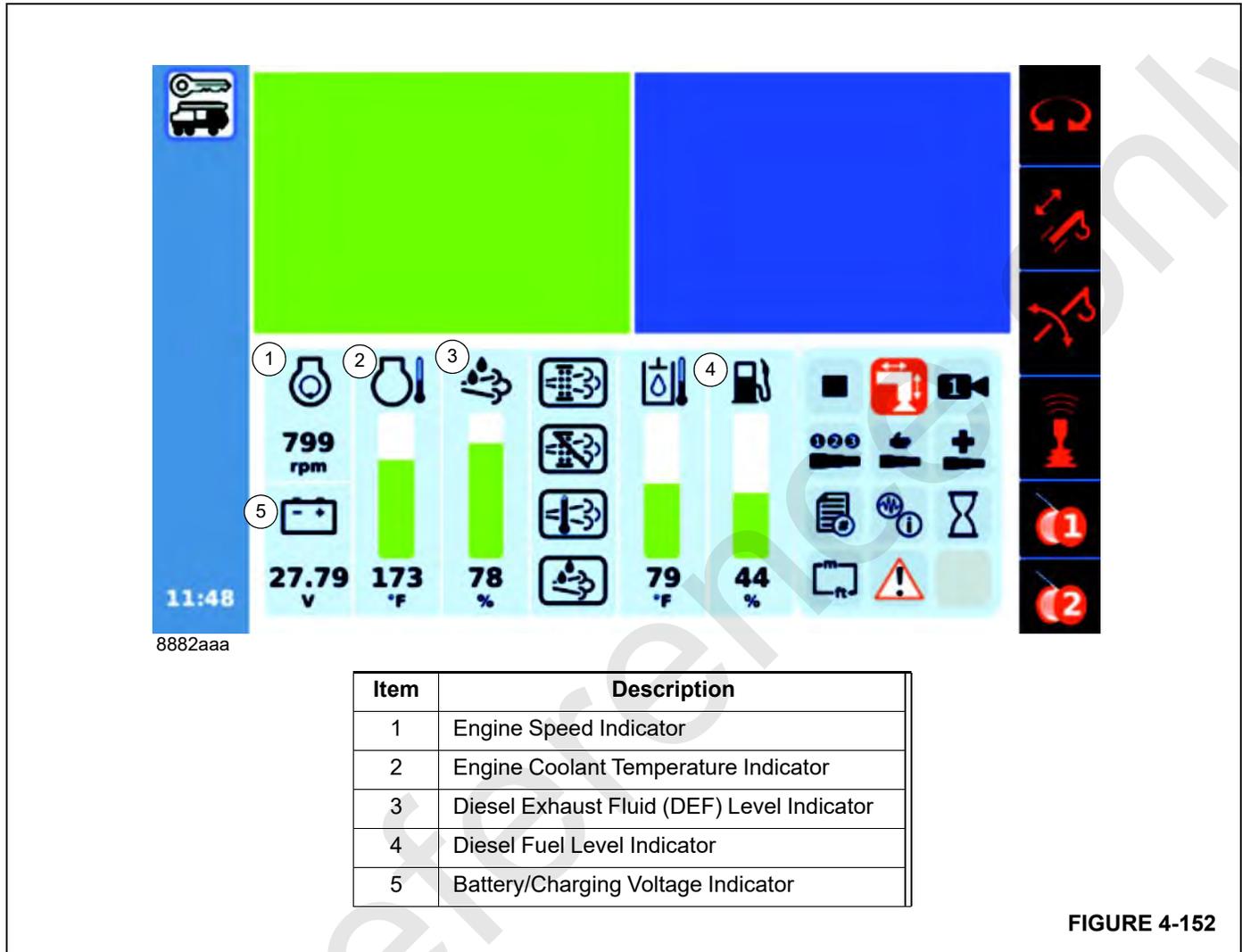
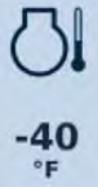


FIGURE 4-152

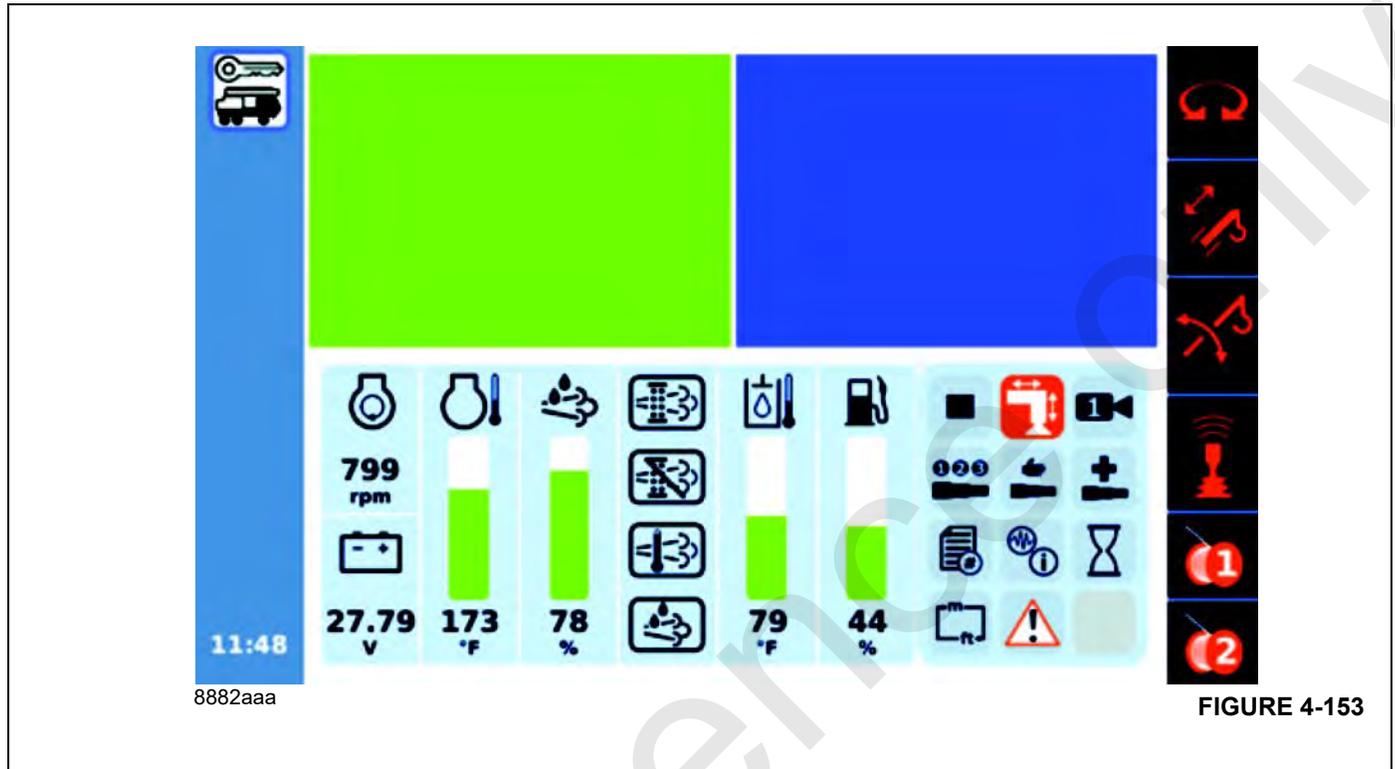
Crane Information Area

Item	Name	Symbol	Description
1	Direction/Gear Indicator		Indicates if the transmission is in neutral (N), forward (F), or reverse (R) and what gear is selected [first gear (1), second gear (2), or third gear (3)].
2	Engine Speed Indicator		Shows engine speed in revolutions per minute (RPM).
3	Engine Coolant Temperature Indicator		Shows engine coolant temperature in the selected unit of measure (°C / °F). If indicator is yellow or red, safely stop the lifting operation, land and secure the load being lifted. If possible, retract and lower the boom. Shut down and secure the crane.
4	Diesel Exhaust Fluid Level Indicator		Shows the DEF level as a percentage. Yellow Indicator - Indicates the DEF tank is between 5% to 10% full. Red Indicator - Indicates the DEF tank is 5% or less full.
5	Diesel Fuel Level Indicator		Shows the fuel level as a percentage. Yellow Bar - Indicates the fuel tank is between 5% to 15% full. Red Bar - Indicates the fuel tank is 5% or less full.
6	Transmission Oil Temperature Indicator		Shows the transmission oil temperature in the selected unit of measure (°C / °F). If indicator is yellow or red, then when safe to do so, move the crane to a location where it can be parked and secured. Let the transmission cool by running the engine at idle.

Item	Name	Symbol	Description
7	<b>Speedometer</b>		Shows the crane travel speed in the selected unit of measure (kph / mph).
8	<b>Battery/Charging Voltage Indicator</b>		<p>Shows the battery voltage when the engine is off and the charging voltage when the engine is running.</p> <p>Red Indicator - Indicates the battery voltage is less than 22V or greater than 30V.</p>
9	<b>Hydraulic Oil Temperature indicator</b>		<p>Shows the hydraulic oil temperature in the selected unit of measure (°C / °F).</p> <p>If indicator is yellow or red, safely stop crane operation and let hydraulic oil cool by running engine at idle with no functions actuated.</p>

**Crane Status Area**

The following indicators make up the Crane Status Area (Figure 4-153) of the ODM Main Screen.

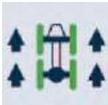


Crane Status Area

Item	Name	Symbol	Description
1	Parking Brake Indicator		Indicates the parking brake is not applied.
	Parking Brake Applied Indicator (Red)		Indicates the parking brake is applied (refer to <i>Parking Brake Control</i> , page 3-10).
2	Marker Light/Headlight Off Indicator		Indicates the marker lights and headlights are off.
	Marker Light/Headlight On Indicator (Green)		Indicates that either the marker lights or headlights are on (refer to <i>Headlights Switch</i> , page 3-7).
3	Economy (ECO) Mode Indicator		Indicates ECO mode is disabled.
			Indicates ECO mode is enabled (refer to <i>Economy (ECO) Mode</i> , page 4-189) but is not active.
			Indicates ECO mode is enabled and actively lowered the engine speed to 1200 rpm.
			Indicates ECO mode is enabled and actively lowered the engine speed to 750 rpm.
4	Suspension Control Indicator		Indicates the suspension is unlocked and the rear axles are free to oscillate from side to side.
			Indicates the suspension is locked and axle oscillation is prevented.

Item	Name	Symbol	Description
5	WRL Indicator		Indicates all working range limiters are off.
	WRL Indicator (Green)		Indicates one or more working range limiters are defined and enabled.
	WRL Bypassed Indicator (Amber - Flashing)		Indicates a WRL lock out function is bypassed by a Limit Bypass Switch.
5	WRL Boom Angle Enabled Indicator (Green)		Indicates that the minimum boom angle limit, the maximum boom angle limit, or both the minimum and maximum boom angle limits are defined.
	WRL Boom Angle Warning Indicator (Amber)		Indicates the boom angle is within 10° of a boom angle limit setpoint. The warning buzzer slowly beeps when the boom angle is within 10° of the boom angle limit setpoint and changes to a fast beep when the boom tip is within 5° of the boom height limit setpoint.
	WRL Boom Angle Stop Indicator (Red)		Indicates the boom angle is at a boom angle limit setpoint. The warning buzzer is on (constant). For cranes that are equipped with the WRL Lock Out Function, the boom up or boom down crane function is locked out, depending upon which limit is reached.
5	WRL Boom Height Enabled Indicator (Green)		Indicates the boom height limit is defined.
	WRL Boom Height Warning Indicator (Amber)		Indicates the boom tip height is within 3 m (10 ft) of the boom height limit setpoint. The warning buzzer slowly beeps when the boom tip is within 3 m (10 ft) of the boom height limit setpoint and changes to a fast beep when the boom tip is within 1.5 m (5 ft) of the boom height limit setpoint.
	WRL Boom Height Stop Indicator (Red)		Indicates the boom tip height is at the boom height limit setpoint. The warning buzzer is on (constant). For cranes that are equipped with the WRL Lock Out Function, the telescope out and boom up crane functions are locked out.

Item	Name	Symbol	Description
5	<b>WRL Radius Enabled Indicator (Green)</b>		Indicates that the minimum boom angle limit, the maximum boom angle limit, or both the minimum and maximum boom angle limits are defined.
	<b>WRL Radius Warning Indicator (Amber)</b>		Indicates the boom radius is within 3 m (10 ft) of a radius limit setpoint. The warning buzzer slowly beeps when the boom radius is within 3 m (10 ft) of the radius limit setpoint and changes to a fast beep when the radius is within 1.5 m (5 ft) of the radius limit setpoint.
	<b>WRL Radius Stop Indicator (Red)</b>		Indicates the boom radius is at a radius limit setpoint. The warning buzzer is on (constant). For cranes that are equipped with the WRL Lock Out Function, the boom up and telescope in, or boom down and telescope out, crane functions are locked out, depending upon which limit is reached.
5	<b>WRL Swing Enabled Indicator (Green)</b>		Indicates the left and right swing angle limits are defined.
	<b>WRL Swing Warning Indicator (Amber)</b>		Indicates the swing angle is within 10° of a swing angle limit setpoint. The warning buzzer slowly beeps when the swing angle is within 10° of the swing angle limit setpoint and changes to a fast beep when the swing angle is within 5° of the swing angle limit setpoint. For cranes that are equipped with the WRL Lock Out Function, when the swing angle is within 10° of the swing angle lock out setpoint, the swing function commanded by the controller may be reduced or suspended depending upon the weight of the load and the swing speed. <b>Warning</b> Due to the free-swing characteristic of the superstructure, the boom and load can potentially swing past the swing angle setpoint, even if the swing function commanded by the controller is reduced or suspended (locked out) by the WRL. This can happen for several reasons, including how level the crane is and environmental conditions, such as wind speed.
	<b>WRL Swing Stop Indicator (Red)</b>		Indicates the swing angle is at a swing angle limit setpoint. The warning buzzer is on (constant). For cranes that are equipped with the WRL Lock Out Function, the swing left or swing right crane function is locked out, depending upon which limit is reached.

Item	Name	Symbol	Description
5	<b>WRL Virtual Walls Enable Indicator</b>		Indicates that one or more virtual walls are defined.
	<b>WRL Virtual Walls Warning Indicator</b>		Indicates the boom tip is within 6 m (20 ft) of a virtual wall that has been set. The warning buzzer slowly beeps when the boom tip is within 6 m (20 ft) of a virtual wall and changes to a fast beep when the boom tip is within 1.5 m (5 ft) of a virtual wall.
	<b>WRL Virtual Walls Stop Indicator</b>		Indicates the boom tip is at a virtual wall that has been set. The warning buzzer is on (constant). For cranes that are equipped with the WRL Lock Out Function, the telescope out, boom down, and swing left or swing right crane functions are locked out.
6	<b>Two-Wheel Drive/Four-Wheel Drive Indicator</b>		Indicates the transmission is shifted to two-wheel high range.
			Indicates the transmission is shifted to four-wheel low range

**Frequently Used Quick Select Menu Area**

The Frequently Used Quick Select Menu Area (1), (Figure 4-154) of the ODM Main Screen shows the six most often selected function icons from the Menu Screen.

These icons appear in descending order of usage, starting at the top left corner and descending to the bottom right corner, as shown by the red arrows in (Figure 4-154).

During the operation of the crane, the function icons that appear in this area will change as their usage changes.

Use the Navigation Control Pad or Jog Dial to select one of the function icons in this area.

These six function icons can also be found in the Menu Screen of the ODM. Selecting one of the six icons in the Frequently Used Quick Select Menu Area (Figure 4-154) or in the Menu Screen (Figure 4-147) will open the same function screen.

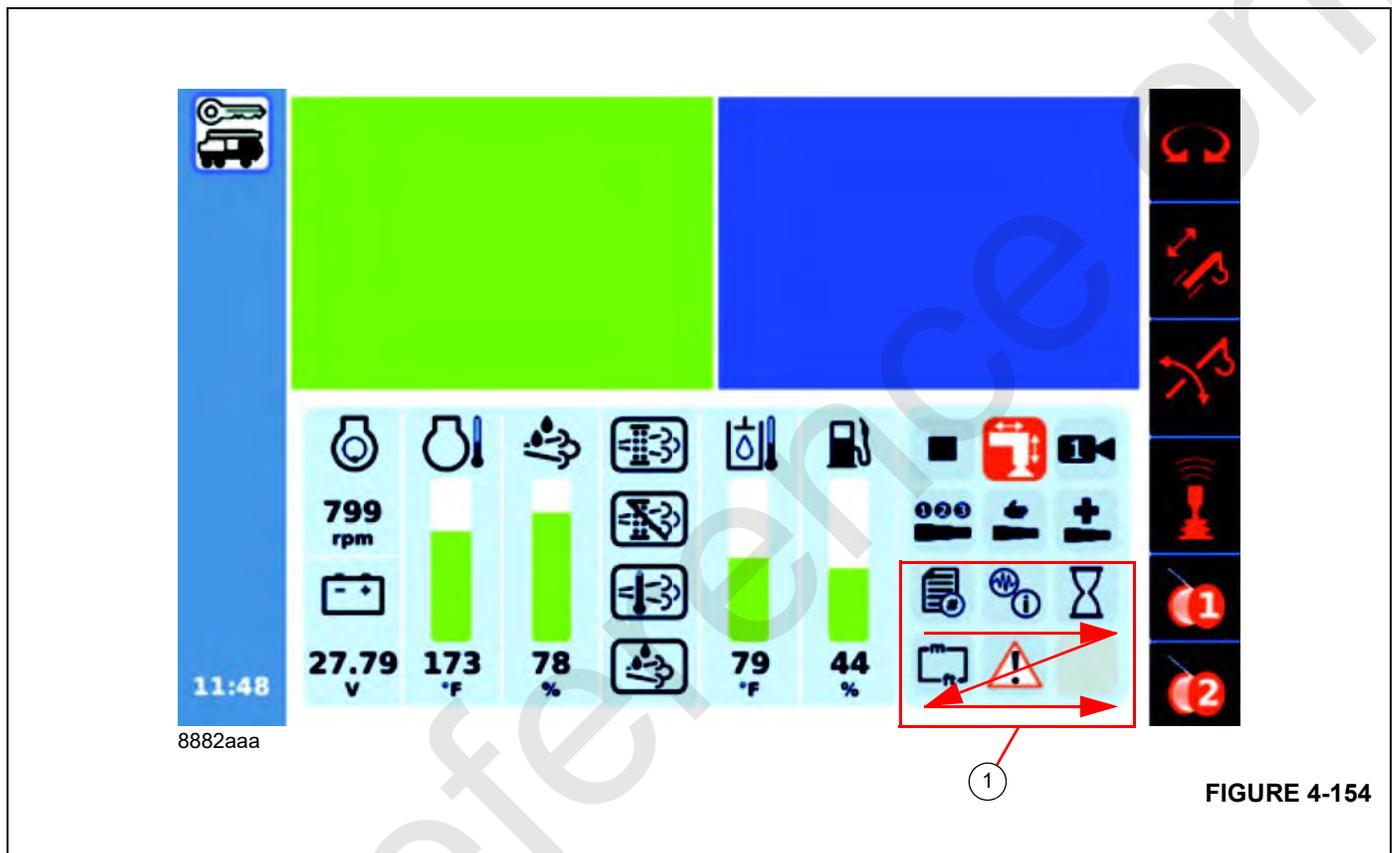


FIGURE 4-154

**Status Bar**

The indicators in the Status Bar (Figure 4-155) represent the crane functions that are operated by the controllers on the armrests.

Crane functions are enabled and disabled by Enable/Disable Switches. As the status of a crane function changes (from disabled to enabled, or back), its related indicator on the Status Bar will change color.

The crane function indicators that show in the Status Bar (Figure 4-155) include the following:

1. Swing (1)
2. Telescope (2)
3. Boom Lift (3)
4. Remote Control Unit (4)
5. Main Hoist (5)
6. Auxiliary Hoist (6)

Each crane function indicator can have the following status:

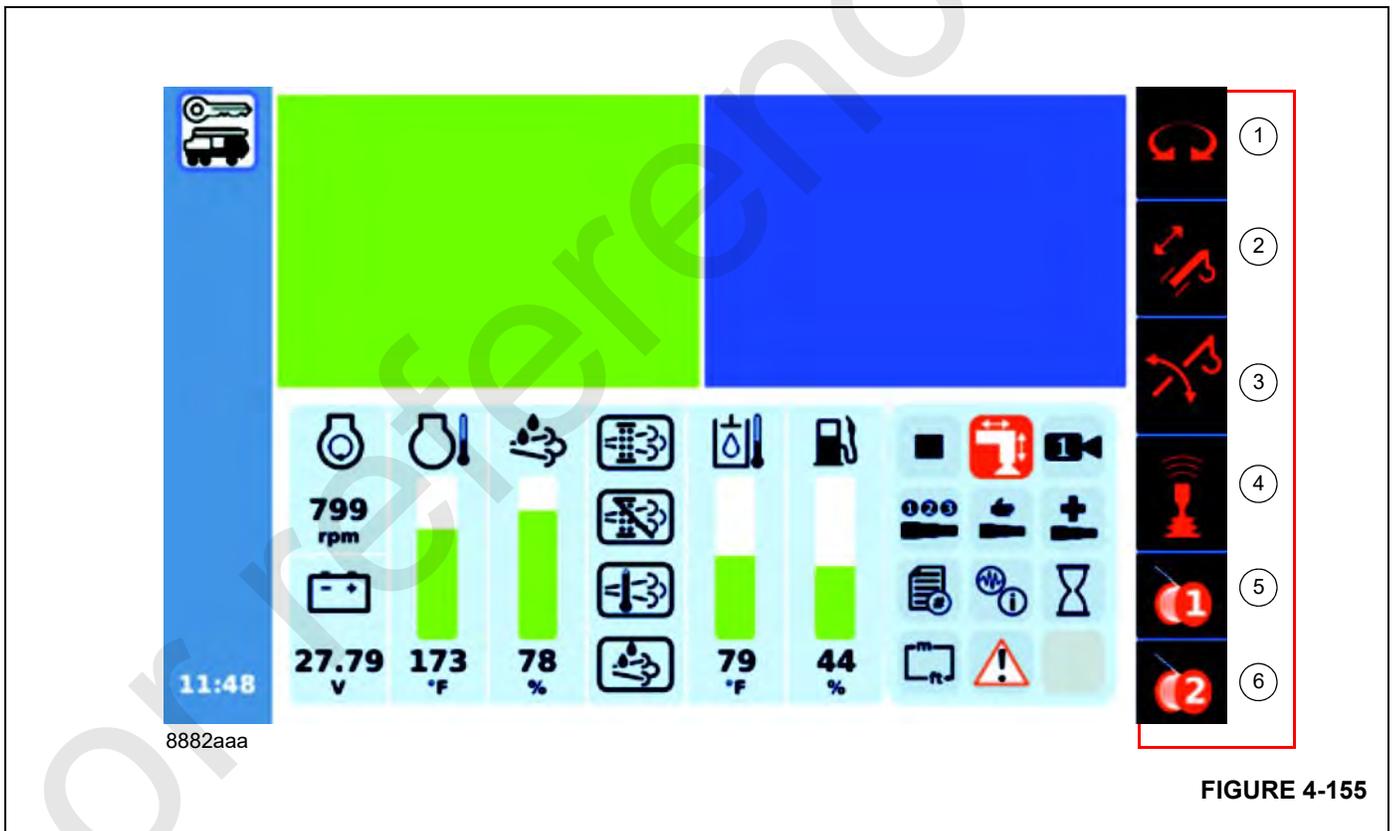
- Blue Indicator – Indicates the crane function is disabled.
- Yellow Indicator (Constant ON) – Indicates the crane function is enabled, but is in a standby mode due to the operator not being seated (causing seat switch to open – refer to *Seat Switch*, page 3-26).

The crane function is re-enabled by either sitting in the operator seat or by actuating a dead-man switch on the left or right dual axis controllers [refer to *Deadman Switches*, page 3-25].

- Yellow Indicator (Flashing) – Indicates the crane function is being commanded [controller is moved out of neutral (center) position] when the crane function is changed from disabled to enabled.

Allow controller to return to its neutral position, then re-enable the crane function.

- Green Indicator – Indicates the crane function is enabled.



Additionally, the main and auxiliary hoist indicators can have the following status:

Name	Symbol	Description
<b>Main Hoist Raise Indicator (Green)</b>		Indicates the main hoist rope is being reeled in.
<b>Main Hoist Lower Indicator (Green)</b>		Indicates the main hoist rope is being let out.
<b>Main Hoist High Speed Indicator (Green)</b>		Indicates the main hoist function and the high speed function are enabled.
<b>Auxiliary Hoist Raise Indicator (Green)</b>		Indicates the auxiliary hoist rope is being reeled in.
<b>Auxiliary Hoist Lower Indicator (Green)</b>		Indicates the auxiliary hoist rope is being let out.
<b>Auxiliary Hoist High Speed Indicator (Green)</b>		Indicates the auxiliary hoist function and the high speed function are enabled.

**Permanent Quick Select Menu Area**

The Permanent Quick Select Menu Area (Figure 4-156) of the ODM Main Screen shows six function icons that are frequently used in the operation of the crane. These six function icons are constantly shown and cannot be changed.

Use the Navigation Control Pad or Jog Dial to select one of the function icons.

These six function icons can also be found in the Menu Screen of the ODM. Selecting one of the six icons in the Permanent Quick Select Menu Area (Figure 4-156) or in the Menu Screen (Figure 4-147) will open the same function screen.

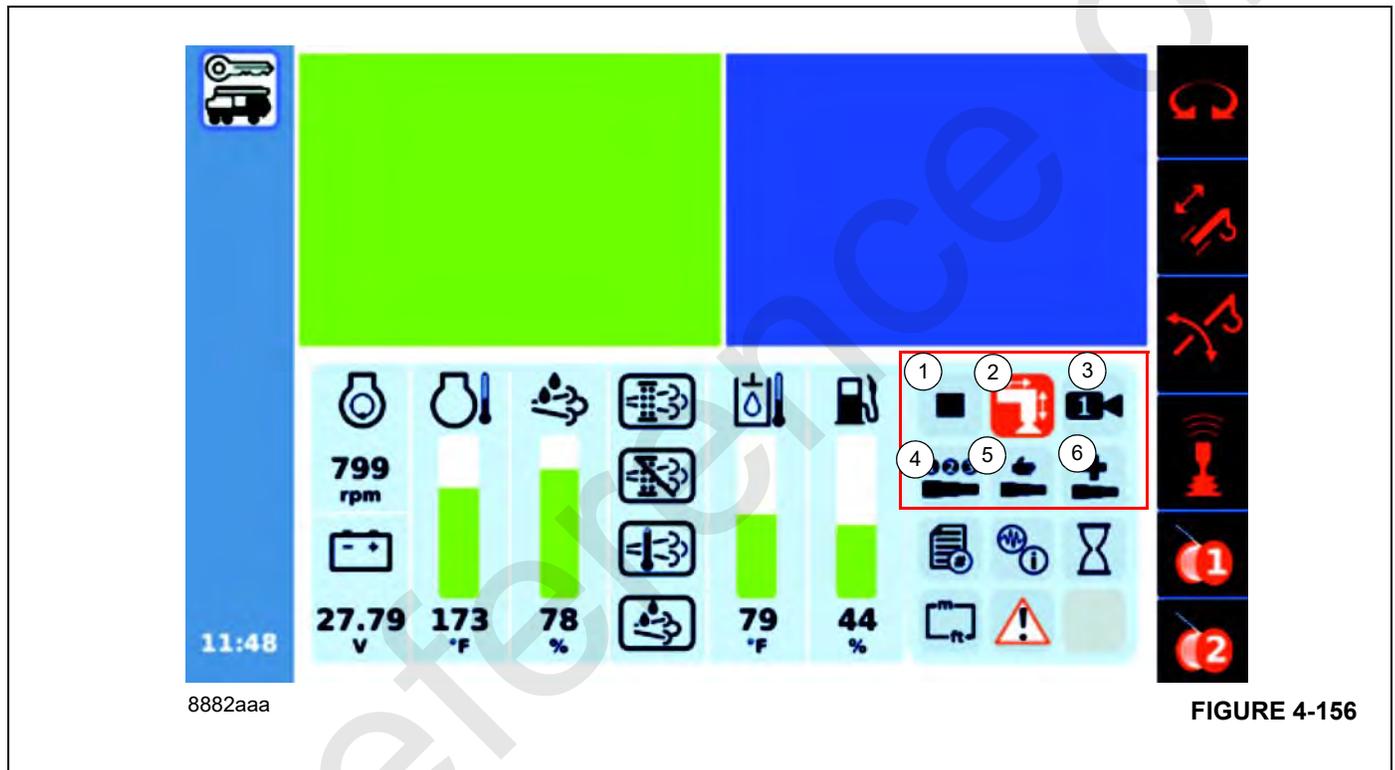


FIGURE 4-156

Item	Name	Symbol	Description
1	Menu Screen Icon		Opens the Menu Screen (page 4-127)
2	Outrigger Function Icon		Opens the Outrigger Extend/Retract function screen (page 4-137)
3	Camera Menu Group Icon		Opens the Camera Menu Group Function for View 1, View 2, or Views 1 and 2 (page 4-189)

Item	Name	Symbol	Description
4	<b>Semi-automatic Telescope Mode Function Icon</b>		Opens the Semi-automatic Telescope Mode function screen (page 4-133)
5	<b>Manual Telescope Mode Function Icon</b>		Opens the Manual Telescope Mode function screen (page 4-169)
6	<b>Emergency Telescope Mode Function Icon</b>		Opens the Emergency Telescope Mode function screen (page 4-171)

For reference only

## Menu Screen

The Menu Screen (Figure 4-158) of the ODM is accessed by doing one of the following:

- Press the Screen Toggle Button (1), (Figure 4-157) at the Jog Dial to select the ODM screen control, then press the Menu Button (2).
- or -
- Press the Menu Button (3), (Figure 4-157) on the Navigation Control Pad at the ODM.

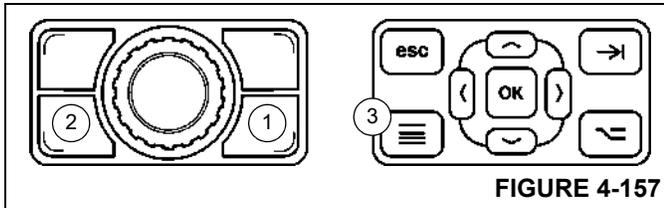


FIGURE 4-157

The ODM Menu Screen (Figure 4-158) has the following menu items for operating the crane:

- **Camera Menu Group Icon (1)**
  - Camera View 1 Icon (2)
  - Camera View 2 Icon (3)
  - Camera Views 1 and 2 Icon (4)
- **Tele-Automation Menu Group Icon (5)**
  - Semi-Automatic Telescope Mode Icon (6)
  - Boom Configurator Mode Icon (7)
- **Crane Function Menu Group Icon (8)**
  - Outrigger Extend/Retract Icon (9)
  - Counterweight Removal/Installation Icon (10)
  - 360° Superstructure Lock/Unlock Icon (11)
  - Boom Extension Deployment/Stowage Icon (12)
- **Working Range Limiter Menu Group Icon (13)**
  - Swing Angle Limitation Icon (14)
  - Boom Angle Limitation Icon (15)
  - Boom Height Limitation Icon (16)
  - Radius Limitation Icon (17)
  - Virtual Walls Icon (18)
  - Third Wrap Hoist Icon (19)
- **Tools Menu Group Icon (20)**
  - Swing Icon (21)
- **Emergency Program Menu Group Icon (22)**
  - Manual Telescope Mode Icon (23)
  - Emergency Telescope Mode Icon (24)
  - Telescope Recovery Mode Icon (Resetting Telescope Configuration) (25)
- **Faults Menu Group Icon (26)**
  - Crane Faults Icon (27)
  - Engine Faults Icon (28)
- **Information Menu Group Icon (29)**
  - Operating Hours Icon (30)
  - Software Versions Icon (31)
- **User Settings Menu Group Icon (32)**
  - Controller Curve Icon (33)
  - Controller Speed Icon (34)
  - Windshield Wiper Stroke Interval Icon (35)
  - ECO Mode Icon (36)
  - Exhaust System Cleaning Icon (If Equipped) (37)
  - Service Menu Icon (38)
- **Display Screen Settings Menu Group Icon (39)**
  - Units of Measure (Metric/Imperial) Icon (40)
  - Display Screen Brightness Icon (41)
  - Time Set Icon (42)

### Menu Screen Display

The Crane Control System (CCS) displays the Operator Display Module (ODM) Menu Groups (Figure 4-158).

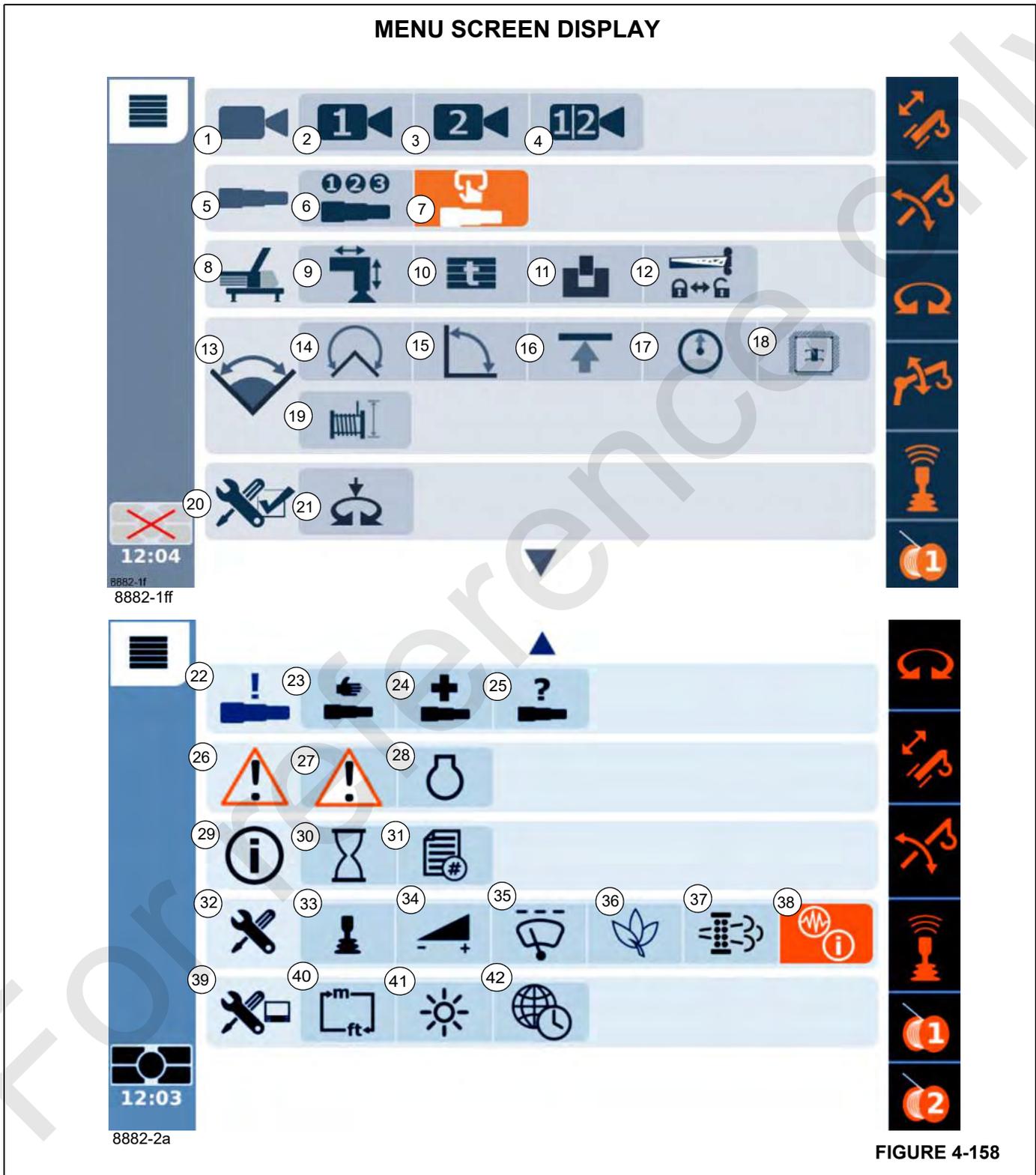


FIGURE 4-158

Item	Description	Page	Item	Description	Page
1	Camera Menu Group Icon	page 3-4	22	Emergency Program Menu Group Icon	page 4-169
2	Camera View 1 Icon	page 4-130	23	Manual Telescope Mode Icon	page 4-169
3	Camera View 2 Icon	page 4-130	24	Emergency Telescope Mode Icon	page 4-171
4	Camera Views 1 and 2 Icon	page 4-130	25	Telescope Recovery Mode Icon - Resetting Telescope Configuration	page 4-132
5	Tele-Automation Menu Group Icon	page 4-132	26	Faults Menu Group Icon	page 4-179
6	Semi-Automatic Telescope Mode Icon	page 4-133	27	Crane Faults Icon	page 4-179
7	Boom Configurator Mode Icon	page 4-75	28	Engine Faults Icon	page 4-181
8	Crane Function Menu Group Icon	page 4-137	29	Information Menu Group Icon	page 4-181
9	Outrigger Extend/Retract Icon	page 4-137	30	Operating Hours Icon	page 4-181
10	Counterweight Removal/Installation Icon	page 4-144	31	Software Versions Icon	page 4-183
11	360° Superstructure Lock/Unlock Icon	page 4-144	32	User Settings Menu Group Icon	page 4-184
12	Boom Extension Deployment/Stowage Icon	page 4-146	33	Controller Curve Icon	page 4-185
13	WRL Menu Group Icon	page 4-147	34	Controller Speed Icon	page 4-187
14	Swing Angle Limitation Icon	page 4-155	35	Windshield Wiper Stroke Interval Icon	page 4-188
15	Boom Angle Limitation Icon	page 4-158	36	ECO Mode Icon	page 4-189
16	Boom Height Limitation Icon	page 4-161	37	Exhaust System Cleaning Icon	page 4-191
17	Radius Limitation Icon	page 4-163	38	Service Menu Icon	page 4-184
18	Virtual Walls Icon	page 4-166	39	Display Screen Settings Menu Group Icon	page 4-192
19	3rd Wrap Hoist Icon	page 4-107	40	Units of Measure (Metric/Imperial) Icon	page 4-194
20	Tools Menu Icon	page 4-123	41	Display Screen Brightness Icon	page 4-193
21	Swing Icon	page 4-78	42	Time Set Icon	page 4-193

## Camera Menu Group

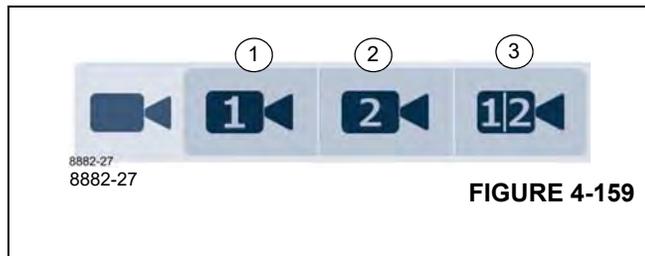
### Switching the Camera

Switching the Camera allows the operator to select a specific camera.

- Open the Camera Menu (Figure 4-159).

Select and confirm the symbol to change the camera.

1	Camera 1
2	Camera 2
3	Camera 1 and 2



Also refer to *Carrier Camera Display and Setup*, page 3-4.

### Operating the Camera

#### Switching ON

- Switch on the ignition.  
The image appears on the display after a few seconds.

#### Switching the Cameras

- Select and confirm a symbol (Figure 4-160) to switch over between the cameras.



### Camera on the Hoists

#### CAUTION

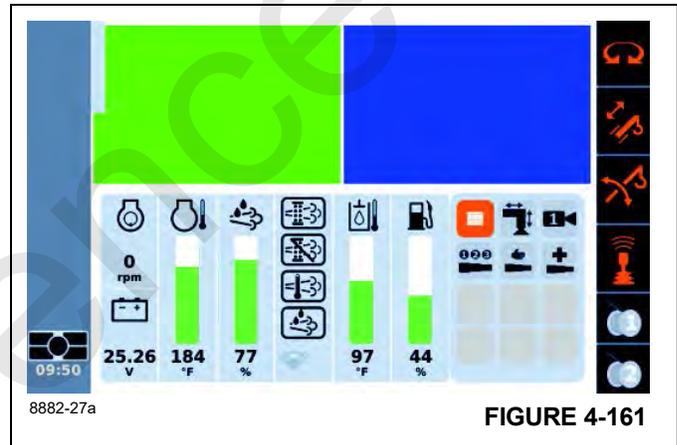
##### Machine Damage!

Always retract the camera before driving. When the camera is extended, the overall height specified for on-road driving is exceeded.

A camera transmits an image of the main and auxiliary hoists to the display in the crane cab.

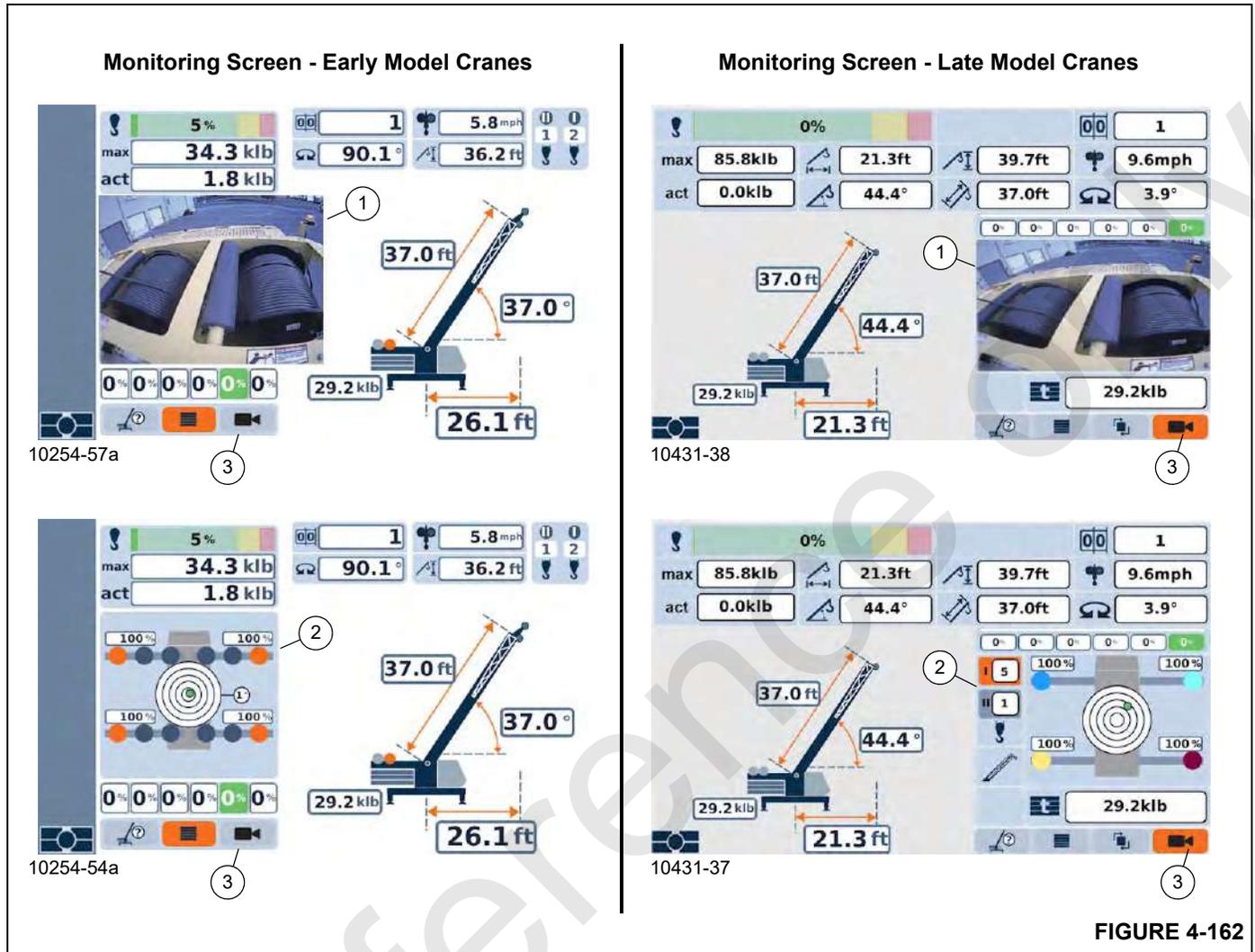
### Viewing the Hoist Camera

The Hoist Camera View can be set to show on the Monitoring Screen of the Rated Capacity Limiter Display Module (RDM) as shown in (Figure 4-161).



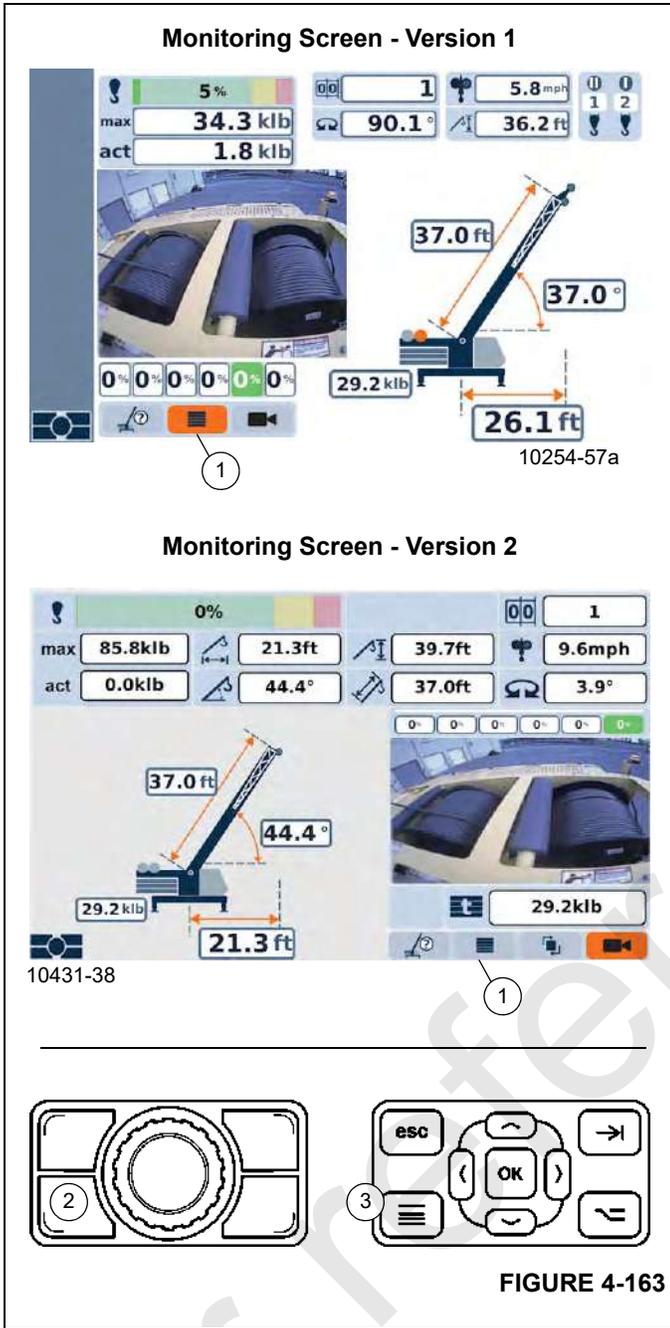
When enabled, the Hoist Camera View (1), (Figure 4-162) will automatically show in place of the Outrigger Position View (2) when the main or optional auxiliary hoist is operating (reeling in or out). When the hoists are not operating, the Outrigger Position View will show on the Monitoring Screen.

Select and confirm the Hoist Camera View Icon (3), (Figure 4-162) to enable or disable the hoist camera view.



The Hoist Camera View can also be set to show continuously in full screen on the RDM (Figure 4-163).

The full screen view of the hoist camera is enabled in the Menu Screen of the RDM. The operator can access the Menu Screen from the Monitoring Screen by selecting and confirming the Menu Icon (1), (Figure 4-163), or by pressing the Menu Button at the Jog Dial (2) or at the RDM Navigation Control Pad (3).



From the Menu Screen, select and confirm the Hoist Camera Icon (1), (Figure 4-164) to open the full screen view of the hoist camera (2).



**Tele-Automation Menu Group**

The Tele-Automatic Menu Group (1), (Figure 4-165) includes the following boom telescoping function icons:

- Semi-Automatic Telescope Mode (2), (Figure 4-165).
- Boom Configurator (3), (Figure 4-165).

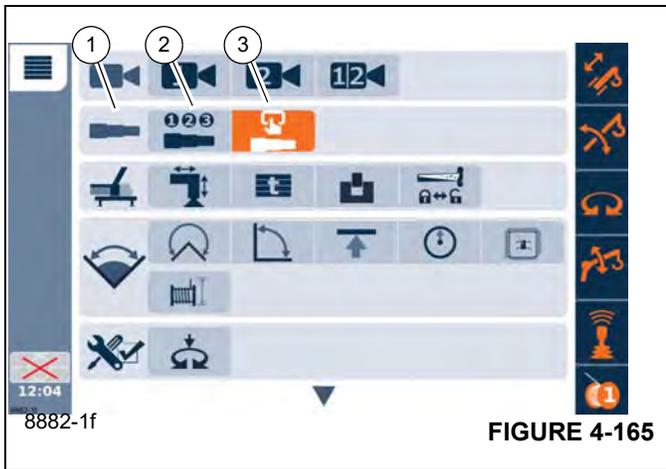


FIGURE 4-165

**Semi-Automation Telescope Mode**

**NOTE:** For more information about telescoping with semi-automation refer to *Semi-Automatic Telescope Mode*, page 4-67.

**Open Menu**

To open: Select symbol (1), (Figure 4-166) and confirm. The menu is opened. The Semi-Automatic Telescope Mode is used to select the amount of telescoping for each boom section.

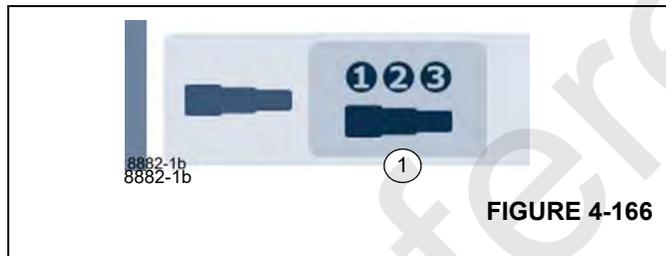


FIGURE 4-166

**Telescope Diagram Display**

Current relation of the telescopic sections to each other – section of top view (Figure 4-167).

The image shown in (Figure 4-167) shows the status of the section and cylinder pins. Green (1), indicates that the pin is locked. Yellow shows that it is in an intermediate position. Red (2) is unlocked. Additionally, if the hazard triangle (3) is present, an error exists.

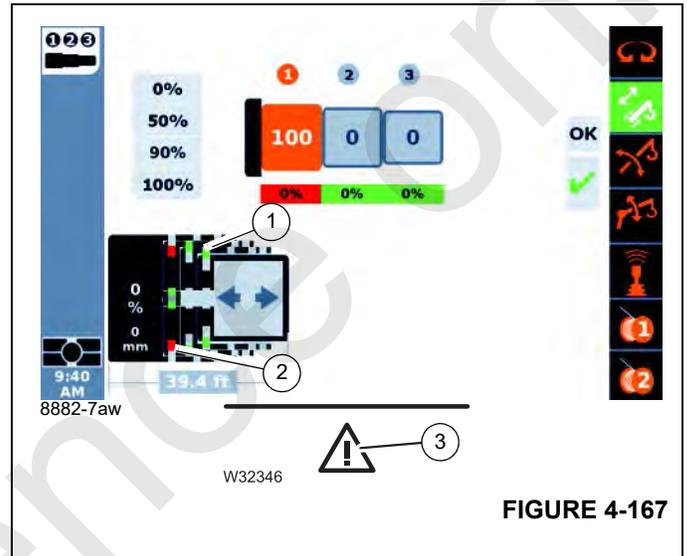


FIGURE 4-167

**Telescoping Cylinder Length Display**

Display:	Current extended length of the telescoping cylinder (1), (Figure 4-168)
Unit of Measurement:	Displayed in mm (millimeters)

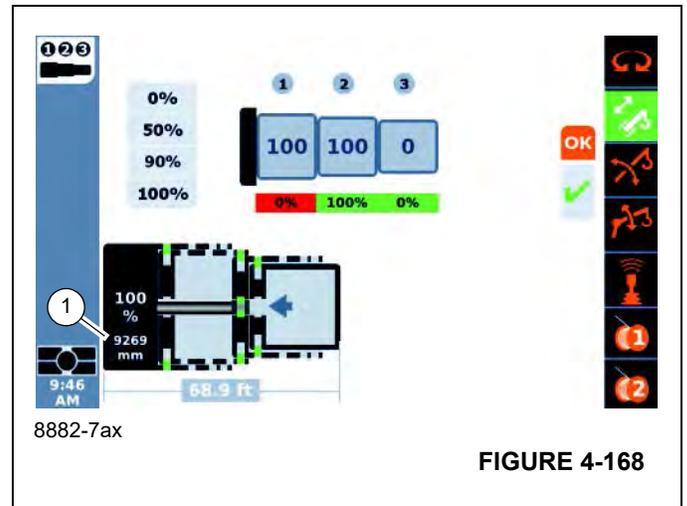


FIGURE 4-168

Main Boom Length Display

Display:	Current extended length of the main boom (1), (Figure 4-169)
Unit of Measurement:	Displayed depending on setting, m (meters) or ft (feet)

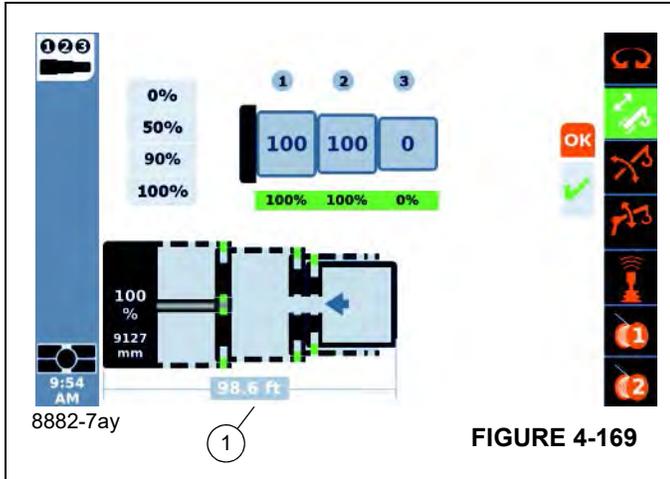


FIGURE 4-169

Telescopic Sections Display

1 - 3	Display of telescopic sections 1 to 3 (1), (Figure 4-170)
-------	---

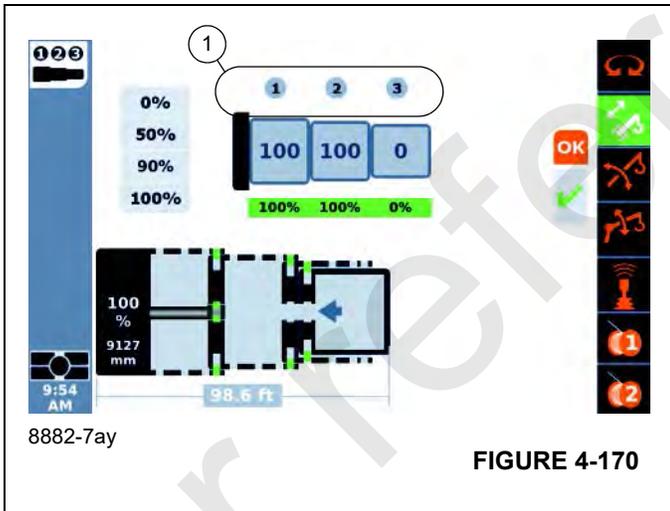


FIGURE 4-170

Refer to Pre-selection for all telescopic sections.

Current Telescope Status Display

Extended length of the telescopic sections in percentage

1 - 3	Display of telescopic sections 1 to 3 (Figure 4-171)
-------	--

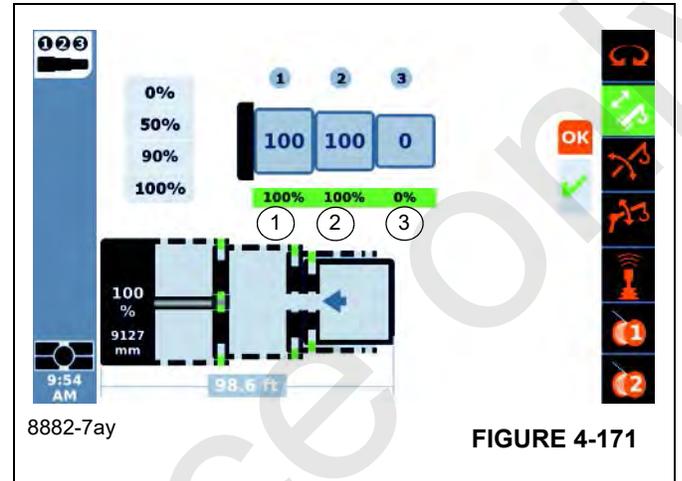


FIGURE 4-171

Pre-selection for Selected Telescopic Section

1	Pre-selection telescoping 0%
2	Pre-selection telescoping 50%
3	Pre-selection telescoping 50%

Pre-selection Individual Telescopic Sections

1 - 3	Display of telescopic sections 1 to 3 (Figure 4-172)
-------	--

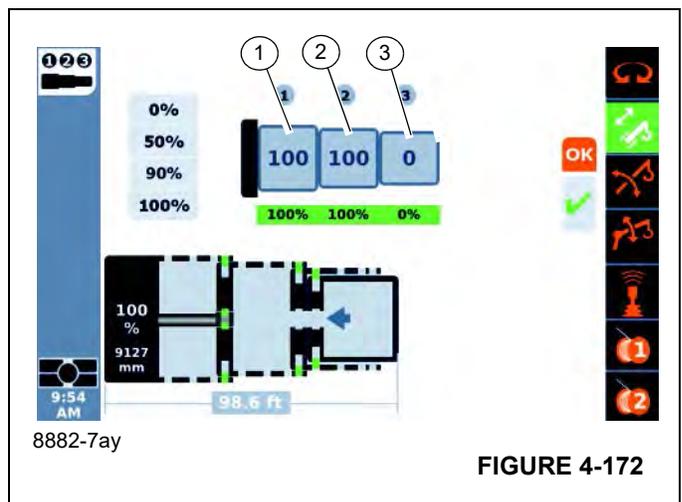


FIGURE 4-172

Tele-automation Direction Display

1	Start telescoping with Retract (Figure 4-173)
2	Start telescoping with Extend

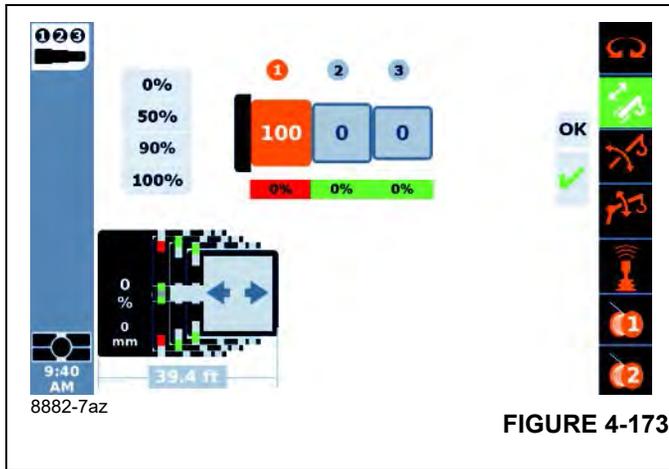


FIGURE 4-173

Confirm Pre-selection

1	Confirm request to use entered telescoping values (Figure 4-174)
2	Once a new set of values are entered for telescoping, the question-mark appears until the OK is confirmed. Then the check-mark or the red-X is shown
3	Requested telescoping is accepted symbol
4	Requested telescoping not accepted symbol

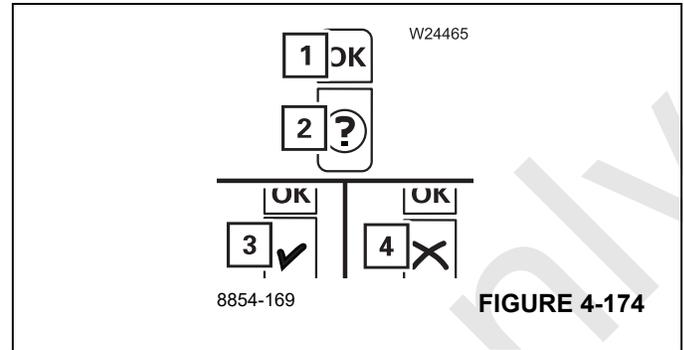


FIGURE 4-174

Boom Configurator Mode

NOTE: Refer to *Boom Configurator*, page 4-75 for more information on how the Boom Configurator screen is used in the telescoping operation.

To open, Select the Boom Configurator Mode and confirm. Menu is opened.

- Boom Configurator (1), (Figure 4-175).

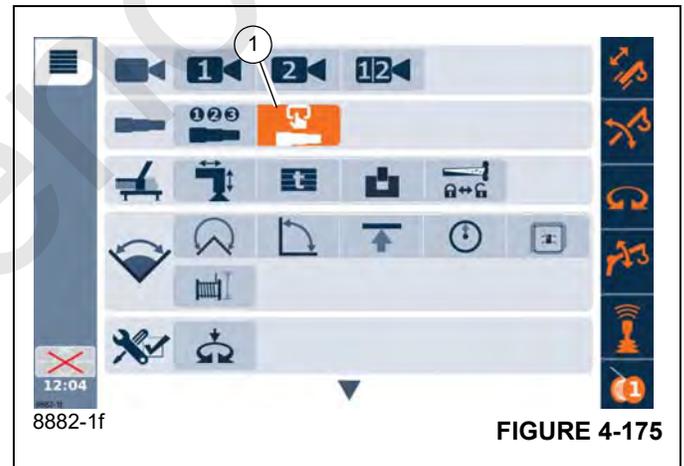


FIGURE 4-175

For additional information on the Boom Configurator, refer to (Figure 4-176) and Table listing below.

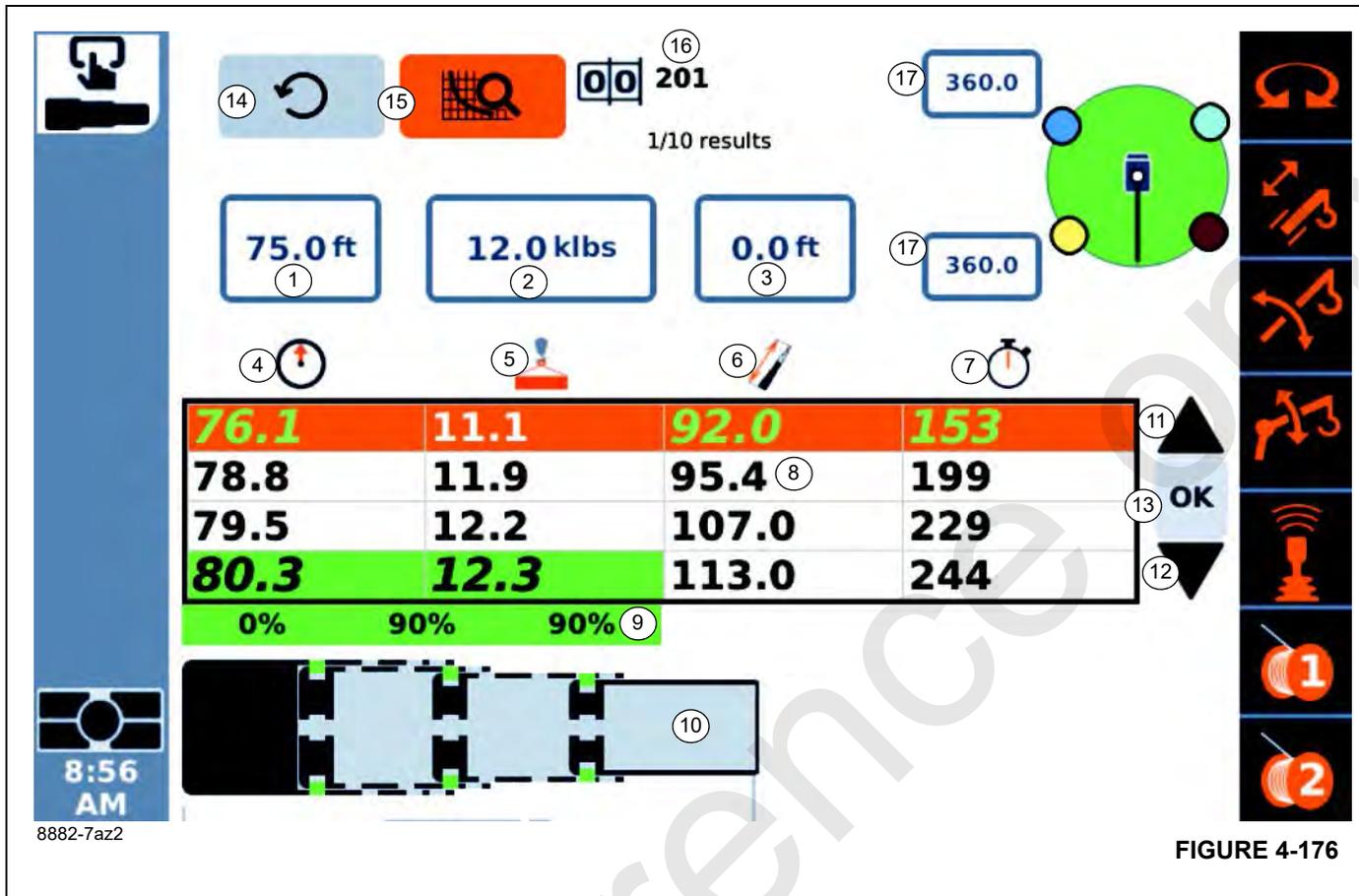


FIGURE 4-176

Item	Description	Item	Description
1	Lift plan radius entry box.	10	For the row in the table that is highlighted, this is a schematic view of the boom configuration.
2	Lift plan hook load entry box.	11	Up arrow, when selected and select Enter, the highlighted row moves up in the table.
3	Lift plan boom length entry box.	12	Down arrow, when selected and select Enter, the highlighted row moved down in the table.
4	Symbol indicating radius.	13	OK Button; when selected and select Enter, the highlighted row's boom configuration is accepted and sent to the Semi-automatic mode screen, and the boom commences to attempt to use this boom configuration.
5	Symbol indicating hook load.	14	Reset option; when selected and select Enter, the lift plan entry values are set to 0 and boom configurations cleared.
6	Symbol indicating boom length.	15	Search Button; when selected and select Enter, search for boom configurations is initiated.
7	Symbol indicating approximate time (in seconds) for boom configuration ("tele pictures") to be completed.	16	Current Rigging Code from the RCL.
8	Table of possible boom configurations ("tele pictures") that meet the lift plan criteria.	17	Swing Angle entry boxes for MaxBase swing zone limits.
9	For the row in the table that is highlighted, this is the boom configuration ("tele picture").		

### Crane Function Menu Group

The Crane Function Menu Group includes the following function icons:

- Outrigger Extend/Retract (page 4-137)
- Counterweight Removal/Installation (page 4-144)
- 360° Superstructure Lock/Unlock (page 4-144)
- Boom Extension Deployment/Stowage (page 4-146)

### Outrigger Extend/Retract Screen

Select the Outrigger Extend/Retract Icon (1), (Figure 4-177) under the Crane Function Group to show the Outrigger Extend/Retract function screen.

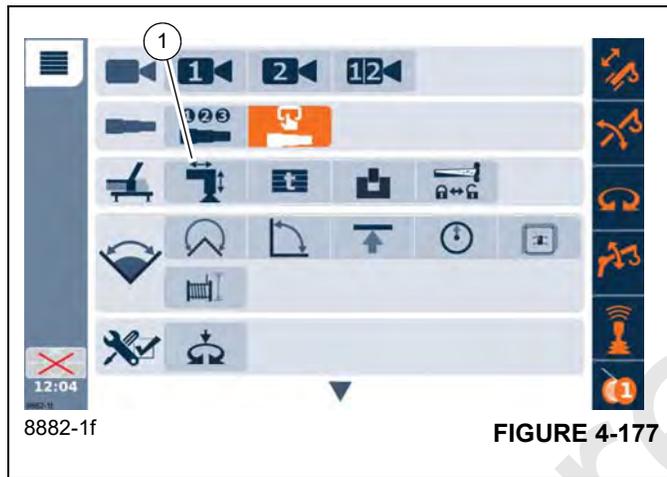


FIGURE 4-177

The Outrigger Extend/Retract function screen (Figure 4-179) allows the operator to set the outriggers and level the crane using either a manual or semi-automatic mode. The outriggers are also retracted and stowed from this function screen.

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

The steering wheel symbol (25), (Figure 4-179) shown on the Outrigger Extend/Retract function screen corresponds to the front of the crane. The terms left and right correspond to the operator's left and right sides when looking forward over the front of the crane.

**NOTE:** Refer to *Using the Outriggers*, page 4-40 for complete procedures to set the outriggers and level the crane, and procedures to stow the outriggers.

**NOTE:** Outrigger controls are only enabled when the engine is running, the parking brake is applied, and the transmission is shifted to neutral.

### Right-Hand Armrest Control Panel

#### Button for Outrigger Pre-selection

The following functions are pre-selected in the same way (Figure 4-178).

1	Left Front beam/Jack Select and Center Front Stabilizer select
2	Right Front Beam/Jack Select
3	Left Rear Beam/Jack Select
4	Right Rear Beam/Jack Select

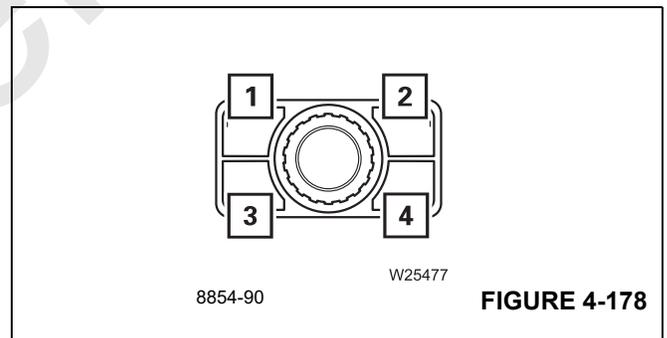


FIGURE 4-178

The Outrigger Extend/Retract function screen (Figure 4-179) is used to deploy and monitor the outriggers.

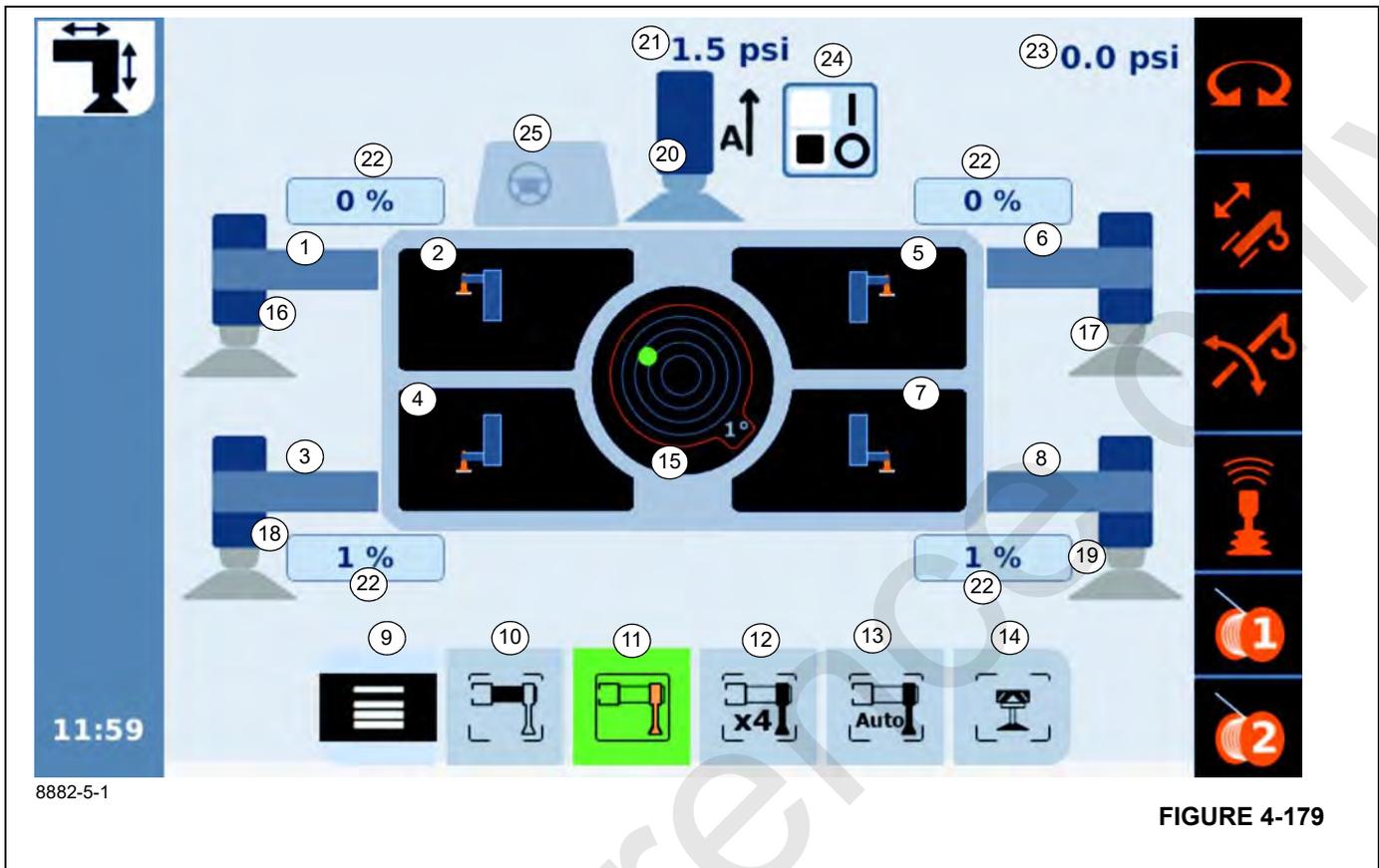


FIGURE 4-179

Item	Description
1	Left Front Beam
2	Jog Dial Top Left Button - left front beam/jack select. This will turn into center front stabilizer when item #14 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	Menu Screen Icon
10	Outrigger Beams Icon
11	Outrigger Jacks Icon

Item	Description
12	Outrigger Jacks x4 Icon
13	Auto(matic) Level Icon
14	Center Front Stabilizer Icon
15	Current Inclination Indicator
16	Left Front Jack
17	Right Front Jack
18	Left Rear Jack
19	Right Rear Jack
20	Center Front Stabilizer
21	Center Front Stabilizer Pressure
22	Percentage the Outrigger Beam is Extended
23	Outrigger Circuit Supply Pressure
24	Cribbing Mode Switch
25	Steering Wheel (to indicate front of crane)

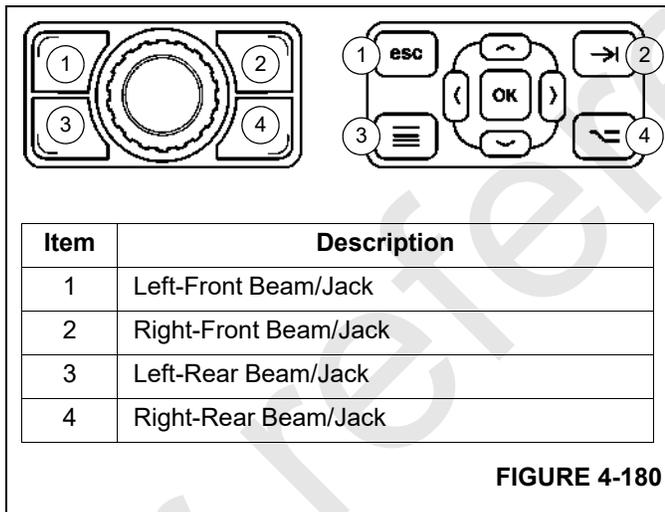
**Extending/Retracting the Outriggers Beams/Jacks**

To extend or retract the outrigger beams/jacks, perform the following procedure:

1. Using the Jog Dial, or the Arrow Buttons at the Navigation Control Pad (Figure 4-180), select the outrigger Beam icon (6), (Figure 4-181). Icon will turn orange when selected.
2. Press the Jog Dial, or the OK Button at the ODM (Figure 4-180), to make the outrigger Beam icon active (Icon will turn green when active).
3. To extend the outrigger beams, position the Outrigger Extend/Retract Switch (1), (Figure 3-29) on the left armrest to the extend position, then press and hold one or more of the four buttons at the Jog Dial or the Navigation Control Pad (Figure 4-180).

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

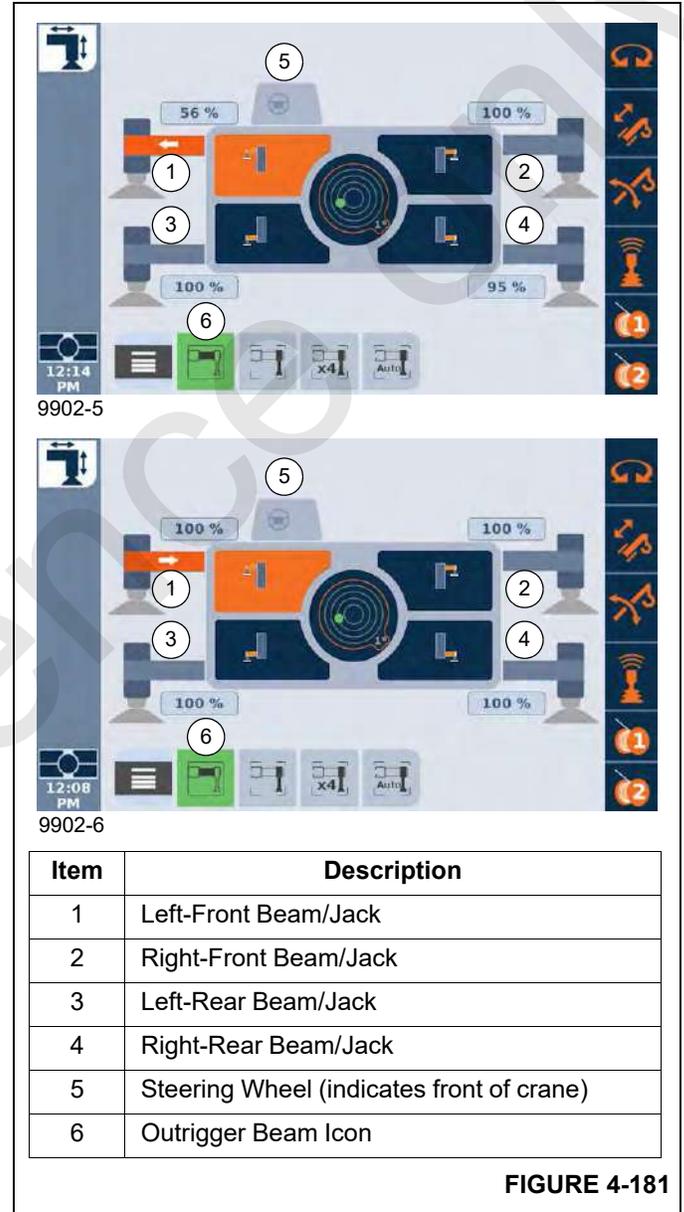
**NOTE:** The outrigger beam positions correspond to the four buttons at the Jog Dial and the ODM Navigation Control Pad (Figure 4-180) and (Figure 4-181).



**FIGURE 4-180**

When a button at the Jog Dial (Figure 4-180) or Navigation Control Pad (Figure 4-180) is pressed and held, the corresponding outrigger beam image turns orange (Figure 4-

181) to indicate that it is actively moving. An arrow will appear to indicate whether the beam is extending or retracting. In the following example (Figure 4-181), the top image shows the Left-Front outrigger beam is extending and the bottom image shows the Left-Front outrigger beam is retracting.



**FIGURE 4-181**

**Extending/Retracting the Outrigger Beams/Jacks - x4**

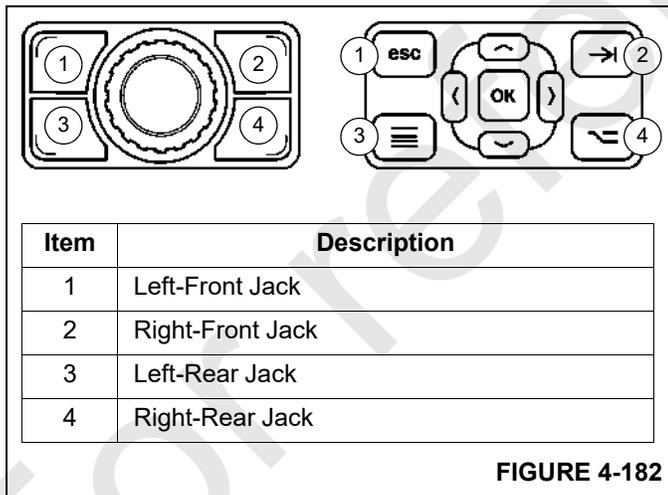
To extend or retract all four outrigger beams/jacks at the same time, perform the following procedure:

1. Using the Jog Dial, or the Arrow Buttons at the Navigation Control Pad (Figure 4-182), select the outrigger Beams/Jack x4 Icon (6), (Figure 4-183).Icon will turn orange when selected.
2. Press the Jog Dial, or the OK Button (Figure 4-182) at the ODM, to make the outrigger Beams/Jack x4 Icon active. Icon will turn green (Figure 4-183) when active.
3. To extend all four outrigger Beams/Jacks at the same time, position the Outrigger Extend/Retract Switch (1), (Figure 3-29) on the left armrest to the extend position, then press and hold the Jog Dial or OK Button at the Navigation Control Pad.

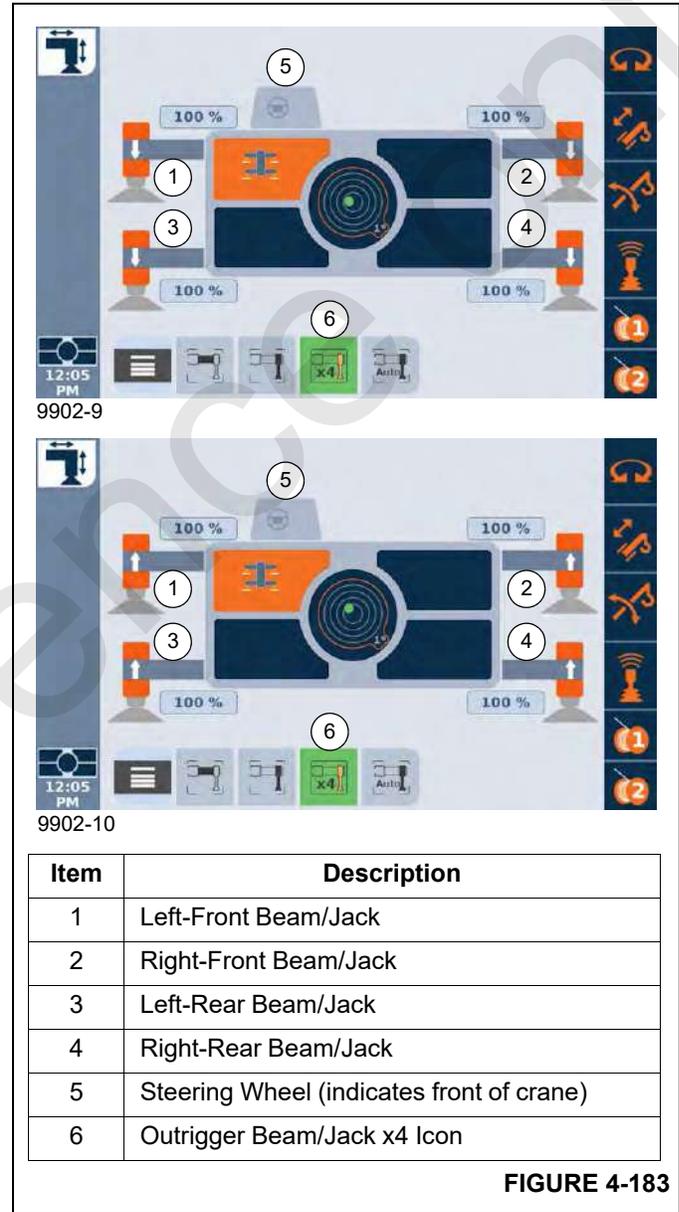
To retract all four outrigger Beams/Jacks at the same time, position the Outrigger Extend/Retract Switch to the retract position, then press and hold the Jog Dial or OK Button at the Navigation Control Pad.

**NOTE:** While the Outrigger Jack Extend/Retract x4 Icon is active, individual outrigger jacks can be extended or retracted by positioning the Outrigger Extend/Retract Switch to the desired direction, then pressing and holding one of the four buttons at the Jog Dial or Navigation Control Pad (Figure 4-182).

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



When extending or retracting all four outrigger jacks at the same time, the four outrigger jack images turn orange to indicate that they are active. Arrows appear to indicate whether the jacks are extending or retracting. In the following example (Figure 4-183), the top image shows all four outrigger jacks/beams are extending and the bottom image shows all four outrigger jacks/beams are retracting:

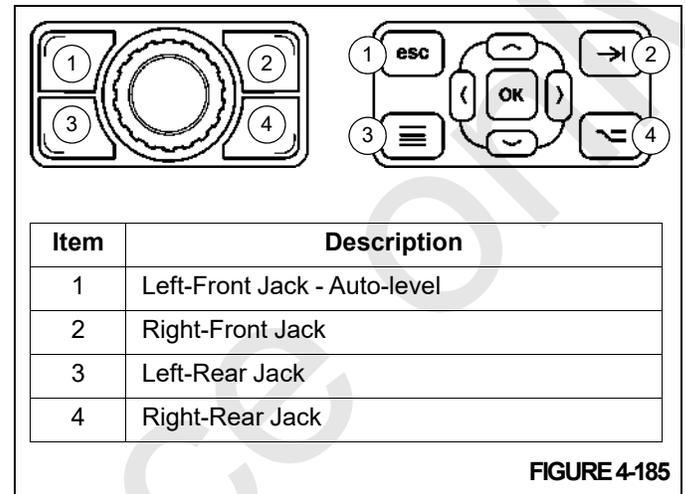
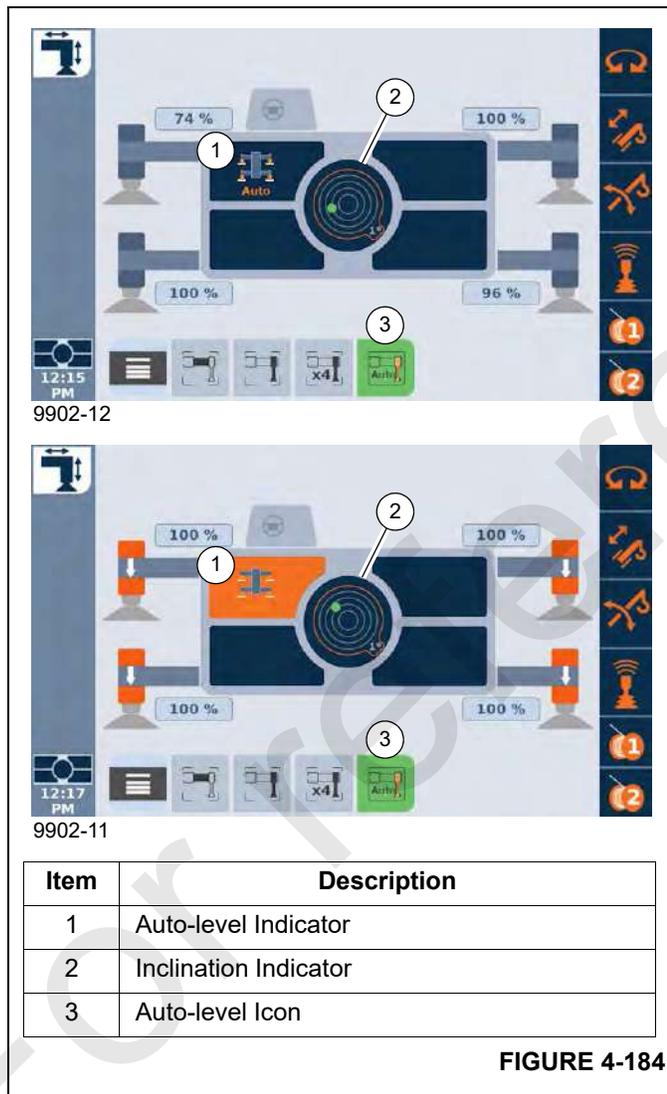


**Leveling the Crane Using Auto-level**

To level the crane using the auto-level function, perform the following procedure:

1. Fully extend the four outrigger jacks.
2. Using the Jog Dial, or the Arrow Buttons at the Navigation Control Pad (Figure 4-185), select the Auto-level Icon (3), (Figure 4-184). Icon will turn orange when selected.
3. Press the Jog Dial, or the OK Button at the ODM, to make the Auto-level Icon active. Icon will turn green when active. The Outrigger Extend/Retract function screen will also change to show the Auto-level indicator(1), (Figure 4-184).

4. To begin the Auto-level function, position the Outrigger Extend/Retract Switch (1), (Figure 3-29) on the left armrest to the extend or retract position, then press and hold the button (1), (Figure 4-185) at the Jog Dial or Navigation Control Pad that corresponds to the Auto-level Button on the screen.



With the two buttons pressed, the Auto-level system will adjust the height of the jacks automatically as it levels the crane. Several adjustments may be necessary.

After an adjustment is made, the Auto-level system will pause for a short time as it does a levelness check of the crane. The operator can watch the leveling process by viewing the inclination indicator (2), (Figure 4-184).

If the crane is still not level, the system will continue to make adjustments, with each adjustment followed by a pause for a level check.

When the crane is level within 0.15°, the Auto-level Indicator (1), (Figure 4-184) flashes. When this occurs, the Auto-level process is complete and no further adjustments are made.

5. Release the Outrigger Extend/Retract Switch and the button (1), (Figure 4-185) at the Jog Dial or Navigation Control Pad.

**Counterweight Removal/Installation Screen**

The Counterweight Removal/Installation Screen (Figure 4-186) shows the status of the swing angle, counterweight cylinders, and pre-tensioning pressure (error menu shown). Also refer to *Rigging the Counterweight*, page 5-21.

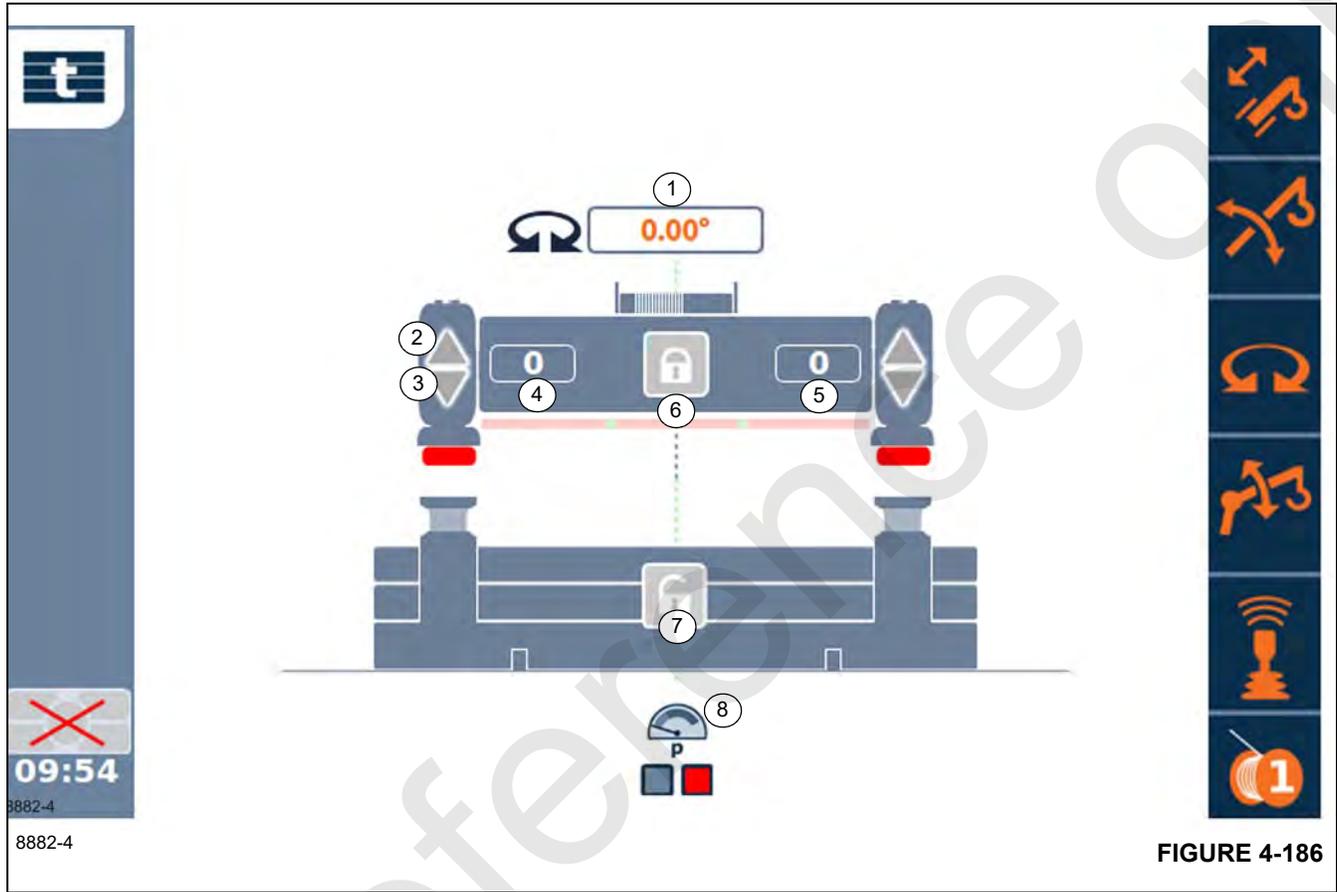


FIGURE 4-186

Item	Description
1	Current Swing Angle
2	Retracting the Lifting Cylinders
3	Extending the Lifting Cylinders
4	Left Counterweight Cylinder Length Percentage
5	Right Counterweight Cylinder Length Percentage
6	Lock the Counterweights
7	Unlock the Counterweights
8	Pre-tensioning Pressure

**CAUTION**

**Machine Damage Hazard!**

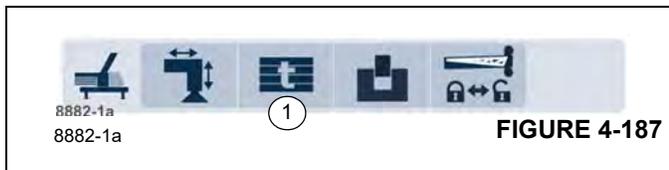
Potential damage to the superstructure if swinging with the 2268 kg or 1361 kg (5000 lb or 3000 lb) slab sitting on the rear mounted counterweight support bracket.

The rear counterweight support bracket is intended to give the option to shift weight from the front axles to the rear axles in a trailing boom configuration only.

The front deck is where the counterweight is assembled and then installed onto the superstructure.

The counterweight menu is used to add or remove counterweights to the superstructure.

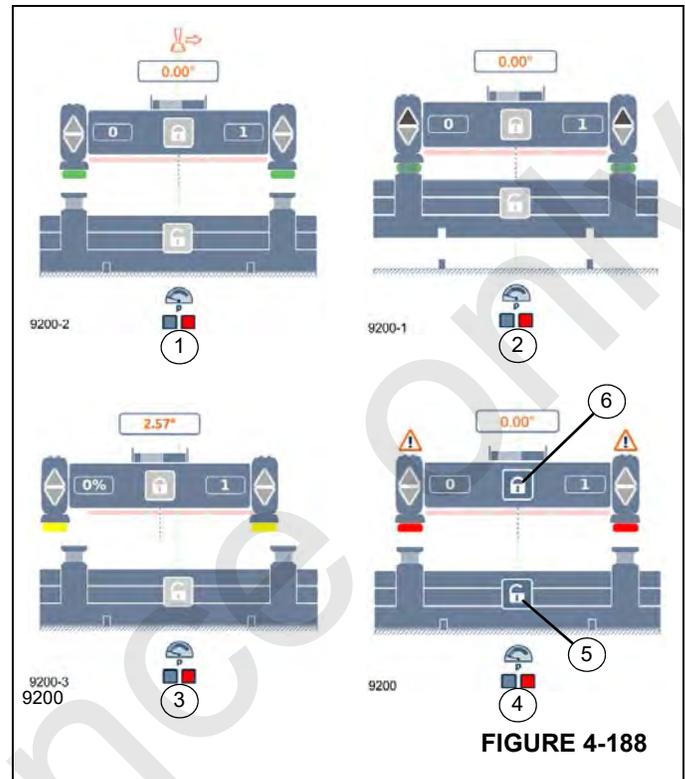
To open: Select symbol (1), (Figure 4-187) and confirm.



**Counterweight Locking Display**

The current status of the counterweight locking is shown by different symbols (Figure 4-188):

1	Green – unlocked
2	Green – raised
3	Yellow – intermediate position
4	Red – error



The cylinders are only considered unlocked (able to be raised/lowered freely) at +4.0 or -4.0 degrees. When lowered at that position the crane is then swung to 0.0 degrees where they are raised to lift the counterweight. To unload the counterweight the reverse happens: crane is swung to 0.0 degrees, cylinders extend to lower counterweight onto the deck, crane swings with cylinders extended to +4.0 or -4.0 degrees, cylinders raise without counterweight.

**Locking/Unlocking the Counterweight**

With the lifting cylinders extended:

To Unlock:	Select symbol 5 (Figure 4-188)
To Lock:	Select symbol 6 (Figure 4-188)

The movement stops after the LOCK or UNLOCK button is released on the display, or when an end position is reached.

**Extending/Retracting the Lifting Cylinders**

With the turntable locked prior to raising the counterweight.

1	Retract:	After reaching the end position the counterweight is pre-tensioned (Figure 4-189)
2	Extend	

The movement stops after the button is released, or when an end position is reached.

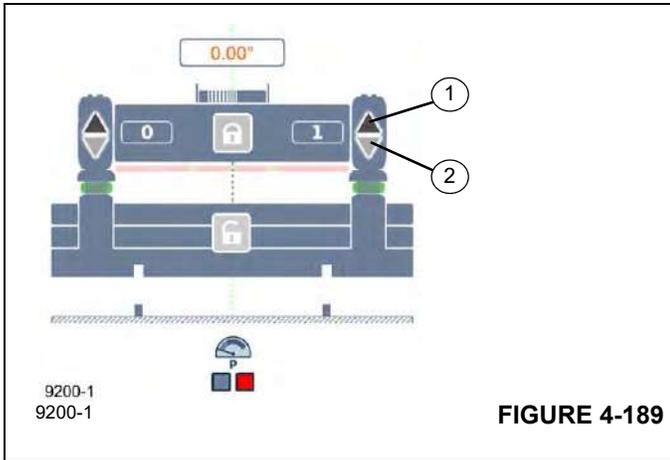


FIGURE 4-189

**Pre-Tensioning Pressure Display**

1	Green:	Pre-tensioning pressure reached (Figure 4-190)
2	Red:	Pre-tensioning pressure too low – pre-tension counterweight

For driving the counterweights should be pinned. For lifts on the job site it is not necessary to pin them. The cylinder pressure may be used to keep them up. The cylinders have a check valve and accumulator which will hold pressure on for several hours. There is no indication to the operator if the cylinders drift down, but the accumulator automatically charges to keep the pressure high - about 190 bar (2756 psi).

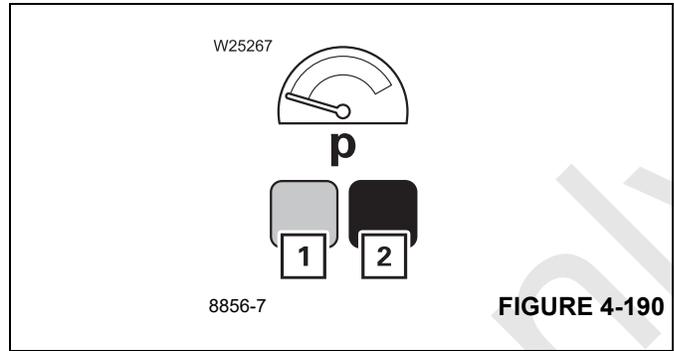


FIGURE 4-190

**Counterweight Removal/Installation**

Select the Counterweight Removal/Installation Icon (1), (Figure 4-191) under the Crane Function Group to show the Counterweight Removal/Installation function screen.

The Counterweight Removal/Installation function screen is used to semi-automatically remove and install the counterweight.

Complete procedures for the removal and installation of the counterweight, including the use of the Counterweight Removal/Installation function screen, are found in *Set-up and Installation*, page 5-1. Also, refer to *Counterweight Removal/Installation Screen*, page 4-142.

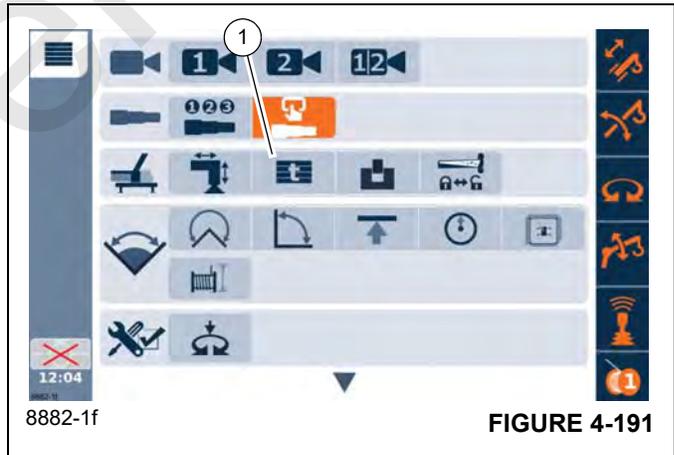


FIGURE 4-191

**360° Superstructure Swing Lock/Unlock (Optional)**

Select the 360° Swing Lock Icon (1), (Figure 4-193) under the Crane Function Group to show the 360° Superstructure Lock/Unlock function screen.

**Swing Gear Display**

**NOTE:** The Swing Gear Display color means the background color of the Icon.

Green:	Swing enabled
Blue:	Swing disabled (Figure 4-192)



FIGURE 4-192

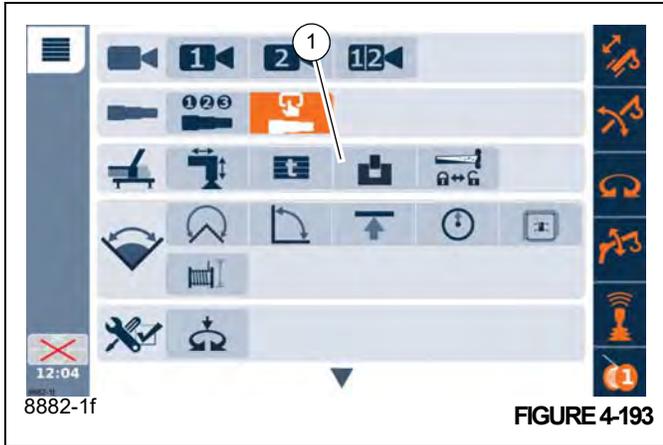


FIGURE 4-193

The 360° Superstructure Lock/Unlock function screen (Figure 4-194) is used to lock the superstructure in position any where throughout its 360° rotation.

The function screen (Figure 4-194) shows the current Swing Angle (1), the Lock and Unlock (2) and (3) Icons for operating the lock function, and the Swing Lock Status Indicator (4), (locked/unlocked).

In (Figure 4-194), the Swing Lock Status Indicator (4) shows the swing lock is in the unlocked position.

**Locking Status Displays**

The current position of the locking mechanism is shown by different symbols: (Figure 4-194).

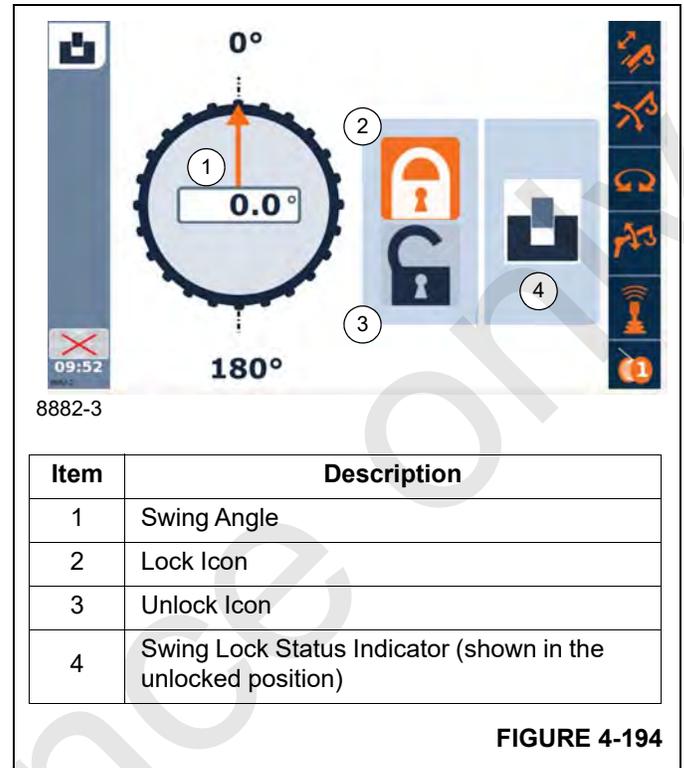


FIGURE 4-194

In (Figure 4-195), the Swing Lock Status Indicator (4) shows the swing lock is in the locked position.

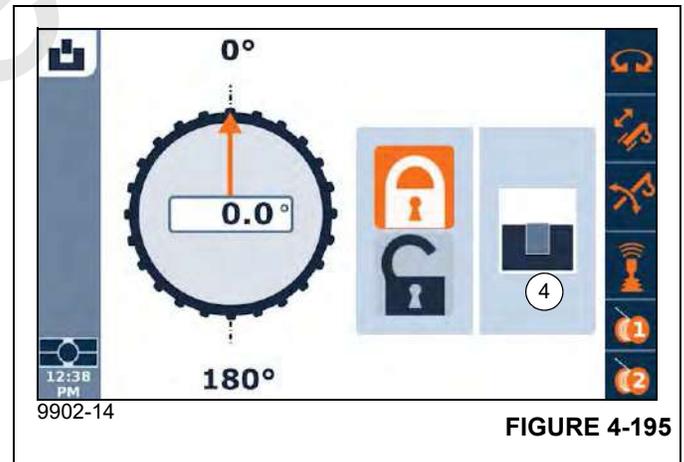


FIGURE 4-195

**Locking the Superstructure**

1. Swing the superstructure to the desired position.
2. Maintain superstructure position by pressing and holding the swing brake pedal.
3. Using the Jog Dial or the Arrow Buttons on the Navigation Control Pad, select the Lock Icon (2), (Figure 4-194).

4. Press the Jog Dial or the OK Button to start the locking process.

When the lock is engaged, the Locked Status Indicator (4), (Figure 4-194) will appear.

**Unlocking the Superstructure**

1. Press and hold the swing brake pedal.
2. Using the Jog Dial or the Arrow Buttons on the Navigation Control Pad, select the Unlock Icon (3), (Figure 4-194).
3. Press the Jog Dial or the OK Button to start the locking process.

When the lock is disengaged, the Unlock Status Indicator (4), (Figure 4-194) will appear.

**Boom Extension Deployment/Stowage Screen**

Select the Boom Extension Deployment/Stowage Icon (1), (Figure 4-196) under the Crane Function Menu Group to show the Boom Extension Deployment/Stowage function screen (also known as the Bi-Fold Boom Extension Icon).

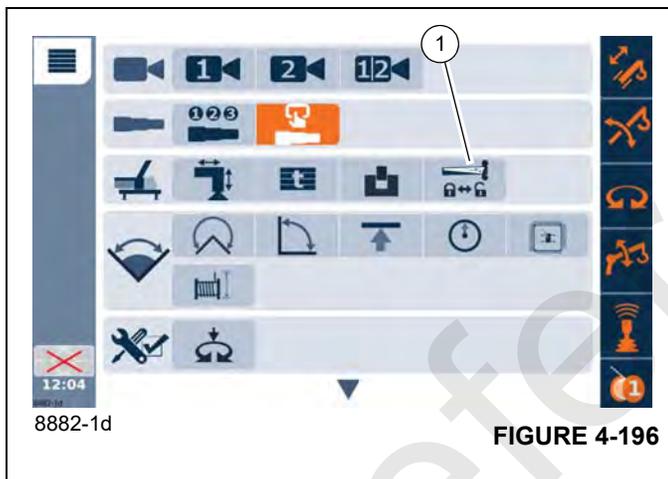


FIGURE 4-196

The Boom Extension Deployment/Stowage function screen is used to extend and retract the front and rear boom

extension pins that secure the boom extension to the boom base section.

The Boom Extension Deployment/Stowage Icon also allows the operator to lock or unlock two connections between the main boom and the boom extension as shown in (Figure 4-197).

Complete procedures for the deployment and stowage of the boom extension, including the use of the Boom Extension Deployment/Stowage function screen, are found in *Installing the Folding Boom Extension*, page 5-49; and *Stowing the 17.0 m (56 ft) Boom Extension*, page 5-61.

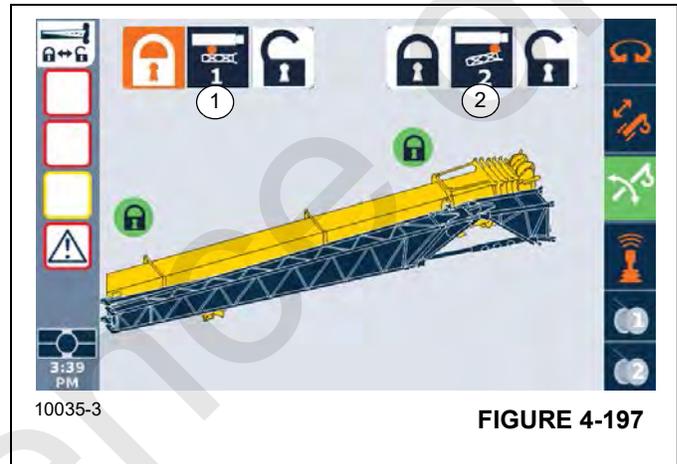


FIGURE 4-197

Item	Description	Refer to
1	Boom extension attachment point	<i>Installing the Folding Boom Extension</i> , page 5-49
2	Boom extension attachment and pivot point	

## Working Range Limiter Menu Group

### Introduction

The Working Range Limiter (WRL) is a feature of the Crane Control System, located on the ODM, that allows the operator to define boundaries or limits identifying the motion of the crane with respect to obstacles and limits for crane operation. With obstacles and limits accurately defined, the WRL will aid the operator in identifying when the boom and/or load is nearing an obstacle by giving both visual and audible alerts.

### CAUTION

The WRL is an operator aid and should not be relied upon in place of good operating practice. The crane functions can be affected to slow and stop with respect to limitations. This behavior is referred to as lock-out. A qualified signal person to observe and direct the lifting operation should be used when necessary.

Refer to (Table 4-8) – WRL Alarm Characteristics for alarm positions.

In addition, when the WRL Lock-Out Function is enabled, crane functions are expected to be used with the same caution as if the lock-out capability was not present. In particular, it must be noted that the swing function has a coasting or free-swing characteristic that will not be affected by the slow-down and lock-out of the swing function. As such, swing speeds are to be no more than 1 degree of swing per second. Again, refer to (Table 4-8) – WRL Alarm Characteristics for swing position limitations and alarms.

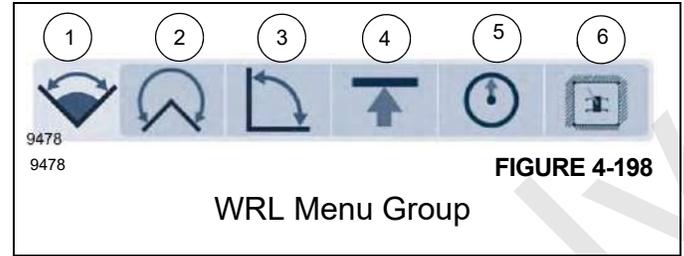
### DANGER

For standard cranes NOT equipped with the WRL Lock-Out Function, the WRL System is an audio/visual indicator only. The system will not stop the movement of the crane when the limit is reached. The operator must continue to control and stop the movement of the crane when alerted by the WRL Indicator.

If the crane’s WRL is configured with the Lock-Out Function, the crane functions can be affected to slow and stop with respect to the programmed limits.

When the Lock-Out feature of the WRL System is enabled, the operator must continue to operate the crane functions with caution.

The WRL Menu Group (1), (Figure 4-198) and sub-menu (2 thru 6), (Figure 4-198) allows the operator to set limits on the location of the boom.



Item	Description	
1	WRL Menu Group	page 4-147
2	WRL Swing Angle Limitation	page 4-155
3	WRL Boom Angle Limitation	page 4-158
4	WRL Boom Height Limitation	page 4-161
5	WRL Working Radius Limitation	page 4-163
6	WRL Virtual Walls Limitation	page 4-166

The following limitations are available under the WRL Menu Icon (1), (Figure 4-198) as noted below. The number next to the limitation indicates the Menu Limitation Icon reflective of that group as shown in (Figure 4-198).

- Swing Angle Limitation Icon (2): Swing angle limits for swing left and swing right directions can be defined.
- Boom Angle Limitation Icon (3): Boom up/down limits can be defined for a minimum and maximum boom angle.
- Boom Height Limitation Icon (4): Boom height limit can be defined for a maximum boom elevation.
- Working Radius Limitation Icon (5): Working radius limits can be defined for minimum and maximum radius working zones.
- Virtual Wall(s) Limitation Icon (6): Up to five virtual walls can be defined to be jobsite objects or warning zones.

### CAUTION

Turning OFF the power to the control system disables any WRL limitations. While powering OFF, the control system will disable all WRL limitations, the limitation values (for example, Swing Angles) will be retained across power cycles.

### Overview of WRL Limitations

For each of the limitations, the limitation must first be ENABLED within the WRL feature of the Crane Control System (CCS) software. This is done with particular screens and buttons on the Operator Display Module (ODM). Once the limitation is enabled, such as using Item 3 in (Figure 4-201), then it can be DEFINED (in terms of specific

angles or locations). This is also done with the screen and buttons on the ODM, as well as possibly operating the boom to define particular locations for the boom.

With the limitation enabled and defined, the control system can then provide the needed feedback and warnings based upon the defined limitations. When the crane is in such a position to cause warning, then the WRL Limitation is considered to be ACTIVE.

In summary, to turn on a WRL Limit, the following steps must be performed:

1. Enable the Limitation
2. Define the Limitation

When a limitation is enabled (but none are active), the ODM shows a green-colored alert indicator icon on its Main Screen (as shown below):

Icon	Description
	<b>Working Range Limiter (WRL) Indicator (Green):</b> Indicates one or more working range limiters are defined.

When a limitation is active, but the boom has not yet reached the requested limit position, the ODM shows an amber-colored alert indicator for the limitation (as shown below). In this condition, audible alarms, as well as slowing of the crane functions (if Lock-Out Function used) will also be apparent. For example, in this condition, the amber-colored Warning Indicator Icon shown below would appear for the swing limitation:

Icon	Description
	<b>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. Refer to Table 4-8 – *WRL Alarm Characteristics*, page 4-149 for the values that produce the audible alarm beeping (or buzzer).

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 4-198) 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
	<b>Swing Angle Stop Indicator (Red):</b> Indicates the swing angle is at a swing angle limit set point. The warning buzzer is on (constant).  For cranes that are equipped with the WRL Lock-Out Function, the swing left or swing right crane function is locked out, depending upon which limit is reached.

If there are multiple limitations enabled, such as a swing limitation and a height limitation, the indicators will alternate, showing one after the other in the ODM.

When a limitation is active, the warning buzzer inside the cab will sound. If there is a solid sound, this will signify being at the limitation.

The Alarm Characteristics are outlined in (Table 4-8).

Table 4-8 – WRL Alarm Characteristics

	LIMITATION	POSITION	ALARM	INDICATOR
1	Swing Angle Limitation	10 deg before limit	Slow beeping	Amber
		5 deg before limit	Fast beeping	Red
		At limit	Solid sound	
2	Boom Angle Limitation	10 deg before limit	Slow beeping	Amber
		5 deg before limit	Fast beeping	Red
		At limit	Solid sound	
3	Boom Height Limitation	10 ft before limit	Slow beeping	Amber
		5 ft before limit	Fast beeping	Red
		At limit	Solid sound	
4	Radius Limitation	10 ft before limit	Slow beeping	Amber
		5 ft before limit	Fast beeping	Red
		At limit	Solid sound	
5	Virtual Walls Limitation	10 ft before limit	Slow beeping	Amber
		5 ft before limit	Fast beeping	Red
		At limit	Solid sound	

**NOTE:** The audible alarm can be silenced by pressing the Tab Button on the Navigation Control Pad (1), (Figure 4-200). It can only 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 slow-down and lockout of the swing function. As such, swing speeds are to be no more than 1 degree of swing per second.

Turning OFF the power to the control system disables any WRL limitations.

**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 4-198).

To access the WRL Function Icon Screen, the Menu Function is used with the display. Once the Main Menu screen is shown, use the Arrow Keys on the Navigational Control Pad or the Jog Dial to move to the corresponding Function Icon you wish to set the limitation on as shown in (Figure 4-198).

**NOTE:** The Working Range Limiter feature is an operator aide to assist the operator by alerting when limits are approached or reached. The WRL should not be relied upon in place of good operating practice, they are there to assist, not direct operation. All appropriate techniques such as other personnel providing visual guidance to the crane operator are to be employed. In addition, when the lockout capability is utilized, crane functions are expected to be used with the same caution as if the lockout 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

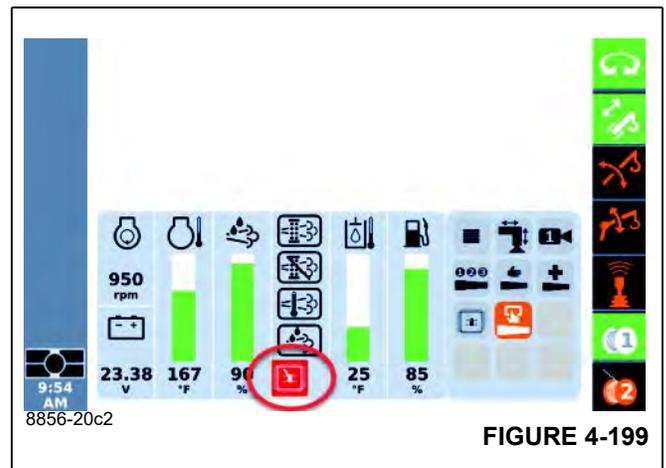


FIGURE 4-199

Figure 4-199 shows the symbol (in the red oval) for the Virtual Wall Limitation at the limit. There are similar symbols for the other limitations. Refer to Table 4-9– WRL Limitation Screen Symbols, page 4-151.

The operator should notice that all the audible alarm triggers use the values of 10 and 5. This may be 10 or 5 degrees, or it may be 10 or 5 ft distance. This is intentional so that the operator can continue to watch the crane operation and not have to look at the display (assuming the 10 and 5 values are

remembered). Whenever slow beeping is heard, this will be a 10 threshold. Whenever fast beeping is heard, this will be a 5 threshold. Whenever there is a solid sound, this will signify being at the limitation.



Item	Description
1	Tab Button
2	OK Button

When a limit is reached, the Main Screen shows an indicator for this condition (again in addition to audible alarms). (Figure 4-199) shows the Main Screen example. (Figure 4-200) shows the buttons on the ODM.

Table 4-9 – WRL Limitation Screen Symbols

Symbol	Description
	<p>Symbol represents the Working Range Limitation (WRL) Menu Group.</p>
	<p>Symbol represents the Swing Angle Limitation.</p>
	<p>Symbol represents the Boom Angle Limitation.</p>
	<p>Symbol represents the Boom Height Limitation.</p>
	<p>Symbol represents the Working Radius Limitation.</p>
	<p>Symbol represents the Virtual Walls Limitation Menu.</p>
	<p>This Symbol is an audible alert selection. If this symbol is shown, the audible alert is functioning. Hitting OK can change this symbol to the Lock-Out Option (shown as the next Symbol below).</p>
	<p>This Symbol is a Lock-Out Warning Symbol. If this symbol is shown, the optional Lock-Out is functioning. Hitting OK will change the function to the audible alert option (as shown above).</p>

Symbol	Description
	<p>Enable/Disable Switch (ON/OFF) Symbol - The Enable/Disable (ON/OFF) Switch Symbol with the orange box indicates the Icon is active and can change. The box in orange next to the “I” would indicate enabled. The orange box next to the “O” indicates disabled. This symbol is used for all of the WRL Limitation Screens.</p> <p>The gray Enable/Disable (ON/OFF) Switch Symbol or “O” without the orange highlight means the switch is not enabled (or not active). This symbol is used for all of the WRL Limitation Screens.</p>
	<p>Working Range Limiter (WRL) Swing Angle Enable Indicator (Green) - Indicates Swing Angle Limitation Enabled (Active).</p>
	<p>Working Range Limiter (WRL) Swing Angle Warning Indicator (Amber) - Indicates the swing angle is within 10° of a swing angle limit set point. (Refer to (Table 4-8) – WRL Alarm Characteristics).</p> <p>The warning buzzer slowly beeps when the swing angle is within 10° of the swing angle limit set point and changes to a fast beep when the swing angle is within 5° of the swing angle limit set point.</p> <p>For cranes that are equipped with the WRL Lock-Out Function, when the swing angle is within 10° of the swing angle lock-out set point, the swing function commanded by the controller may be reduced or suspended depending upon the weight of the load and the swing speed.</p> <p><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
	Working Range Limiter (WRL) Wall Icon - Stop.
	This is the inner or Minimum Radius Limitation Indicator.
	This is the outer or Maximum Radius Limitation Indicator.
	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).
	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.
	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.
	Symbol indicates Wall Number.
	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.
	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).

**WRL - Swing Angle Limitation**

If the Swing Angle Limitation is selected from the menu of WRL Limitations, then the Swing Angle Limitation Screen will be shown (6), (Figure 4-201).

Using the Left Arrow and Right Arrow Function keys (Figure 4-157) on the Navigation Control Pad or the Jog Dial (Figure 4-157) 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 4-201), the orange icon (Item 3) symbol is selected since it has the orange color

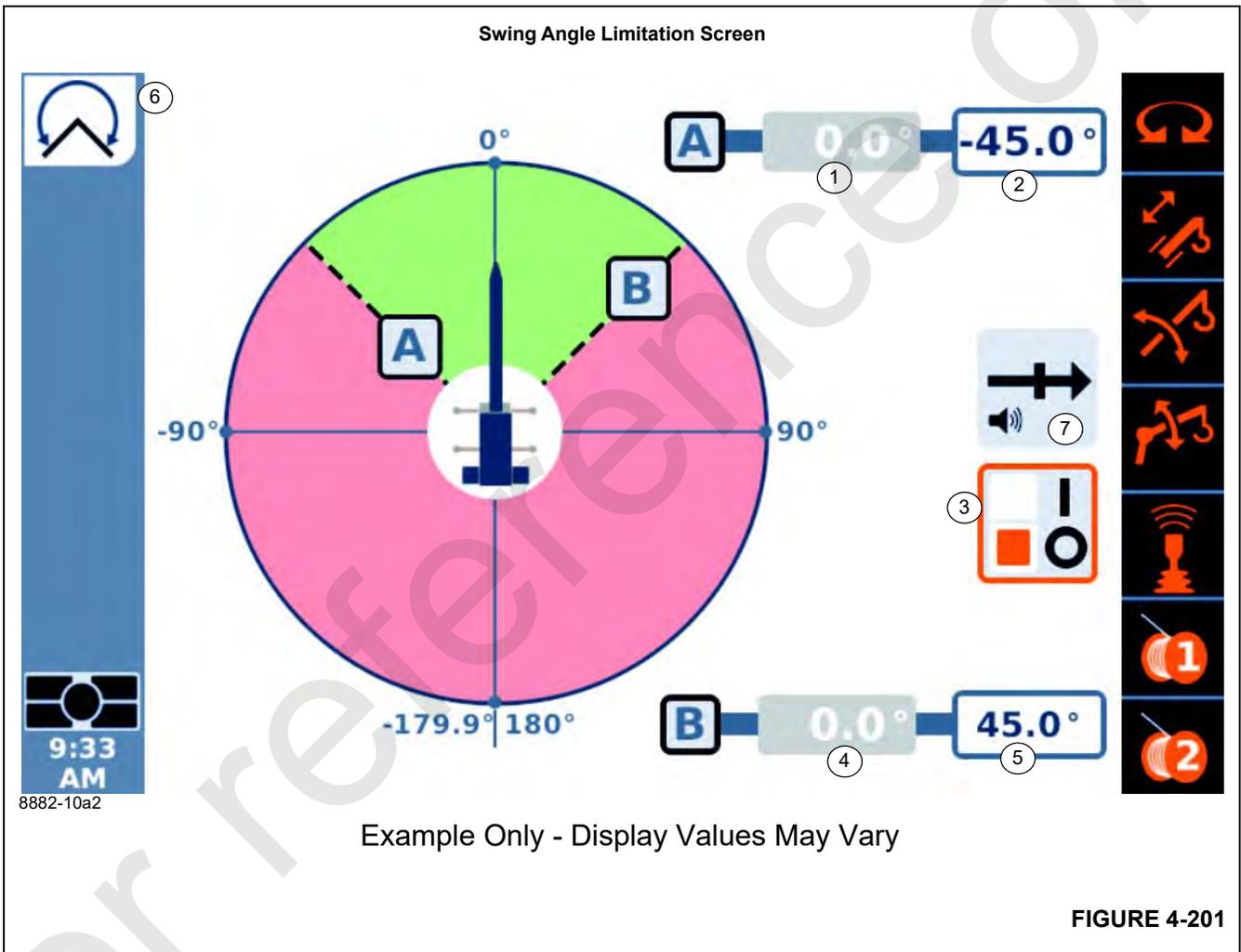
highlighting. (Table 4-9) lists all of the symbols for the Limitation Menus that are available on the WRL Limitation Screens.

**Setting the Swing Angle Limitation**

The Swing Angle Menu allows the operator to set limits for the swing angles which the crane is expected to operate within. Refer to (Figure 4-198) for the WRL Menu and sub-menu. (Table 4-9) lists the WRL Limitation Screen Symbols.

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

**NOTE:** 0 degrees is boom over the rear of the machine.



**The Swing Angle Limitation Menu**

The Swing Angle Limitation Menu allows the operator to set the limits for the boom to operate within.

**NOTE:** The Alarm-only Lock-out icon (7), (Figure 4-201) is a toggle switch to select just getting alarms or

having the boom motion affected as approaching the limits. This same icon is used for all the WRL Limitation Screens, when the Lock-out capability is configured as an option.

Item	Description	Refer to
1	Current Swing Angle A	Figure 4-201
2	Input Maximum Swing Angle A	
3	Enable/Disable Switch	
4	Current Swing Angle B	
5	Input Maximum Swing Angle	
6	Screen Icon for WRL Swing Angle Limitation	
7	Toggle for Alarm-Only or Lock-out (refer to Table 4-9 for the symbols for these options).	

### 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 4-196.
2. Using the Jog Dial (Figure 4-157), go to the ODM Main Menu Screen (Figure 4-158).
3. Select the Swing Angle Menu Screen (2), (Figure 4-198). **NOTE:** The Swing Angle Screen Icon (6), (Figure 4-201) is shown on the top left side of the ODM screen.
4. Enable the limitation by using the Jog Dial or the Arrow Keys (Figure 4-157) and move to the Enable/Disable Switch (3), (Figure 4-201). **NOTE:** The Switch (3), (Figure 4-201) is the Swing Enable/Disable Switch and is a toggle switch. Click OK or the Jog Dial (Figure 4-157) to toggle the switch.
5. Move the Boom to the desired position. This position will indicate the swing angle current value Limitation A (1), (Figure 4-201) swing (left) position.
6. Use the Jog Dial or the Arrow Keys (Figure 4-157) and move to the Limitation Value (1), (Figure 4-201). Click OK to set the current value Limitation A (1), (Figure 4-201) position.

**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 the value for Limitation A (2).

7. Repeat Steps 4 thru 6 to set the Limitation B (4), (Figure 4-201) 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 4-196.
2. Using the Jog Dial (Figure 4-157), go to the ODM Main Menu Screen (Figure 4-158).
3. Select the Swing Angle Menu Screen (2), (Figure 4-198). **NOTE:** The Swing Angle Screen Icon (6), (Figure 4-201) is shown on the top of left side of the ODM screen.
4. Enable the limitation by using the Jog Dial or the Arrow Keys (Figure 4-157) and move to the Enable/Disable Switch (3), (Figure 4-201). **NOTE:** The Switch (3), (Figure 4-201) is the Enable/Disable Switch and is a toggle switch. Click OK or the Jog Dial (Figure 4-157) to toggle the switch.
5. Use the Jog Dial (Figure 4-157) to move and select the Swing Angle Left Limitation A (2), (Figure 4-201) to set the Left Angle Limitation value. Use OK to begin changing the value shown. Enter a value by using the Jog Dial or the upper and lower arrow keys (Figure 4-157) to change the value (in tenths) to the desired swing angle value. Use the OK Button (Figure 4-157) to finish entering the values.

**NOTE:** The Limitation is dependent on the accuracy of the Swing Angle Sensor, which can be  $\pm 2$  degrees.

6. Repeat Step 5 to set the Limitation B (5), (Figure 4-201) 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:

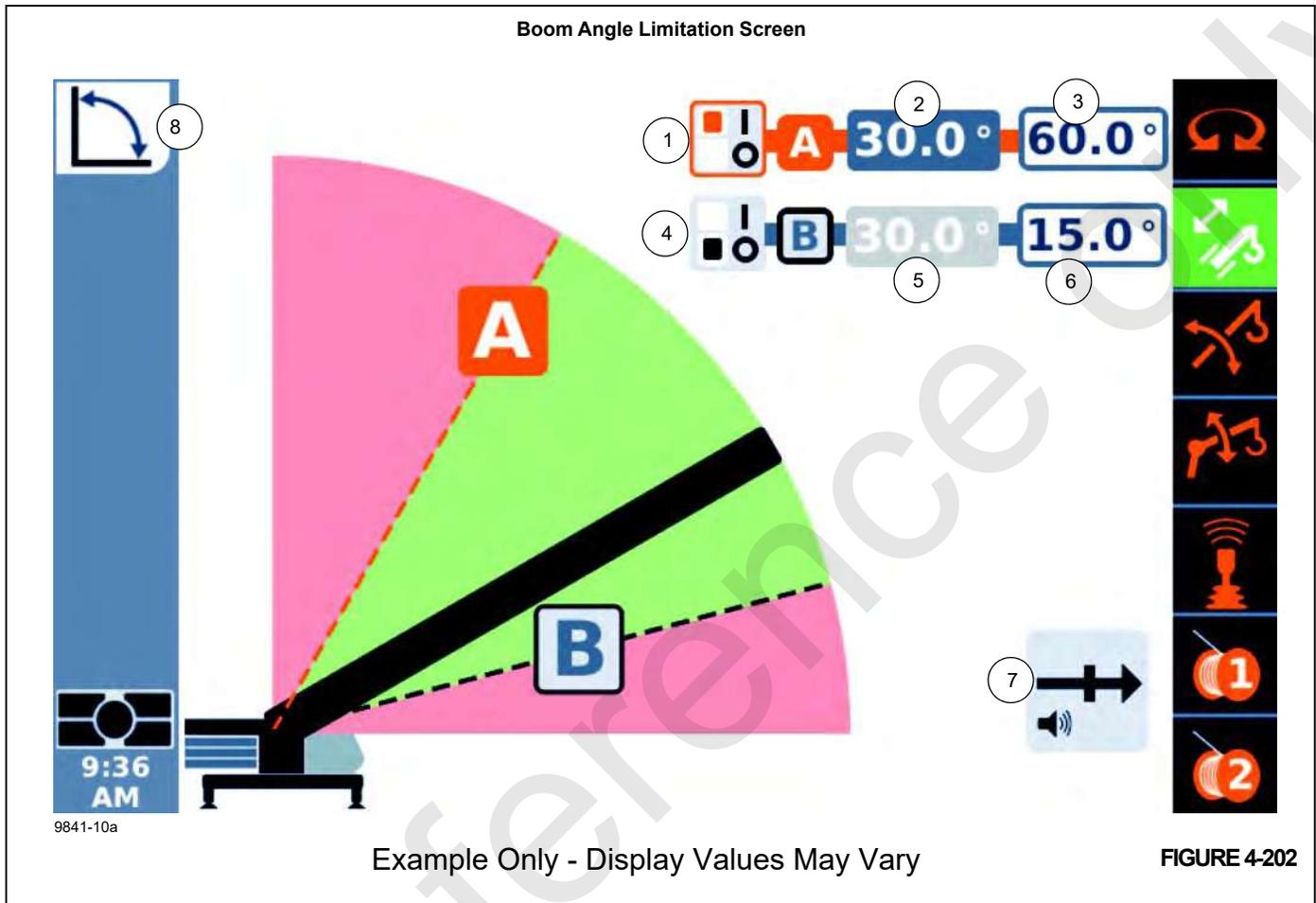
**NOTE:** Turning OFF the power to the control system also disables the WRL Limitations but it will remember the set points (2) and (5) as shown in (Figure 4-201).

**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 4-198). **NOTE:** The Swing Angle Screen (6), (Figure 4-201) Icon is shown on the top left side of the ODM screen.
2. Use the Left Arrow and/or Right Arrow Function keys (Figure 4-157) to highlight the Enable/Disable Switch (3), (Figure 4-201). Enable is "I" and Disable is "O".
3. Use the OK Button or the Jog Dial (Figure 4-157) to toggle to disable the limitation.

**WRL - Boom Angle Limitation**

If the Boom Angle Limitation Menu is selected from the Main Menu of WRL Limitations (3), (Figure 4-198), then the Boom Angle Limitation Screen will be shown (8), (Figure 4-202).



Using the Left Arrow and Right Arrow Function keys on the Navigation Control Pad or the Jog Dial (Figure 4-157) 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 4-202), you will see that the highlighted Icon in

orange for the Enable/Disable Switch Symbol for the maximum boom angle is selected since it has the orange color highlighting. (Table 4-9) lists the WRL Limitation Screen Symbols.

**NOTE:** The Boom Angle can be “typed in” or set by a boom position.

**Setting the Boom Angle Limitation Menu**

The Boom Angle Limitation Menu allows the operator to set the upper and/or lower limits for the boom to operate within.

Item	Description	Refer to
1	Upper A (Maximum Boom Angle) Limit Enable/Disable	Figure 4-202
2	Current Boom Angle	
3	Maximum Boom Angle Limit	
4	Lower B (Minimum Boom Angle) Limit Enable/Disable	
5	Current Boom Angle	
6	Minimum Boom Angle Limit	
7	Audible Alert or Lock-out Symbol (Refer to Table 4-9)	
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 4-196.
2. Using the Jog Dial (Figure 4-157) go to the ODM Main Menu Screen (Figure 4-165).
3. Select the Boom Angle Limitation Menu Screen (3), (Figure 4-198). **NOTE:** The Boom Up Limitation Screen (8), (Figure 4-202) Icon is shown on the top left side of the ODM screen.
4. Move the Boom to the desired position. This position will indicate the boom angle current value A (2), (Figure 4-202) position.
5. Enable the Limitation by using the Jog Dial or the Arrow Keys (Figure 4-157) to move and select the Enable/Disable Switch Symbol (1), (Figure 4-202). **NOTE:** The Switch (1), (Figure 4-202) is a toggle switch. Click OK or the Jog Dial (Figure 4-157) to enable the switch.
6. Use the Jog Dial or the Arrow Keys (Figure 4-157) and move to the Limitation Value (2), (Figure 4-202). Click OK to set the current value Limitation A (2), (Figure 4-202) 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 4-196.
2. Using the Jog Dial (Figure 4-157), go to the ODM Main Menu Screen (Figure 4-165).
3. Select the Boom Angle Limitation Menu (3), (Figure 4-198). **NOTE:** The Boom Angle Limitation Icon (8), (Figure 4-202) is shown on the top left side of the ODM screen.
4. Move the Boom to the desired position. This position will indicate the boom angle current value B (5), (Figure 4-202) position.
5. Enable the Lower Boom Limitation Angle by using the Jog Dial or the Arrow Keys (Figure 4-157) to move and select the Enable/Disable Switch Symbol (4), (Figure 4-202). **NOTE:** The Switch (4), (Figure 4-157) is a toggle switch. Click OK or the Jog Dial (Figure 4-157) to enable the switch.
6. Use the Jog Dial or the Arrow Keys (Figure 4-157) and move to the Limitation Value (5), (Figure 4-202). Click OK to set the current value Lower Boom Angle Limitation B (5), (Figure 4-202) position.

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

7. The lower boom angle is now at the limitation, so alarms will sound. The boom can now be moved away from the current boom angle to cease the alarm.

**Setting the Boom Up Limitation by Value**

To set parameters and enable the Boom Up Elevation Limits Menu using a "typed in" value as the limitation, the following steps can be used:

1. Set the RDM screen parameters first. Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-196.
2. Using the Jog Dial (Figure 4-157), go to the ODM Main Menu Screen.
3. Select the Boom Angle Limitation Menu Screen (3), (Figure 4-198). **NOTE:** The Boom Angle Limitation Icon (8), (Figure 4-202) is shown on the top left side of the ODM screen.
4. Enable the limitation by using the Jog Dial or the Arrow Keys (Figure 4-157) and move to the Enable/Disable Switch (1), (Figure 4-202). **NOTE:** The Switch (1), (Figure 4-202) is the Enable/Disable Switch and is a



toggle switch. Click OK or the Jog Dial (Figure 4-157) to set the switch.

- Use the Jog Dial or the Right Arrow Key to move and select the Maximum Boom Angle (3), (Figure 4-202), Limitation A. Enable the value entry by clicking on OK. Enter a value by using the Jog Dial (Figure 4-157) or the upper and lower arrow keys to change the value (in tenths) to the desired boom angle value (3), (Figure 4-202).

**NOTE:** The Limitation is dependent on the accuracy of the Boom Angle Sensor, which can be  $\pm 1$  degree.

- Use the OK Button (5), (Figure 4-202) to finish entering the value.

**NOTE:** The boom may now be near the limitation (depending on the value entered), so alarms may be active. The boom can now be moved away from the current boom elevation to cease the alarm, if needed.

- The Boom Up Limit is now defined and enabled.

### Setting the Boom Down Limitations 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 4-196.
- Using the Jog Dial (Figure 4-157), go to the ODM Main Menu Screen.
- Select the Boom Angle Limitation Menu Screen (3), (Figure 4-198). **NOTE:** The Boom Angle Limitation Icon (8), (Figure 4-202) is shown on the top left side of the ODM screen.
- Enable the limitation by using the Jog Dial (5), (Figure 4-157) or the Arrow Keys and move to the Enable/Disable Switch (4), (Figure 4-202). **NOTE:** The Switch (4), (Figure 4-202) is the Enable/Disable Switch and is a toggle switch. Click OK, or the Jog Dial (Figure 4-157) to set the switch.
- Use the Jog Dial (Figure 4-157), or the Right Arrow Key to move and select the Minimum Boom Angle Symbol (6), (Figure 4-202), Limitation B. Enable the value entry by clicking on OK (Figure 4-202). Enter a value by using

the Jog Dial or the upper and lower arrow keys to change the value (in tenths) to the desired boom angle value (6), (Figure 4-202).

**NOTE:** The Limitation is dependent on the accuracy of the Boom Angle Sensor, which can be  $\pm 1$  degree.

- Use the OK Button (Figure 4-202) 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):

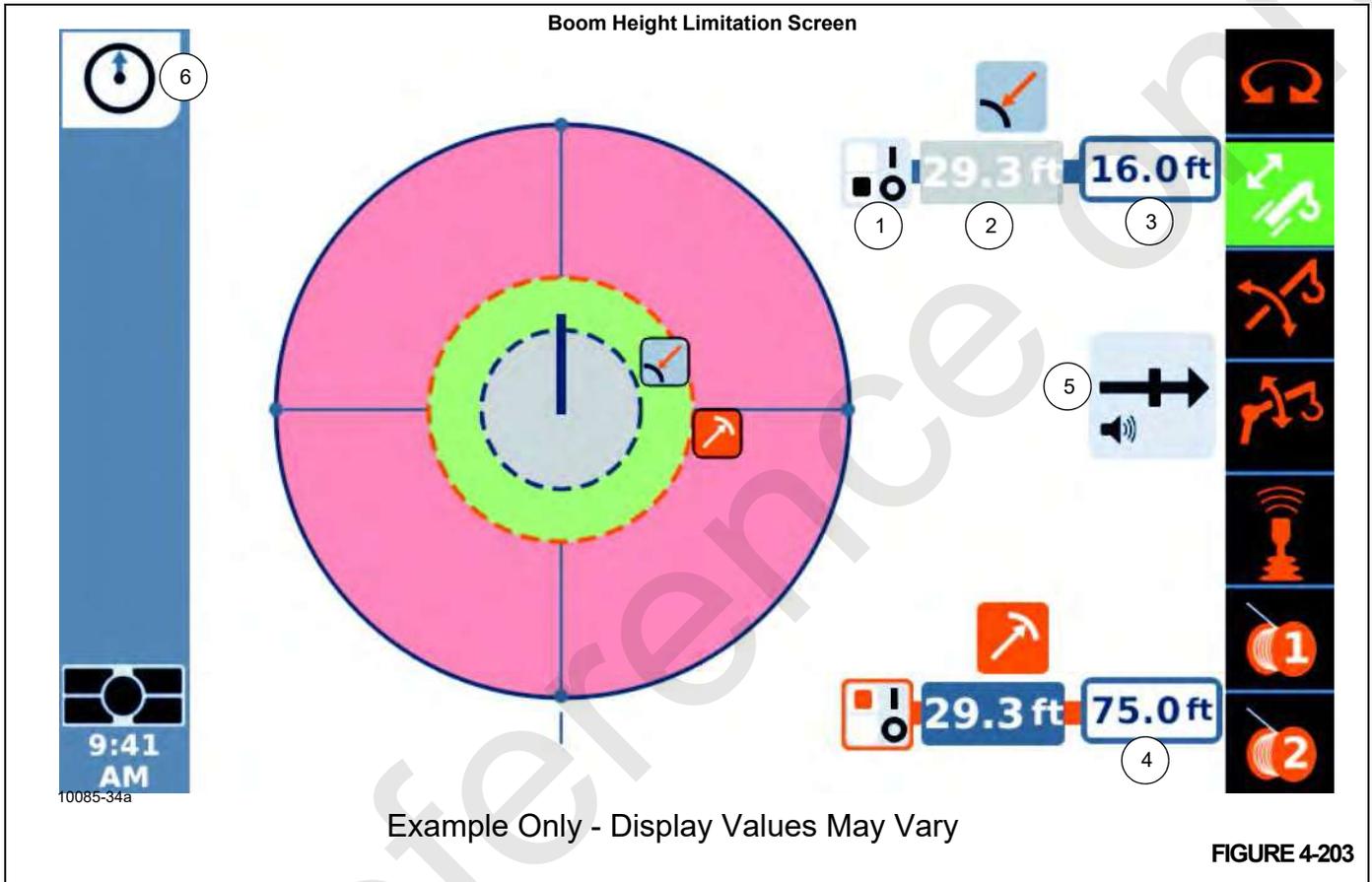
- Select the Boom Elevation Limits Menu Screen (Figure 4-198) on the ODM Main Menu Screen.
- Use the Left Arrow and/or Right Arrow Function keys (Figure 4-157) to highlight the Enable/Disable Switch (3), (Figure 4-200).
- Use an OK button to disable the limitation.

**WRL - Boom Height Limitation**

If the Boom Height Limitation is selected from the menu of WRL Limitations, then the Boom Height Limitation Screen will be shown (4), (Figure 4-198).

Using the Left Arrow and Right Arrow Function keys (Figure 4-157) on the display or the Jog Dial 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 4-203), Item 5 is highlighted in orange.



**Setting the Boom Height Limitation**

The Boom Height Limitation Menu allows the operator to set a limit for the maximum boom height. Item (6), (Figure 4-203) shows the Boom Height Limitation Icon. (Table 4-9) lists the WRL Limitation Screen Symbols.

**NOTE:** The Boom Height can be “typed in” or set by boom position.

Item	Description	Refer to
1	Enable / Disable Switch	Figure 4-203
2	Current Boom Height	
3	Maximum Boom Height Limit	
4	Current Boom Height	
5	Audible Alert or Lock-out Icon (Refer to Table 4-9)	
6	Icon for WRL Boom Height Limitation	

**NOTE:** The Limitation is dependent on the accuracy of the Tip Height Calculation, which can be ±5%.

### Setting the Boom Height Limitation Using Crane Position

To set parameters and enable the Boom Height Limitation, the following steps can be used:

1. Set the RDM screen parameters first. Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-196.
2. Using the Jog Dial (Figure 4-157), go to the ODM Main Menu Screen (Figure 4-158).
3. Select the Boom Height Limitation Menu (4), (Figure 4-198). **NOTE:** The Boom Height Limitation Icon (6), (Figure 4-203) is shown on the top left side of the ODM screen.
4. Move the Boom tip to the desired position. This position will indicate the boom height current value (2 and 4), (Figure 4-203) positions.
5. Enable the Limitation by using the Jog Dial, or the Arrow Keys (Figure 4-157) to move and select the Enable/Disable Switch Symbol (1), (Figure 4-203). **NOTE:** The Switch (1), (Figure 4-203) is a toggle switch. Click OK, or the Jog Dial (Figure 4-157) to toggle the switch.

**NOTE:** The current value in Limitation (2) will automatically populate in the value for Limitation (3).

**NOTE:** The boom is near the limitation, so alarms will sound. The boom can now be moved away from the limit.

6. The Boom Height Limitation is now defined and enabled.

### Setting the Boom Height Limitation by Value

To set parameters and enable the Boom Height Limits Menu using a “typed in” value as the limitation, the following steps can be used:

1. Set the RDM screen parameters first. Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-196.
2. Using the Jog Dial (Figure 4-157), go to the ODM Main Menu Screen (Figure 4-158).
3. Select the Boom Height Limitation Menu Screen (4), (Figure 4-198). **NOTE:** The Boom Height Limitation Icon (6), (Figure 4-203) is shown on the top left side of the ODM screen.

4. Enable the limitation by using the Jog Dial or the Arrow Keys and move to the Enable/Disable Switch (1), (Figure 4-203). **NOTE:** The Switch (1), (Figure 4-203) is the Enable/Disable Switch and is a toggle switch. Click OK, or the Jog Dial to toggle the switch. Click OK.

**NOTE:** The alarm will sound if boom tip is above the limit, when enabled.

5. Use the Right Arrow Function key to highlight the Limitation Value (3), (Figure 4-203). Use the OK Button to begin entering the value. Use the Up Arrow or the Down Arrow or Jog Dial to change the value (in tenths) to the desired tip height value.

6. Use the OK Button (Figure 4-203) to finish entering the value.

**NOTE:** The boom may now be near the limitation (depending on the value entered), so alarms may be active. The boom can now be moved away from the current tip height to cease the alarm, if needed.

7. The Overall Boom Height is now defined and enabled.

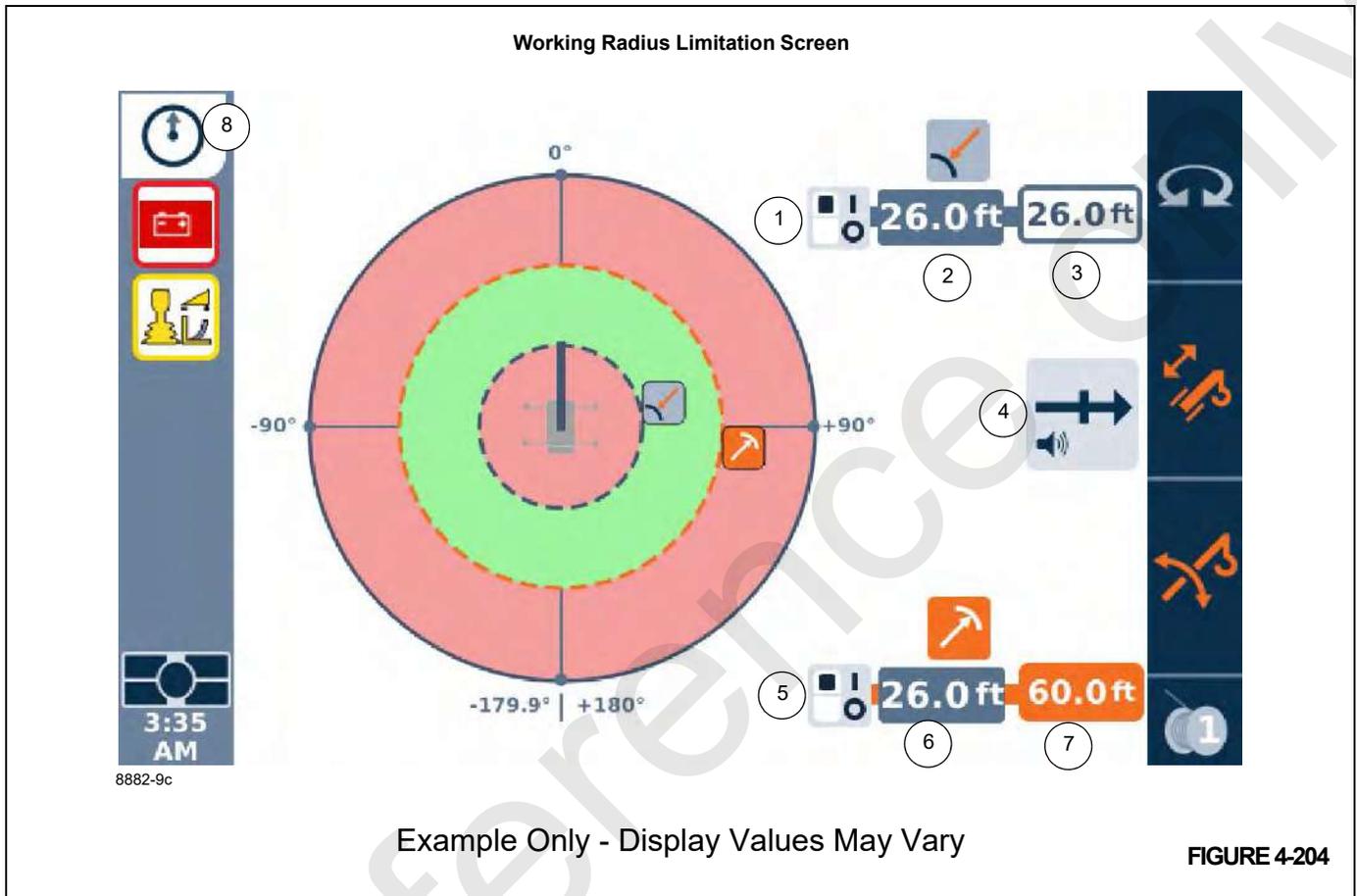
### Boom Height Limitation Disable Procedure

To disable an active Overall Height, the following steps can be used (note that turning off the power to the control system also disables the WRL limitations):

1. Select the Boom Height Menu (4), (Figure 4-203) screen on the Main Menu Screen.
2. Use the Left Arrow and/or Right Arrow Function keys to highlight the Enable/Disable Symbol (3), (Figure 4-203). Enable is “I” and Disable is “O”.
3. Use the OK Button, or the Jog Dial 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 (8), (Figure 4-204).



Using the Left Arrow and Right Arrow function on the display or the jog dial (Figure 4-203) 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 4-9) lists the WRL Limitation Screen Symbols.

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

**WRL - Working Radius Limit Menu**

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

Item	Description	Refer to
1	Minimum Radius Enable/Disable Switch	Figure 4-204
2	Current Working Radius	
3	Minimum Working Radius Limit	
4	Audible Alert or Lock-out Icon (Refer to Table 4-9)	
5	Maximum Radius Enable/Disable Switch	
6	Current Working Radius	
7	Maximum Working Radius Limit	
8	Icon for WRL Working Radius Limitation	

**Setting the Inner/Outer Working Radius Limitation by Crane Position**

To define and enable the Inner Radius Limitation using the crane current hook radius as the limitation, the following steps can be used:

1. Set the RDM screen parameters first. Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-196.
2. Using the Jog Dial, go to the ODM Main Menu Screen (Figure 4-198). Then choose the Working Range Limiter (WRL) Group Menu Icon (5). (Figure 4-198) by using the Arrow keys or the Jog Dial.
3. Select the Working Radius Limitation Menu Screen (5), (Figure 4-198). **NOTE:** The Working Radius Limitation Icon (8), (Figure 4-204) is shown on the top left side of the ODM screen.
4. Move the Boom to the desired position. This position will indicate the inner or minimum radius limitation current value (2), (Figure 4-204) position.
5. Enable the limitation by using the Jog Dial or the Arrow Keys and move to the Enable/Disable Switch (1), (Figure 4-204). **NOTE:** The Switch (1), (Figure 4-204) is the Enable/Disable Switch and is a toggle switch. Toggle to "I" and click OK, or the Jog Dial to enable the switch. (**Note:** alarm will sound as the boom is at the limit).
6. Use the Jog Dial or the Arrow Keys and move to the Limitation Value (2), (Figure 4-204). Click OK to set the current value Limitation (2), (Figure 4-204) 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 4-204) value.

**NOTE:** The boom is near the limitation so an alarm will sound. The boom can now be moved away from the current angle to cease the alarm.

8. The Working Radius Limitation is now defined and enabled.

**Setting the Inner/Outer Working Radius Limitation by Value**

To set parameters and enable the Inner/Outer Working Radius Limitations using a "typed in" value as the limitation, the following steps can be used:

1. Set the RDM screen parameters first. Refer to *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-196.
2. Using the Jog Dial (Figure 4-202), go to the ODM Main Menu Screen. Then choose the Working Range Limiter (WRL) Group Menu Icon (5), (Figure 4-198).
3. Select the Working Radius Limitation Menu Screen (5), (Figure 4-198). **NOTE:** The Working Radius Limitation Icon (8), (Figure 4-204) is shown on the top left side of the ODM screen.
4. Enable the limitation by using the Jog Dial or the Arrow Keys and move to the Enable/Disable Switch (1), (Figure 4-204). **NOTE:** The Switch (1), (Figure 4-204) is the Enable/Disable Switch and is a toggle switch. Toggle to "I" and click OK, or the Jog Dial to set the switch. Click OK. (**Note:** alarm will sound if boom tip is above limit, when enabled).
5. Use the Jog Dial (Figure 4-143), to move and select the Limitation (3), (Figure 4-204) to set the Inner or Minimum Radius Limitation value. Enter a value by using the Jog Dial or the upper and lower arrow keys to change the value (in tenths) to the desired radius value. Use the OK Button (Figure 4-204) 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 4-204) 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 (5), (Figure 4-198) on the Main Menu Screen (4), (Figure 4-153).
2. Use the Left Arrow and/or Right Arrow Function keys to highlight the Enable/Disable Symbol. Enable is "I" and Disable is "O".

Use the OK Button, or the Jog Dial to toggle to disable the limitation.

**WRL - Virtual Walls Limitation**

The Virtual Walls Menu (Figure 4-198) allows the operator to define up to five locations where the crane is not allowed to operate.

If the Virtual Wall Limitation is selected from the menu of WRL Limitations, then the Virtual Wall Limitation Screen will be shown(7), (Figure 4-205).

Using the Left Arrow and Right Arrow Function Keys on the Display or the Jog Dial 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 4-205), one can see that the wall Point "A" Symbol is selected since it has the orange color highlighting.

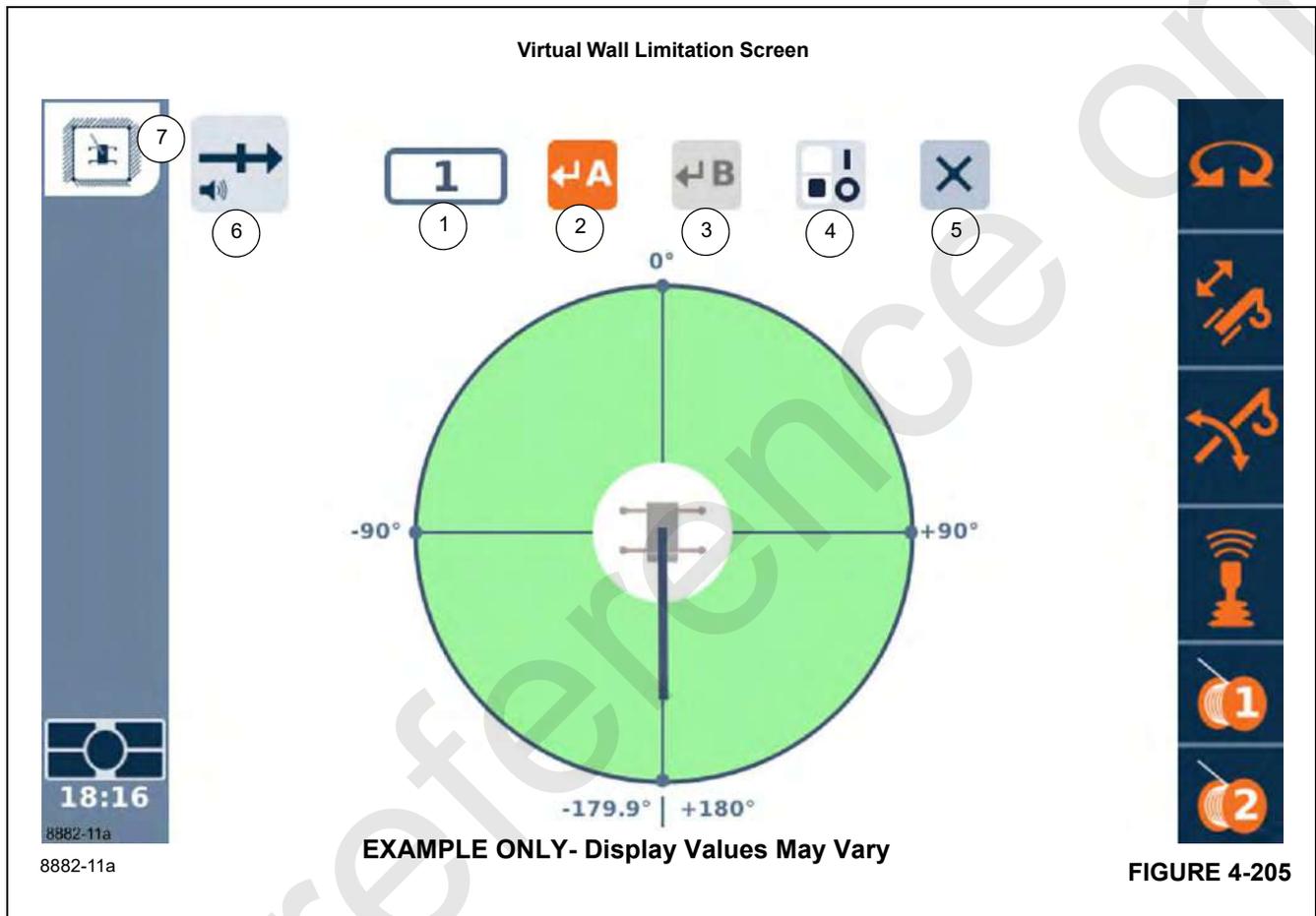


FIGURE 4-205

EXAMPLE ONLY- Display Values May Vary

(Table 4-9) lists the WRL Limitation Screen Symbols.

Item	Description	Refer to
1	Virtual Wall Number (up to 5)	Figure 4-205
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 (Refer to Table 4-9)	
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 4-198) 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 4-205). (Note: The number "1" indicates the number of virtual walls and there 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).

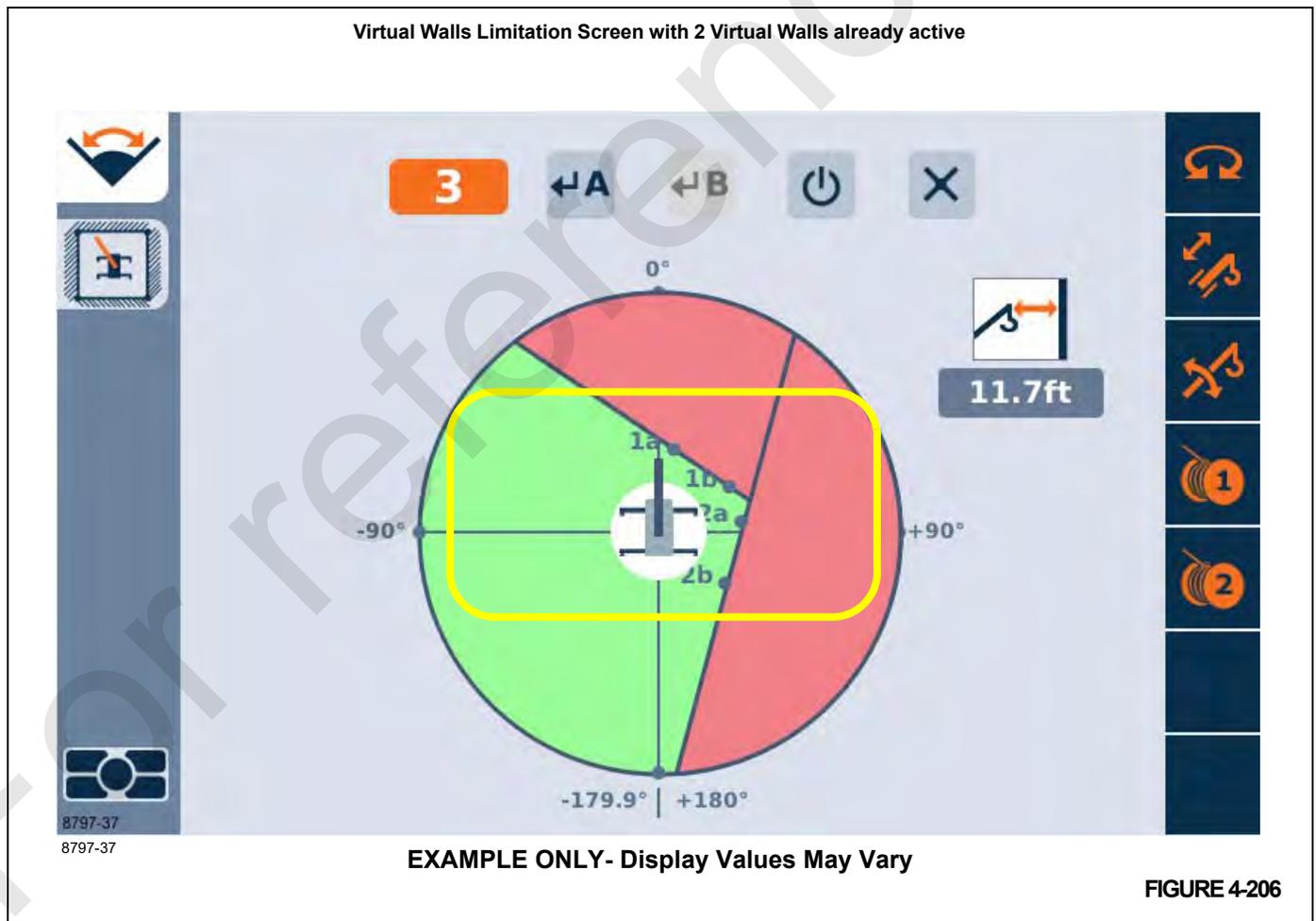
3. Use the Right Arrow (Figure 4-206) Function key to highlight the Accept Crane Position Point A Symbol (2), (Figure 4-205).
4. Use an OK Button (Figure 4-205) to accept the current crane position to be Point A (2), (Figure 4-205). The location of the point should now be shown on the screen with a label of '1a' as indicated in the yellow box in the sample in (Figure 4-206).
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 4-205). **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 3.3m (10 ft) apart.
6. Use the Right Arrow Function key to highlight the Accept Crane Position Point B Symbol (3), (Figure 4-205).
7. Use an OK Button 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 4-206).

**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 4-206), increments if the second wall was just defined, so that it is ready to define a subsequent Virtual Wall, if so desired.



### Defining Subsequent Virtual Walls

To define and enable further Virtual Walls (such as Virtual Walls 2 through 5), the following steps can be used:

1. Be sure you are on the Virtual Walls Limitation Screen Icon (7), (Figure 4-205).
2. Use the Right Arrow function key to highlight the Virtual Wall Number Item (1), (Figure 4-205).
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 to allow modifying the value. Use the Up/Down Arrow Keys to alter the Virtual Wall number to the desired value. Use an OK Button 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 4-205).
5. Use the Right Arrow Function key to highlight the Accept Crane Position Point A Symbol (2), (Figure 4-205).
6. Use an OK Button to accept the current crane position to be Point A as shown in (Figure 4-205). 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 4-206).
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 4-205).

**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 Function key, if needed, to highlight the Accept Crane Position Point B Item (3), (Figure 4-205).
9. Use an OK Button to accept the current crane position to be Point B (3), (Figure 4-205). The location of the point should now be shown on the screen with a label (1b) as shown in yellow highlight in (Figure 4-206).

**NOTE:** The screen should also show another “forbidden zone” for the area beyond the Virtual Wall. Use a visual inspection of the screen and the area around the crane to verify that the Virtual Walls are providing the desired zone correctly. Again, note that the boom is now at the wall limitation, so alarms will sound. The boom can now be moved away from the wall to cease the alarm.

10. Multiple Virtual Walls are now defined and enabled.

### Virtual Walls Limitation Disable Procedure

To disable the active Virtual Walls Limitation, the following steps can be used:

1. Using the Jog Dial go to the Working Range Limiter (WRL) Group Menu (1), (Figure 4-198). Then choose the Virtual Walls Limitation Menu (6), (Figure 4-198).
2. Use the Right Arrow key to highlight the Virtual Wall Number (1), (Figure 4-205).
3. If the wall number shown is not the correct number for wall to be disabled, use an OK Button (Figure 4-205) 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 4-205).
4. Use the Up/Down Arrows to alter the Virtual Walls number to the desired value. Use an OK Button to finish entering the value.
5. Use the Left Arrow and/or Right Arrow keys or the Jog Dial to highlight the Enable/Disable Switch Symbol (4), (Figure 4-205).
6. Use an OK Button 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. Using the Jog Dial go to the Working Range Limiter (WRL) Group Menu (1), (Figure 4-198). Then choose the Virtual Walls Limitation Menu (6), (Figure 4-198).
2. Use the Right Arrow Function to highlight the Virtual Wall Number (1), (Figure 4-205).
3. If the wall number shown is not the correct number for wall to be disabled, use an OK Button 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 4-205).
4. Use the Left Arrow and/or Right Arrow key to highlight the “X” or the Remove Virtual Walls Symbol (5), (Figure 4-205). Use an OK Button (Figure 4-205) or the Jog Dial to delete the wall.

### Emergency Program Menu Group

The Emergency Program Menu Group (1), (Figure 4-207) includes the following boom telescoping function icons:

- Manual Telescope Mode (2)
- Emergency Telescope Mode (3)
- Telescope Recovery Mode (4)

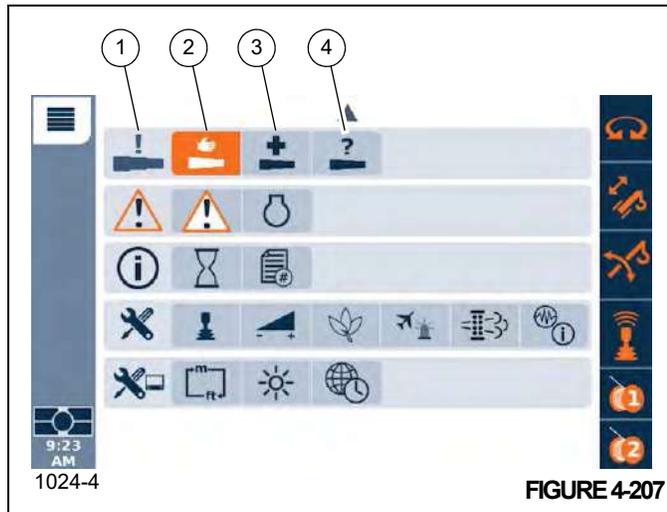


FIGURE 4-207

#### Manual Telescope Mode

The Manual Telescoping Mode allows the operator to manually telescope the boom by manually pinning and unpinning the section and cylinder pins and then extending or retracting the hydraulic cylinder.

**NOTE:** Refer to *Boom Configurator*, page 4-75 for more information on how the Boom Configurator screen is used in the telescoping operation.

To open: Select symbol (1), (Figure 4-208) and confirm – menu is opened (Figure 4-208).



FIGURE 4-208

### Telescoping Cylinder Locked/Released

<b>Display</b>	Yellow	Locking pins intermediate position (Figure 4-209)
	Green	Telescoping cylinder locked
	Red	Telescoping cylinder unlocked

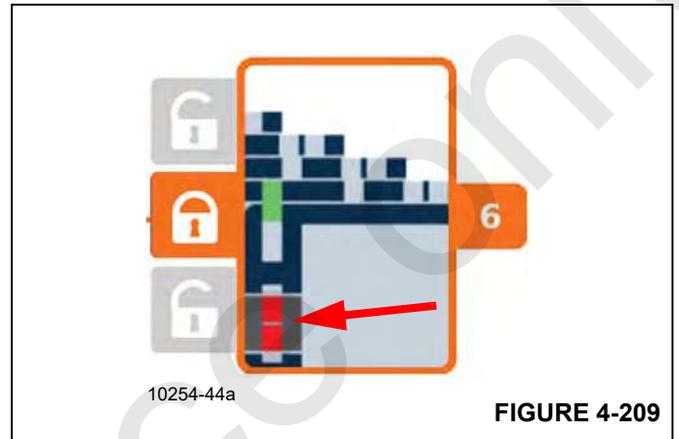


FIGURE 4-209

### Locking/Releasing the Telescoping Cylinder

To lock:	Telescopic section locked: Select symbol (1), (Figure 4-210) and confirm – telescoping section is locked
To unlock:	Telescopic section locked: Select symbol (2), (Figure 4-210) and confirm – telescoping section is unlocked

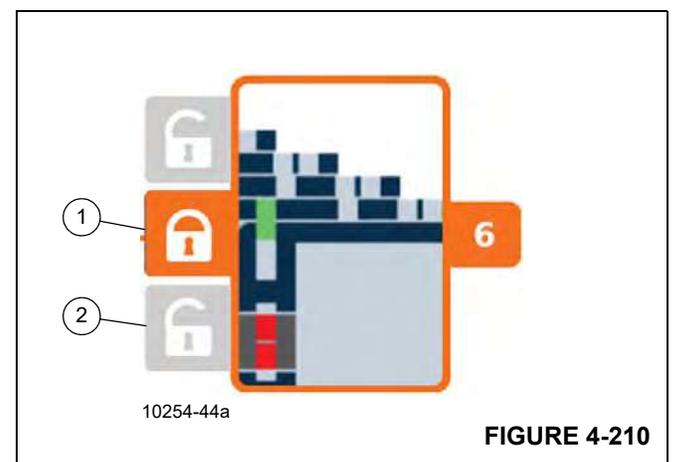
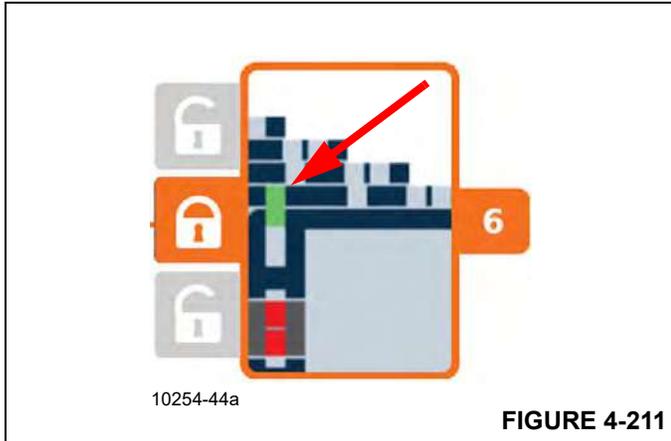


FIGURE 4-210

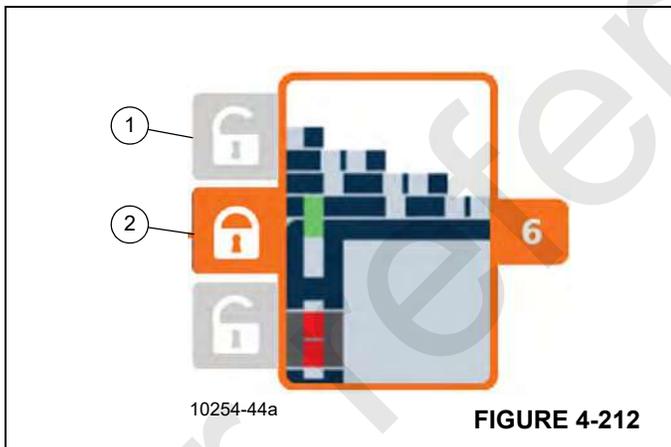
Lock/Release Telescopic Section Indication

Display	Color	Description
Yellow	Yellow	Locking pins intermediate position (Figure 4-211)
Green	Green	Telescopic section locked
Red	Red	Telescopic section unlocked



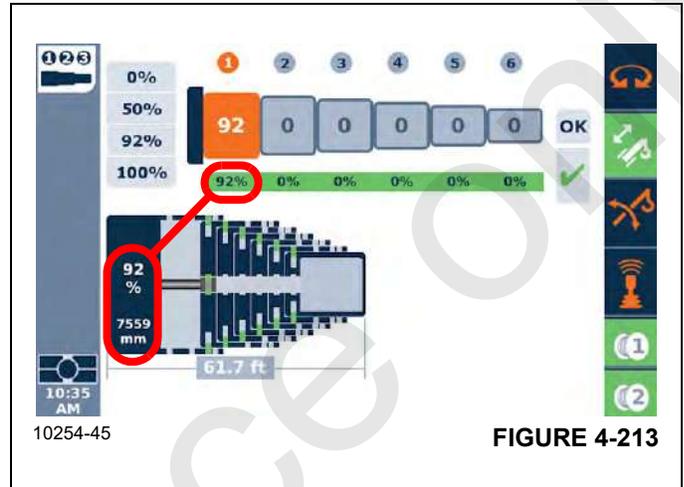
Locking/Releasing the Telescopic Section

To lock	Select symbol (2), (Figure 4-212) and confirm – telescopic section locked
To unlock	Select symbol (1), (Figure 4-212) and confirm – telescopic section is unlocked



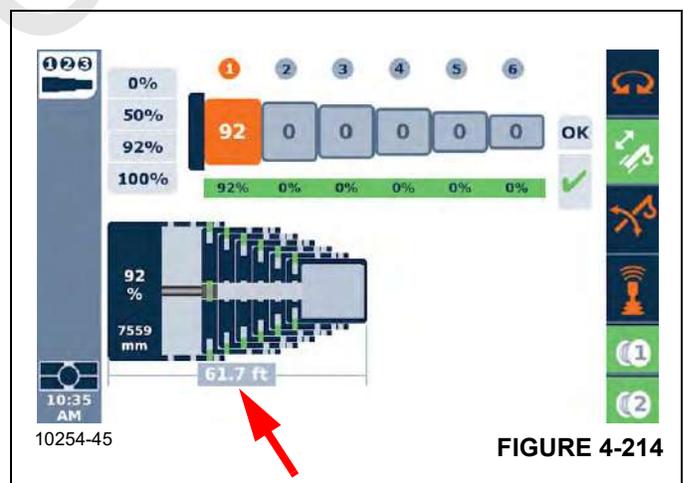
Telescoping Cylinder Length Display

Display	Current extended length of the telescoping cylinder (Figure 4-213)
Unit of measurement	Displayed depending on setting, mm (millimeters) or ft (feet) and percent (%)



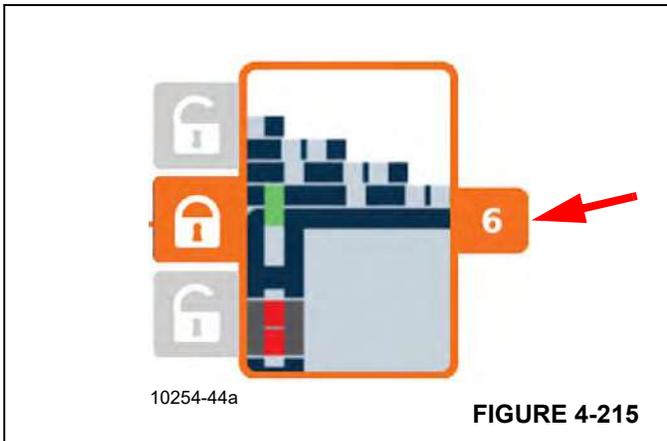
Main Boom Length Display

Display	Current extended length of the main boom (Figure 4-214)
Unit of measurement	Displayed depending on setting, m (meters) or ft (feet)



**Telescoping Section in the Telescopic Section Display**

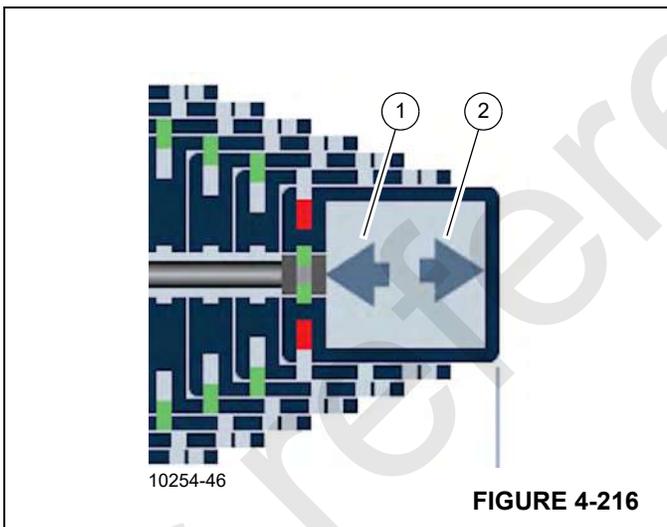
Displayed telescopic section, e.g. Telescopic Section (6), (Figure 4-215).



**FIGURE 4-215**

**Telescoping Direction Display**

1	Start with Retract (1), (Figure 4-216)
2	Start with Extend (2), (Figure 4-216)



**FIGURE 4-216**

**Emergency Telescope Mode**

In the event of a malfunction in the telescoping mechanism, or if maintenance is needed for the tele-cylinder mechanism, you can manipulate the main boom with the Telescoping Emergency Program (1), (Figure 4-217).

The Emergency Program is not intended for crane operation and is therefore restricted to approximately 1000 seconds (or 16 minutes). After that allotted time, the password must be entered again.

**NOTE:** If possible, set down the load before starting the Emergency Program.

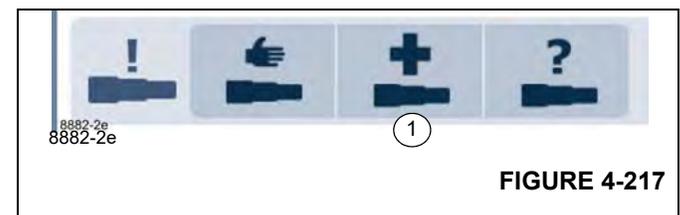
There is a standard control level for the emergency program, and there is an extended control level for the emergency telescope mode. The standard control level or standard emergency program is accessed with the password as shown (HELP). The extended control level or extended emergency program is accessed with the pass code (a set of numbers provided to the customer as described below).

The standard emergency program is intended for standard maintenance, such as bringing the telescoping cylinder to the access hole. In this case, all boom sections are fully retracted, the T1 telescoping section can be unlocked, and then this boom section can be extended to the first locking position, and then this boom section can be locked there, and then the telescoping cylinder can be retracted to the hole. The standard emergency program will only allow extending the telescoping cylinder if the boom length is not longer than this particular configuration (i.e. T1 at first locking position and all other boom sections fully retracted and locked). If the boom is completely retracted, then the telescoping cylinder can be manipulated between the boom sections; this can be used to test the operation of the locking mechanism and the telescoping cylinder.

The extended emergency program has no logical restrictions for the operation of the locking mechanism or the motion of the telescoping cylinder. This level of control is expected to be used when there has been a condition that is not handled by the control system (such as difficulties with hardware, communication loss, or entrapped air in the telescoping system). It is entirely the responsibility of the operator to be aware of the location of the boom components and to use the appropriate commands and motions.

**Open Sub-Menu Emergency Telescope Program**

- Select and confirm the letters H-E-L-P (1), (Figure 4-219) – the screen to access the Emergency Telescoping Mode is opened.



**FIGURE 4-217**

- If Grove Product Support or Local Distributor has provided a pass-code for the extended emergency program, then the pass-code can be entered by using the down-arrow on the display, or the jog-dial rotation, to find the numbers for entry prior to the letter A.
- Confirm the entry with the symbol (2), (Figure 4-219).

The operator can cancel the entry at any time using the (6 or 7), (Figure 4-218) buttons.

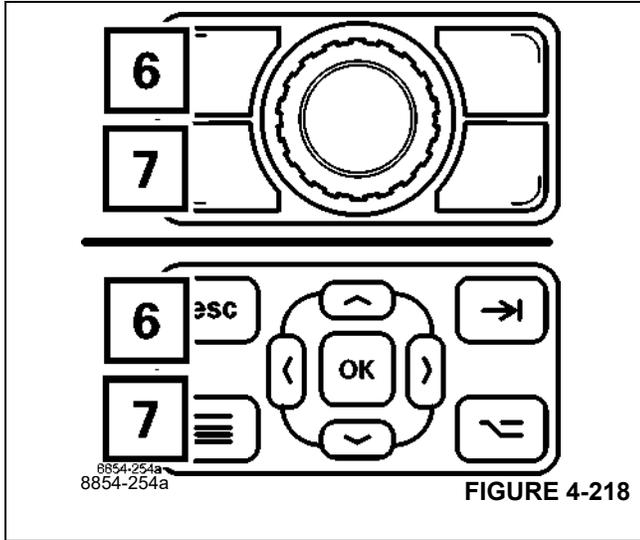


FIGURE 4-218

After the correct entry has been made, the Emergency Telescoping Program is started.

The Emergency Telescoping Program has a time limit. The display (1), (Figure 4-219) shows the remaining time for operating the emergency program.

It runs for approximately 1000 seconds (or 16 minutes).

The telescoping mechanism can be operated with the emergency program within this time.

If the time is not sufficient, then you must restart the emergency program.

**Access Telescoping Emergency Program Menu**

Enter a password to open the Telescoping Emergency Program Menu (Figure 4-219).

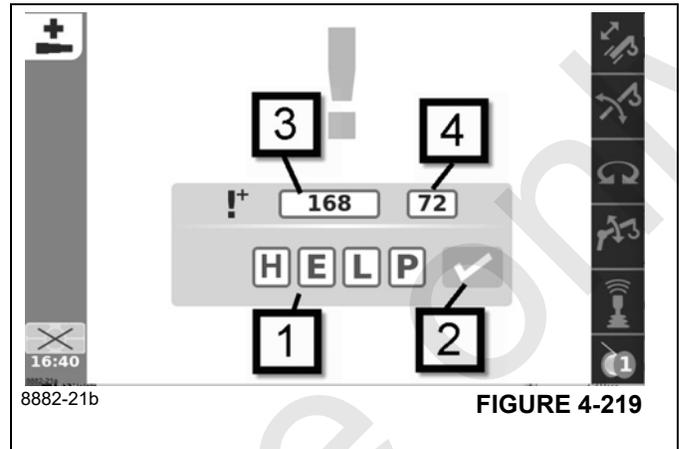


FIGURE 4-219

Item	Description
1	Enter the password HELP to access the Telescoping Emergency Program with basic controls. To enter the password, highlight a letter, select Enter to alter the letter, dial the new letter, and select Enter again. <sup>1)</sup>
2	Select the check-mark after entering the password.
3	Telescoping Emergency Program seed value.
4	Counter for time limit for entering pass-code.

<sup>1)</sup> In order to enter a pass-code (numbers), instead of a password (letters), manipulate the standard letters for the first position (the H position for H-E-L-P) until a selection is shown prior to the letter A, then the digits 0 to 9 will appear.

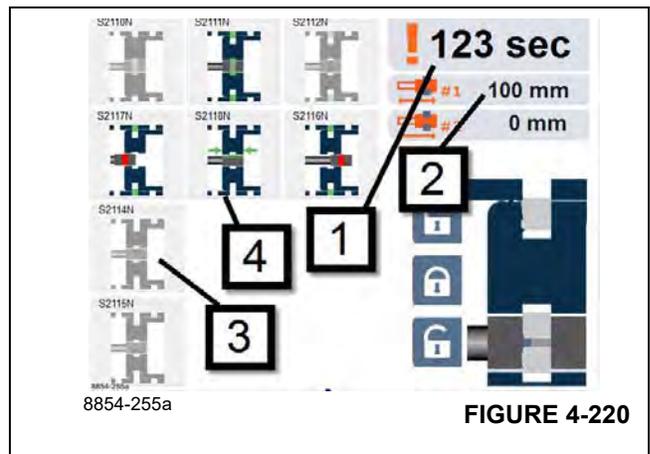


FIGURE 4-220

## Determining the Error Type

### CAUTION

#### Machine Damage Hazard!

Make sure that you always have an overview of the current status of the telescoping mechanism before you initiate locking or unlocking.

In Emergency Mode, there may be no monitoring of prerequisites – the function is performed immediately after pressing the button.

- Check which emergency program procedure is suitable for the current error:

### CAUTION

#### Machine Damage Hazard!

Never telescope the main boom if it is not possible to monitor the length of the tele cylinder by some means.

It would then not be possible for you to monitor operations, and components in the main boom could be damaged, or a situation could arise in which the main boom can no longer be extended or retracted.

If the display shows an obviously unrealistic value, such as -1100 mm, then there is an error on the precision length sensor length indicator of the CCS. Contact Grove Product Support or your Local Distributor to determine if you are permitted to start the telescoping process. Item 1, (Figure 4-220) is the time remaining to correct the error.

In the display, Items 3 and 4 (Figure 4-220) are examples of indicators for proximity switches. Item 3 is switch S2114N, and it is shown in a dimmed fashion. This means the switch has been considered OFF. Item 4 is switch S2118N, and it is shown in active colors; this switch is considered ON.

These switches are shown in a logical fashion based on their function. The top row (S2110N, S2111N, and S2112N) is the switches near the hydraulic actuator. S2111N is physically located between S2110N and S2112N, so these indicators are arranged in the same manner.

The next row (S2117N, S2118N, and S2116N) are indicators for the tele cylinder being aligned with a boom section. S2117N is shown to the left; when the tele cylinder is nearly aligned (for instance within 50 mm of the connection), and S2117N is ON, then the cylinder needs to extend slightly (moving the right joystick to the right, if using the standard joystick arrangement). If S2116N is ON in this near connection condition, then the cylinder needs to retract slightly (moving the previously mentioned joystick to the left). These motions are logical with respect to what is shown on the screen.

The remaining proximity switches, S2114N and S2115N (Figure 4-221), are for the cylinder pins being retracted, so they are shown in a column format to be logical with respect to their location on the tele cylinder.

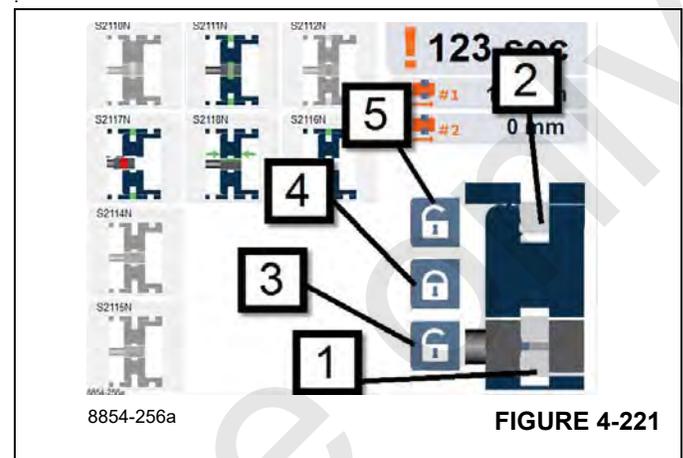


FIGURE 4-221

(Figure 4-221) has further explanation for the Telescoping Emergency Program screen. Item 1 is the graphical representation of the tele cylinder pins that connect to a telescoping boom section. When these cylinder pins are considered retracted, an unlock symbol will appear in this location.

Item 2, (Figure 4-221) is the graphical representation of the boom section and its pins that connect to the next telescoping boom section. Note that in the Telescoping Emergency Program; the actual boom section is no longer able to be determined; the crane operator must determine this. When these section pins are considered retracted (at least the actuator has moved to attempt this), an unlock symbol will appear in this location.

Item 3, (Figure 4-221) is the indicator for a command to attempt to retract the cylinder pins. The arrow buttons on the display or the jog dial can be used to highlight this, and hitting the OK/Enter button will then attempt to execute the command. The lock/unlock symbol on the button does not change based on the cylinder operations (refer to Items 1 and 2).

Item 4, (Figure 4-221) is the indicator for a command to release or re-extend pins. This command works for both the cylinder pin retracting and the section pin retracting; they are connected to the same double-acting hydraulic actuation cylinder, so it can only release the pins that had been previously retracted (whichever they were). The arrow buttons on the display or the jog dial can be used to highlight this, and hitting the OK/Enter button will then attempt to execute the command. The lock/unlock symbol on the button does not change based on the cylinder operations (refer to Items 1 and 2).

Item 5, (Figure 4-221) is the indicator for a command to attempt to retract the section pins. The arrow buttons on the

display or the jog dial can be used to highlight this, and hitting the OK/Enter button will then attempt to execute the command. The lock/unlock symbol on the button does not change based on the cylinder operations (refer to Items 1 and 2).

**CAUTION**

**Machine Damage Hazard!**

Telescoping the main boom when there is an error on the precision length indication and malfunctioning proximity switches can result in damage to the main boom, contact Grove Product Support or your Local Distributor to determine if you are permitted to start the telescoping process. They can provide the pass code to use in the Telescoping Emergency Program with extended capabilities.

A situation could arise in which the main boom can no longer be extended or retracted.

**CAUTION**

**Machine Damage Hazard!**

When an override switch is used, there is no monitoring of boom up and down, swing, telescoping, or hoist operation.

**NOTE:** In the Telescoping Emergency Program, all functions for retracting the main boom remain enabled as long as there are no other errors (hydraulic or mechanical). However, extending boom sections may require the use of an override switch, and only the Telescoping Emergency Program with extended capabilities can be expected to extend any boom section at any time. The Telescoping Emergency Program with basic capabilities is intended to be able to get the tele cylinder to the configuration where the tele cylinder pinning head can be serviced from the access hole in the base section, not to fully retract the boom after failures of sensors or mechanical components.

**NOTE:** The speed is restricted to approximately 30% of the maximum speed.

**Error on Length Indicator**

- If the precision length sensor for the tele cylinder does not show a reasonable value, then the second length sensing can be referred to (6), (Figure 4-222). This is typically from a length potentiometer from the power cable reel in the boom (it is separate from the precision length sensor). This length potentiometer is not as

accurate as the precision length sensor. Thus the two reels may not always show the same values.

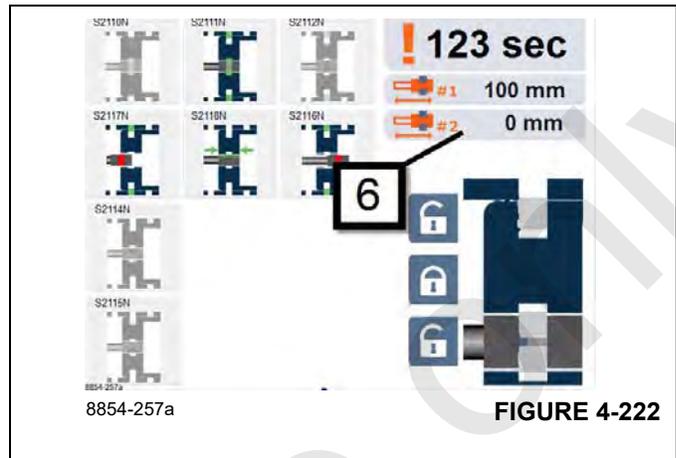


FIGURE 4-222

**Checks Before Telescoping**

Before telescoping, the following conditions are expected to be met, but depending on what components may have failed, the conditions may not be met:

The telescoping emergency program screen should appear as in (Figure 4-223).

The telescoping cylinder is locked to a telescoping boom section (no unlock symbol shown near the graphical representation of the tele cylinder - refer to Item 1 in (Figure 4-221).

The telescoping boom section is unlocked (the unlock symbol is shown near the graphical representation of the section pins - refer to Item 2 in (Figure 4-221).

In the top row of the proximity switches (Figure 4-223), S2110N is ON, the others in the row are OFF. In the middle row of the proximity switches (Figure 4-223), S2118N is ON, and the others in the row are OFF.

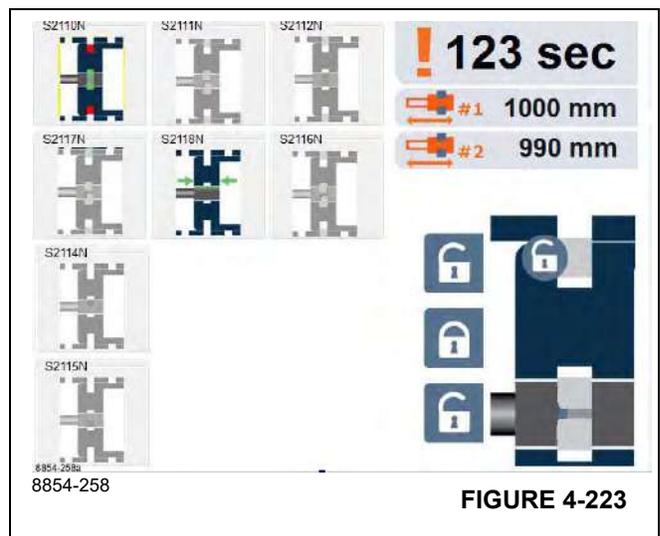
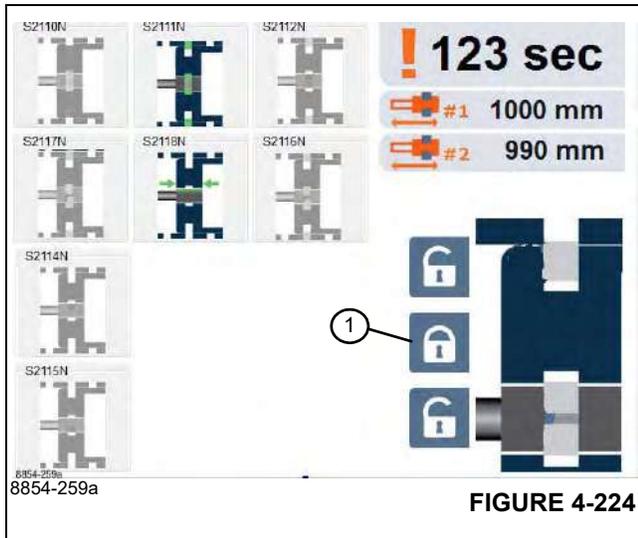


FIGURE 4-223

**Retracting and Locking a Telescopic Section**

During telescoping motion you are not to select Lock. Under no circumstances, while the tele cylinder is moving, should you select and press the symbol (1), (Figure 4-224).



**FIGURE 4-224**

**CAUTION**

**Machine Damage Hazard!**

If you select Lock during telescoping, the locking pins on the telescopic section are slid out immediately and they can damage or tear the electrical or hydraulic components in the main boom.

- Make sure that the section pins are retracted (unlocked), then retract the telescopic section slowly and as far as possible, refer to Table 4-10 on page 175 for the expected value for the precision length sensor (Item 2 in (Figure 4-220)) when the boom sections are fully retracted.
- Now select and confirm the symbol (1), (Figure 4-224).
- After the tele section has been locked to the outer section, retract the tele cylinder approximately 15mm to 30mm to set down the tele section (refer to *Locking Telescopic Sections*, page 4-179).

The telescopic section can be locked (if the actuator is able to release the section pins, and the telescoping boom section is actually aligned with a pinning hole). The screen should appear as shown in (Figure 4-224). In particular, S2111N should be ON.

**Table 4-10: Locking Point Distances for Telescopic Boom Sections (Millimeter)**

	T1 (mm)	T2 (mm)	T3 (mm)
0%	0	263	483
50 / 51%	4603	4897	4990
92%	8262	8415	8415
100%	9176	9318	9338

**Locking Point Distances for Telescopic Boom Sections (Feet)**

	T1 (ft)	T2 (ft)	T3 (ft)
0%	0.00	0.86	1.58
50 / 51%	15.10	16.07	16.37
92%	27.11	27.61	27.61
100%	30.10	30.57	30.64

**Unlocking the Telescopic Cylinder**

If the telescopic section is locked (typically indicated by (Figure 4-223), you can now attempt to unlock the telescoping cylinder.

**WARNING**

**Risk of Damage to Main Boom!**

You can select and confirm the symbol for unlocking the telescopic section. If this does not start the unlocking procedure, contact your local distributor or Grove Product Support.

- Select and confirm the symbol (3), (Figure 4-221).

The telescoping cylinder is unlocked. In the unlocked position, the screen should appear as indicated by (1), (Figure 4-225). The telescoping cylinder is unlocked from any telescoping boom section.

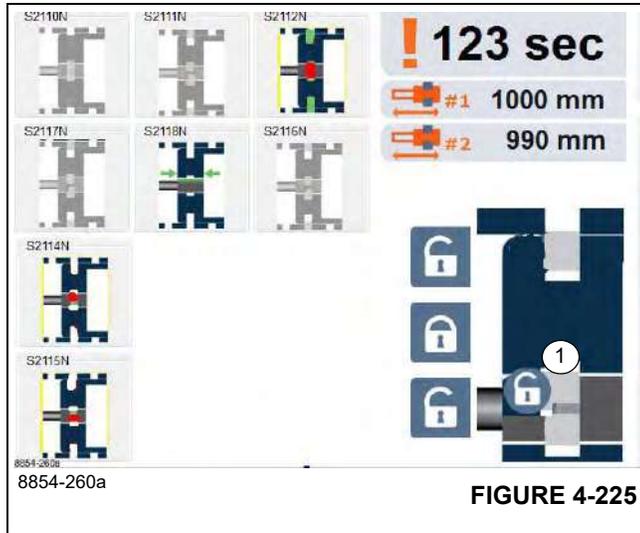


FIGURE 4-225

The telescoping boom section is locked (the unlock symbol is not shown near the graphical representation of the section pins - refer to Item 2 in (Figure 4-221).

In the top row of the proximity switches (Figure 4-225), S2112N is ON, the others in the row are OFF. In the middle row of the proximity switches, S2118N is ON, but the others are ON or OFF depending on the location of the tele cylinder with respect to telescoping boom sections.

You can now move the telescoping cylinder into the next telescopic section, refer to Table 4-11 on page 176 for the expected value for the precision length sensor (Item 2 in (Figure 4-220)) when the tele cylinder is near a connection to a boom section.

Extending and Locking the Telescoping Cylinder

Table 4-11: Locking Point Distances for Telescoping Cylinder (Millimeters)

	T1 (mm)	T2 (mm)	T3 (mm)
0%	0	263	483
50 / 51%	4573	4867	4960
92%	8232	8385	8385
100%	9146	9288	9308

Locking Point Distances for Telescoping Cylinder (Feet)

	T1 (ft)	T2 (ft)	T3 (ft)
0%	0.00	0.86	1.58
50 / 51%	15.00	15.97	16.27
92%	27.01	27.51	27.51
100%	30.01	30.47	30.54

Under no circumstances should you select and press the lock symbol (1), (Figure 4-224) while the tele cylinder is in motion.

**CAUTION**

**Machine Damage Hazard!**

If you select Lock while the telescoping cylinder is moving, the locking pins on the telescopic section are slid out immediately and they can damage or tear the electrical or hydraulic components in the main boom.

Slowly move the telescoping cylinder into the next extended telescopic section.

At the locking point:

- The display (2), (Figure 4-220) shows the length for the current locking point. Refer to : *Locking Point Distances for Telescoping Cylinder (Millimeters)*, page 4-176.
- The proximity switch indicators for S2117N, S2118N, and S2116N are used to align the tele cylinder to the hole in the boom section. S2118N is ON whenever the tele cylinder pins are in the “foot section” or the near end of the boom section weldment where the hole is located. S2116N goes ON when the tele cylinder has extended beyond the hole. S2117N goes ON when the tele cylinder is not extended enough to reach the hole. Therefore, one would operate the tele cylinder until S2118N is ON, and S2116N and S2117N are OFF. This is what is shown in (Figure 4-225).
- Select and confirm the symbol shown as Item 4 in (Figure 4-221).

The telescoping cylinder is locked, if the actuator is able to release the cylinder pins, and the tele cylinder is actually aligned with a pinning location hole in the boom section. The screen should appear as shown in (Figure 4-224).

- With the tele cylinder locked to the section, extend the tele cylinder approximately 15mm to 30mm to clear the cutout on the tele section locking pins (refer to *Locking Points for the Telescopic Sections*, page 4-177). You can now unlock the tele section from its outer section, then operate the telescopic cylinder. Refer to *Retracting and Locking a Telescopic Section*, page 4-175.

**Tables for Approaching the Locking Points**

The extent to which the telescoping cylinder has to be extended in order to reach a locking point depends on whether you want to lock:

- the telescoping cylinder

OR

- a telescopic section.

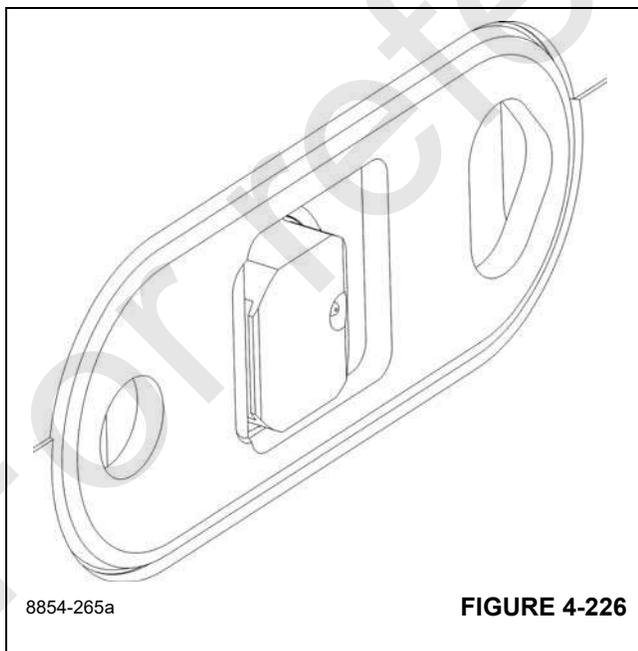
**Locking Points for the Telescoping Cylinder**

Table 4-11 on page 176 shows the extended length for locking the telescoping cylinder.

**Locking Points for the Telescopic Sections**

Table 4-10 on page 175 shows the extended length for locking the telescopic boom sections. The telescopic section should not be set down for locking or unlocking it.

The cutout (1), (Figure 4-226) must be clear. That is why you have to extend the telescoping cylinder further than with a return run.



**FIGURE 4-226**

**Telescoping Cylinder Boom Nose Switch**

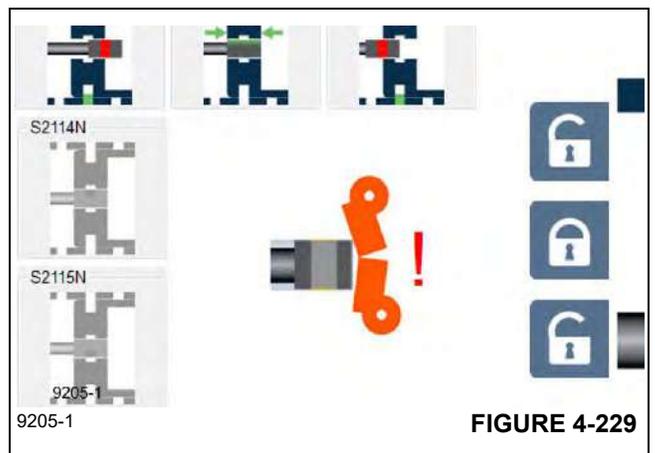
A whisker-style trigger switch is installed at the boom nose to detect the tele cylinder barrel being too close to the boom nose. When this switch is triggered, the symbol shown in (Figure 4-228) should appear on the left side of the ODM display and in the middle of the Emergency Mode screen (Figure 4-229).



**FIGURE 4-227**



**FIGURE 4-228**



**FIGURE 4-229**

In this triggered condition, the telescoping cylinder is no longer expected to be able to extend. If the extended emergency telescoping mode is being used, then it is still possible to still extend the cylinder (such as when the switch is malfunctioning or disconnected), but this should only be

done with physical verification of the telescoping cylinder location with respect to the boom nose. If the telescoping cylinder impacts the boom nose, the boom system will be damaged.

With the telescoping cylinder not moving, and with the joystick not being used, then the bypass switch (Figure 4-230) can be used. The telescoping cylinder will now extend, but when the telescoping cylinder stops moving, or if the joystick is no longer used, then the same steps must be repeated to use the bypass switch.

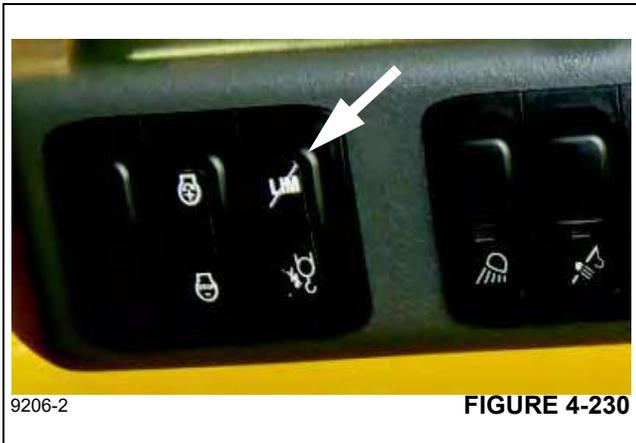


FIGURE 4-230

### Mechanical Emergency Unlocking and Locking of the Telescopic Sections

The mechanical emergency operation must be used whenever the telescoping cylinder can no longer be moved.

For manual unlocking and locking of the telescopic sections, a screw is inserted into each side in the locking pins. When screwed in, the screw collapses the spring internal to the locking pin, thus pulling the locking pin which pulls the locking pin into the telescopic section and thus unlocks the section.

The screw is screwed out again to lock the section manually.

The main boom is designed in such a way that the locks can be operated in emergency mode from the outside for most fixed lengths.

**NOTE:** If the telescoping cylinder is in the foot section of a telescopic section, this telescopic section cannot be locked or unlocked manually.

### Prerequisites:



### WARNING

#### Risk of Crushing from Retracting Boom!

Failure to follow these prerequisites could allow a boom section to retract uncontrolled resulting in injury or equipment damage.

The following prerequisites must be fulfilled before unlocking a telescopic section manually:

- The telescopic section to be unlocked is attached to an auxiliary crane with sufficient load bearing capacity and, in this way, is secured against independent retraction.

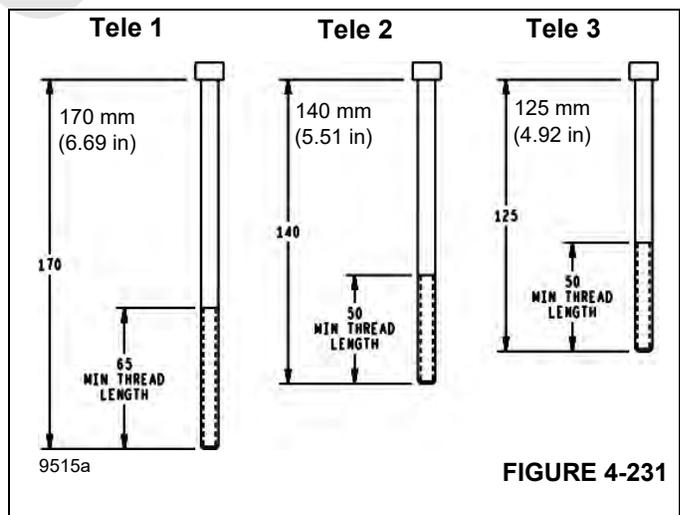
Or

- The main boom is lowered into a horizontal position so that the telescopic section is unable to retract independently.

### Maintenance

For manual unlocking, two screws are supplied for each telescopic section (Figure 4-231):

- 170 mm (6.69 in) length for Telescopic Section 1.
- 140 mm (5.51 in) length for Telescopic Section 2.
- 125 mm (4.92 in) length for Telescopic Section 3.



Refer to (Figure 4-232). You can only lock or unlock a Telescopic Section manually if the recess (2), in the locking pin (1) no longer engages in the Telescopic Section (3) above it.

Refer to (Figure 4-232). Extend the Telescopic Section approximately 20 mm (0.79 in) (with an auxiliary crane, forklift or other means of external force). The locking pin (1)

must be centered in the opening and the recess (2) may no longer engage in the Telescopic Section (3) above it.

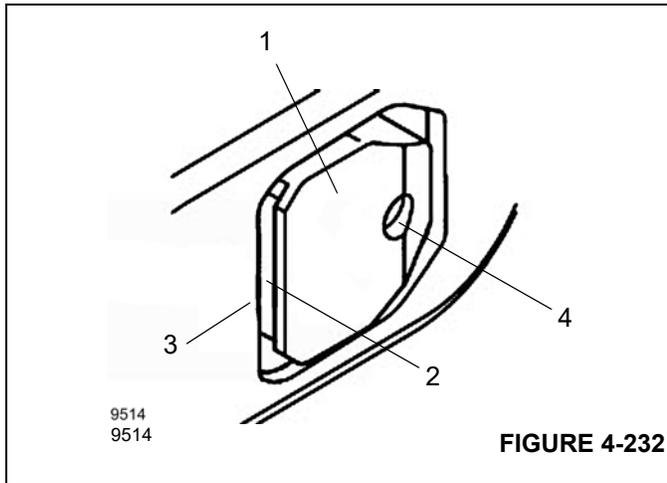


FIGURE 4-232

### Unlocking Telescopic Sections

When unlocking sections, start with Tele 3 and work your way in towards Tele 1 as far as possible. Unlock and lock only one section at a time.

1. Remove the grease fitting from the bore hole (4), (Figure 4-232).
2. Insert a screw into the hole (4), (Figure 4-232). The locking pin (1), (Figure 4-232) is retracted in the process. You can assist this process by lightly hammering on the locking pins.
3. Tighten the screw against the spring load until the locking pin (1), (Figure 4-232) is pulled in as far as it will go and is situated behind the side wall of the Telescopic Section.
4. Unlock the other side of the Telescopic Section using the same procedure.

### CAUTION

#### Risk of Damage in the Event of a Mechanically Released Lock!

Under no circumstances may you operate the telescoping cylinder as long as the lock is mechanically released. Therefore unscrew all screws out of the bore holes immediately after finishing the repair work.

In this way, you prevent the telescoping cylinder from hitting the locking system and consequently damaging it.

Do not unlock a section and then boom up until it slides in. Damage to equipment will result.

Once the pins are retracted, use your external means (second crane, forklift, etc.) to retract that section and then remove the bolts to pin that section in a retracted state. Move to the next section to be retracted (as necessary).

### Locking Telescopic Sections

1. Retract the telescopic section until the locking pin (1), (Figure 4-232) is in the middle of the opening.
2. Remove the screw from the bore hole (4), (Figure 4-232).

The locking pin (1), (Figure 4-232) is then pushed out of the opening due to spring tension.

3. Install the grease fitting into the bore hole.

Retract the telescopic section until the recesses (2), (Figure 4-232) have been set down on the telescopic section (3), (Figure 4-232) above it.

### Faults Menu Group

The Fault Menu Group includes the following function icons:

- Crane Faults (page 4-179)
- Engine Faults (page 4-181)

### Crane Faults

Select the Crane Faults Icon (1), (Figure 4-233) under the Faults Menu Group to view active crane fault codes.

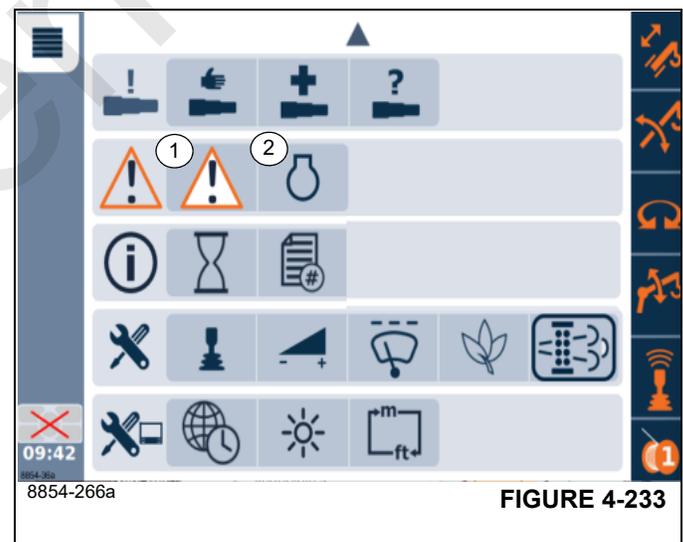


FIGURE 4-233

The Crane Fault Code function screen (Figure 4-235) displays active crane fault codes.

If several fault codes are active, use the Jog Dial or Arrow Buttons on the Navigation Control Pad (Figure 4-234) to select the arrow at the top or bottom of the screen to scroll through the codes.

Crane fault codes with an "X" (Figure 4-235) beside them can be cleared by the operator. Crane fault codes with an "X" surrounded by a red circle with strike-through (Figure 4-235) cannot be cleared without first correcting the malfunction, then cycling the ignition key to the OFF position and back to the ON position.

Additional information about the fault can be accessed by first highlighting a fault code, then pressing the Additional Information or lower right Button, the ALT Key, (1), (Figure 4-234) on the ODM Navigation Control Pad.

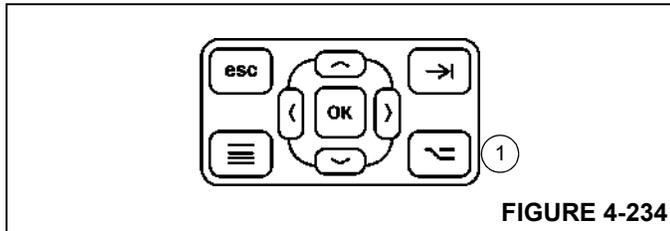


FIGURE 4-234

The Additional Information screen (Figure 4-236) gives the operator details about the location of the system that is at fault, along with an explanation.

A list of all fault codes and their definitions are available through the Manitowoc Diagnostic Code application. For more information, see *Information Menu Group*, page 4-181.

1. Open the fault list screen (Figure 4-233) or the engine faults screen (Figure 4-237) and highlight the fault you're interested in getting more information about.

2. Press the ALT Key(1), (Figure 4-234) on the Display to show additional crane fault information.
3. The ODM Error Code Viewer (Figure 4-236) opens.

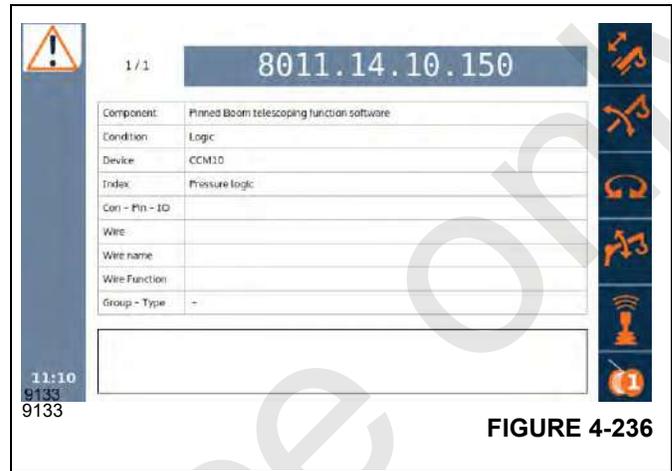


FIGURE 4-236

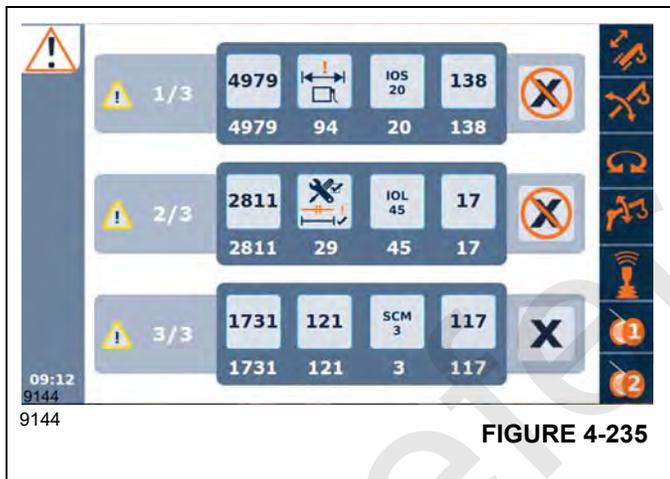


FIGURE 4-235

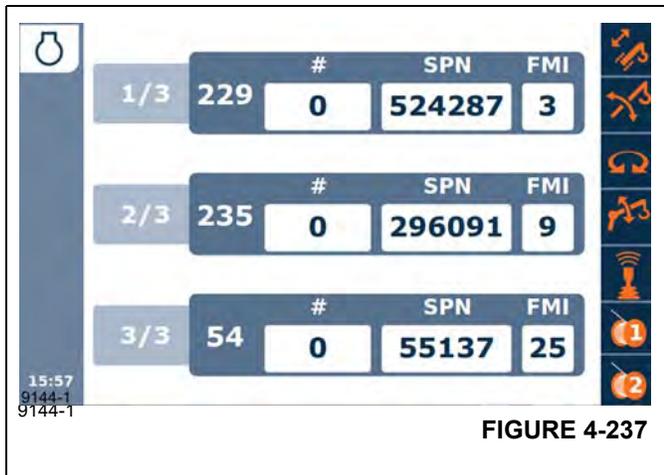


FIGURE 4-237

**Engine Faults**

Select the Engine Faults Icon (1), (Figure 4-238) under the Faults Menu Group to view active engine fault codes.

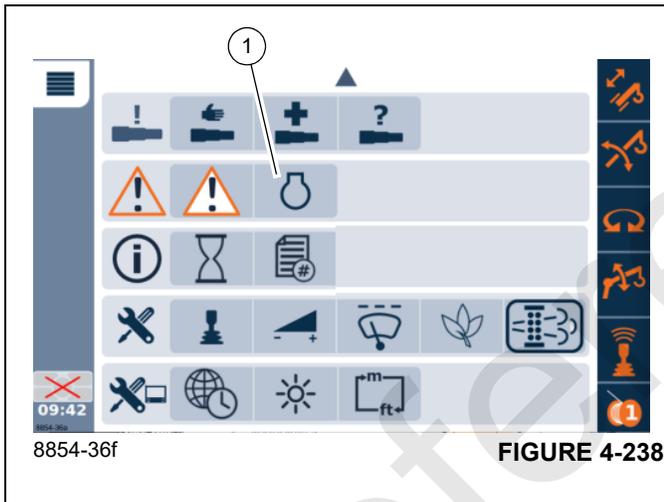


FIGURE 4-238

The Engine Fault Code function screen (Figure 4-239) displays active engine fault codes.

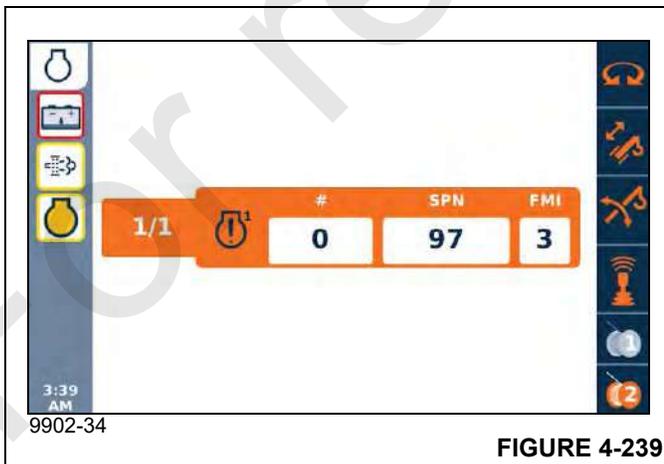


FIGURE 4-239

If several fault codes are active, use the Jog Dial or Arrow Buttons on the Navigation Control Pad to select the arrow at the top or bottom of the screen to scroll through the codes

Engine fault codes cannot be cleared by the operator without first correcting the malfunction, then cycling the ignition key to the OFF position and back to the ON position.

**Information Menu Group**

The Information Menu Group includes the following function icons:

- Operating Hours (page 4-181)
- Software Versions (page 4-183)

**Operating Hours**

The Operating Hours (Figure 4-240) allows the operator to view the total operating hours for all crane functions. You can also reset the recorded operating hours.

The Operating Hours function screen (Figure 4-241) shows the total accumulated operating hours for the different crane functions, and offers a resettable trip meter for each crane function.

Select the Operating Hours Icon (1), (Figure 4-240) under the Information Menu Group to show the Operating Hours function screen (Figure 4-241).

**Displaying the Operating Hours**

For each crane function, the control system will record total operating hours and current operating hours.

The total operating hours **cannot** be reset.

Open the Operating Hours Menu (1), (Figure 4-240).

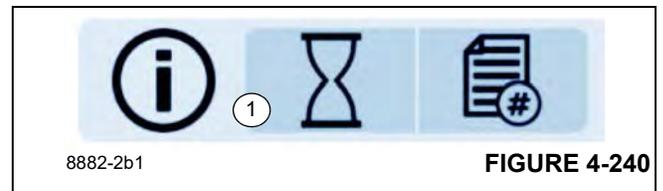
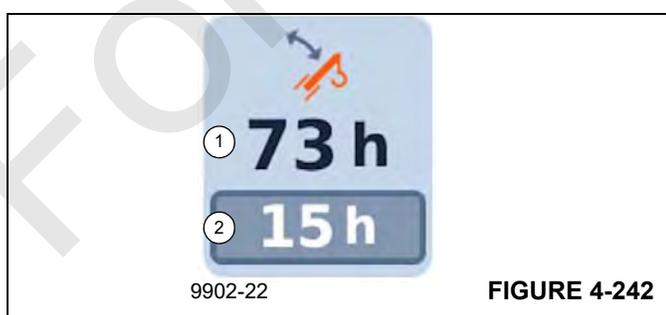


FIGURE 4-240



item	Description
1	Swing Operating Hours
2	Boom Telescoping Operating Hours
3	Boom Lift Operating Hours
4	Main Hoist Operating Hours
5	Auxiliary Hoist Operating Hours
6	Total Engine Operating Hours
7	Transmission Operating Hours
8	Boom Pinning Count
9	Superstructure Hours
10	Reset All Operating Hours Icon

The top number for each crane function shows the total accumulated hours (1), (Figure 4-242). The bottom number shows the total hours since the last reset (2), (Figure 4-242).



The Boom Pinning Count (8), (Figure 4-241) shows how many times the boom has been pinned. All others are in hours.

Reset the time for a crane function by doing the following:

- Using the Jog Dial or Arrow Buttons on the Navigation Control Pad, select the hours under the crane function icon that is to be reset (hours will turn to an orange hour-glass--Example shown (1), (Figure 4-241).
- Press the Jog Dial or OK Button on the Navigation Control Pad to reset the hours to zero (0).

**NOTE:** Allow up to 8 seconds for the meter to reset to 0.0 hours.

To reset all crane function operating hours and counts to zero (0), select the Reset All Icon (10), (Figure 4-241) (Icon will turn orange) on the Operating Hours function screen and then press the Jog Dial or the OK Button.

**Recording Operating Hours**

The operating hours are recorded as follows:

The value (1), (Figure 4-243) indicates the total engine operating hours, e.g. 707 hours.

The value (2), (Figure 4-243) shows the operating hours, which can be reset.

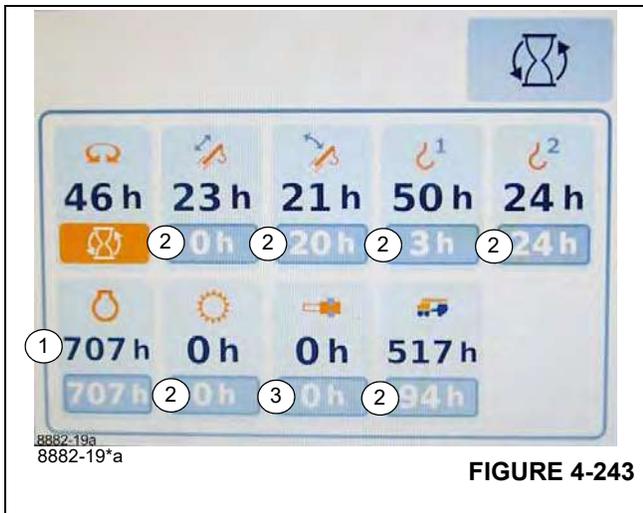


FIGURE 4-243

To reset an individual hour meter, use the jog dial to select the time to reset. The selected function will show the icon orange.

Pressing Enter with the jog dial will reset the hours to zero. If the jog dial is used to select the large hourglass at the top, then pressing Enter will reset all the hour timers.

The value (3), (Figure 4-243) shows the number of times that the pinning system has started and then completed an unlocking procedure (cylinder unlocking or section unlocking).

**Software Versions**

Select the Software Versions Icon (1), (Figure 4-244), under the Information Menu Group, to view the Software Versions function screen.

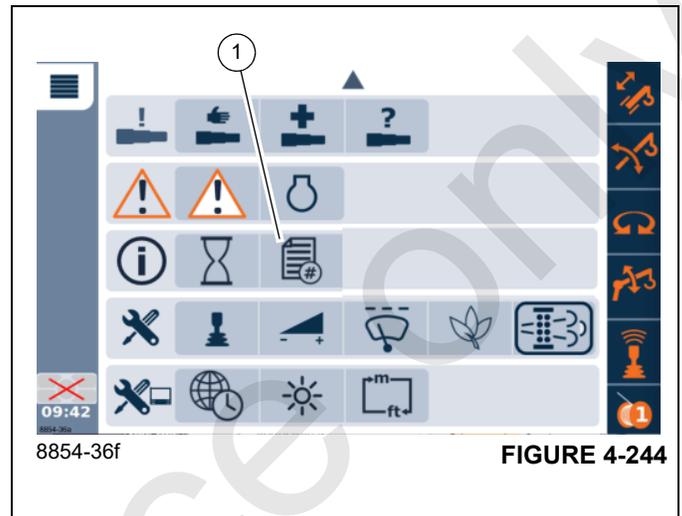


FIGURE 4-244

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

1	2	3
MWSCM3	0.009	b8611
CCM10	0.011	b838
CCM11	0.007	b1140
IOL31	0.007	b1140
IOL45	0.007	b1139
IOS20	0.007	b1139
IOS21	0.007	b1139
ODM	1.002	b241
RDM	1.002	b163
Load Charts	1.000	b53

FIGURE 4-245

Item	Description
1	Module
2	Manual Input Variable
3	CCS Software Version

### User Settings Menu Group

The User Settings Menu Group (Figure 4-246) includes the following function icons:

- Controller Curve (1)
- Controller Speed Function (2)
- Wiper Stroke Interval (3)

- Economy (ECO) Mode (4)
- Exhaust System Cleaning (5)

These menu's allow the operator to select sub-menus to adjust parameters, set display options, and control options.

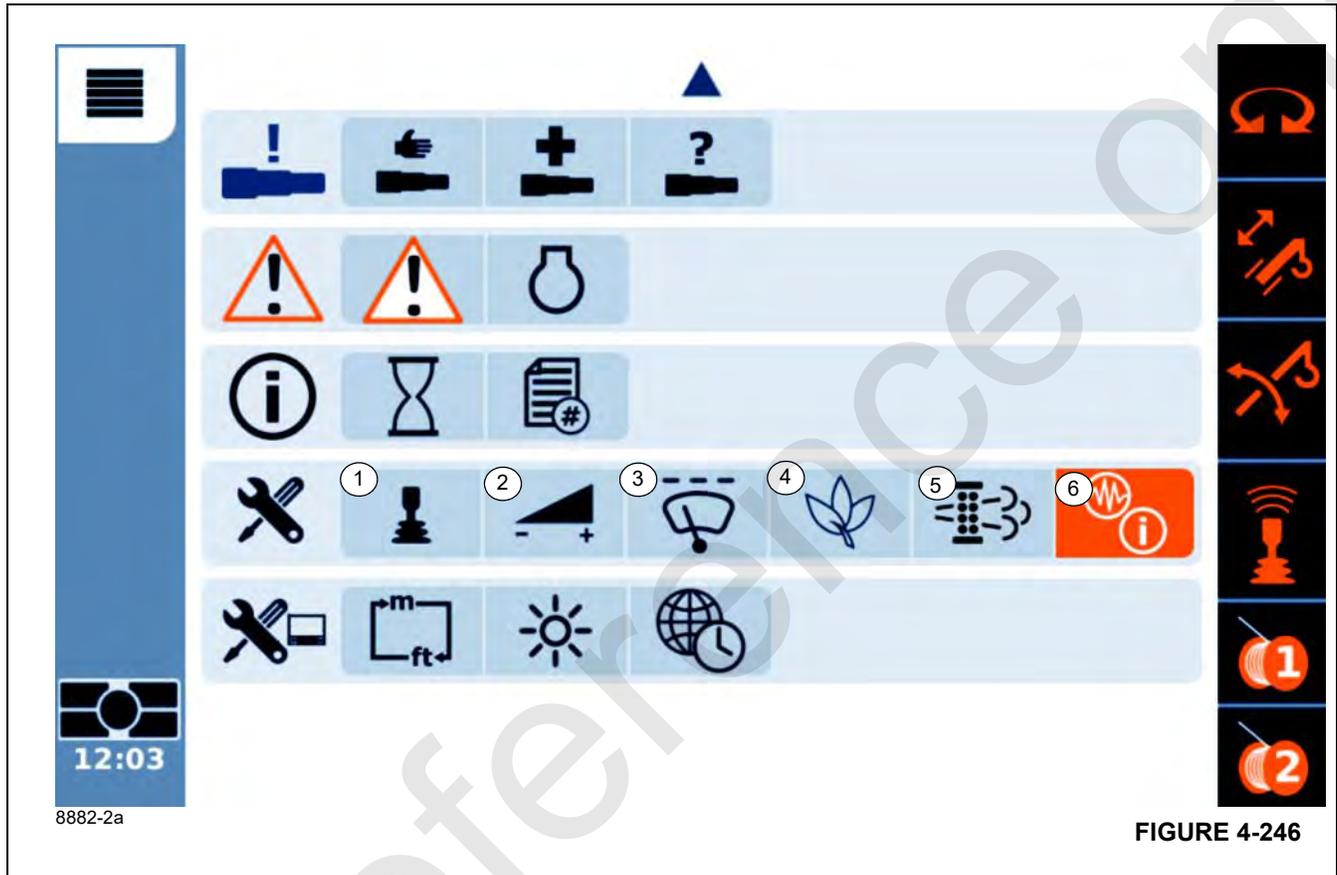


FIGURE 4-246

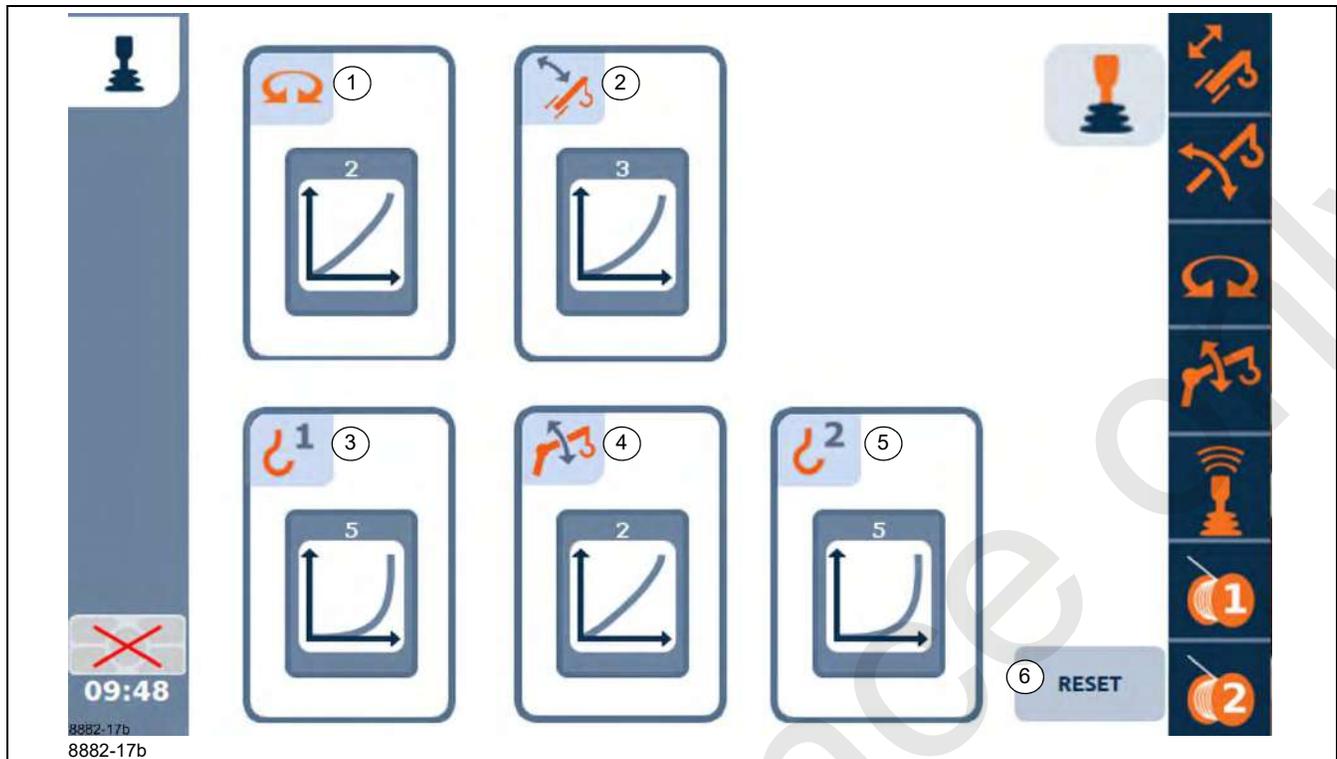
Item	Description	Refer to
1	Controller Curve	page 4-185
2	Controller Speed Function	page 4-187
3	Wiper Stroke Interval	page 4-188
4	Economy (ECO) Mode	page 4-189
5	Exhaust System Cleaning	page 4-191
6	Service Menu Icon	

**Controller Curve**

The Controller Curve (1), (Figure 4-246), under the User Settings Menu Group, allows the operator to set the amount of stroke the control levers required to initiate a response. The operator can adjust the sensitivity of the controllers to the crane functions.

1. Select the Controller Curve Icon (1), (Figure 4-247), under the User Settings Menu Group, to show the Controller Sensitivity Function Screen (Figure 4-248) to adjust the sensitivity of the controllers.





Item	Description	Refer to
1	Swing Function Curve	Figure 4-248
2	Boom Lift Function Curve	Figure 4-248
3	Main Hoist Function Curve	Figure 4-248
4	Luffing Boom Extension Function Curve <sup>(1)</sup>	Figure 4-248
5	Auxiliary Hoist Function Curve <sup>(1)</sup>	Figure 4-248
6	Reset All Function Curves	Figure 4-248
	<sup>1)</sup> Optional Equipment	

FIGURE 4-248

Five different sensitivity curves are available to select from (curves 1 through 5), (Figure 4-251). 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 4-249).

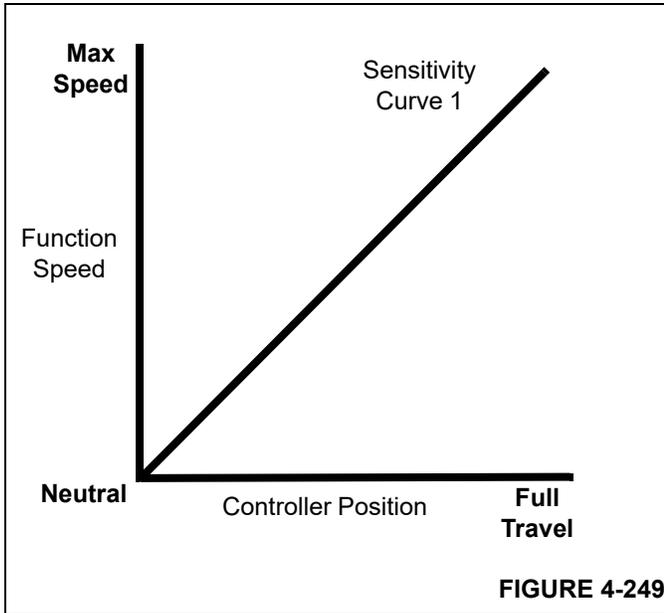


FIGURE 4-249

Selecting a sensitivity curve of 2 through 5 (Figure 4-251) 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 4-250).

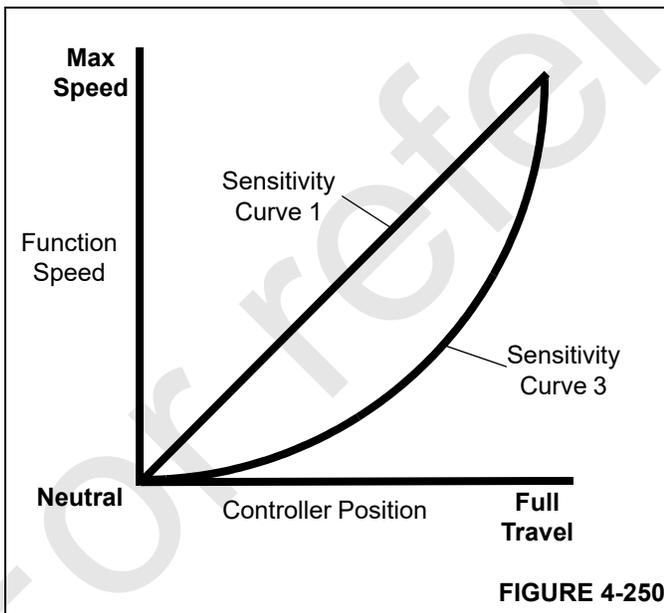


FIGURE 4-250

Sensitivity curve 1 (default) is the most sensitive and sensitivity curve 5 is the least sensitive (Figure 4-251).

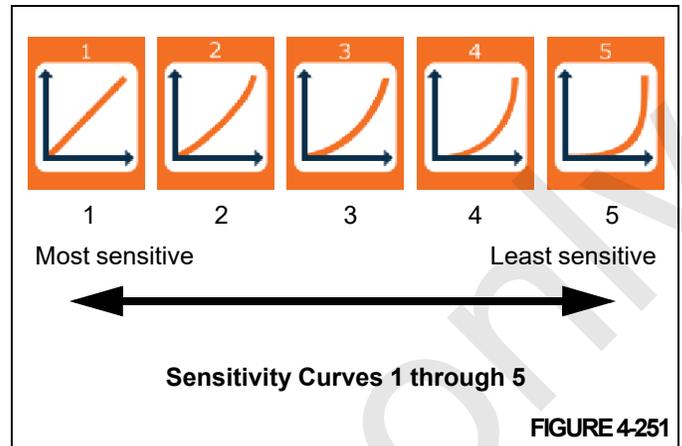


FIGURE 4-251

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

1. Using the Jog Dial or Arrow Buttons on the Navigation Control Pad, select the controller function icon that is to be adjusted (Icon will turn orange).
2. Press the Jog Dial or OK Button on the Navigation Control Pad to make the controller function icon active (Icon background will turn gray).
3. Using the Jog Dial or the Up/Down Arrow Buttons, select one of the five possible sensitivity curves (Figure 4-251).
4. Press the Jog Dial or OK Button to accept the new setting.

Select the Reset All icon (6), (Figure 4-248) on the Controller Sensitivity function screen and press the Jog Dial or the OK Button to set the sensitivity of all functions to the factory default setting (default setting = Curve 1).

**Controller Speed Function**

The Controller Speed Function Screen (Figure 4-252), under the User Settings Menu Group, allows the operator to adjust the crane function speeds relative to the position of the controllers. Adjustment is made as a percentage of full rated speed.

You can enter what percentage of the maximum speed should be enabled for each crane function.

- Select the Controller Speed Icon (1), (Figure 4-252) and confirm the symbol. The Controller Speed Function screen opens.



FIGURE 4-252

The values below the symbols (1) thru (5), (Figure 4-253) indicate the currently set controller function speeds.

The symbol (5), (Figure 4-253) is only active when the auxiliary hoist is connected.

Symbol (6), (Figure 4-253) resets all values without prior selection.

A setting of 100% results in the crane function moving at full rated speed relative to the position of the controller. A setting of 75% results in the crane function moving at 75% of full rated speeds throughout the range of the controller.

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

1. Using the Jog Dial (2), (Figure 4-253) or Arrow Buttons (3), (Figure 4-253) on the Navigation Control Pad, select the controller function icon that is to be adjusted (Icon will turn orange).
2. Press the Jog Dial (2), (Figure 4-253) or OK Button (4), (Figure 4-253) to make the controller function icon active (Icon background will turn gray).
3. Using the Jog Dial (2), (Figure 4-253) or the Up/Down Arrow Buttons, adjust the percentage to the desired setting.

Adjustments are made in 1% increments/decrements. To quickly make large adjustments, hold down the Jog Dial (2), (Figure 4-253) while rotating it.

4. Press the Jog Dial (2), (Figure 4-253) or OK (4), (Figure 4-253) Button to accept the new setting.

Select the Reset All icon (6), (Figure 4-253) on the Controller Speed function screen and press the Jog Dial or the OK Button to set all function speeds to the factory default setting of 100%.

**NOTE:** A crane function speed can be set to 0 (zero) to prevent movement of that function. Crane functions set to a speed of 0 cannot be enabled by way of the related Enable/Disable Switch.

**NOTE:** This is useful in a situation where, for example, a hoist is wound with rope and the rope is tied-off at the hoist. The operator can prevent that hoist from operating by setting its speed to 0.

To cancel the input – press button (1), (Figure 4-253) once.

- Confirm the changed values – press switch (2), (Figure 4-253) or OK button (4), (Figure 4-253) once. The changed values for the power unit are applied.

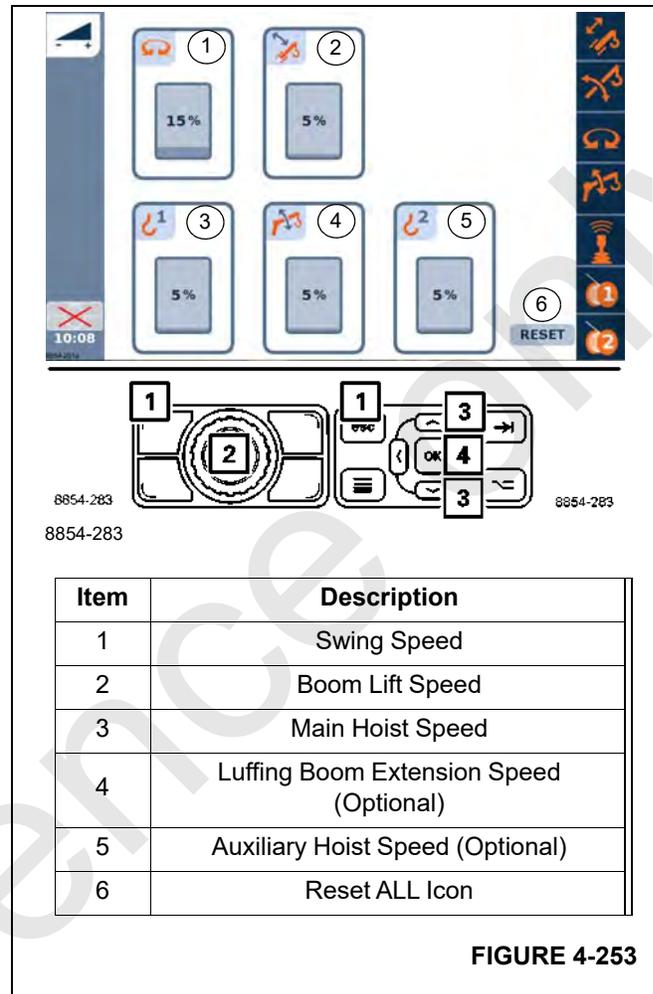


FIGURE 4-253

**Wiper Stroke Interval**

For the Windshield and Skylight Wiper Stroke, you can set a value between 3 and 30 seconds for the windshield and skylight window wiper stroke interval.

**NOTE:** The higher the selected value is, the longer the pauses between the strokes of the wiper are.

Select and confirm the symbol (1), (Figure 4-254).

The Windshield Wiper function opens.

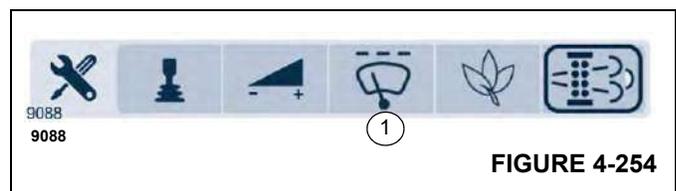


FIGURE 4-254

- The displays (1), (Figure 4-255) and (2) show the current values.

- Select and confirm the symbol.

1	For the windshield wiper – symbol (5) displayed
2	For the skylight window wiper – symbol (6) displayed
3	Interval for windshield wiper
4	Interval for skylight window wiper

- Select and confirm the symbol (7), (Figure 4-255). Symbol is orange – input on.

To cancel the input – press button (9), (Figure 4-255) once.

- Change the value using buttons (8), (Figure 4-255) or (10), (Figure 4-255).
- Confirm the changed value.

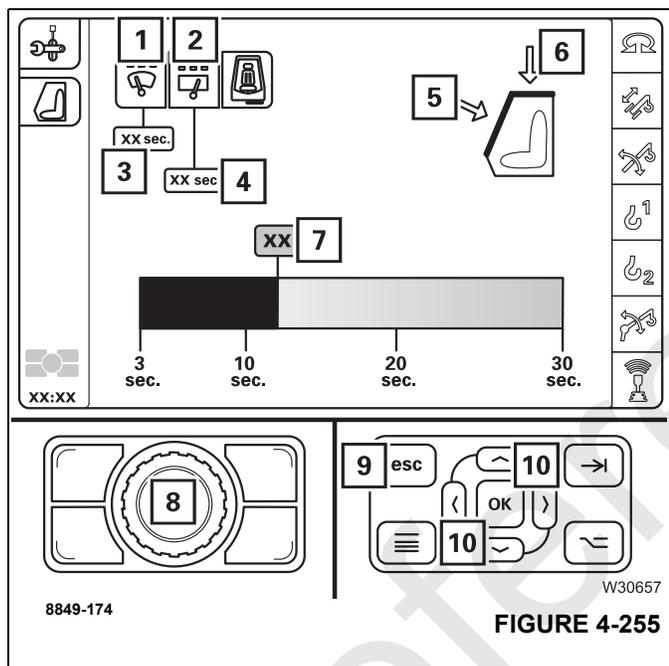


FIGURE 4-255



FIGURE 4-256

The Economy (ECO) Mode function offers the operator a convenient way to reduce noise and fuel consumption during craning operation. ECO Mode does this by automatically increasing the engine speed to an operator specified engine working speed when craning functions are operated and then decreasing the engine speed to idle speeds when no craning functions are operated.

The ECO Mode Function Screen (Figure 4-257) allows the operator to set the ECO Mode function to ON or OFF (1), (Figure 4-257). The function screen also allows the operator to specify the lengths of time of crane function inactivity before the crane's engine speed is reduced from the working engine speed to the two idle speeds (2 and 3), (Figure 4-257).

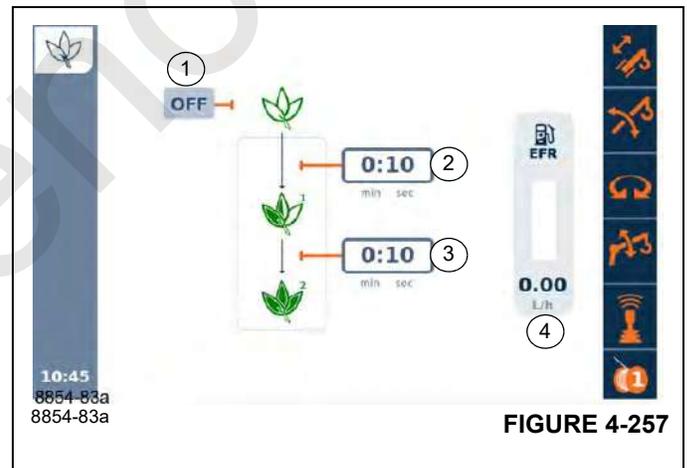


FIGURE 4-257

**Economy (ECO) Mode**

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 Switch, 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.

Select the ECO Mode icon (1), (Figure 4-256) under the User Settings Menu Group to show the ECO Mode function screen.

To open: Select symbol (1), (Figure 4-256) and confirm.

1	Set Economy Mode Function to ON/OFF
2	Idle Speed 1 Time Delay Setting
3	Idle Speed 2 Time Delay Setting
4	Fuel Usage Consumption Graph

The ON/OFF Icon (1), (Figure 4-257) is used to set the ECO Mode function to ON or OFF.

The Idle Speed 1 Time Delay Setting (2), (Figure 4-257) is used to specify the period of time the craning functions must be inactive (controllers in neutral position) before the engine speed is reduced from the operator specified working engine speed to the idle speed of 950 rpm.

The Idle Speed 2 Time Delay Setting (3), (Figure 4-257) is used to specify the period of time the craning functions must be inactive (controllers in neutral position) before the engine

speed is reduced from the operator specified working engine speed to the idle speed of 800 rpm.

**NOTE:** If the hydraulic oil cooling fan is operating, the crane will reduce the fan speed when the Time Delay Setting (3), (Figure 4-257) has been met. This reduces fuel consumption and does not affect cooling performance.

The Fuel Usage Rate graphic (4), (Figure 4-257) indicates fuel usage rate in the selected unit of measure.

The following terms are related to the ECO Mode function:

Term	Definition
ECO Mode OFF	ECO Mode is disabled and will not control engine speed.
ECO Mode ON	ECO Mode is enabled and will automatically control (increase and decrease) engine speed based on the operator's inputs.
Engine Working Speed	Engine speed set by the operator using the Increment/Decrement Switch

By default, ECO Mode is set to OFF from the factory. Once set to ON by the operator, the ECO Mode remains ON until the operator sets it to OFF. The crane software maintains the ECO Mode setting of ON or OFF regardless of whether the engine is shut off or if the battery disconnect switch is set to the off position.

When all crane functions are enabled, ECO Mode will stay ON, but the Engine Working Speed setting will decrease and reset to idle. When this occurs, the operator must again set the Engine Working Speed using the Increment/Decrement Switch (refer to *Engine Idle Increment/Decrement Start/Stop Switch*, page 3-9).

Whether ECO Mode is ON or OFF, the operator can always increase the engine speed above the current engine speed by using the Foot Throttle Pedal.

**NOTE:** ECO Mode only operates when operating craning functions and does not operate when operating the outriggers.

When ECO Mode is set to OFF, the crane operates in the following manner:

- Engine will idle at 800 rpm when no craning functions are enabled.
- Engine speed will increase and idle at 950 rpm when a craning function is enabled.

- Engine speed will return to 800 rpm when all crane functions are disabled.
- Foot Throttle Pedal and Increment/Decrement Switch can be used to set the engine speed between the system specified minimum and maximum engine speeds.

When ECO Mode is set to ON and the two time delays have been specified in the ECO Mode function screen, the crane operates in the following manner:

- Engine will idle at 800 rpm when no craning functions are operated.
- Working Engine Speed is set using the Increment/Decrement Switch.
- Engine speed will automatically increase from idle to the Working Engine Speed when a craning function is operated (controller is moved out of neutral position).
- Engine speed will stay at the Working Engine Speed while craning functions are operated.
- Engine speed will automatically decrease to the idle speed of 950 rpm after all craning functions have stopped (controllers in neutral position) and the time period that was specified in the Idle Speed 1 Time Delay Setting (2), (Figure 4-257) has past.
- Engine speed will automatically decrease to the idle speed of 800 rpm after all craning functions are disabled and the time period that was specified in the Idle Speed 2 Time Delay Setting (3), (Figure 4-257) has past.
- Engine speed can be increased above current engine speed using the Foot Throttle Pedal.

Set ECO Mode to ON and specify the two ECO Mode time delays using the ECO Mode function screen:

1. Press the Screen Toggle Button (1), (Figure 4-258) at the Jog Dial to select the ODM screen control. Using the Jog Dial (2), (Figure 4-258), select one of the time delay number fields (box around number will turn orange, (Figure 4-257), then press the Jog Dial (2), (Figure 4-258) (number will turn white with orange background).

- OR -

Using the Arrow Buttons (3), (Figure 4-258) on the Navigation Control Pad at the ODM, select one of the time delay number fields (box around number will turn orange, (Figure 4-257), then press the OK Button (4), (Figure 4-258) (number will turn white with orange background).

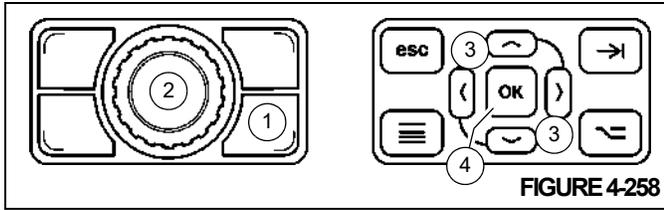


FIGURE 4-258

2. Using the Jog Dial or the Up/Down Arrow Buttons, set the time delay.
3. Press the Jog Dial or OK Button on the Navigation Control Pad to accept the time delay setting.
4. Repeat steps 1 through 3 until the minutes and seconds are set for the time delay.
5. Using the Jog Dial or the Arrow Buttons, select the OFF icon (Icon will turn orange), then press the Jog Dial or the OK Button to set ECO Mode to ON.

**Exhaust System Cleaning**

Select the Exhaust System Cleaning Icon (1), (Figure 4-259), under the User Settings Menu Group, to show the Exhaust System Cleaning function screen.

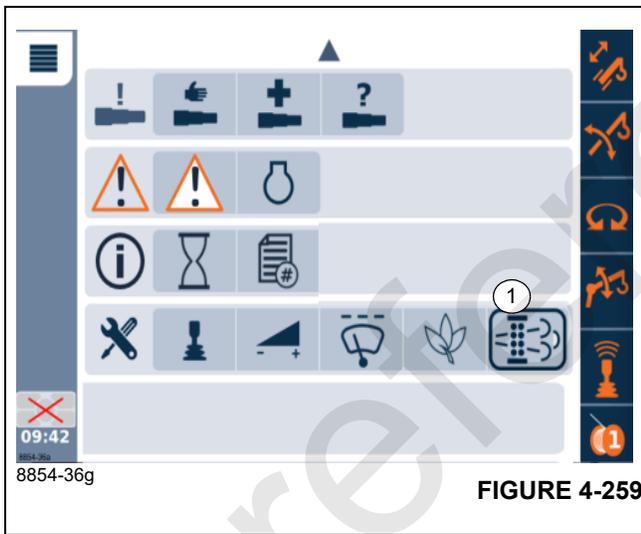


FIGURE 4-259

The Exhaust System Cleaning function (Figure 4-260) allows the operator to either initiate an exhaust system cleaning or inhibit an exhaust system cleaning.

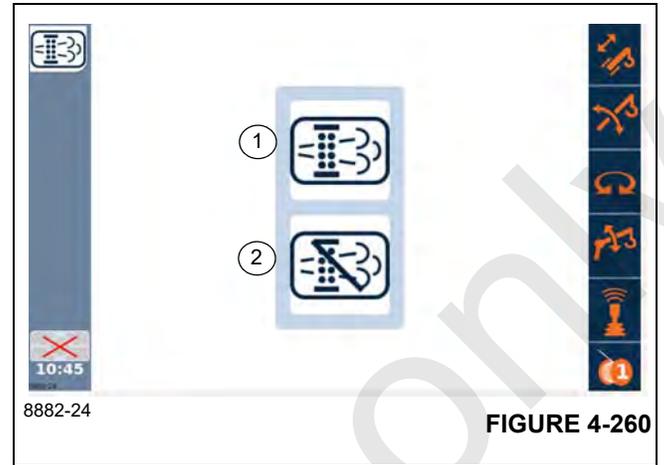


FIGURE 4-260

Item	Description
1	Initiate Exhaust System Cleaning
2	Inhibit Exhaust System Cleaning

**Manual Exhaust System Cleaning**

If the Engine Exhaust Cleaning Required Indicator comes on in the Alerts Area of the ODM, perform the following manual exhaust cleaning process as soon as possible.

**WARNING**  
**Burn/Fire Hazard!**

During the cleaning process, the exhaust and tailpipe become very hot. Keep personnel and flammable objects away from the exhaust. Do not park vehicle near flammable objects.

1. Make sure crane is not parked near flammable objects.
2. Set up a safe area around the crane's exhaust. Remove tools, rags, grease, or any debris from engine exhaust area.
3. Place transmission into neutral.
4. Engage the crane parking brake.
5. Release the service brake pedal and throttle pedal.
6. Using the Jog Dial or the Up/Down Arrow Buttons on the Navigation Control Pad, select the Initiate Exhaust System Cleaning Process Icon (1), (Figure 4-260) (icon turns orange).

- Press the Jog Dial or OK Button on the Navigation Control Pad to start the cleaning process.

Within 5 seconds the engine speed will increase to 1000 to 1400 rpm. The engine will continue to run at this speed, typically, from 45 minutes to 1.5 hours.

Pressing the service brake pedal or throttle pedal during cleaning or selecting the Inhibit Cleaning Process Icon (2), (Figure 4-260) will interrupt the manual cleaning process.

Make sure the crane and surrounding area are monitored during manual cleaning. If any unsafe condition occurs, stop engine immediately.

Engine will return to normal idle speed when the manual cleaning process is complete.

### Inhibit Exhaust System Cleaning

#### CAUTION

##### Crane Damage!

Exhaust system damage can occur if crane is operated for long periods of time with the exhaust cleaning system set to inhibit.

During normal operation of the crane, do not set the exhaust system cleaning to inhibit.

**NOTE:** Refer to section *Exhaust System Cleaning*, page 4-8 for information on the manual and automatic exhaust cleaning modes.

To inhibit, or prevent, the exhaust system from entering the active cleaning mode or to stop the exhaust cleaning process that was manually initiated, do the following:

- Using the Jog Dial or the Up/Down Arrow Buttons on the Navigation Control Pad, select the Inhibit Cleaning Process Icon (1), (Figure 4-261) Icon changes to orange).
- Press the Jog Dial or OK Button on the Navigation

Control Pad to set the cleaning process to inhibit (Inhibit Cleaning Process Icon changes to green).

The Inhibit Exhaust System Cleaning Indicator comes on in the Alerts Area of the ODM, and the active and manual modes of exhaust system cleaning are prevented.

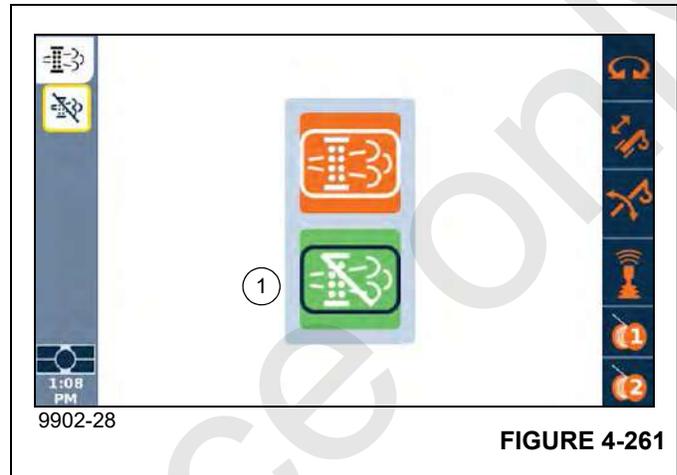


FIGURE 4-261

### Display Settings Menu Group

The Display Settings Menu Group (Figure 4-262) includes the following function icons:

- Time Set (page 4-193).
  - Display Screen Brightness (page 4-193).
3. Units of Measure (Metric/Imperial) (page 4-194).

**Time Set**

Select the Time Set Icon (1), (Figure 4-262), under the Display Settings Menu Group, to show the Time Set function screen.

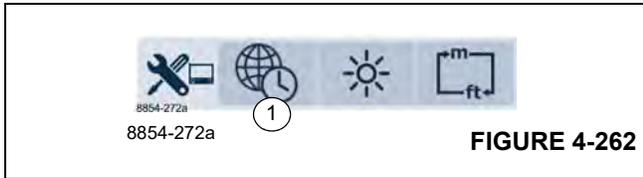


FIGURE 4-262

The Time Set function screen (Figure 4-263) allows the operator to set the time and the time format that is displayed on the ODM and RDM screens.

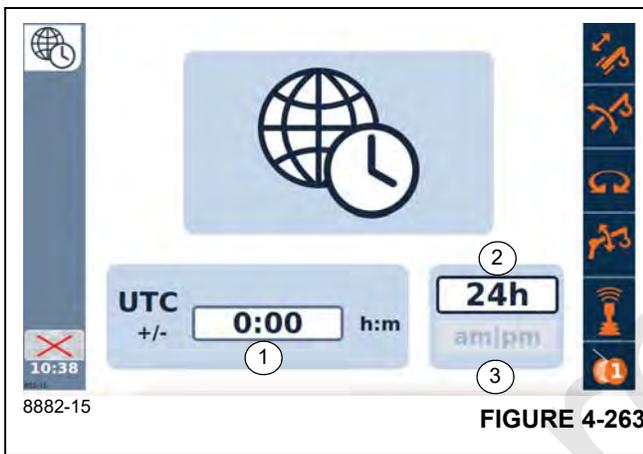


FIGURE 4-263

Item	Description
1	Setting the Time (UTC)
2	Select Time Format
3	Select am/pm for 12-hour Clock

Coordinated Universal Time (UTC) is used as the basis for setting the time. The usage of UTC is based upon a twenty-four-hour clock and the 0 degrees longitude meridian, referred to as the Greenwich Meridian in Greenwich, England. Thus, to set the time, the operator must know what time zone he or she is in relative to the UTC.

The following is a list of the United States GMT/UTC Offsets:

US Time Zone	UTC Offset Standard Time	UTC Offset Daylight Savings Time
Atlantic	UTC - 4h	
Eastern	UTC - 5h	UTC - 4h
Central	UTC - 6h	UTC - 5h
Mountain	UTC - 7h	UTC - 6h

US Time Zone	UTC Offset Standard Time	UTC Offset Daylight Savings Time
Pacific	UTC - 8h	UTC - 7h
Alaska	UTC - 9h	UTC - 8h
Hawaii - Aleutian	UTC - 10h	UTC - 9h

To set the time and time format, do the following:

1. Using the Jog Dial or Arrow Buttons on the Navigation Control Pad, select the UTC Offset field (1), (Figure 4-263).
2. Press the Jog Dial or the OK Button.
3. Turn the Jog Dial or press the Up/Down Arrow Buttons until the correct UTC Offset is shown.
4. Press the Jog Dial or OK Button to accept the value.
5. Using the Jog Dial or Arrow Buttons, select the Time Format field (2), (Figure 4-263).
6. Press the Jog Dial or the OK Button.
7. Using the Jog Dial or Arrow Buttons, select the desired time format, either 24 hour or AM/PM (3), (Figure 4-263).
8. Press the Jog Dial or OK Button to accept the value.

**NOTE:** AM or PM will not be available for selection if the 24h time setting is selected.

**Display Screen Brightness**

The Display Screen Brightness function allows the operator to adjust the brightness of the ODM and RDM display screens. The brightness of the displays are regulated automatically by the display, depending on the ambient brightness. You can set a minimum degree of brightness manually, which is always observed when the brightness is regulated.

Select the Display Screen Brightness Icon (1), (Figure 4-264) under the Display Settings Menu Group to show the Display Screen Brightness function screen.

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

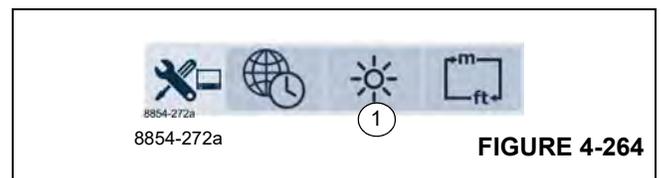


FIGURE 4-264

- Select the symbol (1), (Figure 4-265).
  - Confirm the selection.
- An arrow (2), (Figure 4-265) appears on the left and right of the percentage (1), (Figure 4-265).
- Set the desired minimum brightness.
  - Confirm the selection.

The brightness of the display changes while setting and you can view the set value (0 to 100%) on the display (1), (Figure 4-265).

The brightness set here is the minimum value for automatic regulation.

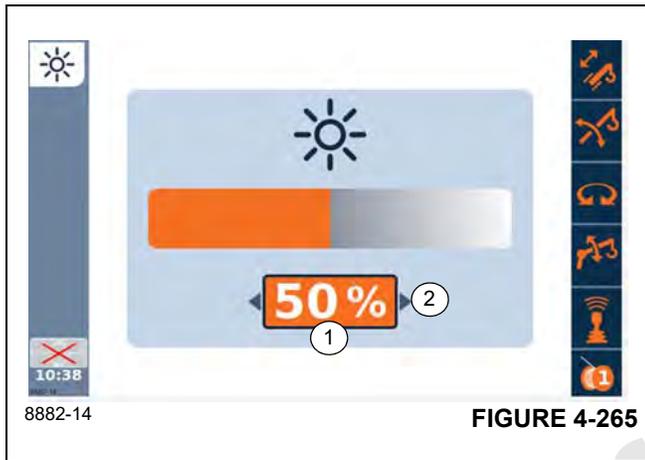


FIGURE 4-265

**NOTE:** There is no automatic regulation if you set the brightness to 100%.

The displays then always show maximum brightness.

You can cancel the entry at any time using the (1), (Figure 4-266) or (2) buttons. The settings are then reset.

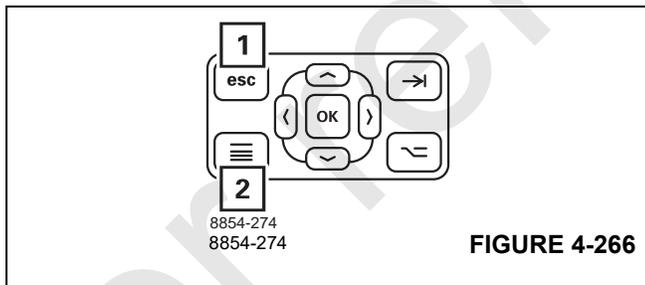


FIGURE 4-266

If the temperature on the display is too high, the brightness is reduced automatically – lamp (1), (Figure 4-267) lights up.

When the temperature falls, the specified brightness is restored – lamp (1), (Figure 4-267) goes out.

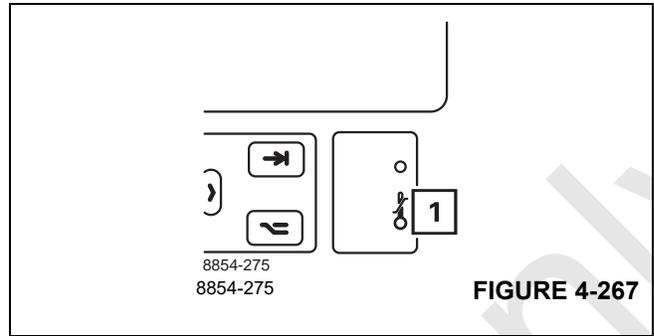


FIGURE 4-267

**Units of Measure (Metric/Imperial)**

Select the Units of Measure (Metric/Imperial) Icon (1), (Figure 4-268), under the Display Screen Settings Menu Group, to show the Units of Measure function screen.



FIGURE 4-268

The Units of Measure function screen (Figure 4-268) allows the operator to change the units of measure (Metric/Imperial) that are used throughout the ODM and RDM.

Use the Jog Dial or Arrow Buttons on the Navigation Control Pad to select the desired unit of measure, then press the Jog Dial or the OK Button to accept the new setting.

Use the Switch Units (Figure 4-269) to select either Metric (1) units of measure or Imperial (2) units of measure.

The symbol (3), (Figure 4-269) shows the respective confirmed selection as shown with a check mark.

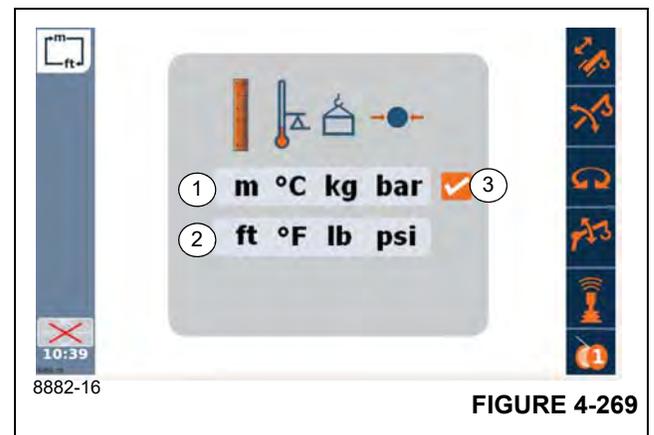


FIGURE 4-269

Item	Description
1	<b>Display Metric Units:</b> <ul style="list-style-type: none"> <li>Meters</li> <li>Degrees Celsius</li> <li>Kilograms</li> <li>Bar</li> </ul>

Item	Description
2	<b>Display Imperial Units:</b> <ul style="list-style-type: none"> <li>Feet</li> <li>Degrees Fahrenheit</li> <li>Pounds</li> <li>Pounds per square inch (PSI)</li> </ul>

**Operation of the Rated Capacity Limiter**

The current rigging mode is determined by:

- measured values,
- manual entry.

Determination Based on Measured Values	Determination Based on Manually Entered Values
Main boom length	Counterweight
Main boom angle	Length of lattice extension
Angle of the hydraulic boom extension	Angle of the lattice extension <sup>1)</sup>
Outrigger span <sup>2)</sup>	Reeving

<sup>1)</sup>Lattice extension – with manual offset.

<sup>2)</sup>**Note: Unless Operator inputs and acknowledges different span.**

During the operation of the crane, a visual and acoustic early warning is issued before the load limit is reached and then the functions are shut down that would lead into the overload range.

**Switching ON the RCL**

**Enable the RCL**

The RCL is switched ON together with the ignition.

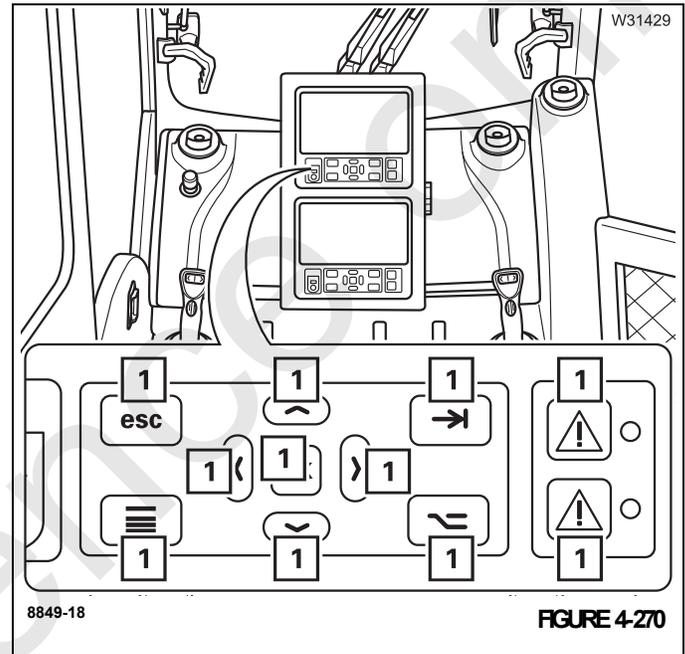
- Enable the ignition.

A test program runs after switching ON the ignition. A continuous buzzer tone sounds for approximately 2 seconds and a lamp test is performed.

- Check whether you can hear a buzzer tone.

**Lamp Test**

Check that lamps (1), (Figure 4-270) light up briefly after turning ON the ignition.

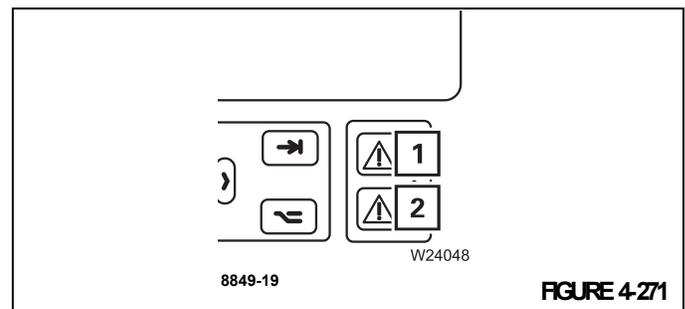


**FIGURE 4-270**

**NOTE:** If one or more lamps do not light up, do not use the crane for lifting service until appropriate measures are taken to ensure safe operation. Contact your local distributor or Grove Product Support for assistance if necessary.

After the test program:

- the lamps (1), (Figure 4-271) and (2), (Figure 4-271) light up,
- all power units are disabled.



**FIGURE 4-271**

The current display depends on whether the RCL either:

- was switched OFF for up to 2 hours,

OR

- was switched OFF for more than 2 hours.

**After a Standstill of Up to 2 Hours**

The Monitoring Menu opens.

The last set rigging mode will be displayed, and symbols (1), (Figure 4-272) and (2), (Figure 4-272) will be green and flashing. **NOTE:** Be sure that the crane configuration has not been changed (or matches) the configuration for the code being displayed.

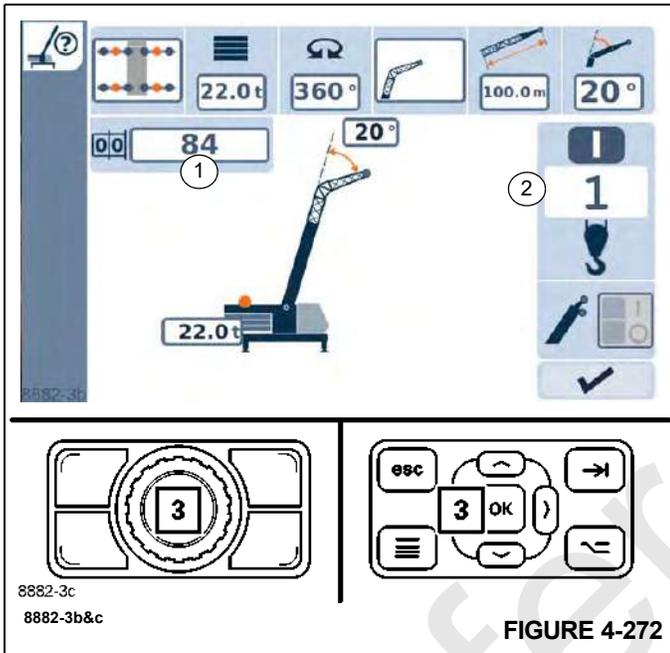


FIGURE 4-272

You can accept the displayed values if they correspond to the current rigging mode:

- Press button (3), (Figure 4-272) once – symbols (1), (Figure 4-273) and (2), (Figure 4-273) will stop flashing.

Lamps (1), (Figure 4-273) and (2), (Figure 4-273) will go out. The RCL code has been applied.

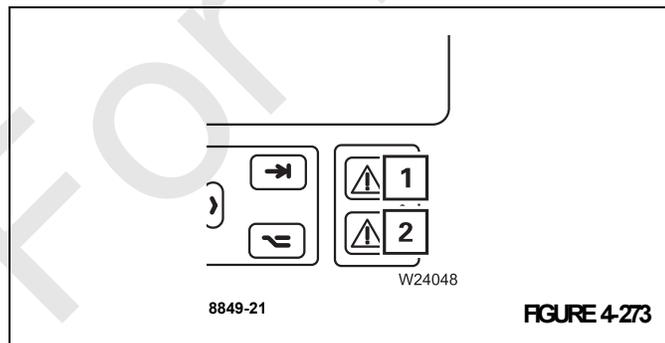


FIGURE 4-273

If no error message is displayed, the RCL is set for crane operation and crane movements are enabled. Refer to *Before Operating the Crane*, page 4-38. This procedure only applies to working with a rigged truck crane (supported and rigged with counterweight). If the truck crane is not yet rigged, refer to *Set-up and Installation*, page 5-1.

If an error is present, a symbol (1), (Figure 4-274) is shown. Refer to *Display in the Event of Errors*, page 4-218.



FIGURE 4-274

You must re-enter the current rigging mode if the displayed values do not correspond to the current rigging mode of the crane. Refer to *Enter Rigging Code*, page 4-198.

**After a Standstill of More than 2 Hours**

The Enter Rigging Code Menu opens.

Display (1), (Figure 4-275) will show RCL code 1100 – the corresponding rigging mode will be displayed.

The display (2), (Figure 4-275) shows the last reeving entered, e.g. 1.

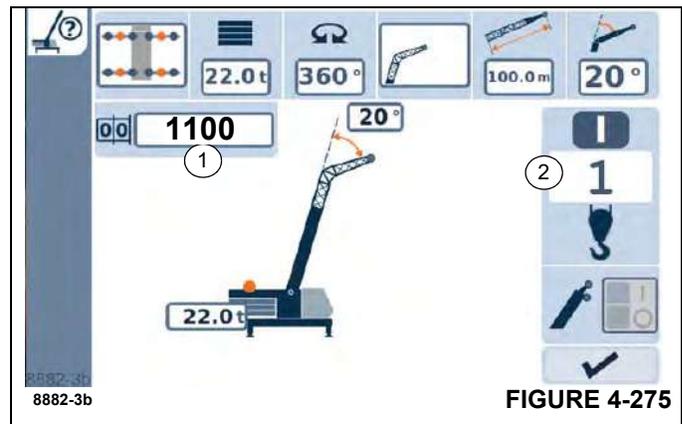


FIGURE 4-275

Enter the current rigging mode. Refer to *Enter Rigging Code*, page 4-198 below.

**Using the Rated Capacity Limiter Display Module (RDM)**

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

**NOTE:** Refer to *Rated Capacity Limiter Display Module (RDM) and Operator Display Module (ODM)*, page 3-44 and (Figure 3-45).

The Rated Capacity Limiter (RCL) is an electro-mechanical sensing system designed to alert the crane operator of impending capacity when the system has been accurately programmed. When an overload condition is sensed, the system provides the operator with visual and audible warnings, and locks out the controller functions to prevent raising and lowering the boom, extending the boom, swinging left or right, or raising the main or auxiliary (optional) hoist ropes.

**! DANGER**

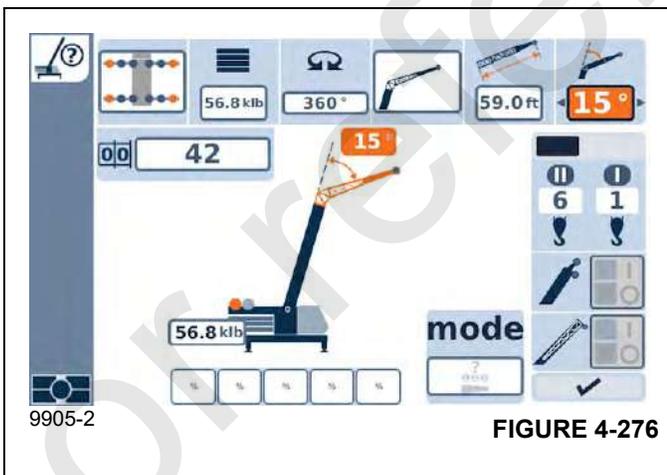
Electronic equipment on this crane is intended as an aid to the operator. Under no condition should it be relied on to replace the use of Load Charts and operating instructions.

Sole reliance on these electronic aids in place of good operating practices can cause an accident.

The rated capacity limiter is abbreviated RCL (**R**ated-**C**apacity-**L**imiter) in these operating instructions.

If the truck crane's current rigging mode is registered properly, the RCL will prevent the permissible lifting capacity from being exceeded and the truck crane from being overloaded.

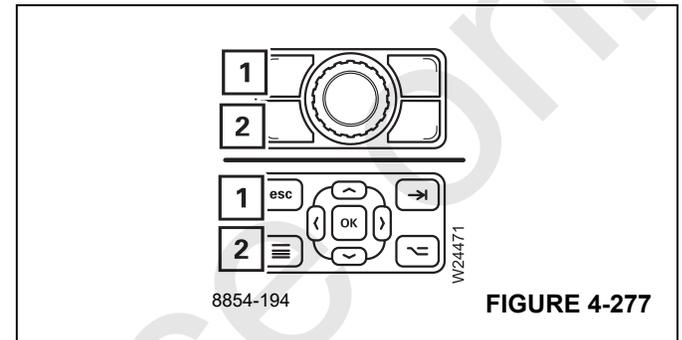
The RCL Setup Screen (Figure 4-276) appears on the RDM when the ignition key is set to the ON position.



From the RCL Setup Screen, the operator can program the RCL either by entering a rigging code number from the *Load Chart Manual* or by entering the crane configuration using the setup wizard.

**Exiting the Menu/Input Mode**

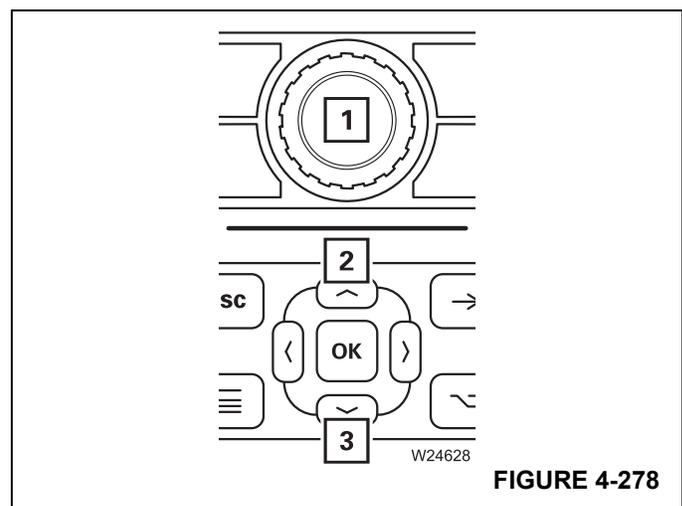
Press button (1):	The opened menu is closed – the main menu is opened (Figure 4-277) Input mode is deactivated
Press button (2):	The opened menu closes – the menu from the next higher level is opened Input mode is deactivated



**Entering RCL Values**

The input mode for the RCL code is switched on.

1	Clockwise (Figure 4-278):	Next greater value
	Counterclockwise:	Next smaller value
	Slowly turning – changes the value gradually	
	Hold down and turn - changes the value quickly	
<b>OR</b>		
2	Next greater value	
3	Next smaller value	



### Enter Rigging Code

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

There are two ways of entering the current rigging code.

- Either enter the individual components (1), (Figure 4-279) to (8), (Figure 4-279) one after the other.
- Or enter the RCL code (12), (Figure 4-279) and the reeving (7), (Figure 4-279).

The newly entered rigging code must then be confirmed

- with (13), (Figure 4-279).

The following section describes the input procedure based on the individual components. If you want to enter the rigging mode based on the RCL code, refer to *Entering the RCL Code*, page 4-206.

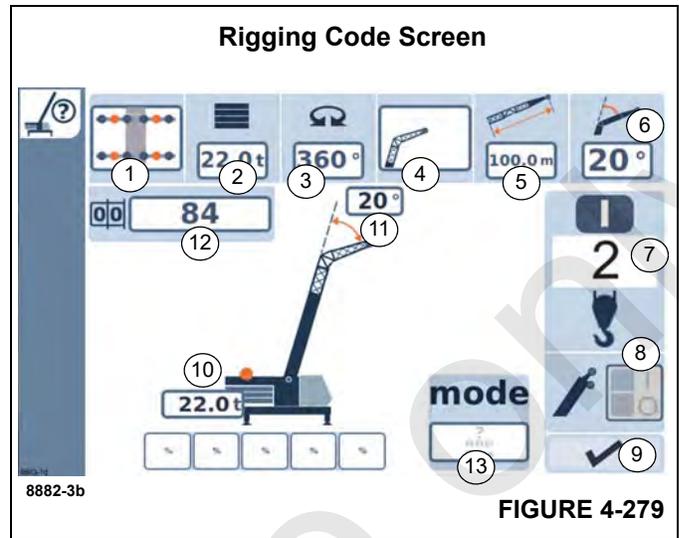


FIGURE 4-279

Item	Description
1	Outrigger Span
2	Counterweight
3	Swing Range
4	Main Boom or Boom Extension
5	Boom Extension length including inserts <sup>1)</sup>
6	Boom extension offset angle <sup>1)</sup>
7	Parts of line for each hoist
8	Aux nose used/not used
9	OK selections/return to main screen
10	Counterweight
11	Boom Extension offset angle
12	Rigging code number
13	Selector for Telescoping Mode Number <sup>2)</sup>

1) Optional equipment.

2) Available when RCL enabled and boom fully retracted and locked.

**NOTE:** All of the Items on this screen are data entries, except for Items 10 and 11. Items 10 and 11 are data displays.

**Entering RCL Individual Components**

With this type of input, select all the components of the rigging mode one after the other.



**DANGER**

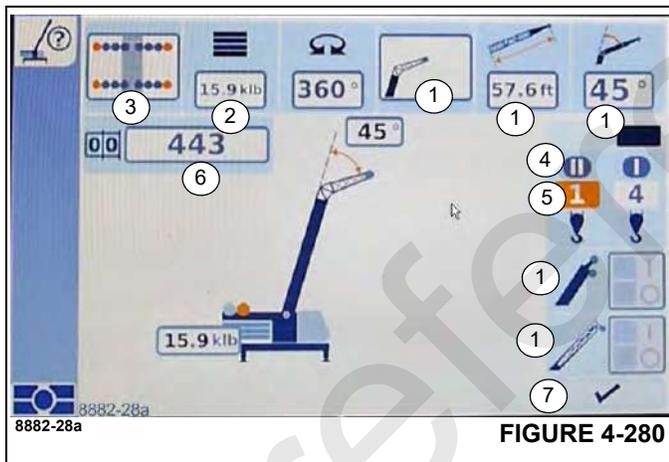
**Overload/Tip Over Hazard!**

The RCL is an operator aid. If it is programmed incorrectly, the system may not warn the operator of impending overload and may not activate function lockouts.

Make sure that the RCL is properly programmed to correspond to the actual crane configuration being used.

When re-entering the rigging mode completely, you can prevent already entered components from changing by making entries in the following order:

- Counterweight (2), (Figure 4-280).
- Boom system (1), (Figure 4-280).
- Outrigger span (3), (Figure 4-280).



**FIGURE 4-280**

In this order, the values that can be selected for the current entry are always restricted by the previous entry. As a result, already entered values do not change.

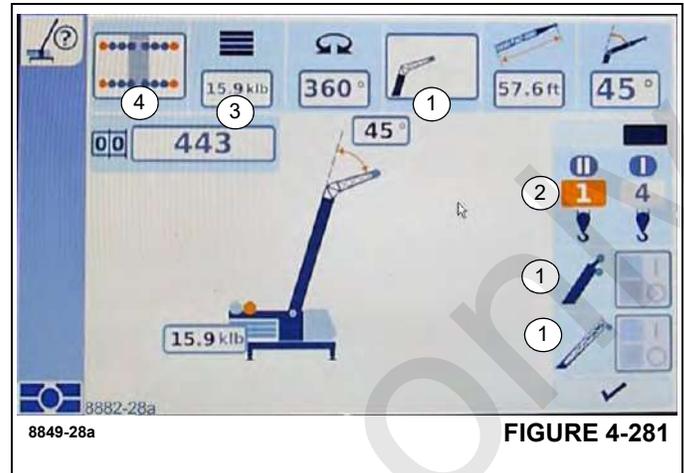
When entering the components, the corresponding RCL code (6), (Figure 4-280) is displayed at the same time.

Then you must enter the current reaving (5), (Figure 4-280) and accept the indicated rigging mode.

**Switching ON Input Mode**

- Select one of the desired components (1), (Figure 4-280) to (4), (Figure 4-280).

The corresponding symbol goes orange.



**FIGURE 4-281**

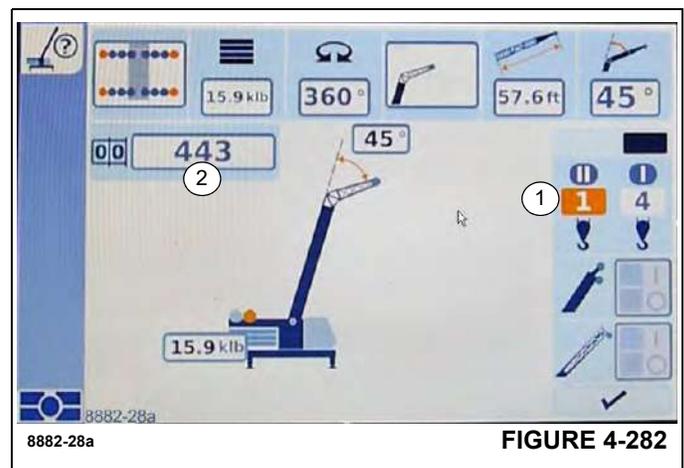
- Confirm the selection.
- Direction arrows appear on the display.
- Input mode is switched ON.

**Selecting Values**

With the input mode switched ON, you can select values that are permissible according to the Lifting Capacity Table.

The selection process is described using reaving as an example.

- Select and confirm the symbol (1), (Figure 4-282) – arrows on the left and right are displayed.
- Select using the left or right buttons on the control panel until the display shows the rigged reaving.



**FIGURE 4-282**

- Confirm the selection.

The display (2), (Figure 4-282) shows the corresponding RCL code.

You can cancel the input at any time. Press button (1), (Figure 4-283) or (2), (Figure 4-283).



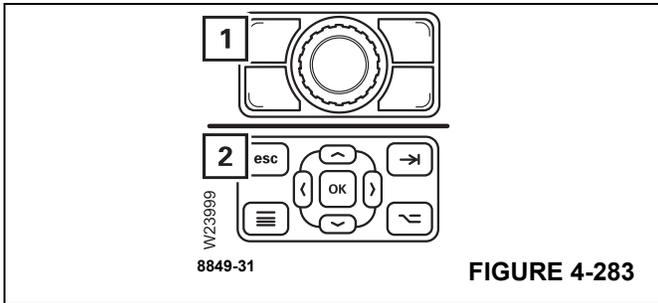


FIGURE 4-283

After the selection procedure, there are three options:

- Cancel input mode:
  - Press the button (3), (Figure 4-284) or (4), (Figure 4-284) once – the config menu is opened.

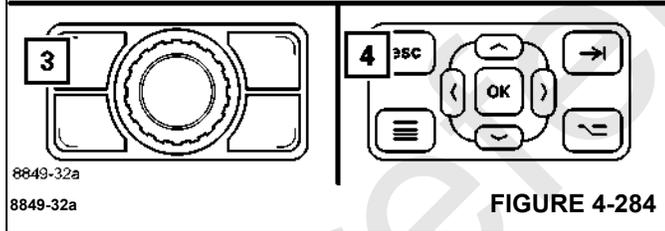
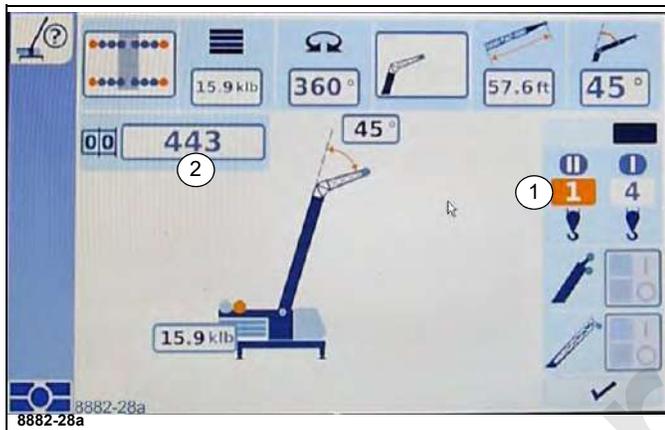


FIGURE 4-284

- Switching over the input mode:
  - Select and confirm a symbol (1), (Figure 4-284) for the next component – symbol red.
- Accept the displayed rigging mode:
  - Select and confirm the symbol (2), (Figure 4-284). Refer to *Accepting the Rigging Code*, page 4-207.

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

**Enter Counterweight**

- Select and confirm the symbol (1), (Figure 4-285).

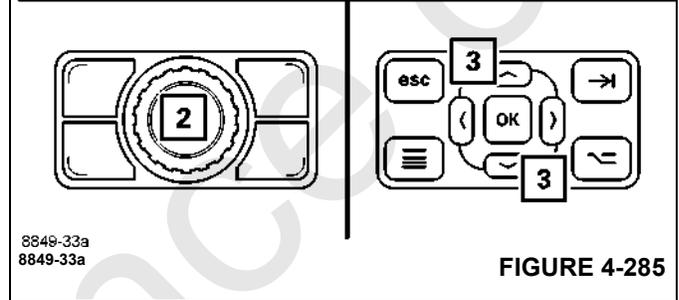
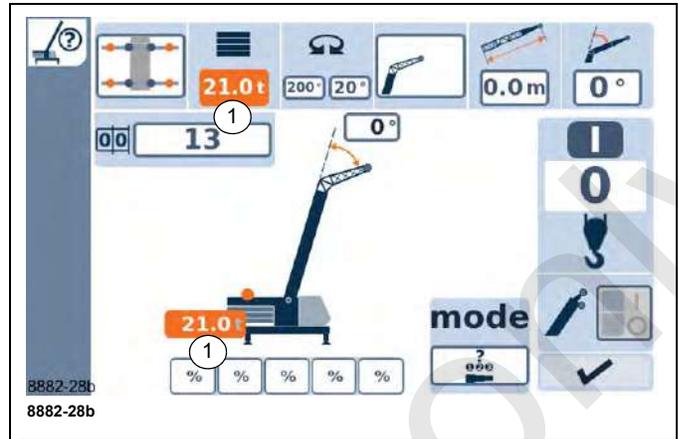


FIGURE 4-285

- Use the buttons (2), (Figure 4-285) or (3), (Figure 4-285) to select the required counterweight combination, e.g. 21.0 klb.
- Confirm the selection. Refer to *Counterweight Versions/Combinations*, page 5-19.

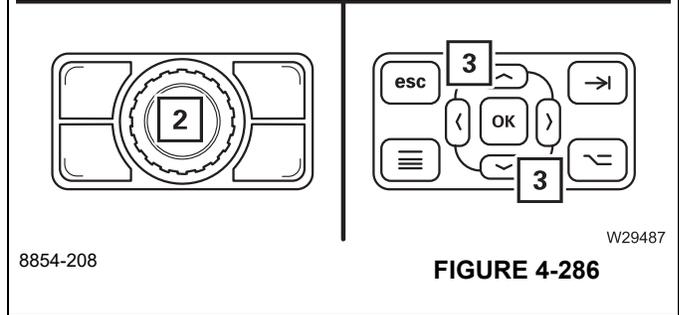
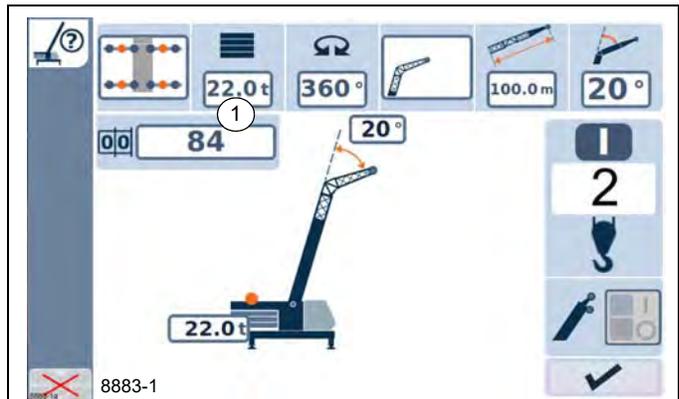


FIGURE 4-286

There are 2 choices: main boom and boom extension (1), (Figure 4-287). Then, if a boom extension is selected, the operator chooses the boom extension length (2) which includes inserts and stinger.

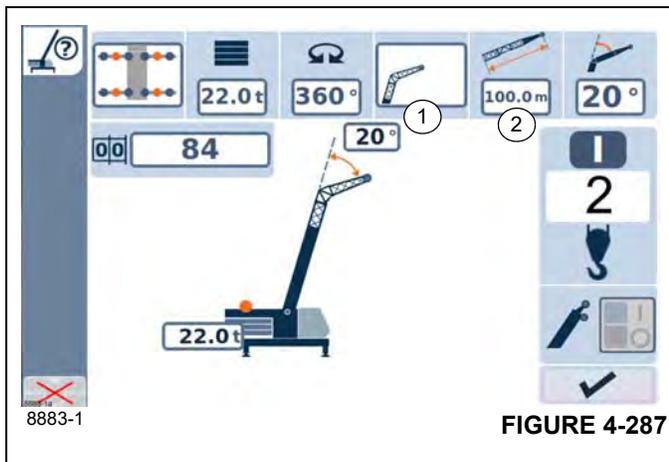


FIGURE 4-287

**Boom System Setup Display**

1	Main boom/auxiliary single-sheave boom top (Figure 4-288)
2	Main boom with lattice extension, or standard lattice extension which can be angled.

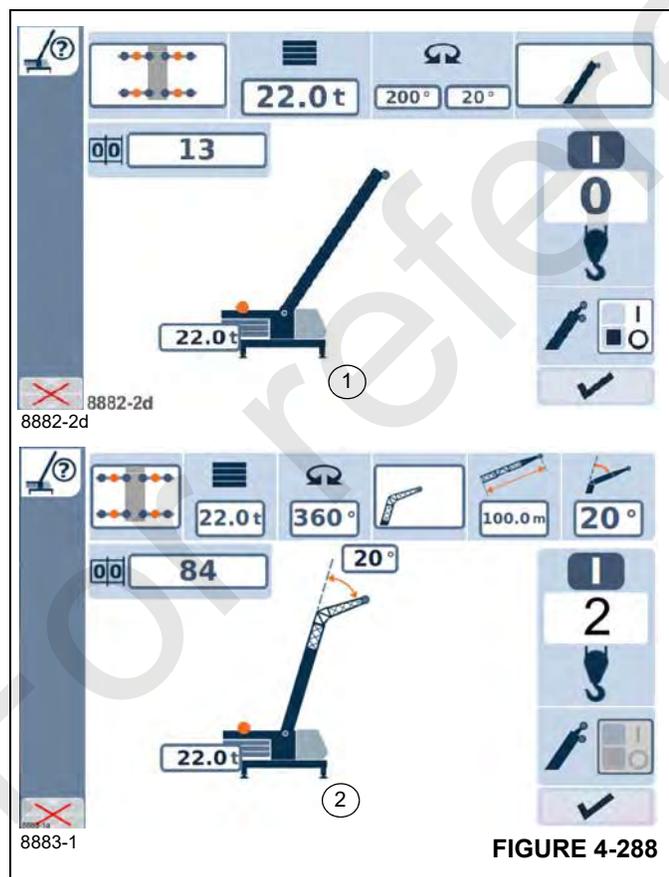


FIGURE 4-288

**Outrigger Span**

Depending on the equipment of the truck crane, the outrigger span (Figure 4-289) is shown in meters, feet or percent (%).

- Select and confirm the symbol (1), (Figure 4-289).
- Use the jog dial buttons (2), (Figure 4-289) or (3), (Figure 4-289) to select the rigged outrigger span.
- Confirm the selection.
- Press the extend/retract button to position the outriggers to the desired position (4), (Figure 4-289).

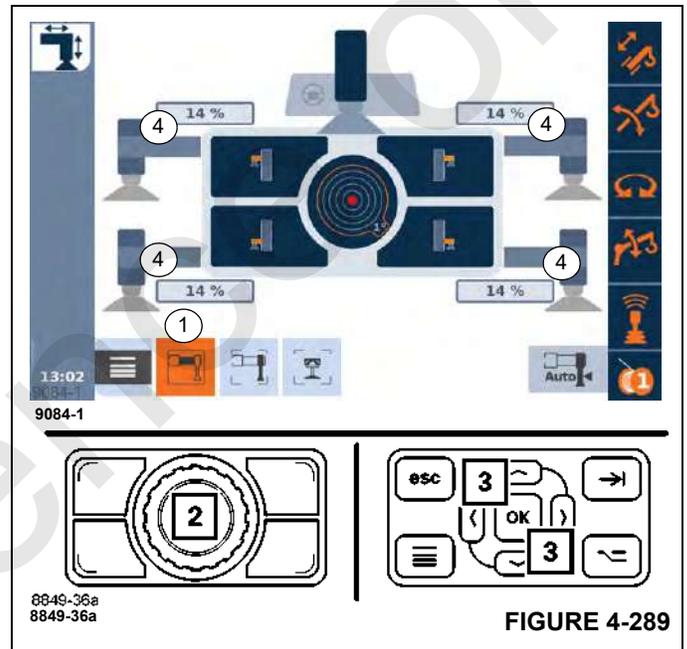


FIGURE 4-289

The outrigger span is monitored. You must check the outrigger span when entering the Rigging Mode.

The TMS875-2/TMS800-2 contains the OMS Screen version for the late model cranes. Upon programming and confirming the rigging code using the RCL Setup Screen, the RCL Monitoring Screen will appear and show the crane configuration information. When the operator accepts a new rigging code, (Figure 4-290) it will be displayed if the measured outrigger positions do not match the required outrigger positions. The rigging code and the required outrigger positions are shown on the left side of the figure. The actual positions are shown on the right side of the figure and are RED if they do not match the required positions.

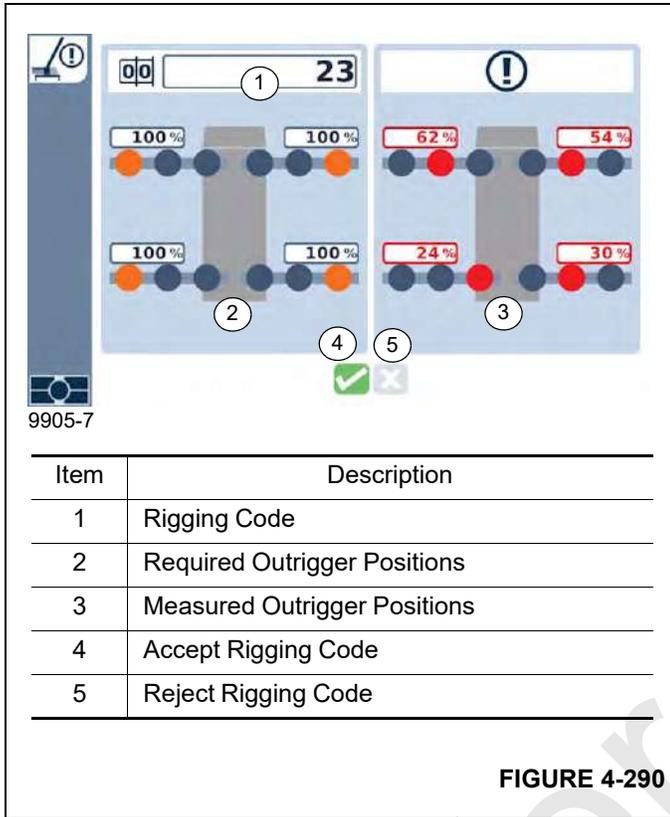
If the outrigger positions match the rigging code selected, this screen is skipped and the display goes directly from the setup screen to the main operating screen.

The operator has the choice of:

- 1) Returning to this setup screen to change the selection

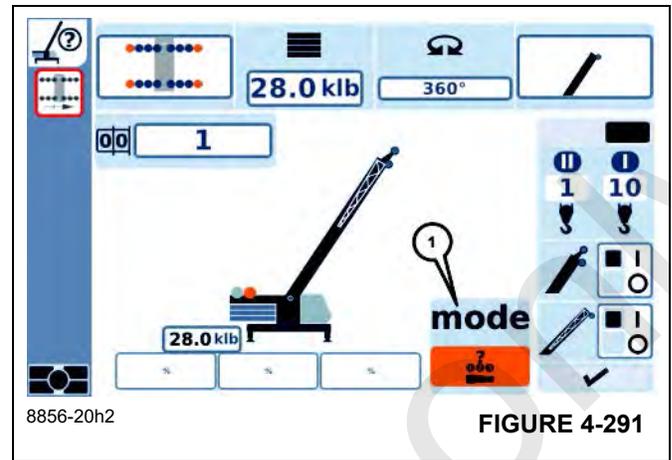
--OR--

2) Verifying that the chosen outrigger position is the one to use even though it does not match the OMS, in which case the screen transitions to the main viewing screen. Also, refer to *Accepting the Rigging Code*, page 4-207 and *Outrigger Monitoring System (OMS)*, page 4-48.

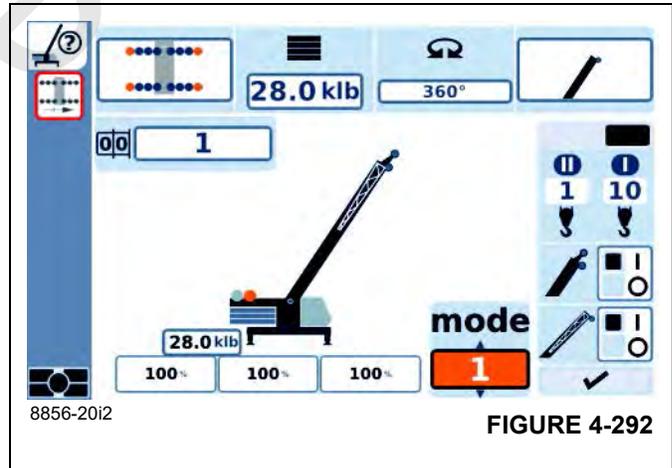


**Telescoping Mode Number Entry**

The telescoping status or pinned boom configuration can be selected from the RDM (RCL display). This is done by selecting a Telescoping Mode Number. Refer to (1), (Figure 4-291). There are 5 available pre-selected Mode Numbers. Referring to (Figure 4-291), the Telescoping Mode Number is available to be selected since this option on the display is selectable. However, this is only selectable after the RCL has been initialized once (having previously used the check-mark on this screen), the telescoping function has been enabled, and the boom is fully retracted and locked.



With the Telescoping Mode Number option available, and using Enter on this item on the screen, the up/down arrows or jog dial can be used to select from 1 to 5. (Figure 4-292) shows the appearance for Mode 1. It is seen that Mode 1 has the requested pinned boom configuration of 100-100-100. If this is the desired configuration, then Enter can be used to select it. Then, when the check-mark is used on this screen, the new requested telescoping status will be used and the semi-automatic telescoping function commences. The ODM (operating display) can then be used to select a telescoping screen and the requested telescoping status should be shown on the ODM.



Note that when the RCL configuration screen is used (such as shown in Figures 4-291 and 4-292), the telescoping function is paused (unable to extend, retract, lock or unlock the boom). Once the check-mark is used, the telescoping function resumes.

**Monitoring RCL Screen**

Displays – depend on rigging mode.

The Rigging Code Screen Icon (Figure 4-293) comes up when the check mark in (Figure 4-291) is selected which

allows the operator to view the monitoring screen. Refer to *Enter Rigging Code*, page 4-198.

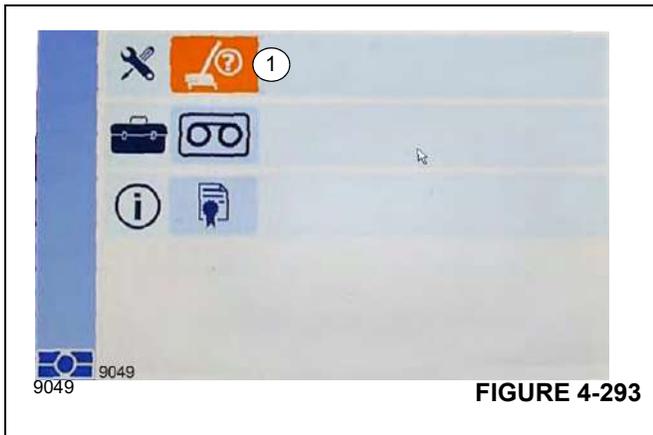


FIGURE 4-293

**Displays During Crane Operation**

The following information is constantly displayed in addition to the displays of the rigging mode:

**Current Overall Height**

Overall height is the approximate vertical distance between the lower edge of the outrigger pad and the highest point of the main boom or lattice extension. The displayed value (1), (Figure 4-294) applies to fully extended outrigger cylinders on the largest outrigger span.

The value is displayed either in meters (m) or in feet (ft), depending on the setting.

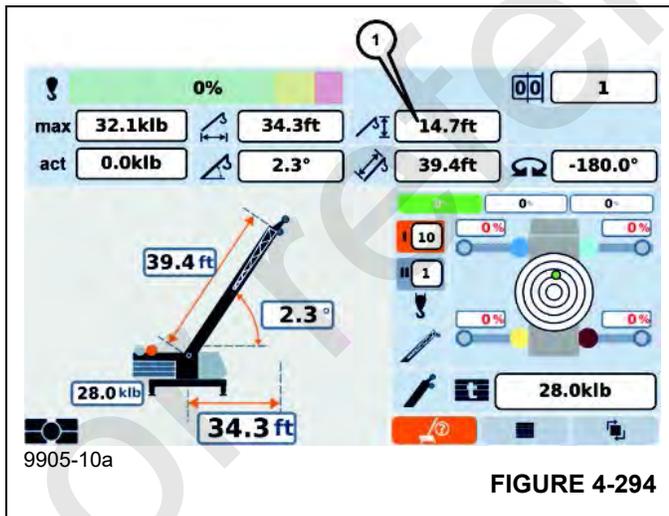


FIGURE 4-294

**Current Lattice Extension Angle**

- **Lifting/lowering lattice extension:** Shows the current lattice extension angle (1), (Figure 4-295) in relation to the main boom in degrees.

- **Lattice extension, can be angled:** Shows the angle of the lattice extension corresponding to the RCL code in degrees (1), (Figure 4-295).

If the displayed RCL code does not apply to a lattice extension, nothing will be displayed.

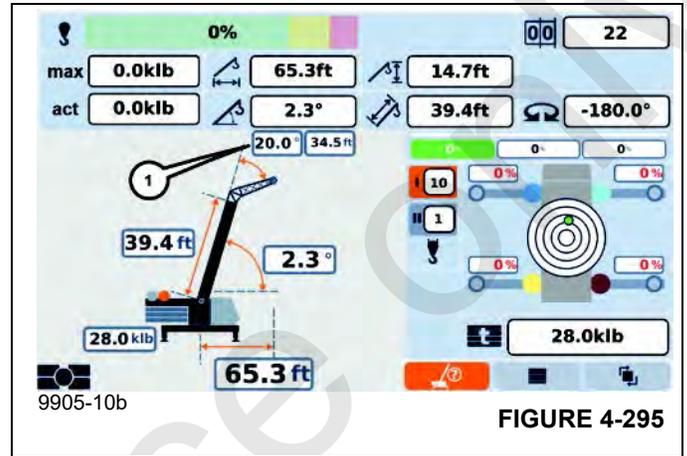


FIGURE 4-295

**Counterweight Display**

Indicated counterweight combination in tons (t) or kilo-pounds (1), (Figure 4-296) for displayed RCL code.

**NOTE:** Units will be metric tons or kilo-pounds (Kilo-pounds is shown on the figure).

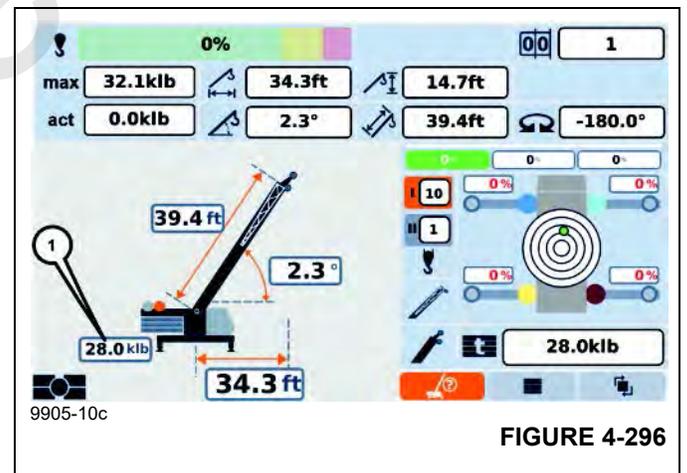


FIGURE 4-296

**Display of the Lattice Extension Offset Angle**

When the RCL is programmed for a lattice extension, the lattice extension offset angle (current angle between the lattice extension and main boom in degrees) will be displayed.

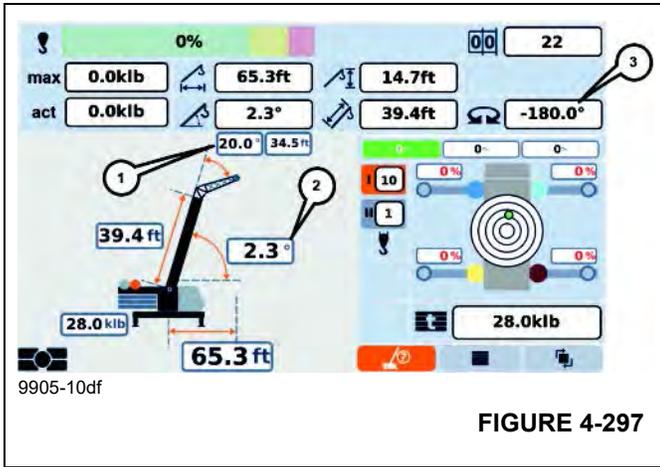


FIGURE 4-297

**Current Main Boom Angle Display**

Display:	Current angle between main boom and horizontal position in degrees (°) (2), (Figure 4-297)
----------	--

**Current Swing Angle Display**

0°:	Position 0° to the rear (3), (Figure 4-297)
180°:	Position 180° to the front
+0.1 to +180.0°:	Turned to the right from 0°
-0.1 to -179.9°:	Turned to the left from 0°

**Current Load Display**

Display:	Lifted load (1), (Figure 4-298) in metric tons (t) or kilo-pounds (klbs) Example: 5.95 klb equals 5,950 lbs.
----------	---

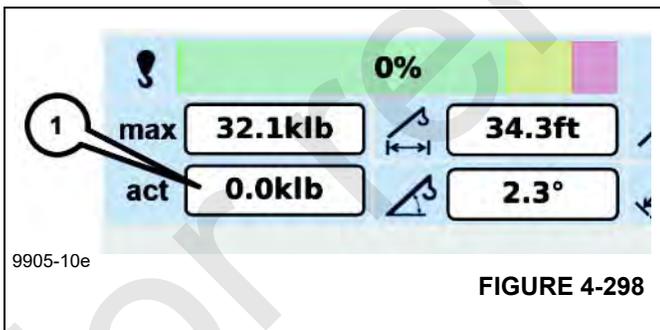


FIGURE 4-298

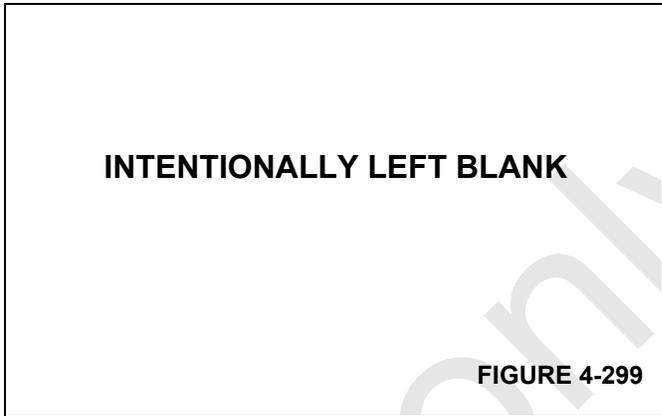


FIGURE 4-299

**Maximum Load Display**

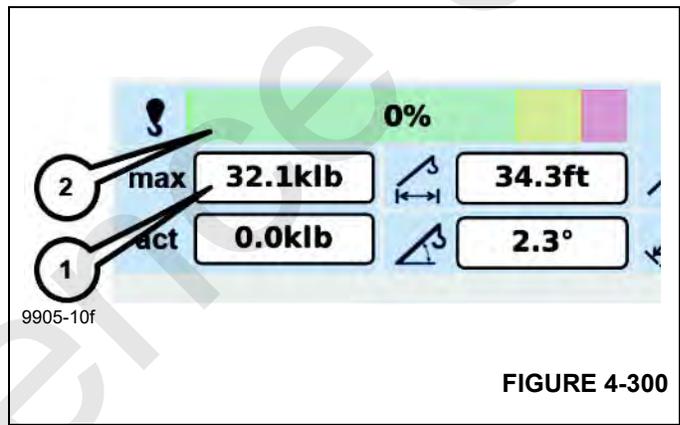


FIGURE 4-300

Display:	Maximum load (1), (Figure 4-300) in metric tons (t) or kilo-pounds (klbs) for the displayed RCL code
----------	--

**Current Degree of Utilization Display**

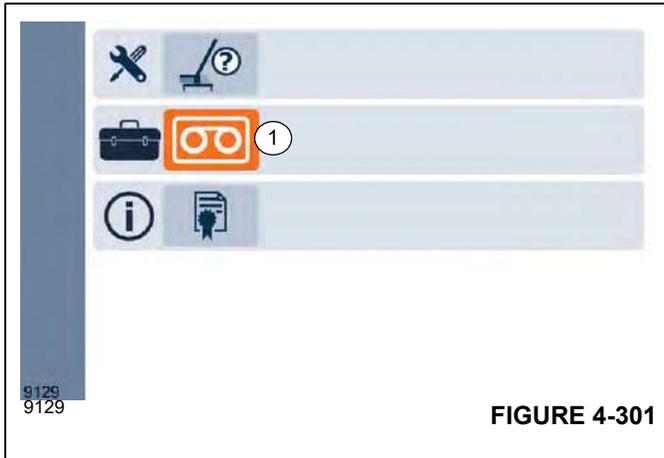
Degree of utilization = 100 x current load/maximum load (2), (Figure 4-300).

1	Color display:	
	• Green:	0 - 90%
	• Yellow:	approx. 90 - 100% – early warning
	• Red:	greater than 100% – lockout
2	Display in percentage	

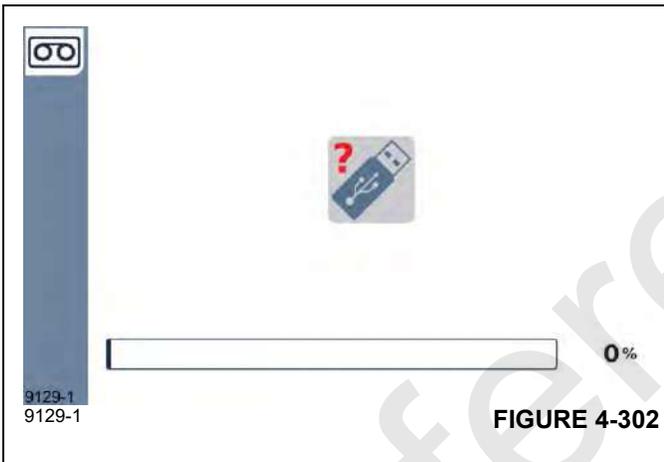
**Data Logger**

The data logger is used to download the status of the machine.

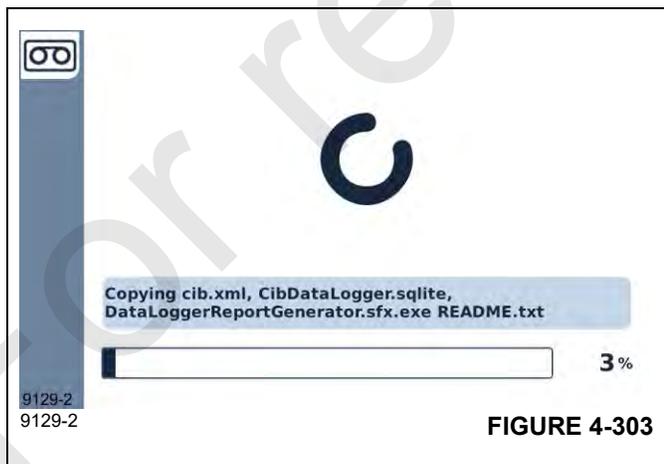
1. Select the data logger icon (1), (Figure 4-301) on the RDM.



2. Insert USB drive into the USB port of RDM (Figure 4-302).



3. Press USB Button once drive is detected to start download (Figure 4-303).

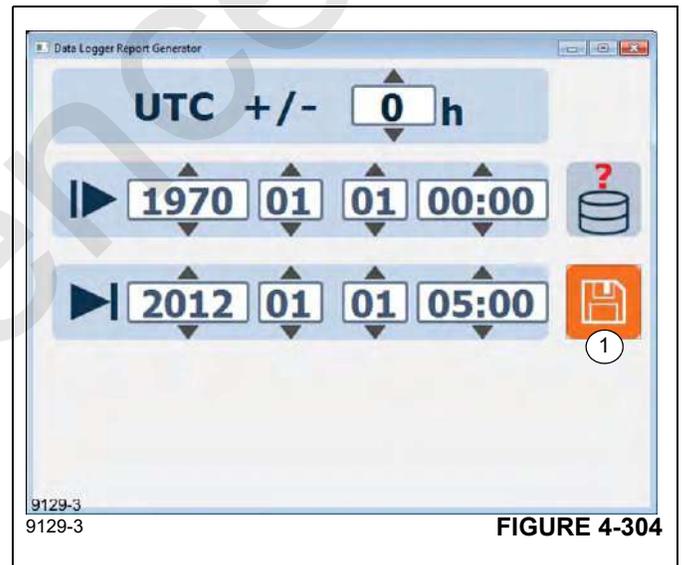


4. Once writing reaches 100% remove the USB drive and plug it into a laptop computer, the following files will have been created:

- CibDataLogger.sqlite
- DataLoggerReportGenerator.sfx.exe
- cib.xml

5. 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.

6. Choose the time span for the report (Figure 4-304), the default is the maximum amount of time possible. After the report is generated the disk save icon (1) will be highlighted. Select the Save Icon and choose the directory to save the report to (Figure 4-304).



7. 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.
8. Open the cib.xml file to see all the possible loggable items and their descriptions.

**Exiting the Menu**

Press button (1), (Figure 4-305) on the Jog Dial or press the ESC Button (2), (Figure 4-305) on the control panel.

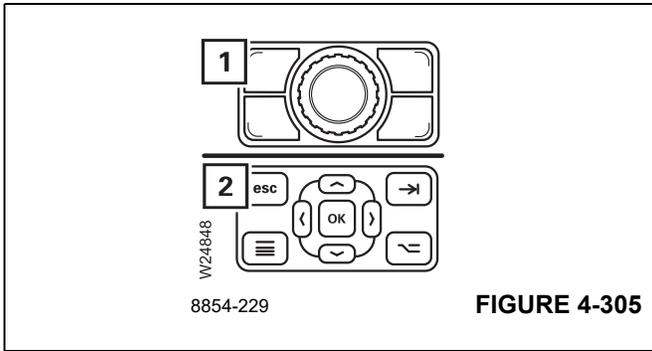


FIGURE 4-305

**Swing Range**

- Select and confirm the symbol (1), (Figure 4-306).
- Use the buttons (2), (Figure 4-306) or (3), (Figure 4-306) to select the required swing range, e.g. 360°.
- Confirm the selection.

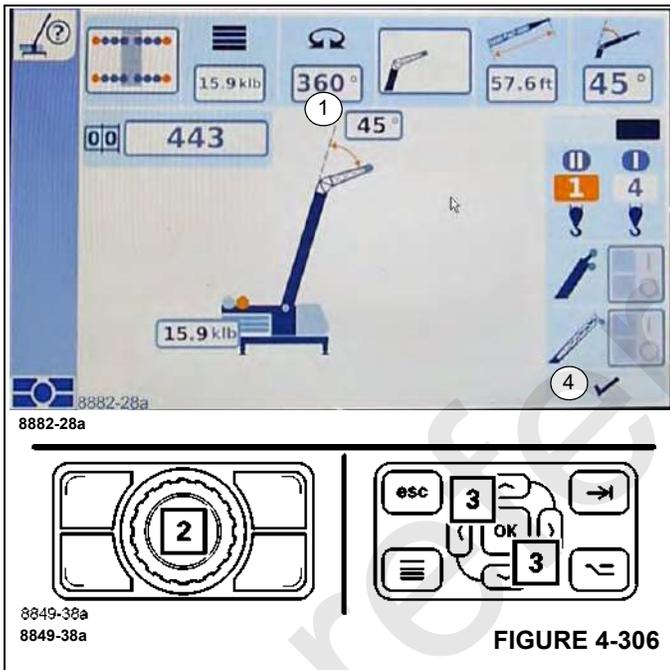


FIGURE 4-306

**Entering the RCL Code**

You may enter the RCL Code for the rigging mode according to the Lifting Capacity Table.

Refer to the Lifting Capacity Table for the current rigging mode. The corresponding RCL Code is specified at the top of the table (e.g. 1100).

- Select and confirm the symbol (1), (Figure 4-307).
- Use the buttons (2), (Figure 4-307) or (3), (Figure 4-307) to select the required RCL Code.

- Confirm the selection.

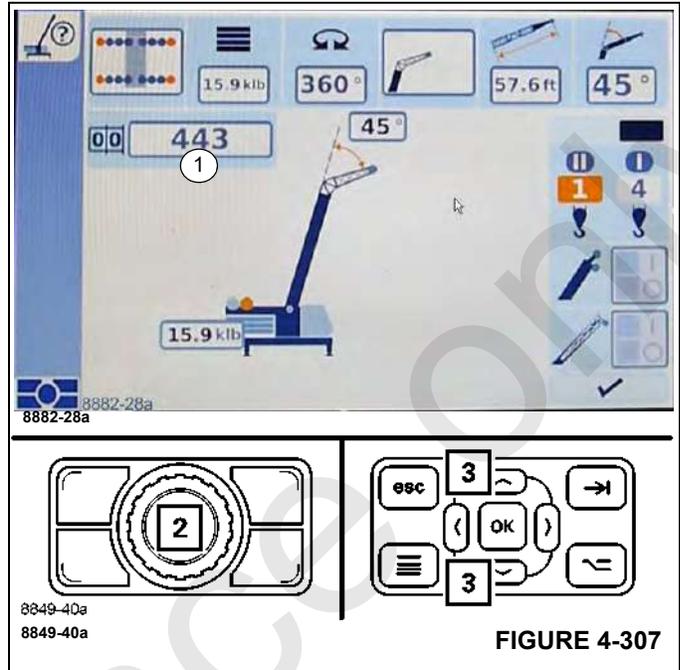


FIGURE 4-307

The other displays will show the corresponding rigging mode.

Now you can enter the reeving and accept the rigging mode.

**Selecting the Hoist and Entering the Reeving**

Entering the reeving does not have an effect on any other component that has already been entered.

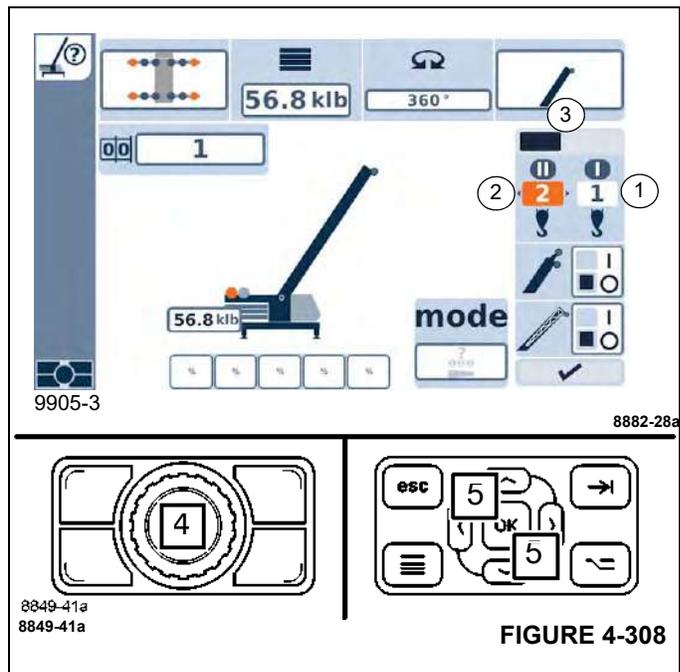


FIGURE 4-308

- Position the slider bar (3), (Figure 4-308) over the top of the hoist that is to be used. Example screenshot in Figure 4-308 shows the Auxiliary Hoist is selected.

1	Symbol for main hoist
2	Symbol for auxiliary hoist

- Confirm the selection.
- Use the buttons (4), (Figure 4-308) or (5), (Figure 4-308) to select the rigged reeving.
- Confirm the selection.

**Accepting the Rigging Code**

Prior to crane operation, you must confirm and accept the newly entered rigging code.

**Confirming and Applying the Rigging Code**

- Select the symbol (1), (Figure 4-309).
- Confirm the selection.

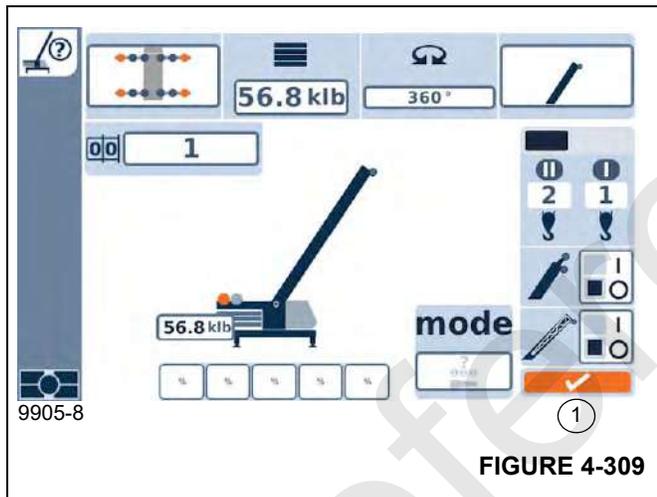


FIGURE 4-309

The Monitoring menu is opened and the rigging code is applied.

If the rigging code is not permissible, symbol 1 cannot be selected.



**WARNING**

**Overload/Tip-over Hazard!**

The RCL is an operator aid. If it is programmed incorrectly, the system may not warn the operator of impending overload and may not activate function lockouts.

Ensure the RCL is properly programmed to correspond to the actual crane configuration being used.

**Hoists Display**

The symbol bar symbol (1), (Figure 4-310) must appear over top of the hoist with which the load is to be lifted.

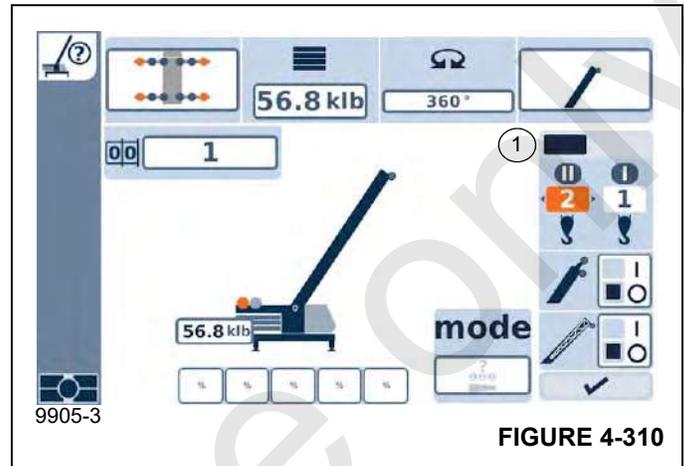


FIGURE 4-310

To switch between main hoist or auxiliary hoist, refer to *Example of how to Switch over the Hoists*, page 4-207.

If you need to correct values, press the button (1), (Figure 4-311) or (2), (Figure 4-311) and open the Enter Rigging Mode (3), (Figure 4-311) Menu.

You can start working with the crane if the correct rigging mode of the crane is displayed.

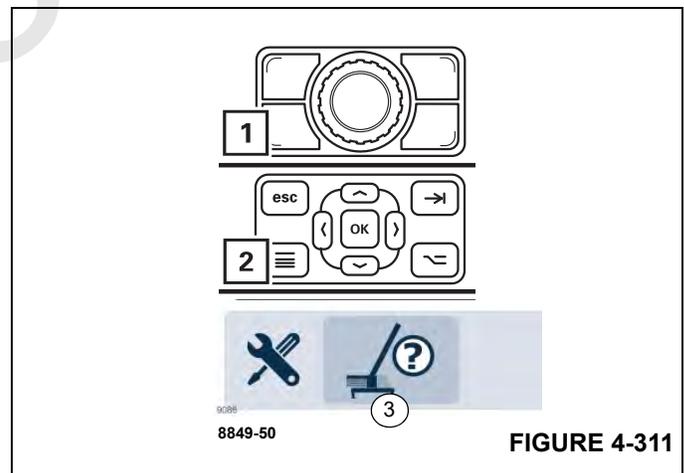


FIGURE 4-311

**Example of how to Switch over the Hoists**

The load is planned to be raised with the main hoist, for example. However, the hoist indicator (1), (Figure 4-312) for the auxiliary hoist is ON and the indicator (2), (Figure 4-312) for the main hoist is OFF.

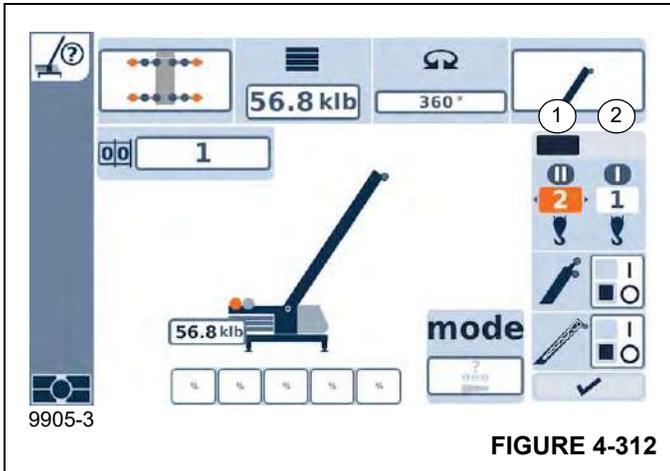


FIGURE 4-312

Switch over the hoists as follows:

- Disable both hoists. The hoists can be individually activated using the arm rest switches. The indications of what functions are enabled are on the ODM (lower display) right side of the screen.

Enable the auxiliary hoist indicator.

The hoist indicator will now be displayed above the auxiliary hoist icon.

**WARNING**  
Overload Hazard!

When operating the crane with two hoists reeved, ensure that the hoist in use is identified in the RCL configuration. Failure to do so may result in overload of the hoist line or crane. Death or Serious Injury could occur.

**Using the RCL Monitoring Screen - Late Model Cranes and MAXbase Equipped Cranes**

**MAXbase (Optional)**

The optional MAXbase feature on the TMS875-2/TMS800-2 crane offers capacities for particular swing angles based on outrigger configuration as compared to a similar 360° Load Chart.

The MAXbase feature offers these capacities by using four different load charts throughout the crane’s rotation. In comparison a standard 360° chart only uses one load chart. The MAXbase load charts calculate capacities based on four different swing angle ranges. This allows for increased capacities for some swing angle ranges based on the crane configuration when compared to another swing angle range. These swing angle ranges are identified in the MAXbase

Load Charts and Rated Capacity Limiter (RCL) as follows:

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

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

**MAXbase Setup Screen**

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

1. **Direct Rigging Code Entry** – operator enters the Rigging Code from the *Load Chart Manual* directly into the rigging code selection field (1), (Figure 4-313).
2. **Setup Wizard** – operator selects each individual component configuration (2 through 5, (Figure 4-313).

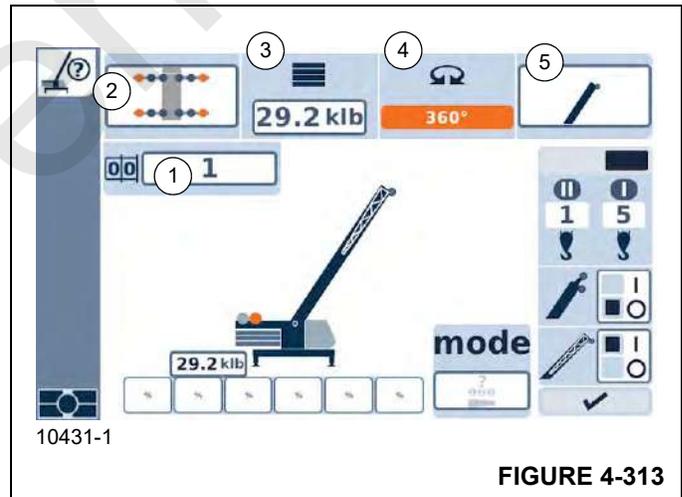


FIGURE 4-313

**NOTE:** The two programming methods are explained in detail under the section titled *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-196.

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

- MAXbase is a menu choice when programming the Swing Range selection field (1), (Figure 4-314).
- Unequal Outrigger Configurations are menu choices when programming the Outrigger Configuration selection field (2), (Figure 4-314).

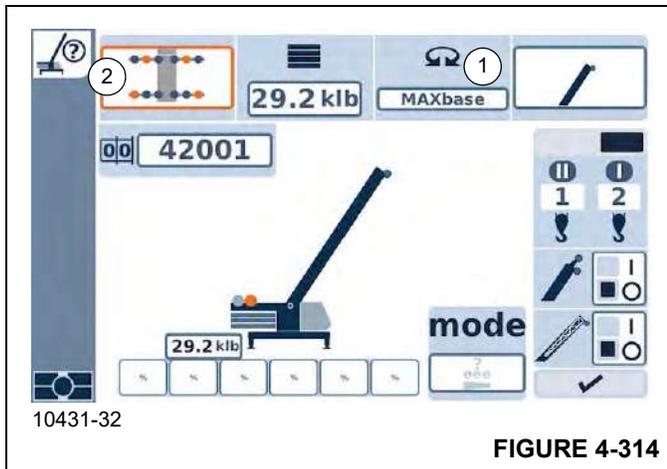


FIGURE 4-314

For MAXbase operations the operator can either use the Direct Rigging Code Entry method and enter a MAXbase Load Chart Rigging Code into the Rigging Code selection field (1), (Figure 4-313) or use the Setup Wizard and select MAXbase in the Swing Range selection field (1), (Figure 4-314).

When entering a MAXbase Load Chart Rigging Code directly, all of the component configurations (2 through 5, (Figure 4-313) are automatically selected. When using the Setup Wizard and MAXbase is first selected in the Swing Range selection field (1), (Figure 4-314), the RCL system will then limit the Outrigger Configuration selection field (2), (Figure 4-314) to only MAXbase outrigger configurations. This limiting feature makes programming the RCL more efficient.

Once a MAXbase load chart has been selected, the operator must then complete the other RCL setup selections as needed (1 thru 4, (Figure 4-315):

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

When all selections have been made, the operator must select and confirm the Check Box (5), (Figure 4-315) to accept the programmed crane configuration.

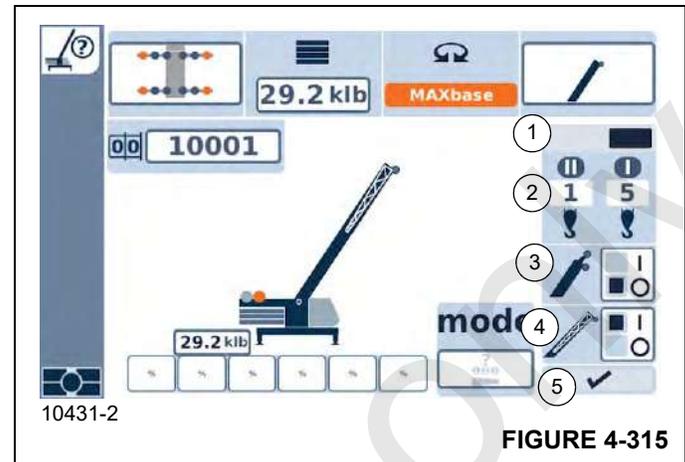


FIGURE 4-315

On cranes equipped with the Outrigger Monitoring System (OMS), upon accepting the programmed crane configuration the RCL will check to make sure the actual horizontal outrigger positions match the outrigger positions that were defined in the RCL Setup Screen. If the outrigger positions measured by the OMS do not match the outrigger positions defined in the RCL, then the Outrigger Beam Override Screen will show. Refer to the section titled *Using the Rated Capacity Limiter Display Module (RDM)*, page 4-196 for information.

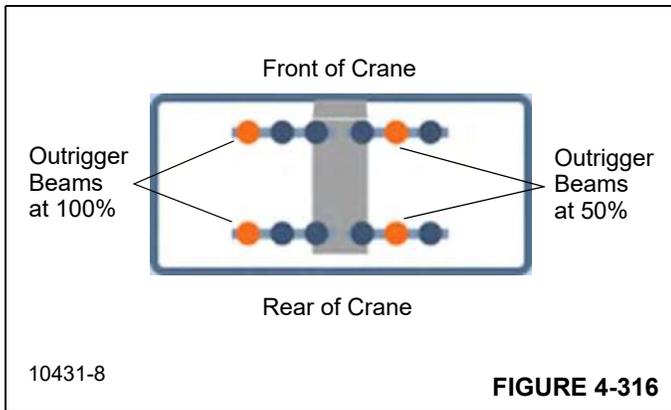
**NOTE:** When deploying the outriggers, the measured outrigger beam position must be within  $\pm 3\%$  of the target outrigger position to be recognized as a valid setup.

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

For a list of the supported MAXbase Load Charts and their outrigger configurations, refer to the section titled *MAXbase Load Charts*, page 4-209

### MAXbase Load Charts

The MAXbase outrigger setups provided on the TMS875-2/ TMS800-2 crane are shown on the Rated Capacity Limiter (RCL) Setup Screen in graphical form as a top view of the carrier with the front of the crane pointed upward on the picture (Figure 4-316). The orange dots represent the position of the outrigger jacks (100%, 50% or 0%).

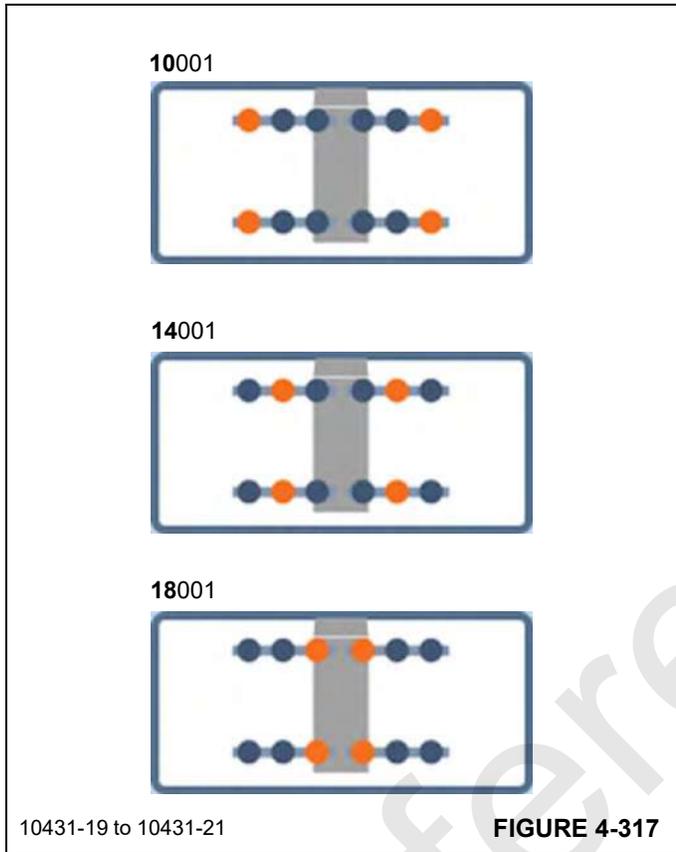


For reference only

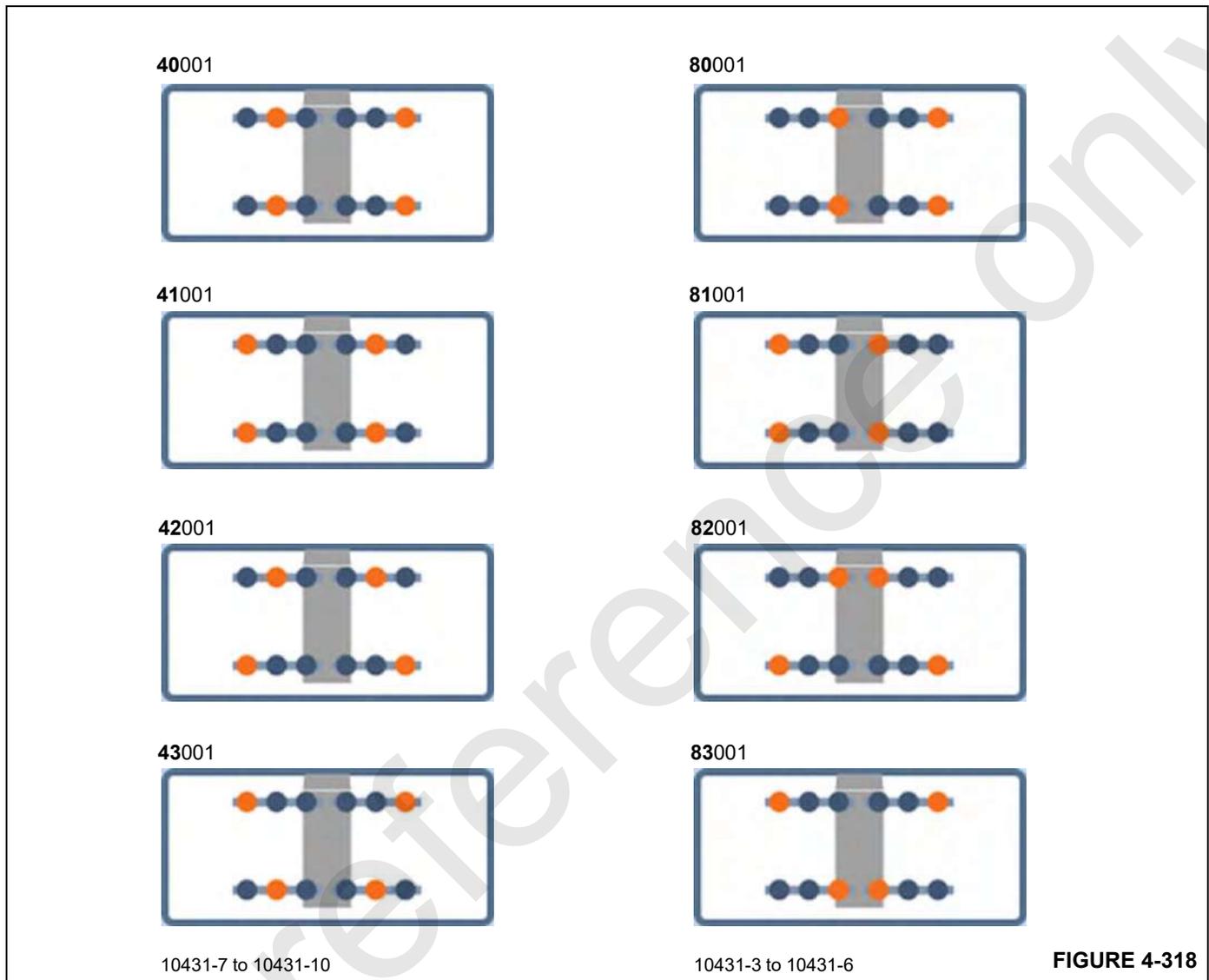
Refer to (Figure 4-317) thru (Figure 4-319) for the MAXbase Load Charts and their outrigger configurations available on the TMS875-2/TMS800-2 crane.

**NOTE:** Additional setups may be acquired by contacting Manitowoc Crane Care for a *Lift Solution*.

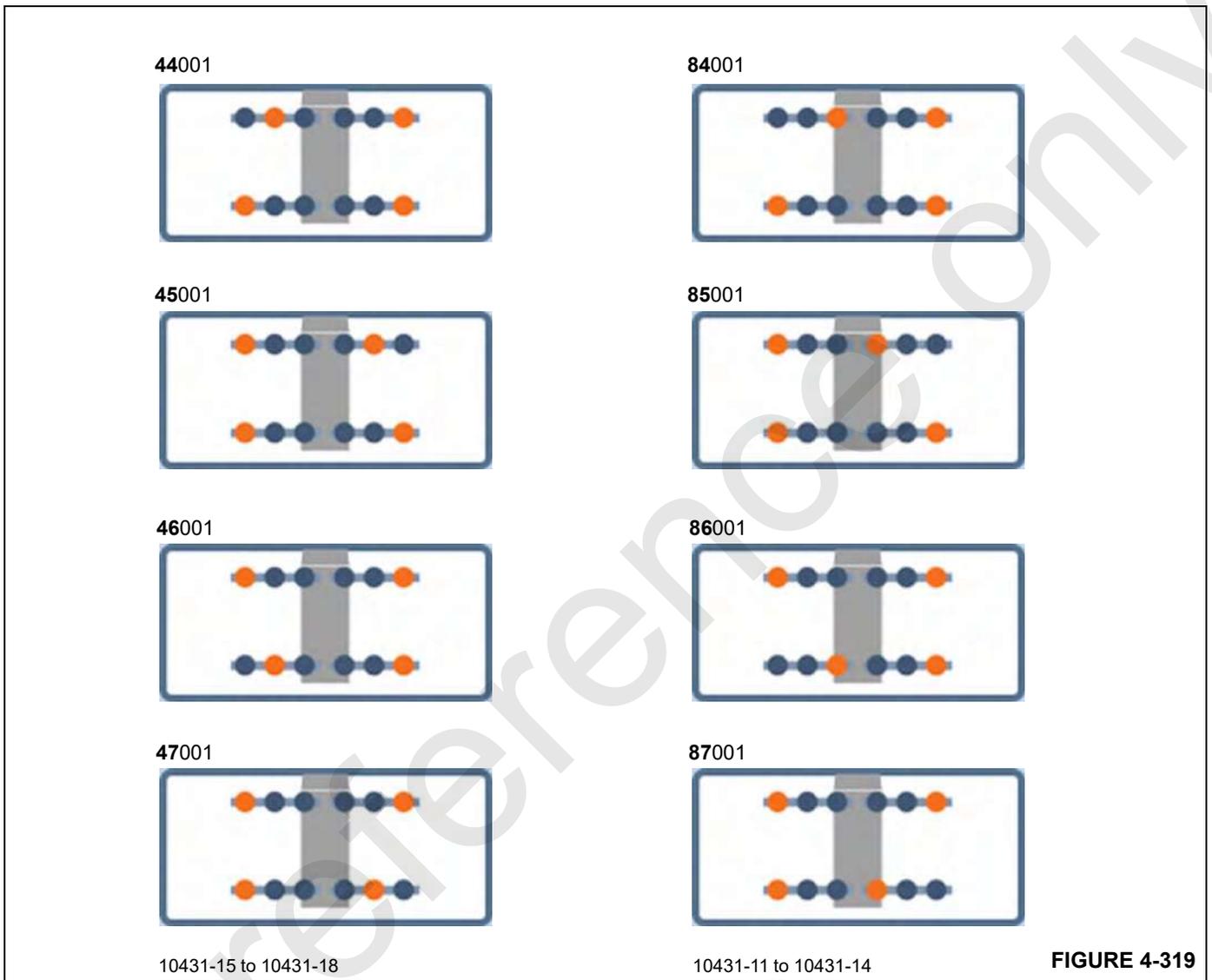
Three symmetrical outrigger extensions (Figure 4-317).



The standard MAXbase setups have at least two adjacent outrigger beams extended to 100%. The other two outrigger beams may be extended to 50% or 0% as shown in (Figure 4-318).



The standard TMS875-2/TMS800-2 MAXbase setups also allow lifting with 3 outrigger beams extended to 100%. The remaining beam may be extended to 50% or 0% as shown in (Figure 4-319).





Program the MAXbase Boom Configurator screen in the following manner:

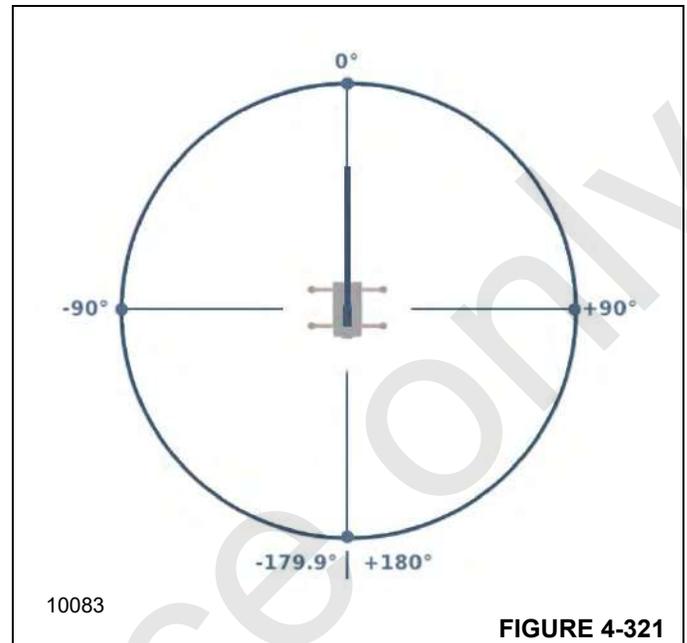
1. Select a MAXbase rigging code using the Setup Screen on the Rated Capacity Limiter Display Module (RDM).
2. Select the Boom Configurator from the list of Operator Display Module (ODM) menu options.
3. Enter the search parameters in the Boom Configurator screen (4 thru 8), (Figure 4-322).

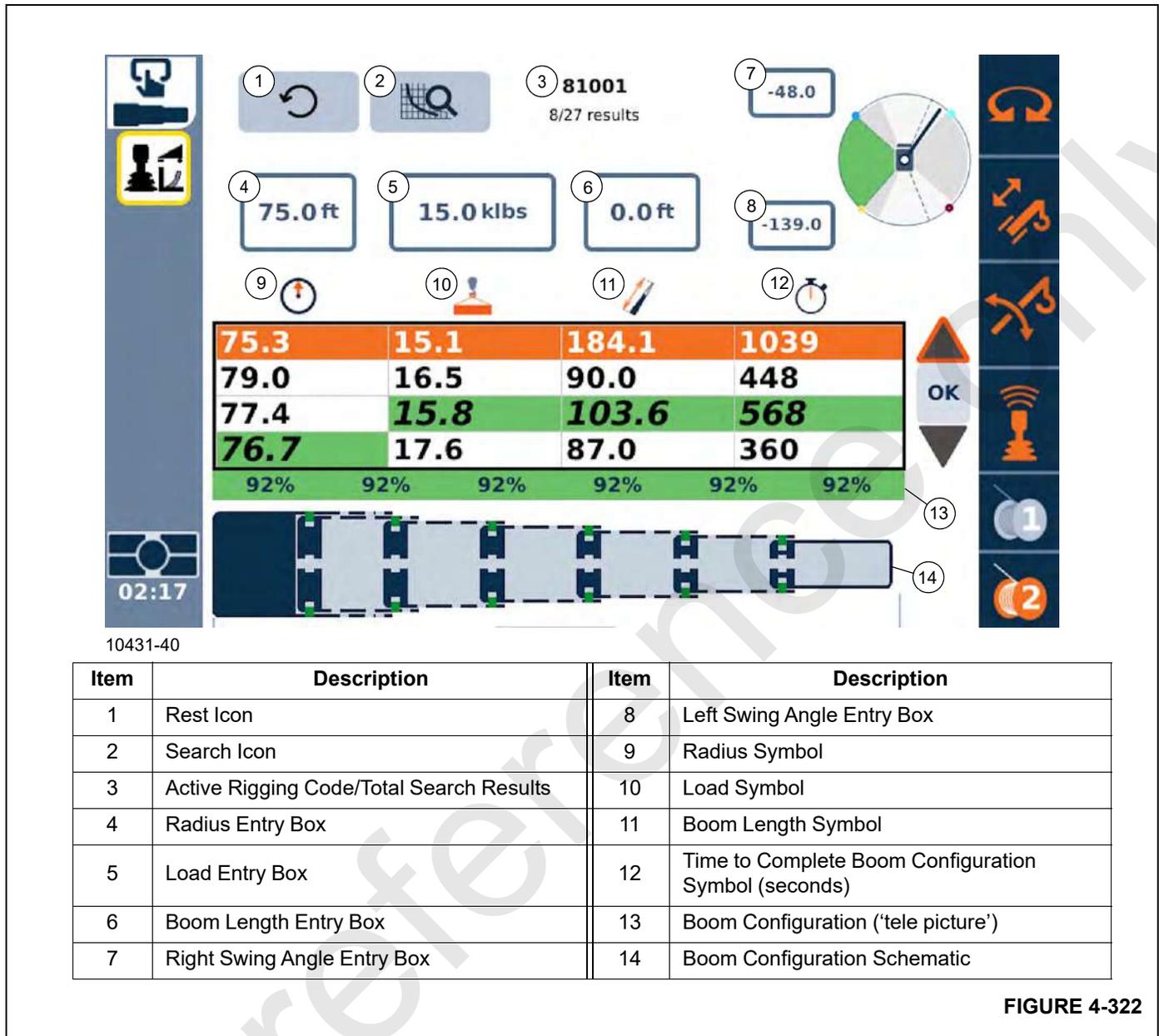
**NOTE:** Parameters (4 thru 6), (Figure 4-322) set to 0.0 will not limit the search results.

When entering a swing angle range using the right and left swing angle entry boxes (7 and 8), (Figure 4-322), angles to the left of the centerline of the crane are entered as negative values ( $0^{\circ}$  to  $-179.9^{\circ}$ ) and angles to the right of the centerline of the crane are entered as positive values ( $0^{\circ}$  to  $180.0^{\circ}$ ) (Figure 4-321).

If both the right and left swing angle limits (7 and 8), (Figure 4-320) are set to the same value, then all load charts will be included in the search.

4. Click the Search Icon (2), (Figure 4-322) to display a filtered list of available boom configurations.





### Checks Before Operating the Crane

#### Open the Menu

Crane operation is only enabled when the Monitoring Menu is open. The Monitoring Menu opens automatically after the rigging code is configured and confirmed.

#### Checks

- Check whether the current rigging mode of the crane corresponds to the displayed rigging mode.



### WARNING

#### Overload/Tip-over Hazard!

The RCL is an operator aid. If it is programmed incorrectly, the system may not warn the operator of impending overload and may not activate function lockouts.

Ensure the RCL is properly programmed to correspond to the actual crane configuration being used.

- Any time the key is off, the Rigging Code Screen is shown. Check (Figure 4-323):

1	Lattice extension angle where necessary
2	Boom length
3	Boom tip/boom extension tip height
4	Rigged counterweight
5	Hoist that is switched ON
6	Number of reeved hoist rope lines
7	Rigged outrigger span

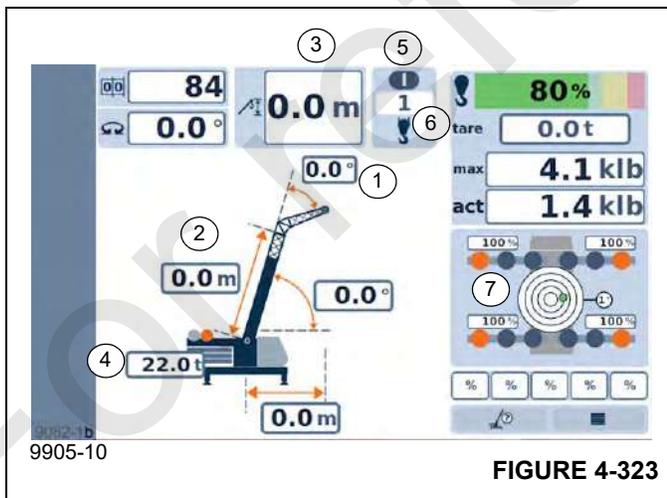


FIGURE 4-323

#### RCL Early Warning

If approximately 90% of the maximum permissible load is exceeded, an RCL early warning will be issued.

- An intermittent buzzer tone will sound. After five seconds, you can disable the buzzer tone using button (2), (Figure 4-324).
- The lamp (3), (Figure 4-324) lights up.
- Display (1), (Figure 4-324) shows the current degree of utilization, e.g. 80%; the bar is green.

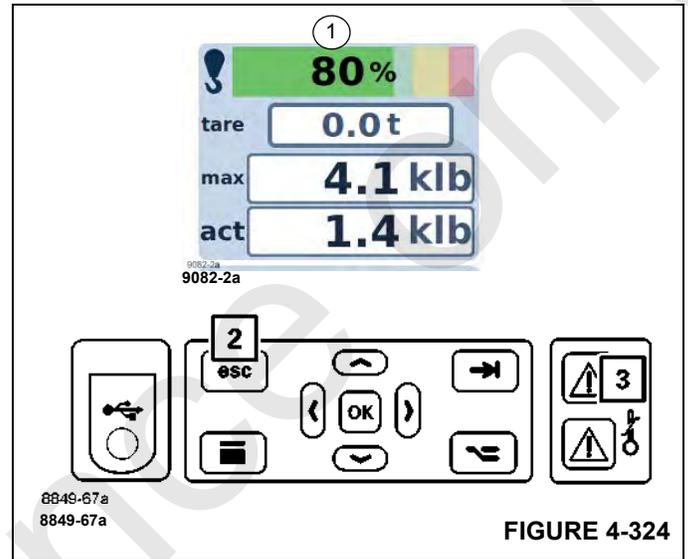


FIGURE 4-324

**NOTE:** If the capacity continues to increase, the RCL will reach an overload state and a RCL shutdown will occur.

#### RCL Shutdown

There are different types of RCL shutdowns:

- Shutdown due to overload.
- Shutdown due to an error.

#### Shutdown Due to Overload

If the maximum permissible load is exceeded, shutdown will occur due to overload.

- All crane movements which increase the load moment will be switched off.
- A continuous buzzer tone will sound.
- After five seconds, you can disable the buzzer tone using button (4), (Figure 4-325).
- Greater than 100%, indicator 5 will illuminate solid
- Lamp (6), (Figure 4-325) will illuminate.
- Display (3), (Figure 4-325) shows the current degree of utilization, e.g. 100%; the bar is red.
- The value on display (2), (Figure 4-325) is equal to or greater than the value on display (1), (Figure 4-325).

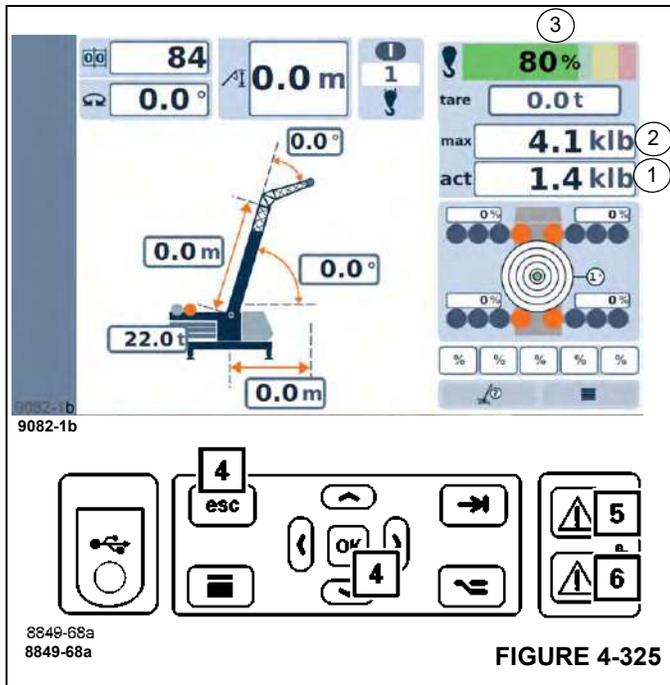


FIGURE 4-325

**Canceling a Shutdown**

- Turn off the buzzer tone if necessary.
- All crane movements are enabled for 30 minutes.
- The status display will flash red.
- Leave the shutdown range by moving the crane according to the following table.

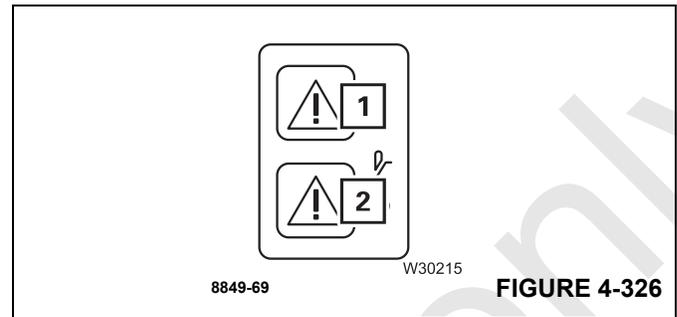
Switched OFF Crane Movements	Permitted Crane Movements
Lift loads	Lower loads
Lower the main boom	Raising the main boom <sup>1)</sup>
Extend the main boom	Retracting the main boom
Swing to the left	Swing to the right
Swing to the right	Swing to the left
Lower the lattice extension	Raise the lattice extension

<sup>1)</sup>In some cases, the RCL will also disable these movements. In this case, leave the shutdown range through other enabled movements. If this is not possible, set down the load.

When booming down the load limit decreases and can eventually lock out crane motions including boom up. Using the boom up bypass key to boom up then causes the load limit to increase again, and quickly eliminates the lockout condition.

The crane movements are reactivated when you have returned to a normal operating state below the maximum

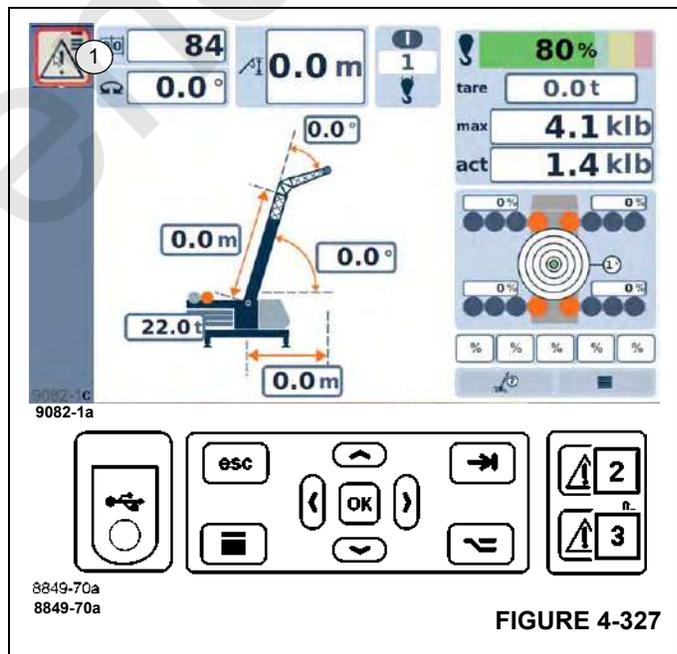
permissible load capacity – lamps (1), (Figure 4-326) and (2), (Figure 4-326) go out.



**Display in the Event of Errors**

If an error occurs, it will be displayed as follows.

- The (1), (Figure 4-327) symbol is displayed in the display area.
- Depending on the type of error, the buzzer tone sounds once or as a continuous buzzer tone.
- Lamps (2) and (3) light up.



**RCL Override**

The override will be canceled when you:

- Disable the ignition
- Press the key-operated switch again.

The override will automatically be canceled 30 minutes after the key-operated switch has been pressed.

If the RCL is overridden, the lockouts are disabled (depending on which switch is used) and the switched off

crane movements are enabled again. Once a limit is reached and crane functions are switched OFF, there are three options for overriding:

- During rigging, you can override the RCL shutdown or the Anti Two-Block Switch for rigging work, refer to *When Rigging*, page 4-219.
- You can release the raise boom function to leave the shutdown area. Refer to *To Raise the Boom*, page 4-220.
- In an emergency, you can override the RCL shutdown completely. Refer to *In Emergencies*, page 4-221.

**When Rigging**

For rigging work, you can:

- override the Anti Two-Block Switch
- OR**
- override the RCL.

**RCL Override**

- Push the button (1), (Figure 4-331) up, and hold it.

**Anti Two-Block Switch**

To install/remove the Anti Two-Block switch, refer to *Installing/Removing the Anti Two-Block Switch*, page 5-32

The Anti Two-Block switch is located at the boom nose and the boom extension noses. The indicator is in the ODM and prevents the hook block from being lifted up to the main boom head and damaging it. The A2B Indicator comes on (red) when a two-block condition occurs.

When a two-block condition occurs, the crane control system will lock out the hoist up, boom down, and telescope out crane functions, which would worsen the two-block condition if operated.

The Anti Two-Block switch only works if it has been unlocked. Refer to *Anti-Two Block Switch*, page 5-92.

The Anti Two-Block switch will be triggered if:

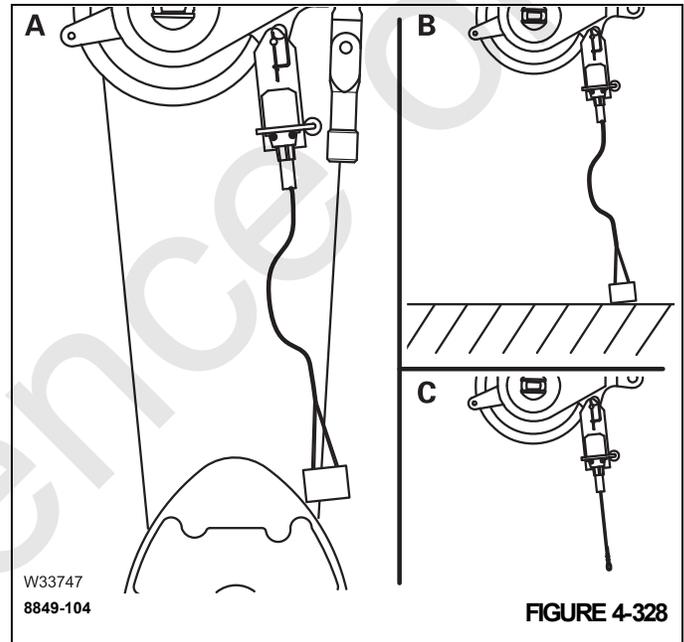
(A), (Figure 4-328) – the hook block raises the Anti Two-Block Switch weight,

**OR**

(B), (Figure 4-328) – the Anti Two-Block Switch weight touches the ground upon lowering,

**OR**

(C), (Figure 4-328) – the Anti Two-Block Switch weight is not attached.



The lamp (1), (Figure 4-329) will light up if the Anti Two-Block Switch has been triggered.

At the same time, all movements which would bring the load closer to the nose will be switched OFF – Lifting, Boom Lowering, Extending and Lowering the Lattice Extension, if necessary.

To cancel the shutdown, leave the shutdown range by performing a different crane movement or by setting down the load.



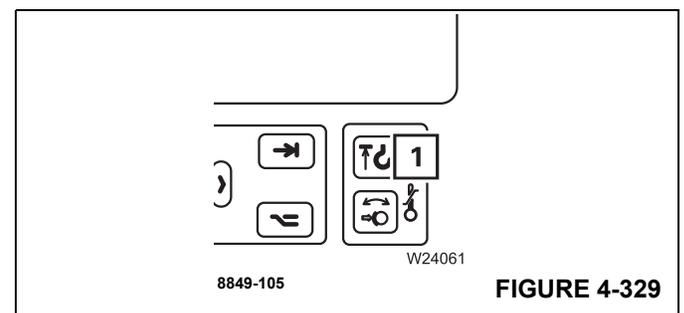
**DANGER**

**Two-Blocking Hazard!**

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

This crane should have a functional Anti Two-Block and control lock-out system. Test daily for proper operation.

**DO NOT PASS LOADS OR BOOM OVER GROUND PERSONNEL.**



**Anti Two-Block Switch Override**

When overriding, the system continues to monitor the crane and provides information on the displays. Only the lockout is disabled when the crane is bypassed.

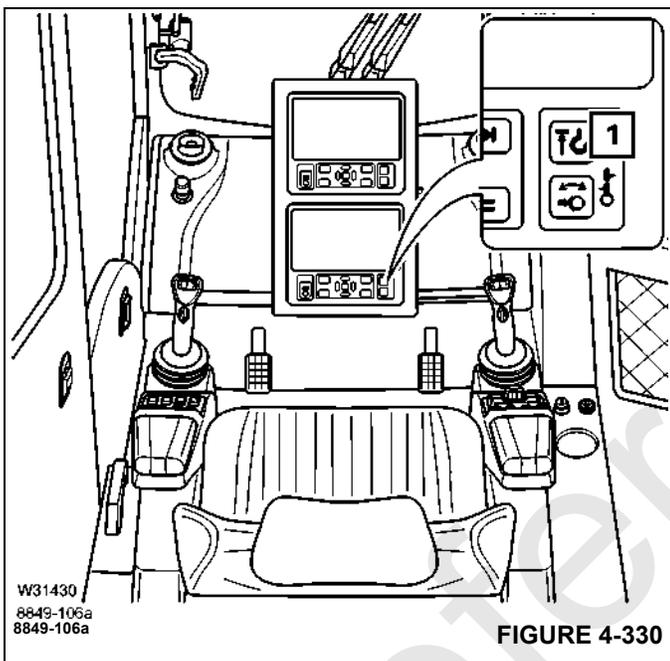
Press the button located on the overhead control panel and keep it depressed – the anti two-block switch is overridden.

If the anti two-block switch is triggered, the crane movement is stopped once and the lamp (1), (Figure 4-330) flashes.

- The lamp (1), (Figure 4-330) goes out, when you release the button (override removed),

**OR**

- If you leave the shutdown range.

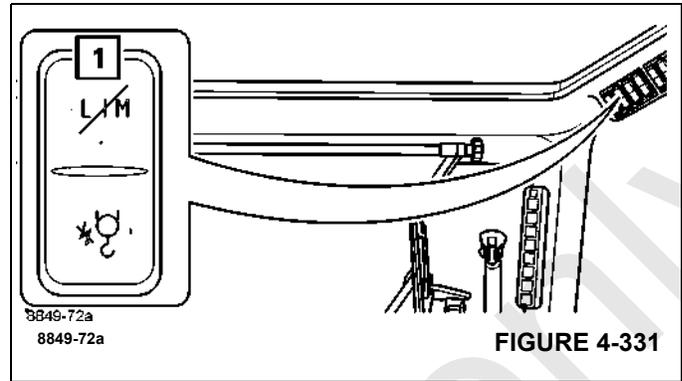


**FIGURE 4-330**

**Anti Two-Block Switch Override**

Push the button (1), (Figure 4-331) down, and hold it.

As long as the button (1), (Figure 4-331) is pushed, the Anti Two-Block Switch is overridden. This is also true for the RCL override.



**FIGURE 4-331**

**After Overriding**

- The status indicator will light up RED.
- The RCL Display will show an information code.

**Canceling the Override**

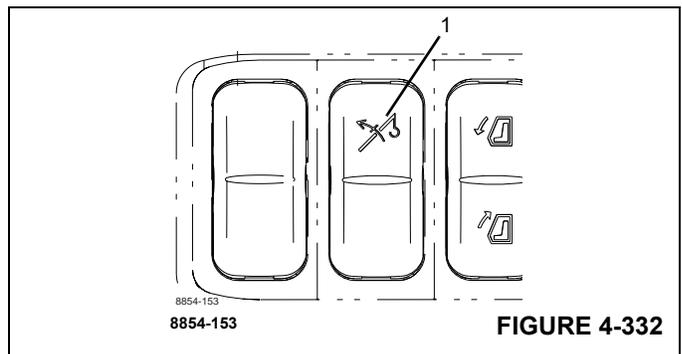
The override will be canceled when you:

- Release the switch or,
- Disable the ignition.

**To Raise the Boom**

You can release the raise boom function for lifting/lowering again within the permitted working range.

The button (1), (Figure 4-332) in the Left-Hand Armrest is only active if the current degree of utilization lies above 100% and the crane movements are switched OFF.



**FIGURE 4-332**

**Raising Main Boom**

- Push the (1), (Figure 4-332) button and hold it.
  - Raising is enabled.
  - The RCL display will show an information code.
- Raise the main boom until the degree of utilization is less than 100%.
  - The crane movements will then be enabled again.
  - The button (1), (Figure 4-332) will no longer need to be used.

**NOTE:** The raising of the main boom will be shut down if the main boom angle is too great. Then all you can do is set the load down.

**Disable Function**

- Release switch (1), (Figure 4-332).

**In Emergencies**

During this type of override, the complete shutdown of the RCL is canceled and no monitoring takes place.

**Crane Operation with Main Boom**

Ensure the crane is level before lifting operation begins.

If the crane is found to be out of level during operation, stop operation, set the load down, return the boom to the travel position and re-level the crane (Figure 4-333). Refer to *Rigging Work for Crane Operation With the Main Boom*, page 5-14.

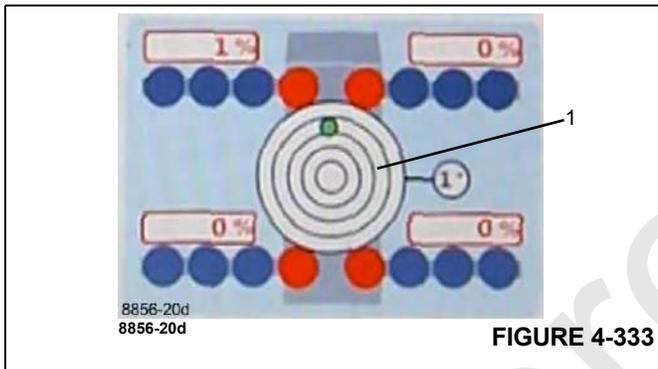


FIGURE 4-333

**External Light Bar (Optional)**

The lamps (5) to (7), (Figure 4-334) of the external light bar (4), (Figure 4-334) light up or flash depending on the RCL degree of utilization and button confirmations.

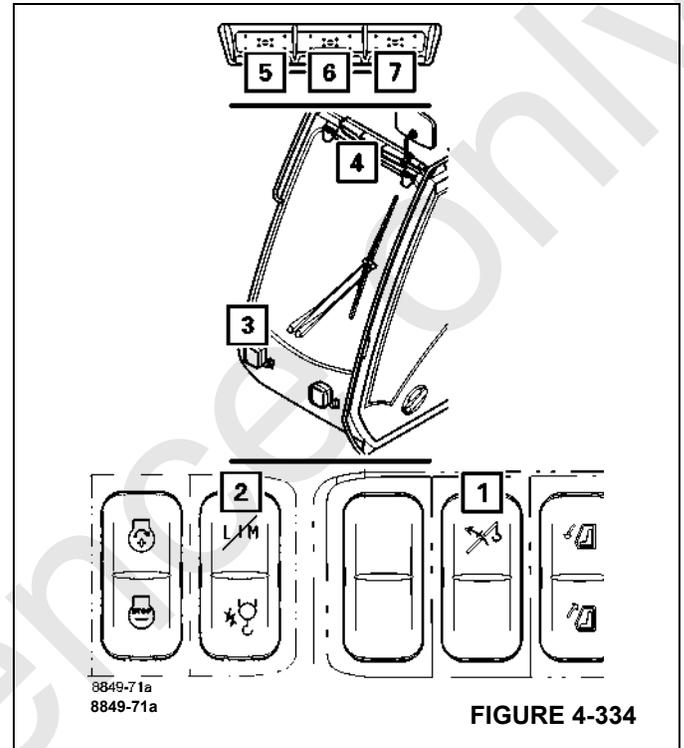
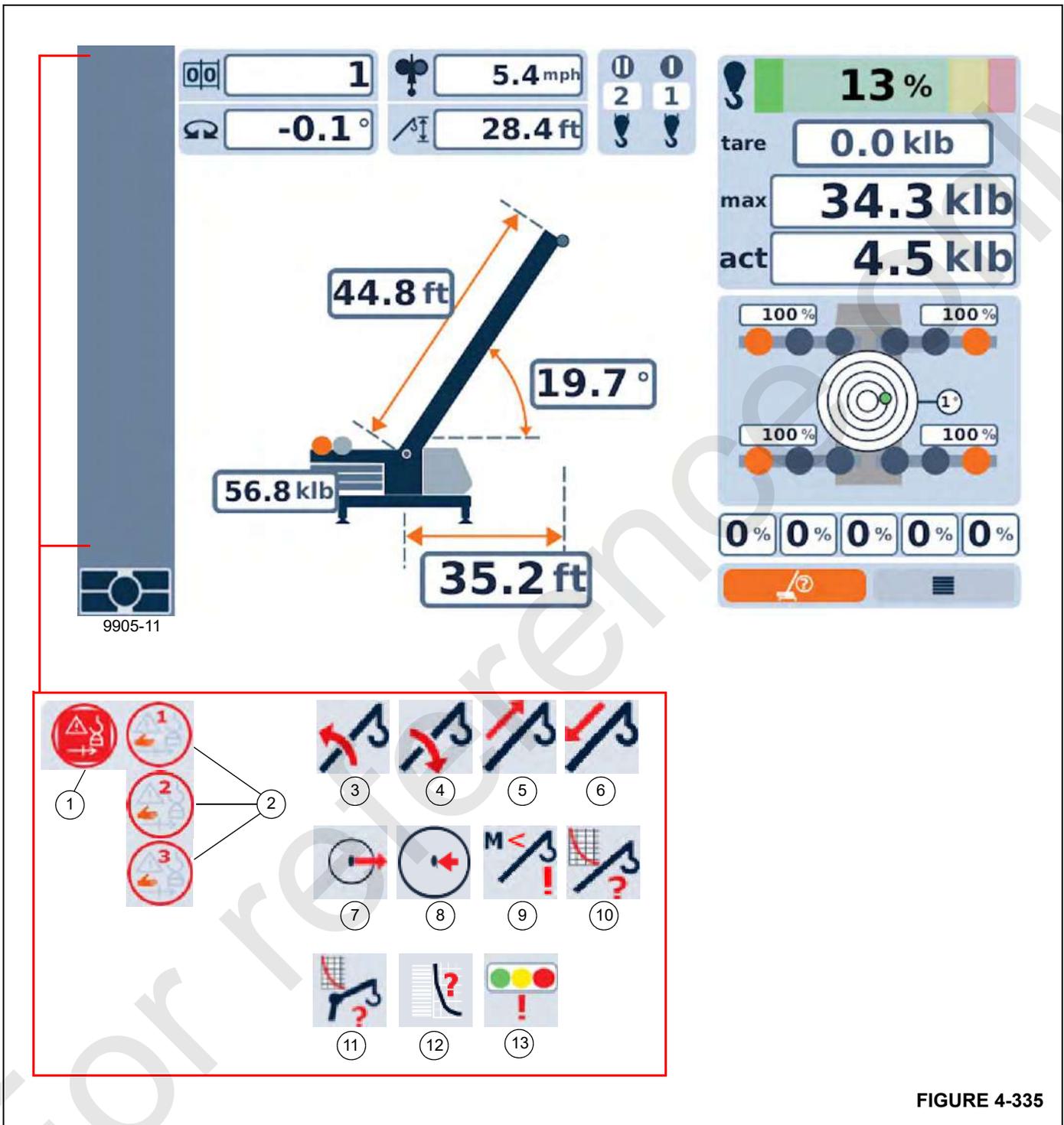
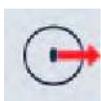


FIGURE 4-334

**Load Chart and Miscellaneous Alerts**

Refer to (Figure 4-335) for a list of alerts and their definitions that can appear at the bottom of the Main Screen of the RDM.



Item	Description	Graphic	Explanation
1	<b>RCL Bypass Active Indicator (Red - Constant On)</b>		Indicates the RCL system is bypassed
2	<b>Bypass 1 Pressed Indicator (Constant On)</b>		Indicates that limiter systems have been bypassed by way of the Limit Bypass Switch located on the right overhead control panel. Refer to <i>Limit Bypass Set-Up Switch</i> , page 3-29 for more information on the switch's operation.
	<b>Bypass 2 Pressed Indicator (Constant On)</b>		Indicates that the limiter systems have been bypassed by way of the Boom Up Bypass Switch located on the right armrest. Refer to <i>Boom Up Bypass Switch</i> , page 3-36 for more information on the switch's operation.
	<b>Bypass 3 Pressed Indicator (Constant On)</b>		Indicates that limiter systems have been bypassed by way of the Limit Bypass Switch located behind the operator's seat on non-CE certified cranes or inside a key-locked single-door enclosure attached to the outside rear of the operator's cab on CE certified cranes. Refer to <i>Limit Bypass Set-Up Switch</i> , page 3-29 for more information on the switch's operation.
3	<b>Boom Angle Too High Indicator</b>		Indicates the boom angle is greater than the maximum angle limit allowed by the selected load chart or the boom angle is greater than 78°.
4	<b>Boom Angle Too Low Indicator</b>		Indicates the boom angle is less than the minimum angle limit allowed by the selected load chart or the boom angle is less than -1°.
5	<b>Boom Length Too Long Indicator</b>		Indicates the boom length is longer than the last length of the selected load chart.
6	<b>Boom Length Too Short Indicator</b>		Indicates the boom length is shorter than the first length of the selected load chart.
7	<b>Radius Too Long Indicator</b>		Indicates the radius is greater than the maximum radius in the selected load chart.

Item	Description	Graphic	Explanation
8	<b>Radius Too Short Indicator</b>		Indicates the radius is smaller than the minimum radius in the selected load chart.
9	<b>Load Too Small Indicator</b>		Indicates the load is smaller than the minimum load in the selected load chart
10	<b>Boom - No Load Chart Indicator</b>		Indicates the main boom load chart is not available for the given crane configuration.
11	<b>Boom Extension - No Load Chart Indicator</b>		Indicates there is no load chart available for the boom extension, but the boom extension has been chosen in the RCL.
12	<b>Curve Chart Point Error Indicator</b>		Indicates there is no load chart found for the given crane configuration (off chart).
13	<b>Status Light Bar Indicator (CE cranes)</b>		Indicates the system setting for CE cranes is disabled but the system setting for the outside light bar is enabled. Accessing the system requires the CAN-link service software and connection cable, which are available through Crane Care to those service technicians who have attended the Grove New Technology training course.

## Work Break

### In Case of Short Work Breaks



### WARNING

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.

- Disable the swing gear.
  - The lamp in the switch (1), (Figure 4-336) must be dimly lit.
  - Then symbol (2), (Figure 4-336) turns orange – swing gear switched OFF.
  - Lamp (3), (Figure 4-336) must light up – swing gear brake applied.

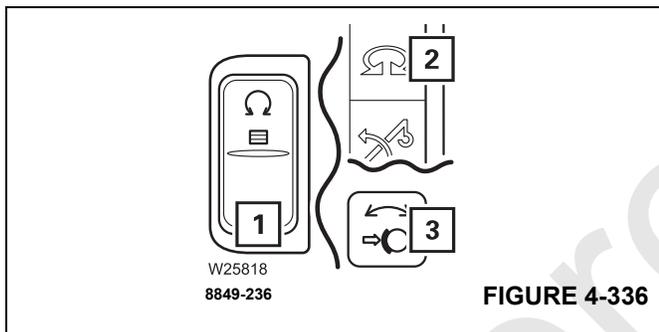


FIGURE 4-336

Switch the engine off, turn the ignition key to position 0 and remove it (Figure 4-337).

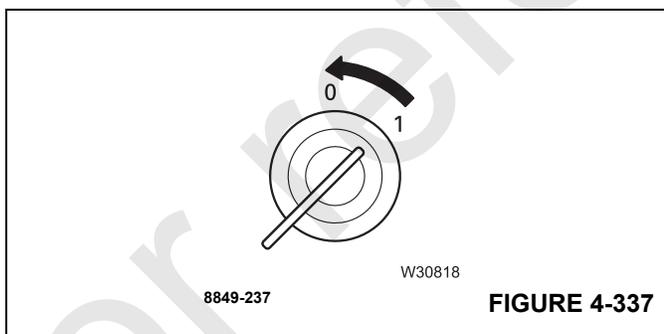


FIGURE 4-337

Make sure that no unauthorized persons can operate the truck crane. Refer to *To Secure the Truck Crane Against Unauthorized Use*, page 4-225.

### In Case of Work Breaks of More than 8 Hours

- Retract all telescopic sections.
- Lower the main boom.
- Disable the swing gear.
  - The lamp in the switch (1), (Figure 4-336) must be dimly lit.
  - Then symbol (2), (Figure 4-336) turns orange – swing gear switched OFF.
  - Lamp (3), (Figure 4-336) must light up – swing gear brake applied.

Switch the engine OFF, turn the ignition key to position 0 and remove it (Figure 4-337).

Disable all current devices.

### To Secure the Truck Crane Against Unauthorized Use

- Secure the truck crane against unauthorized use by:
  - Stowing away the hand-held control in the crane cab,
  - Removing the ignition key, and
  - Locking both cabs.



### WARNING

To prevent unauthorized use of the remote control, turn OFF and store the remote control in its storage holder and lock the cab.

For reference only

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## SECTION 5 SET-UP AND INSTALLATION

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## GENERAL

This section provides procedures for installing the hoist cable on the hoist drum, cable reeving, and erecting and stowing the boom extension as well as setup of the crane before and after transporting.

**NOTE:** For information on synthetic rope refer to the separate manual.

## SETUP OF CRANE BEFORE AND AFTER TRANSPORTING

Secure all valve cover latches with tie-straps to prevent accidental opening during transportation. After transporting the crane, place these components into their working positions.

### Strobe Light or Beacon Lights (Optional)

The optional beacon lights (1), (Figure 5-1) can be installed as part of the optional Auxiliary Lighting and Convenience

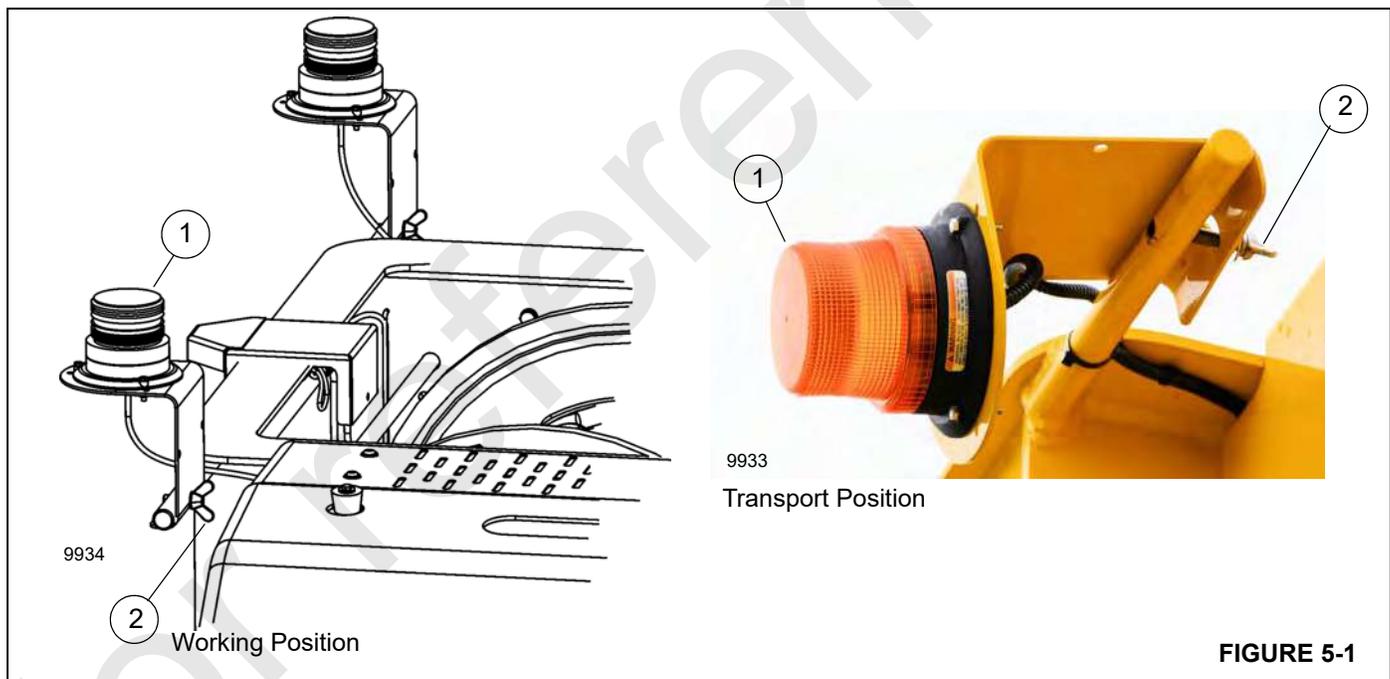
Package. When installed, the beacons are located on the rear of the superstructure. The beacons must be lowered for transport and raised for operation.

#### **Lowering the Beacon Light for Transport**

1. Loosen the wing nut (2), (Figure 5-1). Lower the beacon light (1), (Figure 5-1).
2. Tighten the wing nut (2), (Figure 5-1) to secure the beacon light (1), (Figure 5-1) in the transport position.

#### **Raising the Beacon Light for Operation**

1. Loosen the wing nut (2), (Figure 5-1). Raise the beacon light (1), (Figure 5-1).
2. Tighten the wing nut (2), (Figure 5-1) to secure the beacon light (1), (Figure 5-1) in the working position.



### INSTALLING CABLE ON THE HOIST

Refer to Figure 5-2.

**! DANGER**

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

No storage of components is allowed on the platform.

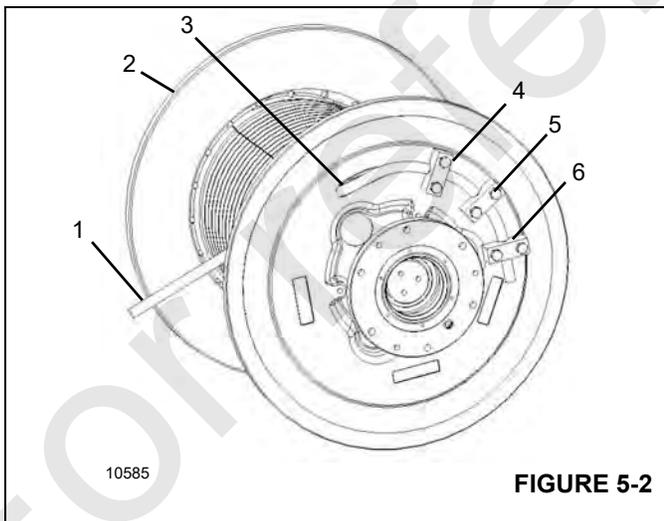
Only one person at a time is allowed on the platform.

**CAUTION**

If cable is wound from storage drum, rotate reel in same direction as hoist.

**NOTE:** Straighten cable before installing on hoist drum.

1. Place cable (1), (Figure 5-2) over boom nose sheave and route to hoist drum (2), (Figure 5-2).
2. Rotate hoist drum so cable slot (3), (Figure 5-2) located on left side of drum is easily accessible.
3. Insert cable (1) through slot (3), (Figure 5-2). Extend cable so that the entire welded end extends past the third clamp (6), (Figure 5-2).
4. Tighten all clamps to a torque of 72 to 80 N-m (53 to 59 lb-ft), starting with clamp (6), (Figure 5-2) followed by clamp (5), (Figure 5-2) and ending with clamp (4), (Figure 5-2).



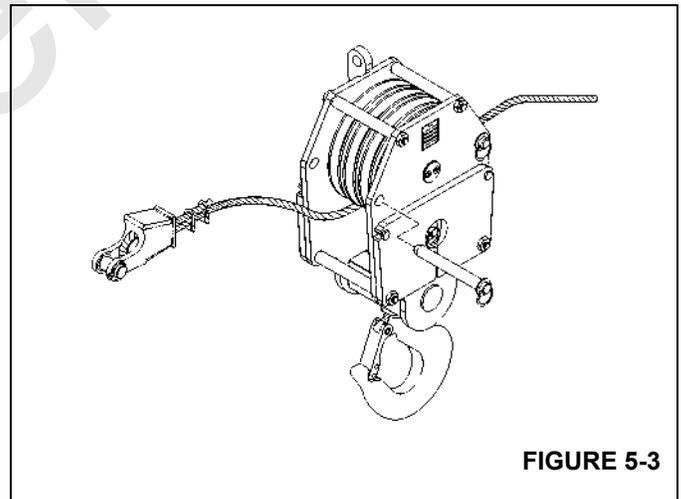
5. Slowly rotate drum and evenly wind first layer of cable. Install remainder of cable as required.

### CABLE REEVING

**NOTE:** There is only one type of cable (rope) available on this crane: 35 x 7 (non-rotating).

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 (part line) is possible with the boom nose and hook block (Figure 5-11 through Figure 5-18). 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 refer to (Figure 5-3).



Checking the Position of the Hoist Ropes

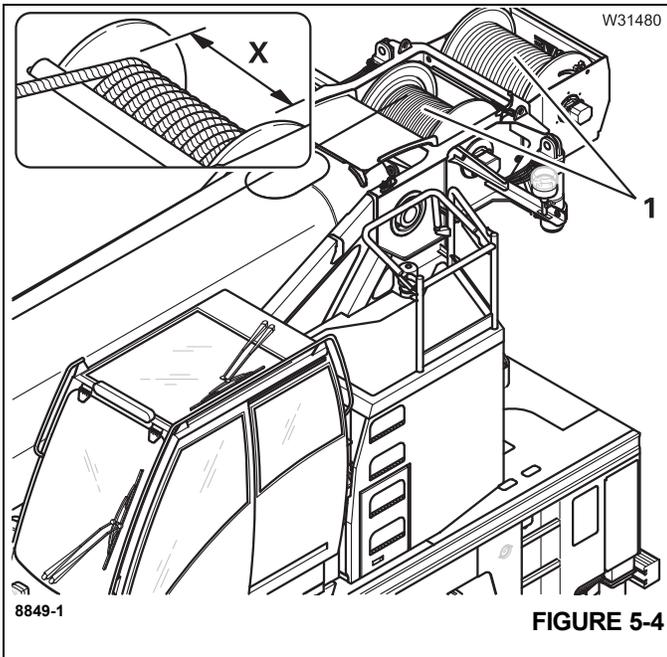
**! DANGER**

**Entanglement Hazard!**

Contact with rope being spooled onto the hoist drum could result in entanglement causing death or serious injury.

Stay clear of the rope and drum while the hoist is in operation.

- When possible check the entire length of the winding of the ropes (1), (Figure 5-4).



- Slowly perform the lowering movement until the rope has moved over a complete width (X) of the rope drum.
  - The rope must be evenly wound.
  - The rope turns on the drum must be evenly spaced, 0 to 2 mm (0 to 0.08 in) apart.
  - The cross-over points must be offset by approximately 180°.

Daily inspection of the rope is to inspect the length of rope to be used that day.

## 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 Grove Product Support.

Do not mix components from different manufacturers. The selection, installation and use of a wedge socket assembly must be in accordance with 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 away from the boom sections, structural damage will occur.

When anchoring the socket to the boom, make sure that the flat face of the socket is in position (Figure 5-5), away from the boom sections.

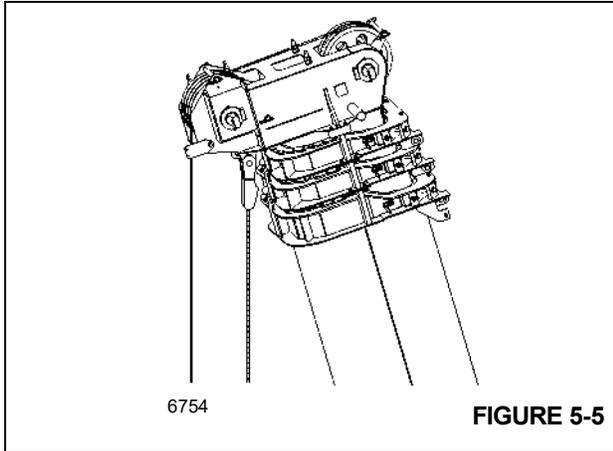


FIGURE 5-5

### 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.

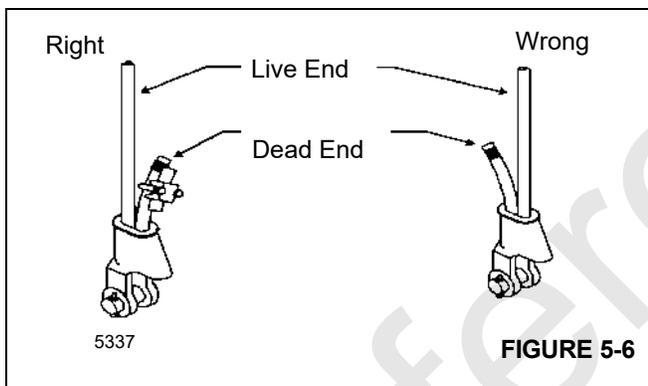


FIGURE 5-6

3. Make sure the live-loaded side (Figure 5-6) 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 the end of a wire rope into the socket, form a loop in the rope, and route the rope back through the socket allowing the "dead" end (Figure 5-6) to protrude from the socket. Make sure that the dead end of the rope is of sufficient length to apply end treatment to the dead end after the wedge has been seated.
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, etc.

Sketches A through F (Figure 5-7) 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 5-1).

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 revision.

Table 5-1: Wire Rope Clip Torque Values

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
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

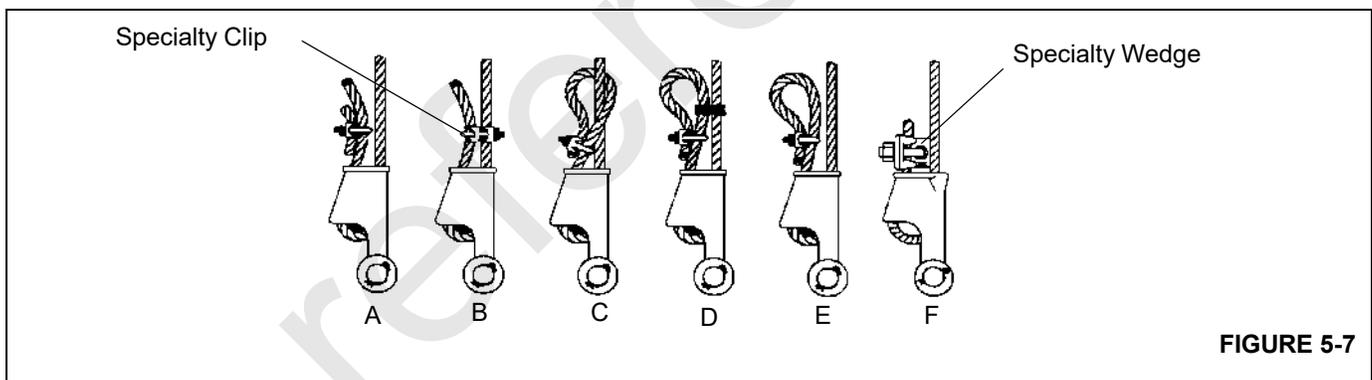
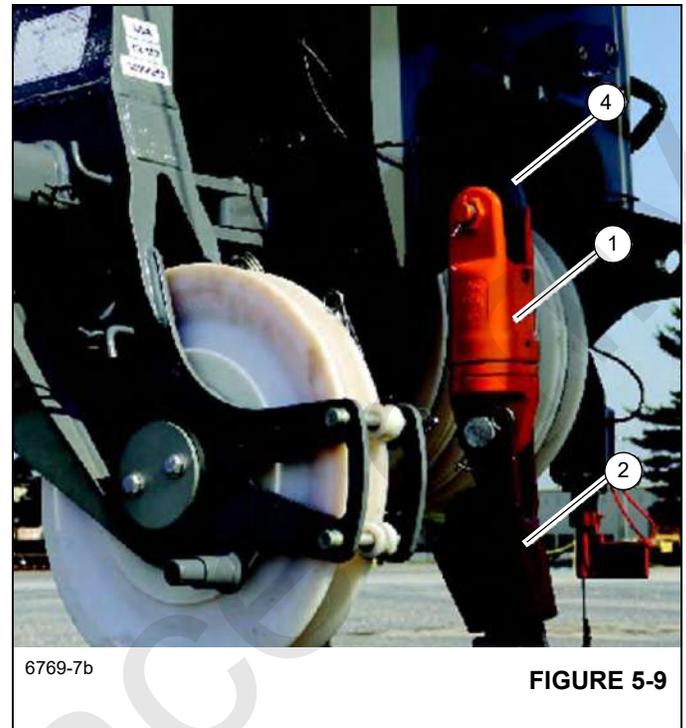
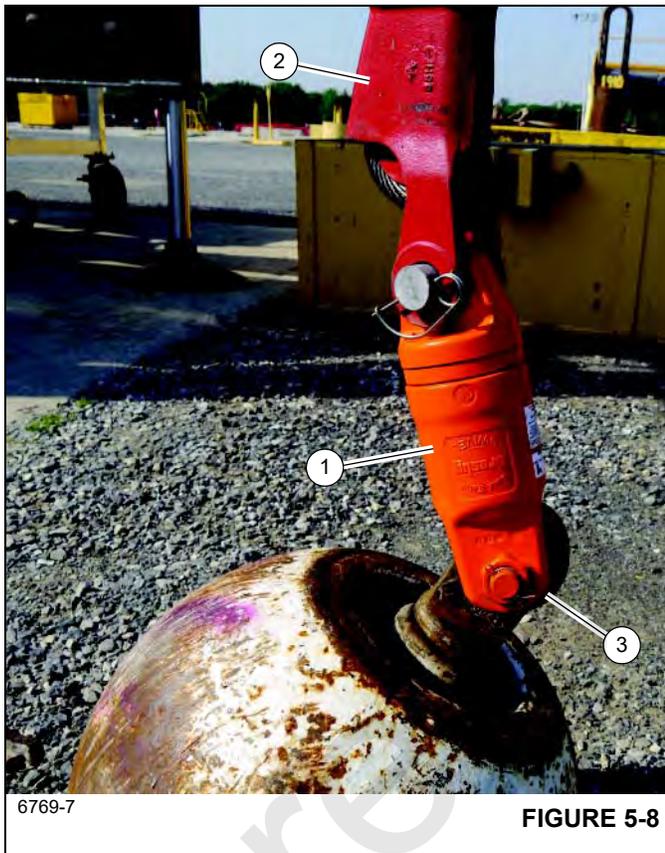


FIGURE 5-7

## ROPE SWIVEL

This crane is equipped with Category 1 Rotation Resistant Rope, which resists rotation the best of typical rope constructions. However, it will still exhibit some tendency to rotate, which may cause the hook block to rotate when operating with very long lengths of rope fall.

To help prevent this rotation, a rope swivel assembly (1), (Figure 5-8) and (Figure 5-9) is supplied with the crane. The rope swivel assembly (1), (Figure 5-8) is installed between the becket (2), (Figure 5-9) and either the overhead ball dead-end connection(3), (Figure 5-8) or the boom nose dead-end lug (4), (Figure 5-9).



### Positioning/Removing the Hoist Cable

#### Positioning the Hoist Cable



### CAUTION

#### Falling Objects Hazard!

Always make sure sheaves and pins that secure the hoist cable are secured with clips. This prevents components from coming loose, falling and causing injury.

1. Remove the retaining rods (1), (Figure 5-10).
2. Guide the rope over the upper boom nose sheaves (2), (Figure 5-10).
3. Guide the rope over the lower boom nose sheave (3), (Figure 5-10).
4. Install the hook tackle or the hookblock. The rope may now be reeved.
5. Reinstall all the retaining rods and secure with retaining clips.

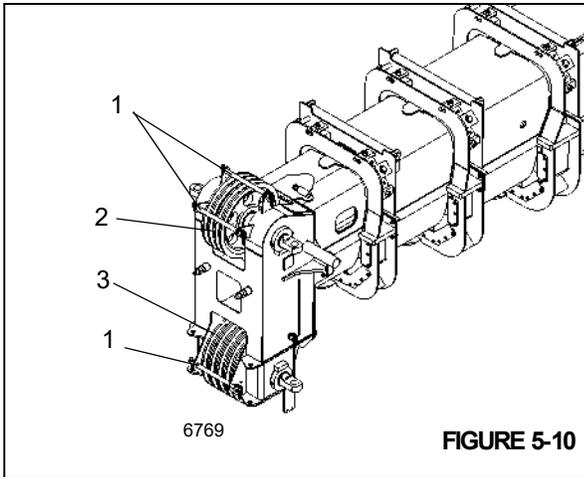


FIGURE 5-10

**Removing the Hoist Cable**

1. Remove the retaining rods (1), (Figure 5-10).
2. Unreeve the hookblock.
3. Take the wire rope off the upper boom nose sheave (2), (Figure 5-10) and place it on the ground on the left side.
4. Replace all retaining rods and secure them with retaining clips.

**Possible Reeving on the Main Boom**

**NOTE:** The maximum load bearing capacity of individual hook blocks does not correspond to the maximum load bearing capacity of the TMS875-2/TMS800-2. The load bearing capacity of the TMS875-2/TMS800-2 may be different from the load bearing capacity of the hook block.

**NOTE:** Please note that the maximum load bearing capacities do not include the weight of the hook block and the lifting gear. You must subtract these weights in order to obtain the actual payload.

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

should be carried by the hookblock or a heavier hookblock should be used.

**With 5 Head Sheaves**

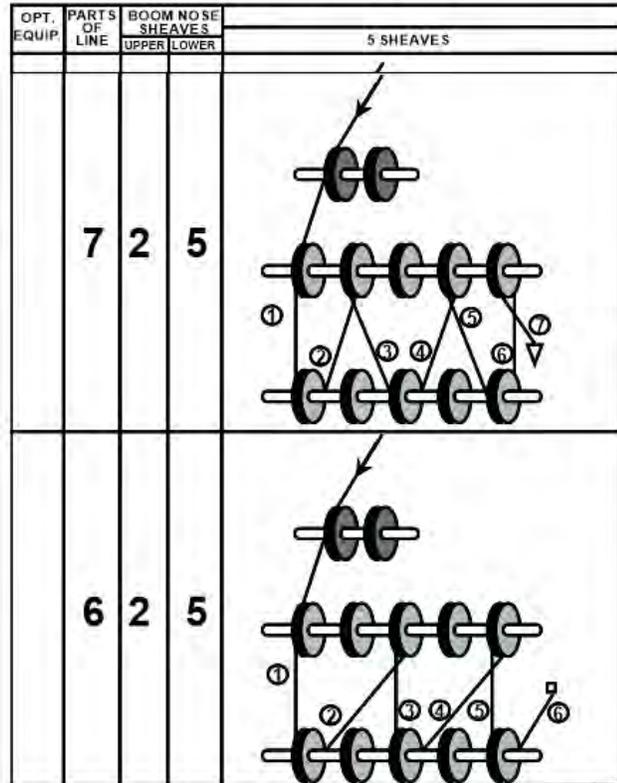
**5-Sheave Hook Block**

<b>5 - SHEAVE BOOM NOSE</b>				
OPT. EQUIP.	PARTS OF LINE	BOOM NOSE SHEAVES		5 SHEAVES
		UPPER	LOWER	
	10	2	5	<p>BOOM NOSE SHEAVES (TYP)</p> <p>HOOKBLOCK SHEAVES (TYP)</p> <p>DEAD END (TYP)</p>
	9	2	5	
	8	2	5	

9136

FIGURE 5-11

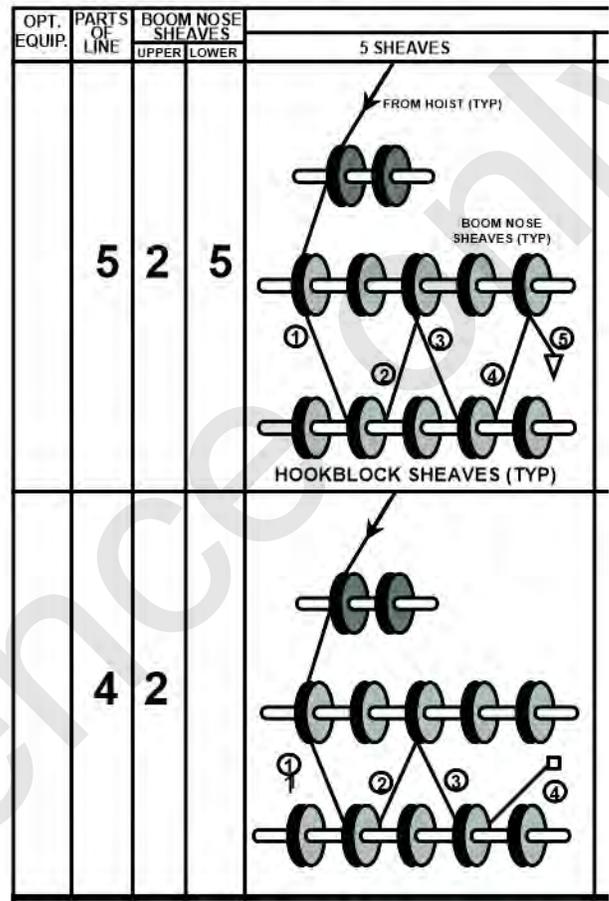
**5 - SHEAVE BOOM NOSE**



9136-2a

FIGURE 5-12

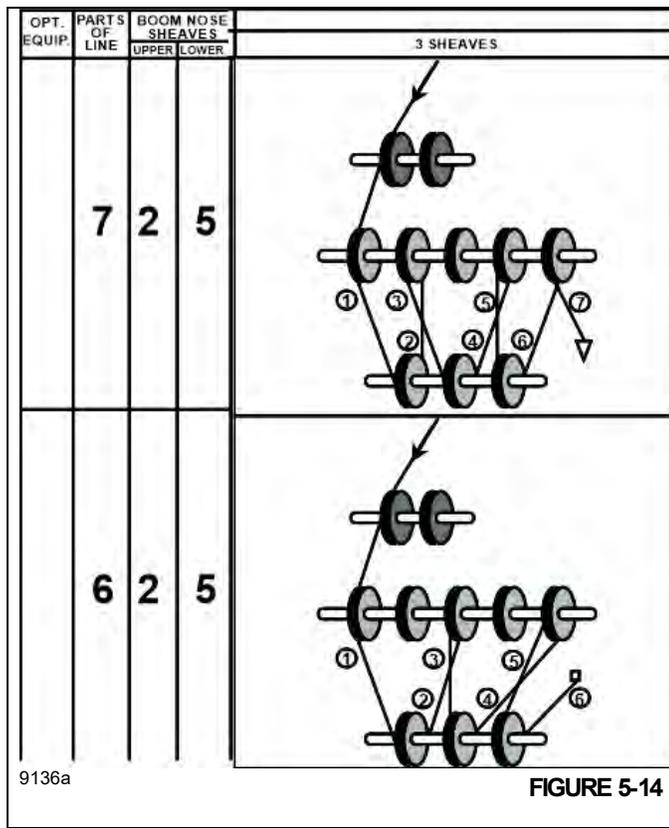
**5 - SHEAVE BOOM NOSE**



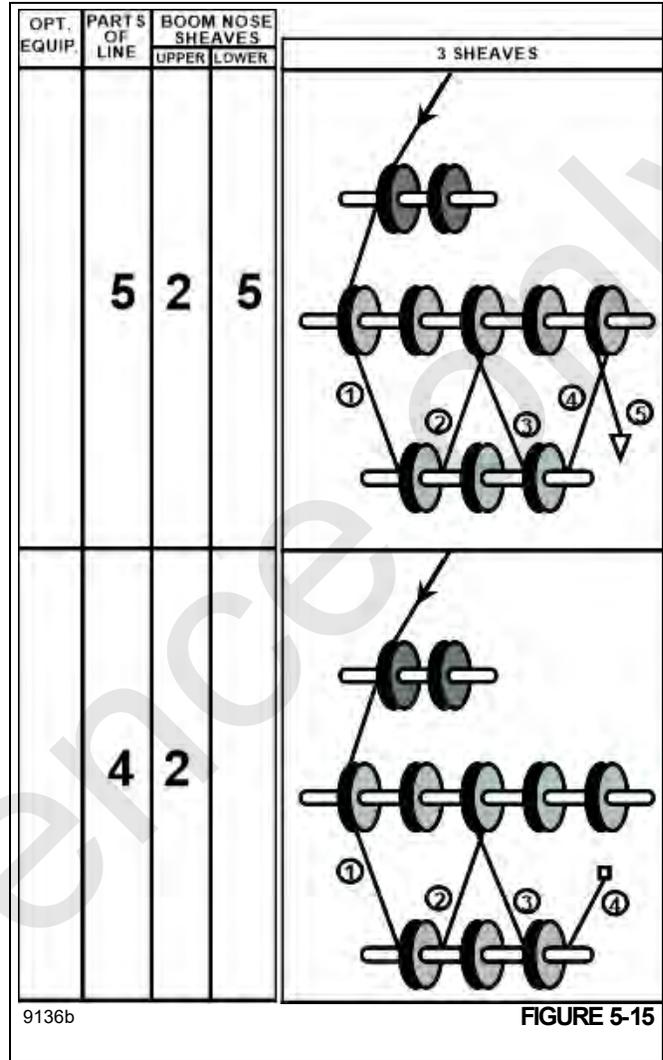
9136-2b

FIGURE 5-13

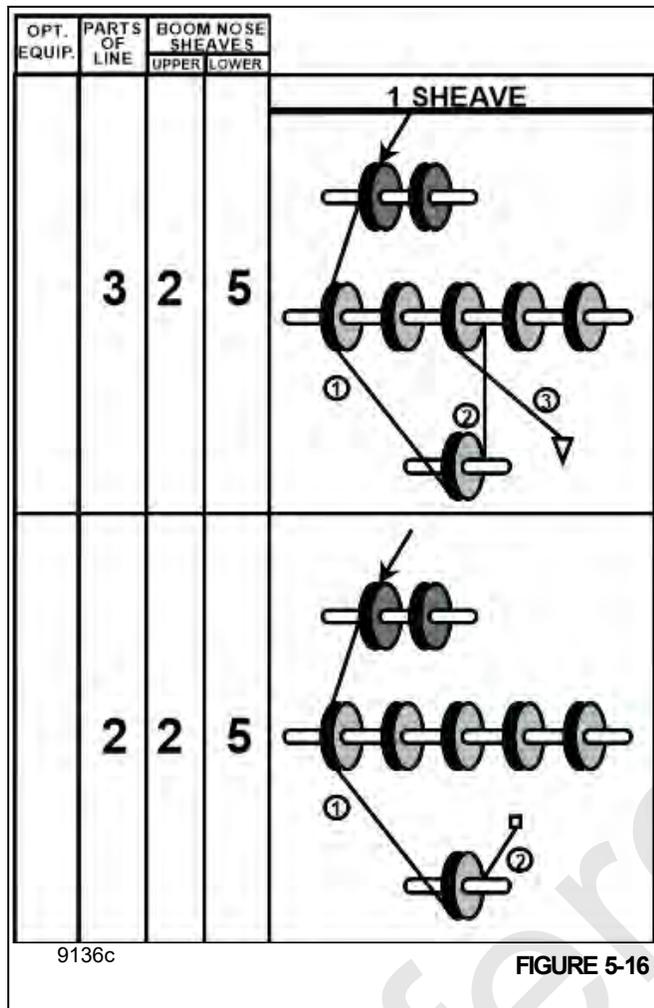
3-Sheave Hook Block



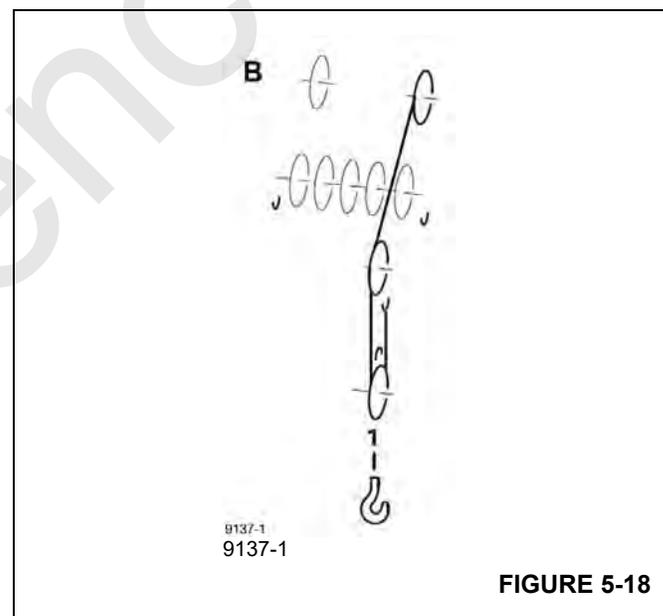
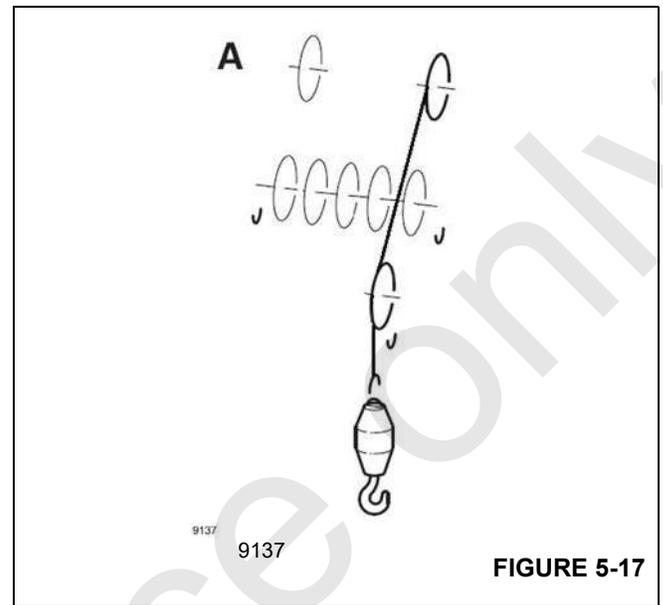
3-Sheave Hook Block



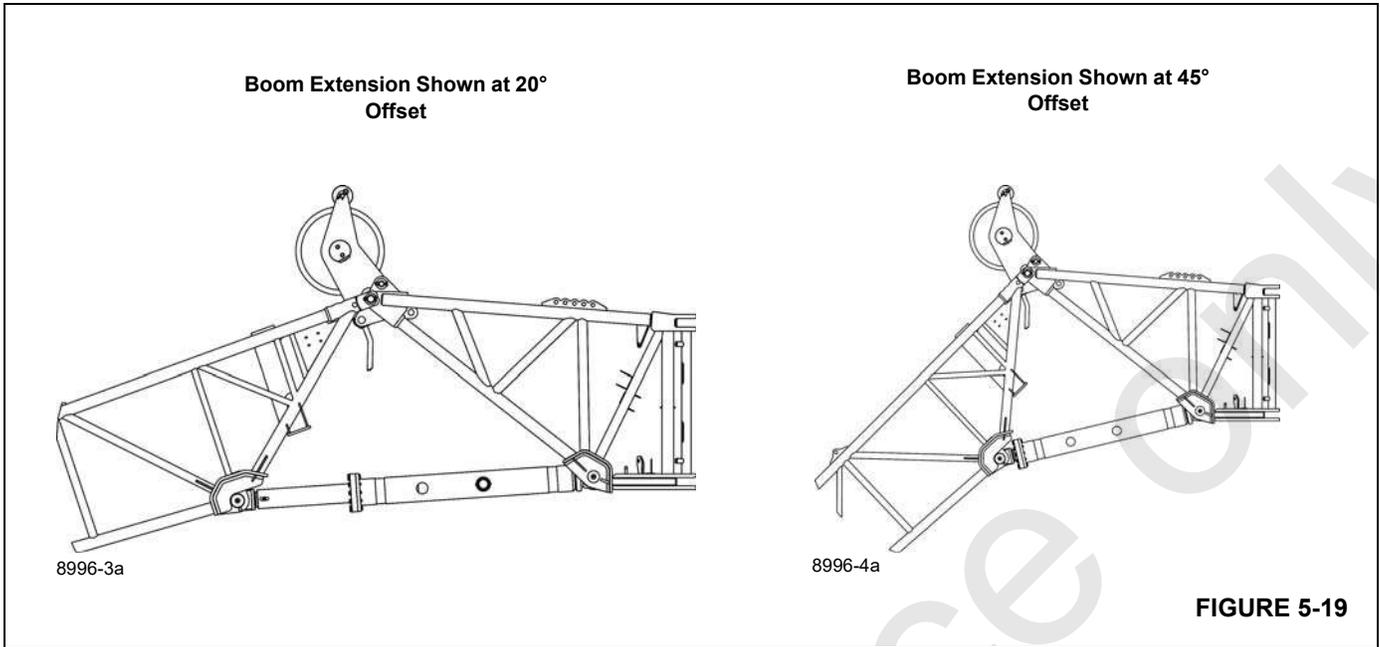
Hook Tackle

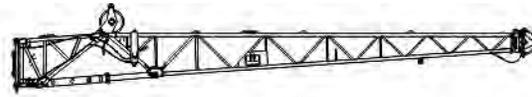


Auxiliary Boom Nose



Reeving	
A	1-part line
B	2-part line

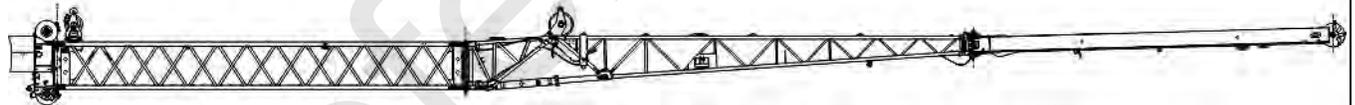




33 Ft (10.05 m) FIXED BOOM  
EXTENSION SHOWN AT 0° OFFSET



56 Ft (17.07 m) BI-FOLD BOOM EXTENSION  
SHOWN AT 0° OFFSET



82 Ft (25 m) BI-FOLD BOOM EXTENSION  
SHOWN AT 0° OFFSET

6453-2a

FIGURE 5-19 continued

## RIGGING WORK FOR CRANE OPERATION WITH THE MAIN BOOM

If the truck crane on the site has already been rigged, proceed according to: *Using the RCL Monitoring Screen - Late Model Cranes and MAXbase Equipped Cranes*, page 4-208.

**NOTE:** This procedure is not complete. There are accompanying operating instructions which are indicated by cross-references.

Ensure the cross-referenced warnings and instructions are followed.

### Rigging

1. Check that the parking brake is applied – if necessary, apply the parking brake.
2. If the main boom is resting on a trailer:
  - Disable the boom floating position.
  - Disable the swing gear freewheel.

**NOTE:** The following points only apply to rigging in Free on wheels working position. Continue the procedure at point 7 when rigging the truck crane on outriggers.

3. For the free on wheels working position:

**NOTE:** Working on free on wheels position is not allowed, unless optional rubber charts are specified, and these are only for directly over the rear of the machine.

- Check that the tire pressure is correctly set.
  - Check that the ground can support the maximum axle loads.
4. Align the truck crane horizontally with the level adjustment system.
  5. On the outriggers:
    - Deflate suspension before extending outriggers.
    - Extend all outrigger beams as far as possible.
    - Move all outrigger pads into the working position.
    - Extend all outrigger cylinders far enough so that the outrigger pads are just above the ground.

**NOTE:** The following points only apply when rigging the truck crane on outriggers. To continue rigging in the Free on wheels working position, continue the procedure at point 11.

6. Check that the ground will support the maximum occurring outrigger pressures.
7. Deflate the suspension.

8. Support the truck crane with the outrigger span required for the job according to the Lifting capacity table and raise until none of the wheels is touching the ground.
9. Align the truck crane horizontally (Figure 5-20).

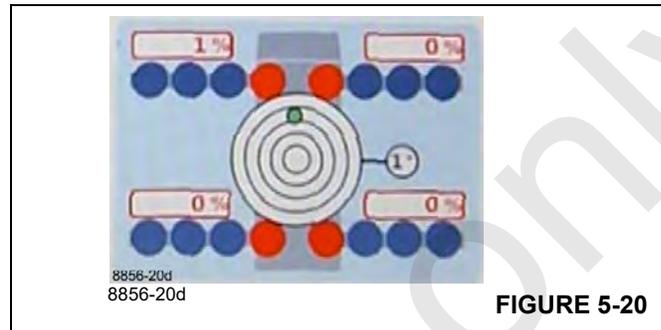


FIGURE 5-20

10. Switch the engine off.
11. Inspect the truck crane, while looking out in particular for any leaking fluids (oil, fuel or water).
12. Extend the Step (Figure 5-21) if necessary. Refer to *Superstructure Cab Platform*, page 4-31.

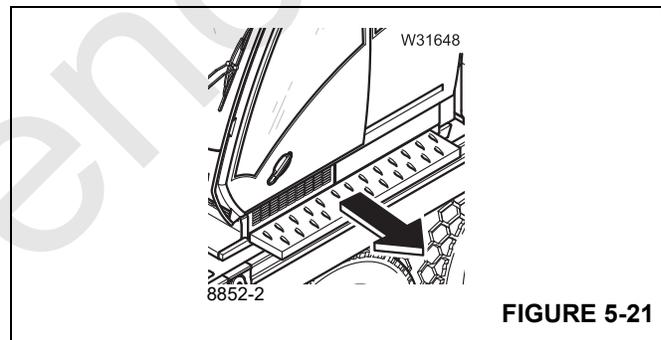


FIGURE 5-21

13. Start the engine for crane operation.
14. Unlock the turntable and, if necessary, disable the 360° lock. Refer to *Switching the 360° Lock ON/OFF (Optional)*, page 4-50.
15. If necessary reeve the hook block then pick up the hook block;
  - *Reeving the Hoist Rope*, page 5-30.
  - *Attaching the Hook Block*, page 5-30.
  - *Reeving the Hoist Rope*, page 5-30.
16. Install the anti-two block switch. Refer to *Installing/Removing the Anti Two-Block Switch*, page 5-33.
17. Install the anemometer and, if necessary, the boom position indicator light. Refer to *Anemometer and Boom Position Indicator Light (Optional)*, page 5-37.
18. Fold out and adjust all mirrors for crane operation.
19. Perform all the required checks prior to crane operation. Refer to *Before Operating the Crane*, page 4-38.

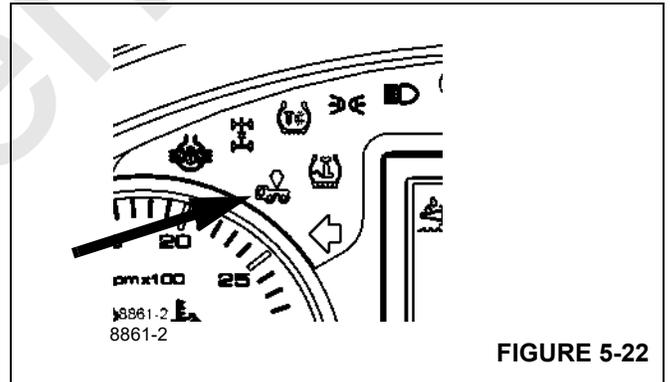
20. Enter the current rigging mode on the RCL. Refer to *Enter Rigging Code*, page 4-198.
21. With the RCL adjusted accordingly, rig the counterweight combination required for the operation according to the Lifting Capacity Table. Refer to *Rigging the Counterweight*, page 5-21.
22. Enter the current rigging mode with the newly rigged counterweight combination on the RCL. Refer to *Enter Rigging Code*, page 4-198.

## Unrigging

**NOTE:** This procedure is not complete. There are accompanying operating instructions which are indicated by cross-references.

Ensure the cross-referenced warnings and instructions are followed.

1. With the RCL set correspondingly, unrig the counterweight. Refer to *Unrigging the Counterweight*, page 5-21.
2. Enter the current rigging mode with the newly rigged counterweight combination on the RCL. Refer to *Enter Rigging Code*, page 4-198.
3. Depending on transport:
  - Attach the hook block to the bumper. Refer to *Attaching the Hook Block*, page 5-30 **OR**
  - Set down the hook block and unreeve the hoist rope. Refer to *Unreeving the Hoist Rope*, page 5-32.
4. Retract the main boom. Refer to *Unlocking Telescopic Sections*, page 4-179.
5. For on-road driving without trailer:
  - Turn the superstructure to the 180° position to the front with the RCL adjusted accordingly.
  - Place the main boom on the boom rest.
6. For on-road driving with a trailer:
  - Unrig the counterweight on the rear counterweight platform. Refer to *Unrigging the Counterweight*, page 5-21.
7. Disable the engine for crane operation.
8. If necessary, remove the anemometer and boom position indicator light. Refer to *Anemometer and Boom Position Indicator Light (Optional)*, page 5-37.
9. Fold in all mirrors for crane operation.
  - Swing the slewable spotlights. Refer to *Before Operating the Crane*, page 4-38.
10. Retract the Step as shown in (Figure 5-21).
11. After operating the truck crane on outriggers:
  - Retract the outriggers.
12. Inflate the suspension.
  - The symbol must be OFF (suspension inflated).



13. Switch the engine OFF.
  - If there is no further work for the truck crane, refer to *In Case of Work Breaks of More than 8 Hours*, page 4-225.

## Removable Counterweight

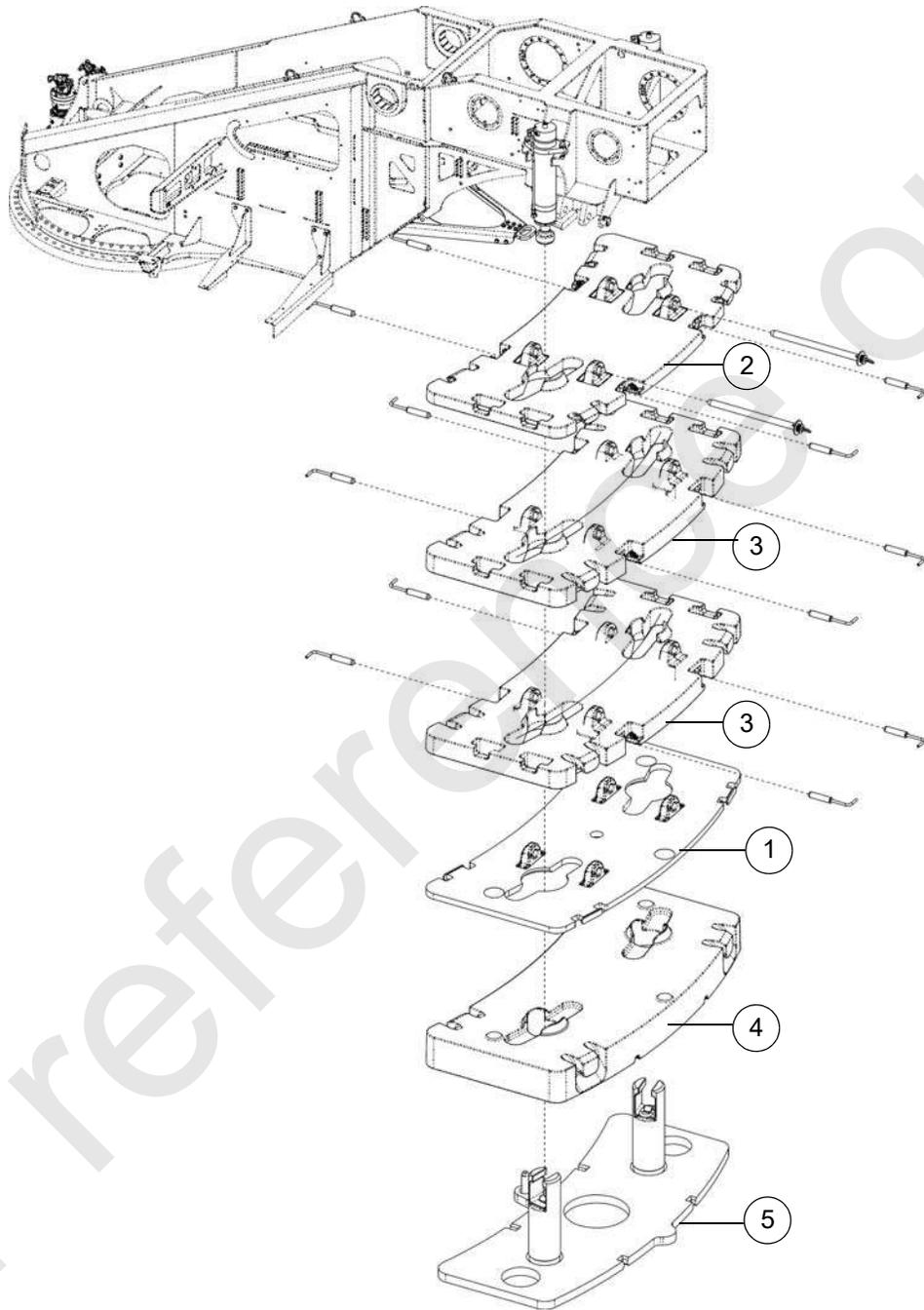
For the TMS875-2/TMS800-2 truck crane, the counterweight combinations are assembled from five removable counterweight sections. Use the following table, *Table 5-2: Standard Counterweight Combinations*, page 5-16 and (Figure 5-22) to determine the correct counterweight combinations.

**Table 5-2: Standard Counterweight Combinations**

	ITEM NUMBER				
	1	2	3	4	5
WEIGHT (lbs)	2,000	3,000	5,000	10,000	3,000 Tray
CWT Combinations					
8,000 lb			1		1
10,000 lb	1		1		1
13,000 lb	1	1	1		1
15,000 lb	1		2		1
16,000 lb		1	2		1
18,000 lb	1	1	2		1
21,000 lb		1	1	1	1
26,000 lb		1	2	1	1
28,000 lb	1	1	2	1	1

To help identify individual counterweight components, the final weight has been steel stamped on each counterweight in kilograms and pounds.

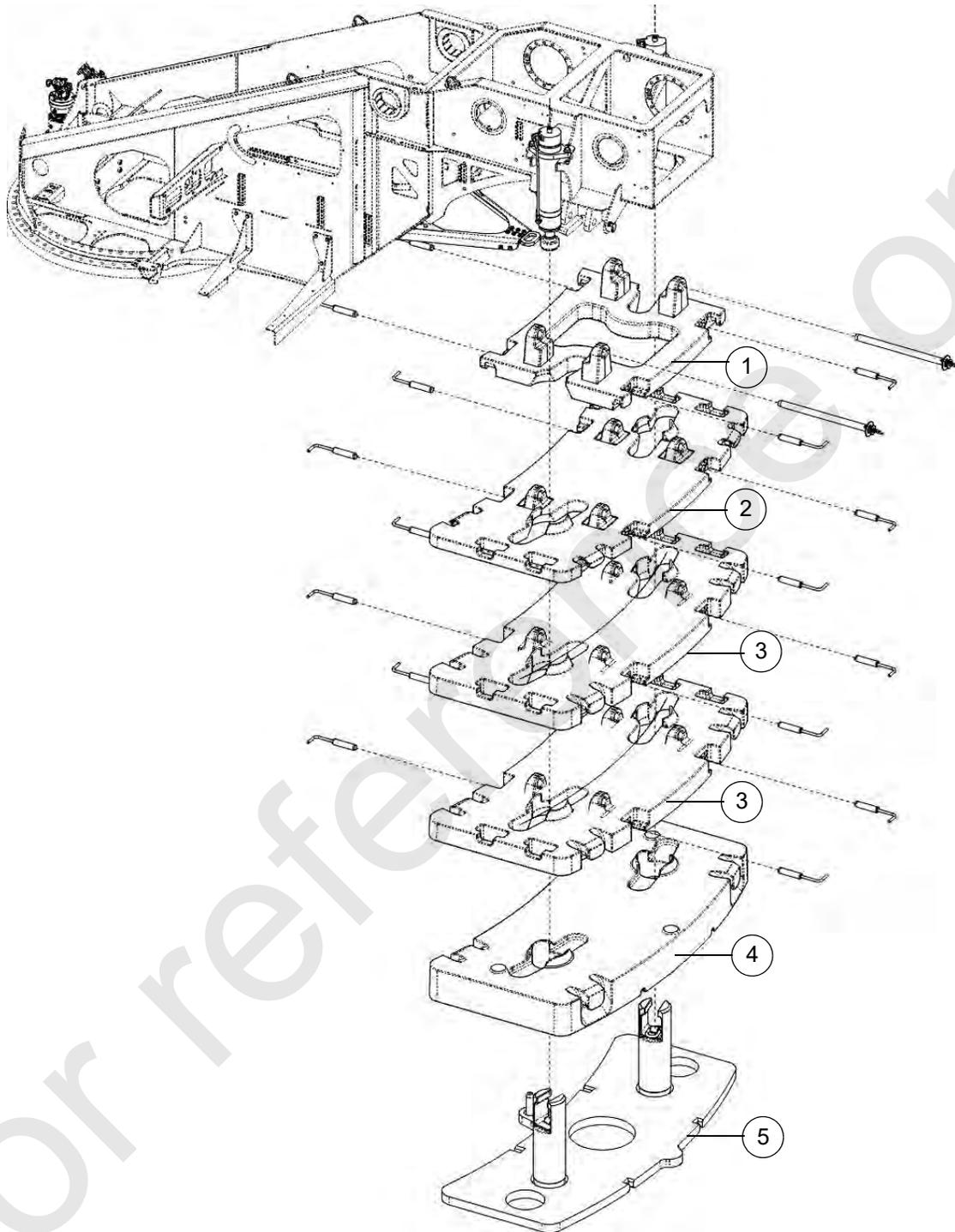
TMS875-2/TMS800-2 Counterweight Package



7018-6ac

FIGURE 5-23

TMS875-2/TMS800-2 Counterweight Package



7018-6ad

FIGURE 5-24

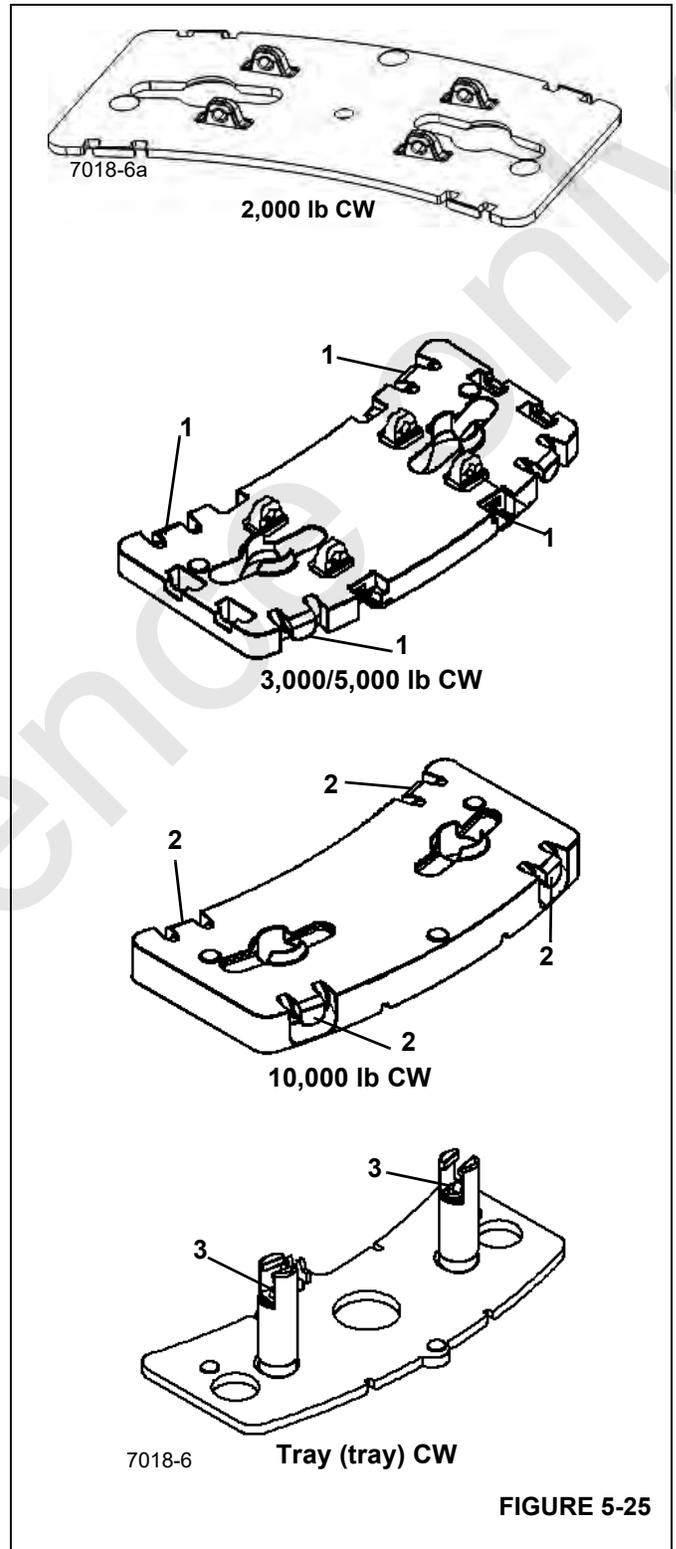
**Counterweight Versions/Combinations**

**WARNING**  
**Crush Hazard!**

Only assemble the counterweights in the proper order. The 3,000 lb counterweight tray, the 10,000 lb counterweight section, the 3,000 lb counterweight section, and the two 5,000 lb counterweight sections.

**Lifting Individual Counterweight Sections**

(Figure 5-25) identifies the lift sling points for the four different counterweight plates used on this machine. When lifting the counterweights onto the carrier platform, attach the lifting sling at the points identified.



Lift the 2,000 lb, 3,000 lb and 5,000 lb counterweight sections using the four casted sling points (1), (Figure 5-25). These three counterweight plates can be lifted onto the

carrier platform together. Be sure to install the locking pins into the plates before lifting these plates together.

Lift the 10,000 lb counterweight sections using the four casted sling points (2), (Figure 5-25).

The 3,000 lb tray section has two lifting lugs (3), (Figure 5-25) welded to the counterweight post for lifting.

### Lifting Stacked Counterweight Sections

Each counterweight plate can be lifted individually onto the crane platform using the lifting points shown in (Figure 5-25). The only combination of counterweight plates that can be lifted together are the 2,000 lb and 3,000 lb (2), (Figure 5-25) and the two 5,000 lb sections (2), (Figure 5-25). All other sections must be lifted individually.



### WARNING

#### Tip Over Hazard!

With a free on wheels truck crane, the superstructure may not be turned. With an outrigger spread of 7.6 ft, the superstructure may only be turned when a maximum of 10,000 lbs counterweight is rigged. This prevents the truck crane from overturning when turning.

The 3,000 lb and two 5,000 lb counterweights can be combined and lifted as shown in (Figure 5-26). Make sure that all locking pins are in the locked position as shown in (Figure 5-29). Place the sling straps on the top counterweight. Do not lift this plate with the 3,000 lb, two 5,000 lb sections or with the 3,000 lb tray. Lift the 10,000 lb plate separately.

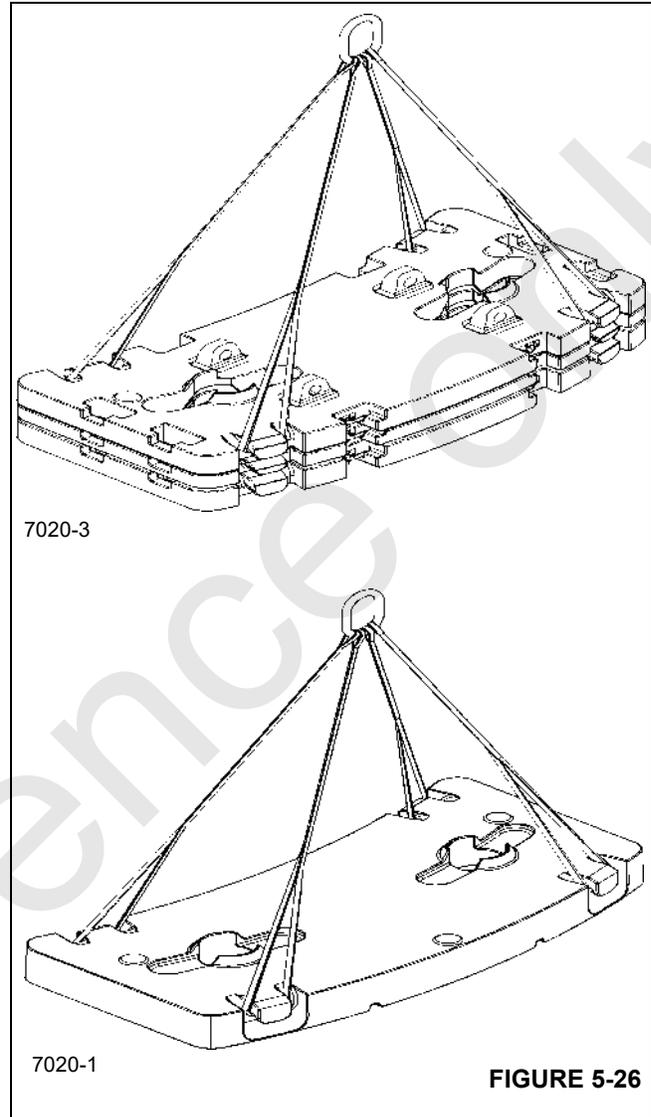


FIGURE 5-26

### CAUTION

#### Locking Pin Damage!

When lifting the 3000 lb and 5000 lb counterweights, make sure that ALL locking pins are completely installed in the lock position (Figure 5-29) before lifting the counterweight sections on and off of the crane.

DO NOT leave the locking pins in the unlocked position while lifting the counterweight sections on and off of the crane. This ensures the counterweight sections are properly locked together when lifting the 3000 lb and 5000 lb sections at the same time. This also ensures that the locking pins do not contact the boom rest or other objects in the work area and become entangled.

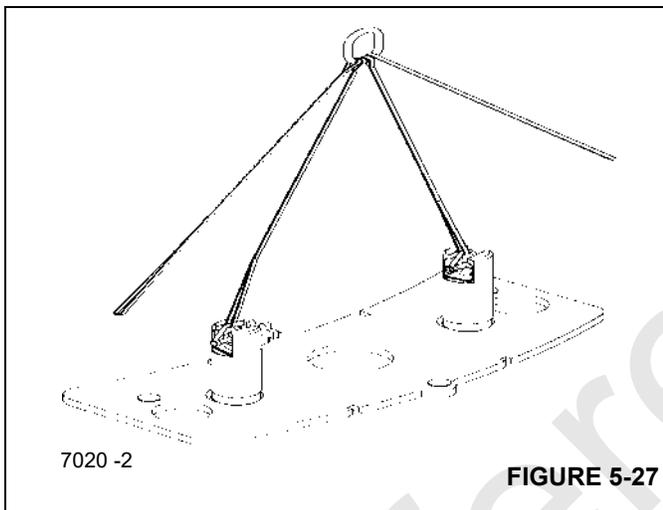
### Slinging Points at the Counterweight Sections

**!** **DANGER**  
**Crush Hazard!**

Only attach the various counterweight sections to the appropriate slinging point and use lifting gear with sufficient lifting capacity.

Lifting of the counterweight sections positioned on each other is only possible under certain conditions.

Use two of the sling straps with shackles (Figure 5-27) attached to each strap, to lift the 3,000 lb tray counterweight section.



**!** **WARNING**

Do not lift this plate combined with any other plate. The lifting lugs are designed to lift only this counterweight.

### Rigging the Counterweight

With a free on wheels truck crane, the superstructure may NOT be turned.

#### Prerequisites:

- With the outrigger span required for crane work, the truck crane is stabilized according to the Load Capacity Chart.
- The RCL is set to the current rigging mode with the currently rigged counterweight.
  - a. The RCL is set to the proper rigging mode for the currently rigged counterweight.
  - b. Lift the 3000 lb tray plate from the separate vehicle and place it onto the counterweight platform.

**!** **WARNING**

The 3000 lb counterweight tray plate must be lowered onto the counterweight platform for counterweight rigging work.

Make sure that the lifting lugs on the 3000 lb counterweight tray are folded in the horizontal position after rigging is complete. This ensures that the lift lugs do not come into contact with the counterweight hoisting unit.

Depending on the desired counterweight version, lift the required counterweight sections onto the 3,000 lb tray plate; assembling the counterweight version.

**!** **WARNING**  
**Tip Over Hazard!**

Always check before swinging whether swinging is permitted in the truck crane's current rigging mode (counterweight, outrigger span, working radius).

Correct the rigging mode if necessary.

- c. Enter the current rigging mode on the RCL.
- d. Assemble required counterweight version – lift counterweight parts one after the other.
- e. Open the Counterweight Sub-Menu. Refer to *Counterweight Removal/Installation Screen*, page 4-142.
  - Correct the rigging mode, if necessary.
  - Swing the superstructure into the rigging range and lift counterweight to the turntable (automatic) and pre-charge.
- f. Enter the current rigging mode with the newly rigged counterweight version on the RCL.

### Unrigging the Counterweight

**!** **WARNING**  
**Tip Over Hazard!**

Before swinging with the rigged counterweight, check whether swinging is permissible with the rigged outrigger span or with the truck free on wheels.

Check whether the truck crane is supported with the required outrigger span as specified in the Lifting Capacity Table.

1. Enter the current rigging mode on the RCL.
2. Open the Counterweight sub-menu.

- Swing the superstructure into the rigging range and set down the counterweight onto the counterweight platform (automatic).
3. Enter the current rigging mode with the presently rigged counterweight version on the RCL.
  4. Lift the counterweight parts off the counterweight platform, as required by the respective driving mode.

### Lower 3,000 lb Tray Plate on the Counterweight Platform

The 3,000 lb tray plate must be placed on the counterweight platform for on-road driving, depending on driving mode. Further counterweight sections can be lowered on the 3,000 lb tray plate. Consult all over the road driving regulations before driving on the highway with counterweights on the crane platform.

Select the current rigging mode on the RCL with the current rigged counterweight on the turntable or enter the corresponding RCL code.



#### WARNING

##### Tip Over Hazard!

With a free on wheels truck crane, the superstructure may NOT be turned. With an outrigger spread of 7.6 ft. (2.3 m), the superstructure may only be turned when a maximum of 10,000 lbs counterweight is rigged. This prevents the truck crane from overturning when turning.



#### WARNING

##### Crushing Hazard!

Make sure that helpers maintain sufficient clearance from the 3,000 lb tray plate with all parts of their bodies during placement.

Remove all objects from the counterweight platform which could become clamped or crushed.



#### DANGER

##### Crushing Hazard!

Make sure that no one is permitted in the swing radius of the crane while they are lifting a counterweight section from the separate vehicle onto the carrier.

Anyone who climbs onto the carrier is in the rotating range of the superstructure.



FIGURE 5-28

On the counterweight platform, there are four retaining brackets (1), (Figure 5-28), which brings the 3,000 lb tray plate (3), (Figure 5-28) into proper position for rigging and for secure driving.

1. Sling the 3,000 lb tray plate and lift it onto the counterweight platform.
2. Position the 3,000 lb tray plate (3), (Figure 5-28) in such a way that the four retaining brackets (1), (Figure 5-28) fit into the four cut outs (2), (Figure 5-28).

### Check the Position of the Locking Pins for 2,000, 3,000 & 5,000 lb Counterweight Sections

There are three counterweight sections that require locking pins during rigging; the 2000 lb, 3000 lb counterweight plate and the 5000 lb counterweight plates. The locking pins allow the 2000 lb, 3000 lb and 5000 lb counterweight sections to be assembled and secured together. Care must be taken to ensure that the locking pins are in the proper positions during rigging work.

The crane can travel on the highway with up to a maximum of 16,000 lbs attached to the superstructure.

Ensure all the locking pins are in the Locked position when:

- Lifting the 2000 lb, 3000 lb and/or the 5000 lb counterweight sections onto and off of the crane.
- Raising and lowering the counterweight assemblies with the counterweight hoisting unit.
- Swinging the turntable with the counterweight attached.
- Traveling with the crane while the 3000 lb and/or the 5000 lb counterweight sections are secured to the turntable.

**NOTE:** It is permissible to travel on the highway with the 3,000 lb counterweight tray attached to the superstructure provided the pin that secures the tray to the wishbone bracket is in place.

Make sure that all the locking pins are in the Unlocked position when:

- Assembling the 2000 lb, 3000 lb and 5000 lb counterweight sections together.
- Disassembling the 2000 lb, 3000 lb and 5000 lb counterweight sections from each other.

### Locking Pin Position

The locking pins (Figure 5-29) are shown in both the Locked (1) and Unlocked (2) position. To place the pin in the Unlocked position, disengage the spring-loaded retainer pin (3), (Figure 5-29). Rotate and remove the locking pin from the holder.

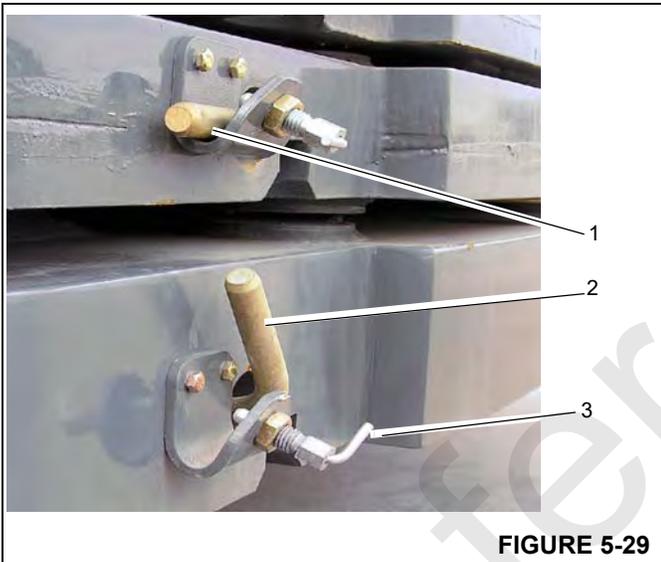


FIGURE 5-29

### CAUTION Locking Pin Damage!

After assembling the 2000 lb, 3000 lb and 5000 lb counterweight sections together, always place the locking pins in the Locked position before rigging the counterweights onto the crane. This prevents the locking pins from protruding or coming free and protruding over the superstructure during crane work.

## Assembling Counterweight Versions/ Combinations



### DANGER

#### Crushing Hazard!

Make sure that no one is permitted in the swing radius of the crane while they are lifting a counterweight section from the separate vehicle onto the carrier.

Anyone who climbs onto the carrier is in the rotating range of the superstructure.



### DANGER

#### Tip Over Hazard!

With a free on wheels truck crane, the superstructure may not be turned.

With an outrigger spread of 7.6 ft. (2.3 m) the superstructure may only be turned when a maximum of 10,000 lb counterweight is rigged. This prevents the truck crane from overturning when turning.



### WARNING

#### Falling Parts Hazard!

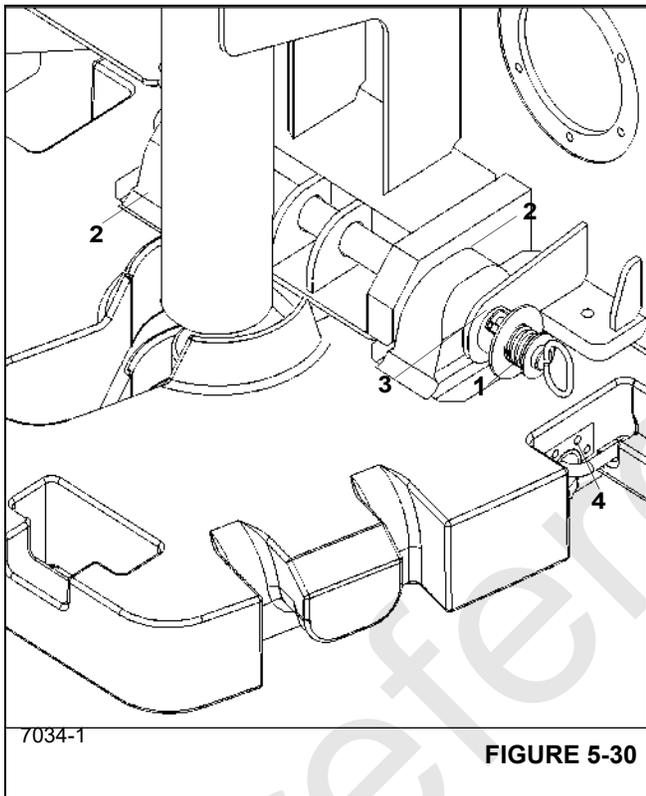
Lifting of the stacked counterweight sections is only possible under certain conditions. Not all counterweight sections are designed for lifting stacked sections.

### Procedures

All recommended counterweight combinations for this machine are identified in *Table 5-2: Standard Counterweight Combinations*, page 5-16. Refer to this table and (Figure 5-25) to select the required combinations of counterweight plates.

1. Use the 3000 lb tray counterweight plate for all counterweight combinations as noted in the *Table 5-2: Standard Counterweight Combinations*, page 5-16, except as noted in Step 5 below. Load the 3,000 lb tray plate onto the counterweight platform first and then the remaining plates on top of it.
2. The 10,000 lb counterweight plate must be rigged with the 3000 lb counterweight tray plate. It must be rigged on top of the 3000 lb tray plate and under the 3000 lb and two 5000 lb counterweight plates.
3. The 3,000 lb and two 5,000 lb counterweight plates can be secured to the turntable. To do this, assemble the 3,000 lb counterweight plate, the two 5,000 lb

counterweight plates, the 10,000 lb counterweight plate, and the 3,000 lb counterweight tray onto the counterweight platform according to (Figure 5-25). Move the turntable into position and raise the counterweight assembly with the counterweight hoisting unit. Secure the top counterweight plate (2,000 lb, 3,000 lb or 5,000 lb) to the turntable with the two bolt pins (1), (Figure 5-30). Place the bolt pins through the two mounting brackets (2), (Figure 5-30) and rotate the roll pins (3), (Figure 5-30) into the slots on the mounting bracket. Make sure that all the locking pins (4), (Figure 5-30) are in the locked position as shown in (Figure 5-29).



### Counterweight Hoist Unit

The counterweight hoist unit consists of two lifting cylinders which are attached to the turntable.

The lifting cylinders raise the 3,000 lb tray plate and the assembled counterweights into position on the turntable. When the counterweight plates are ready to be removed from the turntable the lifting cylinders lower the counterweights back onto the crane counterweight platform.

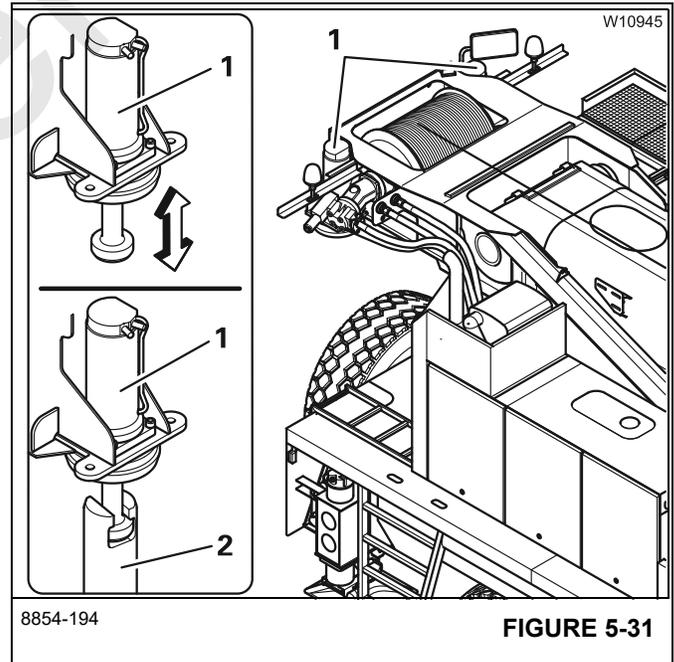
**!** **WARNING**  
**Crush Hazard!**

Before lifting the 3,000 lb tray plate, remove all objects from the top counterweight section which could be crushed.

Be sure that no person is on the counterweight platform while the counterweight is being lifted or lowered.

The lifting cylinders (1), (Figure 5-31) can be extended and retracted.

To lift and lower the counterweight, the lifting cylinders are swung into the posts on the 3000 lb counterweight tray.



If necessary, open the main menu and press the button (1), (Figure 5-32) once.

The Counterweight sub-menu opens.

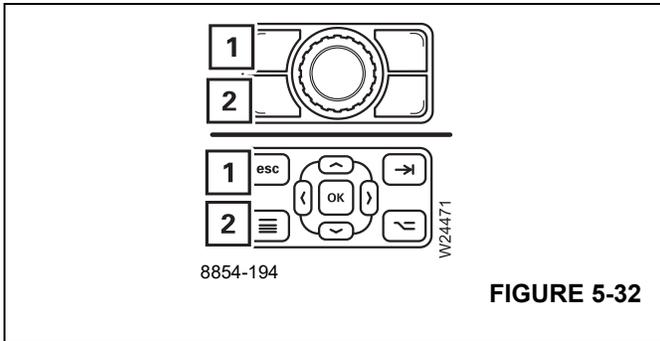


FIGURE 5-32

**Extending/Retracting the Lifting Cylinders**

This section describes how to operate the lifting cylinders manually,

- for correcting the displayed rigging mode, and
- for pre-charging the counterweight afterwards.

**NOTE:** Always lift and lower the counterweight in Automatic Mode, otherwise swing with extended lifting cylinders will be blocked.

**Pre-Charge**

Use the UP arrows (Figure 5-32) to fully raise the cylinders. This is needed if the cylinders were operated manually and not fully raised. Also refer to (Figure 5-35).

**OR**

The accumulator will charge automatically if the pressure is low, the engine is on, and no other function is using the valves.

**Automatic Mode, Rigging**

While the automatic process is being performed, you can always

- Cancel the automatic process, **OR**
- Interrupt the automatic process by letting go of the control lever. After moving the lever in the displayed direction once more, the automatic process is continued.

**Extending/Retracting the Counterweight Lifting Cylinders**

This section describes how to operate the lifting cylinders manually,

- For correcting the displayed rigging mode, and
- For pre-charging the counterweight afterwards.

**CAUTION**

**Machine Damage!**

With the override switch actuated, the functions are always enabled.

Swing the superstructure only when the lifting cylinders are fully retracted.

**NOTE:** Always lift and lower the counterweight in Automatic Mode, otherwise; swinging with extended lifting cylinders will be blocked. Refer to *Automatic Mode Rigging*, page 5-26, and *Automatic Mode Unrigging*, page 5-27.

**Correct the Rigging Mode**

You can use the automatic mode only if the current rigging mode is displayed (Figure 5-33).

A	Counterweight rigged
B	Counterweight unrigged

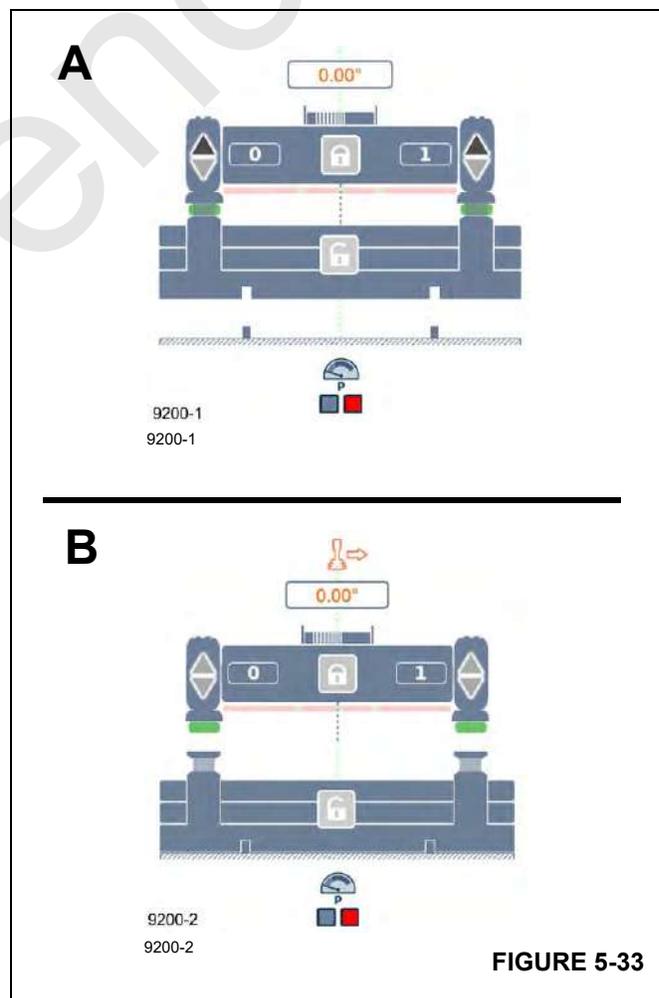


FIGURE 5-33

If necessary, correct the displayed rigging mode as follows:

- Swing the superstructure out of the rigging range so that the lifting cylinders can be freely extended.

Assuming the symbol (4), (Figure 5-34) is yellow with the counterweight unrigged:

- Press the override button (3), (Figure 5-34).
- Fully extend the lifting cylinders – symbol (1), (Figure 5-34).
- Release the override button (3), (Figure 5-34).
- Fully retract the lifting cylinders – symbol (2), (Figure 5-34). Select symbol and hold.

The symbols (4), (Figure 5-34) become green.

You can now use the Automatic Mode.

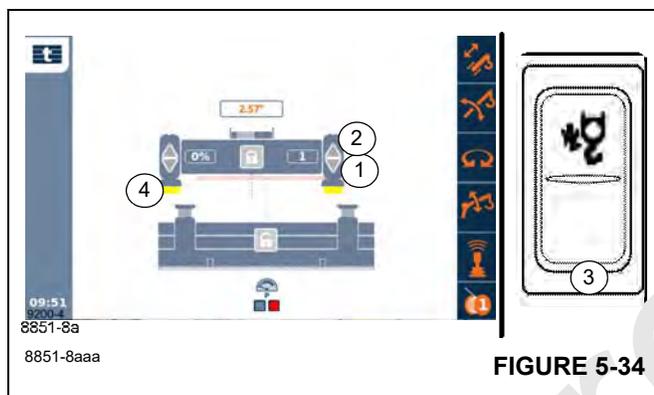


FIGURE 5-34

**Pre-Tensioning**

When the symbol (3), (Figure 5-35) is red, you must pre-tension the counterweight.

- Select and confirm the symbol (1), (Figure 5-35) until the symbol (2), (Figure 5-35) becomes green.

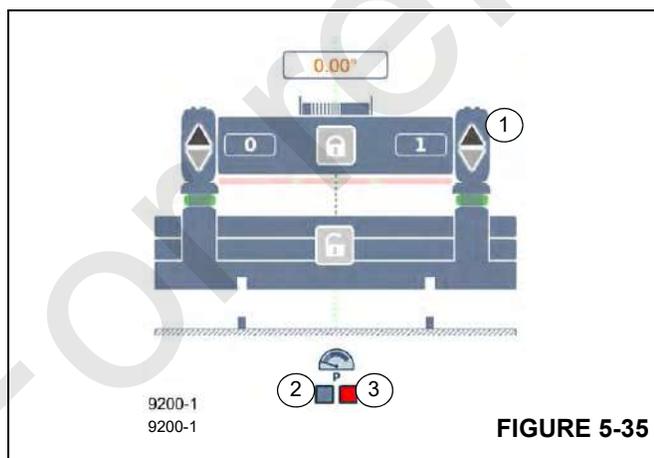


FIGURE 5-35

**Automatic Mode Rigging**

While the automatic mode is being executed, you can always:

- **Cancel** the automatic mode. Refer to *Cancel Automatic Mode*, page 5-29.
- **Interrupt** the automatic mode by letting go of the control lever. After moving the lever in the displayed direction once more, the automatic mode is continued.

**Prerequisites:**

- The counterweight combination must be assembled.
- The lifting cylinders must be fully retracted – symbol (4), (Figure 5-36).
- The swing gear must be switched ON – symbol (1), (Figure 5-36).
- The superstructure must be in the rigging range:
  - Symbol (3), (Figure 5-36) active.
  - Symbol (2), (Figure 5-36) displayed.

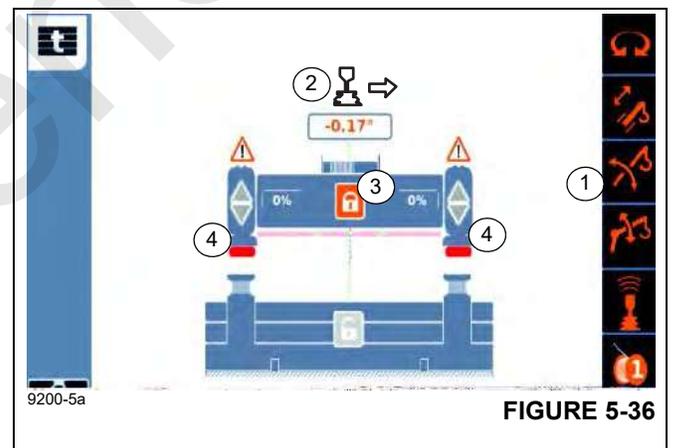


FIGURE 5-36

**Enable Automatic Mode**

- Select and confirm the symbol (3), (Figure 5-37).

**Execute the Automatic Mode**

- To swing, move the control lever in the displayed direction (1) or (2), (Figure 5-37) – the automatic mode starts.
  - The superstructure turns into position (A), (Figure 5-37).
  - The lifting cylinders are extended (B), (Figure 5-37).
- Release the control lever.

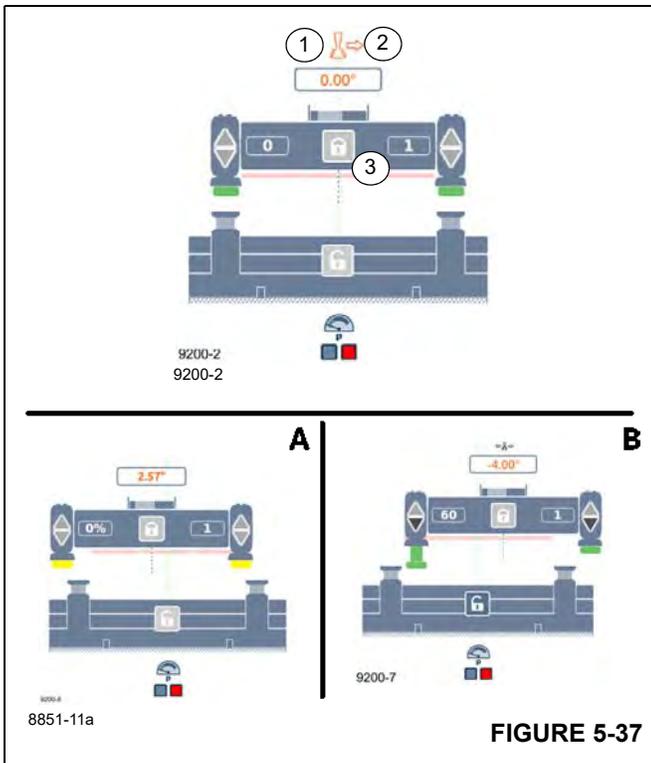


FIGURE 5-37

- To swing, move the control lever in the displayed direction (1), (Figure 5-38) or (2), (Figure 5-38) – the automatic mode continues.
  - The superstructure turns into position (C), (Figure 5-38).
  - The lifting cylinders are retracted (D), (Figure 5-38).

- The counterweight is pre-charged – symbol (3), (Figure 5-38) green.
- Release the control lever.

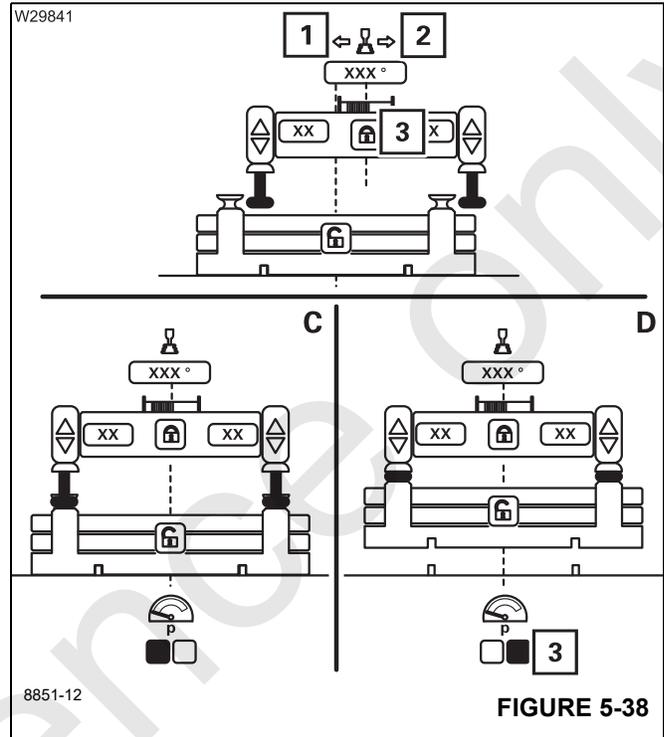


FIGURE 5-38

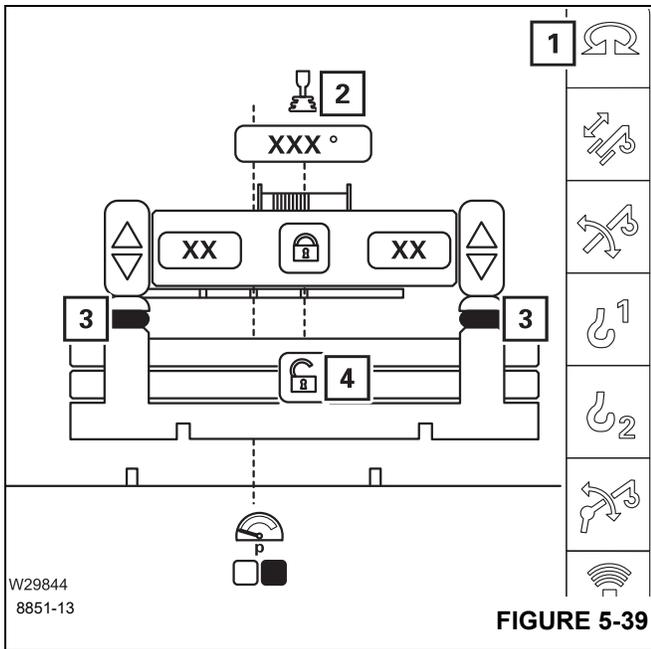
**Automatic Mode Unrigging**

While the automatic mode is being executed, you can always:

- Cancel** the automatic mode. Refer to *Cancel Automatic Mode*, page 5-29.
- Interrupt** the automatic mode by letting go of the control lever. After moving the lever in the displayed direction once more, the automatic mode is continued.

**Prerequisites:**

- The lifting cylinders must be fully retracted – symbol (3), (Figure 5-39) green.
- The swing gear must be switched on – symbol (1), (Figure 5-39) green.
- The superstructure must be in the rigging range:
  - Symbol (4), (Figure 5-39) active,
  - Symbol (2), (Figure 5-39) displayed.

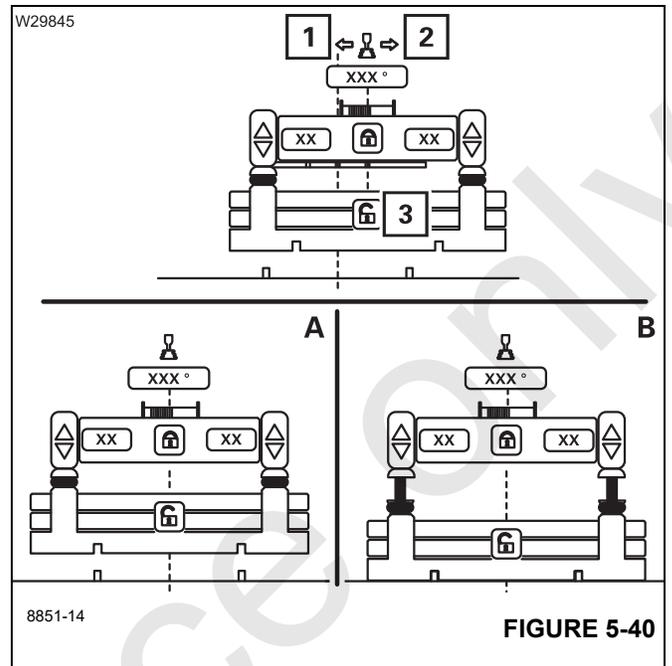


**Enable Automatic Mode**

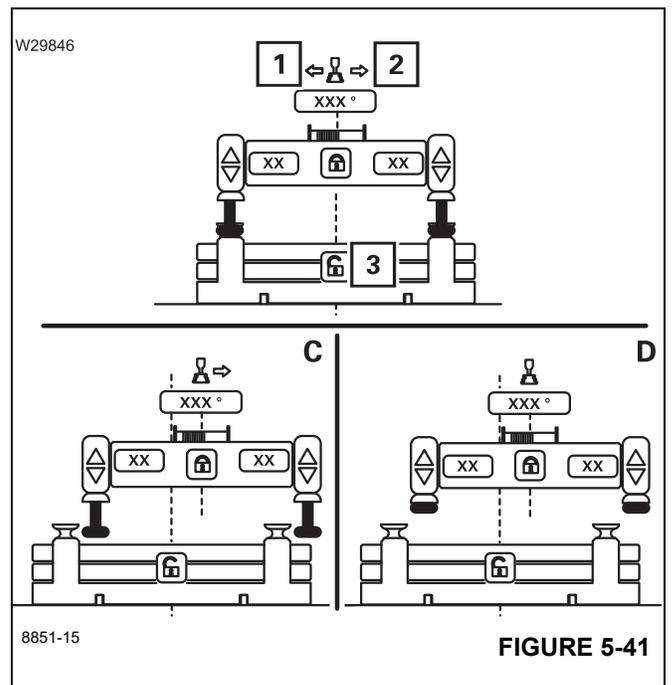
- Select and confirm the symbol (3), (Figure 5-40).

**Execute Automatic Mode**

- To swing, move the control lever in the displayed direction (1), (Figure 5-40) or (2), (Figure 5-40) – the Automatic Mode starts.
  - The superstructure turns into position (A), (Figure 5-40).
  - The lifting cylinders are extended (B), (Figure 5-40).
- Release the control lever.



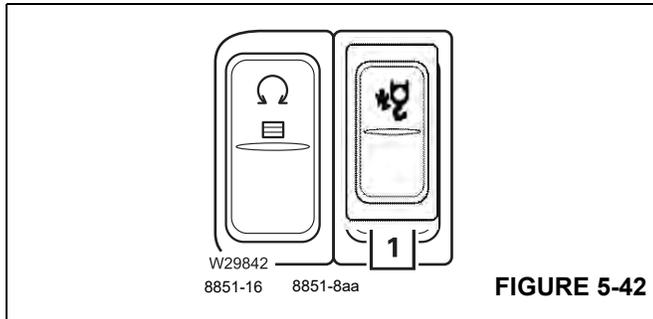
- To swing, move the control lever in the displayed direction (1), (Figure 5-41) or (2), (Figure 5-41) – the automatic mode continues.
  - The superstructure turns into position (C), (Figure 5-41).
  - The lifting cylinders are retracted (D), (Figure 5-41).
- Release the control lever.



**Cancel Automatic Mode**

You can cancel the Automatic Mode any time.

Press the override button (1), (Figure 5-42) – the Automatic Mode is canceled.



- The necessary outrigger span is rigged,
- The respective RCL code is shown, and
- The permissible working radius according to Lifting capacity table is maintained.



**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.

Read the Operator Manual.

**CAUTION**

**Machine Damage!**

With the override switch actuated, the functions are always enabled.

Swing the superstructure only when the lifting cylinders are fully retracted.

**Rotating With the Rigged Counterweight**



**WARNING**

**Tip Over Hazard!**

You may only rotate the superstructure with rigged counterweight if the truck crane is stabilized with a sufficient outrigger span. If this minimum outrigger span is not observed, the truck crane can overturn during rotating.

For small counterweights, the main boom must be raised to one of the angles permitted in the operating area. With larger working radius, the truck crane can overturn during rotating.

If you have canceled the automatic operation, then you must:

**In Position (D), (Figure 5-41):**

- Fully retract the lifting cylinders.

**In Position (C), (Figure 5-41):**

- Turn the superstructure into position.
- Fully retract the lifting cylinders.

**Swinging with Rigged Counterweight**

**CAUTION**

**Machine Damage!**

Always unlock the counterweight platform before you pick up the counterweight.

This prevents damage to the counterweight platform and the base plate.

The following table specifies (depending on the counterweight and outrigger span) whether swinging the superstructure is:

- Permitted
- Only permitted for certain working radii
- Disabled (with the correct rigging mode)

Swinging with a rigged counterweight is only permissible when:

	Support Condition				
	On Tires	0% Retracted	54% Mid-1 Extended	77% Mid-2 Extended	100% Fully Extended
No Counterweight	<b>Rotation NOT Permitted</b>	<b>Rotation Permitted</b>	<b>Rotation Permitted</b>		
8,000 lb					
10,000 lb					
13,000 lb		<b>Rotation NOT Permitted</b>			
15,000 lb					
16,000 lb					
18,000 lb					
21,000 lb					
26,000 lb					
28,000 lb					

**! WARNING**  
**Tip Over Hazard!**

Use the table to check whether sufficient outrigger span is set for the rigged counterweight or the free-standing truck crane, before you unlock and rotate the superstructure. Only rotate the superstructure if the truck crane is sufficiently stabilized. This prevents the truck crane from overturning during rotating because of too much or not enough counterweight mass.

**RIGGING WORK ON THE MAIN BOOM**

**Attaching the Hook Block**

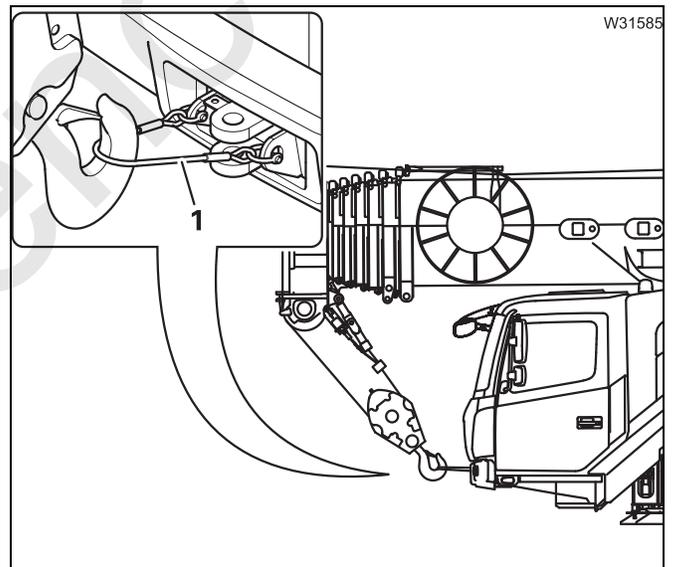
Depending on the driving mode, you can attach the hook block to the front bumper.

**! WARNING**

Ensure that the hookblock does not block the operator's vision for driving when attached to the front bumper.

- Raise the hook block vertically above the retaining rope (1), (Figure 5-43).
- Lower the hook block and attach the hook block to the retaining rope (1), (Figure 5-43).
- Set down the main boom on to the boom rest and pull the hoist rope tight only to the extent that the hook block is stabilized in its position.

**Opening the Hook Block:**



8851-23

FIGURE 5-43

**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.

**Reeving the Hoist Rope**

**CAUTION**  
**Wire Rope Damage!**

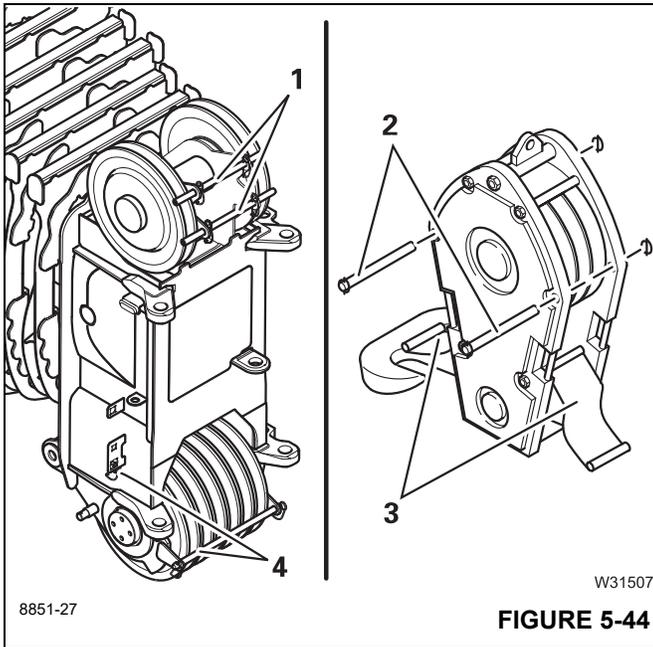
Ensure that the hookblock being used has sufficient overhaul weight to prevent the hoist rope from becoming slack when operating with no load on the hook.

- Pull out the rods (2), (Figure 5-44).

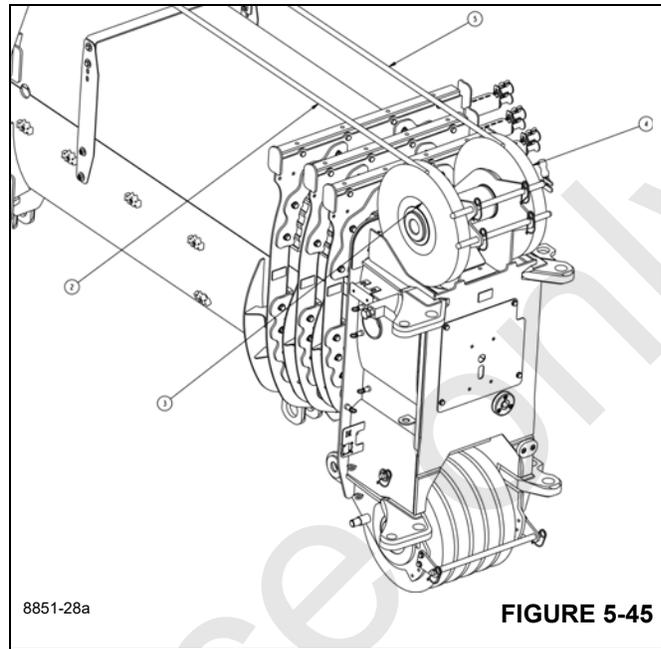
- Fold down the plates (3), (Figure 5-44).

**Positioning the Hoist Rope:**

- Pull out the rods (1), (Figure 5-45) and (4), (Figure 5-45).

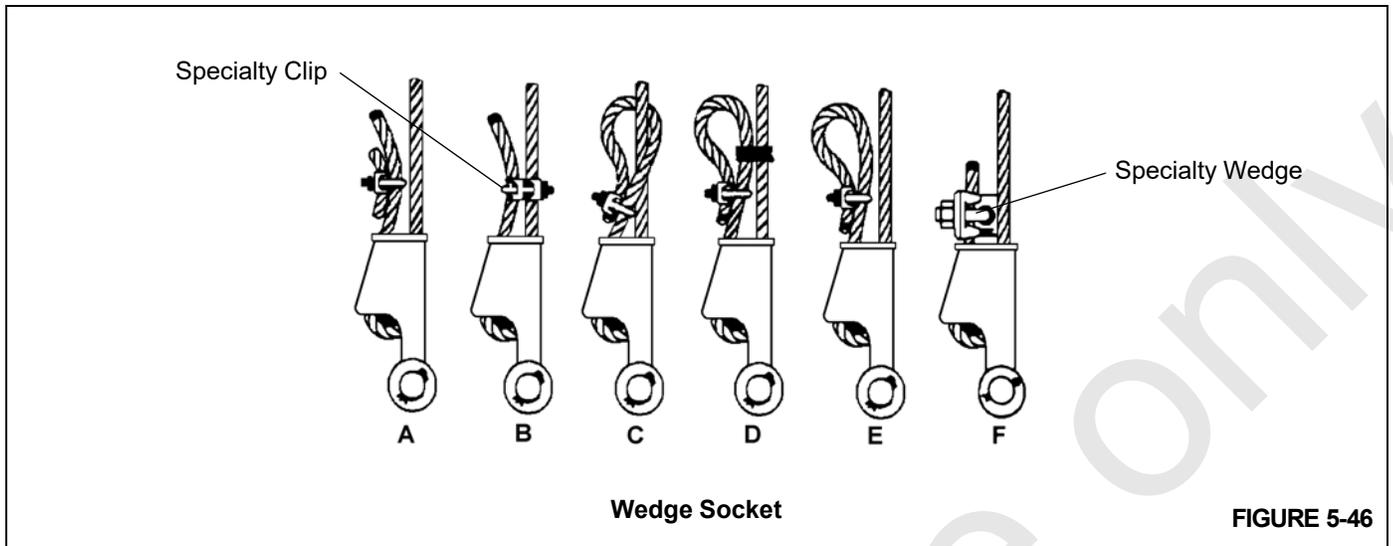


- Feed the main hoist rope to the head sheave (3), (Figure 5-45).
- Feed the auxiliary hoist rope to the head sheave (4), (Figure 5-45).



**Table 5-2**

Wire Rope Clip Torque Values			
Clip Sizes		Torque	
Inches	mm	lb-ft	Nm
1/8	3.18	4.5	6
3/16	4.76	7.5	10
1/4	6.35	15	20
5/16	7.94	30	40
3/8	13.28	45	60
7/16	11.11	65	90
1/2	12.70	65	90
9/16	14.29	95	130
5/8	15.88	95	130
3/4	19.05	130	175
7/8	22.23	225	300
1	25.40	225	300
1-1/8	28.58	225	300
1-1/4	31.75	360	490
1-3/8	38.68	360	490
1-1/2	38.10	360	490



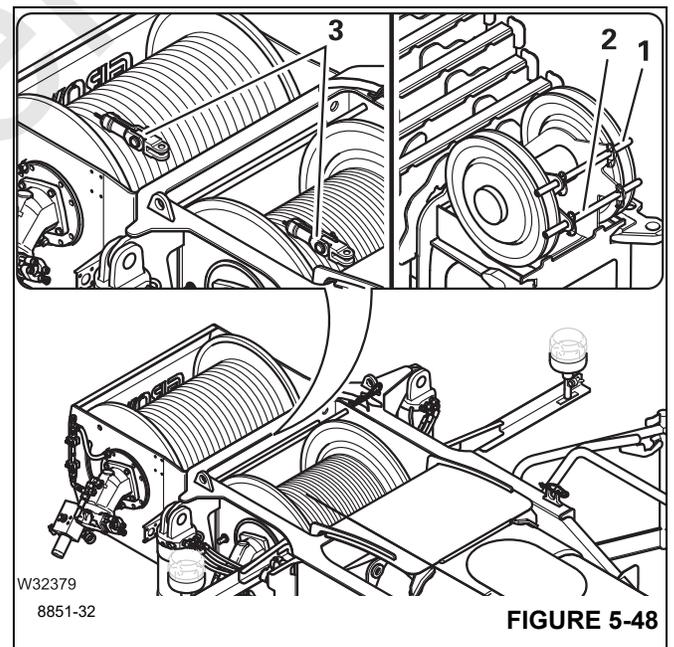
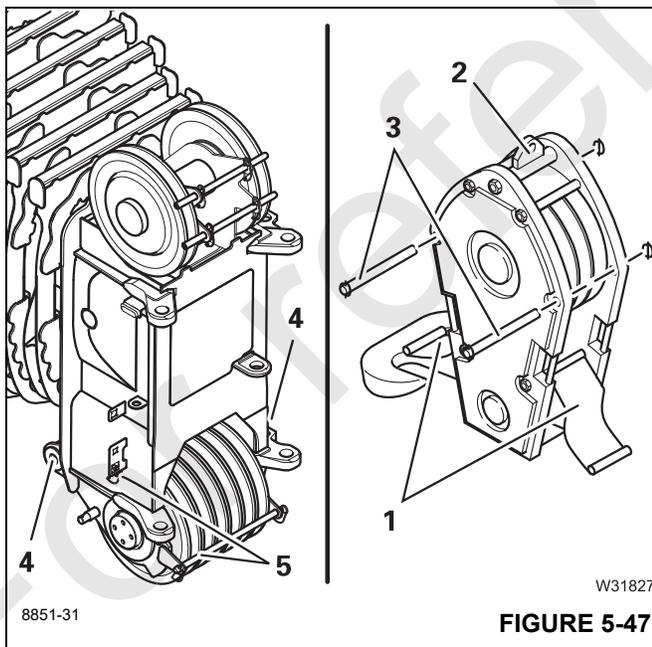
**Unreeving the Hoist Rope**

Refer to (Figure 5-47).

- Pull out the rods (5) and (3).
- Fold down the plates (1).
- Remove the rope end fitting from the fixed point (2) or (4).
- Unreeve the hoist rope.
- Insert the rods (5) and (3) and secure them.

- Pull out the rods (1), (Figure 5-48), (2), (Figure 5-48) and roll the hoist rope (3), (Figure 5-48) on to the drum.

- Insert the rods (1), and (2), (Figure 5-48) and secure them.
- Secure the hoist rope (3), (Figure 5-48).



Depending on the driving mode, you can:

- Fasten the hoist rope to the bumper. Refer to *Attaching the Hook Block*, page 5-30

OR

### Installing/Removing the Anti Two-Block Switch

For every reeved hoist rope, you must install a anti-two block switch, attach a anti-two block switch weight and place it around the hoist rope.

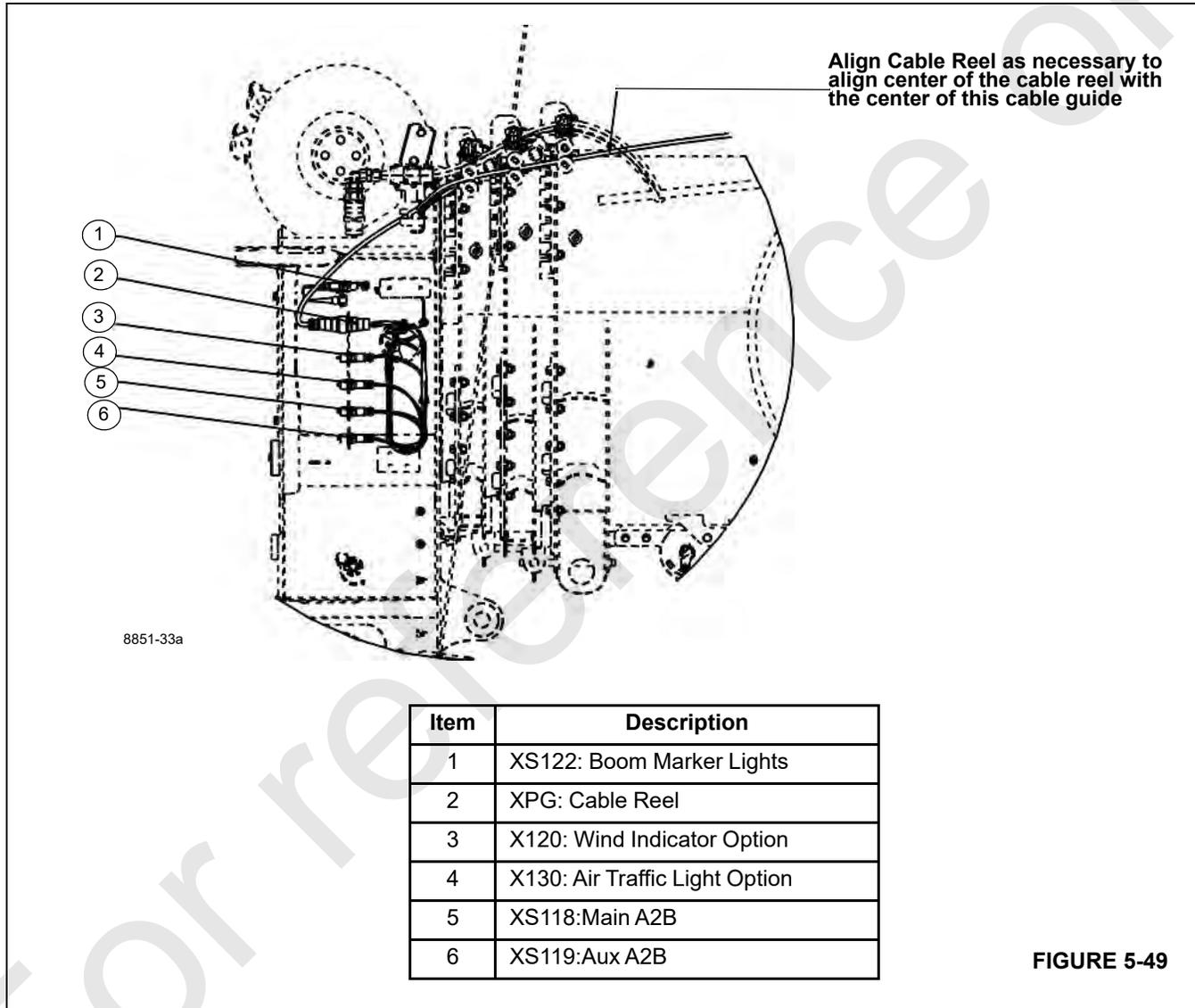
#### Installing the Anti-Two Block Switch

You can attach the anti-two block switch on the right or left side of main boom head. The Main Boom A2B switch gets plugged into the Connector X118 (5), (Figure 5-49). Install the switch on the side that is closer to the last rope line

leading upwards. There can also be one anti-two block switch installed on each side.

#### On the Left Side:

- Plug the anti-two block switch (3), (Figure 5-49) onto the bracket (2), (Figure 5-49) and secure it with the retaining pin.
- Lay the cable (4), (Figure 5-49) in such a way that it will not be damaged during crane operation, and insert the anti-two block switch into the socket connector number (1), (Figure 5-49).



#### On the Right Side:

Refer to (Figure 5-50).

- Plug the anti-two block switch (3) onto the bracket (2) and secure it with the retaining pin.

- Lay the cable (4) in such a way that it will not be damaged during crane operation, and insert the anti-two block switch into the socket (1).

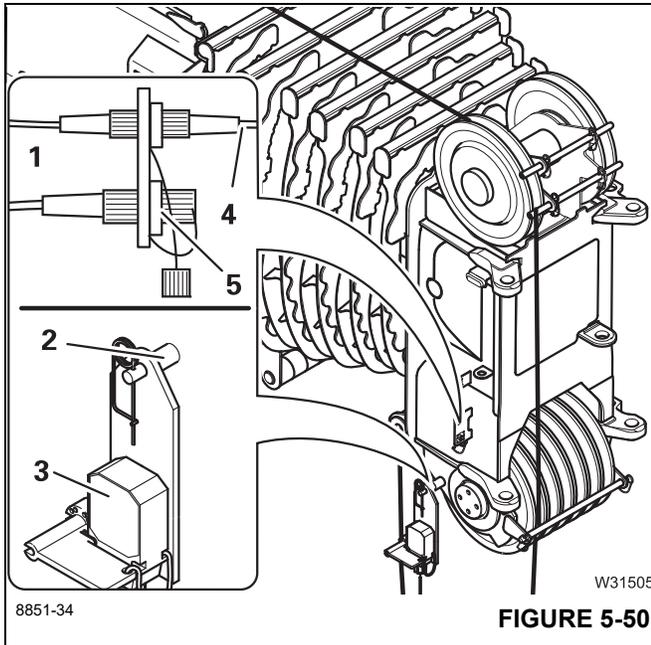


FIGURE 5-50

**If Only One Anti-Two Block Switch has Been Installed:**

Refer to (Figure 5-51).

- Cover the unused socket with the protective cap (2).
- Check whether the lock on the used anti-two block switch, e.g. (1), is released. Refer to *Removing the Lock*, page 5-36.

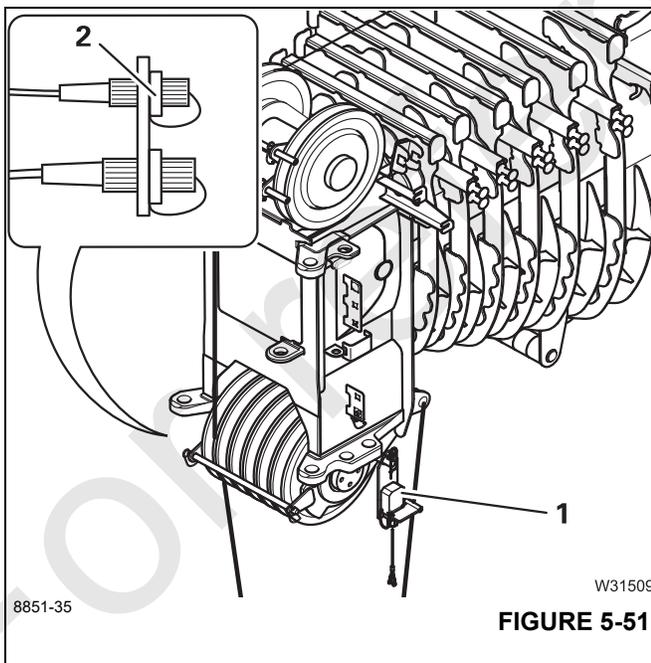


FIGURE 5-51

**! DANGER**  
**Two Block Hazard!**

Do not operate the crane with the anti-two block switch locked.

Failure to unlock the anti-two block switch will prevent the system from working correctly and could result in Death or Serious injury if the rope breaks.

**If Two Anti-Two Block Switches Have Been Installed:**

- Lock the anti-two block switch where there is no anti-two block switch weight attached.

If the anti-two block switch weight has, for example, been attached to the left anti-two block switch (1), (Figure 5-52), you must lock the right anti-two block switch (2), (Figure 5-52). Refer to *Locking*, page 5-36.

Otherwise the movements to Raise Hoisting Gear, Telescope Out, and Lower the Boom will be locked.

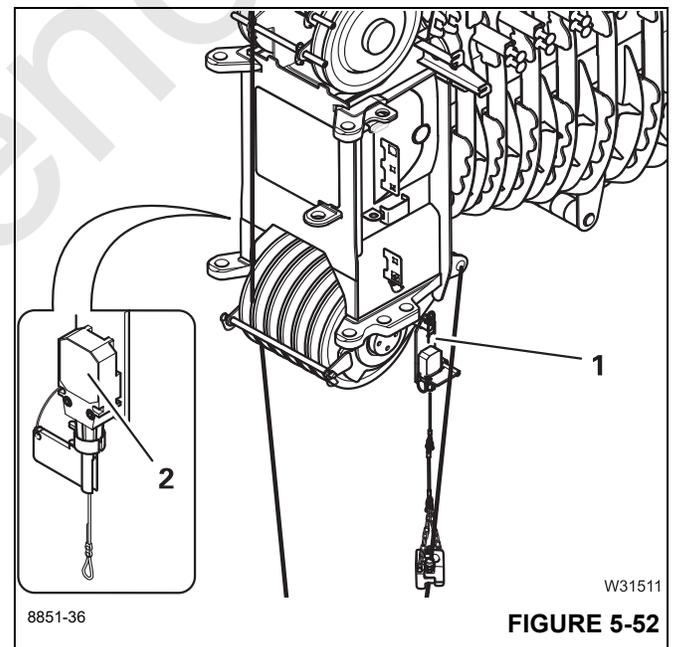


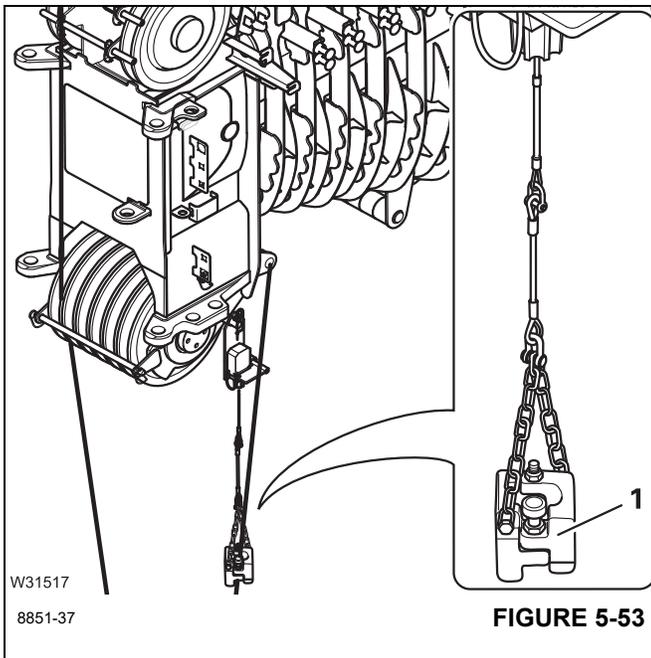
FIGURE 5-52

**Attaching the Anti-Two Block Switch Weight:**

- Attach the anti-two block switch weight (1), (Figure 5-53).

This anti-two block switch must not be locked. Refer to *Removing the Lock*, page 5-36.

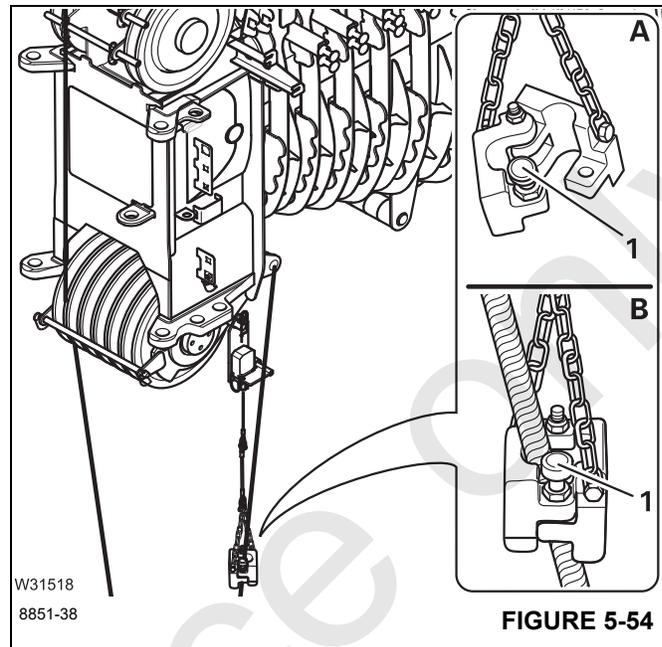
If two hoist ropes are reeved, you must attach a anti-two block switch weight to each of the two anti-two block switches.



#### Placing the Anti-Two Block Switch Weight Around the Hoist Rope:

- (A), (Figure 5-54) – Pull the safety pin (1) out and fold the two halves of the weight apart.
- (B), (Figure 5-54) – Place the two halves of the weight around the last rope line leading upwards.
- Pull the safety pin (1), (Figure 5-54) out and fold the two halves of the weight back together.
- Make sure that the safety pin locks into place and the two halves of the weight are securely attached to each other.

If two hoist ropes are reeved, you must also place an anti-two block switch weight around the second hoist rope.



**NOTE:** If you place the anti-two block switch weight around the last rope line leading upwards, less rope will run through the anti-two block switch weight, especially if there is a high number of reevings per lifting operation. This rope line will even be at a standstill if the number of rope lines is even.

This allows you to reduce the wear of the hoist rope and anti-two block switch weight and prevent unintentional deactivation procedures that may be caused by the running hoist rope lifting the anti-two block switch weight.

#### Removing the Anti-Two Block Switch

This section describes complete removal.

If the hook block is to be attached to the bumper at a later point, you will need to detach the anti-two block switch weight from the hoist rope, so that you can unreeve or reeve when unrigging the hoist rope. You can place the anti-two block switch weight around the hoist rope again before driving.

#### Removing the Anti-Two Block Switch Weight:

- Pull the safety pin (1), (Figure 5-55) out and fold the two halves of the weight apart.
- Remove the halves of the weight from the rope line.
- Pull the safety pin (1), (Figure 5-55) out, fold the two halves of the weight back together and let the safety pin engage.
- Remove the anti-two block switch weight (2), (Figure 5-55).

- Remove the anti-two block switch weight on the other side too, if necessary.

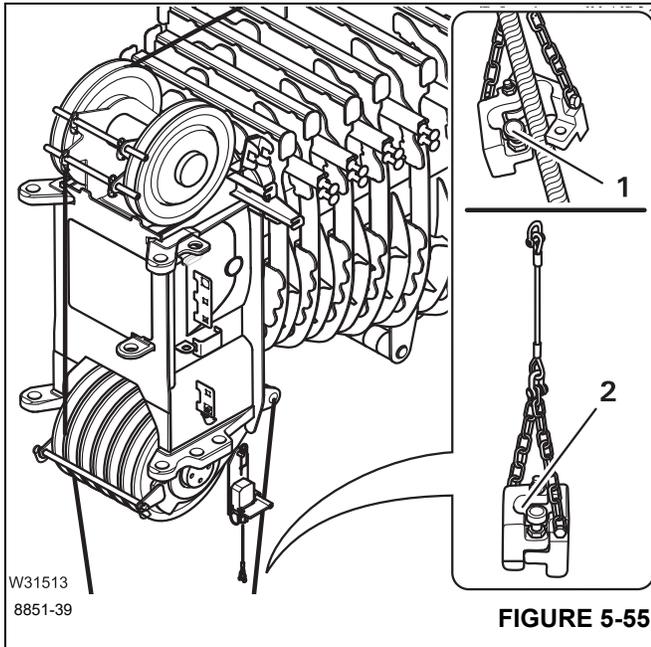


FIGURE 5-55

**Removing the Anti-Two Block Switch:**

- Pull out the plug and close the socket with the protective cap (1), (Figure 5-56).
- Remove the anti-two block switch (3), (Figure 5-56) from the bracket (2), (Figure 5-56).
- Attach the retaining pin (4), (Figure 5-56) to the anti-two block switch.

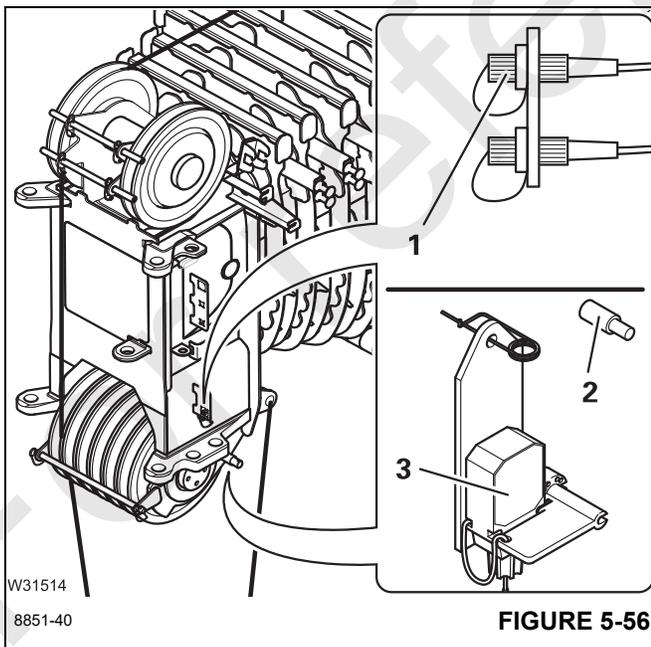


FIGURE 5-56

**Locking/Unlocking the Anti-Two Block Switch**

**Locking**

If two anti-two block switches are installed, you must lock the anti-two block switch not used in order to enable all crane operations unless, both hoists are reeved and being used.

**! DANGER**  
**Two Block Hazard!**

Do not operate the crane with the anti-two block switch locked.

Failure to unlock the anti-two block switch will prevent the system from working correctly and could result in Death or Serious injury if the rope breaks.

- Remove the anti-two block switch weight.
- (A), (Figure 5-57) – Remove the cap (1).
- Pull the rope (2) down; the anti-two block switch is triggered.
- (B), (Figure 5-57) – Secure the rope (2) in this position using the cap (1).

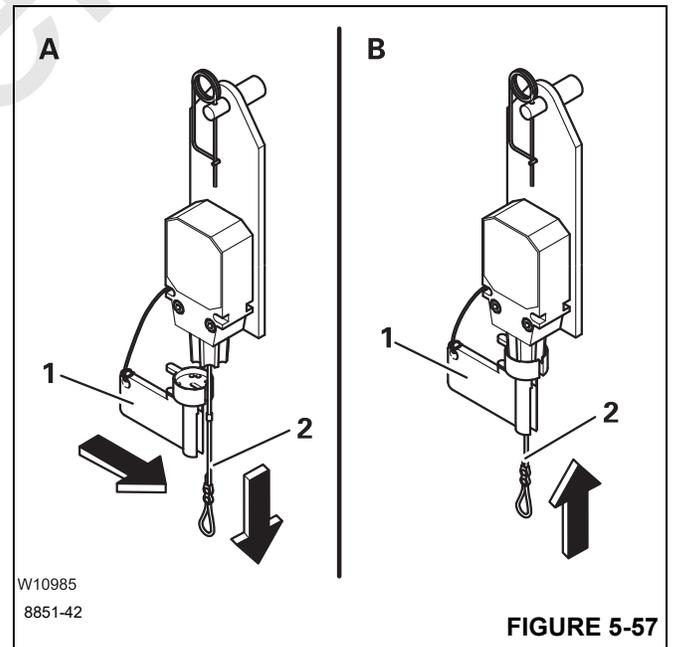


FIGURE 5-57

**Removing the Lock**

You must always release the locking before you place an anti-two block switch weight around the hoist rope.

- (A), (Figure 5-58) – Pull the rope (2) down and take off the cap (1) – the locking is released.

- (B), (Figure 5-58) – Stow the cap (1) onto the anti-two block switch.

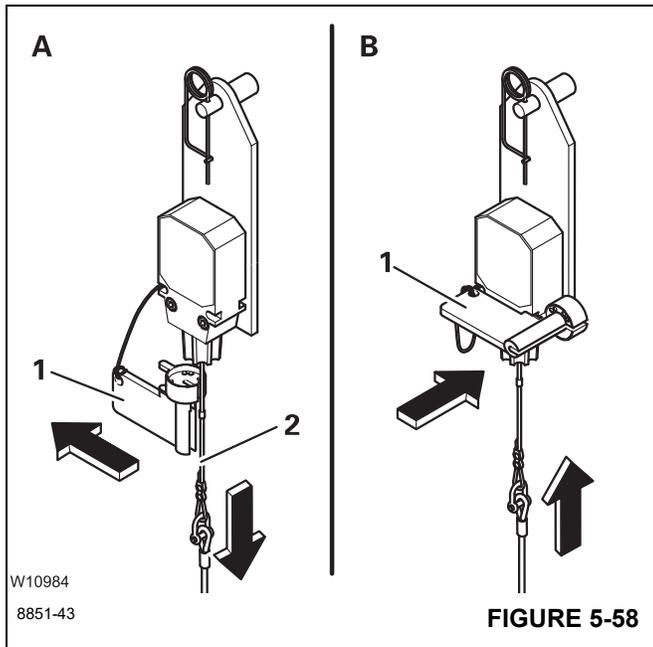


FIGURE 5-58

**Anemometer and Boom Position Indicator Light (Optional)**

**CAUTION**

**Machine Damage!**

Always remove the anemometer and boom position indicator light before on-road driving.

This prevents the specified overall height being exceeded at on-road level, and the anemometer from getting damaged by being rotated too fast.

**Installing**

The anemometer and the boom position indicator light – if provided – are located on the same rod.

- Insert the rod (1), (Figure 5-59) into the holder (3), and secure it with the retaining pins.
- Remove the cable from the holders (2), (Figure 5-59) and connect..

- the anemometer to socket (4), (Figure 5-59).
- the boom position indicator light to the socket (5), (Figure 5-59).

- Lay the cables in such a way that they will not be damaged during crane operation.
- Check that the anemometer is able to swing so that it hangs vertically even when the main boom is raised.

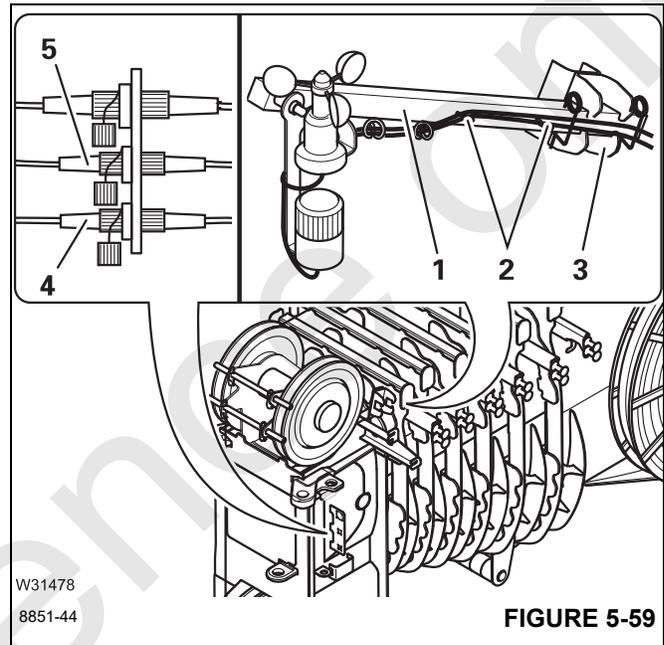


FIGURE 5-59

**Removing**

You must remove the rod with the anemometer/boom position indicator light before driving on the road.

- Disable the boom position indicator light.
- Remove the plug and close the sockets (4), (Figure 5-60) and (5), (Figure 5-60) with the protective caps.
- Wind the cables onto the holders (2), (Figure 5-60).
- Remove the rod (1), (Figure 5-60) from the holder (3), (Figure 5-60).
- For transportation, fasten the retaining pins to the rod (1).

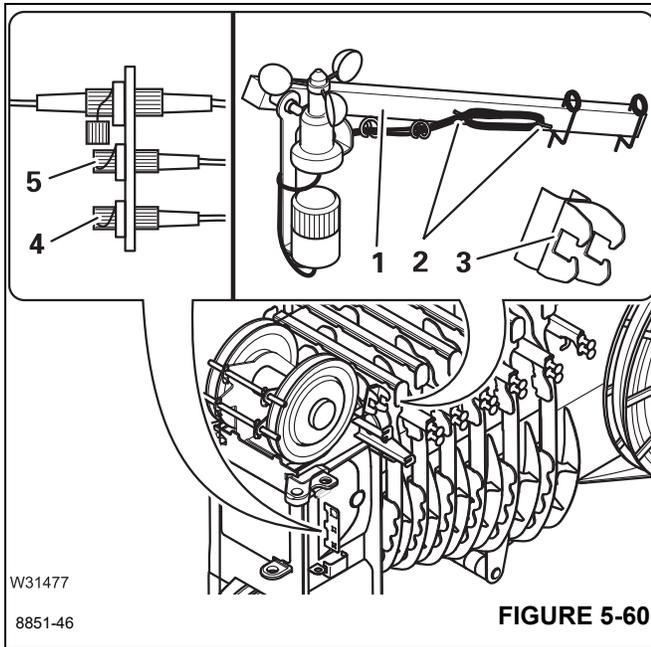


FIGURE 5-60

**OTHER RIGGING WORK**

**Cameras for Crane Operation**

**CAUTION**

**Machine Damage!**

Always retract the camera before driving. When the camera is extended, the overall height specified for on-road driving is exceeded.

A camera transmits an image of the main and auxiliary hoists to the display in the crane cab.

**Viewing the Hoist Camera**

The Hoist Camera View can be set to show on the Monitoring Screen of the Rated Capacity Limiter Display Module (RDM) as shown in (Figure 5-61). For additional information on Hoist Camera's, refer to *Viewing the Hoist Camera*, page 4-130.

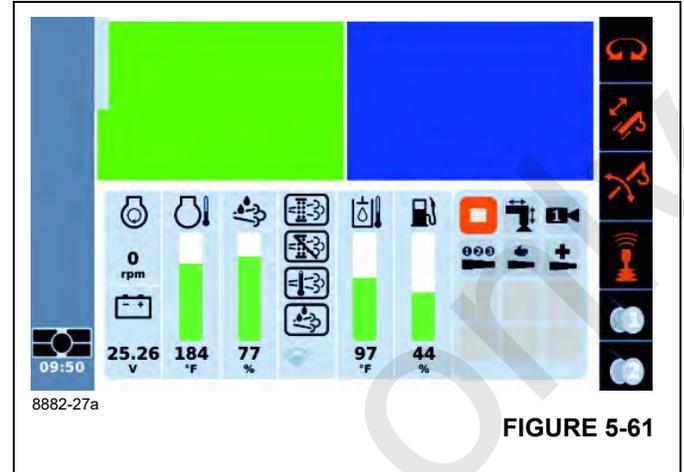


FIGURE 5-61

**Hoist Maintenance Platform**

The turntable is equipped with foldable handrails.



**DANGER**

**Fall Hazard!**

Ensure the railings are erected and secured before entering the hoist maintenance platform. Failure to do so could result in death or serious injury.

**CAUTION**

**Machine Damage!**

Fold down the railings before driving. When the railings are unfolded, the overall height specified for on-road driving is exceeded.

Always fold out the railings when you are working on the hoists. Always fold in the railings before driving.

**(A) – Folding OUT**

- Fold the handrail (1), (Figure 5-62) upwards until the pins (2), (Figure 5-62) latch into place.

**(B) – Folding IN**

- Open the locking pins (2), (Figure 5-62).
- Fold the handrail (1), (Figure 5-62) in until the pins (2), (Figure 5-62) latch into place.

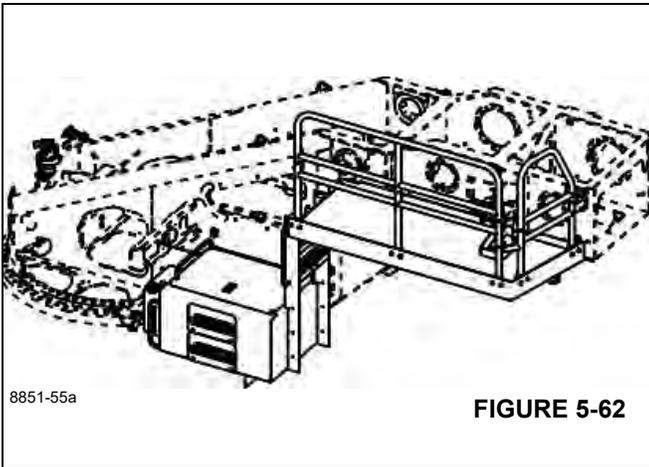


FIGURE 5-62

### Slinging Points for Personal Protective Equipment

The approved slinging points for personal protective equipment are marked with special labels (Figure 5-63).



FIGURE 5-63

### BOOM EXTENSION

Fully read and understand the information under this section before erecting and stowing the boom extension.



### DANGER

To prevent serious injury or death, always wear personal protective equipment; i.e., a hard hat, eye protection, gloves and metatarsal boots.

Refer to (Figure 5-64) for a diagram of the boom extensions available for this crane.

The TMS875-2/TMS800-2 can be used with the following boom extensions:

- 34 ft to 57 ft (10.3 m to 17.3 m) manual off-settable bi-fold swingaway boom extension (folding manual luffing extension), with mechanical offset mechanism for offsets of 0, 20, & 45 degrees, as standard.
- 34 ft to 57 ft (10.3 m to 17.3 m) hydraulic off-settable bi-fold swingaway boom extension (folding hydraulic luffing extension), with hydraulic off-set mechanism for offsets of 0 to 45 degrees.
- 26 ft. (8 m) base extension insert (26 ft insert) to use with any of the 34 ft. to 57 ft. (10.3 m to 17.3 m) folding extensions.

All boom extensions are built specifically for the crane with which they were sold. Each extension is stamped with the crane's serial number.

### CAUTION

#### Equipment Damage Hazard!

Operate the crane only with extensions which have the same serial number as the crane, to prevent malfunctions and damage to the equipment.

To use a single boom extension on several Grove cranes, contact Grove Product Support or your authorized Grove Distributor.

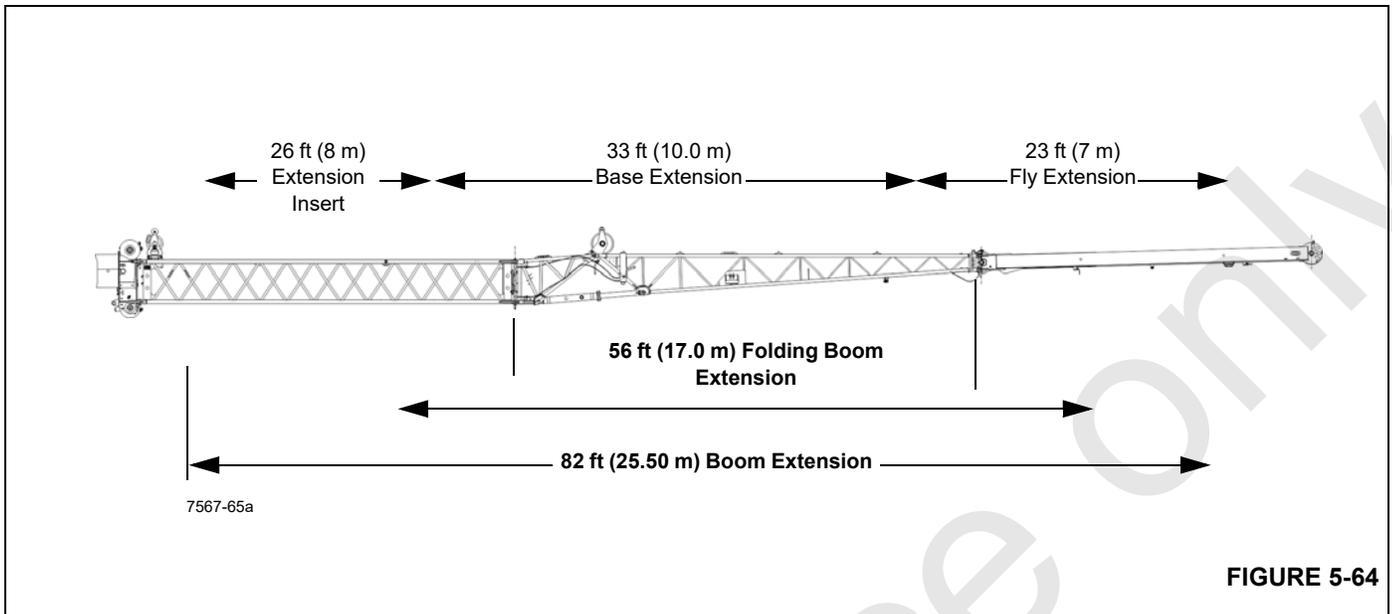


FIGURE 5-64

**General Warnings**

**! DANGER**

Make sure the boom is fully retracted during erection and stowage of the boom extension.

If the boom is extended during this process, the pins may not engage properly and/or the boom extension could move in an uncontrolled manner resulting in death or serious injury.

! DANGER

**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.

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**DANGER**

To prevent serious injury or death, always wear personal protective equipment, including a hard hat, eye protection, gloves, and metatarsal boots.

Before attempting to erect or stow the boom extension, read and strictly adhere to all danger decals installed on the boom/boom nose, boom extension, and stowage brackets to prevent serious injury or death.

Controlling the boom extension during erecting and stowing procedures is accomplished by use of a tag line and by raising or lowering the boom. Failure to control the boom extension could cause serious injury or death.

**Boom Extension Pin Interlock Mechanism**

The boom extension pin interlock mechanism (1, (Figure 5-65)) interlocks the front mounting pin (3) and boom installation pins (4) to ensure that the boom extension is erected and stowed properly. The front mounting pin (3) is extended and retracted electrically from the ODM in the operator cab. Push/pull cables (2) connect the front mounting bracket pin (3) and boom nose installation pins (4). When the front mounting pin (3) is extended, the cables (2) retract the interlock pins (6) from the boom installation pins (4), unlocking them. When the front mounting pin (3) is retracted, the cables (2) insert the interlock pins (6) in the boom installation pins (4), locking them in the extended

position. If the boom installation pins (4) are unlocked, the front mounting pin cannot be retracted.

**Front Boom Extension Mounting Pin**

The front boom extension mounting pin (3, (Figure 5-65)) is electrically operated from the ODM in the operator cab or from the Remote Control Unit. When the front mounting pin is extended, the boom nose installation pins (4) are unlocked, allowing the installation pins to be extended or retracted. When the mounting pin (3) is extended, the proximity sensor in the front mounting bracket signals the control system that the front mounting pin is properly installed. The boom nose installation pins can only be retracted when the mounting pin (3) is extended. When the front mounting pin is retracted, no signal is sent to the control system.

**Boom Nose Installation Pins**

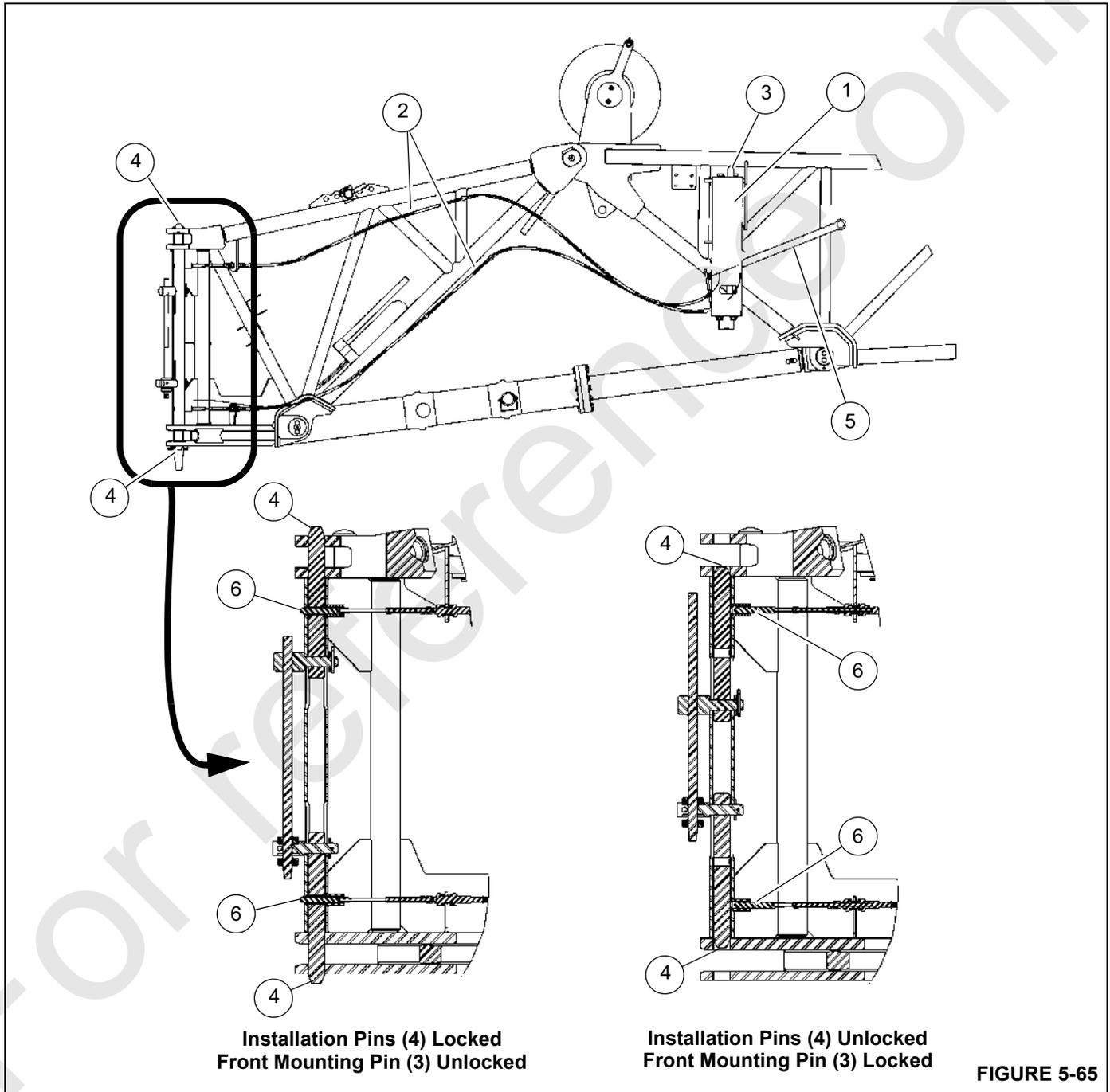
The boom nose installation pins (4, (Figure 5-65)) are used as a pivot to erect the boom extension on to the boom nose and stow the boom extension on the side of the boom base section. Mechanical interlock pins (6) lock and unlock the installation pins (4) based on the position of the front mounting pin (3). When the front mounting pin (3) is retracted, the front mounting pin (3) is removed from the front mounting bracket and the boom nose installation pins (4) are locked in the extended position. When the front mounting pin (3) is extended, the installation pins (4) are unlocked, allowing the installation pins (4) to be extended or retracted. An impact drill is required to extend and retract the boom nose installation pins (4).

**Front Mounting Pin Handle**

The front mounting pin handle (5, (Figure 5-65)) moves in unison with the front mounting pin (3), providing a visual cue for operators outside of the operator cab to know the status of the front boom extension mounting pin (3):

- Handle up—The front mounting pin (3) is extended in the front mounting bracket and the boom nose installation pins (4) are unlocked.
- Handle down—The front mounting pin (3) is retracted and the installation pins (4) are locked.

The handle is also used to manually release the front boom extension mounting pin interlock so that the boom extension can be removed from the crane.



## Boom Extension Mounting Brackets

**NOTE:** The fly section and boom extension base section must be connected together in the stowed position to secure the boom extension to the side of the boom.

The main boom base section features the following mounting brackets for stowing the fly section and boom extension base section:

- Rear Boom Extension Mounting Bracket—Located nearest to the superstructure cab is the rear boom extension mounting bracket (1, (Figure 5-66)). The boom extension base section is pinned to the fly section. The fly section is secured to the side of the main boom with the electrically actuated pin (2).
- Front Boom Extension Mounting Bracket—Located nearest the boom nose is the front boom extension mounting bracket (6, (Figure 5-66)). The boom extension base section is secured to the side of the main boom with the electrically actuated pin (3, (Figure 5-65)), which is part of the Boom Extension Pin Interlock Mechanism. For more information, see “Boom Extension Pin Interlock Mechanism” on page 5-41.
- Middle Fly Section Mounting Bracket—Located near the lift cylinder pin. The middle fly section bracket (9, (Figure 5-66)) secures the fly section to the main boom.

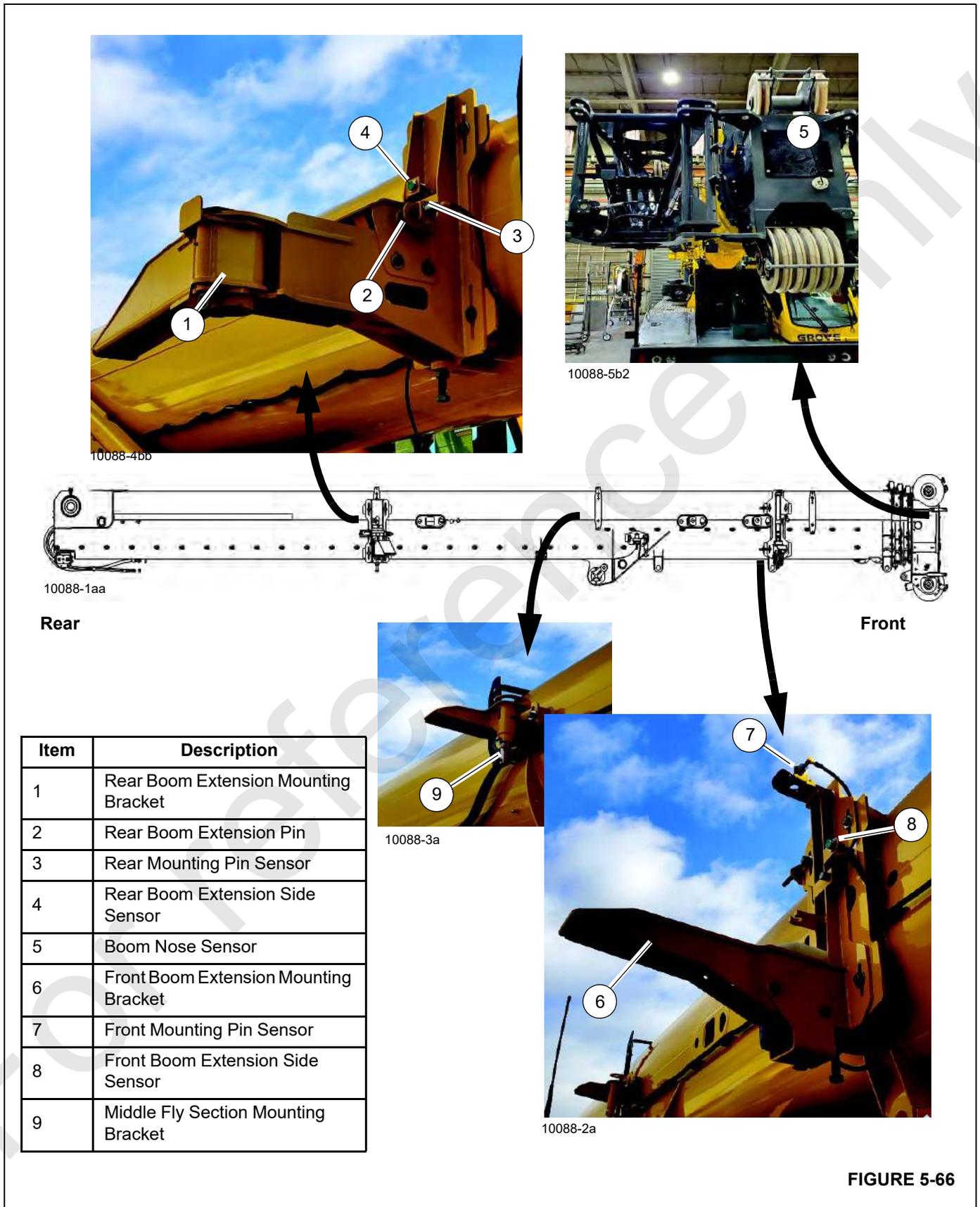


FIGURE 5-66

### Boom Extension Sensors

The front and rear boom extension mounting brackets feature the following sensors:

- Rear Mounting Pin Sensor (3, (Figure 5-66))—Sends a signal to the crane control system when the rear boom extension pin is extended in the rear boom extension mounting bracket. The rear mounting pin is electrically actuated from the ODM in the operator cab.
- Rear Side Sensor (4, (Figure 5-66))—Sends a signal to the crane control system when the boom extension fly section is in the stowed position next to the boom base.
- Front Mounting Pin Sensor (7, (Figure 5-66))—Sends a signal to the crane control system when the front boom extension pin is extended in the front boom extension mounting bracket. The front mounting pin is electrically actuated from the ODM in the operator cab. For more information, see “Boom Extension Pin Interlock Mechanism” on page 5-41.

- Front Side Sensor (8, (Figure 5-66))—Sends a signal to the crane control system when the boom extension base section is against the front stowage bracket.
- Boom Nose Sensor (5, (Figure 5-66))—Sends a signal to the crane control system when the boom extension or auxiliary boom nose is in the erected position.

Signals from the sensors appear in the ODM in the operator cab to inform the operator about the status of the boom extension.

### Lifting Points

The following section describes the sling attaching points for lifting the boom extension.

The boom extension base section features five attaching points on each side (10 total) (1, Figure 5-67). The Transportation and Lifting decal (2) shows the center of gravity information for the boom extension assembly and the boom extension weight. Use the Transportation and Lifting decal to determine which attaching points to use.

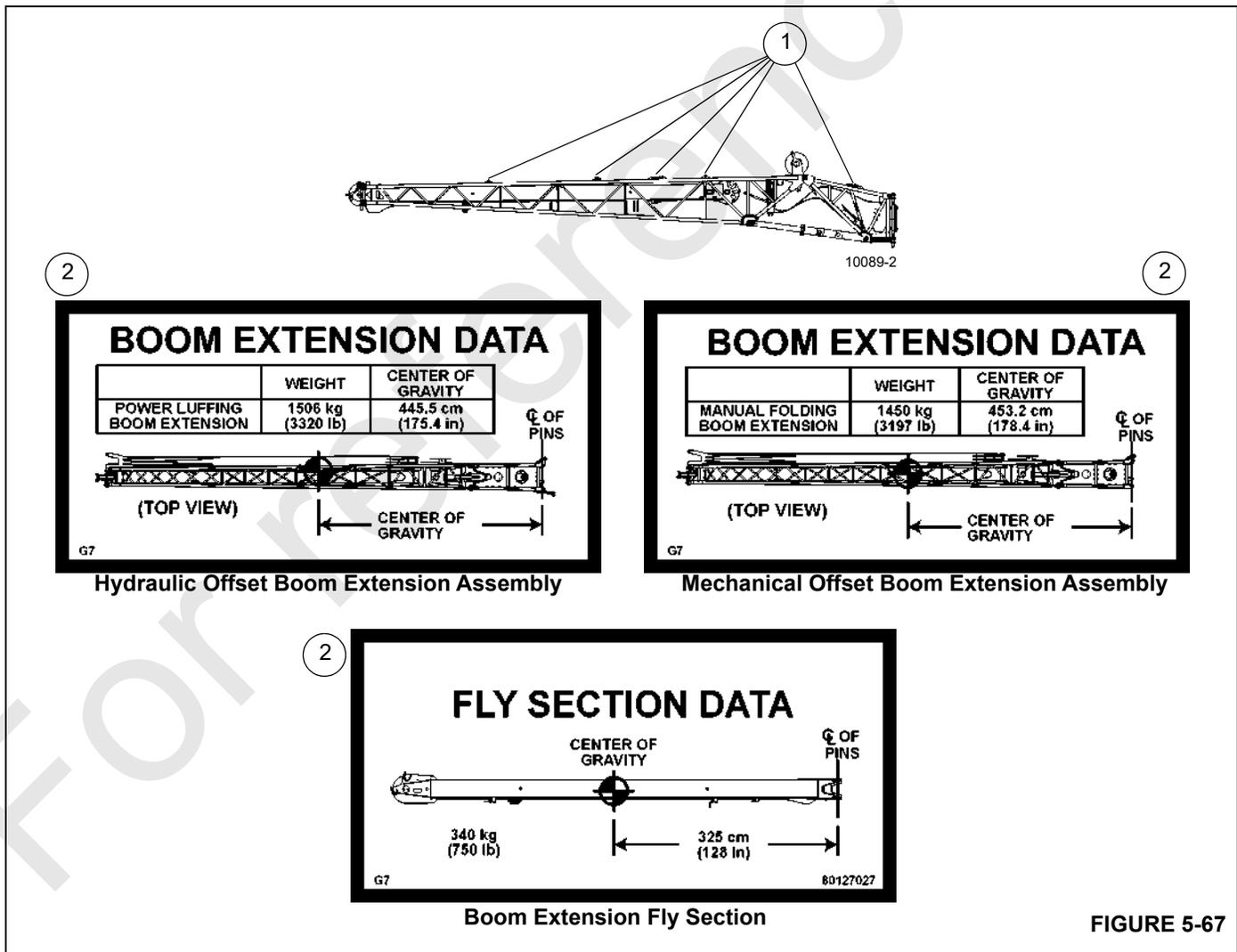


FIGURE 5-67

### About the Boom Extension Group in the ODM

(Figure 5-68) shows the Boom Extension screen in the ODM. Table 5-1 describes the icons on the Boom Extension screen. For more information about the Alerts Area, Active Screen Indicator Area, and Status Bar, see *Using the Operator Display Module (ODM)*, page 4-72.

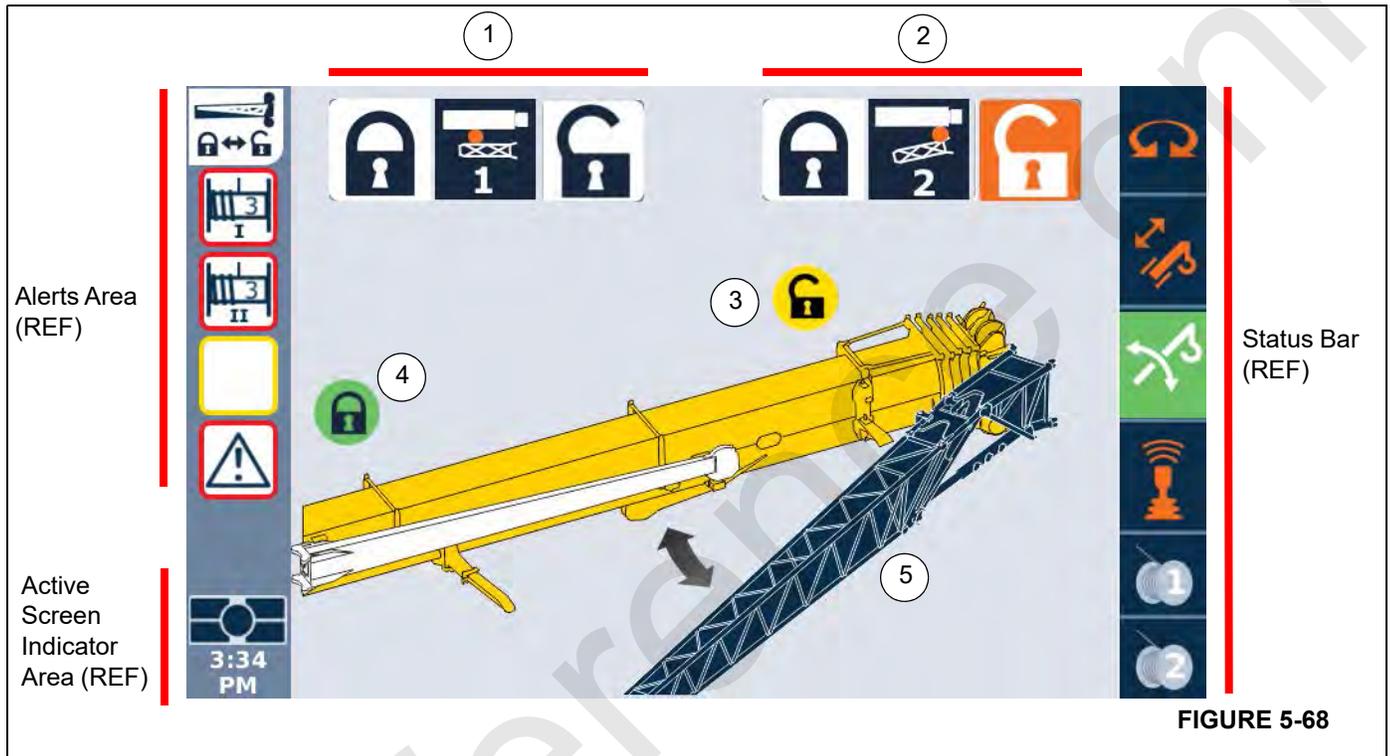


FIGURE 5-68

Table 5-1 Boom Extension Group Icons

Item(s)	Icon	Description
1 and 2		Boom Extension Rear or Front Mounting Pin Locked (Selected).
1 and 2		Boom Extension Rear or Front Mounting Pin Unlocked (Selected)
1 and 2		Boom Extension Rear or Front Mounting Pin Unlocked (Unselected)

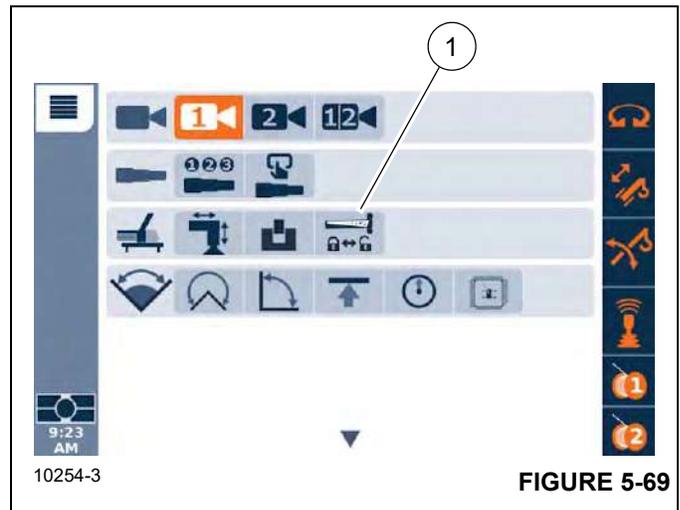
Table 5-1 Boom Extension Group Icons (Continued)

Item(s)	Icon	Description
1 and 2		Boom Extension Rear or Front Mounting Pin Locked (Unselected)
1		Rear Boom Extension Mounting Pin (pin #1).
2		Front Boom Extension Mounting Pin (pin #2).
3 and 4		Boom Extension Rear or Front Mounting Pin Status: Locked
3 and 4		Boom Extension Rear or Front Mounting Pin Status: Unlocked.
5		Boom Extension status indicator. This icon changes depending on the location of the boom extension.

**Accessing the Boom Extension Deployment/Stowage Function Screen in the ODM**

Use the following procedure to access the boom extension deployment/stowage function screen in the ODM. For more information about the ODM navigation control pad or jog dial, see *Navigating the Operator Display Module and Rated Capacity Limiter Display Module*, page 4-103.

1. Access the Menu Screen.
2. Use the ODM navigation pad or jog dial to highlight the Boom Extension Deployment/Stowage icon (1), (Figure 5-69).



3. Press the OK button on the ODM navigation pad or press down on the jog dial to select the Boom Extension Deployment/Stowage icon.

The Boom Extension Deployment/Stowage function screen (Figure 5-68).

### Boom Extension Alert and Warning Screens

During the deployment and stowage of the boom extension, the Crane Control System (CCS) uses five proximity sensors, in addition to the Boom Extension Pin Interlock Mechanism, to help ensure that the boom extension is supported and secure during deployment and stowage. The CCS can use these same systems to help identify when a sensor has malfunctioned. (Refer to the section titled “Boom Extension Sensors” on page 5-45 for information on these proximity sensors. Refer to the section titled “Boom Extension Pin Interlock Mechanism” on page 5-41 for information on the interlock system.)



### DANGER

#### Boom Extension Hazard

Using the override feature of the controls to operate pin 1 or pin 2 could result in the boom extension becoming unsecured and falling. Death or Serious Injury could occur.

If the sensors identify an inconsistency relative to normal operation, one of two possible warning screens will appear.

If a screen shows with three question marks (Figure 5-70), the system has identified that either Pin 1 or Pin 2 is not in the proper locked/unlocked condition for the activity taking

place. This can result in damage to the boom extension or boom extension stowage system.

### CAUTION

#### Possible Crane Damage

If Pin 1 or Pin 2 is not in the proper locked/unlocked condition for the activity taking place, the boom extension or boom extension stowage system can be damaged during stowage.

Always make sure Pin 1 and Pin 2 are unlocked before swinging the boom extension into the front and rear stowage brackets.

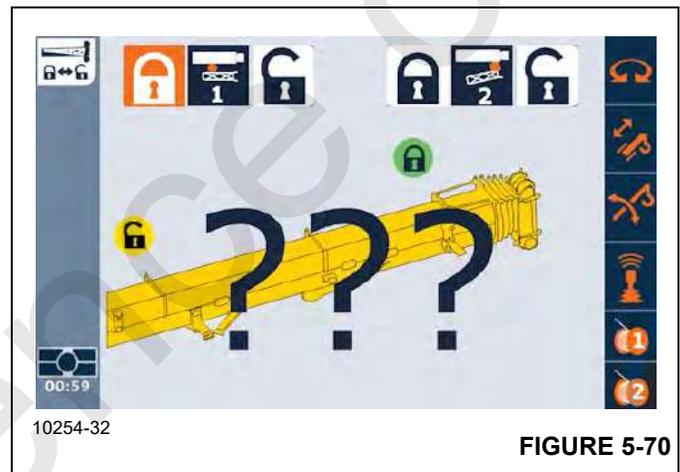


FIGURE 5-70

If a screen shows with an exclamation point in the middle of the screen (Figure 5-71), the system has identified that the boom extension fly section is in the stowed position but not secured by Pin 1 while the base section is either in the intermediate or fully deployed position. If the boom extension fly section is not properly secured, it can fall from the crane resulting in Death or Serious Injury.

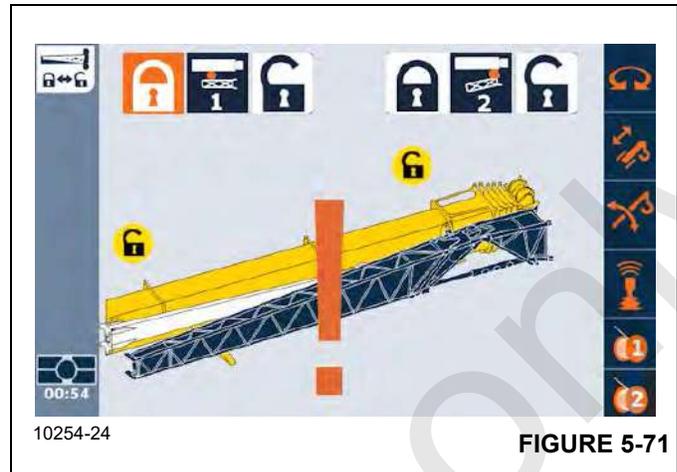


## DANGER

### Falling Boom Extension Hazard!

If the fly section remains stowed on the side of the main boom when erecting or stowing the boom extension base section, the fly section must be secured by Pin 1. If the fly section is not secured properly, it can fall from the crane resulting in Death or Serious Injury.

Always make sure the fly section is secured by Pin when fly section remains stowed on the side of the main boom.



If either of these screens show, do the following:

1. Immediately STOP all activities.
2. Alert anyone near the crane to move away from the boom extension.
3. Determine if the extension is properly secured and supported at all required locations, and then determine if the issue causing the error can be resolved safely before continuing.

If additional assistance is needed, contact your Grove Distributor or Grove Product Support for help.

### Installing the Folding Boom Extension



**DANGER**

**Boom Extension Hazard!**

To avoid death or serious injury, follow procedures and cautions in the Operator and Safety Manuals and decals during erection, stowage and use of boom extension. Install and secure all pins properly and control boom extension movement at all times.



**DANGER**

To prevent serious injury or death, always wear personal protective equipment; i.e., a hard hat, eye protection, gloves and metatarsal boots.

Use this procedure to install the boom extension base section with or without the fly section that are separate from the crane on to the boom nose.

Required Tools	<ul style="list-style-type: none"> <li>• 1/2 in Impact Wrench</li> <li>• 24 in — 1/2 in Drive Impact Extension</li> <li>• 1/2 in Square Drive Socket — 14mm impact rated hex socket</li> </ul>
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**NOTE:** This procedure assumes the boom extension is completely removed from the boom nose and the fly section is stowed on the boom extension base.

**NOTE:** This procedure applies to manual and hydraulic boom extensions unless otherwise noted.

**NOTE:** An auxiliary crane with sling is required to install the boom extension on to the boom nose.

1. Make sure the counterweight is installed. For more information about installing the counterweight, see “Counterweight Versions/Combinations” on page 5-19.
2. Make sure the crane is set up on fully-extended outriggers. For more information, see *Setting the Outriggers*, page 4-42.
3. Fully retract and lower the boom to horizontal.
4. Attach a tag line to the end of the boom extension base section with the nose sheave.
5. Make sure the connecting link (1), (Figure 5-72) is in place that connects the fly section to the boom extension base section.



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**FIGURE 5-72**

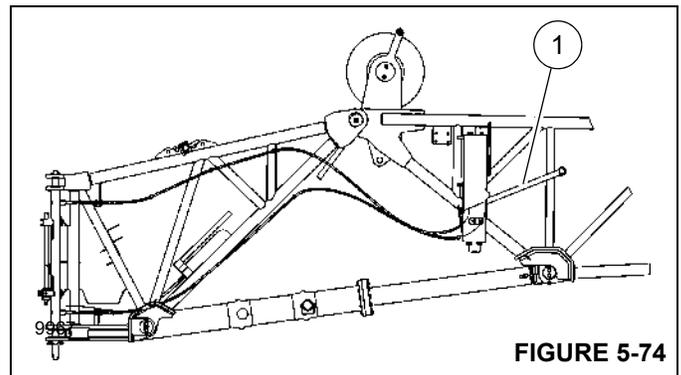
6. Make sure the attachment pin (1), (Figure 5-73) and retaining clip are in place that connects the ends of the fly section and the boom extension base section together.



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8969-23

**FIGURE 5-73**

7. If necessary, raise the front mounting pin handle (1), (Figure 5-74) to unlock the boom extension installation pins.



**FIGURE 5-74**

8. If necessary, turn the jack screw (3), (Figure 5-78) clockwise to fully retract the boom extension installation pins (4) using an impact wrench, extension, and 14 mm socket.

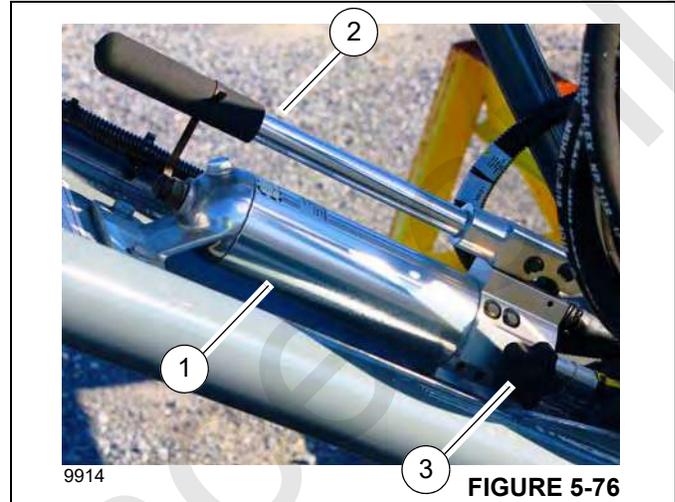
**! DANGER**

When installing the boom extension, make sure that all personnel and equipment are kept clear of the swing path.

9. Using a sling attached to an auxiliary crane, lift the boom extension in front of the boom. For more information about attaching points for the sling, see “Lifting Points” on page 5-45.
10. Raise and lower the boom extension as necessary to align the boom extension anchor fitting holes (1), (Figure 5-78) with the boom nose attachment lug holes (2). Align and secure the boom extension installation pins (4) in the holes in the boom nose using an impact driver, turning the jack screw (3) counterclockwise.
11. Lower the front mounting pin handle (1), (Figure 5-75) to lock the boom extension installation pins.



12. Remove pins (5), (Figure 5-78) and retaining clips (6) from the stowage bracket. Secure the boom extension to the boom nose using four pins (5) inserted through the boom extension anchor fitting holes (1) and the boom nose attachment lug holes (2). Secure the pins (5) with retaining clips (6). Use the jack (1), (Figure 5-76) as necessary to install the fourth pin as follows:



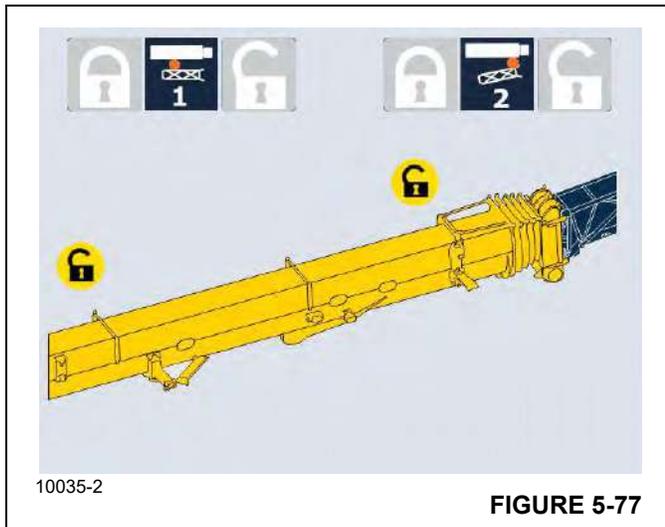
- a. Install three pins to attach the boom extension to the boom nose.
- b. Operate the jack handle (2), (Figure 5-76) to align the holes on the boom extension with the hole in the boom nose.
- c. Install the fourth pin. Secure the fourth pin with retaining clip.

**CAUTION**

After installing the fourth pin, turn the pressure relief nob (3) to retract the jack so the jack does not contact the boom nose. Failure to retract the jack could result in damage to the boom extension jack.

- d. Turn the nob (3) to relieve the pressure to retract the jack pin.
13. Connect the boom extension electrical connector to the main boom electrical connector. For more information, see “Boom Extension Electrical Connections” on page 5-70.

14. Make sure the boom extension is shown as erected in the ODM (Figure 5-77).



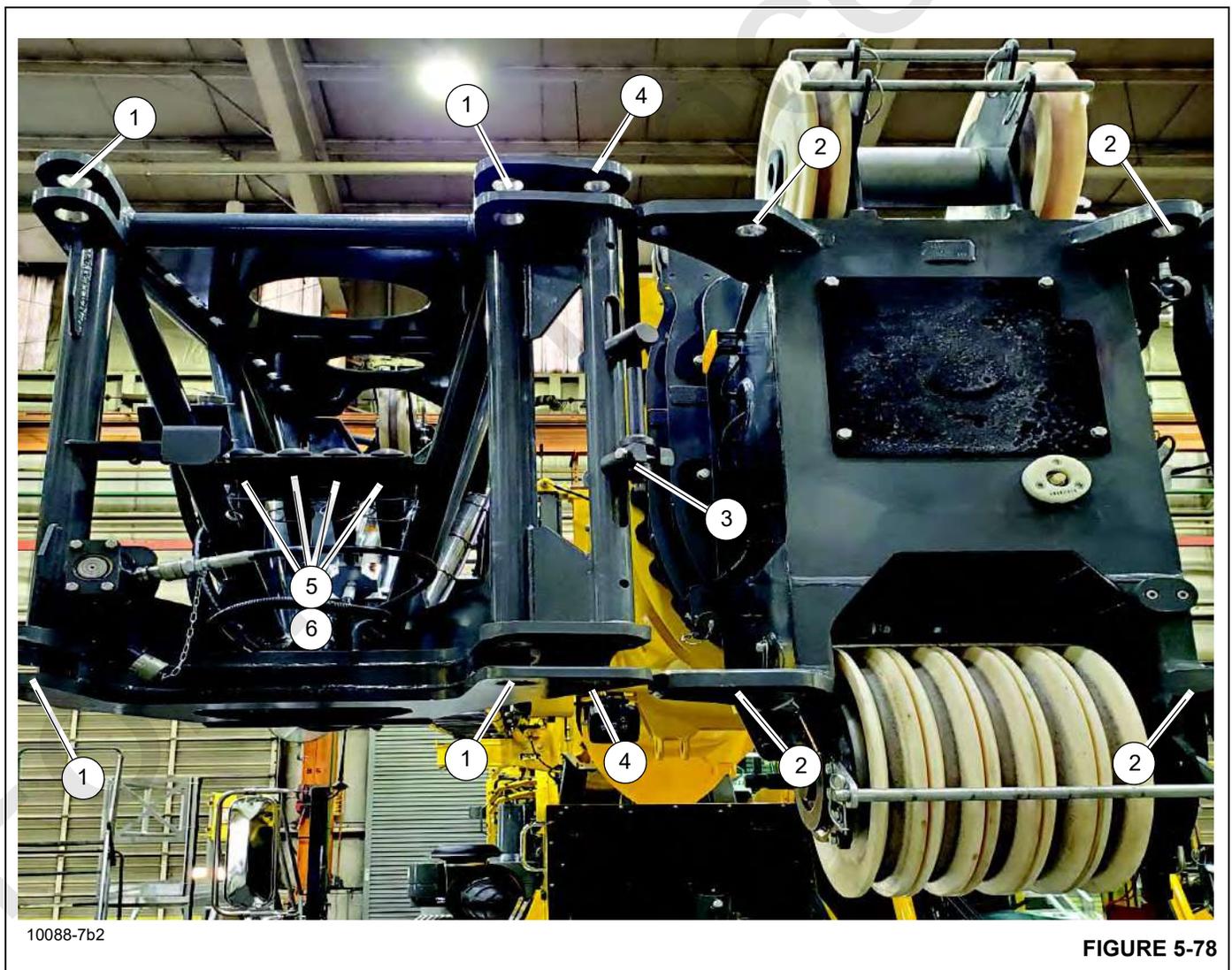
15. If installing the hydraulic boom extension, connect hydraulic hoses. For more information, see “Hydraulic Boom Extension Connections” on page 5-71.

16. Remove the slings from the boom extension.

17. Raise the mast sheave assembly. For more information, see “Folding Mast Sheave” on page 5-82.

18. Reeve the hoist rope. For more information, see “Reeving the Hoist Rope” on page 5-74.

19. Remove the anti-two block switch from the auxiliary boom nose. Install the anti-two block switch on the boom extension. For more information, see “Anti-Two Block Switch on the Boom Extension” on page 5-81.



## Removing the Folding Boom Extension



### DANGER Boom Extension Hazard!

To avoid death or serious injury, follow procedures and cautions in the Operator and Safety Manuals and decals during erection, stowage and use of boom extension. Install and secure all pins properly and control boom extension movement at all times.



To prevent serious injury or death, always wear personal protective equipment; i.e., a hard hat, eye protection, gloves and metatarsal boots.

Use the following procedure to remove the boom extension from the boom nose.

**NOTE:** This procedure assumes the boom extension is erected on the boom nose and the fly section is stowed on the boom extension base section. If the fly section is erected, stow the fly section. For more information, see “Stowing the Fly Section” on page 5-60.

This procedure would also be used to remove only the boom extension base section. In this case the fly section must be left stowed on the boom base section.

Required Tools	<ul style="list-style-type: none"> <li>• 1/2 in Impact Wrench</li> <li>• 24 in — 1/2 in Drive Impact Extension</li> <li>• 1/2 in Square Drive Socket — 14 mm drive 6-point Socket</li> </ul>
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1. Make sure the crane is set up on fully extended outriggers. For more information, see *Setting the Outriggers*, page 4-42.

**NOTE:** An auxiliary crane with sling is required to remove the boom extension from the main boom.

2. Fully retract and lower the boom to horizontal.
3. If necessary, remove the anemometer and boom position light. For more information, see “Anemometer Display (Optional)” on page 4-104.
4. Remove the anti-two block switch from the end of the boom extension. For more information, see “Anti-Two Block Switch on the Boom Extension” on page 5-81.

5. Unreeve the hoist rope from the boom extension sheaves. For more information, see “Reeving the Hoist Rope” on page 5-74.
6. Using A Sling Attached To An Auxiliary Crane, Attach The Auxiliary Crane To The Boom Extension Attaching Points. For More Information About Attaching Points For The Sling, See “Lifting Points” on page 5-45.
7. Attach a tag line to the end of the boom extension base section with the nose sheave.
8. Lower the mast sheave assembly. For more information, see “Folding Mast Sheave” on page 5-82.
9. Disconnect and stow the boom extension electrical connections from the main boom. For more information, see “Boom Extension Electrical Connections” on page 5-70
10. If removing a hydraulic boom extension, disconnect and stow hydraulic connections. For more information, see “Hydraulic Boom Extension Connections” on page 5-71.
11. Make sure that the boom extension installation pins (4), (Figure 5-78) are fully extended in to the holes in the boom nose and that the front mounting pin handle (1), (Figure 5-79) is in the down position (locking the installation pins).



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FIGURE 5-79

12. Remove four retaining clips (6), (Figure 5-78) and pins (5) from the boom extension anchor fitting holes (1) and main boom attachment fitting holes (2). Secure the pins

(5) and retaining clips (6) in the holder on the boom extension.

13. Raise the front mounting pin handle (1), (Figure 5-79) to unlock the boom extension installation pins.

**! DANGER**

When removing the boom extension, make sure the boom extension is properly supported by the auxiliary crane and the movement of the boom extension is controlled at all times.

14. Using an impact drill and 24-inch 1/2-inch impact drill extension, retract the boom extension installation pins.
15. Using the auxiliary crane and the tag line, remove the boom extension from the boom nose. Move the boom extension to a suitable location.

**Erecting the 17.0 m (56 ft) Boom Extension**

**! DANGER**

**Boom Extension Hazard!**

To avoid death or serious injury, follow procedures and cautions in the Operator and Safety Manuals and decals during erection, storage and use of boom extension. Install and secure all pins properly and control boom extension movement at all times.

**! DANGER**

To prevent serious injury or death, always wear personal protective equipment; i.e., a hard hat, eye protection, gloves and metatarsal boots.

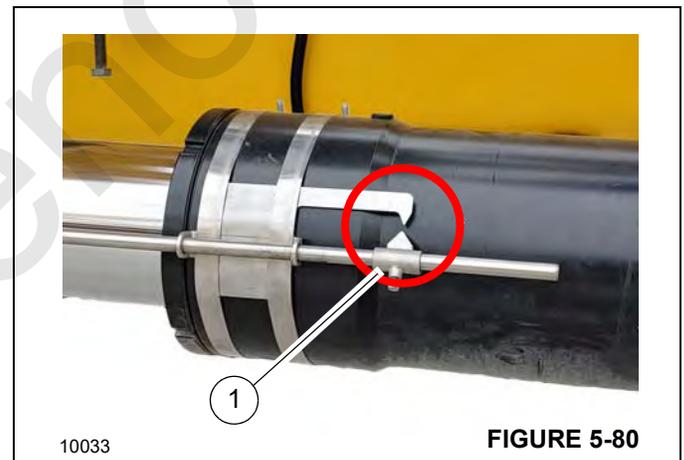
**! DANGER**

To prevent serious injury or death, do not stand on crane decking unless boom extension is secure.

Use the following procedure to erect the boom extension.

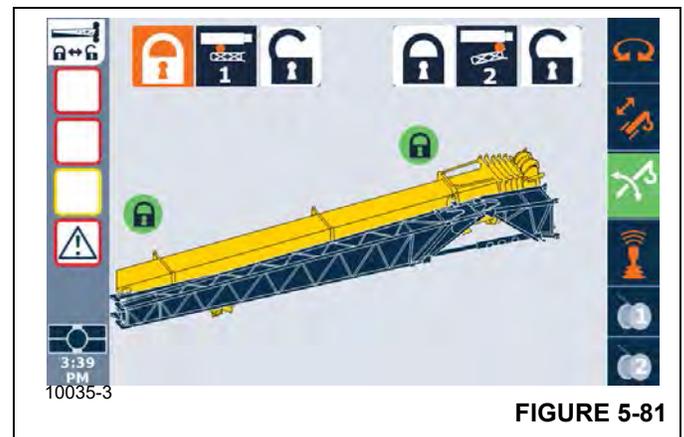
**NOTE:** This procedure assumes the boom extension base and fly sections are stowed on the side of the main boom.

1. Make sure the counterweight is installed. For more information, see “Removable Counterweight” on page 5-16.
2. Make sure the crane is set up on fully-extended outriggers. For more information, see *Using the Outriggers*, page 4-40.
3. Fully retract and lower the boom to horizontal.
4. Connect boom extension electrical connectors. For more information, see “Boom Extension Electrical Connections” on page 5-70.
5. If erecting a hydraulic boom extension, connect hydraulic hoses. For more information, see “Hydraulic Boom Extension Connections” on page 5-71.
6. If erecting an optional hydraulic boom extension, make sure the angle indicator (1), (Figure 5-80) is aligned. If the arrows are not aligned, adjust the boom extension offset as needed to align the arrows. For more information, see “Offsetting the Hydraulic Boom Extension (Optional)” on page 5-80.



**FIGURE 5-80**

7. In the ODM, verify that the front and rear mounting pins are securely installed (Figure 5-81). Visually confirm that the pins are installed.

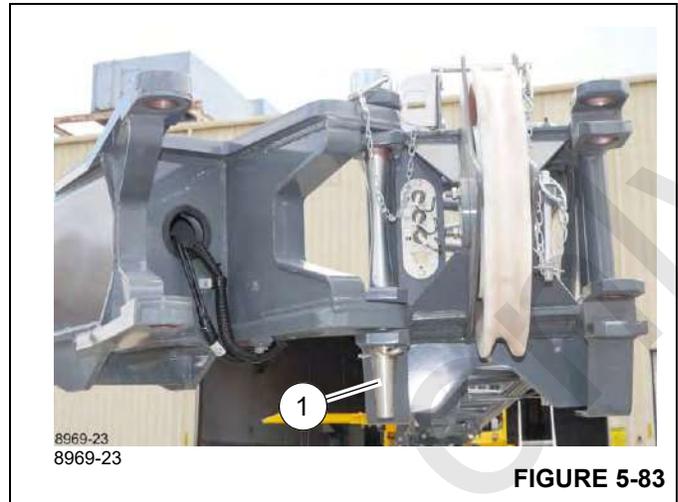


**FIGURE 5-81**

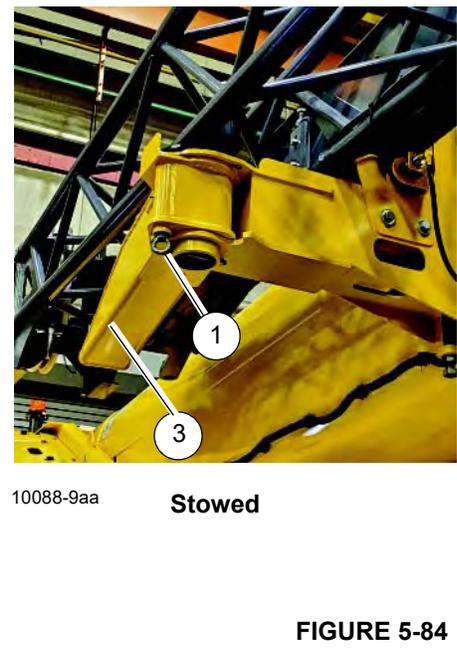
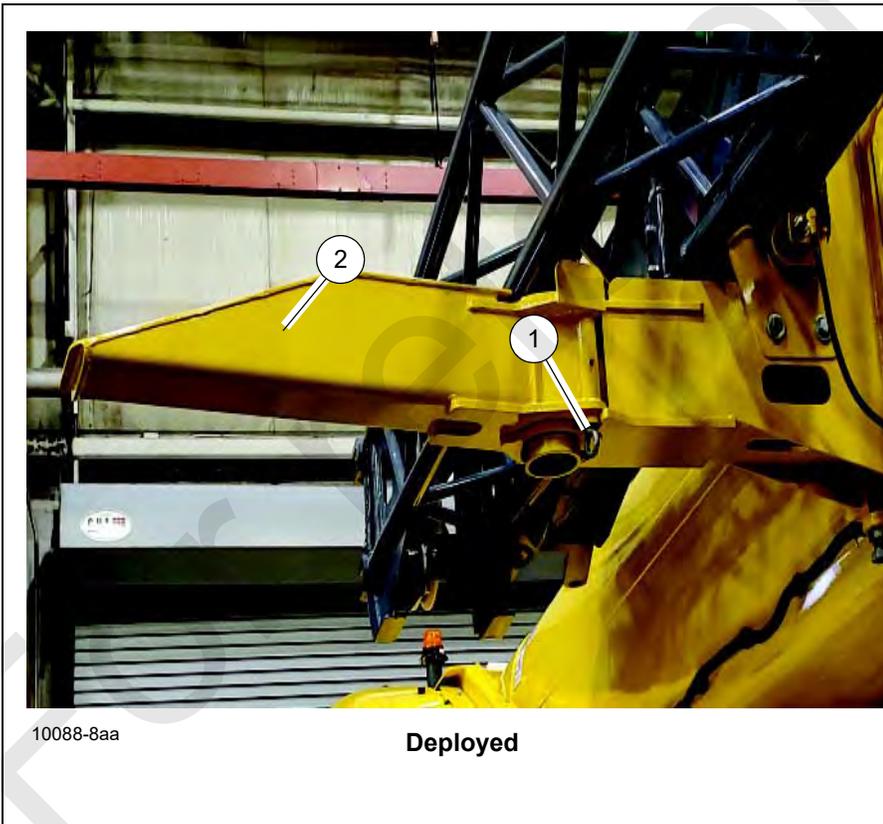
8. Make sure the connecting link (1), (Figure 5-82) is in place that connects the fly section to the boom extension base section.



9. Make sure the attachment pin (1), (Figure 5-83) and retaining clip are in place that connects the ends of the fly section and the boom extension base section together.



10. Tie a tag line to the end of the boom extension base section. The tag line will assist when swinging the boom extension to the boom nose.
11. Pull down on latching pin (1), (Figure 5-84) to release the rear boom extension ramp (2) from the stowed position. Fully swing the rear boom extension ramp (2) into the erected position. Ensure the latching pin (1) locks into position on the rear boom extension bracket.

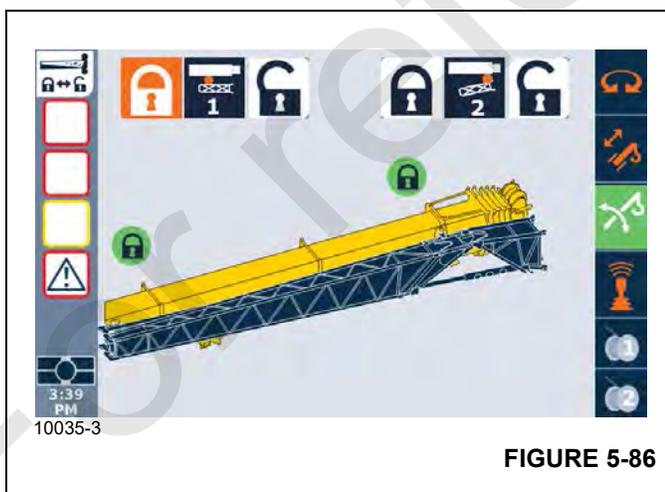


12. Detach fly section from main boom base by doing the following:

- a. Remove retaining clip (1), (Figure 5-85) from pin (2) at fly section stowage bracket (2).
- b. Pull pin (1) downward and turn counterclockwise to lock in place.
- c. Reinstall the retaining clip into the pin.



13. In the ODM (Figure 5-86), highlight the unlock icon and retract the rear boom extension pin (Pin #1) as follows:



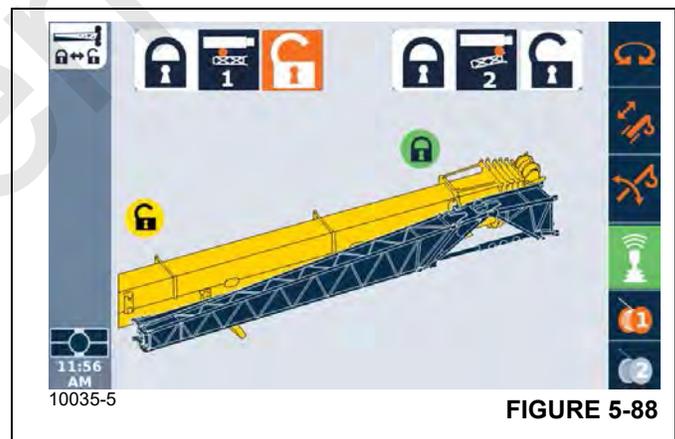
a. Use the ODM control pad arrow buttons or jog dial to highlight the unlock icon.

The unlock icon is highlighted (orange) (Figure 5-87).



b. Press and hold the OK on the ODM control pad or press down on the jog dial.

The lock status icon turns yellow, indicating the pin is retracted (Figure 5-88).



14. Visually confirm that the rear mounting pin is unlocked.
15. Using the tag line, swing the boom extension out on the rear ramp so the boom extension installation pins (4), (Figure 5-78) align with the holes in the boom nose attachment fittings.
16. With an impact wrench and 14 mm socket extension, turn the jack screw (3), (Figure 5-78) counterclockwise to extend the boom extension installation pins (4) into the boom nose attachment fittings. Extend jack screw until the bolts and washers are at the end of the slots. Verify that the pins (4) are fully engaged.

**! DANGER**  
**Crush Hazard**

To avoid death or serious injury, ensure boom extension installation pins (4), (Figure 5-78) are installed prior to retracting the front mounting pin (Pin #2).

17. In the ODM (Figure 5-89), retract the front mounting pin (Pin #2) as follows:

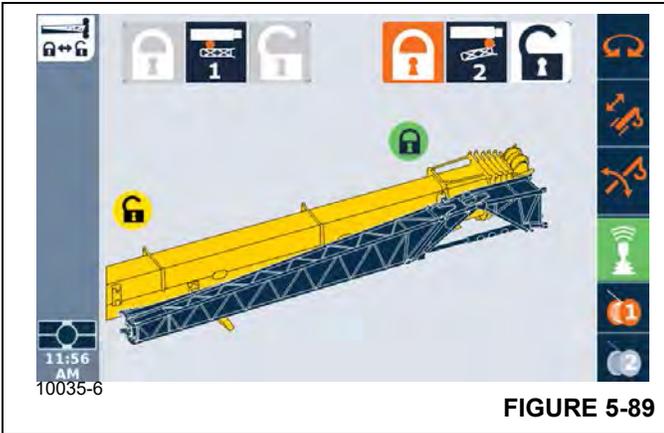


FIGURE 5-89

- a. Use the ODM control pad arrow buttons or jog dial to highlight unlock icon.  
 The unlock icon is highlighted (orange) (Figure 5-90).



FIGURE 5-90

- b. Press and hold the OK on the ODM control pad or press down on the jog dial.

The lock status icon turns yellow, indicating the pin is retracted. The boom extension is displayed as detached from the side of the main boom (Figure 5-91).

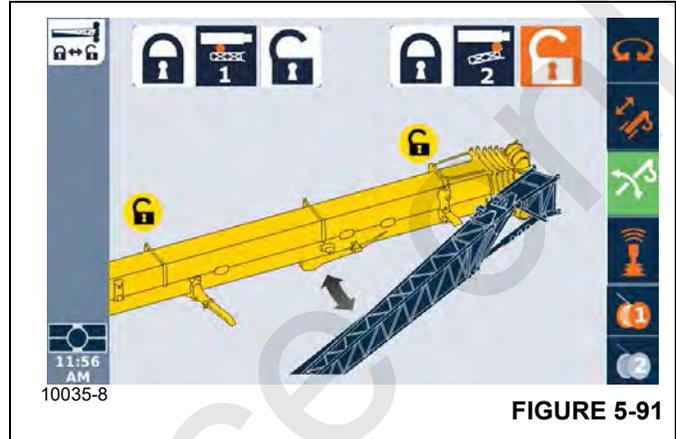


FIGURE 5-91

18. Visually confirm that the front mounting pin is unlocked. The handle should be in the down position. When the handle is in the down position, the front mounting pin is retracted and the boom installation pins are locked.

**NOTE:** The front mounting pin (Pin #2) will not unlock unless the right side boom extension installation pins are fully engaged. If the front boom extension pin (Pin #2) does not unlock, make sure the right side boom extension installation pins are fully engaged and the interlock pins are inserted through the pins.

**! DANGER**

When erecting the boom extension, make sure that all personnel and equipment are kept clear of the swing path.

19. Slightly raise and/or lower the boom to help control the boom extension. Using the tag line, swing the boom extension to the front of the boom nose. Align the boom extension anchor fittings with the main boom attachment fittings.

20. Install four pins (5), (Figure 5-78) and retaining clips (6) to secure the boom extension to the boom nose. If necessary, use the jack (1), (Figure 5-92) to install the fourth pin:

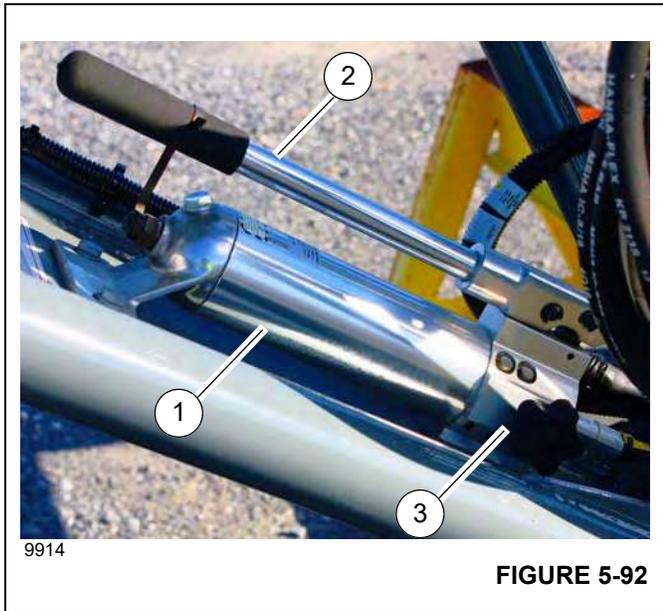


FIGURE 5-92

- a. Install three pins to attach the boom extension to the boom nose.
- b. Operate the jack handle (2) to align the holes on the boom extension with the hole in the boom nose.
- c. Install the fourth pin.
- d. Secure all pins with retaining clips.

**CAUTION**

After installing the fourth pin, turn the pressure relief nob (3) to retract the jack so the jack does not contact the boom nose. Failure to retract the jack could result in damage to the boom extension jack.

- e. Turn the nob (3) to relieve the pressure to retract the jack pin.
21. In the ODM display (Figure 5-93), make sure that ODM shows that the boom extension is erected.

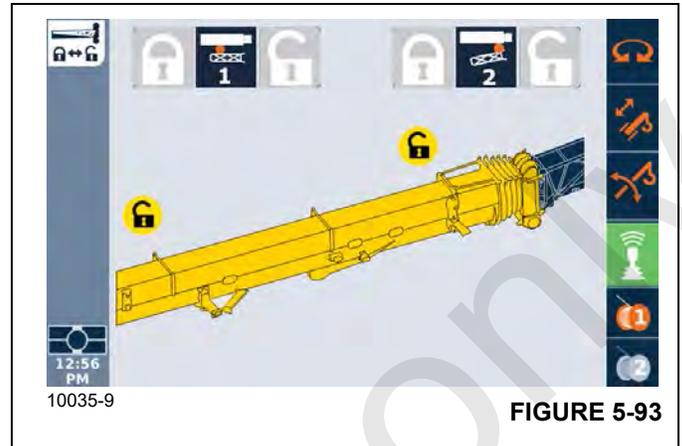


FIGURE 5-93

22. Remove the tag line.
23. Raise the mast sheave assembly. For more information, see “Folding Mast Sheave” on page 5-82.
24. Erect the boom extension fly section following the procedures under *Erecting the Fly Section*, page 5-58

**Erecting the Fly Section**

Use this procedure to erect the boom extension fly section.

**NOTE:** This procedure assumes the boom extension is erected and fly extension is folded on the boom extension base section.

1. Make sure the connecting link (1), (Figure 5-94) is in place that connects the fly section to the boom extension base section together.



FIGURE 5-94

2. Make sure the attachment pin (1), (Figure 5-95) and retaining clip are in place that connects the ends of the

fly section and the boom extension base section together.

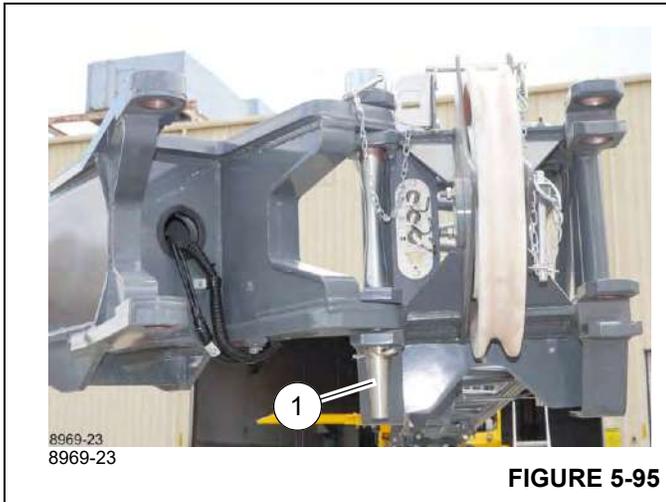


FIGURE 5-95

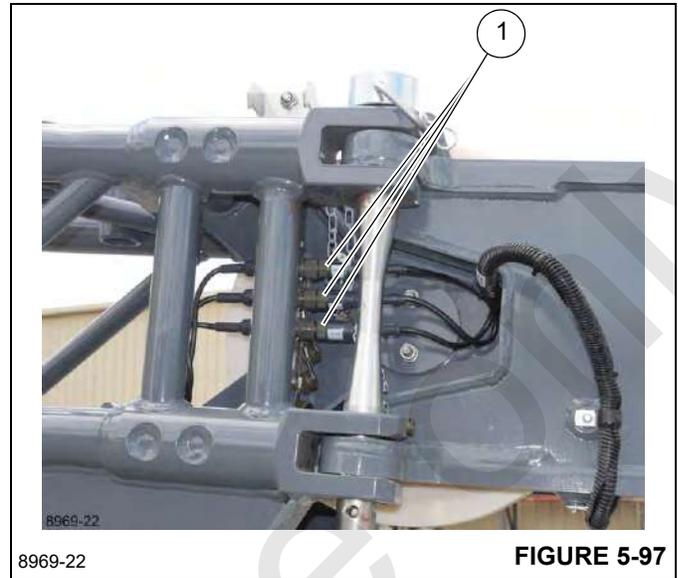


FIGURE 5-97

3. Tie a tag line to the end of the fly section.
4. Detach the fly section from the boom extension base section by removing the retaining clip (2), (Figure 5-94) and pin (3) securing the connecting link (1) to the boom extension base section (4).

With connecting link (1) detached, reinstall the pin (3) and secure with the retaining clip (2).

5. Connect the electrical connections between the boom extension base section and the fly section:
  - a. Remove the wires (1), (Figure 5-96) from their stowed location.



FIGURE 5-96

- b. Connect the plugs (1), (Figure 5-97) to the sockets making sure the plug wire number corresponds to the socket number.

**⚠ DANGER**

When erecting the fly section, make sure that all personnel and equipment are kept clear of the swing path.

6. Slightly raise and/or lower the boom to help control the boom extension. Using the tag line, swing the fly section around and engage the fly section attachment fittings (1), (Figure 5-98) with the base section anchor fittings (2).

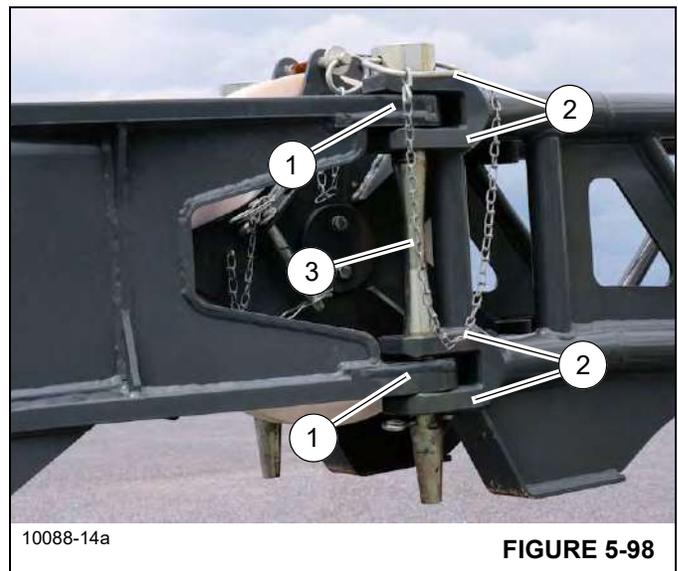


FIGURE 5-98

7. Remove the pin (3), (Figure 5-98) from its holder on the boom extension and insert it into the left side fittings (1, 2). Secure the pin with the retaining clip.

8. (Optional) Install and connect the wind speed indicator (anemometer) and boom position light assembly on the end of the fly section. For more information, see *Anemometer and Boom Position Indicator Light (Optional)*, page 5-37.
9. Remove the tag line from the end of the fly section.
10. Reeve the hoist rope. For more information, see “Reeving the Hoist Rope” on page 5-74.
11. Remove the anti-two block switch from the auxiliary boom nose. For more information, see “Anti-Two Block Switch on the Boom Extension” on page 5-81. Install the anti-two block switch on the nose of the fly section. For more information, see “Anti-Two Block Switch on the Boom Extension” on page 5-81.

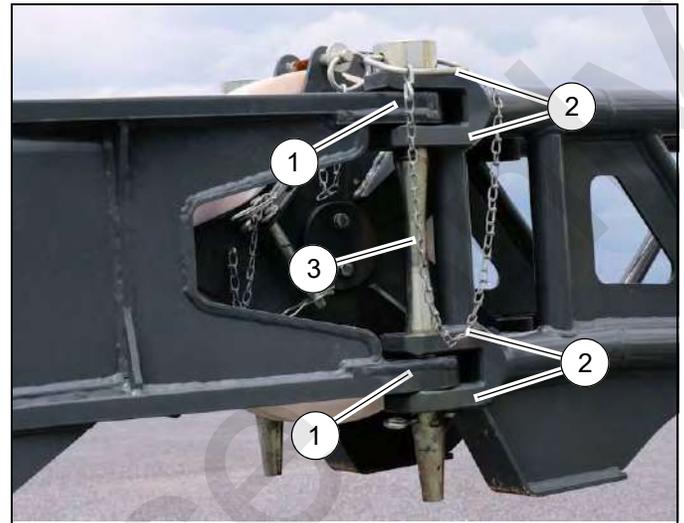
**Stowing the Fly Section**

Use the following procedure to stow the fly section on the boom extension base section.

**NOTE:** This procedure assumes the boom extension base section and fly section are fully erected.

1. Remove the anti-two block switch from the end of the fly section. For more information, see “Anti-Two Block Switch on the Boom Extension” on page 5-81.
2. Unreeve the hoist rope from the fly section sheave assembly and boom extension mast sheave assemblies. For more information, see “Reeving the Hoist Rope” on page 5-74
3. Install the anti-two block switch on the end of the boom extension base section. For more information, see “Anti-Two Block Switch on the Boom Extension” on page 5-81.
4. If installed, disconnect and remove wind speed indicator and boom position light assembly from the end of the fly section. For more information, see “Anemometer and Boom Position Indicator Light (Optional)” on page 5-37.
5. Attach a tag line to the end of the fly section. This tag line will aid in swinging the fly section into position.

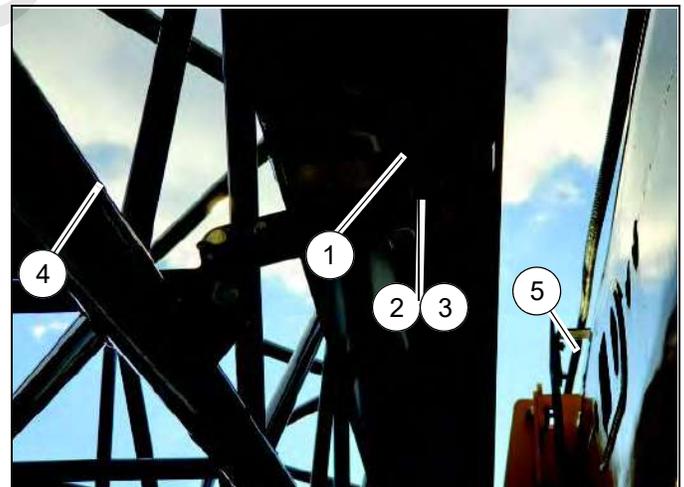
6. Remove the retaining clip and pin (3), (Figure 5-99) that is inserted in to the left side fittings (1, 2). Place the pin in its holder on the boom extension base section and secure with retaining clip.



10088-14a

**FIGURE 5-99**

7. Slightly raise and/or lower the boom to help control the boom extension. Swing and stow the fly section on the boom extension base section.
8. Attach the fly section (Figure 5-100) to the boom extension base section (4) using the connecting link (1). Secure connecting link with pin (3) and retaining clip (2).



10088-11aa

**FIGURE 5-100**

**! DANGER**

When stowing the fly section, make sure that all personnel and equipment are kept clear of the swing path.

9. Disconnect the electrical connections between the boom extension base section and the fly section:

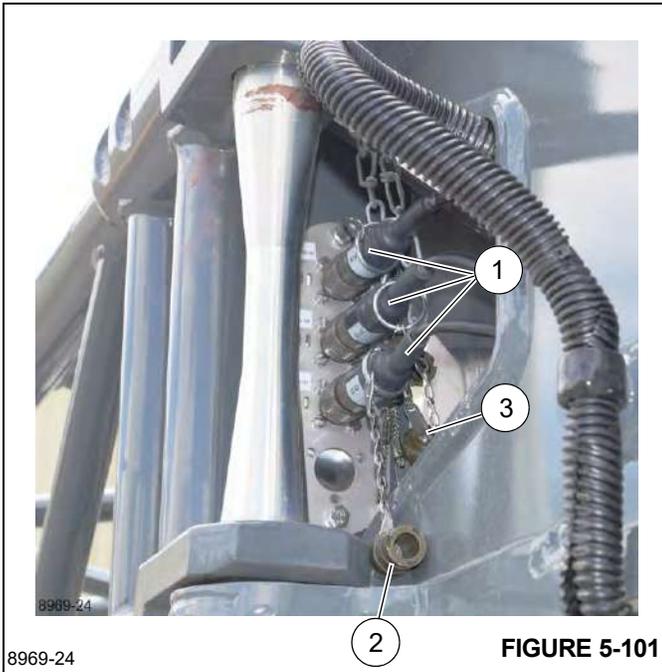


FIGURE 5-101

- a. Remove the plugs (1), (Figure 5-101) from the sockets and seal the plugs with their caps (2). Seal the sockets with their caps (3).
- b. Remove the bridging plug from the dummy socket and plug it into the socket.

10. Remove the tag line from the end of the fly section.

### Stowing the 17.0 m (56 ft) Boom Extension

**! DANGER**

**Boom Extension Hazard!**

To avoid death or serious injury, follow procedures and cautions in the Operator and Safety Manuals and decals during erection, stowage and use of boom extension. Install and secure all pins properly and control boom extension movement at all times.

**! DANGER**

To prevent serious injury or death, always wear personal protective equipment; i.e., a hard hat, eye protection, gloves and metatarsal boots.

**! DANGER**

To prevent serious injury or death, do not stand on crane decking unless boom extension is secure.

Use this procedure to stow the boom extension to the side of the main boom.

**NOTE:** This procedure assumes the fly section is stowed on the boom extension base section. For more information about stowing the fly section, see “Stowing the Fly Section” on page 5-60.

1. Make sure the crane is set up on fully extended outriggers. For more information, see *Using the Outriggers*, page 4-40.
2. Make sure the counterweight is installed. For more information about installing the counterweight, see “Counterweight Versions/Combinations” on page 5-19.
3. Fully retract and lower the boom to horizontal.
4. If necessary, adjust the boom extension offset to 0° depending on the type of boom extension:
  - If stowing a mechanical boom extension, make sure the offset is set to 0°. For more information, see “Offsetting the Mechanical Boom Extension” on page 5-79.
  - or
  - If stowing an optional hydraulic boom extension, make sure the angle indicator (1), (Figure 5-102) is aligned. If the arrows are not aligned, adjust the boom extension offset as needed to align the arrows. For more information, see “Offsetting the Hydraulic Boom Extension (Optional)” on page 5-80.

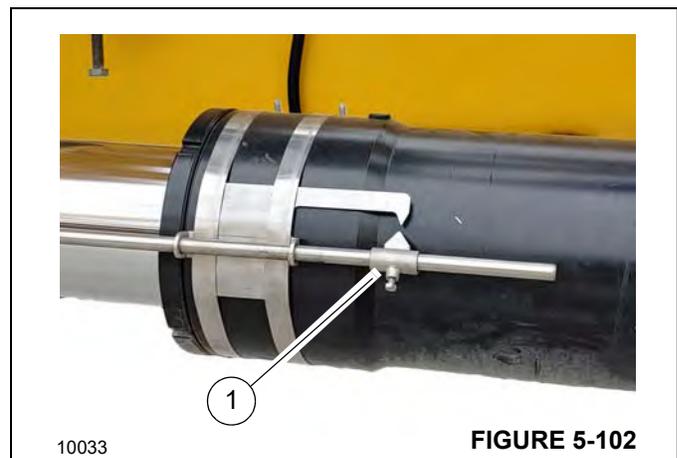
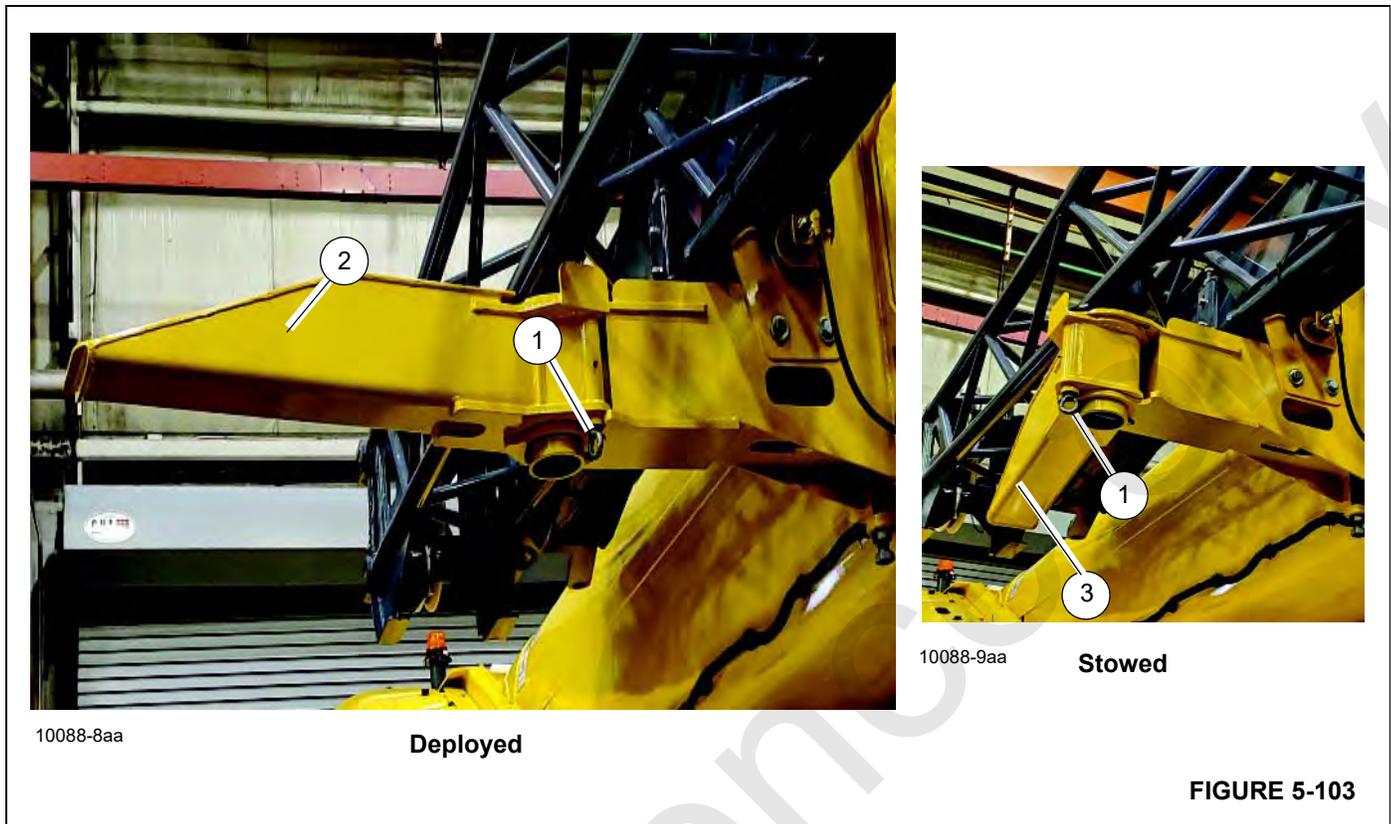


FIGURE 5-102

10033



5. Make sure rear boom extension ramp (2), (Figure 5-103) is in erected position.

If the ramp is not erected, pull down on latching pin (1), (Figure 5-103) to release the rear boom extension ramp (3) into the erected position. Fully swing the rear boom extension ramp (3) into the erected position. Ensure the latching pin (1) locks into position on the rear boom extension bracket.

6. Unreeve the hoist rope as necessary from the boom extension base section mast sheaves. For more information, see “Unreeving Hoist Rope” on page 5-74.
7. If necessary, stow the fly section. For more information, see “Stowing the Fly Section” on page 5-60.
8. Remove the anti-two block switch from the end of the boom extension. For more information, see “Anti-Two Block Switch on the Boom Extension” on page 5-81. Install the anti-two block switch on the auxiliary boom nose. For more information, see “Installing/Removing the Anti Two-Block Switch” on page 5-33.
9. Stow the mast sheave assembly. For more information, see “Folding Mast Sheave” on page 5-82.
10. Attach a tag line to the end of the boom extension base section.

### DANGER

#### Boom Extension Hazard!

The boom extension installation pins (4), (Figure 5-78) must be extended and engaged before removing the four pins (5), (Figure 5-78). If the boom extension installation pins (4), (Figure 5-78) are not extended and fully engaged, the boom extension will fall when pins (5), (Figure 5-78) are removed, resulting in possible injury or death.

11. Make sure the boom extension installation pins (4), (Figure 5-78) are engaged.

### CAUTION

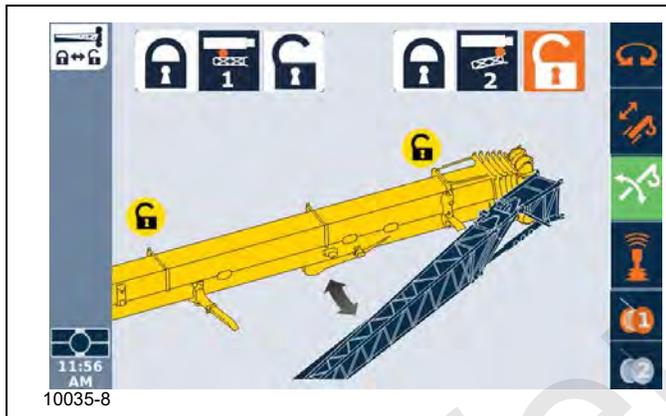
After removing the four retaining clips and pins, the boom extension is free to swing to the side of the main boom.

12. Remove the four pins (5), (Figure 5-78) and retaining clips (6) that attach the boom extension base section to the boom nose. Store the pins (5) and retaining clips (6) on the boom extension stowage bracket.

**! DANGER**

When stowing the boom extension, make sure that all personnel and equipment are kept clear of the swing path.

13. Slightly raise and/or lower the boom to help control the boom extension. Using the tag line, swing the boom extension to the intermediate position on the side of the base section of the boom. Make sure the wheels engage the ramps of the front (6), (Figure 5-66) and rear (1) boom extension mounting brackets.
14. Raise the boom as needed to move the boom extension in against the main boom so the front boom extension pin (Pin #2) can be secured.
15. From the operator cab or with the remote control, lock the front boom extension pin (Pin #2) as follows:



- a. Use the ODM control pad arrow buttons or jog dial to highlight the Pin #2 lock icon. The lock icon highlights (orange).



- b. Press and hold the OK on the ODM control pad or press down on the jog dial.

Pin #2 is extended. The pin status indicator icon turns green when the pin is fully extended and the boom extension is displayed in the intermediate installation position.



16. Make sure the ODM shows that the front mounting pin (Pin #2) is extended. Visually confirm that the front mounting pin is securely installed and the handle is in the up position before continuing.

**DANGER**  
**Crush Hazard**

To avoid death or serious injury, make sure the front mounting pin (Pin #2) is installed and the handle (1), (Figure 5-79) is in the up (locked) position prior to retracting the boom extension installation pins (4), (Figure 5-78).

17. Lower the boom to a horizontal position.
18. Turn the jack screw (3), (Figure 5-78) clockwise with the impact wrench, extension, and 14 mm impact socket to retract the boom extension installation pins (4) from the boom nose.
19. Using the tag line, swing the boom extension towards the boom until the boom extension engages the rear stowage bracket. Raise the boom as necessary to help the boom extension engage the rear stowage bracket.
20. In the ODM, highlight the lock icon and the extend the rear boom extension pin (Pin #1) as follows:



- a. Use the ODM control pad arrow buttons or jog dial to highlight lock icon.  
The lock icon highlights (orange).
- b. Press and hold the OK on the ODM control pad or press down on the jog dial.  
The lock status indicator icon turns green, indicating the pin is extended. The boom extension is displayed as secured to the main boom.



21. Visually verify that the rear mounting pin is securely installed.
22. Attach fly section to boom base by doing the following:
  - a. Remove retaining clip (1), (Figure 5-104) from pin (2) at fly section stowage bracket (3).
  - b. Turn pin (2) clockwise, allowing the spring-action pin to lock into the fly section.
  - c. Reinstall the retaining clip (1) into the pin (2).

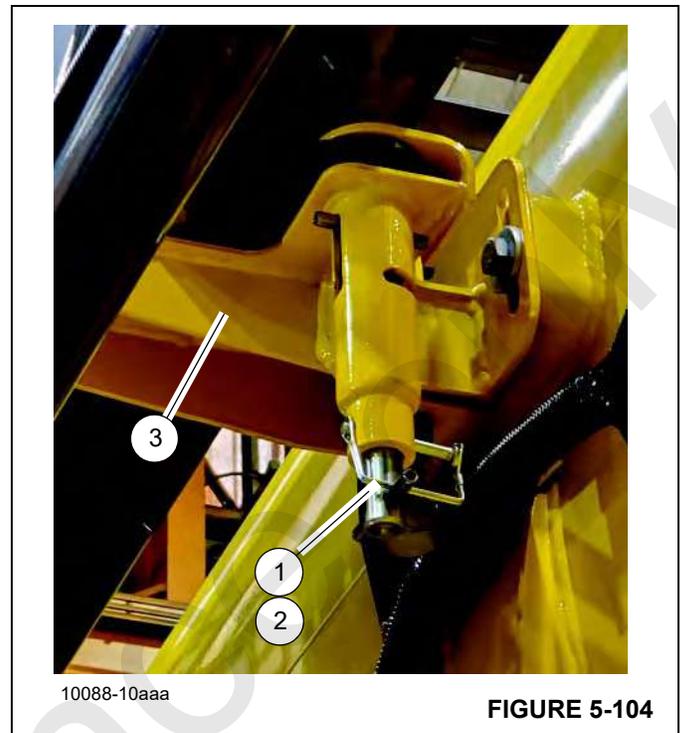


FIGURE 5-104

23. Remove tag line.
24. Disconnect boom extension electrical connections. For more information, see “Boom Extension Electrical Connections” on page 5-70.
25. If stowing a hydraulic boom extension, disconnect hydraulic hoses. For more information, see “Hydraulic Boom Extension Connections” on page 5-71.

### Erecting the 9.9 m (33 ft) Boom Extension Base Section Only

**DANGER**

#### Boom Extension Hazard!

To avoid death or serious injury, follow procedures and cautions in the Operator and Safety Manuals and decals during erection, stowage and use of boom extension. Install and secure all pins properly and control boom extension movement at all times.

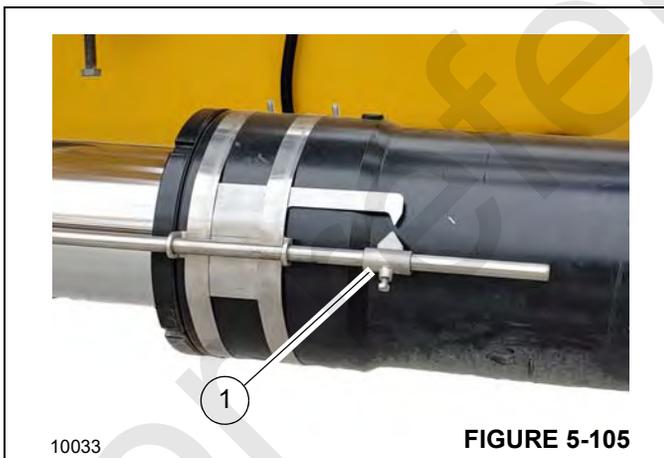
**DANGER**

To prevent serious injury or death, always wear personal protective equipment; i.e., a hard hat, eye protection, gloves and metatarsal boots.

Use the following procedure to erect the boom extension base section. During this procedure, the boom extension base section is detached from the fly section and attached to the boom nose. The fly section remains attached to the side of the main boom. In the ODM, Pin #1 will be shown as locked.

**NOTE:** This procedure assumes the boom extension and fly section are installed on the side of the main boom.

1. Make sure the counterweight is installed. For more information about installing the counterweight, see "Counterweight Versions/Combinations" on page 5-19.
1. Make sure the crane is set up on fully extended outriggers. For more information, see *Setting the Outriggers*, page 4-42.
2. Fully retract and lower the boom to horizontal.
3. Connect boom extension electrical connectors. For more information, see "Boom Extension Electrical Connections" on page 5-70.
4. If erecting a hydraulic boom extension, connect hydraulic hoses. For more information, see "Hydraulic Boom Extension Connections" on page 5-71.
5. If erecting an optional hydraulic boom extension, make sure the angle indicator (1), (Figure 5-105) is aligned. If the arrows are not aligned, adjust the boom extension offset as needed to align the arrows. For more information, see "Offsetting the Hydraulic Boom Extension (Optional)" on page 5-80.



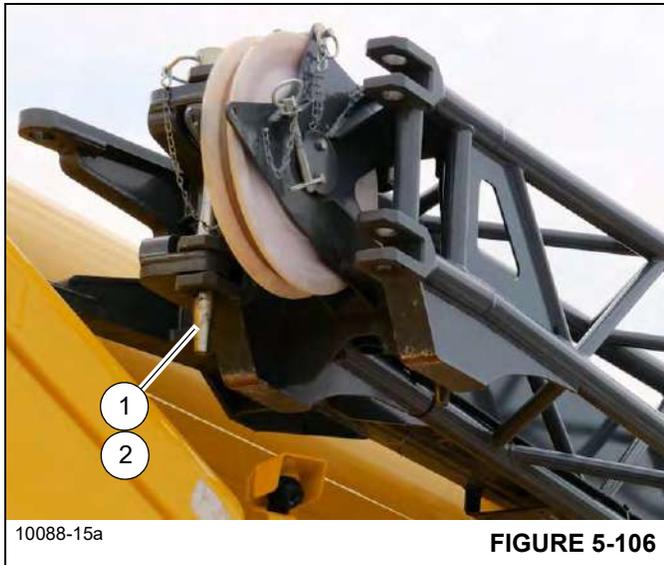
6. In the ODM, verify that the front (Pin #2) and rear (Pin #1) boom extension pins are securely installed. Visually confirm that the pins are installed.



7. Attach a tag line to the tip of the boom extension base section near the sheave. The tag line will assist when swinging the boom extension to the boom nose.
8. Detach the fly section from the boom extension base section by removing the retaining clip (2), (Figure 5-100) and pin (3) securing the connecting link (1) to the boom extension fly section (4).
9. Pull down on latching pin (1), (Figure 5-84) to release the rear boom extension ramp (3) from the stowed position. Fully swing the rear boom extension ramp (3) into the erected position. Ensure the latching pin (1) locks into position on the rear boom extension bracket.
10. Visually confirm the rear boom extension pin (Pin #1 in the ODM) (2), (Figure 5-66) properly secures the fly section to the main boom. Visually confirm the pin at the middle fly section mounting bracket (9), (Figure 5-66) properly secures the fly section to the main boom.
11. Remove retaining clip (1), (Figure 5-106) and pin (2) to detach the boom extension base section from the fly section. Place the pin in its holder on the boom extension base section and secure with retaining clip.

### **CAUTION**

After removing the retaining clip and pin that secures the boom extension base section to the fly section, the boom extension is free to swing away from the side of the main boom.



12. Using the tag line, swing the boom extension on to the rear ramp so the boom extension installation pins (4), (Figure 5-78) align with the holes in the boom nose attachment fittings.
13. With an impact wrench and 14 mm socket extension, turn the jack screw (3), (Figure 5-78) counterclockwise to extend the boom extension installation pins (4) into the boom nose attachment fittings. Extend jack screw until the bolts and washers are at the end of the slots. Verify that the pins (4) are fully engaged.

**! DANGER**  
Crush Hazard

To avoid death or serious injury, make sure boom extension installation pins (4), (Figure 5-78) are installed prior to retracting the front mounting pin (Pin #2).

14. In the ODM, highlight the front boom extension pin (Pin #2) unlock icon and retract Pin #2 as follows:
  - a. Use the ODM control pad arrow buttons or jog dial to highlight unlock icon.

The unlock icon is highlighted (orange).

- b. Press and hold the OK on the ODM control pad or press down on the jog dial.

The lock status indicator icon turns yellow, indicating Pin #2 is retracted.



15. Visually confirm that the front boom extension pin (Pin #2 in the ODM) is unlocked. The boom extension interlock handle should be in the down position. When the handle is in the down position, the front mounting pin is retracted and the boom installation pins are locked.

**NOTE:** The front mounting pin (Pin #2) will not unlock unless the right side boom extension installation pins are fully engaged. If the front mounting pin does not unlock, make sure the right side boom extension pins are fully engaged and the cable ends are inserted through the pins.

**! DANGER**

When erecting the boom extension, make sure that all personnel and equipment are kept clear of the swing path.

16. Slightly raise and/or lower the boom to help control the boom extension. Using the tag line, swing the boom extension to the front of the main boom. Align the boom extension anchor fitting holes (1), (Figure 5-78) with the main boom attachment fitting holes (2).

17. Install four pins (5), (Figure 5-78) and retaining clips (6) to secure the boom extension to the boom nose. If necessary, use the jack (1), (Figure 5-107) to install the fourth pin:

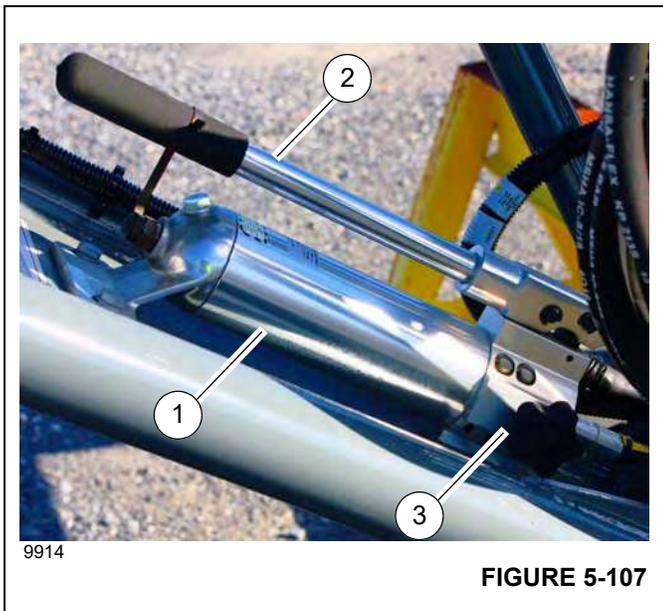


FIGURE 5-107

- a. Install three pins to attach the boom extension to the boom nose.
- b. Operate the jack handle (2) to align the holes on the boom extension with the hole in the boom nose.
- c. Install the fourth pin. Secure the fourth pin with retaining clip.

### CAUTION

After installing the fourth pin, turn the pressure relief nob (3) to retract the jack so the jack does not contact the boom nose. Failure to retract the jack could result in damage to the boom extension jack.

- d. Turn the nob (3) to relieve the pressure to retract the jack pin.
18. Connect boom extension electrical connectors. For more information, see “Boom Extension Electrical Connections” on page 5-70.
19. If erecting a hydraulic boom extension, connect hydraulic hoses. For more information, see “Hydraulic Boom Extension Connections” on page 5-71.
20. Raise the mast sheave assembly. For more information, see “Folding Mast Sheave” on page 5-82.
21. Reeve the hoist rope. For more information, see “Reeving the Hoist Rope” on page 5-74.
22. Remove the anti-two block switch from the main boom nose. For more information, see “Installing/Removing

the Anti Two-Block Switch” on page 5-33. Install anti-two block switch on the end of the boom extension. For more information, see “Anti-Two Block Switch on the Boom Extension” on page 5-81.

23. (Optional) Install the anemometer and boom position light assembly. For more information, see “Anemometer and Boom Position Indicator Light (Optional)” on page 5-37.

### Stowing the 9.9 m (33 ft) Boom Extension Base Section Only



#### DANGER

#### Boom Extension Hazard!

To avoid death or serious injury, follow procedures and cautions in the Operator and Safety Manuals and decals during erection, stowage and use of boom extension. Install and secure all pins properly and control boom extension movement at all times.



#### DANGER

To prevent serious injury or death, always wear personal protective equipment; i.e., a hard hat, eye protection, gloves and metatarsal boots.

Use the following procedure to stow the boom extension base section to the side of the main boom.

**NOTE:** This procedure assumes only the boom extension base section is erected and the fly section is secured to the side of the main boom.

**NOTE:** The boom extension base section cannot be stowed if the fly section is not first stowed on the side of the main boom.

1. Make sure the crane is set up on fully extended outriggers. For more information, see *Using the Outriggers*, page 4-40.
2. Make sure the counterweight is installed. For more information about installing the counterweight, see “Counterweight Versions/Combinations” on page 5-19.
3. Fully retract and lower the boom to horizontal.
4. (Optional) Remove the anemometer and boom position light assembly. For more information, see “Anemometer and Boom Position Indicator Light (Optional)” on page 5-37.
5. Remove the anti-two block switch from the end of the boom extension. For more information, see “Anti-Two Block Switch on the Boom Extension” on page 5-81.

Install the anti-two block switch on the auxiliary boom nose. For more information, see “Installing/Removing the Anti Two-Block Switch” on page 5-33.

6. Remove the hoist rope from the boom extension base section sheaves. For more information, see “Reeving the Hoist Rope” on page 5-74.
7. If necessary, adjust the boom extension offset to 0° depending on the type of boom extension:
  - If stowing a mechanical boom extension, make sure the offset is set to 0°. For more information, see “Offsetting the Mechanical Boom Extension” on page 5-79.
  - or
  - If stowing an optional hydraulic boom extension, make sure the angle indicator (1), (Figure 5-108) is aligned. If the arrows are not aligned, adjust the boom extension offset as needed to align the arrows. For more information, see “Offsetting the Hydraulic Boom Extension (Optional)” on page 5-80.

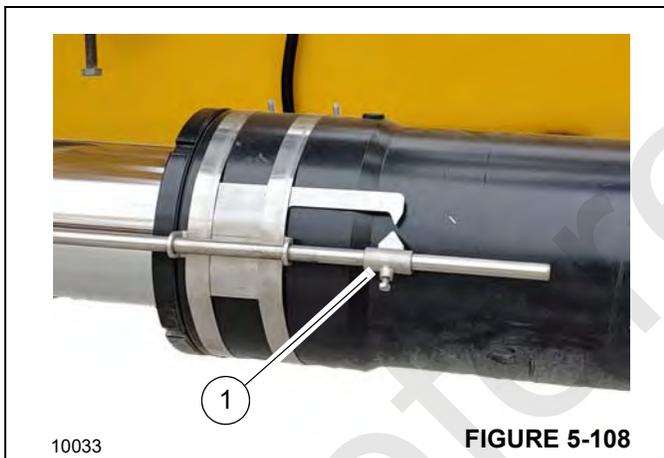


FIGURE 5-108

8. Stow the mast sheave assembly. For more information, see “Folding Mast Sheave” on page 5-82.
9. Attach a tag line to the tip of the boom extension base section near the sheave.

**! DANGER**

**Boom Extension Hazard!**

The boom extension installation pins (4), (Figure 5-78) must be extended and engaged before removing the four pins (5) from the boom extension anchor fitting holes (1) and the boom nose attachment lug holes (2). If the boom extension installation pins (4) are not extended and fully engaged, the boom extension will fall when pins (5) are removed, resulting in possible injury or death.

10. Make sure the boom extension installation pins (4), (Figure 5-78) are engaged.

**! CAUTION**

After removing the four retaining clips and pins, the boom extension is free to swing to the side of the main boom.

11. Detach the boom extension base section from the boom nose by removing the four retaining clips (6) and pins (5), (Figure 5-78) from the boom extension anchor fitting holes (1) and the boom nose attachment lug holes (2). Store the pins (5) and retaining clips (6) on the boom extension stowage bracket.

**! DANGER**

When stowing the boom extension, make sure that all personnel and equipment are kept clear of the swing path.

12. Slightly raise and/or lower the boom to help control the boom extension. Using the tag line, swing the boom extension to the intermediate position on the side of the base section of the boom. Make sure the wheels engage on the front and rear boom extension ramps.
13. Raise and lower the boom as needed to move the boom extension in against the main boom so the front boom extension pin (Pin #2) can be secured.
14. From the operator cab, lock the front mounting pin (Pin #2 in the ODM) as follows:
  - a. Use the ODM navigation pad arrow buttons or jog dial to highlight the Pin #2 lock icon. The lock icon is highlighted (orange).



10035-15

- b. Press and hold the OK on the ODM navigation pad or press down on the jog dial.

When front extension pin is locked, the status indicator show a green lock icon.



- 15. Visually confirm that the front boom extension pin (Pin #2 in the ODM) is locked. The handle should be in the up position. When the handle is in the up position, the front mounting pin is extended and the boom installation pins are unlocked.

**DANGER**  
**Crush Hazard**

To avoid death or serious injury, make sure the front mounting pin (Pin #2) is installed and the handle (1), (Figure 5-74) is locked prior to retracting the boom extension installation pins (4), (Figure 5-78).

- 16. Turn the jack screw (3), (Figure 5-78) counterclockwise with the impact wrench and extension to retract the boom extension installation pins (4) from the boom nose.
- 17. Move the boom extension to the fully stowed position.
- 18. Remove the pin from its holder on the boom extension base section. Attach boom extension base section to fly section by installing the pin (2), (Figure 5-109) and securing it with the retaining clip (1).



- 19. Attach the fly section to the boom extension base section using the connecting link (1), (Figure 5-110). Secure connecting link with pin (3) and retaining clip (2).



- 20. Disconnect electrical connections. For more information, see "Boom Extension Electrical Connections" on page 5-70.
- 21. If stowing a hydraulic boom extension, disconnect hydraulic connections. For more information, see "Hydraulic Boom Extension Connections" on page 5-71.

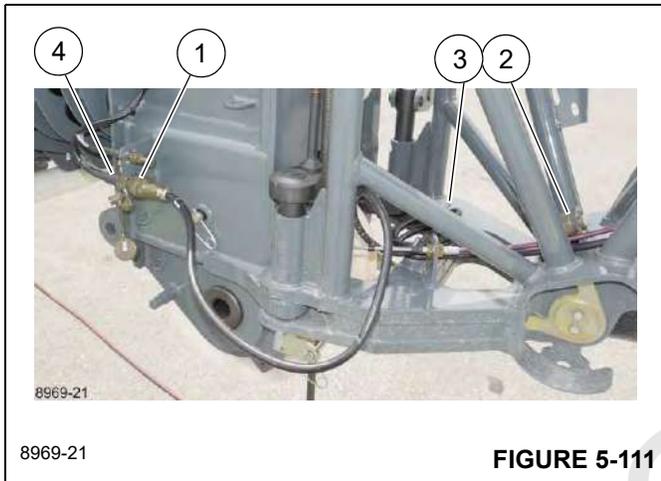
## Boom Extension Electrical Connections

To connect the anti-two block switch, boom position indicator light or anemometer to boom extensions, the following procedures must be performed.

### Connecting Electrical Connection at Boom Nose

Use the following procedure to connect the boom extension electrical connector to the boom nose:

1. Remove the plug (1), (Figure 5-111) from the storage socket (2) and unwind the cable from the storage location (3). Connect the plug (1) to the socket (4).



This connects the extension to the main boom circuit.

2. Wind the cable around the storage location (3) such that it will not be damaged during crane operation.

### Disconnecting Electrical Connection at Boom Nose

Use the following procedure to disconnect the boom extension electrical connector (1), (Figure 5-111) from the electrical connector on the boom nose. Be sure to stow the boom extension electrical connector on the storage bracket to prevent water damage to the connector.

1. Disconnect the plug (1), (Figure 5-112) from the socket (4).
2. Wind excess cable around the storage location (3), then connect plug (1) to storage socket (2).
3. Install protective cap on boom nose electrical socket (4).

## Hydraulic Boom Extension Connections

Use the following procedures to connect and disconnect the optional hydraulic boom extension to the main boom.

Disconnect and retract the hydraulic lines from the boom nose whenever the operation of the crane does not require hydraulic power. This will extend the life of the hose drum, hoses, and associated hardware. For more information, see "Retracting Hydraulic Hoses for Main Boom Operation" on page 5-72.

### Checking the Locking Device on the Hose Drum

The hose drum on the side of the main boom provides the hydraulic supply to the boom nose/luffing boom extension. The hose drum is equipped with a locking device. The drum must be unlocked before operation.

If the hose drum has to be removed, the drum must be locked.

---

### CAUTION

#### Equipment Damage Hazard!

Always verify the drum is unlocked before using extensions or other equipment that require hydraulic power. Damage to hydraulic hoses or the boom may occur.

---



### CAUTION

#### Spring Loaded Equipment Hazard!

The drum must be locked before removal. The drum is spring loaded and must be locked to prevent damage or injury.

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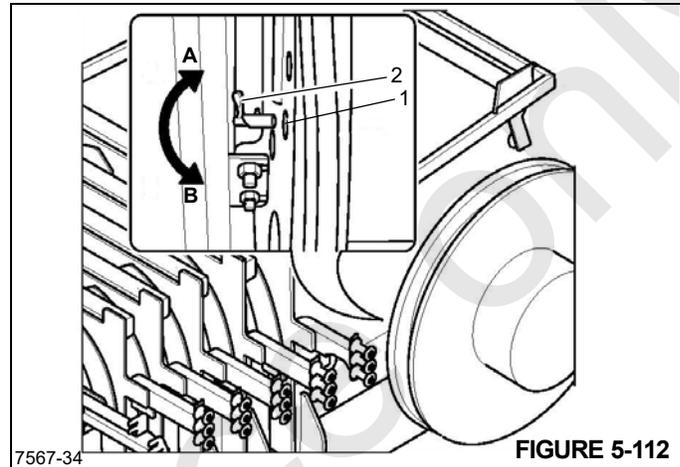
Holes (1), (Figure 5-112) are distributed on the inner wheel of the hose drum. Rotating the latch (2) engages one of the holes to lock the drum, preventing it from turning.

### Unlocking the Drum

Rotate the latch (2), (Figure 5-112) clockwise (A), to disengage it from the hole.

### Locking the Drum

1. Turn the hose drum until a hole is aligned with the latch (2), (Figure 5-112).
2. Rotate the latch (2) counterclockwise to position (B), until the latch fully engages the hole.



### CAUTION

#### Spring Loaded Equipment Hazard!

If the strain relief is detached after the locking device has been released, do not under any circumstances let go of the strain relief before it has been re-attached. If you let go of the strain relief, the hydraulic hoses will spring back uncontrollably due to the spring force in the hose drum and may injure persons or damage parts of the crane.

---

### Hydraulic Hose Installation

1. Unlock the hose drum.
2. Remove the hinged pins (1), (Figure 5-113) and fold up the guide sheaves (2).
3. Remove the strain relief (3) from its main boom mounting bracket (4) and pull the hydraulic hoses (5) towards the boom nose.
4. Hook the strain relief onto the boom nose mounting bracket (6).

5. Fold down the guide sheaves (2) and secure them with the hinged pins (1).

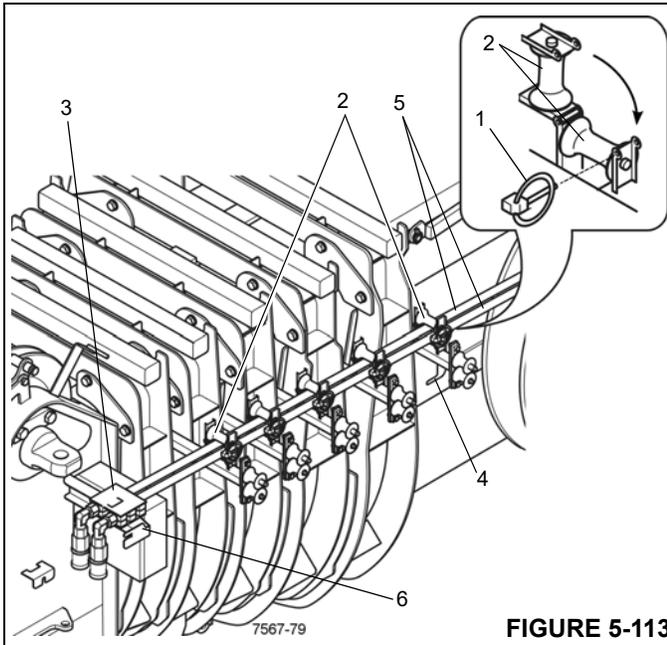


FIGURE 5-113

**Retracting Hydraulic Hoses for Main Boom Operation**

The locking device on the hose drum must be undone:

1. Loosen the hinged pins (5), (Figure 5-114) and fold up the guide sheaves (4).
2. Detach the strain relief from the holder (3) and attach it to the holder (2).
3. Fold down the guide sheaves (4) and secure them with the hinged pins (5).

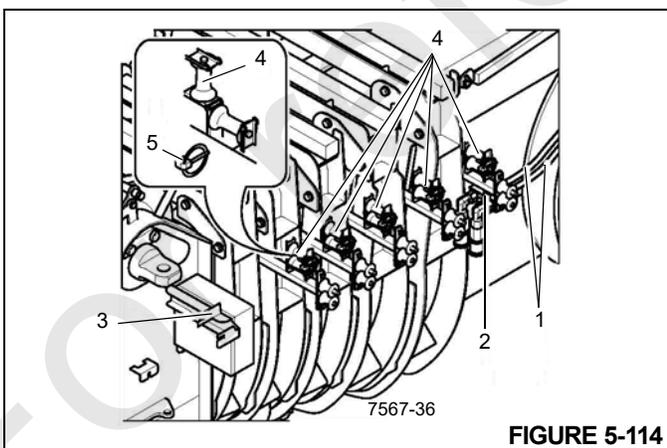


FIGURE 5-114

**Establishing the Hydraulic Connection**

1. If necessary, bring the connections (1), (Figure 5-115) into the position for boom extension operations.
2. Remove the hose line (2) from the clamp (4).
3. Feed the hose lines towards the left hand side through the lower opening (3) in the boom extension base section under the boom head.
4. Remove the protective caps to the connections (1) and attach the hose lines (observe color code).

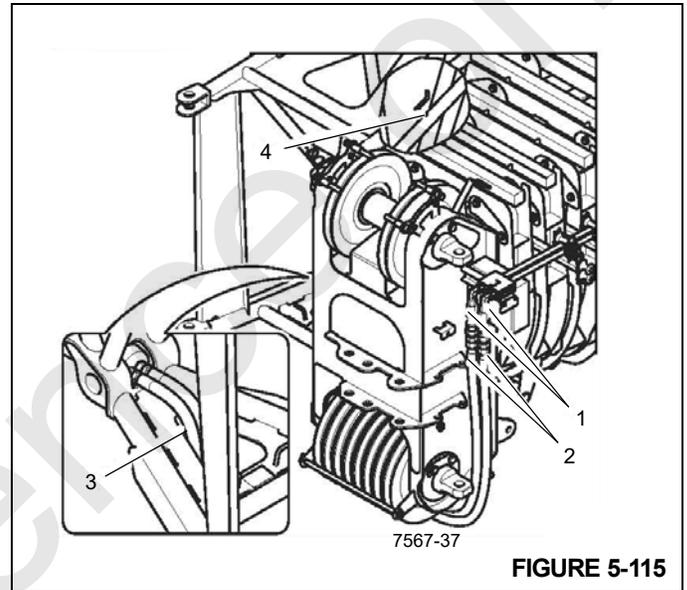
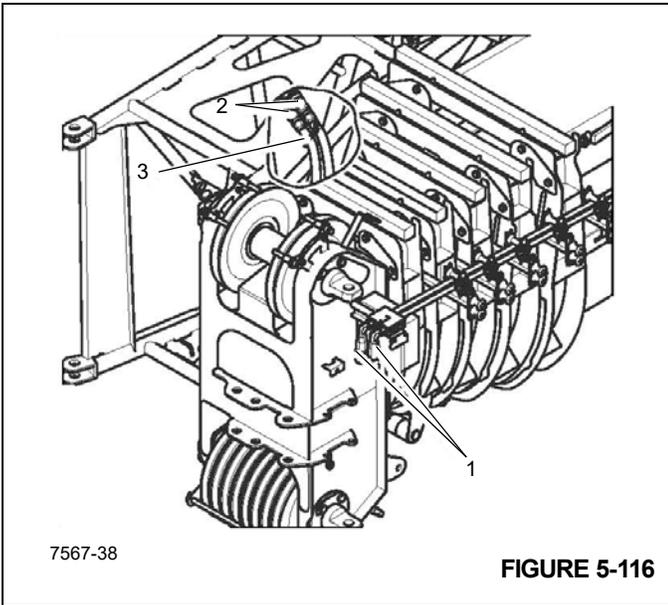


FIGURE 5-115

**CAUTION!**

**Machine Damage!**

Feed the hydraulic hoses under the main boom head in such a way that they hang freely. Take care that the hoses are not torn off when folding the boom extension base section. This prevents damage to the hydraulic hoses.

**Disconnecting the Hydraulic Connection**

1. Remove the hose lines (2), (Figure 5-116) from the connections (1).
2. Close off the hose lines and the connections (1) with the protective caps.
3. Secure hoses in holder (3) on the boom extension base section.

## Reeving the Hoist Rope

Use the following to reeve the hoist rope on the mast sheave assembly.

### Reeving the Hoist Rope



### CAUTION

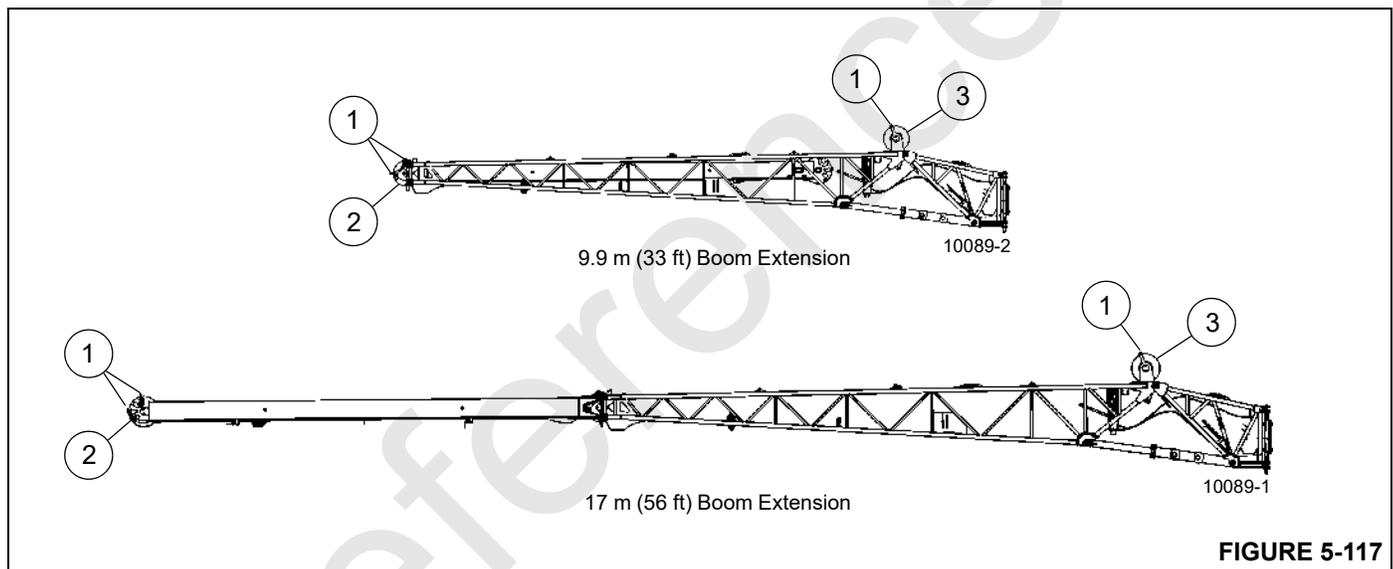
#### Falling Objects Hazard!

Always make sure sheaves and pins that secure the hoist cable are secured with clips. This prevents components from coming loose, falling and causing injury.

1. Remove the retaining clips and rope retaining pins (1), (Figure 5-117).
2. Guide the rope over the mast sheave (3), and over the nose sheave (2) of the extension.
3. Reinstall all rope retaining pins (1) and secure with retaining clips.
4. Install the overhaul ball or the hook block.

### Unreeving Hoist Rope

1. Unreeve the hook block or unpin the overhaul ball.
2. Remove the retaining clips and rope retaining pins (1), (Figure 5-117).
3. Take the hoist rope off the nose sheave (2) and mast sheave (3) and place it on the ground on the left side.
4. Replace all rope retaining pins (1). Secure with retaining clips.



**ANEMOMETER/BOOM POSITION LIGHT (OPTIONAL)**

**CAUTION**

**Machine Damage!**

Always remove the anemometer and boom position indicator light before on-road driving.

This prevents the specified overall height being exceeded at on-road level, and the anemometer from getting damaged by being rotated too fast.

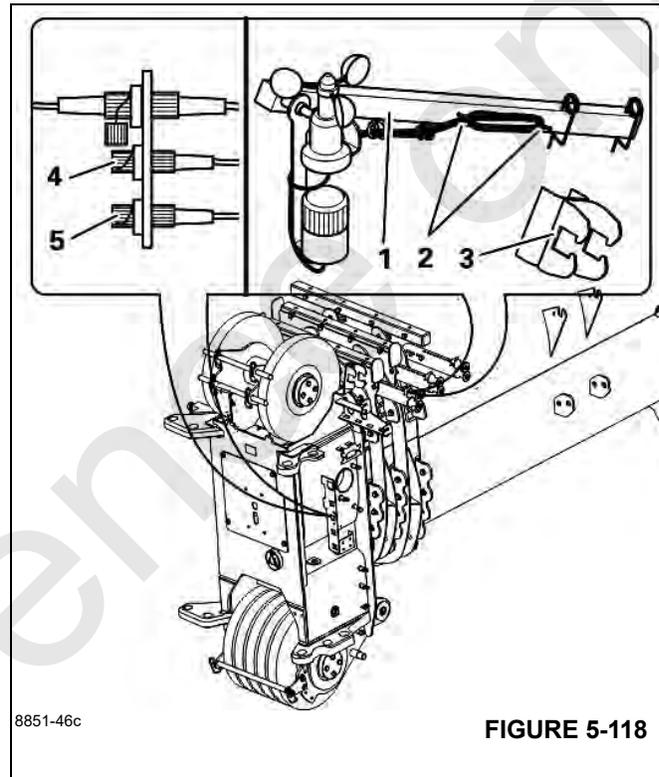
**Installing**

The anemometer and the boom position indicator light – if provided – are located on the same rod.

- Insert the rod (1), (Figure 5-118) into the holder (3) and secure it with the retaining pins.
- Remove the cable from the holders (2) and connect.
  - the anemometer to socket (4).
  - the boom position indicator light to the socket (5).
- Lay the cables in such a way that they will not be damaged during crane operation.
- Check that the anemometer is able to swing so that it hangs vertically even when the main boom is raised.

For Boom Nose:	
4	X120: Wind Indicator Option
5	X130: Air Traffic Light Option

For Jib:	
4	X127: Wind Indicator Option
5	X130: Air Traffic Light Option



**Switching the Boom Position Indicator Light ON and OFF**

To switch on:	Select symbol (1), (Figure 5-119) and confirm – symbol ON is displayed
To switch off:	Select symbol (2) and confirm – symbol OFF is displayed

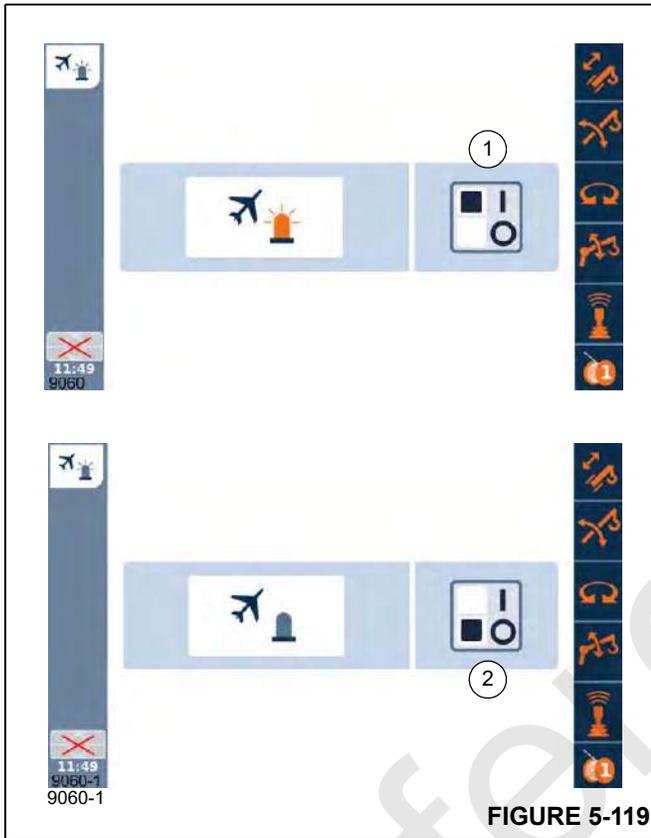
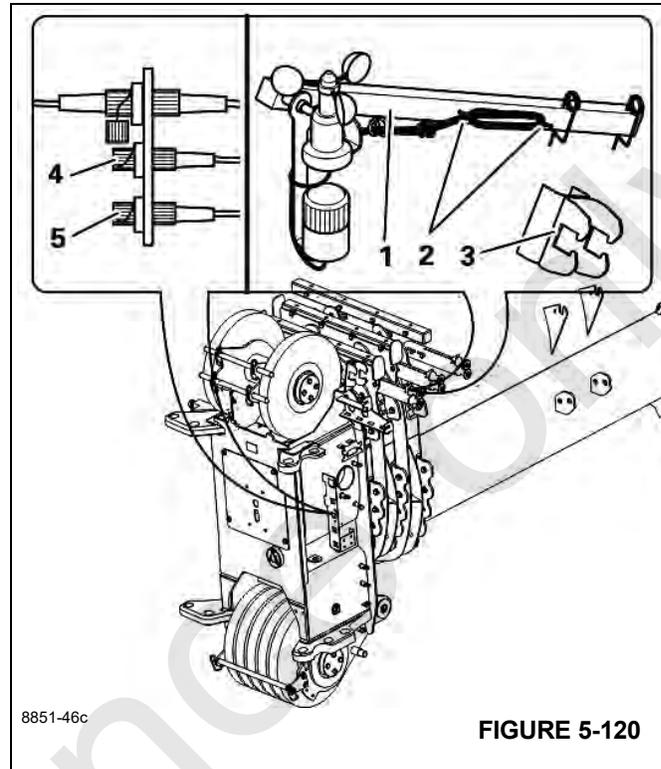


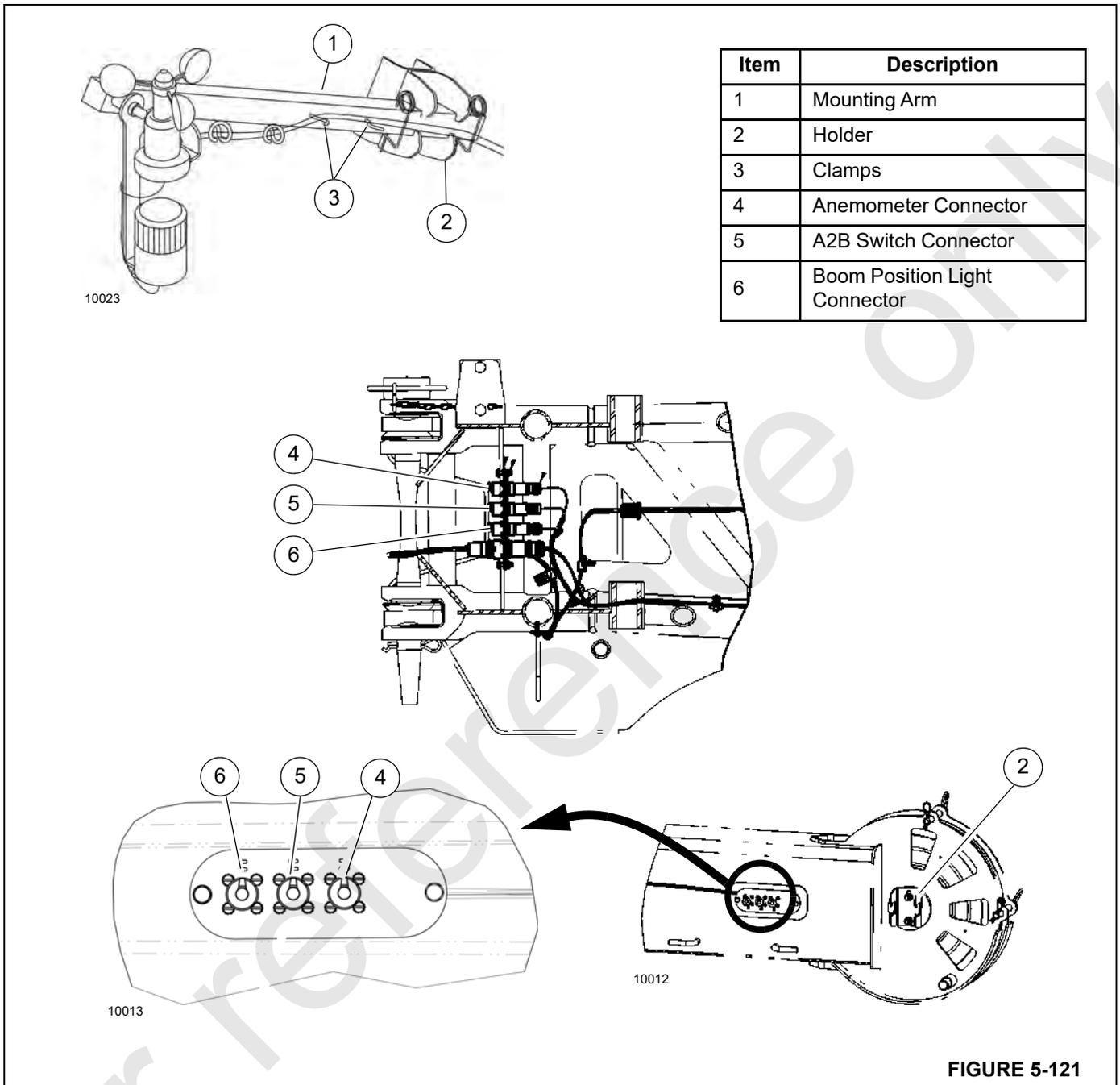
FIGURE 5-119

### Removing

Remove the rod with the anemometer/boom position indicator light before driving on the road.

- Switch off the boom position indicator light.
- Remove the plug and close the sockets (4), (Figure 5-120) and (5) with the protective caps.
- Wind the cables on to the holders (2).
- Remove the rod (1) from the holder (3).
- For transportation, fasten the retaining pins to the rod (1).





## Offsetting the Mechanical Boom Extension

The boom extension features manual offset or hydraulic offset. The standard boom extension can be offset manually to 0°, 20°, or 45°. The hydraulic boom extension can be offset from 0° to 45° and controlled from the operator cab.

### **! WARNING** Crushing Hazard!

Always secure the adjustable boom extension with an auxiliary crane or set the nose of the extension on the ground before you remove the adjusting pins when adjusting the angle of the boom extension.

This prevents the extension from suddenly unfolding and causing serious injury or death.

### **CAUTION**

#### **Risk of Equipment Damage!**

Always stow the mast sheave assemblies before adjusting the boom extension offset angle.

This will prevent any interference between the mast sheave assemblies and boom extension.

### **! DANGER** Crushing Hazard!

During installation and removal, always use the proper equipment with sufficient load bearing capacities.

### **Mechanical Extension Angle Adjusting Mechanism**

### **! WARNING** Crushing Hazard!

Uncontrolled movement of the boom extension can result in death or serious injury. The Boom extension must be supported before removing the adjusting pins.

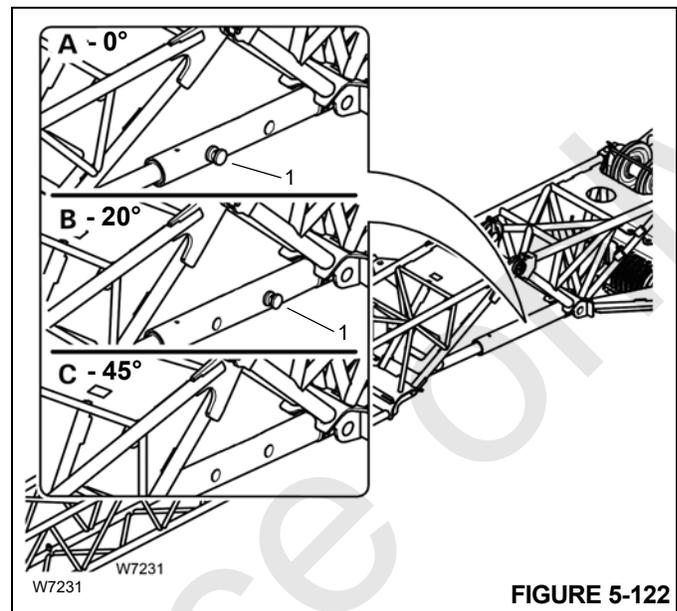
Support the extension with an assist crane or set the tip of the extension on the ground before adjusting the angle.

### **CAUTION**

#### **Machine Damage!**

The mast sheave must be stowed before adjusting the offset angle of the extension. Failure to stow the deflection sheave may result in damage to the extension or sheave.

Refer to Figure 5-122.



**FIGURE 5-122**

The boom extension angle is determined by the position of the adjusting pin. There are three positions:

- **0° angle: (A)** – For a 0° angle, the pin (1) is installed in the front location and is secured with the retaining clip.
- **20° angle: (B)** – For a 20° angle, the pin (1) is installed in the rear location and is secured with the retaining clip.
- **45° angle: (C)** – For a 45° angle, the pin (1) is removed and stored in the operator cab.

### **Setting the Offset Angle with an Auxiliary Crane**

**NOTE:** The information in this section only applies to the mechanical luffing boom extension.

1. Lift the extension with the auxiliary crane until the pin (1), (Figure 5-122) is relieved of load.
2. Lift or lower the extension with the auxiliary crane until the adjusting pin can be installed into the hole for the required angle (refer to (Figure 5-122)).
3. Install the pin into the 0° or 20° offset hole, and then secure with the retaining clip. If offset is to be 45°, remove pin and store in the operator cab.
4. Lower the boom extension with the auxiliary crane and remove the lifting gear.

When setting a 45° offset, if the boom extension now touches the ground at the current angle, the angle will set itself when the main boom is raised.

**Setting the Offset Angle without an Auxiliary Crane**

If an auxiliary crane is not available, the extension head must rest on the ground before the angle is changed.

**CAUTION****Rope Damage!**

The hoist cable can be damaged if it is reeved while the extension nose is on the ground. Unreeve the hoist cable from the extension nose before adjusting the offset angle.

1. Extend and set the outriggers.
2. Program the Rated Capacity Limiter (RCL) with the correct rigging code for the chosen boom extension offset angle (refer to *Entering the RCL Code*, page 5-80).
3. Swing boom over rear of crane.
4. Lower and extend the boom until boom extension nose touches the ground and pressure is relieved from the adjusting pin (1), (Figure 5-122).

If unable to touch the ground due to the limitations of the rigging code, incline the crane (refer to *Inclining the Crane*, page 5-80).

5. Remove the adjusting pin.
6. Raise or lower the boom until the adjusting pin can be installed into the hole for the required angle (refer to (Figure 5-122)).
7. Install the pin into the 0° or 20° offset hole, and then secure with the retaining clip. If offset is to be 45°, remove pin and store in the operator cab.

**Entering the RCL Code**

Enter the RCL rigging code for the boom extension offset angle in accordance with the current rigging mode of the crane, refer to the *Load Chart, Chapter Remarks*.

When adjusting the angle without an auxiliary crane, you must enter an RCL rigging code. The RCL rigging code depends on:

- the rigged outrigger span
- the rigged counterweight
- the working position.

The superstructure must be in a working position permitted by the *Load Chart* for the RCL rigging code that was entered.

**Inclining the Crane**

In order to set the offset angle of the adjustable extension, you must set it down on the ground by extending and lowering the main boom over the rear.

Depending on the space available, the condition of the terrain or a limitation on the telescoping due to the current rigging mode, it may be that the nose of the boom extension cannot be set on the ground by telescoping and lowering the main boom.

In this case, you can use the outriggers to incline the crane.

1. Fully extend the front outriggers and jack cylinders.
2. Fully extend the rear outriggers.
3. Extend the rear jack cylinders until the rear wheels are just off the ground.

**WARNING****Tipping Hazard!**

Make sure that the wheels do not touch the ground when the crane has been inclined. This prevents a reduction in the stability of the crane, which could lead to it tipping over when setting the angle of the lattice extension or overloading the axles, causing serious injury or death.

**Offsetting the Hydraulic Boom Extension (Optional)**

Use the following procedure to set the offset for the hydraulic boom extension. The hydraulic boom extension offset range is 0° to 45°.

1. In the operator cab, enable the Luffing Jib Enable/Disable Switch. For more information about the Luffing Jib Enable/Disable Switch, see *Superstructure Right-Hand Armrest Controls*, page 3-38 and *Superstructure Left/Right Control Levers*, page 3-41.
2. Using the right joystick, raise or lower the hydraulic (luffing) boom extension. For more information about the Boom Lift – Main Hoist – Telescope – Luffing Jib Controller (Dual Axis), see *Superstructure Right-Hand Armrest Controls*, page 3-38 and *Superstructure Left/Right Control Levers*, page 3-41.

## Anti-Two Block Switch on the Boom Extension

Use the following procedures to install and remove the anti-two block (A2B) switch from the boom extension base and fly sections.

### 9.9 m (33 ft) Extension Anti-Two Block Installation

To electrically connect the anti-two block switch the electrical connections to this extension must be completed, refer to *Boom Extension Electrical Connections*, page 5-70.



FIGURE 5-123

1. Install the anti-two block switch assembly on to the pin (1), (Figure 5-123) and secure it with a retaining clip.
2. Route the cable so that it will not be damaged during crane operation, and connect the anti-two block connector to the socket, with the same number.

### 9.9 m (33 ft) Extension Anti-Two Block Removal

When the extension is no longer needed or if installing the boom extension fly section for 17.6 m (57.6 ft) extension operation, the anti-two block switch must be removed.

1. Remove the anti-two block connector from the socket.
2. Install the cap on the storage socket.

3. Remove the retaining clip from the mounting pin and remove the anti-two block switch assembly.

The anti-two block switch can now be moved to another location and connected.

### 17 m (56 ft) Extension Anti-Two Block Installation

To electrically connect the anti-two block switch the electrical connections to this extension must be completed, refer to *Boom Extension Electrical Connections*, page 5-70.

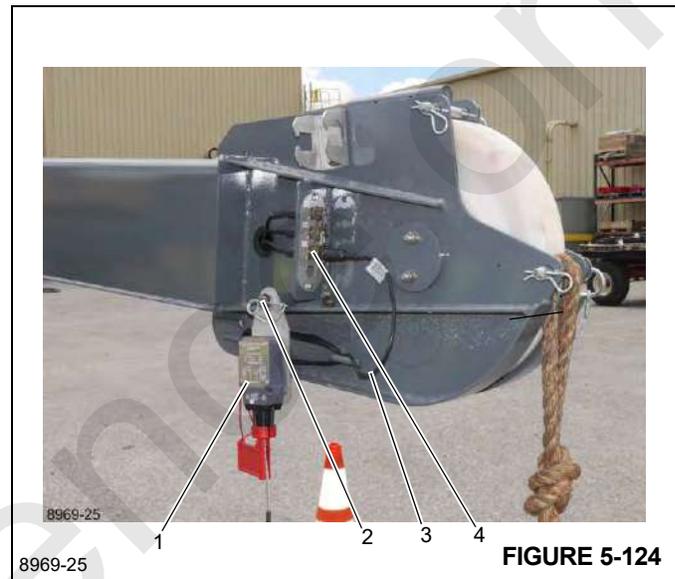


FIGURE 5-124

1. Install the anti-two block switch (1), (Figure 5-124) on to the pin (2) and secure it with a retaining clip.
2. Route the anti-two block cable (3) such that it will not be damaged during crane operation, and connect the anti-two block switch to socket (4).

### 17 m (56 ft) Extension Anti-Two Block Removal

1. Remove the plug from the socket (4), (Figure 5-124).
2. Remove the anti-two block switch assembly (1) from the pin (2).
3. Fasten the retaining clip to the anti-two block switch.

## Folding Mast Sheave

Use the following procedures to erect and stow the mast sheave on the boom extension base section.

### Erecting the Mast Sheave

The mast sheave shall be erected when the boom extension is used. The sheave must be lowered for travel.

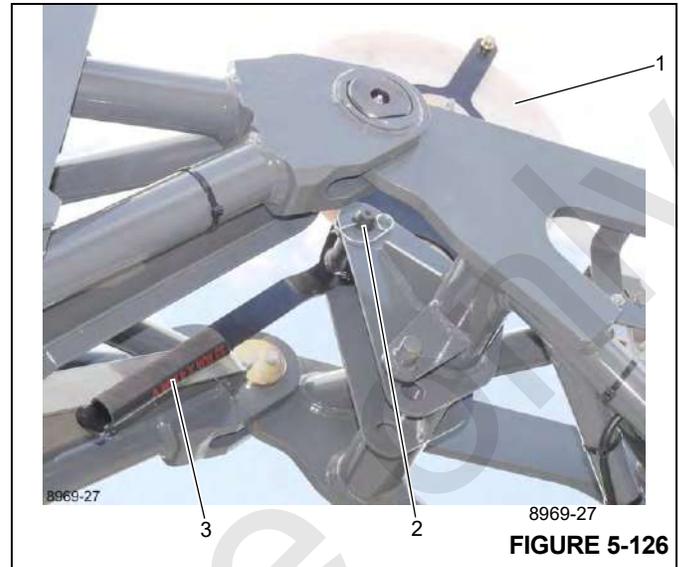
**! CAUTION**  
**Pinch Hazard!**

Keep hands clear of the moving mast sheave during erecting and stowing. Always use the handle provided to control the movement.

1. Remove the retaining clip from the pin (1), (Figure 5-125).



2. Hold the mast sheave by the handle (2), (Figure 5-125) and pull out the pin (1).



3. Fold the mast sheave (1) up and fasten it in this position with the pin (2), (Figure 5-126).
4. Secure the pin (2) using the retaining clip.

### Stowing Mast Sheave

1. Remove the retaining clip from the pin (2), (Figure 5-126).
2. Hold the mast sheave by the handle (3) and pull out the pin (2).
3. Fold the mast sheave (1) down and fasten it in position with the pin (2).
4. Secure the pin (2) using the retaining clip.

## Installing and Removing the 26 ft (8 m) Extension Insert

**! DANGER**  
**Crushing Hazard!**

During installation and removal, always use the proper equipment with sufficient load bearing capacities.

### Installation

1. Using another crane or lifting device, remove the (9.9 m) or 33 ft or (17.0 m) or 56 ft extension from the boom.
2. Use another crane or suitable lifting device to install the insert.
3. Connect a sling to the two lifting lugs (1), (Figure 5-127).

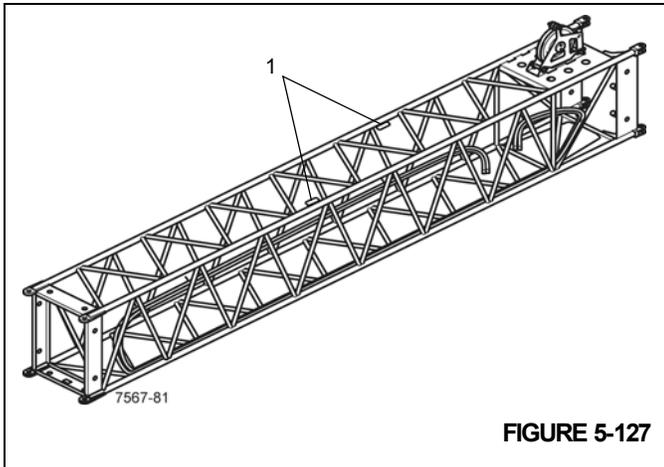


FIGURE 5-127

4. Lift the insert in front of the main boom head so that the four connecting points (1), (Figure 5-128) align on both sides.
5. Remove the pins from the holders.
6. Insert the pins into the connecting points (1), (Figure 5-128) and secure them with retaining clips.

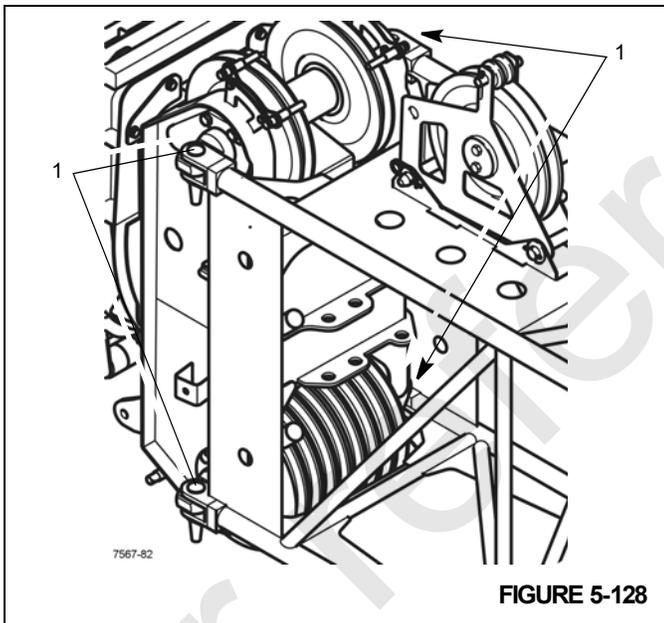


FIGURE 5-128

7. Reinstall the fixed lengths to 9.9 m (33 ft) or 17.0 m (56 ft) extension onto the insert.

8. Refer to *Insert Electrical Connection*, page 5-84 and *Connecting the Folding Extension Electrical Circuit*, page 5-85 to connect the electrical connections.
9. Refer to *Connecting Main Boom Hydraulics*, page 5-86 and *Connecting the Folding Extension Hydraulics*, page 5-87 to connect the hydraulic lines.

### Removal

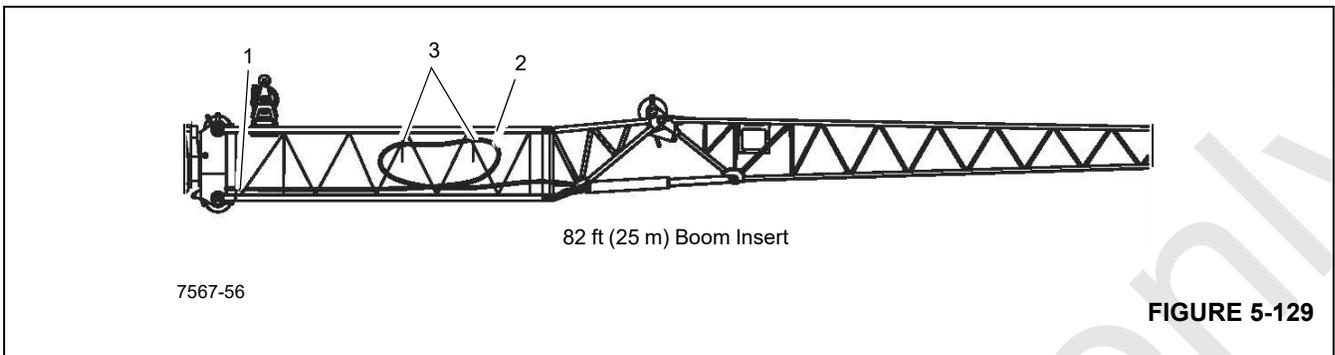
#### CAUTION

#### Equipment Damage Hazard!

Before removing an extension, make sure that the electrical and hydraulic connections have been disconnected and properly stowed to prevent damaging the cable and hydraulic hoses.

1. With the 9.9 m (33 ft) or 17.0 m (56 ft) extension already removed.
2. Use another crane or suitable lifting device to remove the insert.
3. Connect a sling to the two lifting lugs (1), (Figure 5-127) and lift the insert enough to take the load off the connecting pins.
4. Verify the electrical and hydraulic connections have been disconnected. Refer to *Extension Hydraulic Connection*, page 5-86 and *Disconnecting Main Boom Electrical Connection*, page 5-85.
5. Remove the pins from the connecting points (1), (Figure 5-128).
6. Insert the pins into the holders and secure them with retaining clips.
7. Remove the insert.

**Insert Electrical Connection**

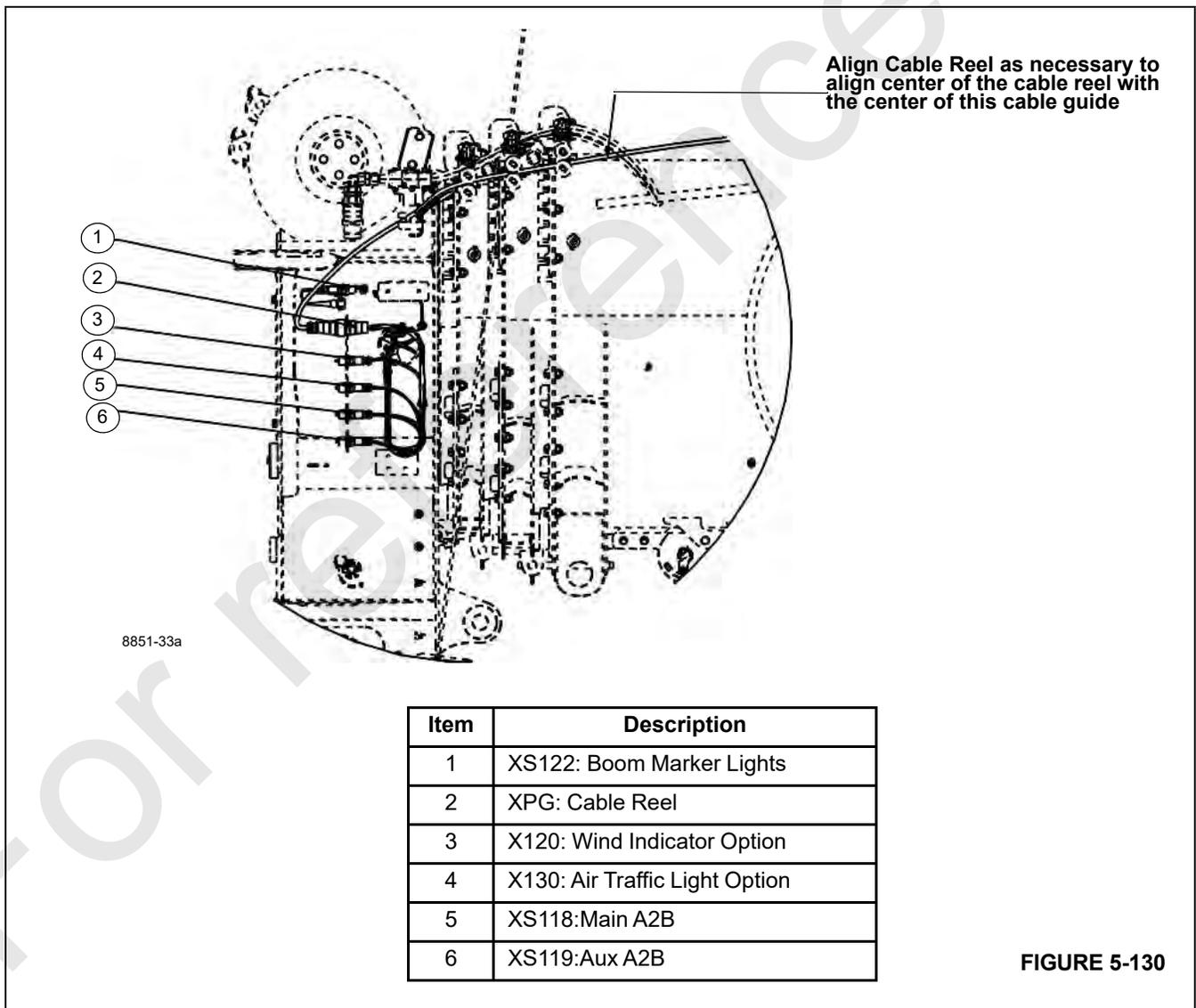


The electric cable (1), (Figure 5-129) is installed in the 26 ft (8 m) insert (2), (Figure 5-129) with the long end of the cable wound on the stowage lugs (3), (Figure 5-129).

**Connecting the 26 ft (8 m) Insert to the Main Boom**

**Establishing a Connection**

- Refer to (Figure 5-130) and (Figure 5-131).



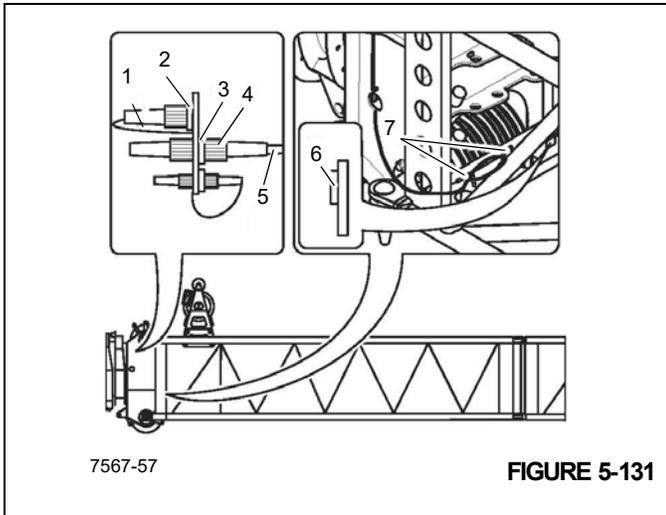


FIGURE 5-131

1. Remove the protecting cap (1), (Figure 5-131) from the socket (3), (Figure 5-131).
2. Unwind the cable (5), (Figure 5-131) from the holder (7), (Figure 5-131).
3. Remove plug (4), (Figure 5-131) from the dummy socket (6), (Figure 5-131) and plug into the socket (3), (Figure 5-131).
4. Wind up the cable (5), (Figure 5-131) far enough on the holder (7), (Figure 5-131) so that it will not be damaged during operation.

**Disconnecting Main Boom Electrical Connection**

Refer to (Figure 5-130) and (Figure 5-132).

1. Remove the plug (4), (Figure 5-132) from the socket (3), (Figure 5-132) and plug into the dummy socket (6), (Figure 5-132).
2. Wind the cable (5), (Figure 5-132) onto the holder (7), (Figure 5-132).
3. Install protective cap on main boom nose connector.

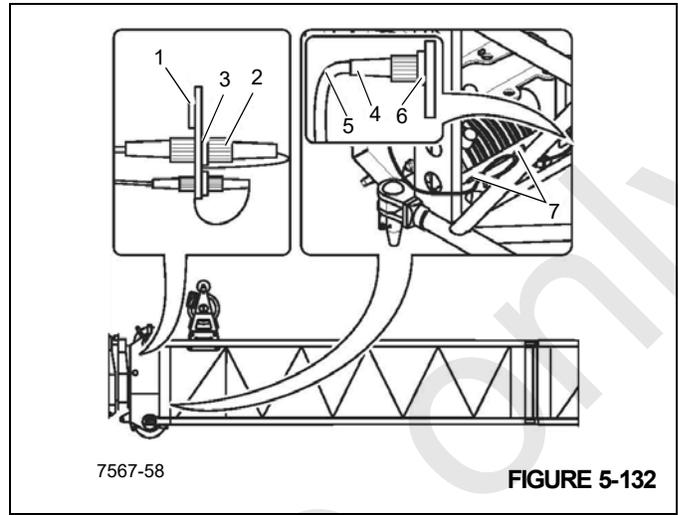


FIGURE 5-132

**Connecting the Folding Extension Electrical Circuit**

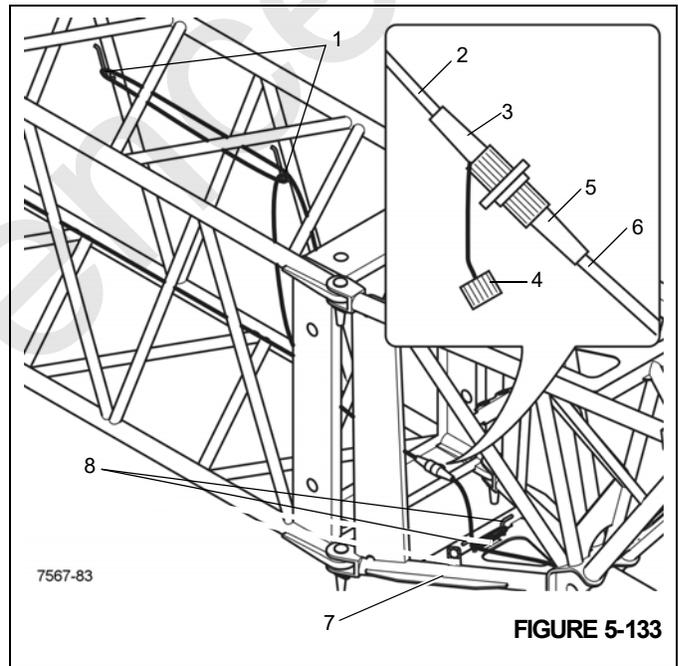


FIGURE 5-133

1. Unwind the cable (2), (Figure 5-133) from the holder (1), (Figure 5-133).
2. Remove the cap (4), (Figure 5-133) off the socket (3), (Figure 5-133).
3. Unwind the cable (6), (Figure 5-133) from the holder (8), (Figure 5-133).
4. Remove the bridging plug (5), (Figure 5-133) from the dummy socket (7), (Figure 5-133) and plug it into the socket (3), (Figure 5-133).
5. Wind up the cable (8), (Figure 5-133) far enough on the holder (7), (Figure 5-133) so it will not be damaged during operation.

6. Wind up the cable (2), (Figure 5-133) far enough on the holder (1), (Figure 5-133) so it will not be damaged during operation.

**Disconnecting the Folding Extension Electrical Circuit**

1. Remove the bridging plug (5), (Figure 5-134) from the socket (3), (Figure 5-134) and plug it into the dummy socket (7), (Figure 5-134).
2. Wind the cable (6), (Figure 5-134) on to the holder (8), (Figure 5-134).
3. Install the protective cap on the socket (3), (Figure 5-134).
4. Wind the cable (2), (Figure 5-134) onto the holder (1), (Figure 5-134).

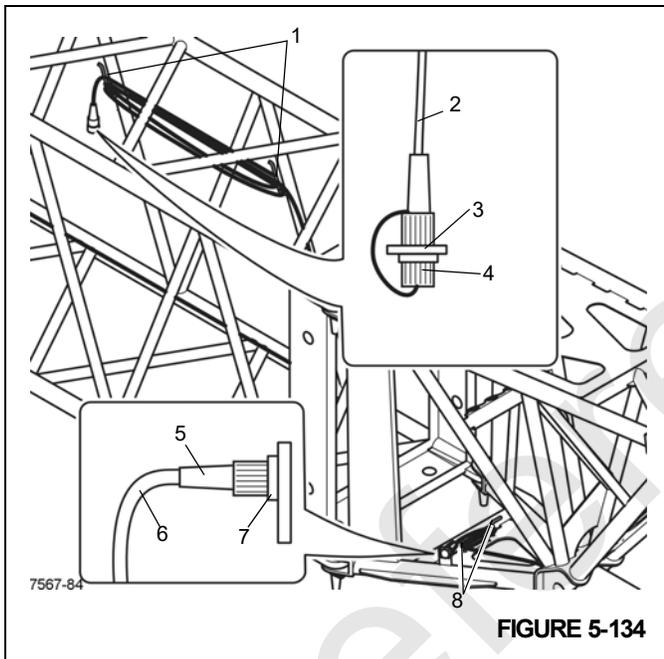


FIGURE 5-134

**Extension Hydraulic Connection**

All hydraulic lines are located in the 26 ft (8 m) extension (Figure 5-135). The hose lines are installed so that short ends are located to the rear and long ends to the front of the extension.

The long ends (1), (Figure 5-135) of the hoses are suspended from clamps.

The short ends (2), (Figure 5-135) of the hoses are positioned at the rear of the lower cross-strut.

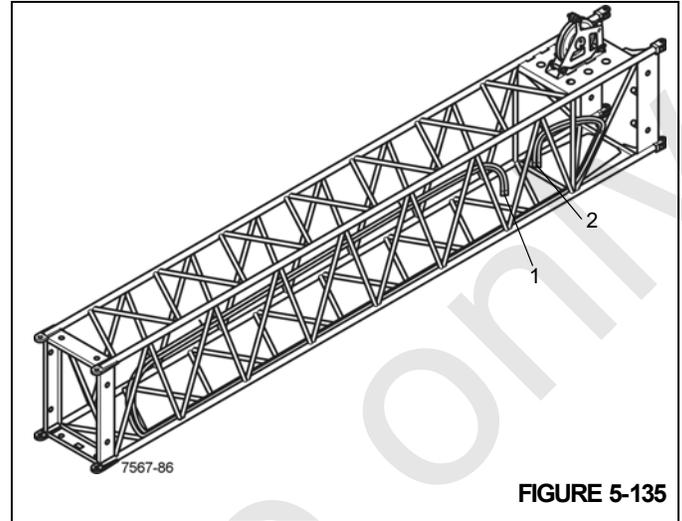


FIGURE 5-135

**Connecting Main Boom Hydraulics**

1. If necessary, install the hydraulic hoses (1), (Figure 5-136) on the boom nose. Refer to *Extension Hydraulic Connection*, page 5-86.
2. Route the short ends (2), (Figure 5-136) to the main boom head.
3. Remove the protective caps and connect the short ends (2), (Figure 5-136) to the boom nose connectors (1), (Figure 5-136).

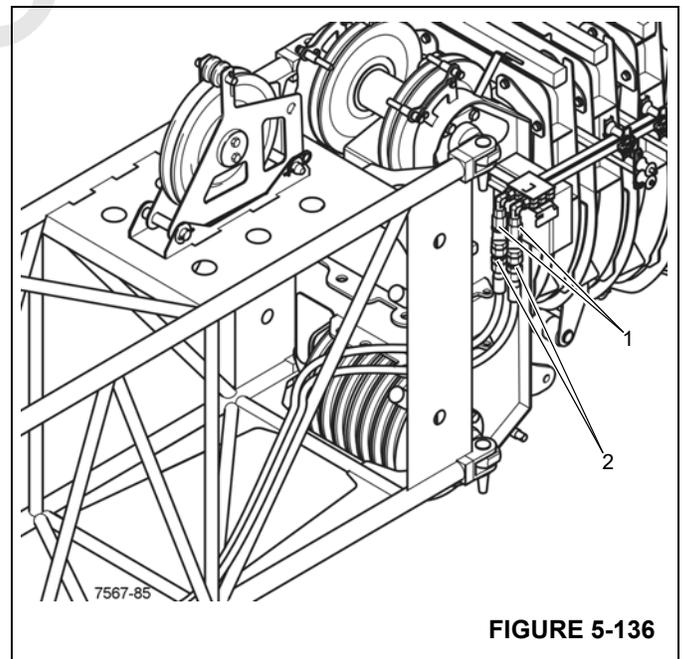


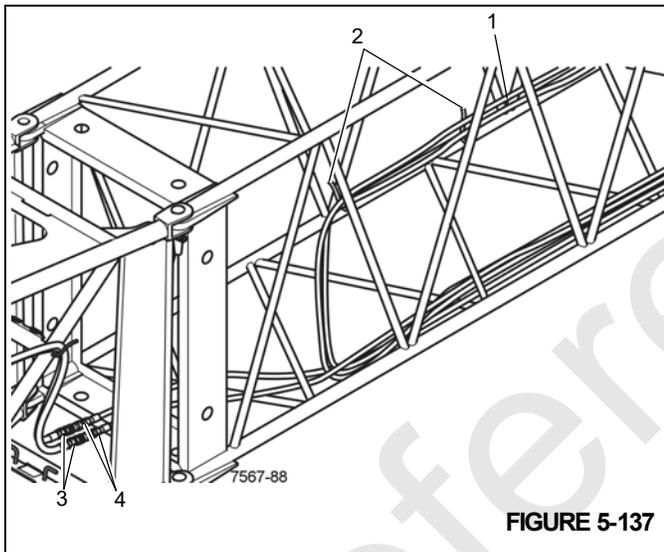
FIGURE 5-136

### Disconnecting Main Boom Hydraulics

1. Disconnect the short hose ends (2), (Figure 5-136) from the boom nose connectors (1), (Figure 5-136).
2. Cover the short end and boom nose connectors with the protective caps.
3. Route the short ends (2), (Figure 5-136) inside and place them in front of the lower cross-strut so that they do not hang down.

### Connecting the Folding Extension Hydraulics

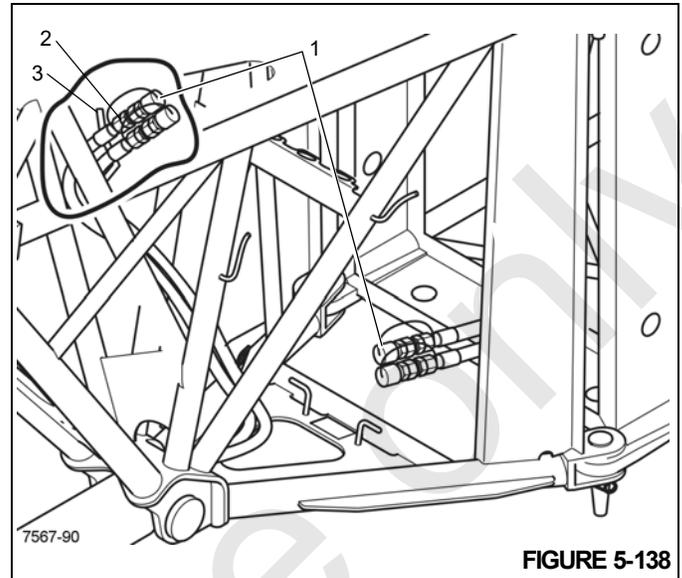
1. Remove the long hose (1), (Figure 5-137) from the holders (2), (Figure 5-137) on the insert.
2. Route the hoses to the front of the insert.
3. Remove the protective caps and connect the folding extensions hoses (3), (Figure 5-137) to the long hose ends (4), (Figure 5-137).



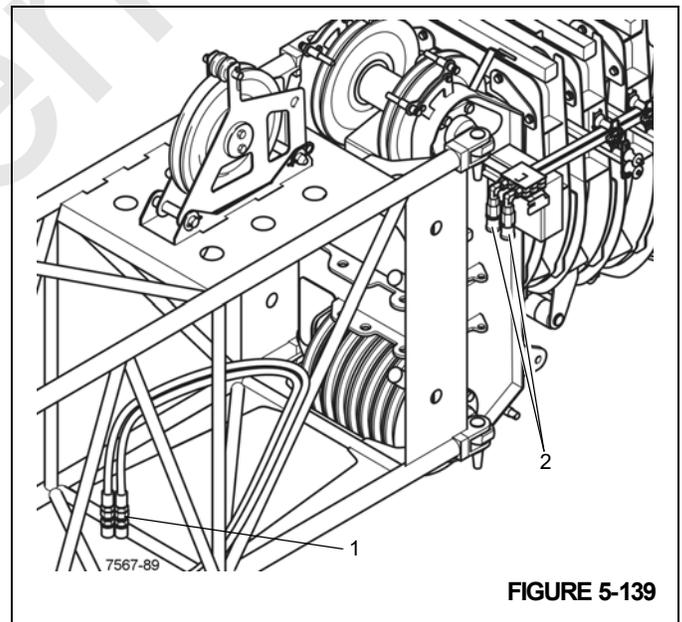
4. Secure the hoses (1), (Figure 5-137) to the holders (2), (Figure 5-137) to make sure that the hoses are not damaged during operation.

### Disconnecting the Folding Extension Hydraulics

1. Disconnect the hoses (3), (Figure 5-138) from the long hose ends (4), (Figure 5-137).
2. Install protective caps (1), (Figure 5-138) on the hose ends.



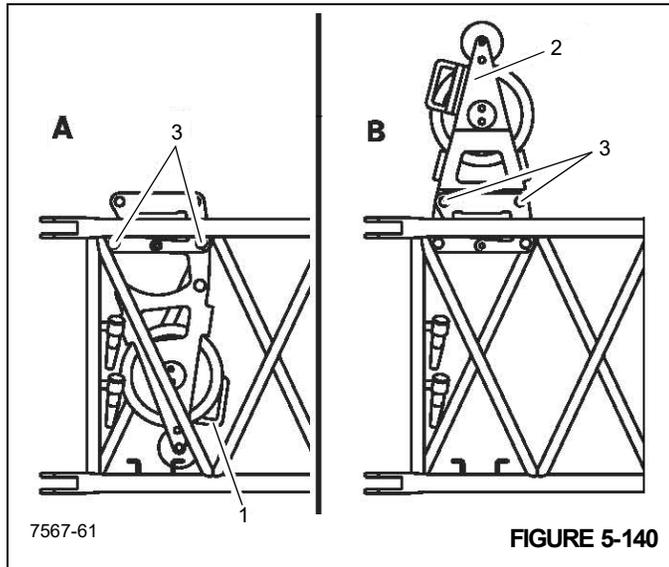
3. Secure the hoses (2), (Figure 5-138) to the holder (3), (Figure 5-138) in the 35 ft (10.5 m) section.
4. Stow the long hoses (1), (Figure 5-138) on the holders (2), (Figure 5-138) provided.



5. Disconnect the short end hoses (1), (Figure 5-139) from the boom nose connectors (2), (Figure 5-139).
6. Install protective caps on the hose ends.

### Folding the Deflection Sheave on the 26 ft (8 m) Extension

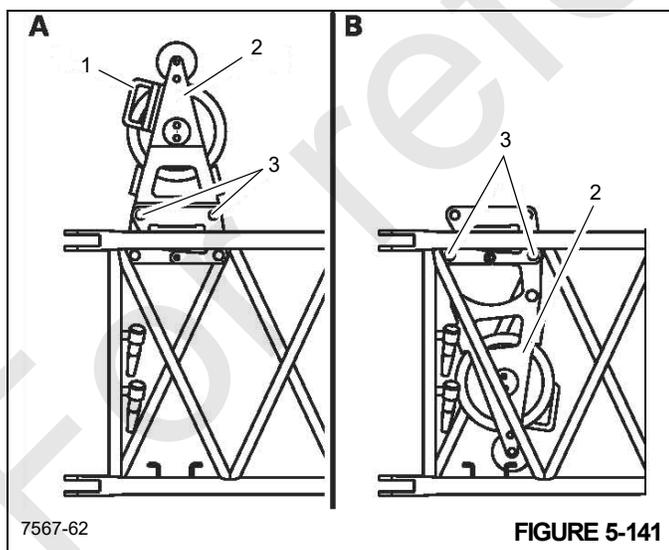
**NOTE:** For folding and unfolding the deflection sheaves on the 36 ft section.



### Folding OUT the Deflection Sheave

1. Remove the retaining clips from the pins (3), (Figure 5-140).
2. Hold the deflection sheave by the handle (1), (Figure 5-140) and pull out the pins (3), (Figure 5-140).
3. Fold the deflection sheave up by the handle (1), (Figure 5-140) and insert the pins (3), (Figure 5-140).
4. Secure the pins using the retaining clips.

### Folding IN the Deflection Sheave



1. Remove the retaining clips from the pins (3), (Figure 5-141).
2. Hold the deflection sheave by the handle (1), (Figure 5-141) and pull out the pins (3), (Figure 5-141).
3. Fold the deflection sheave (2), (Figure 5-141) downwards and fasten it in this position with the pins (3), (Figure 5-141).
4. Secure the pins (3), (Figure 5-141) using retaining clips.

### TELESCOPING WITH RIGGED LATTICE EXTENSION



#### CAUTION

#### Overload Hazard!

The main boom may become overloaded!

If you telescope the main boom with a rigged lattice extension or boom extension, you must not rotate the superstructure at the same time. This prevents the main boom being subjected to additional side forces and increased vibration and becoming overloaded.

**NOTE:** Do not actuate the swing gear when telescoping.

Telescoping is permitted only at main boom angles of approximately 75° - 80°, depending on the length of the lattice extension.

### OPERATING WITH THE LATTICE EXTENSION

**NOTE:** The information in this section also applies to operation with the boom extension. Ensure the cross-referenced warnings and instructions are followed.

**NOTE:** The hoisting, lowering, swinging, lifting and telescoping movements are done in the same way as when operating with the main boom.

### Procedure If the Permissible Wind Speed is Exceeded

Strong winds can over-strain the crane. Therefore, closely observe the instructions in Table 5-1.

Table 5-1

With Wind Speed UP to 48 km/h (30 mph)	With Wind Speed Over 48 km/h (30 mph)
<ul style="list-style-type: none"> <li>Set down the load.</li> <li>Swing the superstructure so that the main boom creates as little wind resistance as possible.</li> </ul>	<ul style="list-style-type: none"> <li>Set down the load.</li> <li>Fully retract the main boom.</li> <li>Set down the lattice extension.</li> </ul>

**Anti-Two Block Troubleshooting**

**NOTE:** The information in (Table 5-2) applies to malfunctions during operation with the 35 ft to 58 ft (10.5 m to 17.7m) lattice extension.

Table 5-2

Malfunction	Cause	Remedy
No function of the anti-two block switch	Anti-two block switch not connected	Connect the anti-two block switch.
	Electrical connection between the boom head and lattice extension and between 10.5 m (35 ft) section and 17.7 m (58 ft) section is not established.	Establish electrical connection.
	Anti-two block switch on the main boom head not locked.	Lock the anti-two block switch on the main boom head.
	When operating with a 17.7 m (58 ft) lattice extension or boom extension, the short-circuit plug is not inserted on the head of the 10.5 m (35 ft) section.	Insert short-circuit plug.
Anti-two block switch is locked.	Anti-two block switch is locked.	Unlock anti-two block switch.
The main boom cannot be telescoped with the rigged lattice extension or boom extension.	The main boom is lifted to such an angle at which telescoping is not permissible	Position the main boom within the required angle range.
The lattice extension angle can not be changed. <b>NOTE:</b> Only applies to the Hydraulic Luffing Boom Extension.	Lifting/lowering mechanism of the lattice extension is switched off.	Enable the lifting/lowering mechanism of the lattice extension.

**AUXILIARY SINGLE-SHEAVE BOOM NOSE**

**Identification**

The auxiliary single-sheave boom nose is designed for the crane it was delivered with.

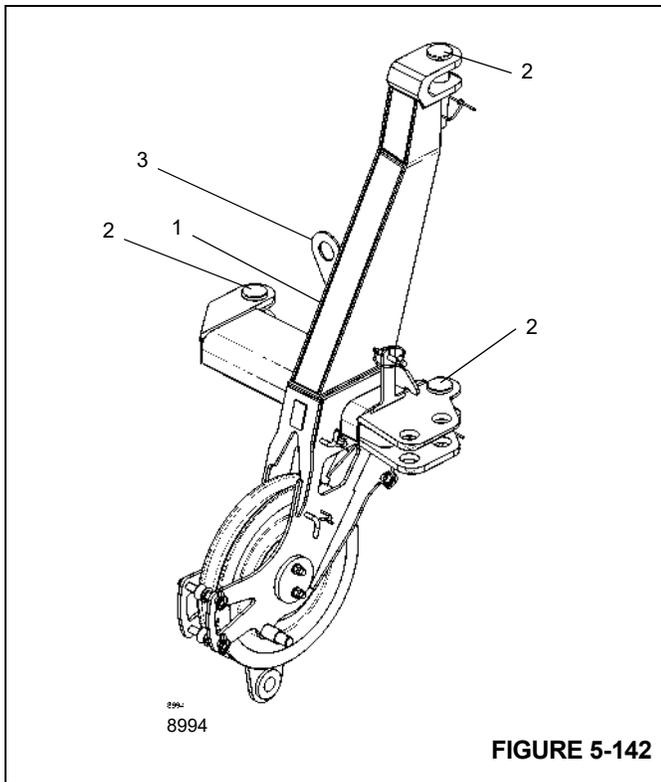
**CAUTION**

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 Grove Product Support.

**CAUTION**

The auxiliary single-sheave boom nose should only be adjusted by your Grove distributor or Grove Product Support.



The serial number (1), (Figure 5-142) is on a plate on the right side on the auxiliary single-sheave boom nose.

## Installing/Removing Auxiliary Single-Sheave Boom Nose



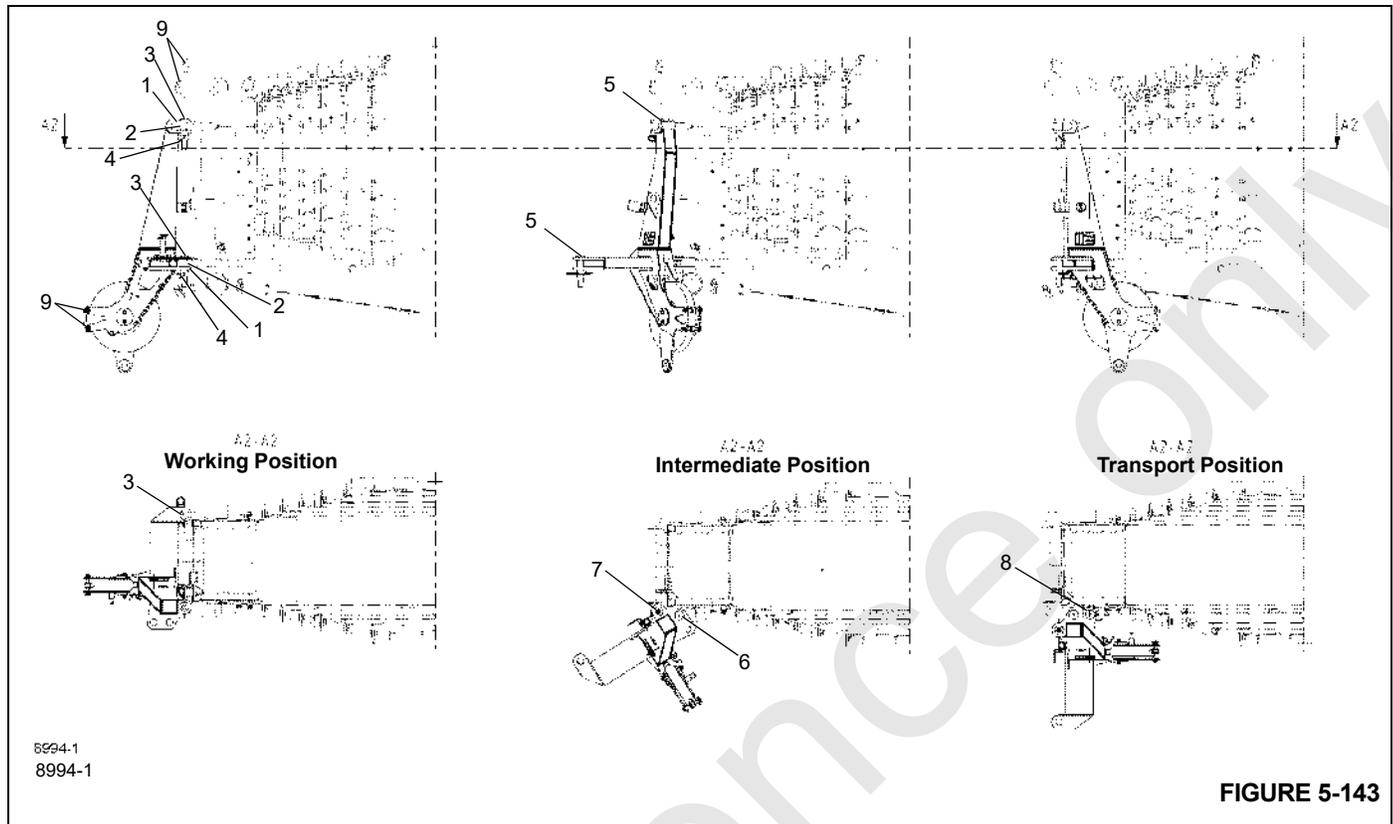
### DANGER

#### Crushing Hazard!

During installation and removal, always use the proper equipment with sufficient load bearing capacities.

### Installing Auxiliary Single-Sheave Boom Nose

1. Remove the retaining clips from the pins (2), (Figure 5-142) and remove the pins from the attachment lugs (Figure 5-142).
2. Use an auxiliary crane attached to the lifting eye (3), (Figure 5-142) on the auxiliary boom nose and lift it to the front of the main boom head.
3. Align the auxiliary single-sheave boom nose so that the attachment lugs (1), (Figure 5-143) line up to the boom nose attachment lugs (2), (Figure 5-143).
4. Secure the auxiliary single-sheave boom nose to the main boom nose using pins (3), (Figure 5-143).
5. Secure the pins (3), (Figure 5-143) with retaining clips (4), (Figure 5-143).
6. Depending on the application, bring the auxiliary single-sheave boom nose into transport position or working position.



### Removing the Auxiliary Single-Sheave Boom Nose

In the working position, the auxiliary single-sheave boom nose is positioned in front of the main boom head and is fastened with three pins (3), (Figure 5-143).

In the transport position, the auxiliary single-sheave boom nose is positioned to the side of the main boom head and is fastened with two pins.

1. Attach an auxiliary crane to the lifting eye of the boom nose.
2. Remove the retaining clips and remove all the pins out of the bores and lugs.
3. Lift the auxiliary single-sheave boom nose from the head of the main boom.

### RIGGING THE AUXILIARY SINGLE-SHEAVE BOOM NOSE

#### Rigging in Transport Position

1. Remove the retaining clips and take pins (5), (Figure 5-143) out of the lugs at the front of the main boom head (Figure 5-143).
2. Rotate the auxiliary boom nose to the side of the main boom head.

3. Insert pin (6), (Figure 5-143) into lugs and secure with retaining clip.
4. Remove the retaining clip from the pin (7), (Figure 5-143) and remove the pin.
5. Rotate the auxiliary boom nose further to the side of the main boom nose. Insert pin (8), (Figure 5-143) into the lugs and secure with the retaining clip.

#### Rigging in Working Position

1. Remove the retaining clip from the pin (8), (Figure 5-143) and remove the pin from the lugs.
2. Swing the auxiliary single-sheave boom nose to the front of the main boom head so the pin (7), (Figure 5-143) can be inserted and secured with a retaining clip.
3. Remove the retaining clip and take out the pin (6), (Figure 5-143).
4. Swing the auxiliary boom nose into position in front of the main boom head. Insert pins (3), (Figure 5-143) into the lugs and secure with the retaining clips.

The auxiliary single-sheave boom nose is now in working position.

### Attaching and Removing Hoist Cable

1. Remove the cable holding rods from the head of the main boom and from the auxiliary single-sheave boom nose (9), (Figure 5-143).
2. When reeving, guide the hoist cable over the left hand upper sheave of the main boom.
3. Insert the rope holding rods into the appropriate bore holes and secure them with the corresponding retaining clips.
4. Fasten the cable end clamp on the overhaul ball or the hook block.

Reverse the sequence of operations to remove the hoist cable before rotating the auxiliary boom nose into transport position.

### Possible Reeving Methods on the Auxiliary Single-Sheave Boom Nose

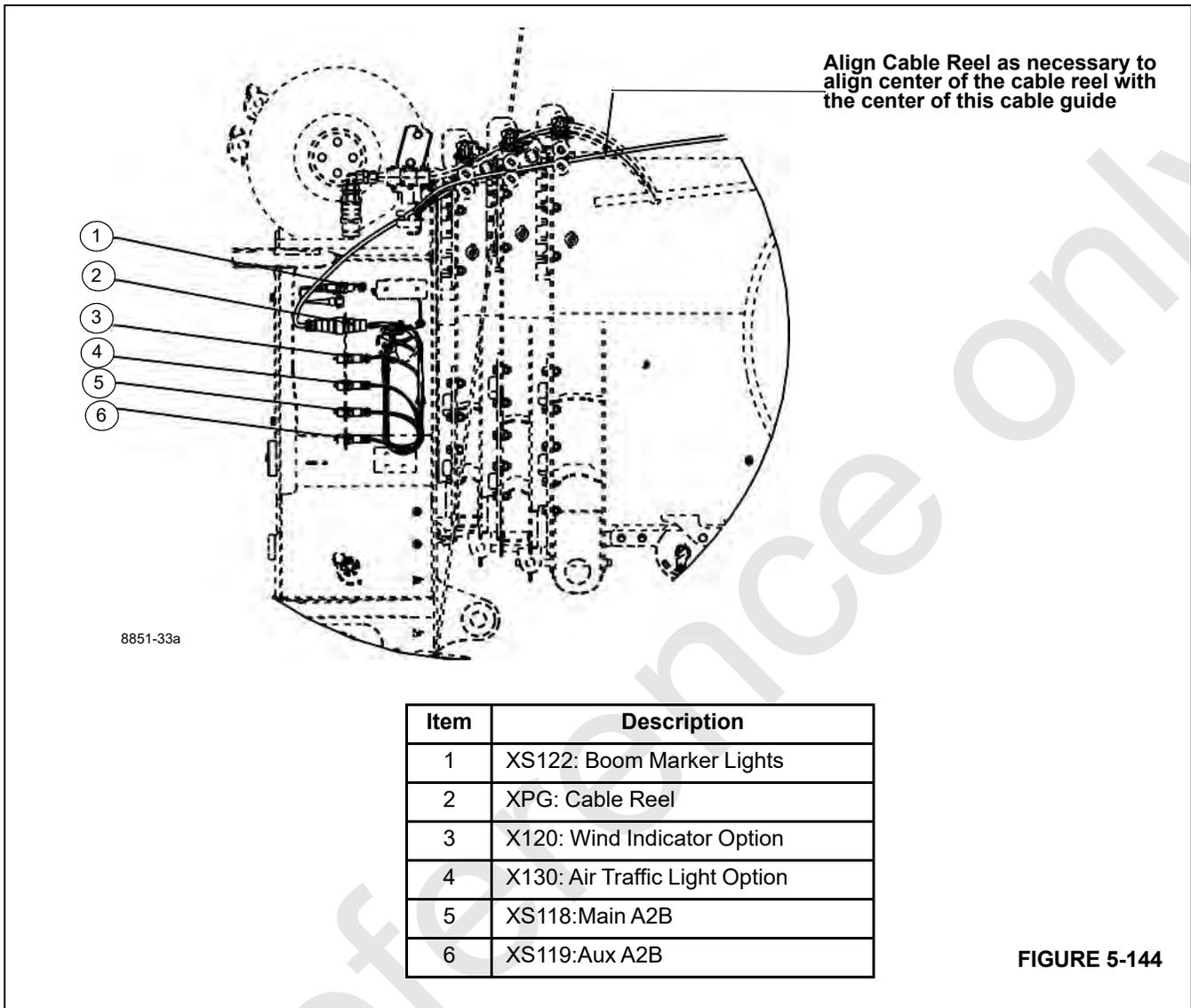
**NOTE:** The hoist cable may be reeved for single part of line and two parts of line.

Maximum load bearing capacity for single-reeving, 7.3 t (16,000 lb). Maximum load bearing capacity for two parts of line is 17.2 t (34,320 lbs).

### Anti-Two Block Switch

#### In Operation

1. Pull the plug of the connecting cable from the storage socket.
2. Unwind the connecting cable from the holders.
3. Insert the plug of the connecting cable into the socket on the main boom head (Figure 5-144).
4. Guide the hoist cable through the anti-tow block switch weight.



**During Transport**

1. Insert the plug of the connecting cable into the storage socket.
2. Wind the connecting cable onto the holders.
3. Plug the short-circuit plug into the socket.

To raise and lower the main boom with a rigged lattice extension, the main boom must be fully retracted.

For raising and lowering, the following prerequisites must be fulfilled:

- Apart from the hook block there is no load on the lattice extension.

**RAISING AND SETTING DOWN THE MAIN BOOM WITH RIGGED LATTICE EXTENSION**

**NOTE:** The information in this section also applies for raising and setting down the main boom with a rigged boom extension.

For reference only

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## SECTION 6 MAINTENANCE AND 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 Grove Product Support.

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.

### 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.

### 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](http://quickserve.cummins.com) and login with a current username and password or create a new account by selecting “Create an Account” under information, choose Limited Owners Plan and register. When 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.

### Arctic Conditions Below -18° C (0° F)

In general, petroleum based fluids developed especially for low temperature service may be used with satisfactory results. However, certain fluids, such as halogenated hydrocarbons, nitro hydrocarbons, and phosphate ester hydraulic fluids, might not be compatible with hydraulic system seals and wear bands. If you are in doubt about the suitability of a specific fluid, check with your authorized Grove Cranes distributor or Grove Product Support.

Regardless of temperature and oil viscosity, always use suitable start-up procedures to ensure adequate lubrication during system warm-up.

### 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. Grove Product Support has Boeshield® T-9 Premium Metal Protectant available in 12 oz. aerosol cans by ordering part number 9999101803 through the Parts Department.

Cylinder operation and inclement weather will remove the Boeshield® protectant; therefore, inspect machines once a week and reapply Boeshield® to unprotected rods.

### LUBRICATION POINTS

A regular frequency of lubrication must be established for all lubrication points. Normally, this is based on component operating time. The most efficient method of keeping track of lube requirements is to maintain a job log indicating crane usage. The log must use the engine hourmeter to ensure coverage of lube points that will receive attention based on their readings. Other lubrication requirements must be made on a time basis, i.e. weekly, monthly etc.

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, levers etc., should be lubricated with oil once a week. Motor oil, applied sparingly, will provide the necessary lubrication and help prevent the formation of rust. An Anti-Seize compound may be used if rust has not formed, otherwise the component must be cleaned first.

Grease fittings that are worn and will not hold the grease gun, or those that have a stuck check ball, must be replaced.

Where wear pads are used, cycle the components and relubricate to ensure complete lubrication of the entire wear area.

**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 6-1:) for a list of the recommended standard lubricants.

**TABLE 6-1: Standard Lubricants/Fluids [Down to -9°C (15°F)]**

Lubricant/Fluid	Grove Spec.	Recommended Lubricant		
		Type	Grade	Classification
<b>Extreme Pressure 3% Moly Grease</b>	6829015304	Citgo: Lithoplex CM2 Mobil: Mobilgrease CM-P Ipiranga: IPIFLEX LI-COMP Moly 2	NLGI Grade 2	
<b>Synthetic Gear Lube SAE 40</b>	80078954	Emgard MTF 7000 (BASF) Phillips 66 Triton Synthetic MTF Kendall SHP Synthetic MTF		
<b>Gear Lube (GL-5)</b>	6829014058	CITGO, Synthetic 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>Extended Service Interval Gear Lubricant</b>	6829012964	Century Unigear Semi-synthetic Texaco Multigear SS Chevron DELO	80W-90	
<b>Engine Oil</b>	6829104182	Conoco Fleet Supreme EC (non-current, replaced by Phillips 66 Product) Mobil Delvac 1300 Super Mobil Delvac MX ESP Mobil HDEO Phillips 66 Fleet Supreme EC 15W-40 Other Products listed on Cummins' "Oil Recommendation List" for CES-20086	15W-40	CJ-4
<b>Hydraulic/Transmission Oil</b>	6829006444	Kendall Hyken 052 Exxon Torque Fluid 56 Esso Torque Fluid 56 BP-Eldoran UTH & Trak-Tran 9 BP- Blend- 7367 Phillip 66 PowerTran XP	10W-20	Must Meet John Deere Std. JDM J20c
		Exxon Mobil 424	10W-30	



TABLE 6-1: Standard Lubricants/Fluids [Down to -9°C (15°F)]

Lubricant/Fluid	Grove Spec.	Recommended Lubricant		
		Type	Grade	Classification
Hoist Gear/Swing Drive Oil	6829014058	CITGO, Synthetic 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	GL-5
Grease, Multipurpose	6829003477	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	
Open Gear Lube	6829102971	Fuchs Ceplattyn 300 Spray	NLGI 1-2	
Anti-Seize Compound (ASC)	6829003689	Jet Lube Kopr Kote Loctite C5-A Compound		
Antifreeze Coolant	6829101130	Old World Industries, Inc. Fleet Charge SCA Caterpillar DEAC Fleetguard Complete EG	Mix 50/50	
Supplemental Coolant Additive (SCA)	6829012858	Fleetguard DCA4 Fleetguard DCA2 Penray Pencool 3000		
Diesel Fuel		Ultra Low Sulfur Diesel Fuel	#2-D	
Diesel Exhaust Fluid (DEF)	80019225	Fleetguard StableGuard™ Urea 32 Premix AdBlue® TerraCair Ultrapure® DEF		
Bechem High--Lub LM2 EP (400g)	03313195	Bechem High-Lub LM2 EP (400g)		
Multi-purpose Grease	01373458	Berulub PAL 1		
Hydraulic Oil - ATF 66M Avia Fluid	01930670	Avia 66M		

## Cold Weather Lubricants

Cold weather lubricants are used on all Grove cranes when the crane is ordered with a cold weather package. These

optional lubricants are effective in ambient temperatures down to -29°C (-20°F). Refer to (TABLE 6-2:) for a list of the recommended optional lubricants.

**TABLE 6-2: Optional Lubricants/Fluids [Down to -29°C (-20°F)]**

Lubricant/Fluid	Grove Spec.	Recommended Lubricant		
		Type	Grade	Classification
<b>Extreme Pressure 3% Moly Grease</b>	6829104275	Mobil: Mobilith SHC 220 (Red) Petro-Canada: Precision Synthetic EP1 ( ) Phillips 66: Triton 220 (replaced by Multiplex FS220) (Purple) Phillips 66: Multiplex FS 220 (Purple)	NLGI Grade 2	
<b>Synthetic Gear Lube SAE 40</b>	80078954	Emgard MTF 7000 (BASF) Phillips 66 Triton Synthetic MTF Kendall SHP Synthetic MTF		
<b>Gear Lube (GL-5)</b>	6829014058	CITGO, Synthetic 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>Extended Service Interval Gear Lubricant</b>	6829014058	CITGO, Synthetic Gear Lube 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	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	Exxon Mobil Univis HVI 26		
<b>Extreme Pressure Gear Lube</b>	6829103636	Mobil SHC629 Petro-Canada; Enduratex Synthetic EP 150		AGMA No. 4 EP
<b>Extreme Pressure Multipurpose Grease</b>	6829104275	Mobil: Mobilith SHC 220 Petro-Canada; Precision Synthetic EP1	NLGI 2	
<b>Open Gear Lube</b>	6829102971	Fuchs Ceplattyn 300 Spray	NLGI 1-2	
<b>Multipurpose Grease</b>	01373458			

TABLE 6-2: Optional Lubricants/Fluids [Down to -29°C (-20°F)]

Lubricant/Fluid	Grove Spec.	Recommended Lubricant		
		Type	Grade	Classification
Extreme Pressure Gear Lube	02313611	Aral Getriebeöl EP Synth. SAE 75W-90		
Hydraulic Oil - ATF 66M Avia Fluid	01930670	Avia Fluid ATF 66 M		
Bechem High-Lub LM2 EP (400g)	03313195			
Anti-Seize Compound (ASC)	6829003689	Jet Lube Kopr Kote Loctite C5-A Compound		
Antifreeze Coolant	6829101130	Old World Industries, Inc. Fleet Charge SCA Caterpillar DEAC Fleetguard Complete EG	Mix 50/50	
Supplemental Coolant Additive (SCA)	6829012858	Fleetguard DCA4 Fleetguard DCA2 Penray Pencool 3000		
Diesel Fuel	80069407	Ultra Low Sulfur Diesel Fuel	#1-D	
Diesel Exhaust Fluid (DEF)	80019225	Fleetguard StableGuard™ Urea 32 Premix AdBlue® TerraCair Ultrapure® DEF		

## 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 Grove Product Support 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 the *Operator Manual* to ensure adequate lubrication during system warm-up and proper operation of all crane functions.

### Cold Weather Package and Lubricants

Grove recommends cold weather lubricants for use with ambient temperatures down to -29°C (-20°F) (TABLE 6-2:). The following lube intervals are to be used as a guideline only. Actual lube intervals should be formulated by the operator to correspond according to conditions such as continuous duty cycles and/or hazardous environments.

#### Notes Listed in the Following Tables

1. All points requiring periodic lubrication shall be lubricated as required at assembly.
2. 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!
3. Change filter when changing gear oil.
4. Capacities indicated are for a fully formulated mixture of 50% AFC and 50% water.
5. Brush lubricant on top and bottom of outrigger beams contact area.
6. The hydraulic oil shall meet or exceed ISO 4406 class 17/14 cleanliness level (reference SAE J1165).
7. Brush lubrication on the I.D. of the jack cylinder support tubes and wear bands before installing jack cylinders.
8. Use grease fittings provided.
9. Fill radiator to bottom of filler neck per Engineering Specification 80029046. Run engine through 2 thermal cycles. Check level and refill as required. To insure that the

cooling system is completely filled at initial fill on cranes with SCR coolant lines:

1. Open cab heater line valves and SCR cooling line valves.
2. Open petcocks at the Diesel Exhaust Fluid (DEF) Tank (A), Decomposition Pipe enclosure (B) and Top Radiator Tube (C) to allow trapped air to bleed. Reference the SCR Lines Installation drawing for location of the DEF tank and the Decomp. Pipe enclosure.
3. Slowly fill the system at 3.0 GPM to the bottom of the surge tank fill neck. Note: A fill rate faster than 3.0 GPM can give a false reading.
4. Petcock "A" (DEF Tank): Verify a steady stream of fluid (no more than 1 qt) then close.
5. Petcock "B" (Decomposition Pipe enclosure): Verify a steady stream of fluid (no more than 1 qt) then close.
6. Petcock "C" (Top Radiator Tube): Verify a steady stream of fluid (no more than 1 qt) then close.
7. Start the engine and run at idle for 10 seconds. Accelerate to high idle for 1 minute and return to idle.
8. Top off the surge tank.
9. Operate the engine through two (2) thermal cycles and re-check the fluid level. Re-fill as necessary repeating Step #3.
10. Fill through dipstick opening.
11. Check fluid level using sight gauge on the side of the tank with boom retracted and in boom rest and all outrigger cylinders retracted.
12. Engine shall be running during lubrication to ensure equal distribution of grease.
13. Clean magnetic drain plug when changing lubricant.
14. Service by whichever interval occurs first.
15. Air conditioner - refer to applicable air conditioner manual.
16. See operator's manual when ambient temperatures are expected between +4°C (+40°F) and -62°C (-80°F).
17. Generously coat the wheel pilot or hub pads with lubricant. Do not lubricate the face of the wheel or the hub.
18. Apply lubricant during assembly and reapply lubricant whenever wheels are removed for service.
19. Clean coolant strainer after first 100 hours of use and at 2000 hrs/1 yr intervals thereafter.
20. Replace air cleaner element when indicator shows red (25" H<sub>2</sub>O).

21. Change filter at first 200 hours. thereafter, at normal intervals. Drain with oil temperature at 65°C - 95°C (150°F - 200°F).

22. Change filter when changing gear oil.

23. Drain water trap every ten hours or daily.

24. SERVICE HOURS:

- a. 500 (0-55 PPM Sulfur Fuel)
- b. 400 (500-5000 PPM Sulfur Fuel)
- c. 250 (<5000 PPM Sulfur Fuel. Not Recommended)

25. Only use on X12 engine machines.

26. Extend boom for access.

27. Lubricate more frequently than interval indicated in table if environmental conditions and/or operating conditions necessitate.

28. Access through hole in Base Section.

29. Access through hole in Tele 1 Section.

30. Access through hole in Tele 2 Section.

31. Access through hole in Tele 3 Section.

32. **CAUTION:** DEF is corrosive to certain metals and paint and should be washed off with mild soap and water if spilled.

33. Fill turntable gearbox until oil level is at bottom of fill/level plug. The fill plug is used to define the oil level.

34. Fill turntable gear brake until oil level is at top of sight gauge.

35. Fill grease container until grease level is at the "max" mark.

36. Brush lubricant on top and bottom wear pads of outrigger beams.

37. 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.

38. Access through hole in the boom nose with the boom fully retracted.

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.

For reference only

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**Drivetrain Lubrication**

ITEM NUMBER	LOCATION NAME	APPROXIMATE CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
<b>DRIVETRAIN</b>							
1	ENGINE CRANKCASE X12	-----	6829104182	2, 14	1	CHECK & FILL	10 HRS/DAILY
	WITH FILTER	47.3 L (12.5 GAL)	6829104182	2	1	DRAIN & FILL	750 HRS
2a	ENGINE COOLING SYSTEM	-----	6829101130	4, 9, 14	1	CHECK & FILL	10 HRS/DAILY
	ENGINE COOLING SYSTEM - X12	70.0 L (18.5 GAL)	6829101130		1	DRAIN & FILL	SEE SERVICE MANUAL
2b	ENGINE COOLING SYSTEM - X12	AS REQUIRED	6829012858		1	TEST AND ADD	750 HRS
2c	COOLANT STRAINER	-----	-----	14, 19	1	CHANGE FILTER	2000 HRS/ 1 YR
3a	TRANSMISSION - MANUAL	-----	80078954	2, 14	1	CHECK & FILL	500 HRS/6 MONTHS/ 9000 MI
		16.1 L (17.0 QT)	80078954	2, 14	1	DRAIN & FILL	2 YRS/50000 MI
3b	TRANSMISSION - AUTOMATED MANUAL	-----	80078954	2, 14	1	CHECK & FILL	500 HRS/6 MONTHS/ 9000 MI
		16.1 L (17.0 QT)	80078954	2, 14	1	DRAIN & FILL	2 YRS/50000 MI
3c	TRANSMISSION FILTER	-----	-----	2, 21	1	CHANGE FILTER	3000 HRS
4a	PUMP DRIVE SHAFT U-JOINTS	-----	6829003477	8	2	LUBE	250 HRS
4b	PUMP DRIVE SHAFT SPLINE	-----	6829003477	8	1	LUBE	500 HRS
5	CLUTCH RELEASE BEARING	-----	6829003477	8, 12	1	LUBE	250 HRS See "Clutch Release Bearing Grease Interval" on page 13.
6	CLUTCH LINKAGE (MANUAL TRANSMISSION ONLY)	-----	6829003477	8	3	LUBE	500 HRS

ITEM NUMBER	LOCATION NAME	APPROXIMATE CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
7	TRANSMISSION SHIFT U-JOINTS/ CONTROL UNIT	-----	6829003477	8	3	LUBE	500 HRS
26	AIR CLEANER FILTER	-----	-----	20	1	CHANGE FILTER	SEE NOTE 20
27	FUEL FILTER - PRIMARY	-----	-----	23	1	CHANGE FILTER	1000 HRS/6 MONTHS
8	DRIVELINE SLIP	-----	6829003477	8, 14	2	LUBE	500HRS/10000 MI

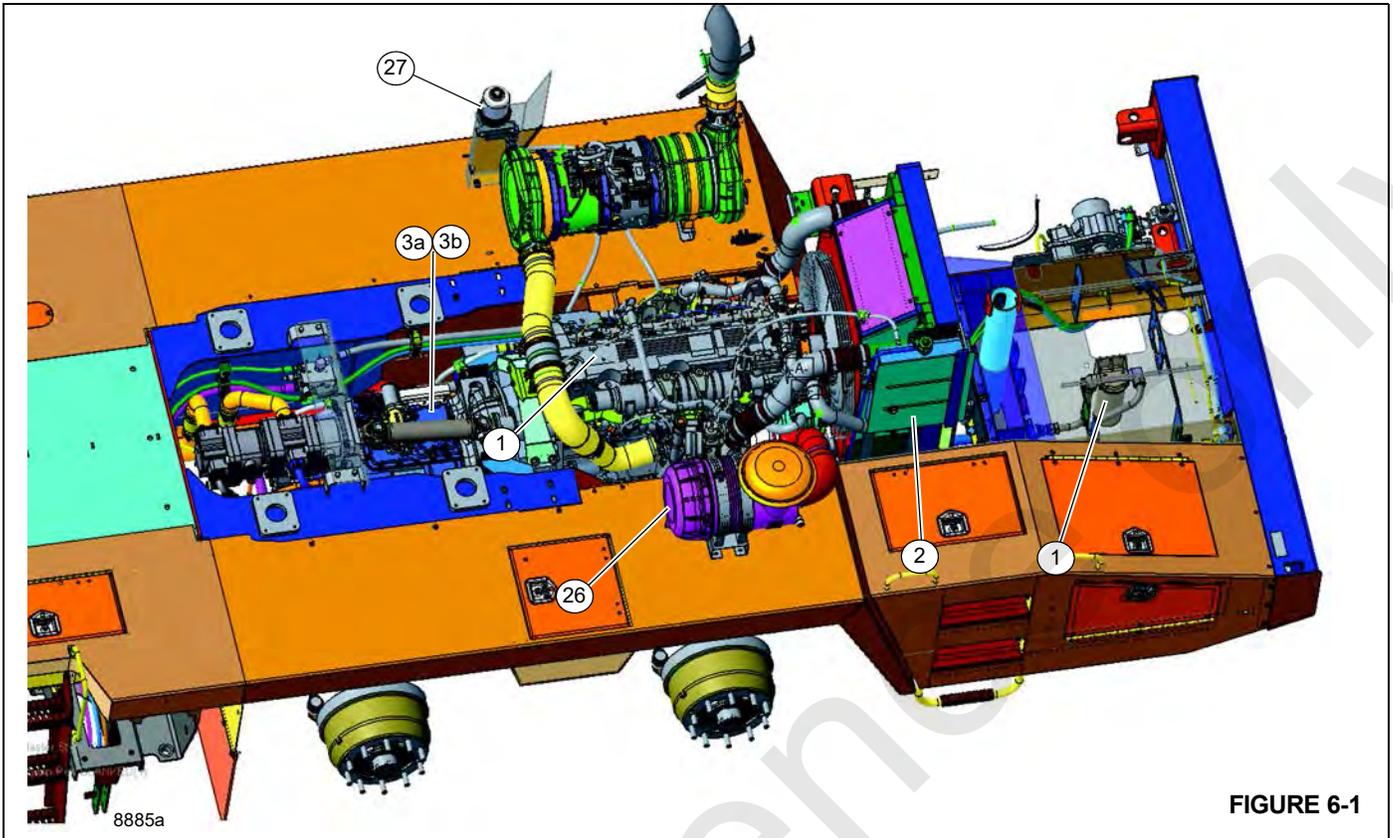
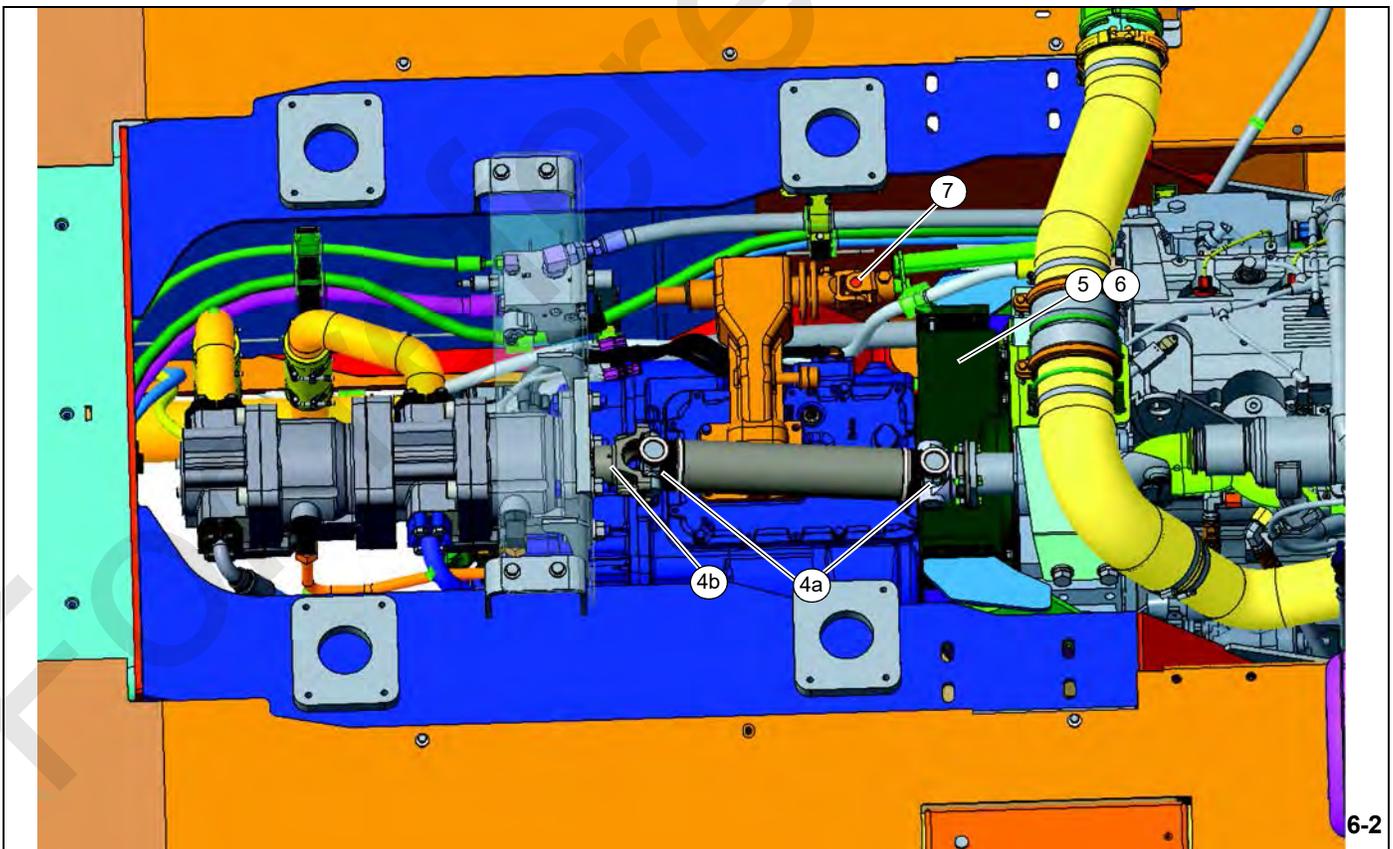


FIGURE 6-1



### Clutch Release Bearing Grease Interval

The transmission has an optional prognostic feature that notifies the operator when the clutch release bearing needs greasing. At the appropriate grease interval and after each engine start, "GI" will momentarily appear in the gear display, along with an audible tone. This will continue to occur at each engine start until clutch service has been completed.

**NOTE:** "GI" stands for GREASE INTERVAL and may be mis-read as "G1" on the gear display.

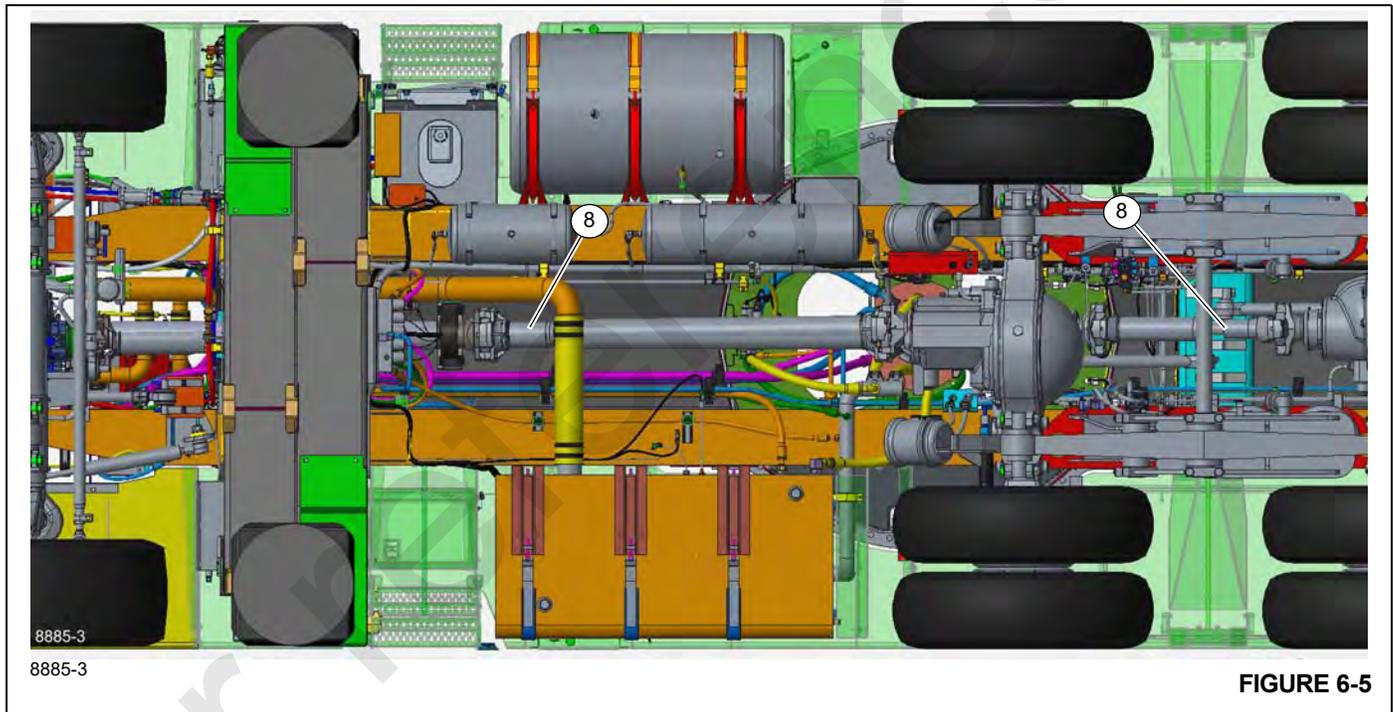
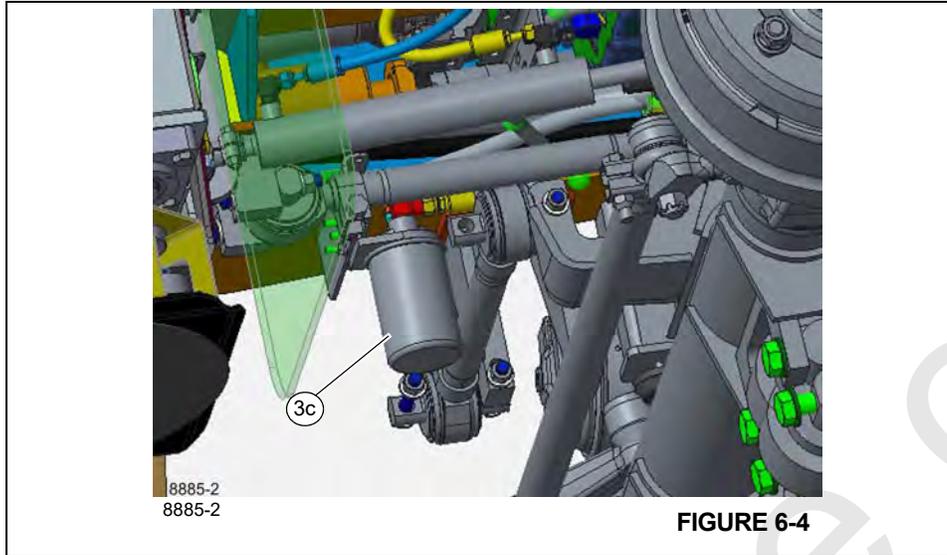
The operator can choose to follow this automated lube schedule or lubricate every 250 hours (See Item 5, page 6-9). It is important to reset the grease interval count every time the release bearing is greased.

### Clutch Release Grease Interval Reset

1. From the **OFF** position, turn ignition **ON** without cranking engine.
2. Move the transmission shift lever to **LOW**. Do not apply the brake pedal.
3. Press the manual up-shift button (1) until the gear display shows "3" (2), (Figure 6-3).
4. Press Accelerator to the floor. Gear display will show a "Down" arrow.
5. Release the Accelerator. Gear display will be "0".
6. Select **NEUTRAL**.
7. Turn ignition to **OFF** in order to save the reset.

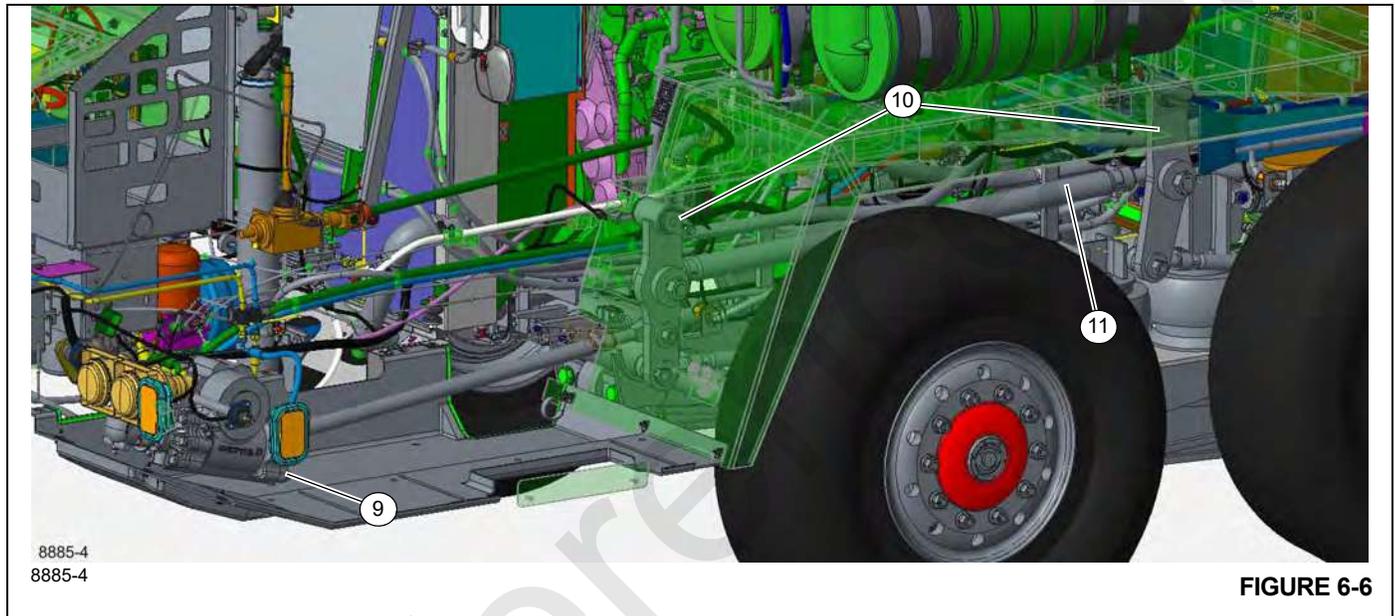


FIGURE 6-3



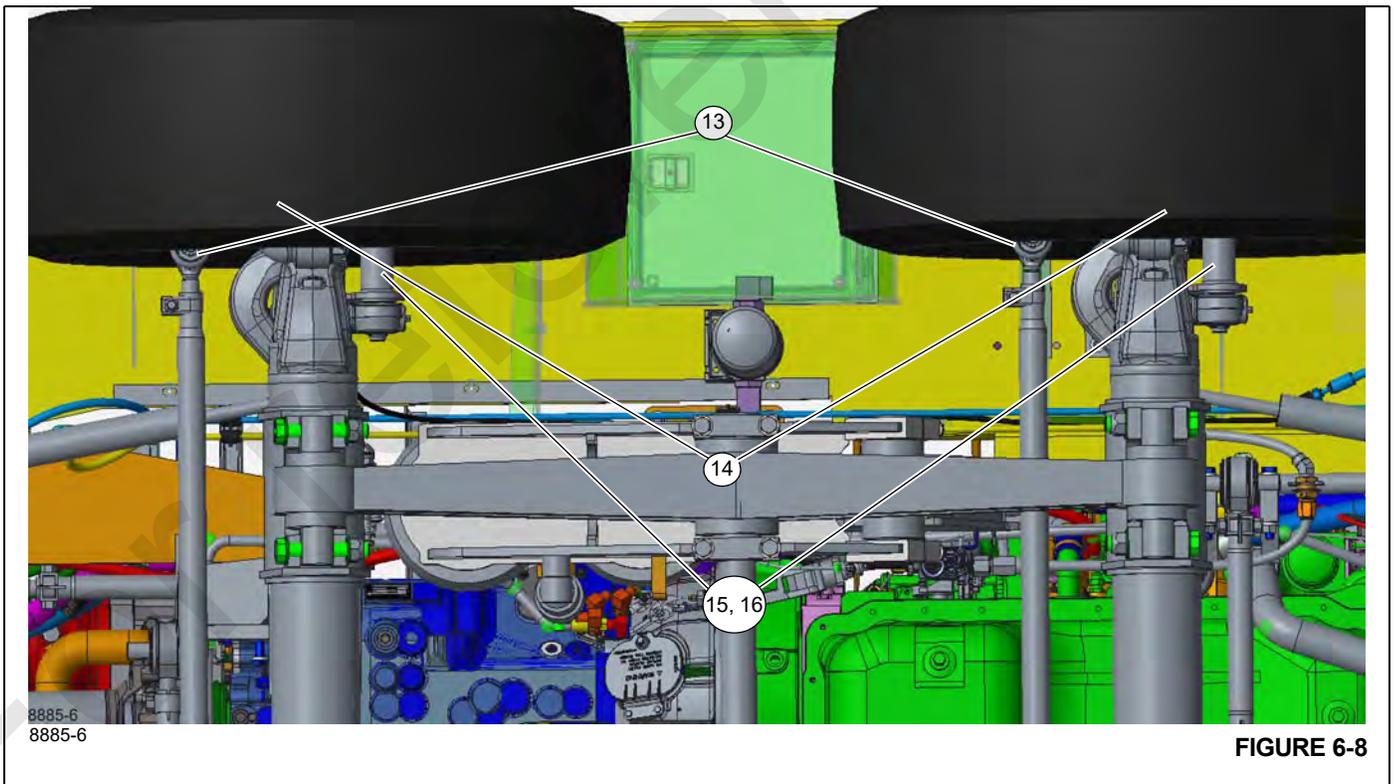
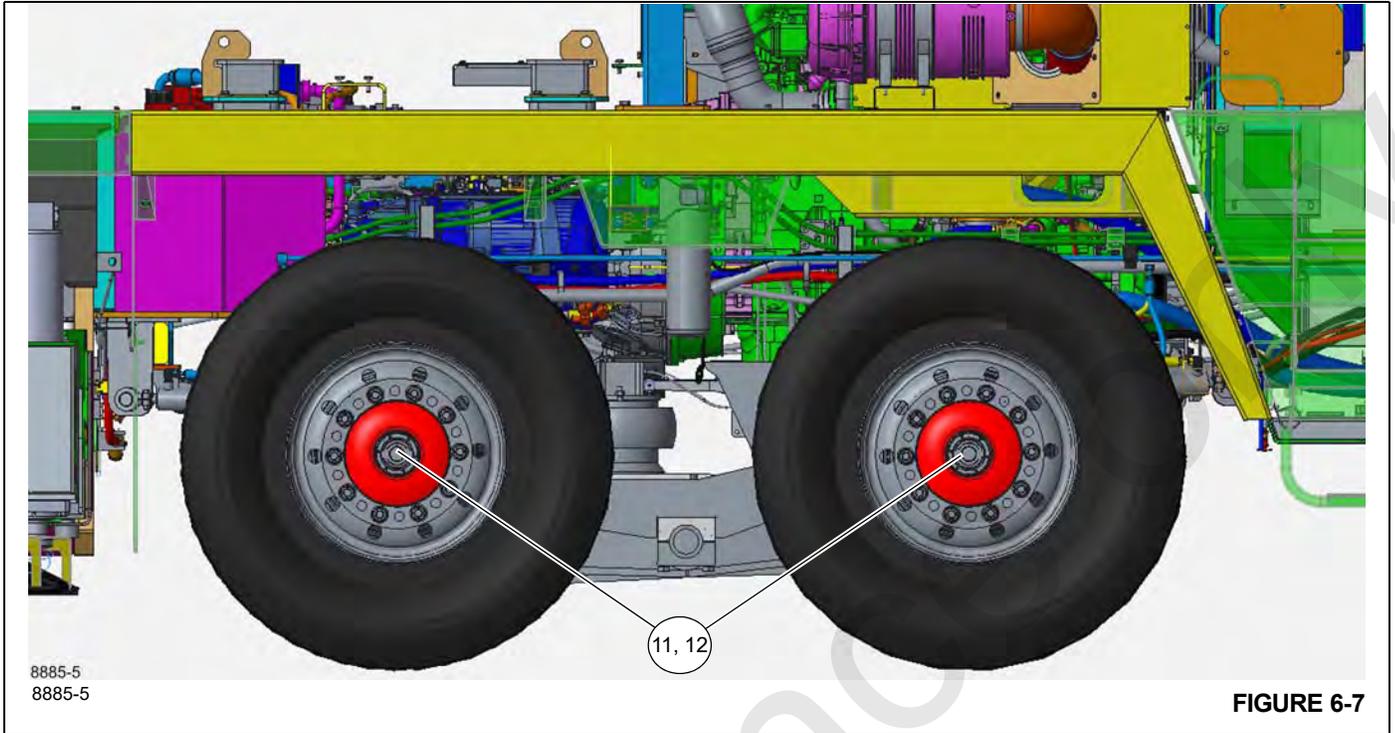
Steering Lubrication

ITEM NUMBER	LOCATION NAME	APPROX. CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
STEERING							
9	POWER STEERING GEARBOX	-----	6829003477	8	1	LUBE	1000 HRS
10	STEERING RELAY ARMS	-----	6829003477	8	2	LUBE	250 HRS
11	DRAG LINK	-----	6829003477	8	2	LUBE	1000 HRS

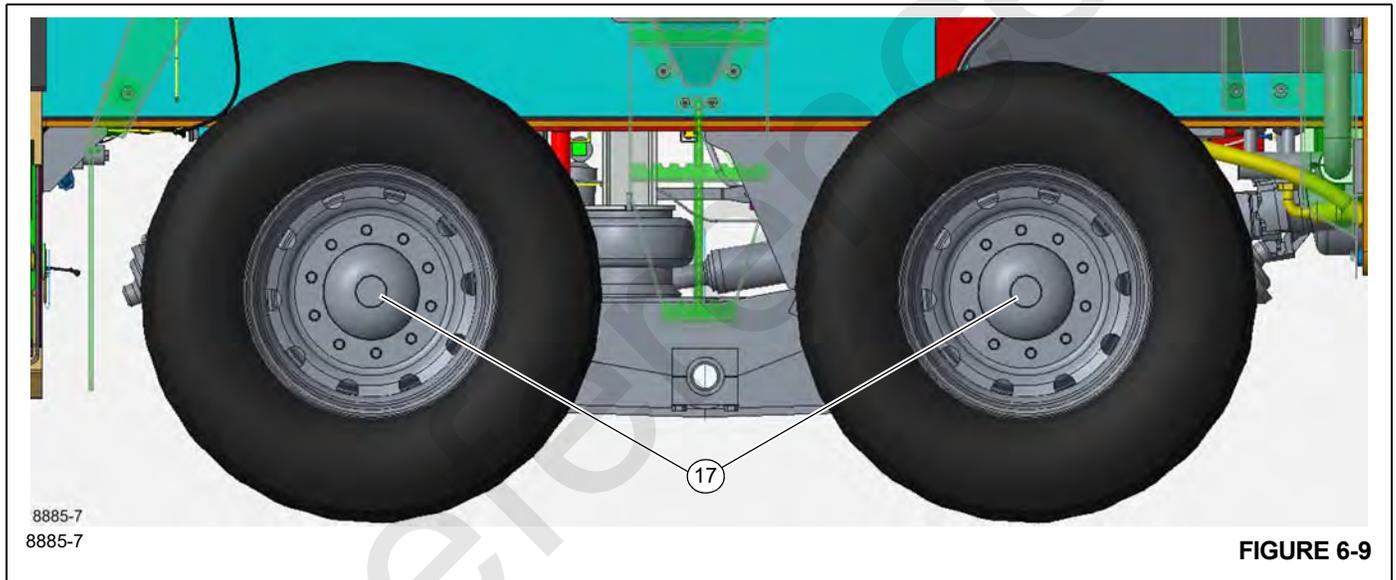


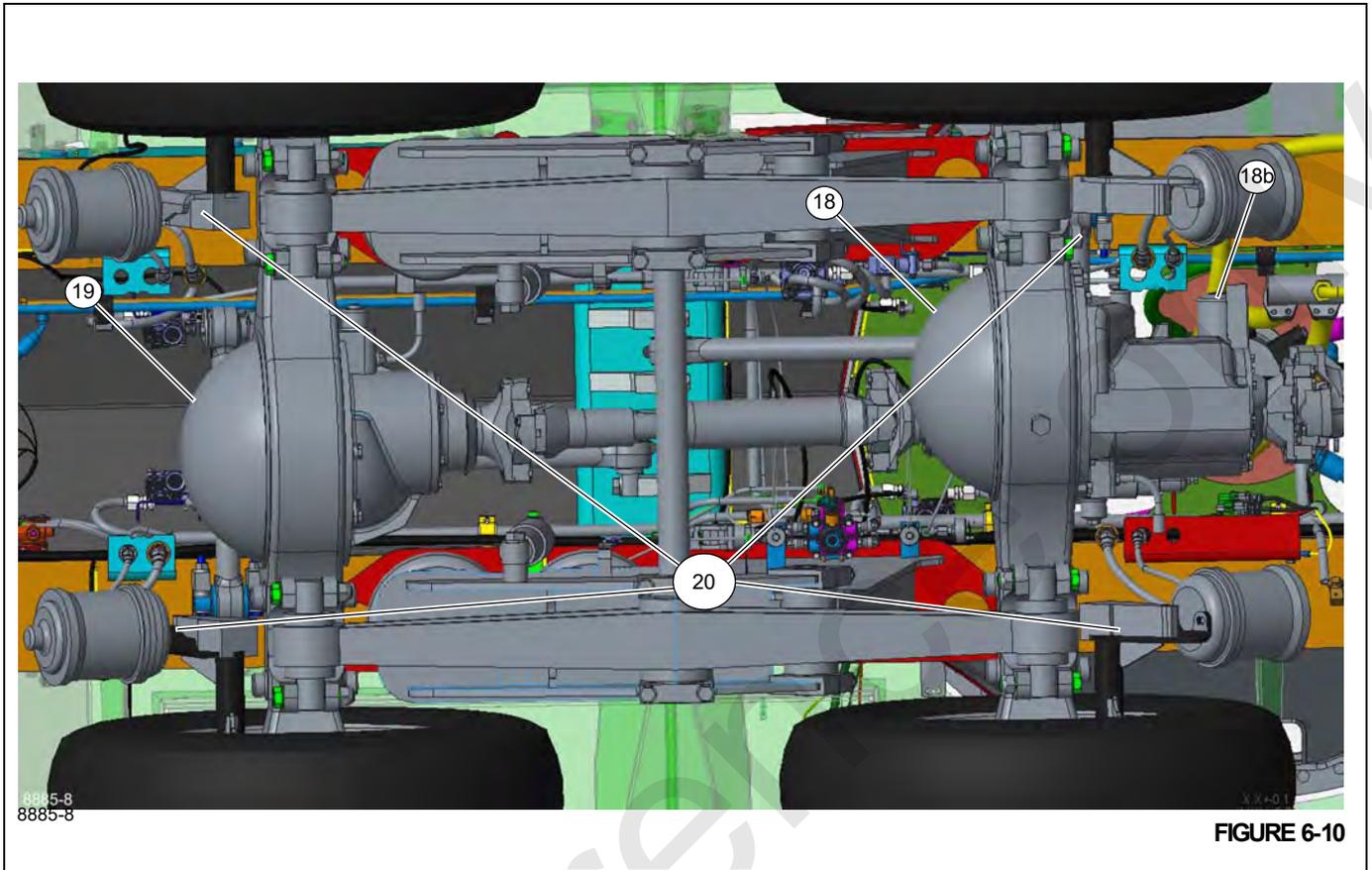
**Axle Lubrication**

ITEM NUMBER	LOCATION NAME	APPROX. CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
FRONT AXLES							
11	FRONT WHEEL PILOTS	-----	6829003689	17	4	BRUSH ON	SEE NOTE 18
12	FRONT AXLE HUBS	.47 L (1 PT) EACH	6829012964	2	4	CHECK & FILL	250 HRS
13	FRONT AXLE TIE ROD ENDS	-----	6829003477	8	4	LUBE	1000 HRS
14	FRONT AXLE KING PINS	-----	6829003477	8	8	LUBE	1000 HRS
15	FRONT AXLE BRAKE SLACK ADJUSTERS	-----	6829003477	8	4	LUBE	1000 HRS
16	FRONT AXLE BRAKE CAMSHAFTS	-----	6829003477	8	4	LUBE	1000 HRS



ITEM NUMBER	LOCATION NAME	APPROX. CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
<b>REAR AXLES</b>							
17	REAR WHEEL PILOTS	-----	6829003689	17	8	BRUSH ON	SEE NOTE 18
18	FRONT REAR AXLE BOWL	-----	6829012964	2	1	CHECK & FILL	250 HRS
		20.5 QTS	6829012964	2, 3, 13, 14	1	DRAIN & FILL	2 YRS/50000 MI
18b	DIFFERENTIAL FILTER	-----	-----	22	1	CHANGE FILTER	2 YRS/50000 MI
19	REAR REAR AXLE BOWL	-----	6829012964	2	1	CHECK & FILL	250 HRS
		19.5 QTS	6829012964	2, 13, 14	1	DRAIN & FILL	2YRS/50000 MI
20	REAR AXLE BRAKE SLACK ADJUSTERS	-----	6829003477	8	4	LUBE	1000 HRS





Outrigger Lubrication

ITEM NUMBER	LOCATION NAME	APPROX. CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
OUTRIGGERS							
22	O/R BEAMS	-----	6829015304	5, 14	8	BRUSH ON	50/1 WEEK
23	CENTER FRONT STABILIZER CYLINDER SUPPORT TUBE	-----	6829015304	7	5	BRUSH ON	SEE NOTE 7
24	WEAR PADS	-----	6829003689	36, 14	24	BRUSH ON	50/1 WEEK

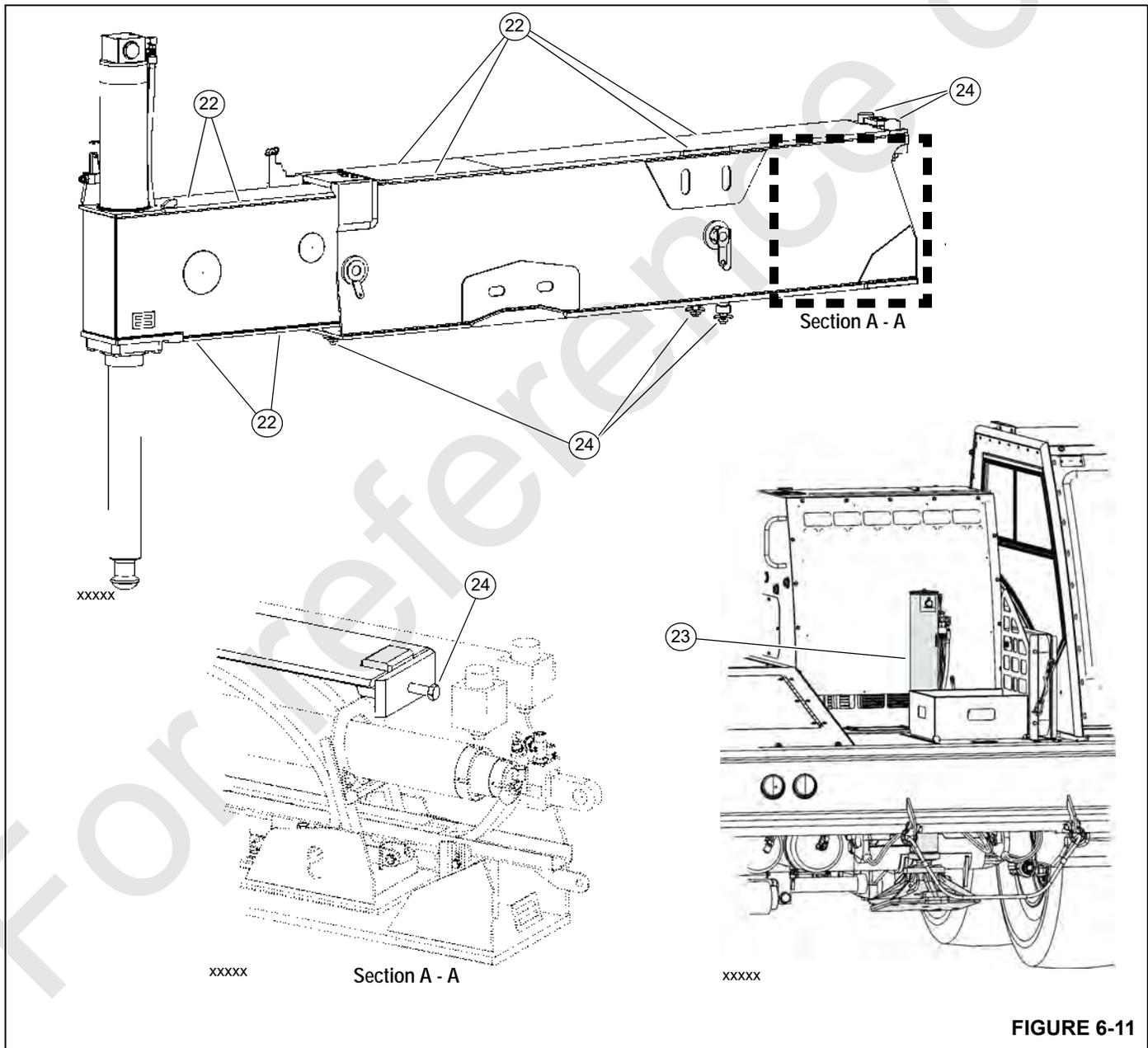


FIGURE 6-11

Miscellaneous Lubrication

ITEM NUMBER	LOCATION NAME	APPROX. CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
MISCELLANEOUS							
25	HYDRAULIC RESERVOIR	507 L (134 GAL) (TANK ONLY)	6829006444	6, 11, 14	1	CHECK & FILL	10 HRS/DAILY
95	HYDRAULIC FILTER & BREATHER	-----	-----	39	1	CHANGE FILTER & BREATHER	SEE NOTE 39
28	DEF SUPPLY MODULE FILTER	-----	-----	-----	1	CHANGE FILTER	4500 HRS/ 200000 MI
29	DIESEL EXHAUST FLUID TANK	37.9 L (10 GAL) (TANK ONLY)	80019225	32	1	CHECK & FILL	-----
30	DEF TANK FILTER	-----	-----	-----	1	CHECK FILTER	1 YEAR

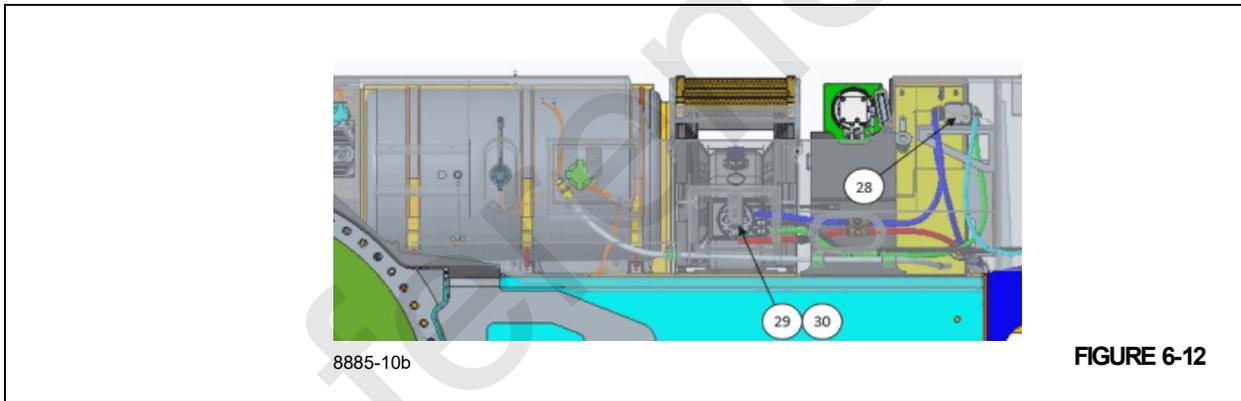
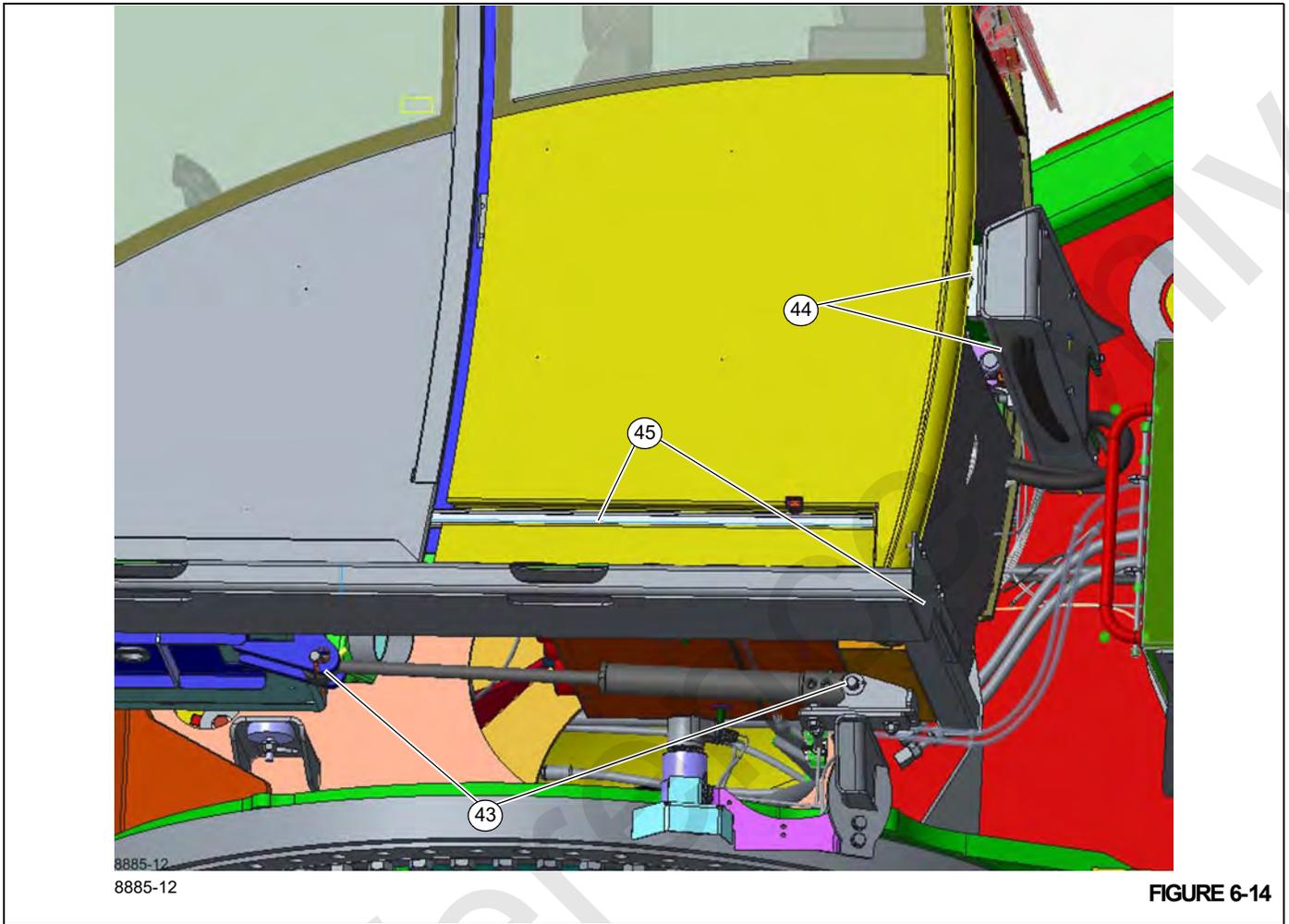


FIGURE 6-12

**Turntable & Cab Tilt Lubrication**

ITEM NUMBER	LOCATION NAME	APPROX. CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
<b>TURNTABLE &amp; CAB TILT</b>							
40	TURNTABLE GEAR BOX	0.9 L (.95 QT)	6829014058	35	2	CHECK & FILL	50 HRS/1 WEEK
		0.9 L (.95 QT)	6829014058	14, 35	2	DRAIN & FILL	1000 HRS/12 MONTHS
41	TURNTABLE GEAR & DRIVE PINION	-----	6829102971	1, 14	2	SPRAY ON	500 HRS/6 MONTHS
42	TURNTABLE 360° SWIVEL LOCK	-----	6829003477	1, 14	1	LUBE	500 HRS/6 MONTHS
43	TILT CYLINDER PIVOT PINS	-----	6829003477	1, 14	2	LUBE	500 HRS/3 MONTHS
44	PILLOW BEARING	-----	6829003477	1, 14	2	LUBE	500 HRS/3 MONTHS
45	CAB TRACK & ROLLERS	-----	LIGHT OIL				

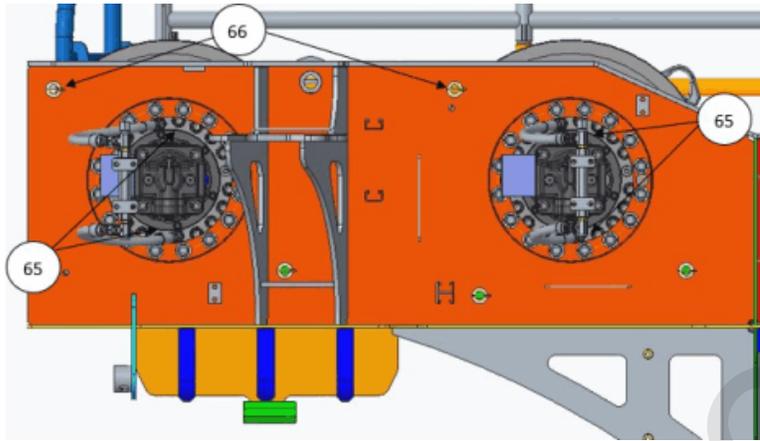




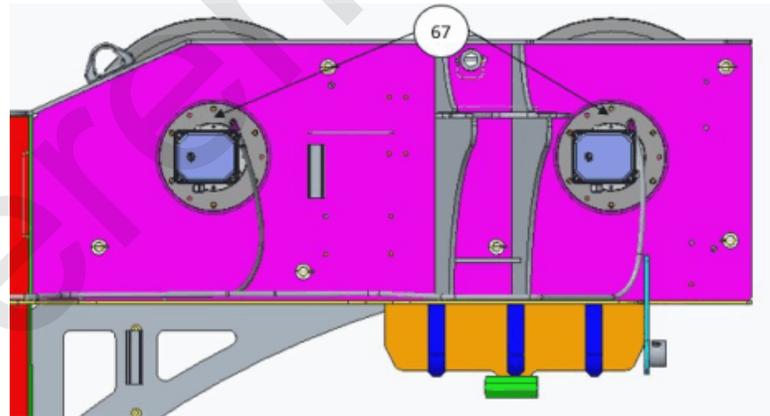
Hoist Lubrication MTW 19-78-243

ITEM NUMBER	LOCATION NAME	APPROX. CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
Hoist Lubrication MTW 19-78-243							
65	HOIST DRUMS (MAIN & AUXILIARY)	4.9 L (1.3 gal)	6829100213	1, 2, 4	2	CHECK AND FILL; CHECK AND CLEAN	Every 1000 hours, or 12 months of service, whichever interval comes first.
66	HOIST ROPE ROLLERS	-----	6829003477	1, 3	2	BRUSH ON	Every 250 hours, or 3 months of service, whichever interval comes first.
67	HOIST BEARINGS	-----	6829003477	1, 4	2	LUBRICATE	Every 250 hours, or 3 months of service, whichever interval comes first.

Hoist Lubrication – MTW 19-78-243



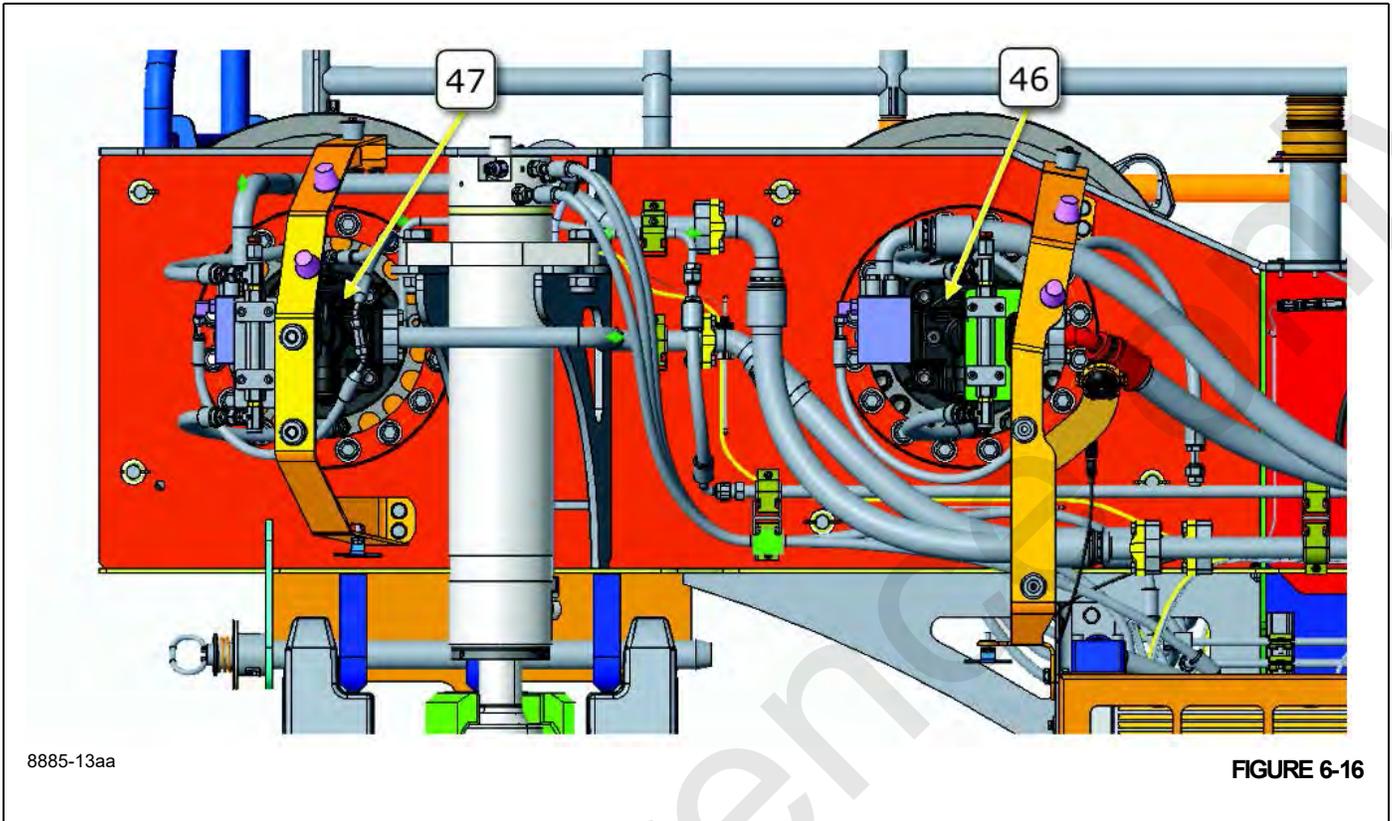
HOIST DRUM – RIGHT SIDE



HOIST DRUM – LEFT SIDE

HOIST DRUMS – (MAIN and AUXILIARY)

FIGURE 6-15



**Turntable Central Lubrication**

ITEM NUMBER	LOCATION NAME	APPROX. CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
<b>HOIST</b>							
49	TURNTABLE (SLEW) BEARING - INNER RACE	-----	6829003477	37	4	LUBE (AUTO)	50 HRS/1 WEEK
	LIFT CYLINDER PINS	-----	6829003477	37	1	LUBE (AUTO)	50 HRS/1 WEEK
	BOOM PIVOT PIN	-----	6829003477	37	4	LUBE (AUTO)	50 HRS/1 WEEK
	AUX HOIST - GEARS	-----	6829003477	37	1	LUBE (AUTO)	50 HRS/1 WEEK
50	HOIST LOWER LIMIT SWITCH	-----	01373458		2	LUBE	250 HRS/ 3 MONTHS

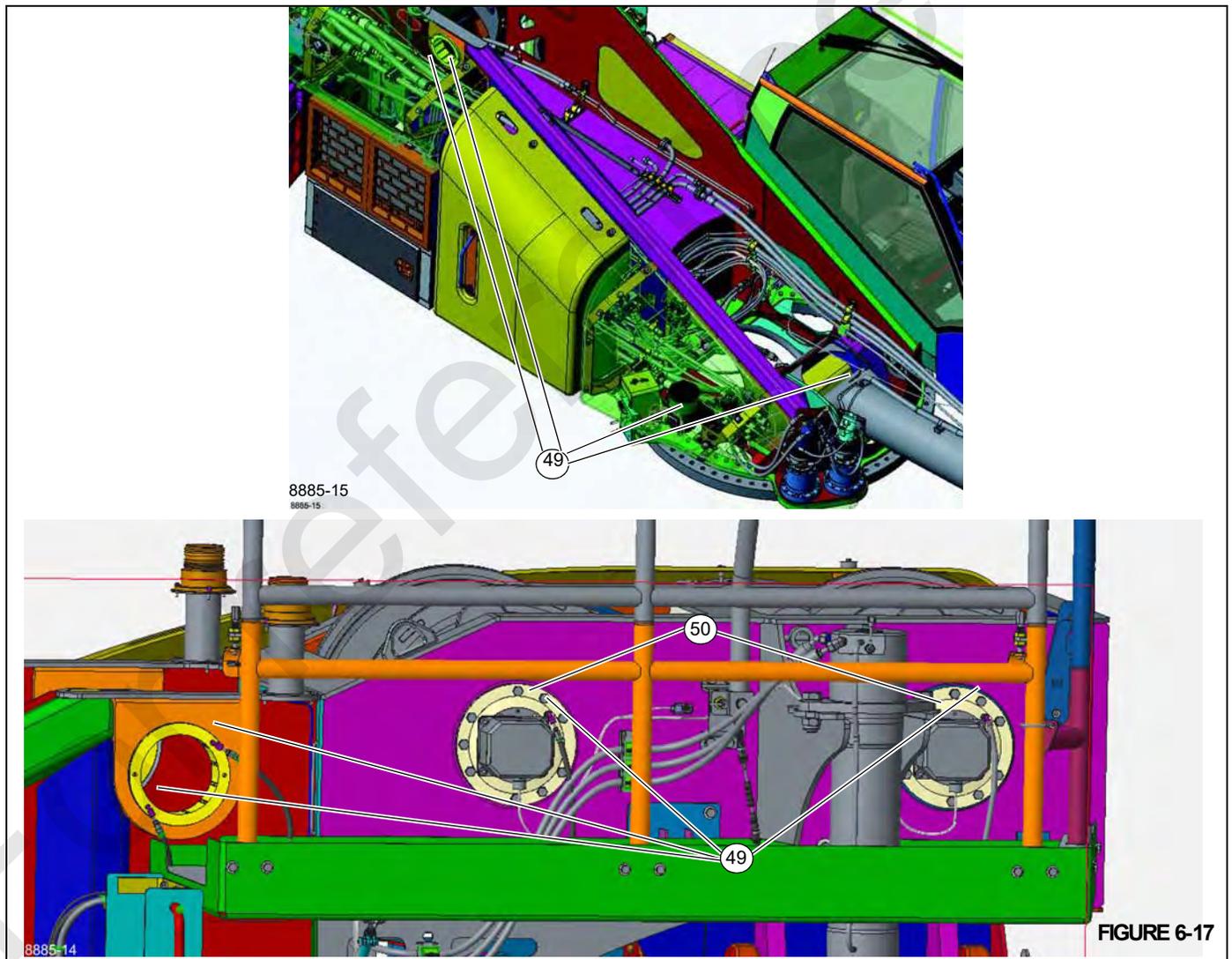


FIGURE 6-17

**Boom Lubrication**

**Crane Setup**

- Machine to be set up on firm level surface with fully extended outriggers and a minimum of 6,000 lbs counterweight installed. Make sure that the crane is level.
- Boom must be directly over the rear.

- Set boom angle at zero degrees (horizontal).
- Disable the swing function to engage the swing brakes, and engage the 360-swing lock, if applicable.
- To grease each of the rear upper wear pads (Items 71-75), extend the boom to the Tele sequence shown in the Table below to expose the grease fittings.

LUBRICATION OF TELE SECTION	TO GREASE TELE 3	TO GREASE TELE 2	TO GREASE TELE 1
TELE 1	0	50	100
TELE 2	50	100	0
TELE 3	100	0	0

**Greaseless Boom**

The operator should ensure that each of the telescoping boom sections are clean during operation. Any dirt that is on the painted boom sections can get stuck in the wear pads, and this will lead to scoring of the paint. Eventually, the telescoping of a section with damaged paint will become more difficult to complete as the paint damage becomes more severe. Each of the telescoping boom sections should

be cleaned and wiped down with a non-solvent cleaning agent at least once a month or as required.

The operator has the option to grease the boom if they so choose. All of the grease fittings still exist in the boom. However, from that point forward, the boom will always need to be greased on a typical interval.

ITEM NUMBER	LOCATION NAME	APPROX. CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
<b>BOOM</b>							
70	TELESCOPIC SLIDE FACES	-----	01373458	1, 14, 27, 28	5	BRUSH ON	500 HRS/6 MONTHS
71	TELE 1 REAR UPPER WEAR PAD	-----	01373458	1, 14, 27, 28, 29, 34	2	LUBE	500 HRS/6 MONTHS
72	TELE 2 REAR UPPER WEAR PAD		01373458	1, 14, 27, 28, 30, 34	2	LUBE	500 HRS/6 MONTHS
73	TELE 3 REAR UPPER WEAR PAD		01373458	1, 14, 27, 28, 31, 34	2	LUBE	500 HRS/6 MONTHS
74	TELE 3 LOCK PIN		03313195	1, 14, 26, 31	2	LUBE	250 HRS/3 MONTHS
75	TELE 2 LOCK PIN		03313195	1, 14, 26, 31	2	LUBE	250 HRS/3 MONTHS
76	TELE 1 LOCK PIN	-----	03313195	1, 14, 26, 31	2	LUBE	250 HRS/3 MONTHS
77	TELE-CYLINDER SLED	-----	01373458	14, 26, 27, 31, 36	1	BRUSH ON	500 HRS/6 MONTHS
78	DERRICKING CYL PIVOT PIN	-----	6829003477	1, 8, 14	2	LUBE	100 HRS/MONTHLY
79	ADAPTER SECTION PIVOT PIN	-----	6829003477	1, 8, 14	2	LUBE	100 HRS/MONTHLY

ITEM NUMBER	LOCATION NAME	APPROX. CAPACITY	LUBE SPEC	NOTES	SERVICE POINTS	SERVICE	SERVICE HOURS
<b>BOOM</b>							
80	BOOM EXTENSION SHEAVE	-----	6829003477	1	2	LUBE	DURING REPAIR
81	MAST SHEAVE	-----	6829003477	1	2	LUBE	DURING REPAIR
82	BOOM NOSE SHEAVES	-----	6829003477	1	7	LUBE	DURING REPAIR
83	AUX BOOM NOSE SHEAVE	-----	6829003477	1	1	LUBE	DURING REPAIR
84	JIB SCREW	-----	6829003477	1	1	LUBE	DURING REPAIR
85	ROPE SWIVEL	-----	6829003477	8, 14	1	LUBE	250 HRS/3 MONTHS
86	HOOK BLOCK - 75 MTON (5 SHEAVE) SWIVEL BEARING	-----	6829003477	8, 14	3	LUBE	250 HRS/3 MONTHS
87	HOOK BLOCK - 45 MTON (3 SHEAVE) SWIVEL BEARING	-----	6829003477	8, 14	3	LUBE	250 HRS/3 MONTHS
88	HOOK BLOCK - 26 MTON (1 SHEAVE) SWIVEL BEARING	-----	6829003477	8, 14	3	LUBE	250 HRS/3 MONTHS
89	OVERHAUL BALL/WEIGHT - SWIVEL	-----	6829003477	8, 14	1	LUBE	250 HRS/3 MONTHS

**Telescope Section 3 (Tele 3)**

1. Make sure that the Tele cylinder is locked to Tele 3.
  2. Extend and lock Tele 3 to the 100% pinning location.
  3. Extend and lock Tele 2 to the 50% pinning location.
  4. Lower the boom to 0° and perform the following greasing in this position:
    - a. Grease outer sides of Tele 3 in the areas that touch the front wear pads of Tele 2.
    - b. Grease the rear upper wear pads of Tele 3 on both sides, at the grease fittings through the openings in Tele 2.
    - c. Grease locking pins on both sides.
- NOTE:** To grease the rear upper wear pads of Tele 3 at the 50% or 92% pinning locations, extend and lock Tele 3 to these pinning locations and repeat **Step 4b** greasing.
5. While in the horizontal position, first retract Tele 2, and then retract and extend Tele 3 several times to make sure that grease is properly distributed.

6. When Tele 3 greasing is complete, retract and lock Tele 3 to the 0% pinning locations.

7. Raise boom to 70°.

**Telescope Section 2 (Tele 2)**

1. Make sure that the Tele cylinder is locked to Tele 2.
2. Extend and lock Tele 2 to the 100% pinning location.
3. Extend and lock Tele 1 to the 50% pinning location.
4. Lower the boom to 0° and perform the following greasing in this position:
  - a. Grease outer sides of Tele 2 in the areas that touch the front wear pads of Tele 1.
  - b. Grease the rear upper wear pads of Tele 2 on both sides, at the grease fittings through the openings in Tele 1.
  - c. Grease locking pins on both sides.

**NOTE:** To grease the rear upper wear pads of Tele 2 at the 50% or 92% pinning locations, extend and lock Tele 2 to these pinning locations and repeat **Step 4b** greasing.



5. While in the horizontal position, first retract Tele 1, and then retract and extend Tele 2 several times to make sure that grease is properly distributed.
6. When Tele 2 greasing is complete, retract and lock Tele 2 to the 0% pinning location.
7. Raise boom to 70°.

**Telescope Section 1 (Tele 1)**

1. Make sure that the Tele cylinder is locked to Tele 1.
2. Extend and lock Tele 1 to the 100% pinning location.
3. Lower the boom to 0° and perform the following greasing in this position:
  - a. Grease outer sides of Tele 1 in the areas that touch the front wear pads of the base section.
  - b. Grease the rear upper wear pads of Tele 1 on both sides, at the grease fittings through the openings in the base section.
  - c. Grease locking pins on both sides.

**NOTE:** To grease the rear upper wear pads of Tele 1 at the 50% or 92% pinning locations, extend and lock

Tele 1 to these pinning locations and repeat **Step 3b** greasing.

4. While in the horizontal position, extend and retract Tele 1 several times to make sure that grease is properly distributed.
5. When Tele 1 greasing is complete, retract and lock Tele 1 to the 0% pinning location.

Boom Tele Section Lubrication procedures are complete.

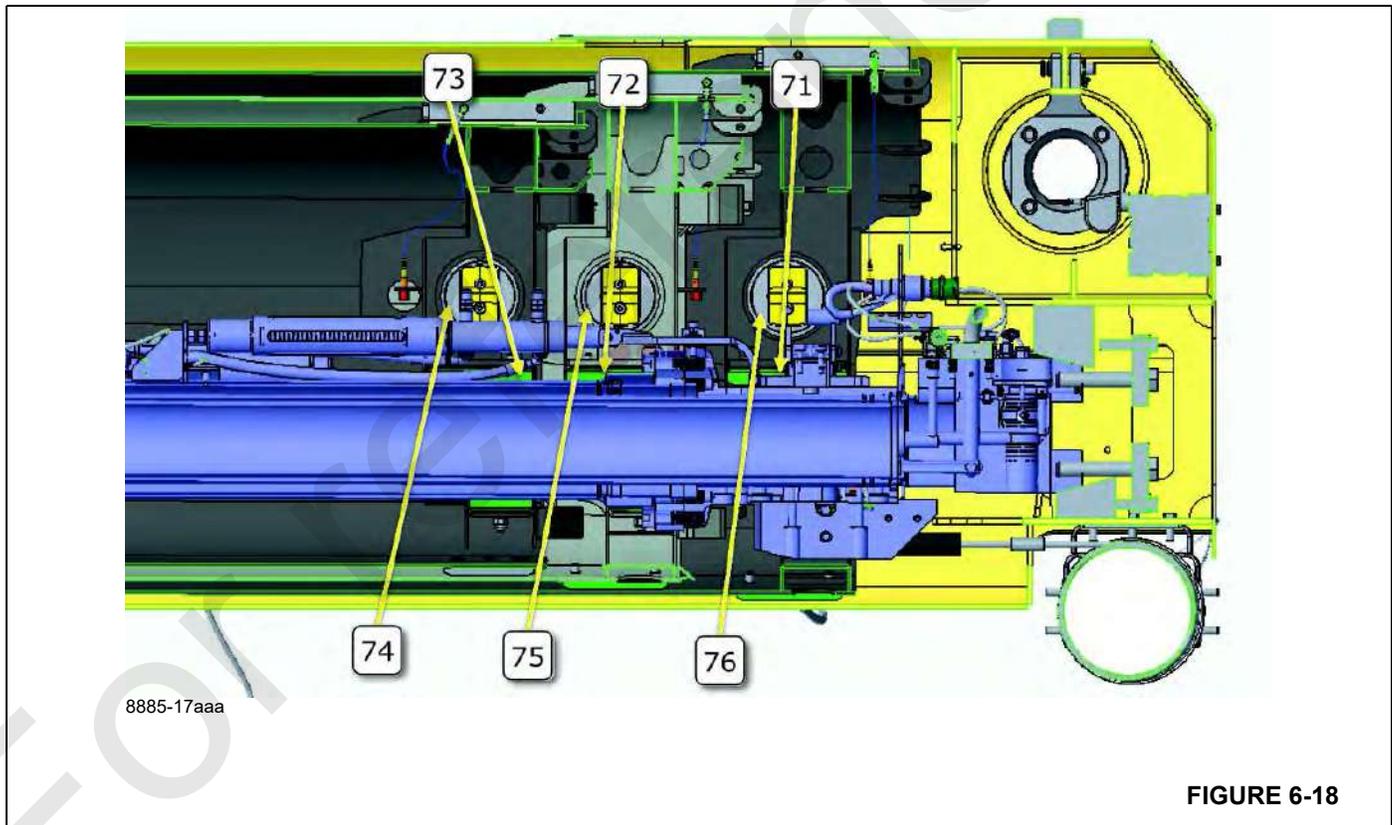


FIGURE 6-18

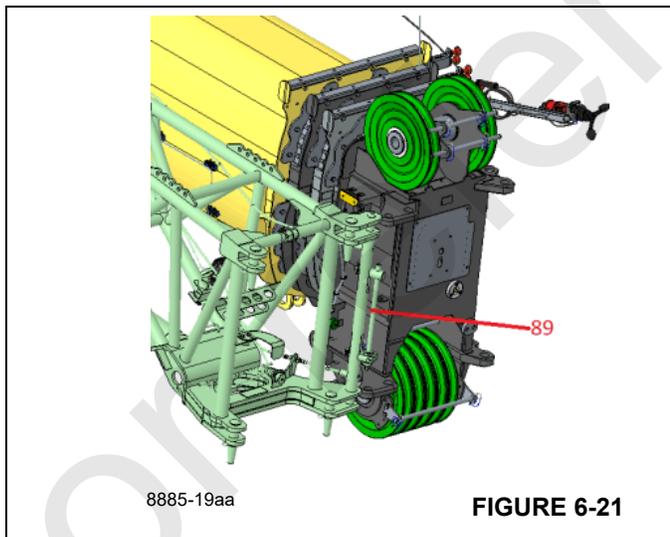
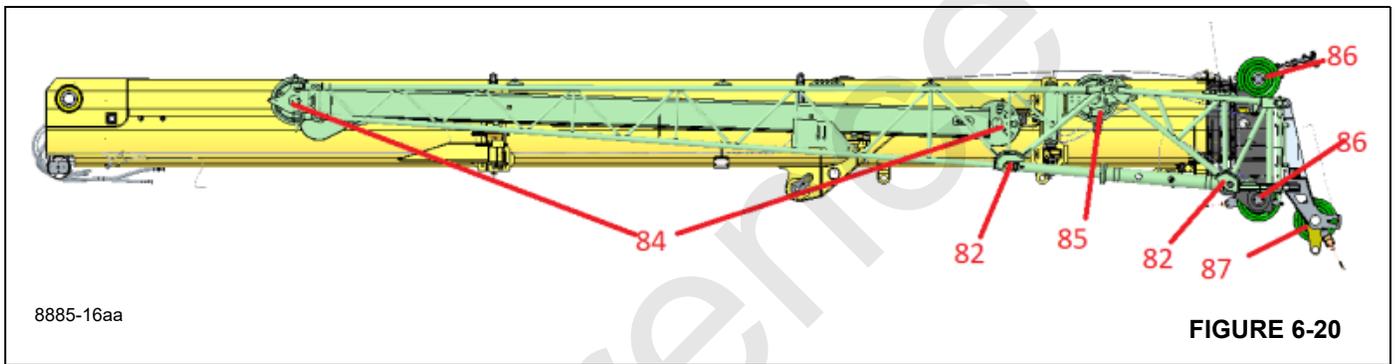
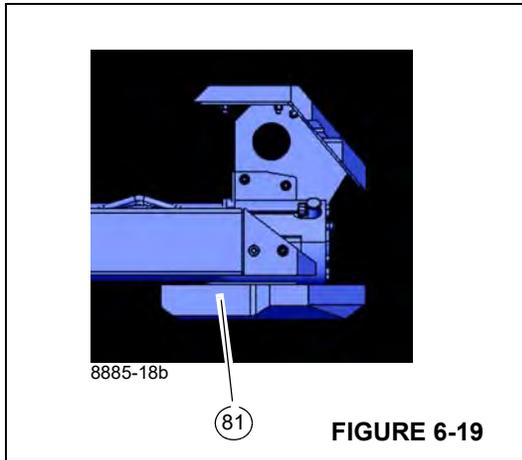




FIGURE 6-22

**Monthly Lubrication Work**

**Pins**

Lubricate the following:

- 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,
- the spring latch on the run-up rail.

**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.

## CARWELL® RUST INHIBITOR

### Protecting Cranes From Corrosion

Grove cranes are manufactured to high quality standards, including the type of paint finish demanded by today's industry. In partnership with our paint supplier, we are also doing our part to help prevent premature corrosion of cranes.

Grove cranes 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.

When 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 ensure long-term protection of their crane against corrosion. This procedure provides information and guidelines to help maintain the paint finish on Grove cranes.

The most common causes of corrosion include the following:

- Road salts, chemicals, dirt, and moisture trapped in the hard-to-reach areas;
- Chipping or wear of paint, caused by minor incidents or moving components;
- Damage caused by personal abuse, such as using the decks to transport rigging gear, tools, or cribbing; and
- Exposure to harsh environmental hazards such as alkaline, acids, or other chemicals that can attack the crane's paint finish.

While 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 (e.g., moisture held in mud), where certain crane parts may become corroded even though other parts remain dry; or
- in high humidity, or when temperatures are just above the freezing point.

### Cleaning Procedures

To help protect against corrosion of Grove cranes, Grove Product Support recommends washing the crane at least monthly to remove all foreign matter. More frequent cleaning may be needed when operating in harsh environmental conditions. To clean the crane, follow these guidelines:

- High pressure water or steam is effective for cleaning the crane'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

##### Possible Machine Damage!

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, Grove Product Support recommends an inspection to detect areas that may have become damaged by stone chips or minor mishaps. A minor scratch (one that has not penetrated to the substrate surface) can be buffed with an automotive-type scratch remover. It is recommended that a good coat of automotive wax be applied to this area afterwards.
- 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:

Grove Product Support recommends that a qualified body repairman prepare, prime and paint any major scratch(es) or minor damage.

**NOTE:** To the extent any damage is structural in nature, Grove Product Support 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, areas where winter road salt is regularly used, etc.), reapplication of treatment is recommended sooner than 12 months, e.g., 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, rubber gaskets, etc. Unit should not have puddles or runs evident anywhere.
- To ensure 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 Grove Product Support (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 Grove Product Support should you have any questions.

### Areas of Application

- 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, slew ring fasteners and all interior surfaces of the frame.
- Frame application areas are; hose ends and fittings, all unpainted fasteners and hardware, all bare metal surfaces, outrigger pads, and back up alarm hardware.
- Superstructure applications are; hose ends and fittings, wire rope on hoists, roller tensioning springs on hoists,

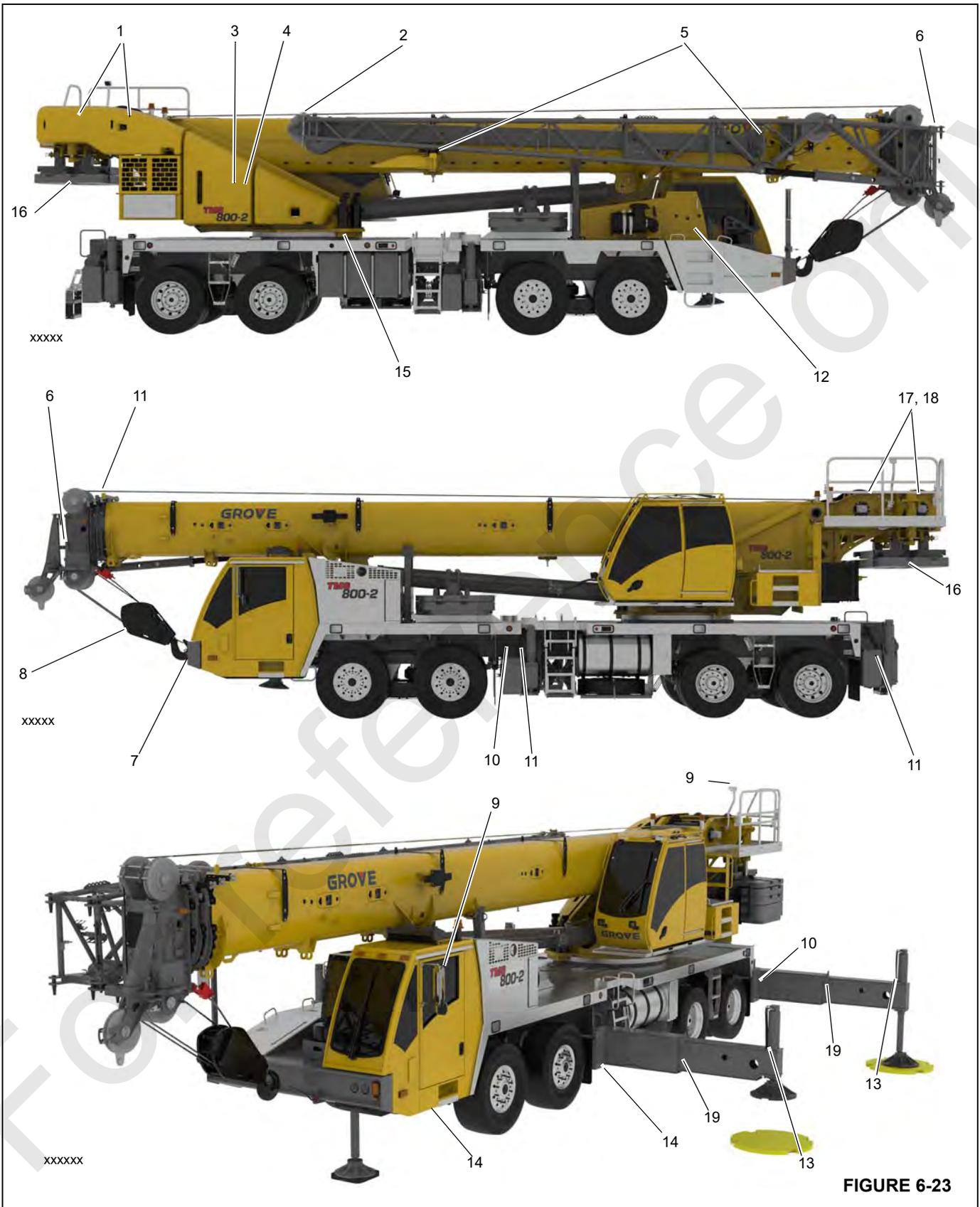
all unpainted fasteners and hardware, valves, slew ring fasteners and all bare metal surfaces.

- Boom applications areas are; pivot pins, hose ends and fittings, boom extension 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	Item	Description
1	Hoist Hose Connections	11	All Hardware, Clips, Pins, Hose Connections not painted O/R Pins, Clips
2	Boom Extension Pins, Clips	12	Powertrain Hardware Inside Compartment
3	Valve Bank	13	O/R Pins, Clips
4	Hose Connections Inside Turntable	14	Entire Underside of Unit
5	Boom Extension Hanger Hardware	15	Turntable Bearing Fasteners
6	Boom Nose Pins, Clips	16	Counterweight Pins
7	Hook Block Tie-down Cable	17	Wire Rope
8	Overhaul Ball/Hook Block	18	Tension Spring
9	Mirror Mounting Hardware	19	Outrigger Beam Wear Pad Adjustment Hardware
10	O/R Hose Connections		

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