

# CD15

## Operator Manual



8905-1



## **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.

1565 Buchanan Trail East PO Box 21  
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## CHANGE OF OWNERSHIP FORM

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

PREVIOUS COMPANY NAME: \_\_\_\_\_

CURRENT COMPANY NAME: \_\_\_\_\_

CONTACT NAME: \_\_\_\_\_

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

CITY/STATE: \_\_\_\_\_ POSTAL CODE: \_\_\_\_\_

TELEPHONE NUMBER: \_\_\_\_\_

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

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

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

## **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.



# OPERATOR MANUAL

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

## CD15

Crane Model Number

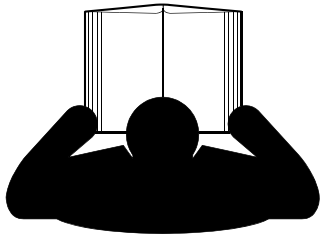

This Manual is divided into the following sections:

SECTION 1	INTRODUCTION
SECTION 2	SAFETY INFORMATION
SECTION 3	OPERATING CONTROLS AND PROCEDURES
SECTION 4	CAPACITY CHART
SECTION 5	ATTACHMENTS
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### 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's 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. Do not operate this crane unless:</b></p> <ul style="list-style-type: none"><li>• You are trained in the safe operation of this crane. Manitowoc is not responsible for qualifying personnel.</li><li>• You read, understand, and follow the safety and operating recommendations contained in the crane manufacturer's manuals and load charts, your employer's work rules, and applicable government regulations.</li><li>• You are sure that all safety signs, guards, and other safety features are in place and in proper condition.</li><li>• The Operator Manual and Load Chart are in the holder provided on crane.</li></ul>
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# SECTION 1 INTRODUCTION

## SECTION CONTENTS

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## THE MANUAL

This operator’s manual provides the information you need to correctly operate and maintain the CD15 crane.

**NOTE:** Before you operate the crane, carefully read this manual completely, so you will understand the safety instructions and the operation of the controls and safety equipment. You must comply with all **DANGER, WARNING, and CAUTION** notices. They are for your benefit.

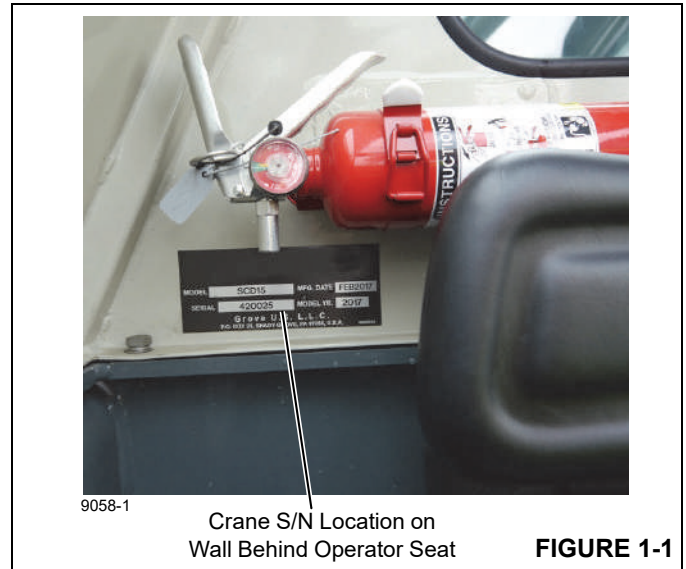
## DIRECTIONAL REFERENCE

All references to the right side, left side, front, and rear are given from the operator’s seat looking in a forward direction.

## SERIAL NUMBER PLATE

For easy reference, when contacting the Grove distributor/Product Support about this machine, record the machine’s serial number in the space provided in the next column. The numbers are stamped on the serial plate which is located behind the operator’s seat. See Figure 1-1. Components, such as the pump, transmission, engine, axles, etc., have their own serial plates that will be found on the housing of the component.

**NOTE:** The replacement of any part of this product with anything other than a Product Support authorized replacement part may adversely affect the performance, durability, or safety of this product and will void the warranty. Grove Product Support assumes no liability for unauthorized replacement parts which adversely affect the performance, durability, or safety of this product.



**Serial Number** \_\_\_\_\_

## REPORTS

**NOTE:** A Delivery Report form must be filled out by the Grove distributor, signed by the purchaser, and returned to Product Support once the product is sold and/or put into service. This report activates the warranty period, assuring that your claims during the warranty period will be honored and processed expeditiously. To guarantee full warranty service, make sure your Grove distributor has returned the report to Product Support. An engine warranty form must also be filled out, signed and returned to the engine manufacturer for full warranty coverage.

## DISCLAIMER

Grove industrial crane reserves the right to make improvements in design or changes in specifications at any time without incurring any obligation to install them on units previously sold.

## CUSTOMER SUPPORT

### Distributor

Grove industrial crane 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.

## Safety Information

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

### New Owners

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

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

## NOMENCLATURE

Refer to the following table and to Figure 1-2 for identification of crane components.

8905

Item	Description
1	Hook Block or Downhaul Weight
2	Optional Jib (boom extension)
3	Anti-Two-Block and RCL Device
4	Pivoting Boom Head
5	3rd Boom Section (4th section optional)
6	2nd Boom Section
7	1st Boom Section
8	Lift Cylinder
9	Hoist (load)
10	Counterweight (1-piece)
11	Engine Compartment
12	Carrier
13	Rear Axle (drive or non-drive)
14	Outrigger (qty 4)
15	Operator's Cab (open or enclosed with split door)
16	Front Drive Axle (steerable)
17	Optional Winch
18	Hook Tie-Back Sling
19	LED Lighting
20	Carry Deck
21	Main Control Valve Location
22	Swing Drive and Turntable Bearing
23	Mast

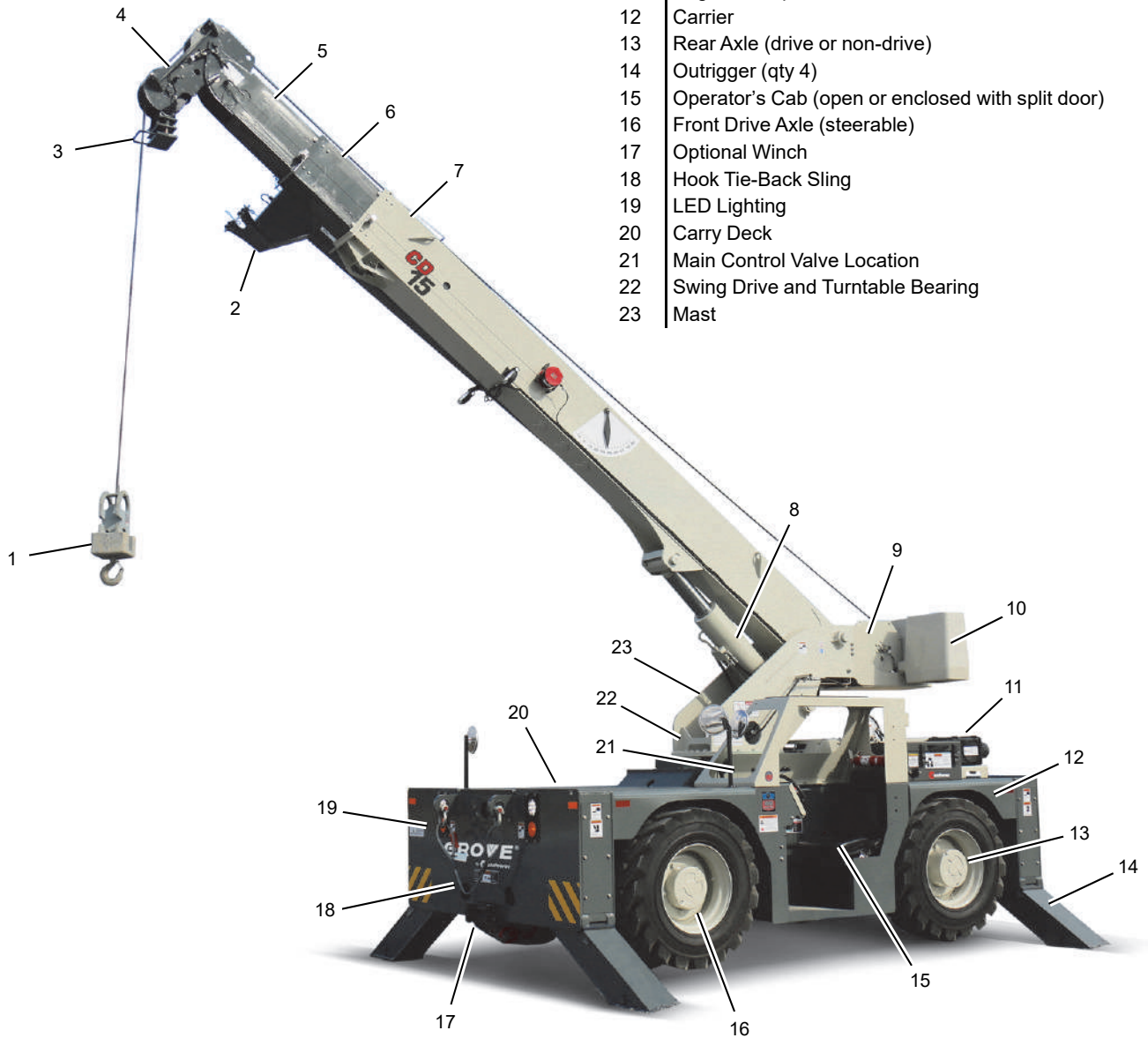


FIGURE 1-2

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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 Industrial Crane dealer must be immediately advised of the incident and consulted on necessary inspections and repairs. Should the dealer not be immediately available, contact should be made directly with Manitowoc 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 Industrial Crane distributor and/or Industrial Product Support.

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

### The Manitowoc Company, Inc.

1565 East Buchanan Trail  
Shady Grove, PA 17256-0021

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

Fax: 717-593-5152

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

## OPERATOR INFORMATION

You must **read** and **understand** this *Operator Manual* and the *Load Chart* before operating your new crane. You must also **view** and **understand** the supplied safety video. This manual and *Load Chart* must be readily available to the

operator at all times and must remain in the cab (if equipped) or operator's station while the crane is in use.

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

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

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



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

Inspect the crane every day (before the start of each shift). Ensure 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.

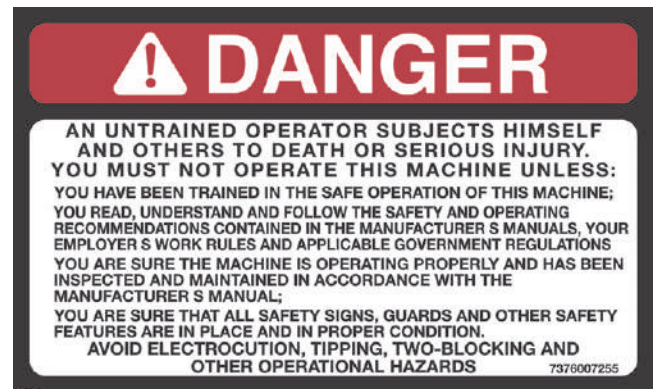
## OPERATOR QUALIFICATIONS

**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.

Ensure 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 cranes 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. 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.

Industrial Crane remains committed to providing reliable products that enable users and operators to safely lift and position loads. Industrial Crane 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 Industrial Crane 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 (If Equipped)

Your crane may be 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 ensure 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 safe load indicator (SLI); Industrial Crane 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, headache 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 free fall.

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

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

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

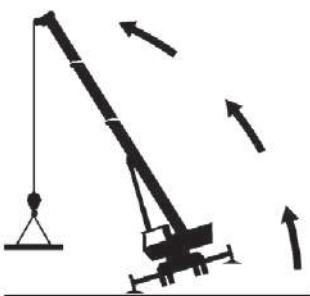

Never interfere with the proper functioning of operational aids or warning devices.

**Working Area Limiter (If Equipped)**

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

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

**⚠ DANGER**

	<p><b>TIPPING HAZARD</b></p> <p>To avoid death or serious injury, ensure load and crane's configuration are within capacity as shown on crane's load rating chart and notes.</p> <p>This crane should have a functional load moment indicator and control lock-out system. Test daily for proper operation.</p> <p><b>POSITION CRANE ON FIRM SURFACE. EXTEND OUTRIGGERS AND LEVEL CRANE.</b></p>	<p><b>TO AVOID DEATH OR SERIOUS INJURY:</b></p> <p><b>NEVER</b> handle personnel with this machine unless the requirements of the applicable national, state and local regulations and safety codes are met.</p> <p><b>NEVER</b> use this crane for bungee jumping or any form of amusement or sport.</p> <p><b>NEVER</b> permit anyone to ride loads, hooks, slings or other rigging for any reason.</p> <p><b>NEVER</b> get on or off a moving crane.</p> <p><b>NEVER</b> allow anyone other than the operator to be on this crane while it is operating or traveling.</p>
	<p><b>TWO-BLOCKING HAZARD</b></p> <p>To avoid death or serious injury, keep load handling devices away from boom/jib tip when extending or lowering the boom and when hoisting up.</p> <p>This crane should have a functional anti-two-block and control lock-out system. Test daily for proper operation.</p> <p><b>DO NOT PASS LOADS OR BOOM OVER GROUND PERSONNEL.</b></p>	<p><b>ELECTRONIC EQUIPMENT</b> on this crane is intended as an aid to the operator.</p> <p>Under no condition should it be relied upon to replace the use of capacity charts and operating instructions. Sole reliance upon these electronic aids in place of good operating practices can cause an accident.</p> <p>Do not remove any decal, the load chart, or the Operator's and Safety Handbook from this crane.</p>

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**FOLLOW INSTRUCTIONS IN OPERATOR'S AND SAFETY HANDBOOK.**
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**CRANE STABILITY/STRUCTURAL STRENGTH**

To avoid death or serious injury, ensure that the crane is on a

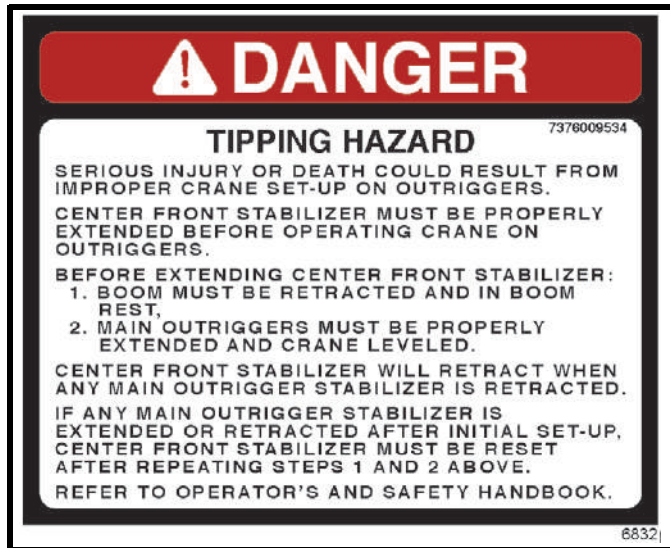
firm surface with load and crane's configuration within capacity as shown on the crane's *Load Chart* and notes.



Ensure 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.

Read and follow the following safety decal for cranes with center front stabilizers.



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 the *Load Chart* for backwards stability.

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. Ensure the outriggers (or tires if lifting on rubber) are firmly positioned on solid surfaces. Ensure 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. Be sure that the surfaces will support a load greater than the crane's weight and maximum capacity.

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

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

**WIND FORCES**

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

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

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

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

stability, wind on the underside of the boom can result in decreased backward stability, wind on the side of the boom can result in structural damages, etc.)

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

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

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

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

Table 2-1 Beaufort Wind Scale

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

**Wind Speeds**

The maximum permissible wind speed referred to in the load charts is the 3-second wind gust speed measured at the boom tip height and is designated as **V(z)**. This value is either recorded at boom tip or calculated based on mean wind speed recorded at crane operation site. For lift planning

purposes only, the 3-second wind gust speed, **V(z)**, may be calculated based on mean wind speed reported at <http://www.windfinder.com> "Super Forecast".

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



configurations and maximum permissible wind speed.

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

- a) If  $V(z)$  is  $\leq 13.4$  m/s (30 mph), then the **allowable** load is the published rated capacity from the Load Chart.
- b) If  $V(z)$  is  $> 13.4$  m/s (30 mph) and is  $\leq 20.1$  m/s (45 mph), the **allowable** load is the published rated capacity multiplied by the Capacity Reduction Factor from Table 2-4 (metric) or (non-metric).

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

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

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

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

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



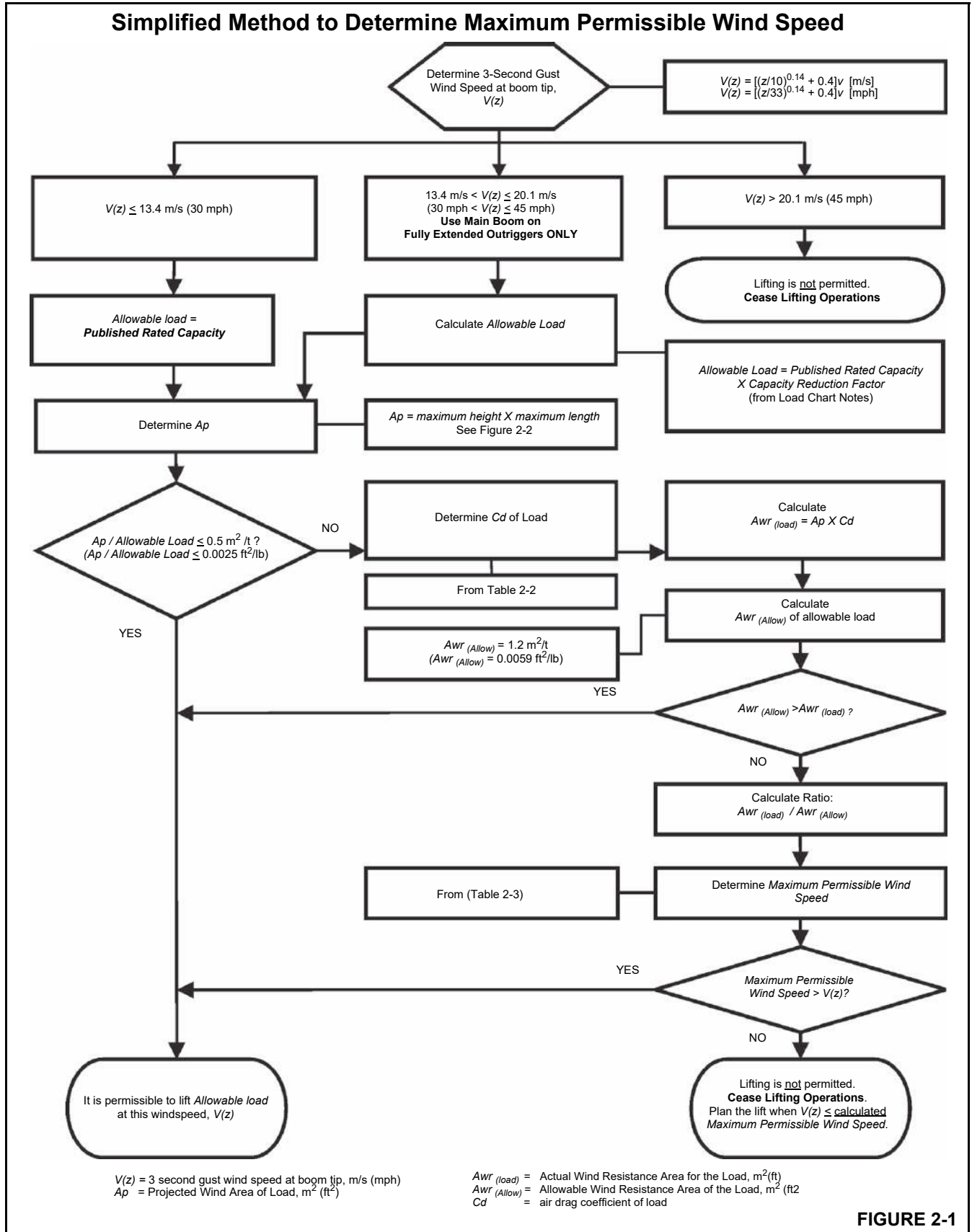


FIGURE 2-1

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

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

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

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

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

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

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

where:

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

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

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

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

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

then:

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

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

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

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

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

**Size and Shape of the load:**

These rated capacities are also based on the assumption that the Wind Resistance Area of load,  $Awr_{(load)}$  is not more

than 0.0012 square meters per kilogram (0.0059 sq.ft per pound of load). (See below Formulas 2.4 and 2.5.)

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

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

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

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

where:

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

$A_p$  [m<sup>2</sup>] [ft<sup>2</sup>] - projected wind area,

$C_d$  - wind drag coefficient.

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

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

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

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

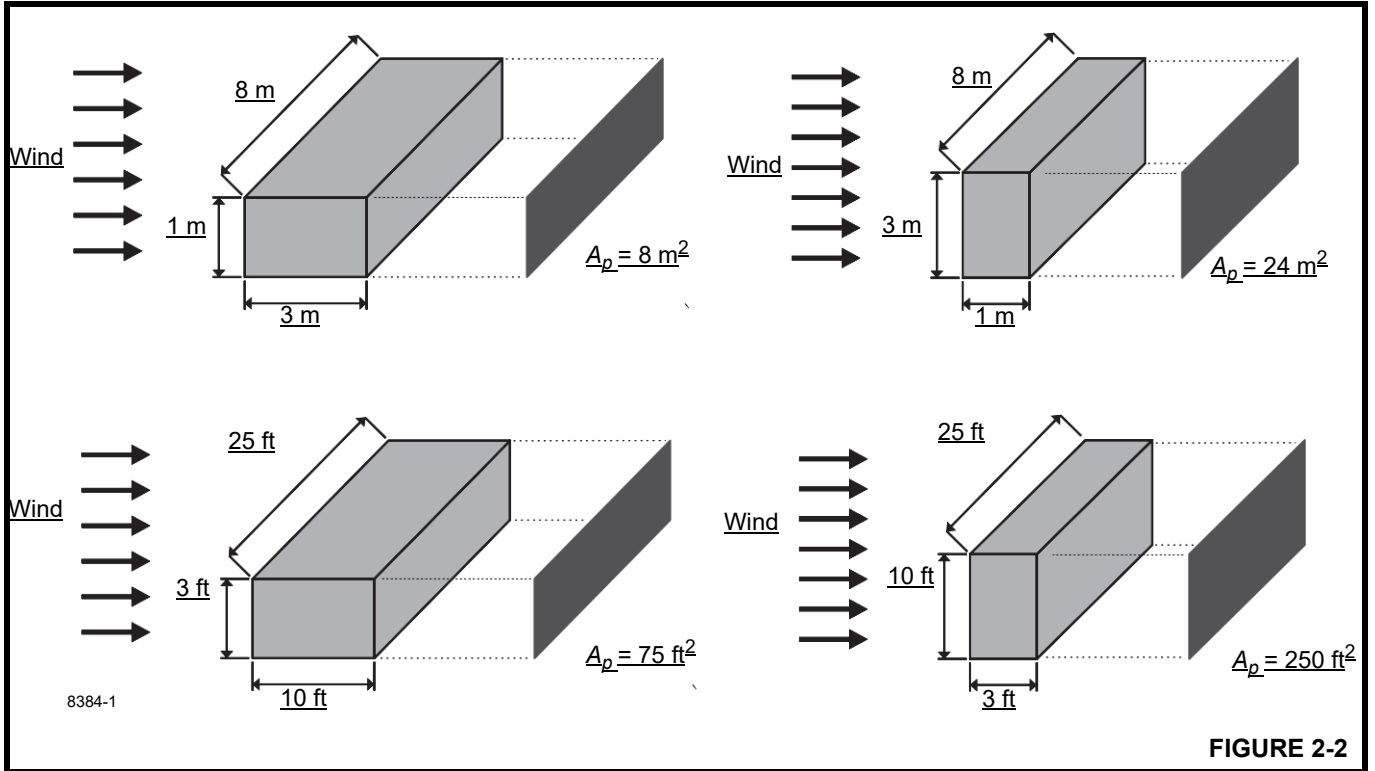
$$Awr_{(allow)} = 0.0012 \times m_{(load)} \quad (2.4)$$

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

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

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

Calculation of Projected Wind Area ( $A_p$ ):



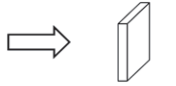


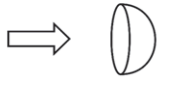



**Determining Wind Drag Coefficient ( $C_d$ )**

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

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

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

Table 2-2 Wind Drag Coefficient

Shape	$C_d$	
	1.1 to 2.0	
	0.3 to 0.4	
	0.6 to 1.0	
	0.8 to 1.2	
	0.2 to 0.3	
	0.05 to 0.1	Turbine Blade or Complete Rotor
	Approximately 1.6	

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**Maximum Permissible Wind Speed**

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

Table 2-3  $Awr$  Ratio and Permissible Wind Speed  $V(z)$  - Imperial units

Note: Permissible and rated wind speeds in this table are the 3-second gust wind speeds at boom tip height.					
Ratio:	1.2	1.4	1.6	1.8	2
	Maximum Permissible Wind Speed (mph)				
For Rated Capacity at 30 mph	27.4	25.4	23.7	22.4	21.2
For Allowable Capacity at 45 mph	41.1	38.0	35.6	33.5	31.8
<b>NOTE:</b> Not all crane models allow lifting operations in all configurations or speeds of 20.1 m/s (45 mph). Refer to load chart notes for allowable configurations and maximum permissible wind speed.					

Rated Load Chart Example - Metric

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

Radius in Meters	#001								
	Main Boom Length in Meters								
	10.9	12.2	15.2	**18.4	21.3	24.4	27.4	30.5	33.5
3	+60,000 (69.5)	40,950 (72)	40,950 (76)						
3.5	53,000 (66.5)	40,950 (69.5)	40,950 (74)	28,350 (78)					
4	47,450 (63.5)	40,950 (66.5)	40,950 (72)	28,350 (75.5)	*18,225 (78)				
4.5	42,875 (60.5)	40,950 (64)	40,950 (70)	28,350 (73.5)	18,225 (76)				
5	39,050 (57.5)	39,025 (61.5)	38,300 (67.5)	28,350 (72)	18,225 (75)	*18,225 (78)			
6	32,950 (50.5)	32,925 (55.5)	32,825 (63.5)	28,350 (68.5)	18,225 (72)	18,225 (75)	*18,225 (78)		
7	28,325 (42.5)	28,300 (49)	28,225 (59)	26,250 (65)	18,225 (69)	18,225 (72)	18,225 (74.5)	*16,725 (78)	*11,400 (78)
8	24,150 (32.5)	24,150 (42)	23,975 (54.5)	23,275 (61)	18,225 (69.5)	18,225 (72)	16,575 (74.5)	15,250 (74.5)	11,400 (76)
9	20,600 (16.5)	20,550 (33.5)	20,375 (49.5)	20,250 (55)	18,225 (63)	16,575 (67)	15,050 (70)	13,875 (72.5)	11,400 (74.5)
10		17,200 (20.5)	17,175 (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 (59)	11,600 (63)	10,725 (66.5)	10,050 (69)
14				9,000 (35)	9,360 (46)	9,730 (53.5)	9,955 (58.5)	9,205 (62)	8,620 (65)
16				6,750 (19)	7,110 (37.5)	7,475 (47)	7,920 (53)	7,980 (57.5)	7,470 (61.5)
18					5,775 (27)	5,960 (39.5)	6,340 (47.5)	6,525 (53)	6,530 (57.5)
20						4,755 (30.5)	5,145 (41)	5,320 (48)	5,495 (53)
22							3,790 (16.5)	4,210 (33.5)	4,545 (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.

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

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

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

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

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

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

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

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

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

**Example and Sample Calculations (metric)**

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

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

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

**Example 1: Crane Configuration:**

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

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

The maximum allowable wind resistance area of load is:

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

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

**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 m<sup>2</sup>

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

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

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

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

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

- Maximum load 12,040 kg
- Maximum wind resistance area of load 14.45 m<sup>2</sup>

At wind speeds greater than 13.4 m/s, it is not permissible to lift a load greater than 12,040 kg, even if the wind resistance area of the load is less than 14.45 m<sup>2</sup>.

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

**Load example 1.1:**

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

- load to be lifted of 11,200 kg,
- Projected Wind Area **Ap** = 9.20 m<sup>2</sup>,
- Wind Drag Coefficient **Cd** = 1.5

wind resistance area of load can be estimated as

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

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

- Is the load to be lifted less than allowable load?  
11,200 kg  $\leq$  12,040 kg YES
- Is **Awr<sub>(load)</sub>** less than **Awr<sub>(allow)</sub>**?  
13.8 m<sup>2</sup>  $\leq$  14.45 m<sup>2</sup> YES

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

**Load example 1.2:**

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

- Load to be lifted of 10,000 kg,
- Projected Wind Area **Ap** = 5.45 m<sup>2</sup>,
- Wind Drag Coefficient **Cd** = unknown

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

- the wind resistance area of load can be estimated as  
**Awr<sub>(load)</sub>** = **Ap** x **Cd** = 5.45 x 2.4 = 13.08 m<sup>2</sup>

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

- Is the load to be lifted less than allowable load?  
10,000 kg  $\leq$  12,040 kg YES
- Is **Awr<sub>(load)</sub>** less than **Awr<sub>(allow)</sub>**?  
13.08 m<sup>2</sup>  $\leq$  14.45 m<sup>2</sup> YES

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

**Load example 1.3a:**

With large wind resistance area of the load **Awr<sub>(load)</sub>**,

- Load to be lifted of 14,000 kg,
- Projected Wind Area **Ap** = 21.85 m<sup>2</sup>,
- Wind Drag Coefficient **Cd** = 1.2

the wind resistance area of load can be estimated as:

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

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

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

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

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

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

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

- Is **Awr<sub>(load)</sub>** less than **Awr<sub>(allow)</sub>**?  
26.22 m<sup>2</sup>  $\leq$  18.06 m<sup>2</sup> NO

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

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

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

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

**Load example 1.3b:**

With large wind resistance area of the load **Awr<sub>(load)</sub>**,

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

the wind resistance area of load can be estimated as

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

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

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

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

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

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

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

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



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 (59)	33,550 (62.5)	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 (68)	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				15,550 (53)	17,400 (41)	18,200 (49.5)	19,100 (55)	18,550 (69.5)	17,350 (62.5)
55					14,300 (33.5)	14,300 (44)	16,000 (51)	16,400 (56)	15,600 (60)
60					11,000 (23.5)	12,700 (38.5)	13,550 (46.5)	13,950 (52.5)	14,100 (56.5)
65						11,000 (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)	28,700 (34.2)	17,950 (44.2)	13,050 (54.6)	10,050 (64.2)	7,790 (74.2)	6,300 (84.2)	4,900 (94.2)	3,900 (104.2)

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

FIGURE 2-4

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

(Only for lifting with main boom on fully extended outriggers, with or without stowed extension)									
For wind speed $Vz$ (3-second gust speed at boom tip height) is greater > 30 mph (45 mph), the Reduced Capacity shall be calculated by multiplying the Published Rated Capacity by the following factors:									
	Main Boom Length in Feet								
Wind Speed $Vz > 30$ mph $\leq 45$ mph	36	40	50	60	70	80	90	100	110
Factor	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.7	0.5
Wind resistance area of load, $Awr_{(load)}$ , shall not exceed maximum allowable wind resistance area $Awr_{(allow)}$ .									
Maximum allowable wind resistance area $Awr_{(allow)} = 0.0059 \times$ calculated reduced capacity in lb.									
Wind resistance area of load, $Awr_{(load)} =$ projected wind area $Ap \times$ wind drag coefficient $Cd$ for the load.									
For wind resistance area of load, $Awr_{(load)} >$ maximum allowable wind resistance, $Awr_{(allow)}$ , refer to crane Operator Manual.									
<b>NOTE:</b> Not all crane models allow lifting operations in all configurations or speeds of 20.1 m/s (45 mph). Refer to load chart notes for allowable configurations and maximum permissible wind speed.									

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

**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 2-23 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.

## 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 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.
- Ensure 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.
- 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 ensure 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.
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- The main hoist line shall be used to raise the panel into the vertical position.

### Tilt-Up Panel Lifting

Requirements and recommendations regarding operation and use of Grove Cranes are stated on decals and in the Operator and Safety Handbook and other manuals 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 and Safety Handbook, 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.
- 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.

Ensure 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.

### 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, Industrial Crane 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.**



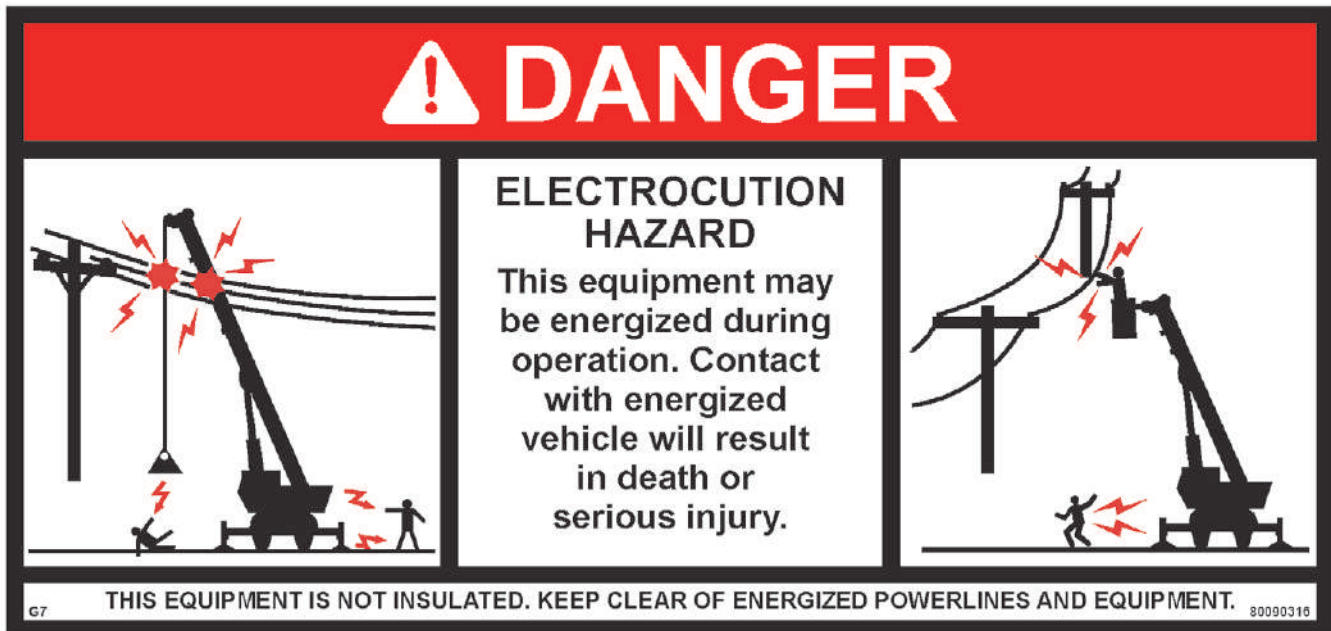
**DANGER**

#### Electrocution Hazard!

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

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

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



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

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

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

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

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

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

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

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

## Set-Up and Operation

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

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

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



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

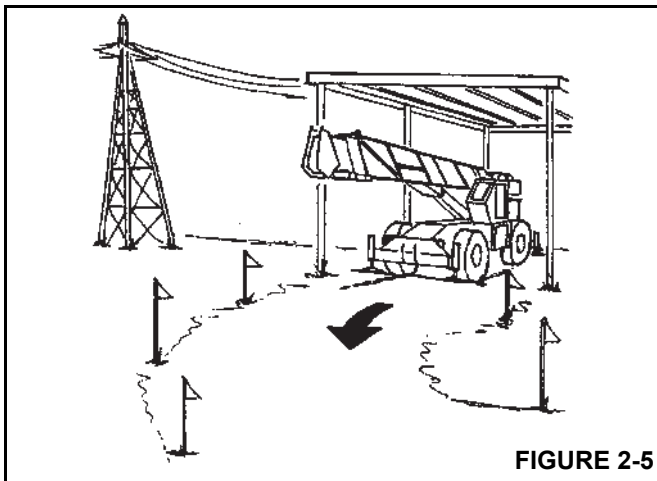


FIGURE 2-5

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

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

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

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

## Electrocution Hazard Devices

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

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

The only protection that may be afforded by an insulated link is below the link (electrically downstream), provided the link has been kept clean, free of contamination, has not been

scratched or damaged, and is periodically tested (just before use) for its dielectric integrity.

Boom cages and boom guards afford limited protection from electrocution hazards. They are designed to cover only the boom nose and a small portion of the boom. Performance of boom cages and boom guards is limited by their physical size, insulating characteristics, and operating environment (e.g. dust, dirt, moisture, etc.). The insulating characteristics of these devices can be compromised if not kept clean, free of contamination, and undamaged.

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

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

Some variables you must know and understand are:

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

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

## Electrical Contact

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

1. Stay in the crane cab. **Don't panic.**
2. Immediately warn personnel in the vicinity to stay away.
3. Attempt to move the crane away from the contacted power source using the crane's controls which may have remained functional.
4. Stay in the crane until the power company has been contacted and the power source has been de-energized.

**No one** must attempt to come close to the crane or load until the power has been turned off.

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

Following any contact with an energized electrical source, the Industrial Crane 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 dealer not be immediately available, contact Industrial 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 Industrial Crane distributor or Industrial 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 packed with insulating material (e.g. wooden planks).



### WARNING

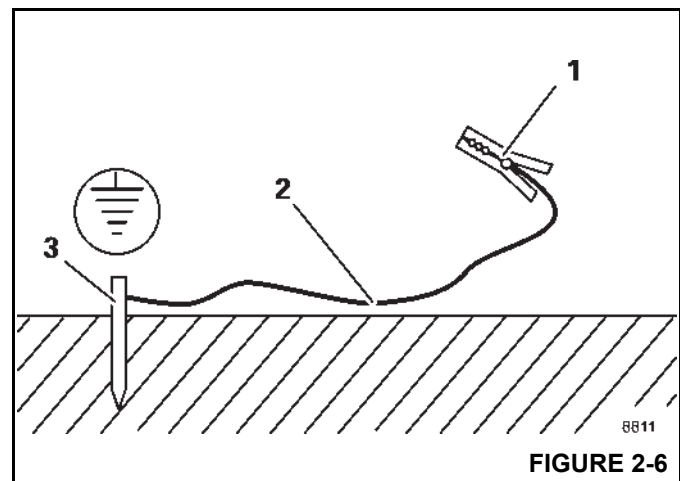
#### Risk of accidents due to electric shock!

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 inches<sup>2</sup>).
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!

Ensure 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 publishes the American National Standard entitled, *Personnel Lifting Systems*, ASME B30.23-2016:

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 an Industrial Crane to handle personnel is acceptable provided:

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

- The crane is in proper working order.
- The crane must be equipped with a boom angle indicator that is visible to the crane operator.
- The crane's *Load Chart* is affixed at the operator's station and readily accessible to the operator. The total weight of the loaded personnel platform and related rigging shall not exceed 50 percent of the rated capacity for the radius and configuration of the crane.
- The crane is level within one percent of level grade and located on a firm footing. Cranes with outriggers shall have them all deployed following manufacturer's specifications.
- The crane's *Operator Manual* and other operating manuals are at the operator's station and readily accessible to the operator.
- The platform meets the requirements as prescribed by applicable standards and regulations.
- For hoist rope suspended platforms:
  - The crane is equipped with a hook that can be closed and locked, eliminating the throat opening.
  - The crane is equipped with a functional anti-two-block device.
  - The platform is properly attached and secured to the load hook.
- For boom mounted platforms:
  - The platform is properly attached and secure.

To avoid death or serious injury:

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

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

- *ASME (formerly ANSI) B30 Series American National Safety Standards For Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings; ASME B30.5, Mobile And Locomotive Cranes, and ASME B30.23, Personnel*

*Lifting Systems*, are available by mail from the ASME, 22 Law Drive, Fairfield, New Jersey, 07007-2900

- or -

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 Industrial 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 ensure that routine maintenance and lubrication are being dutifully performed. **Never** operate a damaged or poorly maintained crane.

Industrial Crane continues to recommend that cranes be properly maintained, regularly inspected and repaired as necessary. Industrial Crane reminds crane owners to ensure that all safety decals are in place and legible. Industrial Crane 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 Industrial Crane 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 Industrial Crane 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.**

Any modification, alteration, or change to a crane which affects its original design and is not authorized and approved by Industrial Crane is **strictly prohibited**. All replacement parts must be Industrial Crane approved. 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 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 Industrial 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.

Ensure all lug nuts are properly torqued.

Ensure 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 Industrial 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 ensure 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 Industrial Crane as indicated on the crane's *Capacity 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 Industrial 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 (eg. 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.

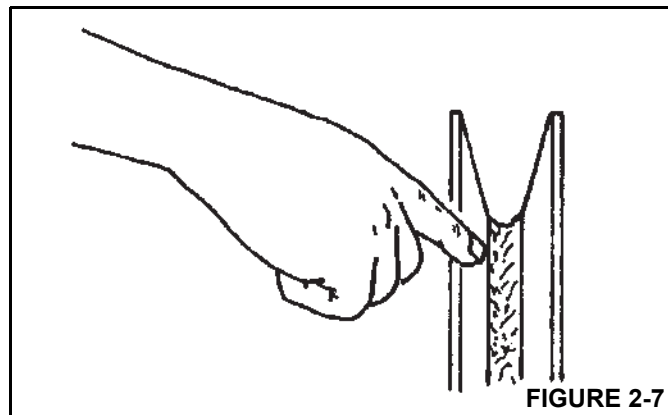
When installing a new rope:

- 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 insure tight, even spooling onto the hoist drum.
- Operate the new rope - first through several cycles at light load and then through several cycles at intermediate load to allow the rope to adjust to operating conditions.

When using a wedge socket:

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

## Sheaves



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

Ensure 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. Ensure 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. Ensure 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. Ensure 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.Engine

## 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, ensure 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.

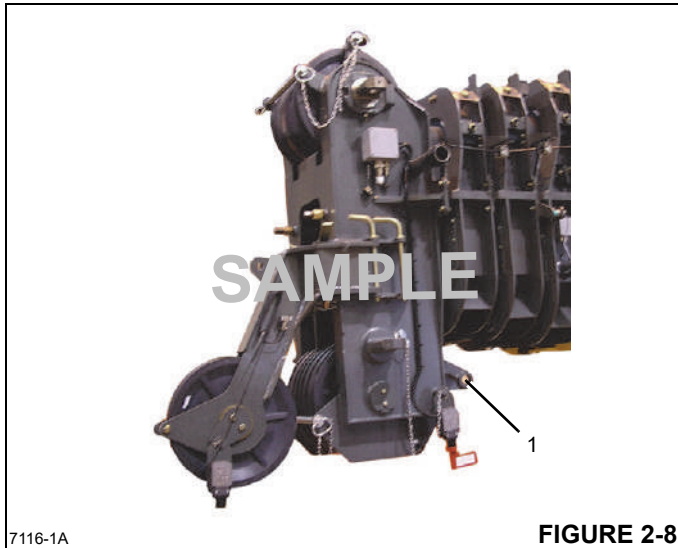
Check load limits of bridges on the travel route and ensure they are greater than the combined weight of the crane and transporting vehicle.

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

Ensure the crane is adequately secured to the transporting vehicle.

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





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FIGURE 2-8

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

Either the hook block may be reeved over the main boom nose or the headache ball may be reeved over the main boom nose or auxiliary boom nose; the other must be removed. If the hook block or headache 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.

Industrial cranes are manufactured with no 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, ensure 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, ensure they will carry a load greater than the crane’s weight.

If it is necessary to take the 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, ensure 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 ensure 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 hand-holds 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 Industrial Product Support.

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 hand-holds, 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.
- Ensure 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 ensure 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 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.

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.

Ensure the hoist rope is properly routed on the hook block and boom nose and that all rope guards are in place.

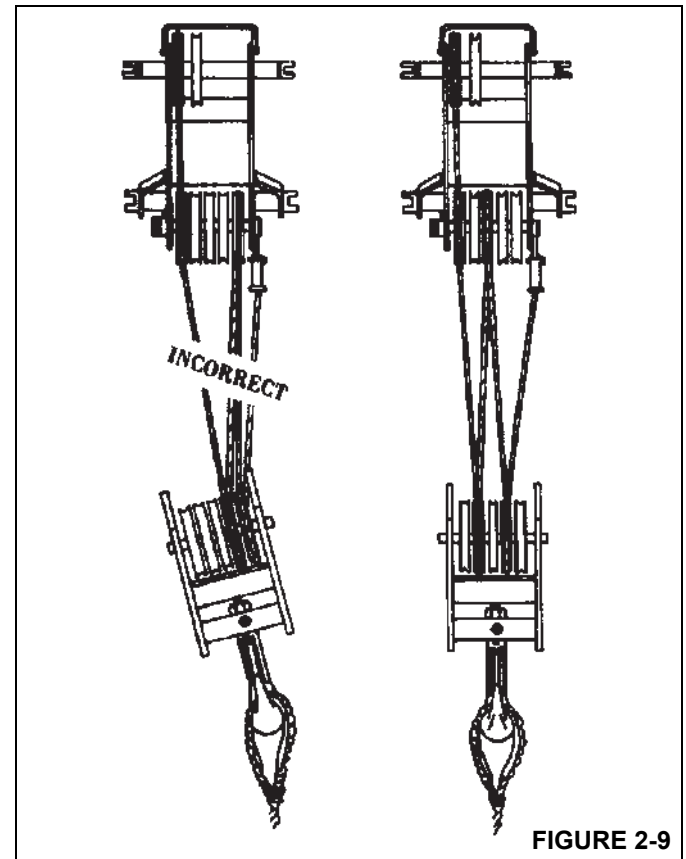


FIGURE 2-9

<p>SUPERSTRUCTURE ROTATION</p>	<p><b>⚠ DANGER</b></p>
<p>COUNTERWEIGHT REMOVAL</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>

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

**Lifting**

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 certain they are correctly positioned and secured before raising or lowering the loads.

Be sure 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.

Be 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% of the crane's capacity.

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

Ensure that all slings, ties, and hooks are correctly placed and secured before raising or lowering the load.

Be 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. Be sure 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.

**Lift one load at a time.** Do not lift two or more separately rigged loads at one time, even if the loads are within the crane's rated capacity.

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, ensure *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. Ensure weight of load is within 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.

Be sure 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:

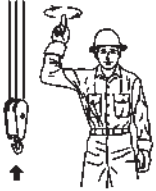
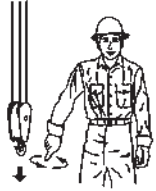

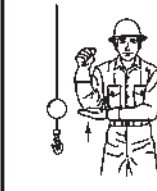
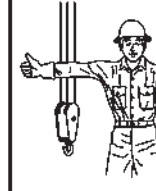
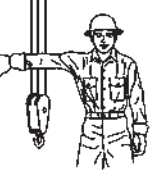
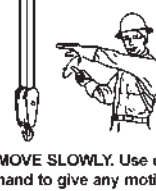
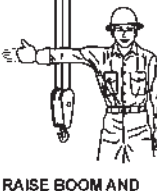
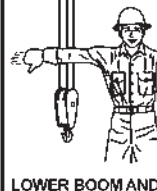
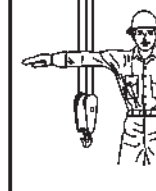
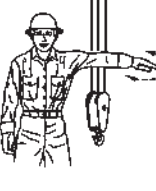
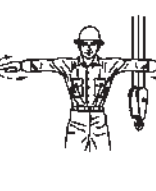
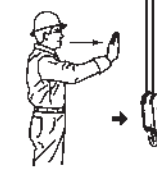
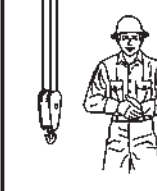

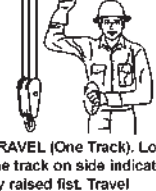
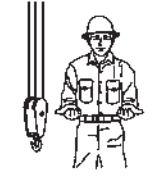
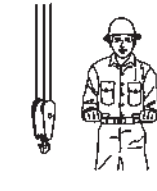


- Working in the vicinity of power lines.
- The crane operator cannot clearly see the load at all times.
- Moving the crane in an area or direction in which the operator cannot clearly see the path of travel.

At all times use standardized hand signals (Figure 2-10) - 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.

<b>STANDARD HAND SIGNALS FOR CONTROLLING CRANE OPERATIONS</b> Complies with ASME B30.5-2014				
 <p><b>HOIST.</b> With forearm vertical, forefinger pointing up, move hand in small horizontal circle.</p>	 <p><b>LOWER.</b> With arm extended downward, forefinger pointing down, move hand in small horizontal circle.</p>	 <p><b>USE MAIN HOIST.</b> Tap fist on head; then use regular signals.</p>	 <p><b>USE WHIPLINE (Auxiliary Hoist).</b> Tap elbow with one hand; then use regular signals.</p>	 <p><b>RAISE BOOM.</b> Arm extended, fingers closed, thumb pointing upward.</p>
 <p><b>LOWER BOOM.</b> Arm extended, fingers closed, thumb pointing downward.</p>	 <p><b>MOVE SLOWLY.</b> Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal (hoist slowly shown as an example).</p>	 <p><b>RAISE BOOM AND LOWER LOAD.</b> With arm extended, thumb pointing up, flex fingers in and out as long as load movement is desired.</p>	 <p><b>LOWER BOOM AND RAISE LOAD.</b> With arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired.</p>	 <p><b>SWING.</b> Arm extended, point with finger in direction of swing of boom.</p>
 <p><b>STOP.</b> Arm extended, palm down, move arm back and forth horizontally.</p>	 <p><b>EMERGENCY STOP.</b> Both arms extended, palms down, move arms back and forth horizontally.</p>	 <p><b>TRAVEL.</b> Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.</p>	 <p><b>DOG EVERYTHING.</b> Clasp hands in front of body.</p>	 <p><b>TRAVEL (Both Tracks).</b> Use both fists in front of body, making a circular motion about each other, indicating direction of travel, forward or backward. (For land cranes only.)</p>
 <p><b>TRAVEL (One Track).</b> Lock the track on side indicated by raised fist. Travel opposite track in direction indicated by circular motion of other fist, rotated vertically in front of body. (For land cranes only.)</p>	 <p><b>EXTEND BOOM (Telescoping Booms).</b> Both fists in front of body with thumbs pointing outward.</p>	 <p><b>RETRACT BOOM (Telescoping Boom).</b> Both fists in front of body with thumbs pointing toward each other.</p>	 <p><b>EXTEND BOOM (Telescoping Boom). One Hand Signal.</b> One fist in front of chest with thumb tapping chest.</p>	 <p><b>RETRACT BOOM (Telescoping Boom). One Hand Signal.</b> One fist in front of chest, thumb pointing outward and heel of fist tapping chest.</p>
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FIGURE 2-10

## BOOM EXTENSION

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

Install and secure all pins properly.

Control movement of the boom extension at all times.

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



### DANGER

#### Boom Extension Hazard!

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

Do not remove all the pins from both front and rear stowage brackets 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 3 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 3 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, Industrial Crane 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 in erection mode, 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).
- Place crane function power switch to OFF (if equipped).
- Place controls in neutral position.
- Shut down the engine and remove the ignition key.
- 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

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 cubic centimeters per cubic centimeter of volume for 1°C of temperature change (0.00043 cubic inches per cubic inch 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

This information supplements the Rated Capacity Limiter (RCL) manual supplied with each Industrial crane.

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

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



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

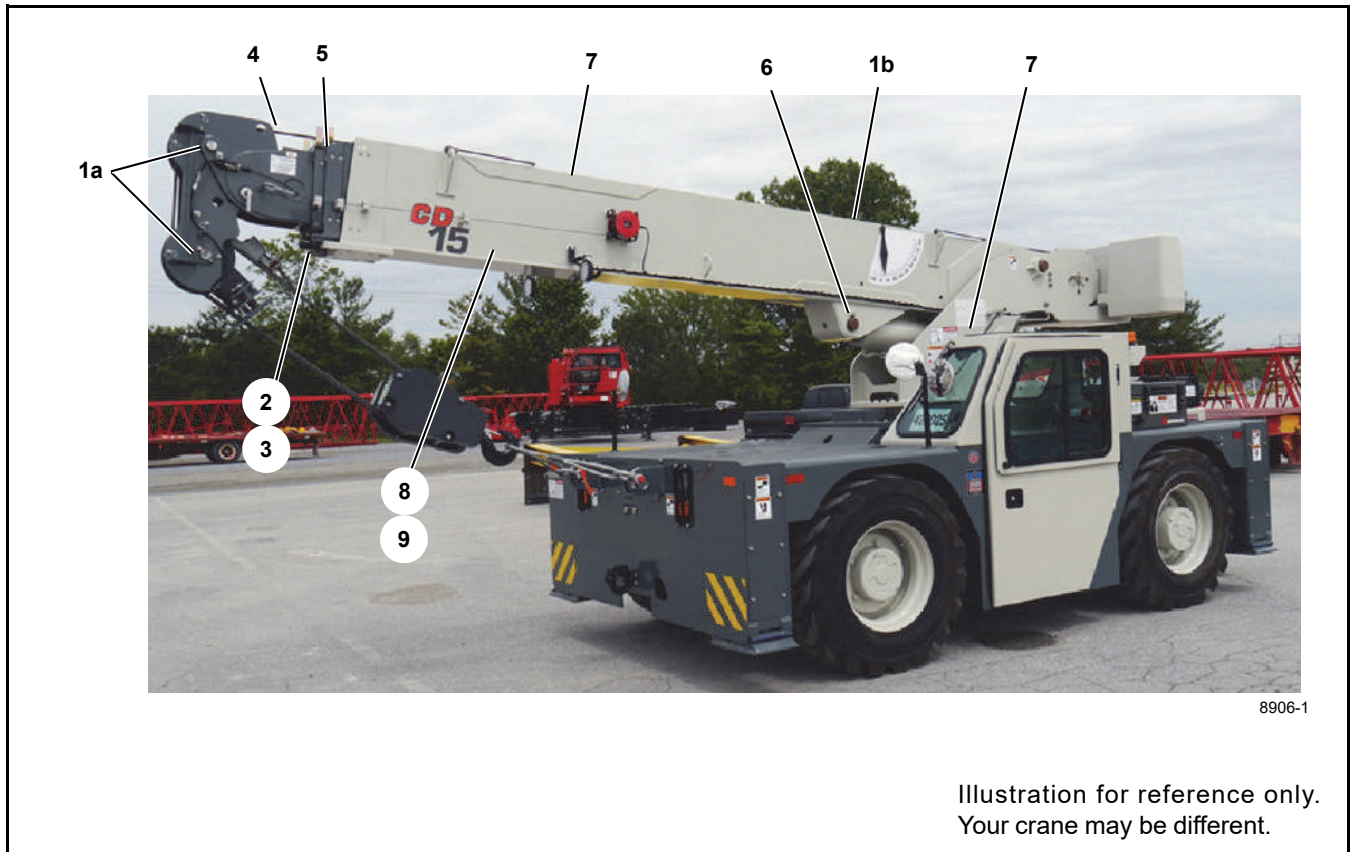
To avoid an accident caused by overload damage to your crane:

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

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

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

**Boom Inspection**



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

<b>Overload less than 25%</b>			
<b>1a</b>	Boom Sheaves, Rope Guides	Inspect all for damage.	
<b>1b</b>	Jib Sheave, Rope Guides	Inspect all for damage.	
<b>2</b>	Collar-Wear Pads, Pad Retainers	Inspect for damage.	
<b>Overload from 25% to 49%</b>			
<b>1</b>	Sheaves, Rope Guides	Inspect all for damage.	
<b>2</b>	Collar-Wear Pads, Pad Retainers	Inspect all for damage.	
<b>3</b>	Collar-welds	Inspect all for damage.	
<b>4</b>	Jib Pinning Areas	Inspect all for cracks.	
<b>5</b>	Telescopic Sections	Inspect for bent or twisted sections. Check the boom for straightness.	
<b>6</b>	Lift Cylinder Head Area	Inspect for bends or cracked welds.	
<b>7</b>	Jib Section (far side)	Inspect for bent or twisted section. Check for straightness.	
<b>8</b>	Welds	Inspect for cracks.	
<b>9</b>	Paint	Inspect for cracked paint which could indicate twisted, stretched, or compressed members.	

Mast Inspection

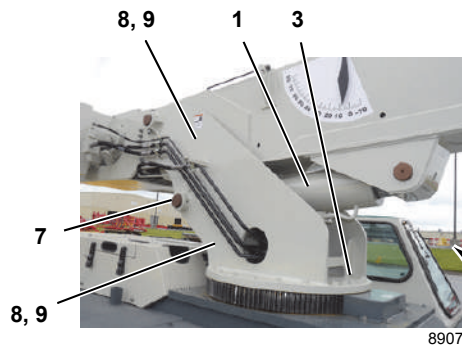


Illustration for reference only.  
Your crane may be different.

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

<b>Overload less than 25%</b>			
1	Lift Cylinder	Inspect for leaking.	
2	Wire Rope	Inspect all for damage.	See topic in Introduction section of Service Manual.
3	Turntable Bearing	Check bolts for proper torque.	See topic in Swing section of Service Manual.
<b>Overload from 25% to 49%</b>			
1	Lift Cylinder	Inspect for leaking.	
2	Wire Rope	Inspect all for damage.	See topic in Introduction section of Service Manual.
3	Turntable Bearing	Check bolts for proper torque.	See topic in Swing 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	Turret Area	Inspect for deformation, cracked welds.	
9	Mounting Studs	Check bolts for proper torque.	
10	Welds	Inspect for cracks.	
11	Paint	Inspect for cracked paint which could indicate twisted, stretched, or compressed members.	

Carrier Inspection



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Typical 4 Places

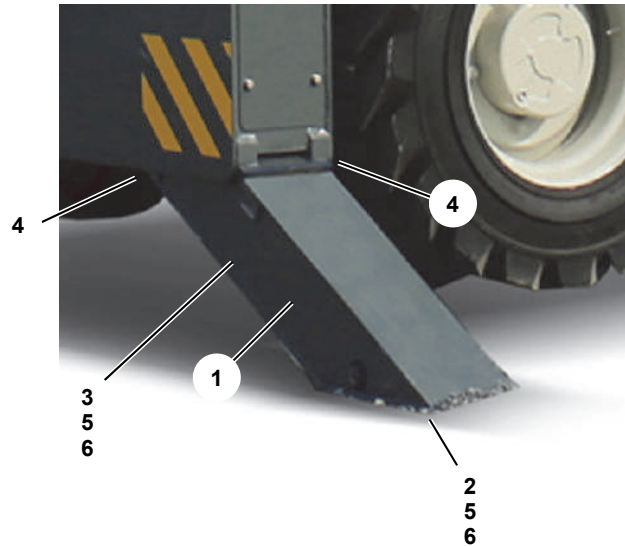


Illustration for reference only.  
Your crane may be different.

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

<b>Overload less than 25%</b>			
1	Outrigger Cylinders	Inspect for leaking.	
2	Outrigger Pads	Inspect for deformation and cracked welds.	
<b>Overload from 25% to 49%</b>			
1	Outrigger Cylinders	Inspect for leaking.	
2	Outrigger Pads	Inspect for deformation and cracked welds.	
3	Outrigger Beams	Inspect for deformation and cracked welds.	
4	Outrigger Wear Pads (qty 8)	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.	

## SECTION 3 OPERATING CONTROLS AND PROCEDURES

### SECTION CONTENTS

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## CONTROLS, SWITCHES, AND GAUGES

## Crane Controls

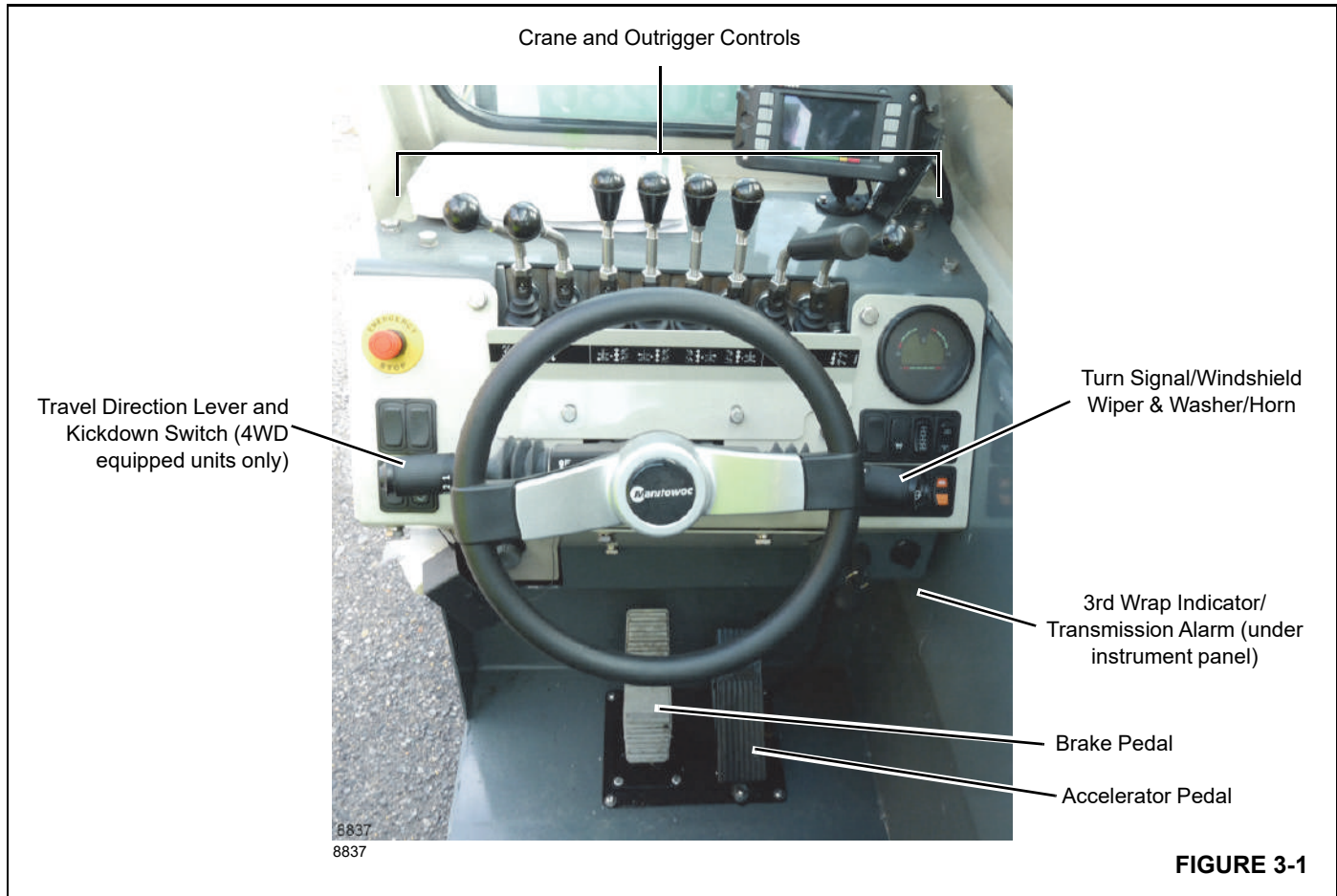


FIGURE 3-1

**Brake Pedal**

See Figure 3-1 for the following procedure.

Pressing down on the brake pedal applies the service brakes, which slows and stops the crane travel movement.

The pedal must be depressed before shifting the transmission into gear.

**Accelerator Pedal**

See Figure 3-1 for the following procedure.

Controls travel speed and the hydraulic working speeds of the crane functions. Pressing down on the accelerator pedal increases the engine speed. The pedal is spring-loaded to return to idle speed.

**Travel Direction Lever /Kickdown Switch**

See Figure 3-1 for the following procedure.

Selects the forward and reverse travel directions of the crane.

For more information see Traveling the Crane on page 3-13.

On units equipped with 4WD, the kickdown switch temporarily shifts down a gear (from 2nd, 3rd or 4th) for a period of 6 seconds before reverting to the selected gear. The kickdown switch does not work if the engine is over-speeding.

The gear selector switch shifts the transmission to any one of four gear ratios.

For more information, see Shifting Gears (Travel Speed) on page 3-14.

**Turn Signal/Windshield Wiper/Horn Lever**

See Figure 3-1 for the following procedure.

Lever up – **LEFT** turn signal lights on.

Lever centered – turn signal lights **OFF**.

Lever down – **RIGHT** turn signal lights on.

See Figure 3-2 for the following procedure.



The wiper switch has three settings; O, I, II. Rotate the switch to operate the wipers at the desired speed.

Press on the end of the switch to operate the windshield washer. Press the button on the end of lever to sound the horn.

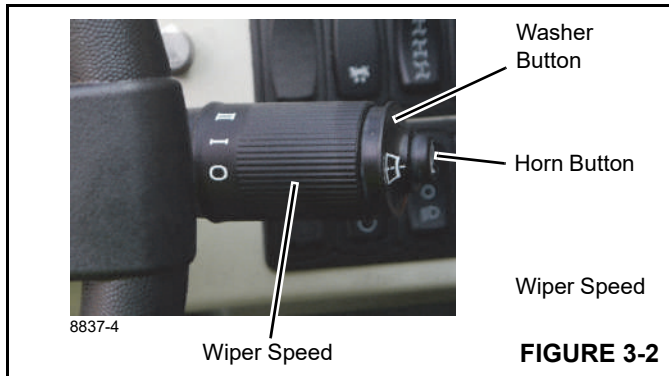


FIGURE 3-2

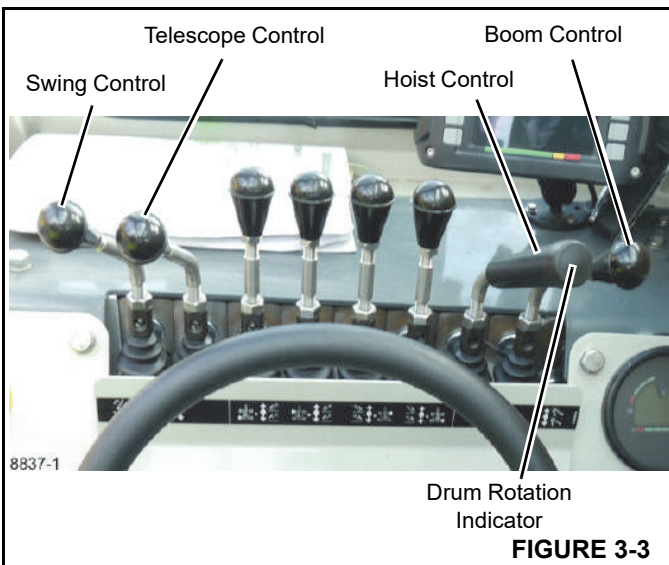


FIGURE 3-3

**Swing Control**

See Figure 3-3 for the following procedure.

The swing control operates the boom/mast rotation function. The boom and mast will rotate continuously through a full 360° circle. See Boom Swing Operation on page 3-22.

**Telescope Control**

See Figure 3-3 for the following procedure.

The telescope control extends and retracts the boom sections. See Boom Telescope Operation on page 3-24.

**Hoist Control**

See Figure 3-3 for the following procedure.

The hoist control raises and lowers the hook block or the downhaul weight. See Hoist Operation on page 3-28.

**Drum Rotation Indicator**

See Figure 3-3 for the following procedure.

The “thumb thumper” under the hoist control handle cover will move up and down to signal the operator by feel that the hoist drum is being operated in either direction.

**Boom Control**

See Figure 3-3 for the following procedure.

The boom control raises or lowers the boom assembly.

See Boom Lift Operation on page 3-26.

**Outrigger Controls**

See Figure 3-4 for the following procedure.

This set of controls extends and retracts the outriggers. The back up alarm will come on when any outrigger control is being operated.

See Operating Outrigger Controls on page 3-18.

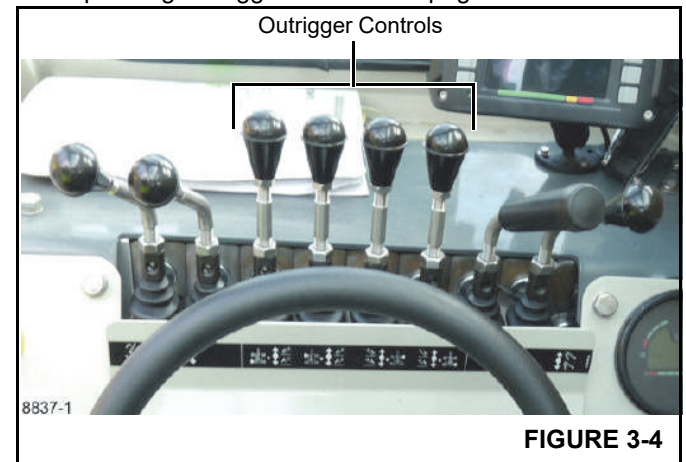


FIGURE 3-4

**Warning Alarms**

Two warning alarms are provided:

**3rd wrap indicator/transmission alarm** which comes on when:

- There are three wraps of wire rope on the hoist drum
- There is a transmission speed sensor fault (see Shifting Gears (Travel Speed) on page 3-14)

**Back up/outrigger alarm** (at rear of carrier) which comes on when:

- The crane is being backed up
- The outrigger controls are being operated

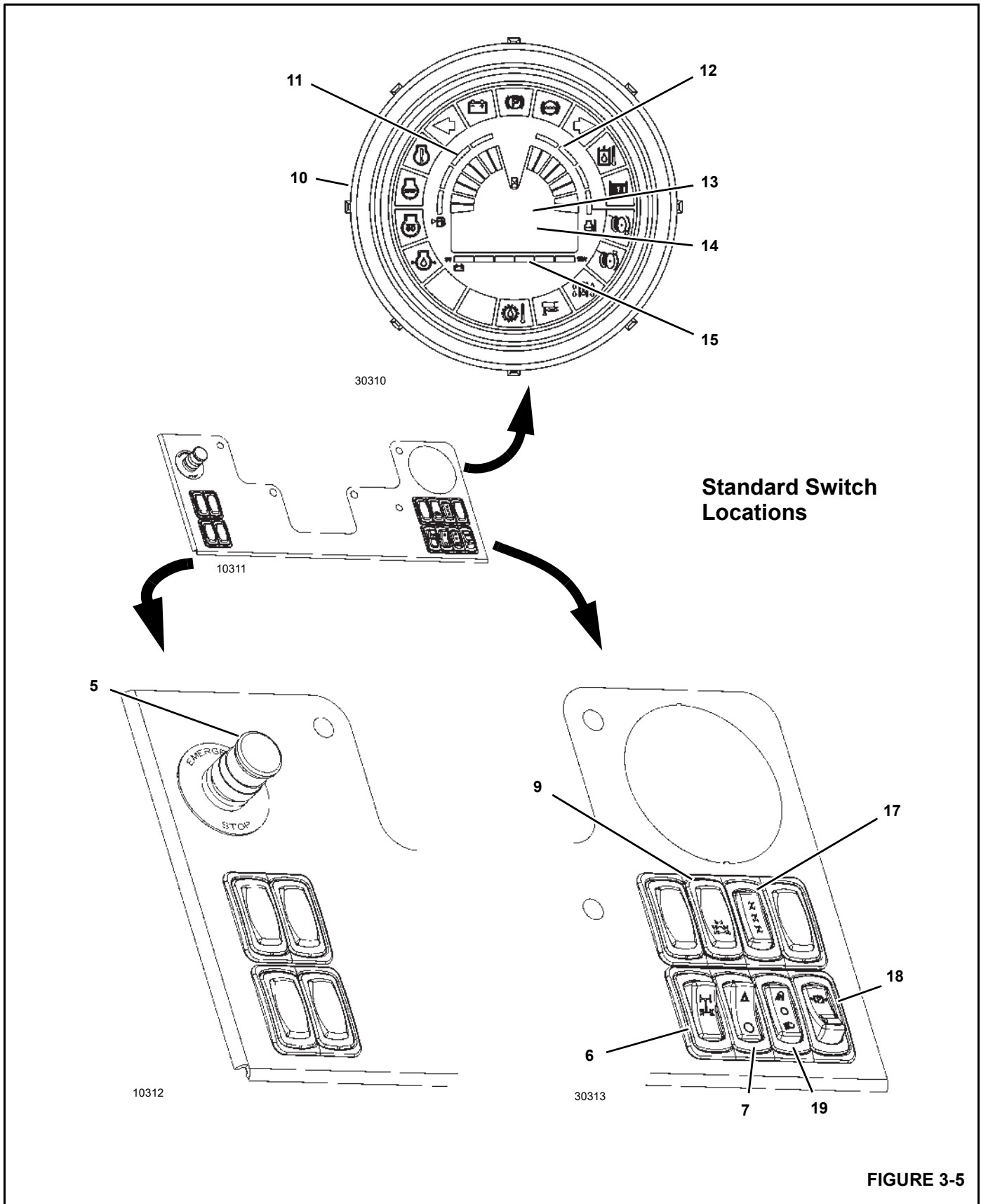


FIGURE 3-5

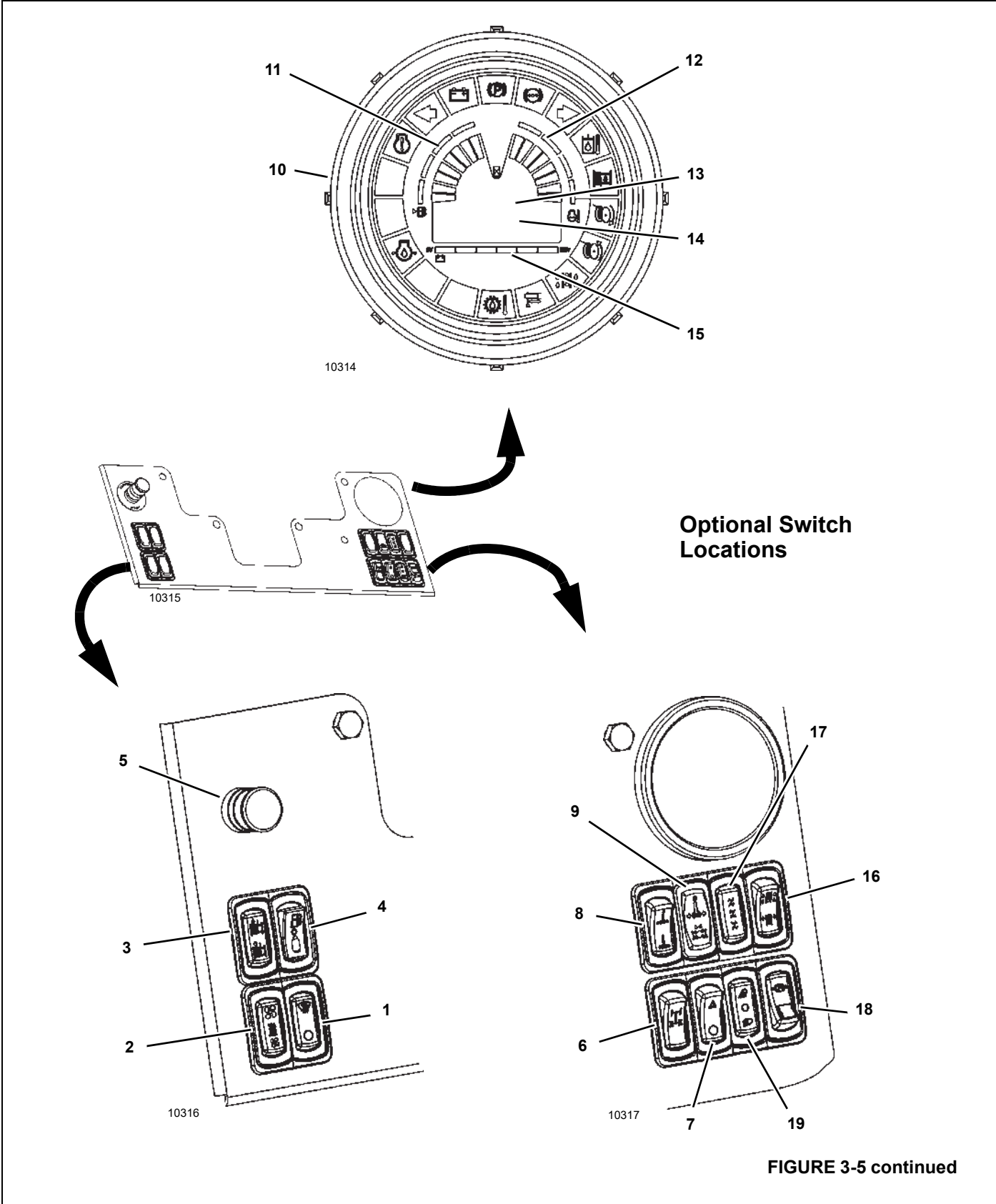


FIGURE 3-5 continued

## Panel Switches, Gauges, and Indicators

Item numbers in following headings correspond to item numbers in Figure 3-5.

### 1 – Defroster Switch

This switch is used to start the defroster fans.

Top position – Fan **ON**.

Bottom position – Fan **OFF**.

### 2 – Heater Switch

This switch is used to operate the heater when equipped with the heat only option.

Top position – operate heater in **HIGH**.

Center position – heater **OFF**.

Bottom position – operate heater in **LOW**.

### 3 – Auxiliary Winch Switch

This switch operates the optional winch attached under the front end of the crane.

Top position (held down) – **UNWIND** rope from the winch drum.

Center position – **STOP** the winch drum.

Bottom position (held down) – **WIND** rope onto the winch drum.

### 4 – Dual Fuel Select Switch

This switch is used to select the fuel type when equipped with the dual-fuel engine option.

Top position – **GAS**.

Center position – **OFF**.

Bottom position – **PROPANE**.

For information about switching the fuel type, see Switching LP/Gasoline Fuel (Dual Fuel Engines) on page 3-32.

### 5 – Emergency Stop Switch

Push knob **DOWN** to **STOP engine** only in an emergency — for example, if a crane function does not stop when the control handle is released to off or any other uncontrolled motion of a crane function is observed.

**Beware** — when the knob is pushed down, the engine stops, the brakes apply, and any **functions being operated come to an abrupt stop**.

**NOTE:** The knob must be pulled up before the engine can be restarted.

Use the engine ignition switch to stop the engine for normal operating conditions.

### 6 – Steering Sync Switch

Top position held down – **FOUR-WHEEL** steer turned **ON**.

If the rear wheels not centered light comes on, use the steering sync switch to re-center the rear wheels. The steering sync switch will by-pass the steer select switch and place the steering in four-wheel steer mode allowing the operator to re-center the rear wheels with the steering wheel in the cab. The wheels not centered light will go off once rear wheels are centered,

### 7 – Emergency Flasher Switch

This switch flashes all four turn signals.

Top position – emergency flashers **ON**.

Bottom position – emergency flashers **OFF**.

### 8 – Swing Lock Switch

Top position – swing lock **APPLIED**.

Center position – swing lock **RELEASED**.

---

## CAUTION

### Avoid Crane Damage!

Do not apply the swing lock while swinging. Damage to the crane can occur.

Disengage the swing lock before swinging. Damage to the crane can occur.

---

### 9 – Swing Lock/Rear Wheels Not Centered Light

**RED** when the option swing lock is engaged.

**AMBER** when the rear wheels are not centered. To select one of three steering modes the rear wheels must be centered.

### 10 – Indicator Lights

See Figure 3-6 for identification of the indicator lights in the gauge cluster.

Take immediate corrective action when a red or amber warning light comes on.

### 11 – Fuel Gauge

Indicates the amount of fuel in the fuel tank.

### 12 – Engine Coolant Temperature Gauge

Indicates the engine coolant temperature.

### 13 – Hourmeter

Indicates the total hours the engine has been operating. Use this gauge to perform preventive maintenance scheduling.

**14 – Tachometer**

Indicates engine speed in rpm.

**15 – Voltmeter**

The voltmeter (battery gauge) indicates the voltage being supplied to or from the batteries.

**16 – 2WD/4WD Switch**

This switch is used to select either two wheel drive or four wheel drive.

Top position – **4WD**.

Bottom position – **2WD**.

**17 – Steering Selection Switch**

This switch is used to select one of three steering modes in which the crane can be steered. The wheels must be aligned in a straight forward direction before switching into another steering mode. See *Steering the Crane* for more information.

Top position – **CRAB** steer.

Center position – **TWO-WHEEL** steer.

Bottom position – **FOUR-WHEEL** steer.

Press the button on the end of the turn signal selector lever to sound the horn. Gauges and Indicators

**18 – Parking Brake Switch**

The parking brake switch is used to engage and disengage the parking brake.

Top position – **DISENGAGE** the parking brake

Bottom position – **ENGAGE** the parking brake.

---

**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.

---

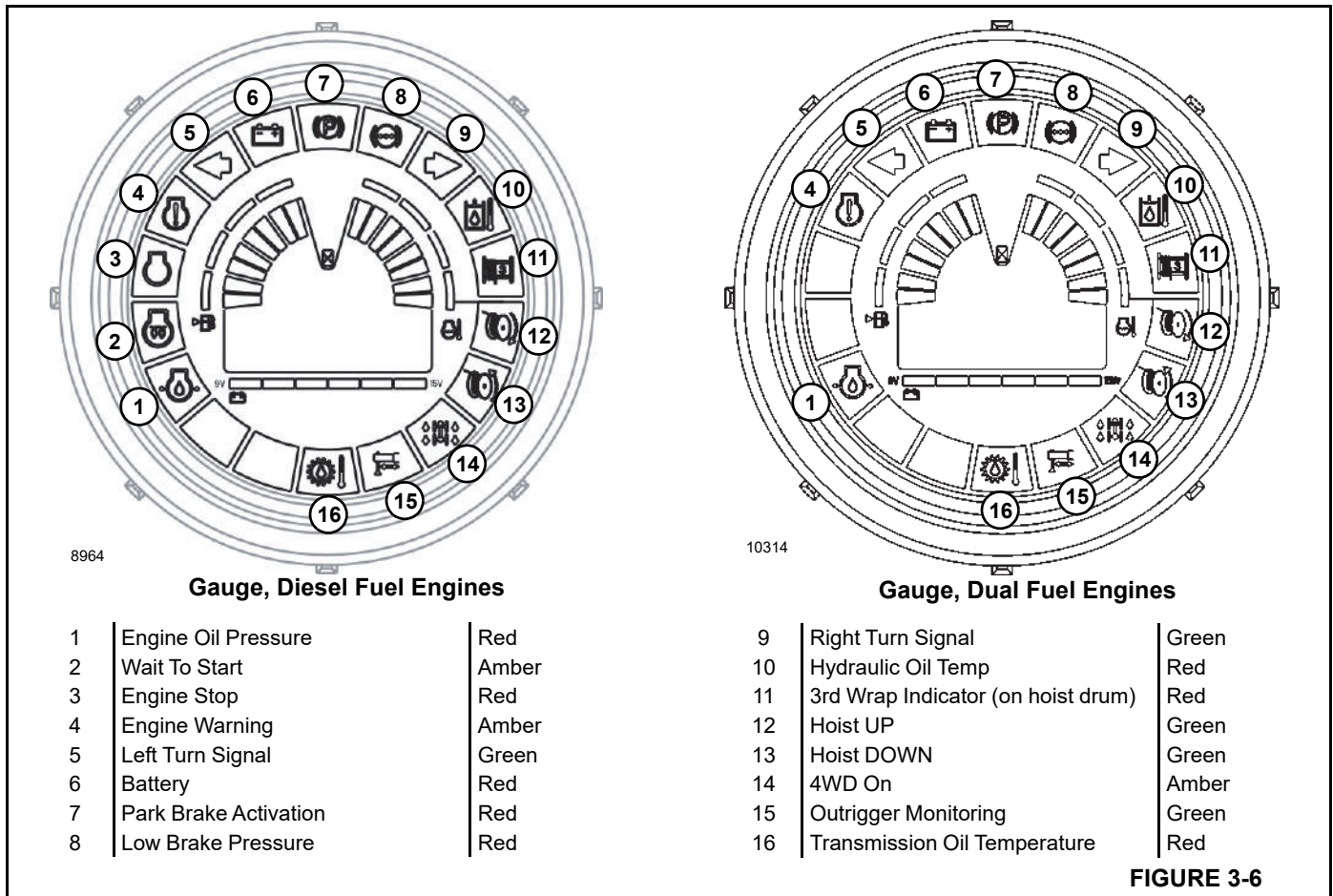
**19 – Work Light/Head Light Switch**

A three-position switch controls the crane's lights.

Top position – Turn **ON** work lights, head lights, tail lights, and instrument panel lights.

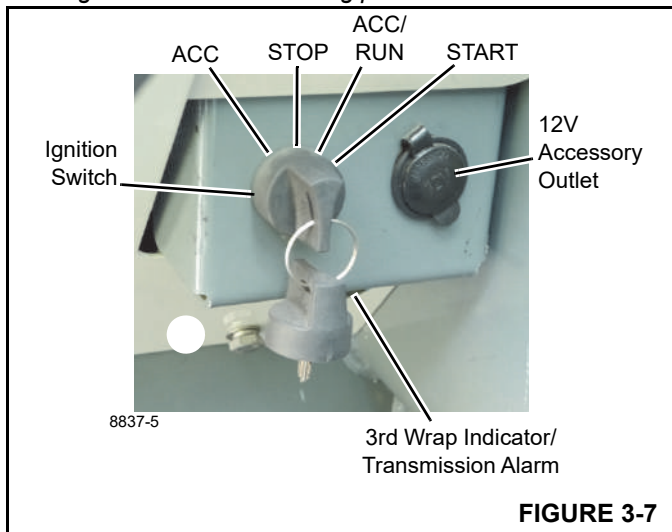
Center position – Turn **OFF** all lights.

Bottom position – Turn **ON** head lights, tail lights, and instrument panel lights.



### Ignition Switch

See Figure 3-7 for the following procedure.



The key included with this crane is necessary for operation of the ignition switch.

ACC – maintained position energizes the accessory electrical circuit.

STOP – maintained position stops the engine and de-energizes the accessory electrical circuits.

ACC/RUN – maintained position energizes the accessory and ignition electrical circuits.

START – momentary position which starts the engine. Release the switch to the ACC/RUN position once the engine starts.

See Starting the Engine on page 3-12.

**NOTE:** The engine stop and warning lights come on (self test) briefly when the ignition switch is turned to the ACC/IGN position. The park brake, transmission oil temperature, and outrigger lights do not come on (self test) when the ignition switch is turned to the ACC/IGN position.



## Operator Aids

### Strobe Light

The amber strobe light behind the cab comes on when the engine started

### Dome Light

Use the switch on the dome light to turn it ON-OFF.

### 12 volt Accessory Outlet

See Figure 3-7 for the following procedure.

Use this outlet to power a 12 volt accessory with a maximum amperage of 10 amps.

### Crane Level Indicator

See Figure 3-8 for the following procedure.

A bubble-type level indicates crane levelness.



**NOTE:** ASME B30.5 specifies that if a crane is not level within 1% of grade, the allowable capacities must 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 rest). Raise and level the crane using the outriggers; refer to Operating Outrigger Controls on page 3-18.

A working crane may settle during lifting operations. Frequently check the crane for level. When rechecking the crane for level, the boom must be positioned over the front of the crane, fully lowered to horizontal and fully retracted (for cranes fitted with a boom rest, the boom shall be stowed onto the rest). If necessary, re-level the crane using the procedures under Operating Outrigger Controls on page 3-18.

**NOTE:** The bubble level adjustment should be checked periodically; if it is suspected that the bubble level is out of adjustment, verify and adjust the bubble level as follows:

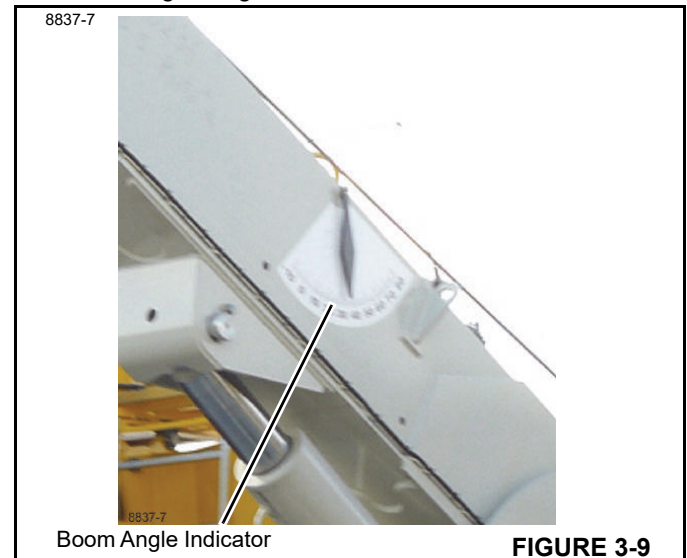
- Position the crane on a firm, level surface.
- Extend and set the outriggers. Level the crane, as indicated by the bubble level indicator, using the outriggers.
- Place a digital level, carpenter level, or similar type device on a machined surface such as the turntable bearing or bearing mounting surfaces.
- Using the outriggers, level the crane as indicated on the leveling device used in the preceding step.
- Using the bubble level mounting screws, adjust the bubble level to show level.

### Boom Angle Indicator

See Figure 3-9 for the following procedure.

The boom angle indicator is a plumb arrow and a decal with angular graduations. It is located on both sides of the boom and is visible from the operator's cab in most boom positions. Use the indicator to determine the boom angle when reading the capacity chart. See Section 4 of this manual.

The boom angle range on this crane is 0-70°.



### Rated Capacity Limiter (RCL)

The RCL (Figure 3-10) provides information on angle, load, radius, capacity, etc. and allows the operator to set limits for these variables. For operating instructions, refer to the RCL manual provided.



FIGURE 3-10

**Operational Aid Malfunction**

When crane operational aids such as the RCL/A2B system are inoperative with the display malfunctioning, override capabilities will be unavailable. All crane operations must be shut down until the problem is corrected. Contact a technician for consultation and repair. Repair and recalibrate the system before returning the crane to lifting service.

**OPERATOR'S CAB**

**Seat Belt**

The operator's seat is equipped with a seat belt. Use this belt at all times when operating the crane.



**Seat Adjustment**

Adjust the operator's seat correctly. Full foot pedal control must be obtained with your back firmly against the seat back.

To adjust the seat, move the control lever (Figure 3-11) to the right. Move the seat to proper position and then move the control lever back to the left to lock the seat position.

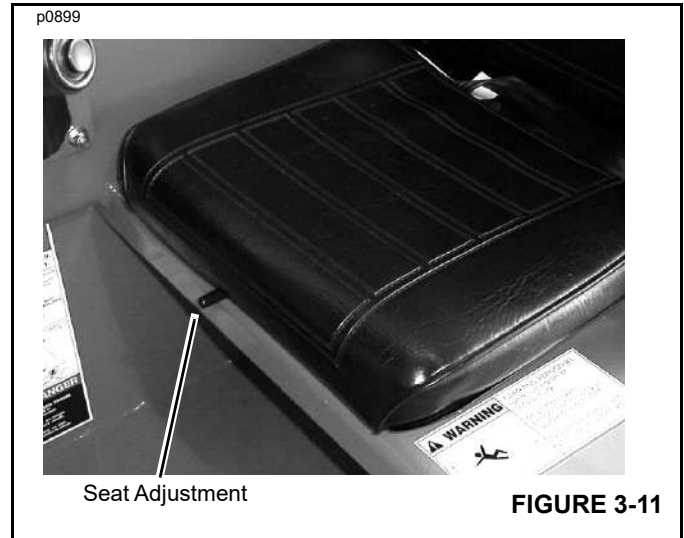


FIGURE 3-11

**Cab Door (Enclosed Cab)**

**Opening the Cab Door From Outside (Enclosed Cab)**

Pull the door latch out to release the cab door latch (Figure 3-12).

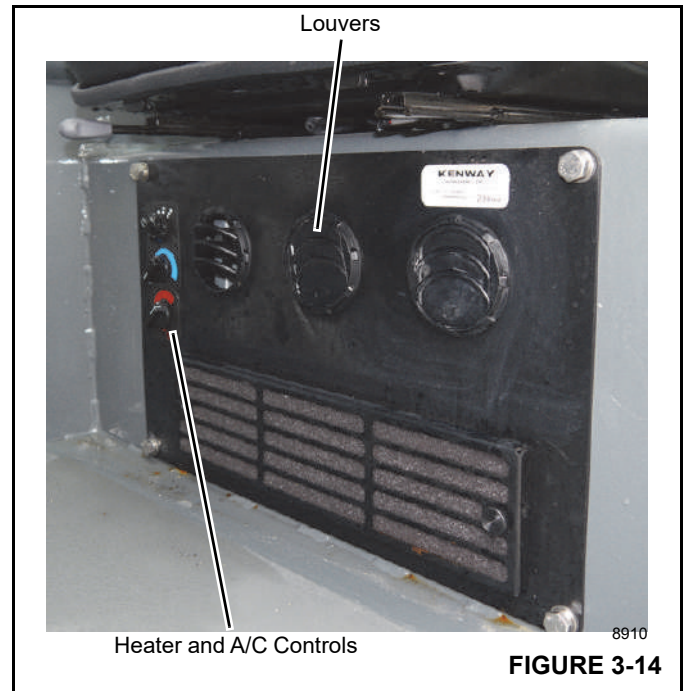
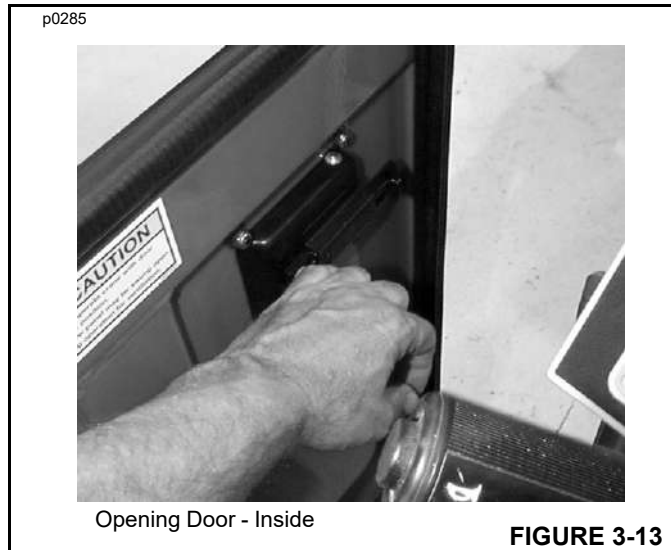


FIGURE 3-12



**Opening the Door From Inside (Enclosed Cab)**

Pull the door handle back to release the cab door latch (Figure 3-13).

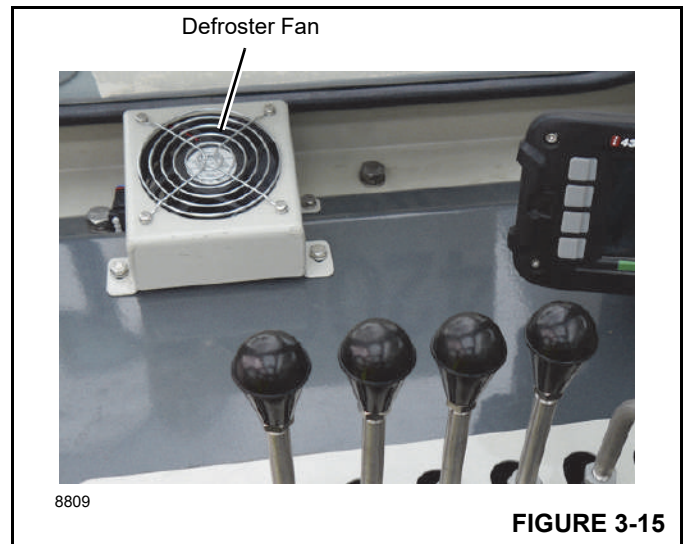


**Heater, A/C, and Defroster**

The cab heater and A/C (furnished as an option with enclosed cabs) is located under the operator's seat (Figure 3-14). To operate the heater or A/C, use the controls on the panel. Position the louvers for the desired amount and direction of air flow.

The windshield defroster fan is located below the front windshield (Figure 3-15).

To operate the defroster fan, use the switch located on the instrument panel (see Figure 3-5). Select the desired fan speed.



**NOTE:** Be sure the shut-off valve in the hot water supply line is open. The shut-off valve is located on the engine.

### Fire Extinguisher

The fire extinguisher is located in the cab behind the operator's seat (Figure 3-16). Study the manufacturer's instructions printed on the fire extinguisher for its proper use.



The crane is equipped with a fire extinguisher. Maintain a charged fire extinguisher AND KNOW HOW TO USE IT.

FIGURE 3-16

## CRANE OPERATION

### Starting the Engine

#### Normal Engine Starting

**NOTE:** Never leave the engine running while the crane is unattended. Shut off the engine to inhibit unauthorized persons from operating the controls.

Walk around the crane and warn all personnel who may be servicing the crane or are in the crane's path prior to starting. Do not start until all personnel are clearly away from the crane.

This crane is equipped with an engine block heater that can be plugged in to aid in cold weather starting (see Engine Manual).

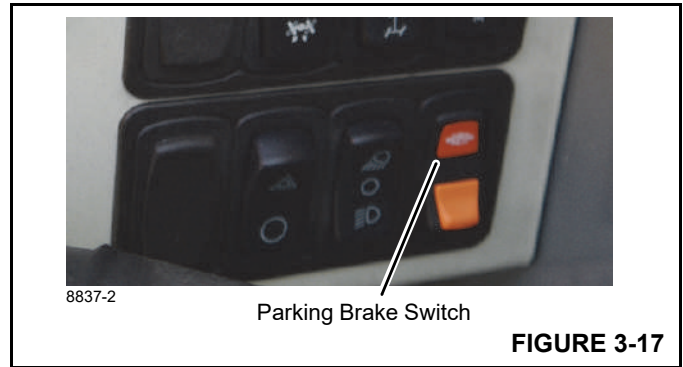
1. Enter the cab and adjust the operator's seat for comfortable operation.
2. Fasten the seat belt. **Use the seat belt at all times when operating the crane.**
3. Check that the parking brake is engaged (Figure 3-17).

### CAUTION

#### Avoid Crane Damage!

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

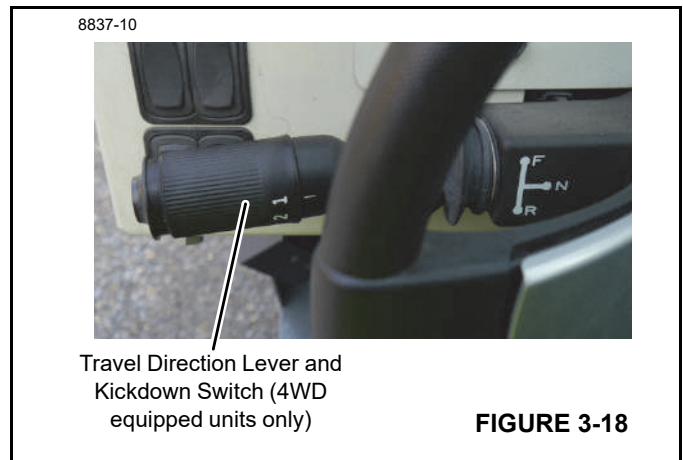
Disengage the parking brake before driving. Damage to the crane can occur.



Parking Brake Switch

FIGURE 3-17

4. Place the travel direction lever in the neutral (N) position (Figure 3-18).



Travel Direction Lever and Kickdown Switch (4WD equipped units only)

FIGURE 3-18

**NOTE:** Do not bypass the crane's neutral-start system. The neutral start system must be repaired if it malfunctions.

5. Turn the ignition key switch to the ACC/RUN position. The WAIT TO START light will come on in the gauge cluster.
6. Once the wait to start light goes off, turn the ignition key switch to the START position and hold until the engine starts.
7. Release the ignition key switch as soon as the engine starts.

**NOTE:** **DO NOT** crank the starter motor continuously for more than 30 seconds. Damage to the starter motor could occur.

**DO NOT** operate the engine at full RPM or apply a full load until the engine is warm. During cold weather, it may be necessary to run the engine at a higher speed to keep the correct operating temperature.

8. Once the engine starts, increase engine speed as necessary to keep the engine running.

9. Take immediate correction action if faults appear in the gauge cluster. Do not operate the crane if the faults do not go away soon after the engine is started, or if any come on during operation.
10. Check the brakes, steering and all controls for proper operation. If a malfunction is found, shut down the engine immediately and park the crane until the malfunction is corrected or the crane can be safely towed. See Towing a Disabled Crane for more information.
11. Disengage the parking brake before you travel with the crane. See the Travel Instructions later in this section.

---

### 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.

---

#### Towing or Pushing the Crane to Start the Engine

If the battery is discharged, **DO NOT** try to start the engine by towing or pushing the crane. Damage to the transmission will occur. Instead use booster batteries to jump start the engine.

#### Jump Starting Hazard

Do not attempt to jump start the crane.

---

### CAUTION

It is strongly recommended that the batteries not be “jumped” with a different vehicle, portable power pack, etc. The surge of power from these sources can irreparably damage the various electronic controls and computer systems. Jump starting the crane batteries with a different vehicle while the engine is running can damage the donor vehicle electronics as well if done improperly.

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

The batteries should be completely disconnected from the crane electrical system and charged using a battery charger of appropriate voltage level or replace the batteries with fully charged batteries. Refer to *Charging the Batteries*, page 3-13.

## 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 found to be 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 should be used.

## Traveling the Crane



**NOTE:** If travel sight is restricted, do not attempt to travel with the crane until a signalman gives a signal that the crane is clear of obstacles in the wheel path. Remove any obstacles from the wheel path before moving.

**NOTE:** To help inhibit accidents, use a slow moving vehicle sign and a flashing strobe light (where legal) for traveling on highways or public roads.

1. Enter the operator’s cab, close the door, if equipped, and fasten the seat belt. **Use the seat belt at all times when operating the crane.**

Start the engine and disengage the parking brake.

**CAUTION**

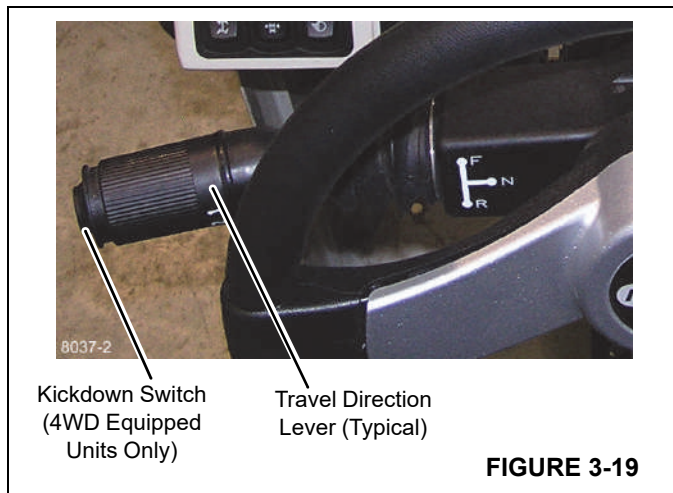
**Avoid Crane Damage!**

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

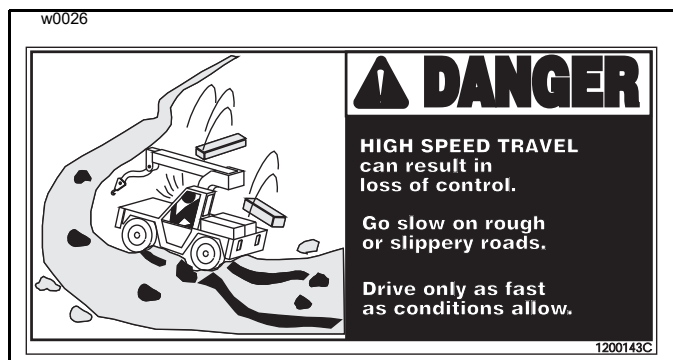
Disengage the parking brake before driving. Damage to the crane can occur.

2. Depress and hold the brake pedal down.
3. Select either the Forward (F) or Reverse (R) travel position with the travel direction lever (Figure 3-18). Pull the handle back and then move it up or down to select the travel direction.

The back up/outrigger alarm at the rear of the carrier will sound while traveling in reverse.



**FIGURE 3-19**



**NOTE:** Cranes equipped with 2WD have no suspension. Cranes equipped with 4WD have limited suspension. Traveling at high speeds, especially on rough roads, can create a bouncing effect that can result in loss of control. Personal injury, death and property damage could result. Reduce speed if bouncing occurs.

4. Start out traveling from a stopped position in 1st speed. Travel speed may be shifted from 1st to 2nd, 2nd to 3rd when the crane is moving. See Shifting Gears (Travel Speed) below. Avoid operating at too high of gear selection when moving a heavy load, as this may cause “lugging” on the engine. Use a lower gear when moving a heavy load; higher gear when moving a lighter load. **Selecting the correct travel speed will prolong engine life.**

**Shifting Gears (Travel Speed)**

The transmission used on this crane is not an automatic transmission. The gears and clutches will not shift automatically. Each gear range must be selected manually.

1. Up shifting to the next gear (travel speed) may be done at any engine speed, while the crane is in motion, but first ease up on the accelerator pedal.

**NOTE:** On units equipped with 4WD, the transmission is equipped with a speed sensor that protects certain transmission shifting functions. The speed sensor is connected to a warning alarm (under instrument panel). If a speed sensor signal is not received by the transmission electronic control unit (ECU) on power up, the ECU inhibits the selection of 4th gear. This is intended to indicate a faulty sensor or wiring and all speed protection is lost. If the signal is lost after power up, 4th gear will not be selectable until the power is turned off.

2. When down shifting, do not over-rev the engine. Allow the crane to slow down before shifting to the next lower gear. Down shifting is subject to speed limitations. If the speed is too high a repeated double beep of the alarm is sounded and will continue until the speed drops below the limit or downshift is deselected.
3. On units equipped with 4WD, the Kickdown Switch (Figure 3-19), located on the end of the gear lever, can be used to select the next lowest gear providing the speed is not too high (a double beep will be heard if the speed is too fast). Press the switch to select the next lowest gear (except when in 1st gear). The transmission will downshift for approximately 6 seconds and then return to the higher gear. Pressing the button again cancels the kick down selection. Reversal of direction will also cancel the kick down selection.
4. It is recommended that the crane come to a complete stop before shifting between forward and reverse.

The following practices could result in transmission failure:

- Shifting between forward and reverse while the engine is at high speed or heavy throttle, such as when the driving wheels are in mud or snow — commonly called rocking.
- Shifting to reverse or forward while operating the engine at high speed in neutral.



- Operating the transmission at or near “stall speed” for more than 10 seconds at a time. “Stall condition” is when the engine runs at high speed while the transmission is in forward or reverse and the drive wheels are not moving. For example, when the wheels are mired in deep sand or mud, or when the crane is against a fixed barrier.
- Down shifting at high speeds causing the engine to over rev.

**Steering the Crane**

The crane can be operated in three steering modes: Two-Wheel Steer, Four-Wheel Steer and Crab Steer. These modes are selected using the steering selector switch shown in Figure 3-20.

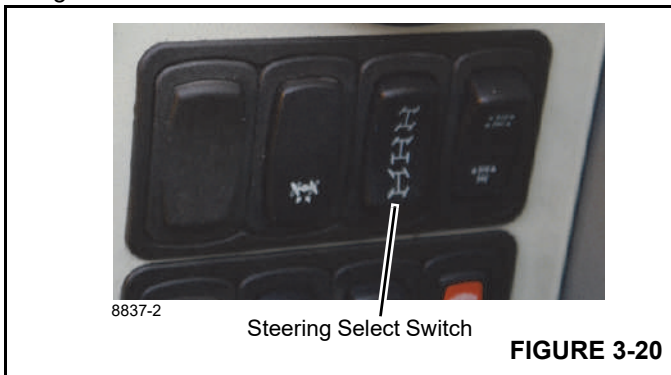


FIGURE 3-20

Before selecting different steering mode, all tires must be aligned in a straight forward position. If they are not, the steering may not index properly. Should this happen, follow the instructions later in this section for indexing procedures.

The steering modes are selected using the Steering Selector Switches shown in Figure 3-20.

**1. Two-Wheel Steer Mode**

See Figure 3-21 for the following procedure.

The front wheels steer the crane. The rear wheels remain in the fixed forward position.

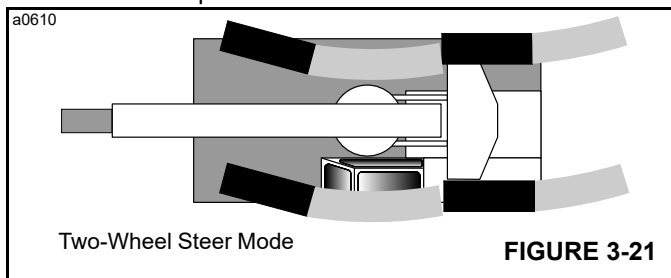


FIGURE 3-21

**NOTE:** If the rear wheels do not track with the front wheels in the two-wheel steer mode, the steering sync switch can be used to re-center the rear wheels. See 6 – Steering Sync Switch on page 3-6

**2. Four-Wheel Steer Mode.**

See Figure 3-22 for the following procedure.

**NOTE:** DO NOT travel at high speed with the crane in the four-wheel steer mode. Possible tipping may occur when turning.

The front wheels steer in the direction that the steering wheel is turned and rears wheels turn in the opposite direction. This mode allows for an extremely short turning radius. It enables the rear wheels to follow the track of the front wheels. This is an advantage in muddy or sandy conditions.

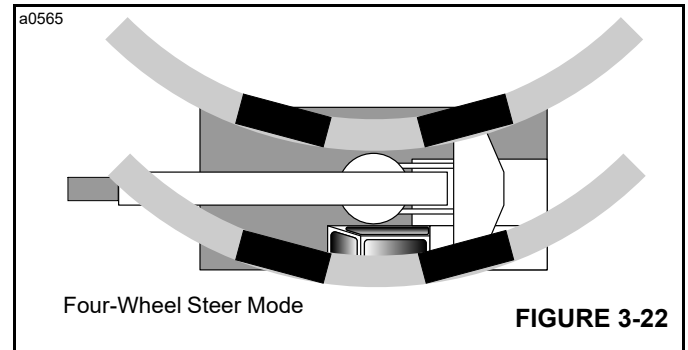


FIGURE 3-22

**3. Crab Steer Mode**

See Figure 3-23 for the following procedure.

**! DANGER**

Crane travel in crab steer mode without boom in the forward, retracted and down position can affect backward stability and possibly result in MACHINE TIPOVER.

- MAKE CERTAIN AXLE OSCILLATION LOCK-OUT IS ENGAGED.
- MAINTAIN MINIMUM REQUIRED BOOM ANGLE.
- TRAVEL SLOWLY AND AVOID JERKY STARTS AND STOPS.

All of the wheels steer in the same direction. This mode permits the operator to move the crane sideways for short distances. This feature is especially helpful in repositioning the crane in tight areas.

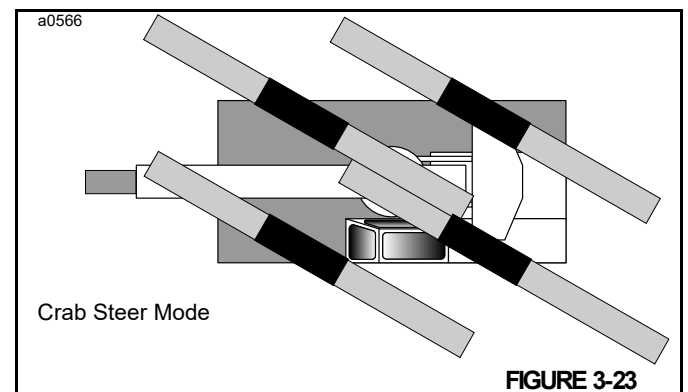


FIGURE 3-23

**Four-wheel Steering Indexing Procedure**

Use this procedure whenever a steering mode cannot be properly selected.

1. Switch to the four-wheel steer mode.
2. Turn the steering wheel until the rear wheels are aligned.
3. Once the rear wheels are aligned, switch to the two-wheel steer mode.
4. Next, switch back to the four-wheel steer mode or to the crab steer mode.

The steering mode valve will shift to the four-wheel steer mode or to the crab steer mode once the steering wheel is turned so that the front wheels are aligned. This will allow the user to align the wheels for the desired steering mode.

**NOTE:** If the rear wheels happen to get out of alignment while in the two-wheel steer mode, the user will not be able to switch back to four-wheel steer mode or to the crab steer mode without using the steer synchronize switch.

This will manually switch the steering mode valve to the four-wheel steer mode, allowing the user to align the rear wheels while in two-wheel steer mode. After this, the steer synchronize switch can be released and the steer mode switch can then be changed to four-wheel steer mode or to the crab steer mode.

### Changing Travel Direction

1. The crane must come to a complete stop before changing travel direction.
2. Move the travel select lever to the opposite travel direction.

**NOTE:** To avoid possible damage to the transmission **DO NOT** attempt to start the engine by pushing or towing with another vehicle. The power train does not allow starting this way, and transmission damage may occur.

**NOTE:** The following practices could result in transmission failure:

- Shifting between forward and reverse while the engine is at high speed or heavy throttle, such as when the driving wheels are in mud or snow – commonly called rocking.
- Shifting to reverse or forward while operating the engine at high speed in neutral.
- Operating the transmission at or near “stall speed” for more than 10 seconds at a time. “Stall condition” is when the engine runs at high speed while the transmission is in forward or reverse and the drive wheels are not moving. For example, when the wheels are mired in deep sand or mud, or when the crane is against a fixed barrier.

- Continually down shifting and over-revving the engine.

**NOTE:** The transmission electronic control unit (ECU) contains a setting that will inhibit a reversal in direction from taking place (to protect the transmission from abuse) when the traveling speed is too high. A repeated double beep of the alarm (under instrument panel) will sound until the speed drops and a reversal in direction is given, or the reversal is deselected.

### Stopping Travel

1. Apply the service brakes and down shift as necessary to slow the crane until it comes to a complete stop.
2. Place the travel select lever in Neutral (N) and engage the parking brake.

---

## 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.

---

3. Turn the ignition switch to the OFF position to stop the engine.
4. If the crane is parked and unattended, remove the ignition key.

## COLD CLIMATE ENGINE OPERATION

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

### 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 Lubrication section of your crane's *Operator Manual*, by contacting your local Grove distributor, or by contacting 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 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 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. Cold Engine Startup: After allowing the engine to warm by idling it for 3 to 5 minutes, slowly 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 Industrial Cranes:**

1. Engage the parking brake and apply the service brake.
2. Shift the transmission into the highest gear and increase the engine RPM to 1500 for 15 seconds, then allow the engine RPM to return to idle.
3. Repeat Step 2. until the temperature of the transmission sump reaches normal operating temperature.

**Alternate Warm-up Procedures for Industrial Cranes:**

1. Setup the crane on outriggers.
2. Engage the transmission and allow crane to run at idle until the temperature of the transmission sump reaches normal operating temperature.

**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:**

1. Without operating the hoist function, warm the hydraulic oil (see *Hydraulic Oil System* on page 3-17).
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.

**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 mast at a speed of less than one RPM for at least one complete revolution in one direction, then rotate the mast 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 mast at a speed of less than one-half RPM for at least two complete revolutions in one direction, then rotate the mast at a speed of less than one-half RPM for at least two complete revolutions in the opposite direction.

**Hydraulic Oil System****Operating Limits and Warm-up Procedures:**

- **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 (joystick 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 there is any unusual sound coming from the crane's hydraulic pumps or motors, stop the operation and engine immediately and contact a Grove distributor.
- **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 (joystick position) until the fluid reaches at least 10°C (50°F).
- **From 95°C to 10°C (200°F to 50°F):** Crane operation with a load is allowed with no restrictions.
- **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.

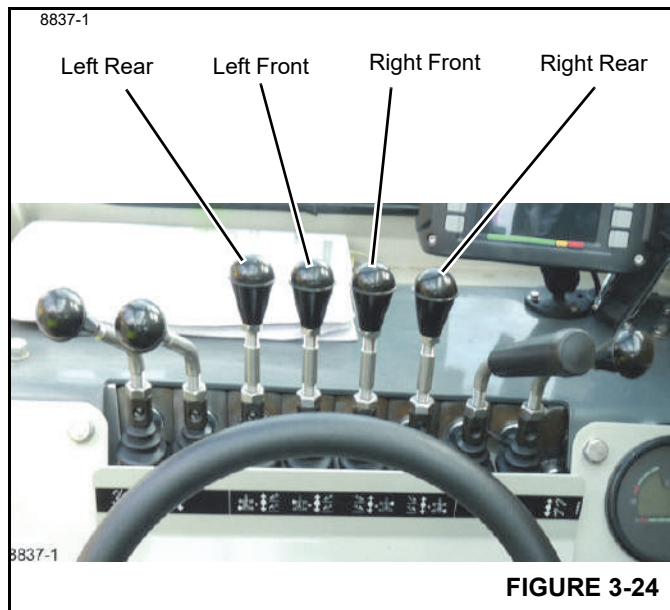
## OPERATING OUTRIGGER CONTROLS

### Raise and Lower the Outriggers

Each outrigger is independently controlled (Figure 3-24). Two or more outriggers may be simultaneously lowered or raised by simultaneously actuating the controls for each of the outriggers.

The back up/outrigger alarm at the rear of the carrier will sound while any outrigger control is being operated.

1. Determine which outriggers are to be raised or lowered; left, right or all.
2. **To Lower** - (Figure 3-25) Run the engine at idle speed (accelerator pedal released). Move the control lever forward to the LOWER position and hold it in position. Press the accelerator pedal to increase the engine speed, which will accelerate the outward movement of the outrigger. Release the accelerator pedal and the outrigger control lever when the outrigger is extended.
3. **To Raise** - (Figure 3-25) Pull the control lever back to the RAISE position and hold it in position. Press the accelerator pedal to increase the engine speed, which will accelerate the retracting speed of the outrigger. Release the accelerator pedal and the control lever when the outrigger is fully raised.



### Outrigger Monitoring System (OMS)

Optional—Standard in North America

The Outrigger Monitoring System (OMS) aids the operator by using an indicator (15, Figure 3-6) on the control panel that lights when all outriggers are fully deployed. The OMS uses four proximity sensors, one per outrigger beam, to identify when an outrigger beam is fully extended.

Set up of the outriggers is the same for cranes equipped with OMS; refer to *Operating Outrigger Controls*, page 3-18. The OMS indicator only indicates the fully extended position of the outrigger beam and should not be used to deploy the beam.

Outriggers fully retracted or outriggers fully extended are the only outrigger positions documented on the *Load Charts*.

Each proximity switch senses the presence of its respective outrigger beam until the beam reaches its fully extended position.

Proximity switch outputs are wired in series such that when all outrigger beams are fully extended, each proximity switch will no longer sense presence of its outrigger beam, the output contact will then close illuminating the green indicator on the control panel signaling all outriggers are fully extended and lifts can be made per Outriggers Fully Extended Load Chart.

Any outrigger beam not fully extended or functional failure of any proximity switch will cause the indicator to not illuminate, indicating the outrigger beams are not fully extended and lifts can only be made per the Outriggers Retracted or On Rubber Load Charts.

Outrigger beam position monitoring is not interfaced with the RCL (if equipped). The crane operator is responsible for selecting the correct load chart.



Outrigger lower - push forward  
Outrigger raise - pull backward



8837-1

**NOTE:** Left front outrigger control shown. The remaining outrigger controls work the same.



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RAISE



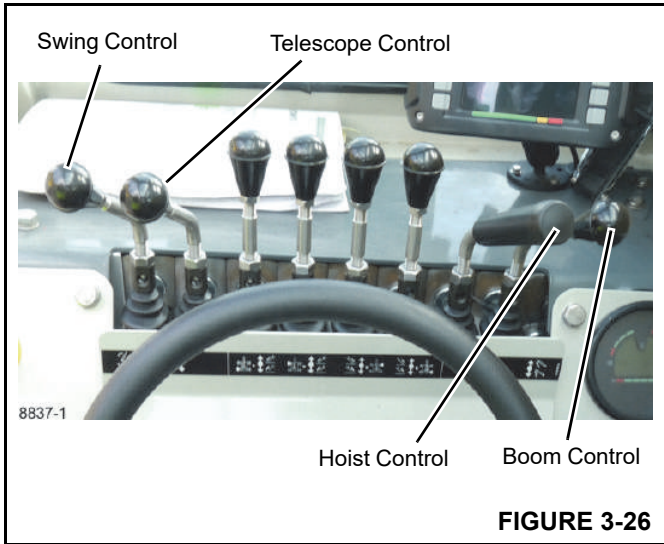
LOWER

**FIGURE 3-25**

### OPERATING CRANE CONTROLS

Four levers in the operator's cab control the crane functions. See Figure 3-26. These levers are connected directly to the main control valves.

When operating each control, press the accelerator pedal to increase engine speed to maximum RPM. Slowly move the control lever. The farther the control lever is moved the faster the function will operate. To stop function movement, move the control lever to the neutral position, then lower the engine speed to idle.



**Anti-Two Blocking System**

See Figure 3-27

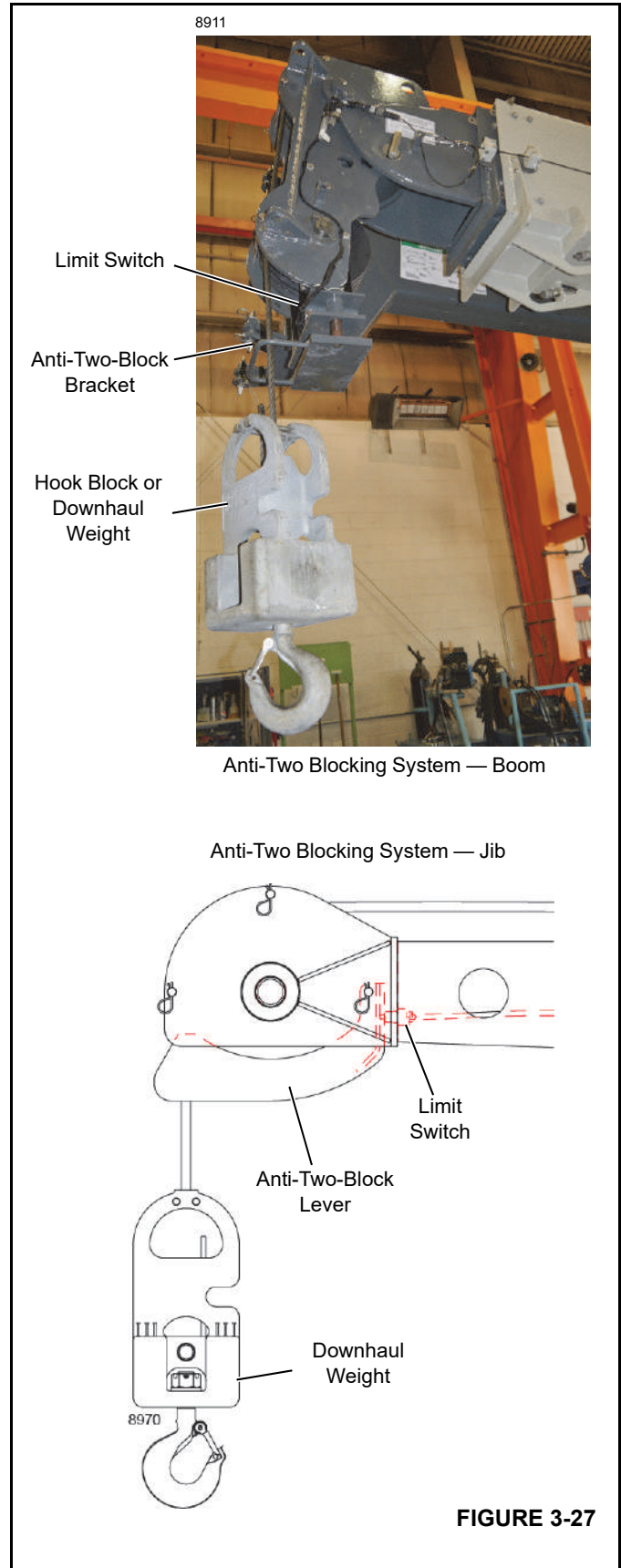
This system inhibits the hook block or the downhaul weight from being pulled into the boom or jib head during boom extension, boom raising, and load hoisting operations.

If the hook block or the downhaul weight contacts the anti-two-block bracket under the boom head or the anti-two-block lever under the jib head, the limit switch is actuated.

The limit switch stops hydraulic oil flow to the telescope out, boom lift, and hoist motor raise functions. A horn is activated to give a warning to the operator in all cases.

Before operation can resume, the hook block or the downhaul weight must be lowered away from the boom or jib head.

**NOTE: DO NOT** disconnect the anti-two-block system. Possible damage to the boom, hoist or crane could result.



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## Boom Swing Operation



Before rotating the boom, be sure there is enough clearance on all sides and that all persons are away from the area. A pinch point between the operator's cab and mast can cause injury or death.

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### CAUTION

#### Avoid Crane Damage!

Do not apply the swing lock (if equipped) while swinging. Damage to the crane can occur.

Disengage the swing lock before swinging. Damage to the crane can occur.

---

#### *To Rotate the Boom to the Left (Counterclockwise)*

Press the accelerator pedal to increase the engine speed to maximum RPM. Slowly pull back on the swing control lever (Figure 3-28) until the desired swing speed is obtained. The farther the control is pulled back the faster the boom will rotate.

#### *To Stop Rotation*

Slowly move the control lever to the neutral position and decrease the engine speed to idle.

#### *To Rotate the Boom Right (Clockwise)*

Press the accelerator pedal to increase the engine speed to maximum RPM. Slowly push forward on the swing control lever (Figure 3-28) until the desired swing speed is obtained. The farther the control is pushed forward the faster the boom will rotate.

**NOTE:** Never put side loads on the boom. Side loads can damage the swing gearbox. Move the boom so that it is directly above the load before lifting the load.

Swing Right - Push Forward  
Swing Left - Pull Backward

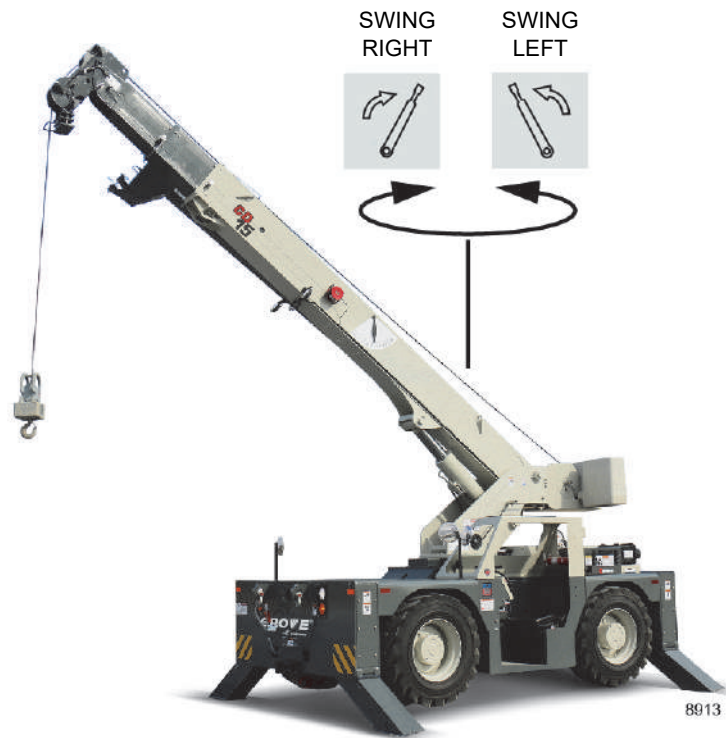
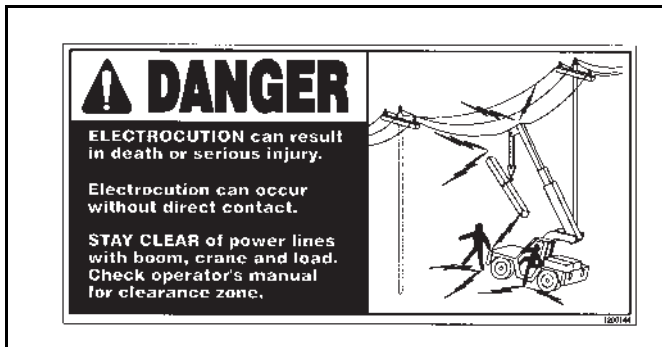


FIGURE 3-28

## Boom Telescope Operation

**NOTE:** Always operate the hoist control to unwind the wire rope when extending the boom. **DO NOT** let the hook block touch the boom head. An automatic cutout device is installed on this crane to inhibit the hook block from being pulled into the boom head. When the hook block touches the anti-two-blocking bracket (Figure 3-27) hanging from the boom head, a switch is activated and the hydraulic flow to extend the telescope cylinder is stopped. A horn will sound, warning the operator that the block has touched the bracket. The operator must then lower the hook block to stop the horn and allow for extension of the boom.

The above information also pertains when a boom extension is attached to the boom.



**NOTE:** Look for overhead obstructions before raising the boom. Possible damage or electrocution could occur if the boom comes in contact with overhead power lines.

### **To Extend the Boom Sections**

Press the accelerator pedal to increase the engine speed to maximum RPM. Slowly push forward on the telescope control lever (Figure 3-29) until the desired extend speed is obtained. The farther the control is pushed forward the faster the boom will extend.

### **To Stop Extension/Retraction**

Slowly move the control lever to the neutral position and decrease the engine speed to idle.

### **To Retract the Boom Sections**

Press the accelerator pedal to increase the engine speed to maximum RPM. Slowly pull back on the telescope control lever (Figure 3-29) until the desired retract speed is obtained. The farther the control is pulled back the faster the boom will retract.

Extend Boom - push forward  
Retract Boom - pull backward

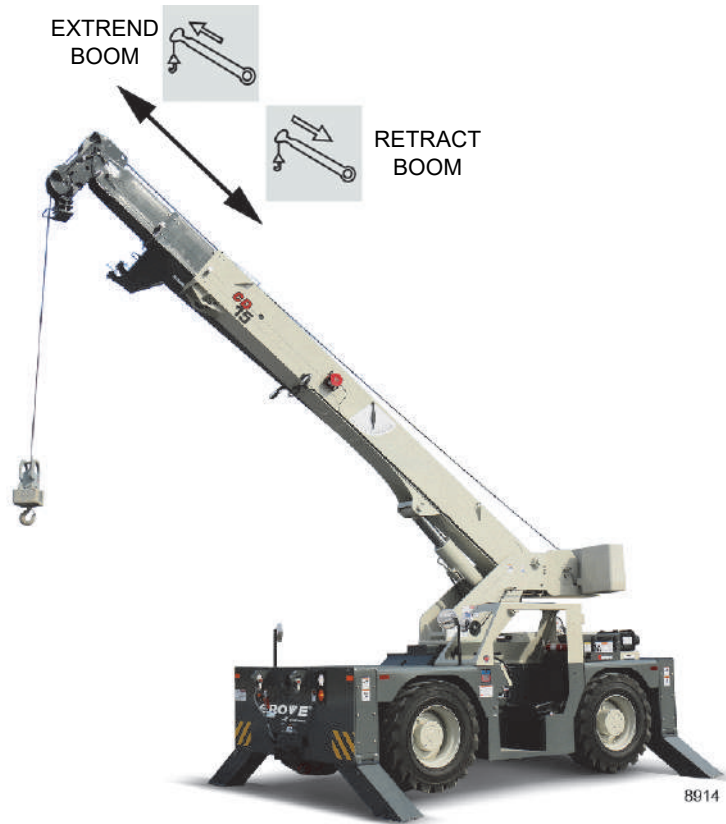
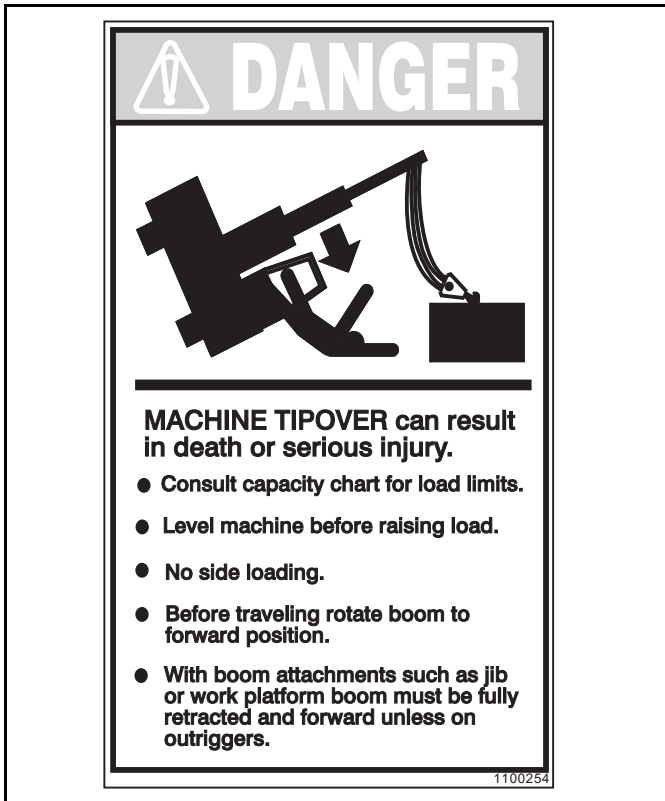


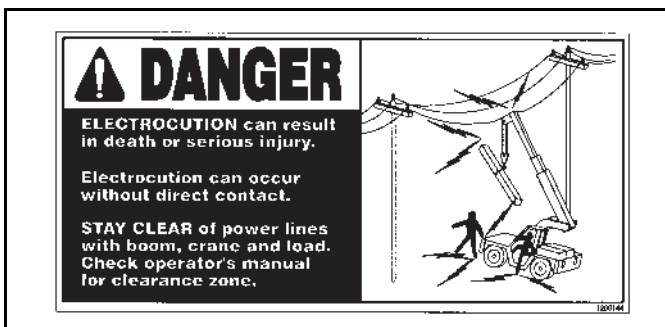
FIGURE 3-29



**Boom Lift Operation**



Know the capacity of the crane. The operator must be familiar with the crane’s capacity chart before lifting a load. See how to read the capacity chart in Section 4 of this manual. A falling load or crane tip-over can cause injury or death.



Look for overhead obstructions before raising the boom. Possible damage or electrocution could occur if the boom comes in contact with over head power lines.

Always operate the hoist control to unwind the wire rope when raising the boom. **DO NOT** let the hook block touch the boom head. An automatic cutout device is installed on this crane to inhibit the hook block from being pulled into the boom head. When the hook block touches the anti-two-blocking bracket (Figure 3-27) hanging from the boom head, a switch is activated and the hydraulic flow to extend the lift cylinder is stopped. A horn will sound, warning the operator that the block has touched the bracket. The operator must then lower the hook block to stop the horn and allow for raising of the boom.

The above information also pertains when a boom extension is attached to the boom.

**To Raise the Boom**

Press the accelerator pedal to increase the engine speed to maximum RPM. Slowly pull back on the boom control lever (Figure 3-30) until the desired raising speed is obtained. The farther the control is pulled back the faster the boom will raise.

**NOTE:** **DO NOT** fully raise the boom and dead end the cylinder. If the cylinder dead ends, the RCL will sense an overload situation and shutdown the hoist operation. The bypass switch on the RCL must then be actuated in order to resume operation.

**To Stop Boom Movement**

Slowly move the control lever to the neutral position and decrease the engine speed to idle.

**To Lower the Boom**

Press the accelerator pedal to increase the engine speed to maximum RPM. Slowly push forward on the boom control lever (Figure 3-30) until the desired lowering speed is obtained. The farther the control is pushed forward the faster the boom will lower.



Lower Boom - push forward  
Raise Boom - pull backward

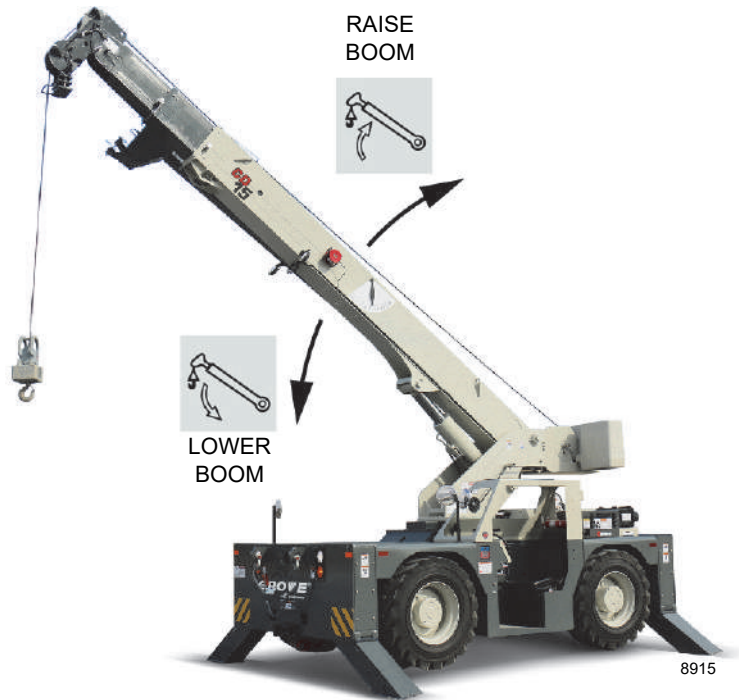
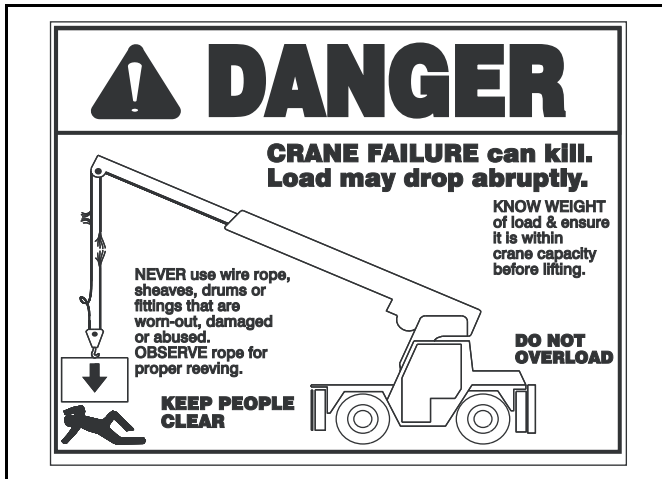
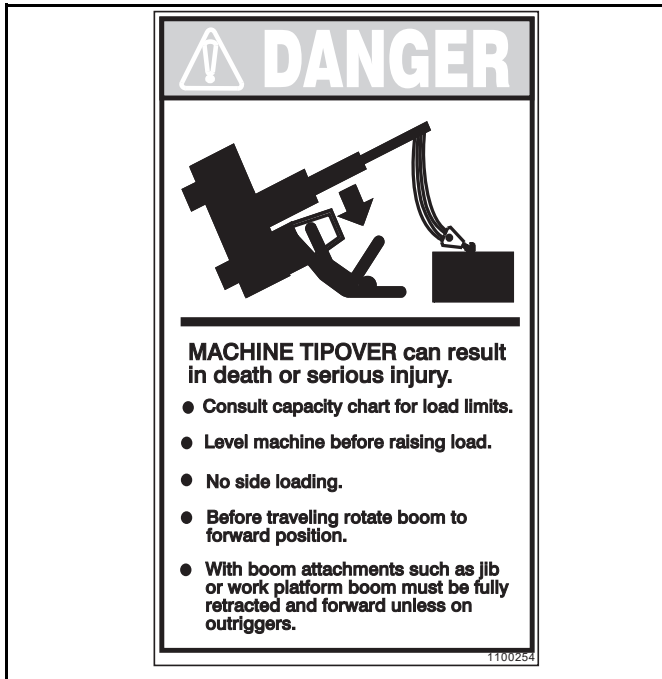


FIGURE 3-30

Hoist Operation



Before making a lift, be sure all persons are clear of the load. A falling load can cause injury or death.



Know the capacity of the crane. The operator must be familiar with the crane’s capacity chart before lifting a load. A falling load or crane tip-over can cause injury or death.

When lifting a load, keep your eyes on the load at all times. If you must look away, stop the movement of the load first. A moving load can cause injury or death.

Always have a flagman give assistance if you can not see a moving load. Be sure you can see the flagman at all times. Agree in advance to hand signals to be used. A moving load can cause injury or death and/or property damage.

Do not let the hook block touch the boom head. An automatic cutout device is installed on this crane to inhibit the hook block from being pulled into the boom head. When the hook block touches the anti-two-blocking bracket (Figure 3-27) hanging from the boom head, a switch is activated and the hydraulic flow to raise the hook block is stopped. A horn will sound, warning the operator that the block has touched the bracket. The operator must then lower the hook block to stop the horn and allow for other boom functions.

The above information also applies when a boom extension is attached to the boom.

**NOTE:** The “thumb thumper” under the hoist control handle cover will move up and down to signal the operator by feel that the hoist drum is being operated in either direction.

**To Raise the Load**

Press the accelerator pedal to increase the engine speed to maximum RPM. Slowly pull back on the hoist control lever (Figure 3-31) until the desired raising speed is obtained. The farther the control is pulled back the faster the load will raise.

**To Stop the Load**

Slowly move the control lever to the neutral position and decrease the engine speed to idle.

**To Lower the Load**

Press the accelerator pedal to increase the engine speed to maximum RPM. Slowly push forward on the hoist control lever (Figure 3-31) until the desired lowering speed is obtained. The farther the control is pushed forward the faster the load will lower.

Lower load- push forward  
Raise load - pull backward



RAISE  
LOAD



LOWER  
LOAD



FIGURE 3-31

**OPERATING OPTIONAL CONTROLS**

**Auxiliary Winch Operation**

See Figure 3-32 for the following procedure.



Always keep hands and clothing clear of the fairlead rollers and front opening while the winch is operating. Keep persons away from the area. Injury can be caused if the wire rope breaks or the hook becomes disconnected.

**To Engage/Disengage the Winch**

Pull the clutch handle out and turn it 90° to DISENGAGE the

winch clutch. This position allows the wire rope to be manually pulled off the drum.

Turn the clutch handle 90° and release it (in) to ENGAGE the winch clutch. This position allows the winch drum to be hydraulically powered.

**To Pay Out the Wire Rope**

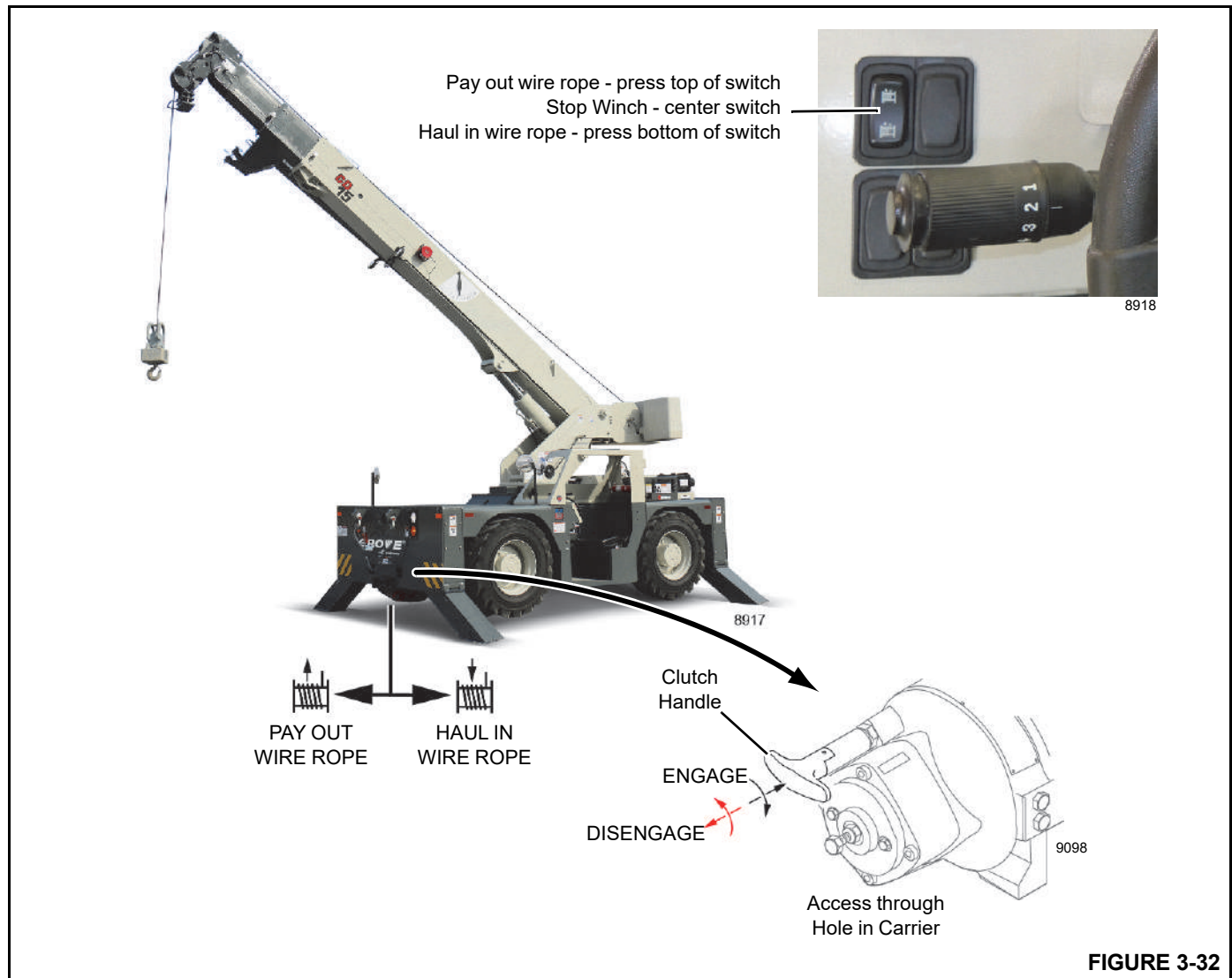
Engage the winch clutch. Hold down the top of the switch (Figure 3-32). Keep tension on the wire rope to inhibit twisting of the wire rope on the winch drum.

**To Stop the Winch**

Release the switch to the center.

**To Haul In the Wire Rope**

Engage the winch clutch. Hold the bottom of the switch.



**FIGURE 3-32**

## OPERATING PRACTICES

### Handling A Load

The crane must not be loaded beyond the specifications of the rated load chart. The load being lifted must be within the rated capacity of the crane.

When loads which are not accurately known are to be lifted, the operator of the crane must ascertain that the weight of the load does not exceed the crane ratings at the radius at which the load is being lifted.

### Attaching the Load

The hoist rope must not be wrapped around the load as the wire rope will be damaged.

The load must be attached to the hook by means of slings or other devices of sufficient capacity.

### Holding the Load

The operator must not leave the controls while a load is suspended. An exception to this is under those circumstances where a load is to be held suspended for a period of time exceeding normal lifting operations, the operator may leave the controls provided that, prior to that time, the appointed individual and operator establish the requirements for restraining the boom hoist, telescope, load, swing and outrigger functions, and provide notices, barricades or whatever other precautions may be necessary.

No person should be permitted to stand or pass under a suspended load.

### Moving the Load

1. The person directing the lift must see that:
  - a. The crane is level and where necessary, blocked.
  - b. The load is well secured and balanced in the sling or lifting device before it is lifted more than a few inches.
  - c. The lift and swing path is clear of obstructions.
2. Before starting to lift the load, the following conditions should be noted:
  - a. That the boom when extended, is laterally straight.
  - b. That the hoist rope is not kinked or damaged.
  - c. That multiple-part lines are not twisted around each other.
  - d. That the hook is brought over the load in such a manner as to minimize swinging.
  - e. If there is a slack condition in the wire rope, it must be determined that the rope is seated on the hoist drum and in the sheaves as the slack is removed.

- f. The effect of ambient wind on the load and crane stability.
3. During lifting operations care must be taken that:
    - a. There is no sudden acceleration or deceleration of the moving load.
    - b. Load, boom and other parts of the crane do not contact any obstruction.
  4. The load must not be lowered below a point where less than three full wraps of rope remain on the hoist drum.
  5. When two or more cranes are used to lift one load, one designated person shall be responsible for the operation. That person must analyze the operation and instruct all personnel involved in the proper positioning, rigging the load and the movements to be made. Decisions such as the necessity to reduce crane ratings, load positions, boom location, ground support and speed of movement must be in accordance with this determination.
  6. When rotating the boom with a load, sudden starts and stops must be avoided. Rotational speed must be such that the load does not swing out beyond the radius at which it can be controlled. A tag or restraint line must be used when rotation of the load is hazardous.

### Traveling with a Load (Pick and Carry)

**NOTE:** Pick and carry is not allowed when the boom extension is attached and used to lift the load.

When traveling with a load, a designated person must be responsible for the operation. Decisions, such as the necessity to reduce crane ratings, load position, boom location, ground support, travel route and speed of movement must be in accordance with that person's determination. Specified tire pressure must be maintained. The boom should be carried in line with the direction of travel. Sudden starts and stops should be avoided. Tag and restraint lines should be used to control swinging of the load.

### Turning Clearances

The front end of the boom extends beyond the end of the frame. The operator must be aware of the maximum sweep of the boom when turning and allow for adequate clearance between boom and other objects.

### Crane Shutdown

1. Park the crane on level ground.
2. Place the travel select lever in Neutral (N) and engage the parking brake.

**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.

3. Lower any load to the ground and fully retract and lower the boom.
4. Turn the ignition switch to the OFF position and remove the key.

**Unattended Crane**

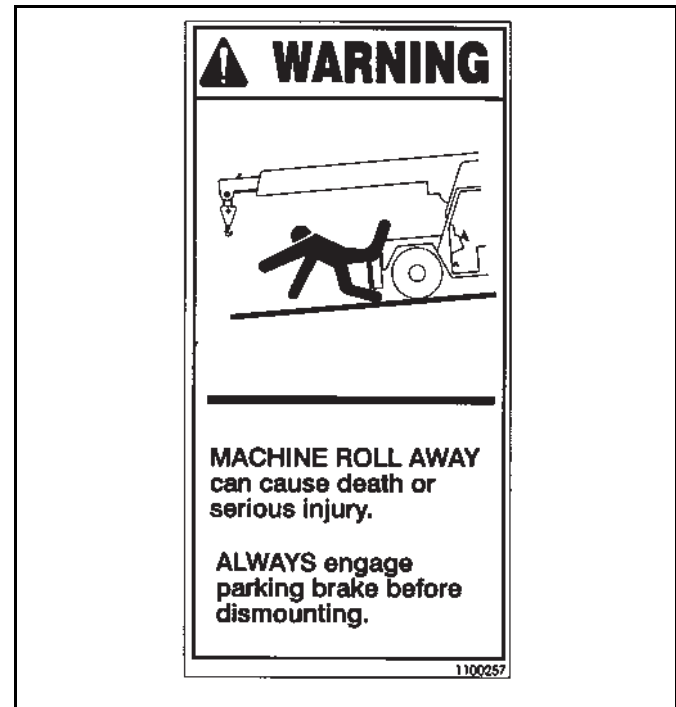
Changing weather conditions including but not limited to: wind, ice accumulation, precipitation, flooding, lightning, etc. should be considered when determining the location and configuration of a crane when it is to be left unattended.

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

**Towing A Disabled Crane**

If the crane becomes disabled and can not be moved under engine power, the crane may be towed for a distance of one mile (1.5 km) by another piece of equipment, which is designed for towing. Always use a rigid tow bar and ensure that the travel select lever and the transmission are in Neutral (N). Restrict the travel to 15 mph (25 kmph).



If it is necessary to tow the crane for a distance in excess of one mile (1.5 km), the drive shafts must be disconnected to inhibit damage to the transmission system.

**Switching LP/Gasoline Fuel (Dual Fuel Engines)**

Use the following procedure when switching from either propane or gasoline.

**CAUTION****Liquid Propane/Gasoline Fuel Switching**

Use the following procedure when switching the fuel type. Engine performance can be temporarily impaired if the procedure is not followed correctly.

1. Engage the parking brake.
2. With the engine running on either propane or gasoline, place the Dual Fuel Select Switch (4, Figure 3-5) to the center position (fuel off).
3. After the engine shuts down, push the Dual Fuel Select Switch (4) to the desired fuel type, then restart the engine.

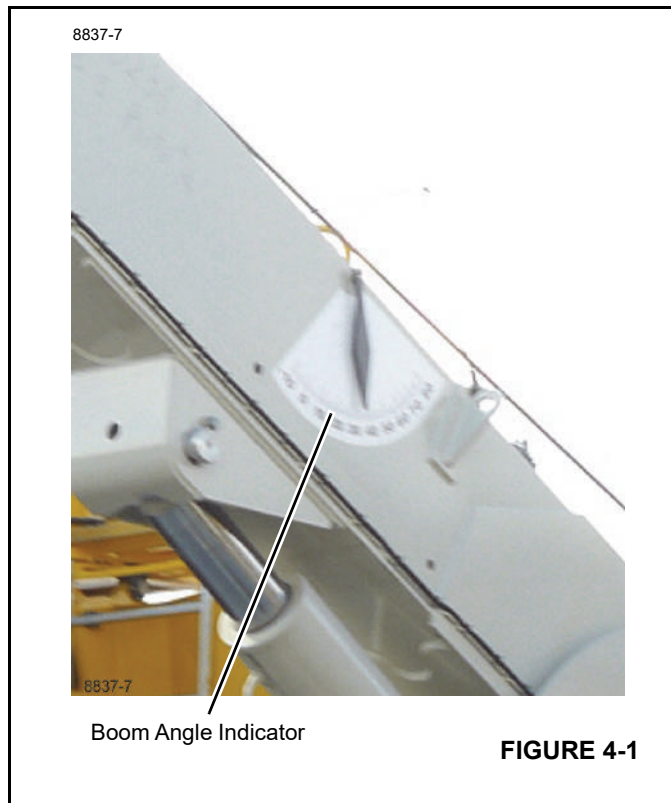
## SECTION 4 CAPACITY CHART

### SECTION CONTENTS

<p><b>Using the Capacity Chart</b> . . . . . 4-1</p> <p style="padding-left: 20px;">Determine Operating Status . . . . . 4-1</p> <p style="padding-left: 20px;">Determining Lift Capacity . . . . . 4-1</p>	<p>Things to Observe When Using the Capacity Chart . . . . . 4-2</p> <p>Determining Lift Capacity at the Boom Extension . . . . . 4-2</p> <p>Pick and Carry Ranges . . . . . 4-2</p>
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### USING THE CAPACITY CHART

The capacity chart for this crane is located on the inside of the operator's cab to the right of the seat. The chart provides maximum loads that can be safely lifted and give conditions under which these maximum lifts can be made.



### Determine Operating Status

Operating radius is the distance from the centerline of rotation to the center of the hook block or the downhaul weight, depending on which is installed.

Located on both sides of the boom is a indicator that gives the angle at which the boom is positioned (Figure 4-1). This angle along with the amount the boom is extended can be applied to the range diagram in the Load Rating Chart to determine the approximate lifting operating radius of the boom. For example, if the boom is at a 60° angle and is fully extended with the 4th section extended, the lifting radius is approximately 23 feet (7 m). See sample chart in Figure 4-3.

**NOTE:** To determine the exact lifting radius, use a tape measure and measure from the center rotation of the mast to the center of the hook on either the hook block or the downhaul weight, depending on which one is installed.

### Determining Lift Capacity

Lift capacity is the weight that can safely be raised or lowered by the crane. It is determined by two factors; structural strength of the boom and boom extension, and crane stability.

Located on the Load Rating and Range Diagram Chart are the Main Boom Load and Boom Extension Ratings. Find the approximate radius in the chart. Always use the next highest radius if the actual radius is not on the chart. Read across the line to the appropriate column to determine what can be lifted at that radius.

**NOTE:** Exceeding the capacity is dangerous and voids the crane's warranty.



## Things to Observe When Using the Capacity Chart

1. The rated loads are the maximum lift capacities as determined by operating radius, boom length and boom angle. The operating distance from a projection of the axis of rotation to the supporting surface, before loading, to the center of the vertical hoist line or tackle load applied.
2. The rated loads shown in the Capacity Chart **on Outriggers** do not exceed **85%** of actual tipping. The rated loads shown **on rubber** do not exceed **75%** of actual tipping. These ratings are based on freely suspended loads with the crane leveled, standing on a firm, uniform supporting surface. Practical working loads depend on supporting surface, operating radius and other factors affecting stability. Hazardous surroundings, climatic conditions, experience of personnel and proper training must be taken into account by the operator.
3. The weights of all load handling devices such as hooks, hook blocks, slings, jib boom, etc., except the hoist rope, shall be considered as part of the load. The weights for these items is stated on the capacity chart.
4. Ratings on outriggers are for FULLY EXTENDED outriggers.
5. Ratings on rubber depend on tire capacity, condition of the tires and proper inflation pressure of 125 psi (9 bar). Loads on rubber may be transported at a maximum speed of 2.5 mph (4 km/h) on a smooth level surface with the boom retracted to the shortest length possible and centered over the front. Do not use the boom extension with the crane on rubber.
6. For operating radius not shown on the Load Rating and Range Diagram Chart, use load rating of the next larger radius.
7. With a load both on the boom (pick and carry) and on the cranes' deck the maximum combined load is 16,000 lb. (7258 kg). The maximum load that can be placed only

on the deck with nothing attached to the boom is 20,000 lb. (9070 kg).

8. Do not induce any external side loads to the boom or the boom extension.

## Determining Lift Capacity at the Boom Extension

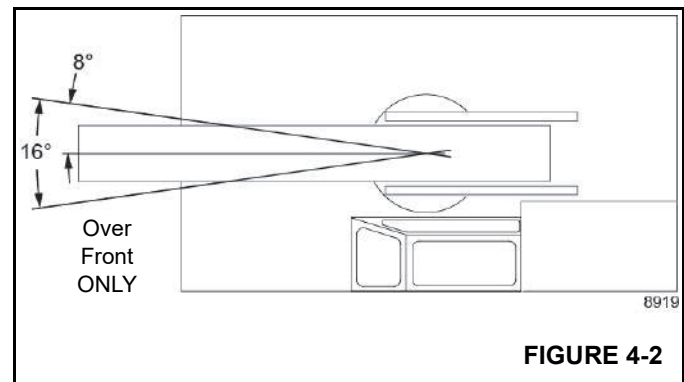
The boom extension increases the length of the boom assembly by 15 feet (4.57 m).

The capacity of the boom extension is determined in two (2) steps. First, as with the main boom, check the main capacity chart after determining the operating radius. These capacities are based on main boom strength and machine stability. Second, check the boom extension (jib boom) structural capacities after determining boom angle. These limits are based on the boom extension structural strength. Use the lesser of these two capacities such that neither is exceeded.

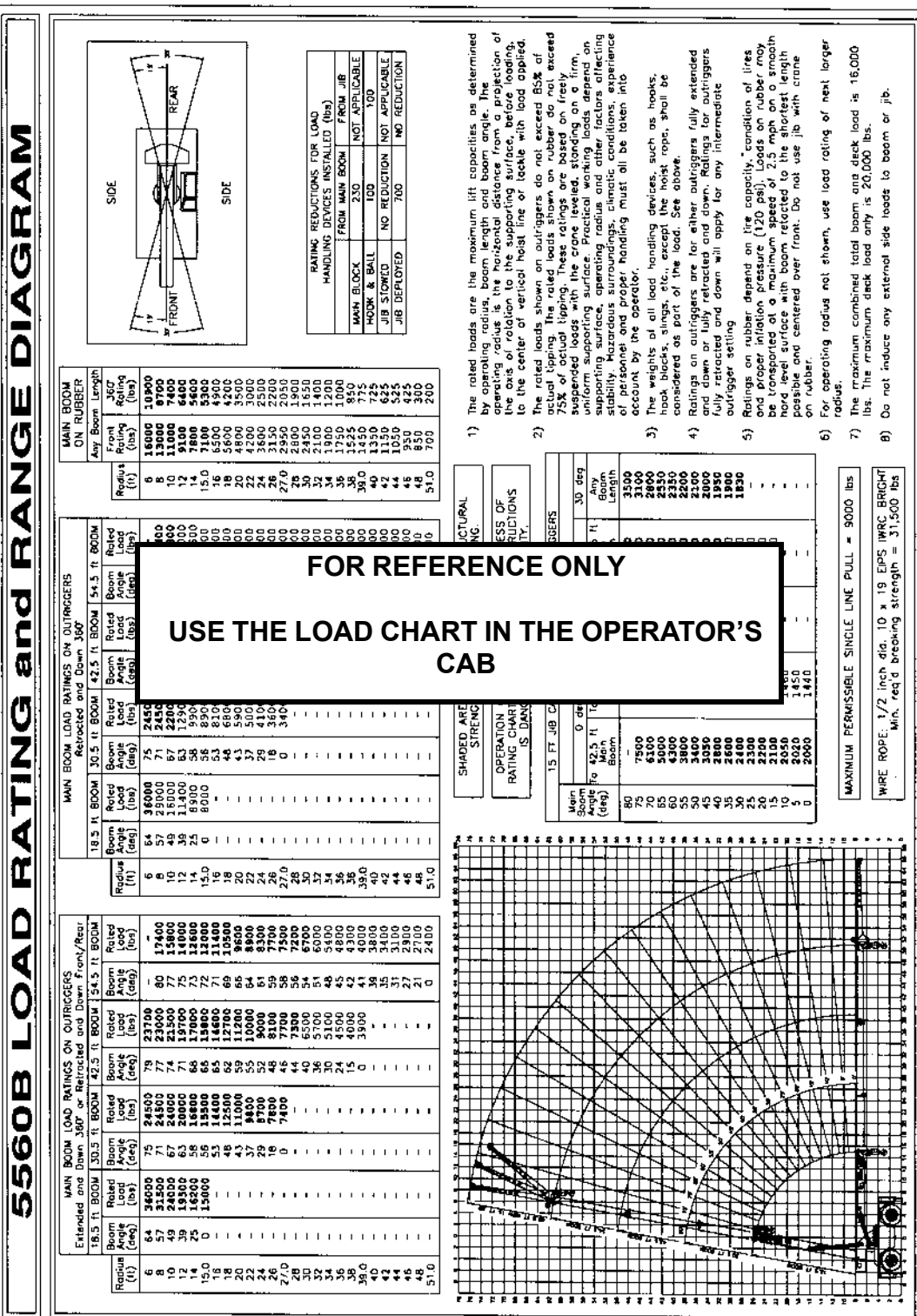
**NOTE:** Exceeding the Capacity is dangerous and voids the crane's warranty.

## Pick and Carry Ranges

Figure 4-2 illustrates the range of operation for pick and carry loads. Do not pick and carry outside of the specified ranges. The crane could become unstable and tip over.



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Load Rating and Range Diagram Chart- 4 Section Boom

FIGURE 4-3

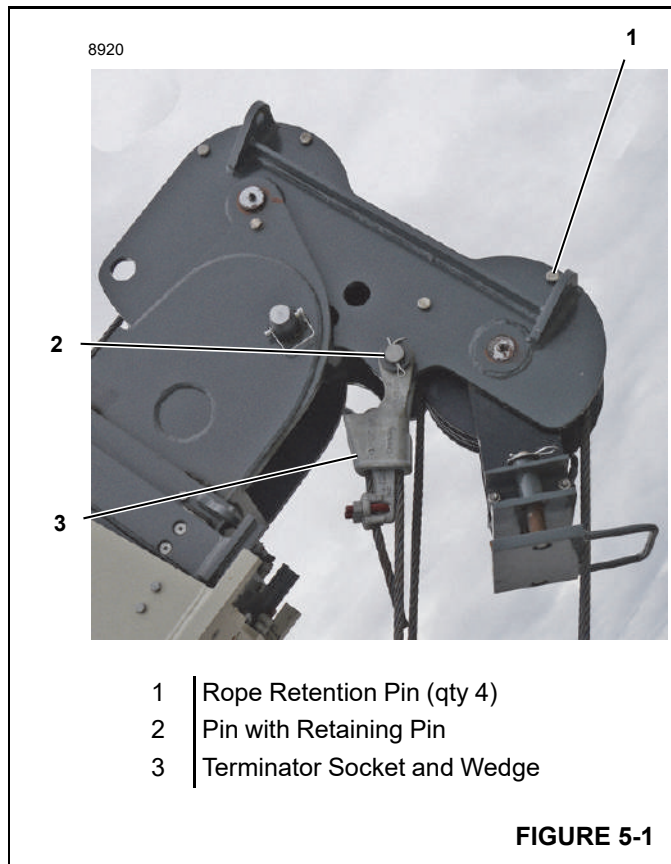


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## SECTION 5 ATTACHMENTS

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### HOOK BLOCK

#### Removing the Hook Block

1. Lower the hook block to the ground to place slack in the wire rope.

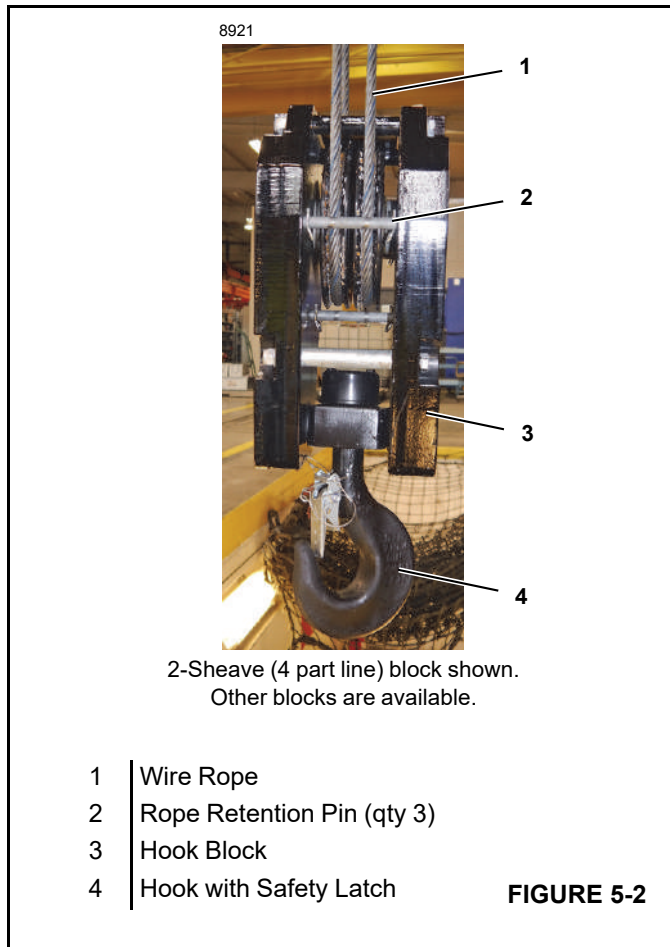
**CAUTION**

Ensure that the hook block's safety latch (Figure 5-2) does not get damaged.

2. Remove the pin (2, Figure 5-1) securing the socket and wedge socket (3) to the boom head.
3. If necessary, remove the socket and wedge from the wire rope.

**NOTE:** When removing the hook block to install the downhaul weight, the socket and wedge does not have to be removed from the wire rope.

4. Remove the three rope retention pins (2, Figure 5-2).
5. Pull the wire rope and the socket and wedge through the hook block.
6. Reinstall the three rope retention pins (2, Figure 5-2) in the hook block.



### Installing the Hook Block

1. Remove the three rope retention pins (2, Figure 5-2) from the hook block (3).
2. Attach the socket and wedge to the wire rope as shown in Figure 5-1.
3. Thread the socket and wedge and the wire rope through the sheaves in the boom head and the hook block.

4. See Figure 5-10 for the 4-part reeving diagram.
5. Reinstall the three rope retention pins (2, Figure 5-2) in the hook block (3).
6. Pin the socket and wedge to the boom head Figure 5-1.
7. Lift the hook block off of the ground.
8. Be sure the wire rope is engaged in the sheave grooves in the boom head and the hook block.
9. Be sure the rope retention pins are installed.

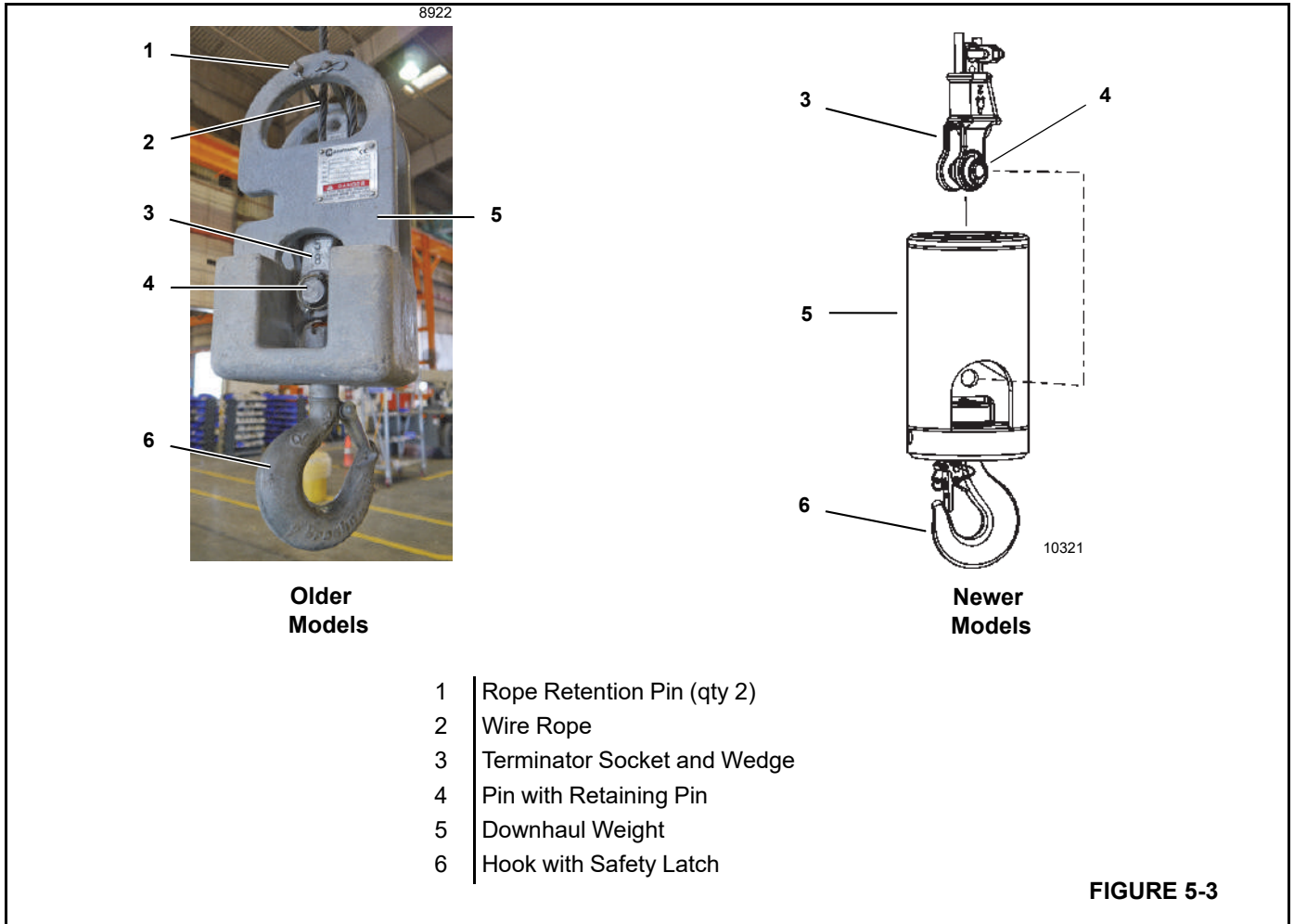
### DOWNHAUL WEIGHT

#### Installing the Downhaul Weight

1. Follow the instructions at the beginning of this section to remove the hook block. It is not necessary to remove the socket and wedge from the wire rope.
2. On older models, remove the rope retention pins (1, Figure 5-3) from the downhaul weight (5).
3. Pin the socket and wedge (3) to the downhaul (5) with pin (4).
4. On older models, install the rope retention pins (1). Be sure the wire rope is routed between the two pins.
5. Lift the downhaul weight off of the ground.

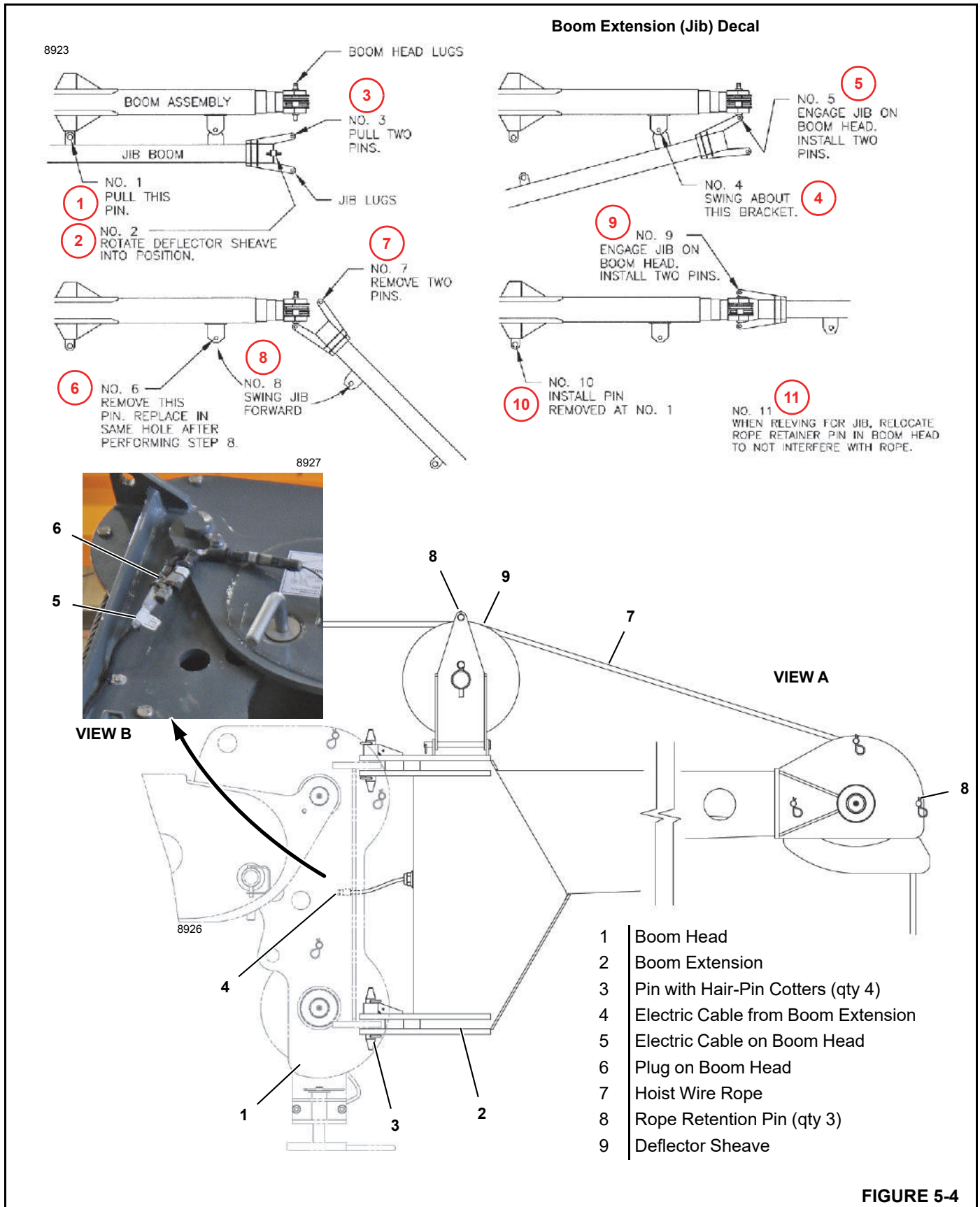
#### Removing the Downhaul Weight

1. Lower the downhaul weight to the ground.
2. On older models, remove the rope retention pins (1, Figure 5-3) from the downhaul weight (5).
3. Remove the pin (4).
4. Remove the socket and wedge (3) from the downhaul weight (5).
5. On older models, reinstall the rope retention pins (1) in the downhaul weight (5).



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## BOOM EXTENSION (JIB)

### Installing the Boom Extension

Location numbers in the following procedure are identified by red circled numbers in Figure 5-4.

1. Completely retract the boom sections and lower the boom to its horizontal position.
2. Pin the boom head in the 0° position. See Figure 5-5 and Changing the Boom Head Position (without Boom Extension) on page 5-8.
3. Remove the pin from the boom extension anchor bracket at location No. 1.
4. If necessary, pin the deflector sheave (location No. 2) in the working position.
5. Pull the two pins at location No. 3.
6. Swing the boom extension about the pivot point at location No. 4.
7. Align and engage the boom extension with the mounting holes at location No. 5 on the boom head. Install the two pins.

**NOTE:** It may be necessary to extend the boom slightly to align the holes on the boom head with the pin hole on the boom extension to install the pin.

8. Remove the pins at locations No. 6 and 7.
9. Swing the boom extension (location No. 8) away from the boom and reinstall the pin removed from location No. 6.
10. Continue swinging the boom extension around to the front of the boom head until the two pins can be installed and secured at location No. 9.
11. Remove the hook block from the hoist wire rope.
12. Remove the hoist wire rope and the socket and wedge from the boom head sheaves.
13. Remove three rope retention pins (8, View A) from boom extension sheaves.
14. Pay out the hoist wire rope and route it over the boom extension sheaves.
15. Reinstall the three rope retention pins (8, View A).
16. Disconnect the anti-two-block electric cable (5, View B) from the plug (6) on the boom head.

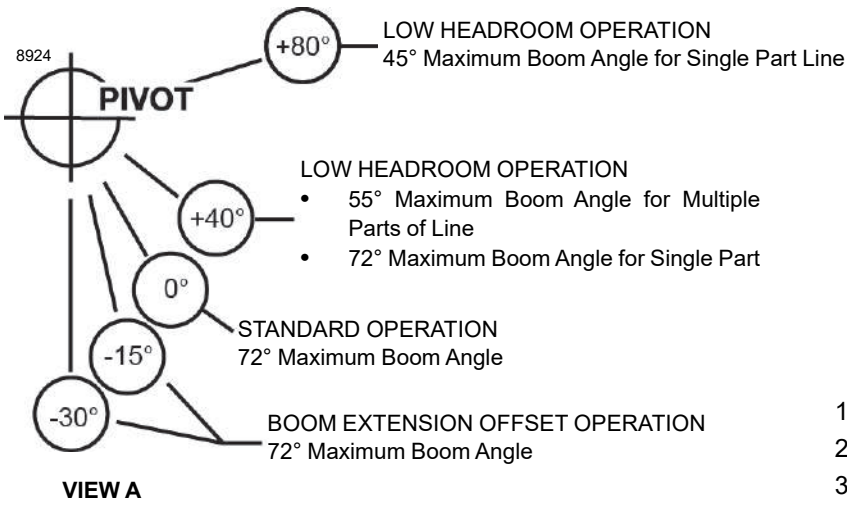
17. Connect the electric cable (4, View A) to the plug (6, View B).

18. Attach the downhaul weight to the hoist wire rope.

### Stowing the Boom Extension

Unless otherwise specified, refer to Figure 5-4 for the following procedure.

1. Lower the boom to its horizontal position. Fully retract the boom sections.
2. Pin the boom head in the 0° position (see Figure 5-5).
3. Remove the downhaul weight from the hoist wire rope.
4. Disconnect the electric cable (4, View A) from the plug (6, View B).
5. Connect the electric cable (5, View B) to the plug (6) on the boom head.
6. Remove the three rope retention pins (8, View A) from boom extension sheaves.
7. Haul in the hoist wire rope and disengage it from the boom extension sheaves.
8. Reinstall the three rope retention pins (8, View A) on the boom extension sheaves.
9. Install the hoist wire rope and the socket and wedge at the boom head sheaves.
10. Remove the two pins at location No. 9 and at location No. 6.
11. Swing the boom extension toward the stowed position until the pin removed at location No. 6 can be installed into brackets on the boom extension and the boom assembly at location No. 4. Install and secure the pin.
12. Install the two pins removed at location No. 9 in the boom extension lugs at location No. 7.
13. Remove the two pins at location No. 5 and at location 10.
14. Swing the boom extension into position so the pin removed at location No. 10 can be installed in the boom extension anchor bracket at location No. 1. Install and secure the pin.
15. Install the two pins removed at location No. 5 in the boom extension lugs at location No. 3.
16. Reeve the boom head (see Figure 5-10).
17. Install the hook block.



- 1 | Pivoting Boom Head
- 2 | Pivot Pin
- 3 | Rope Retention Pin
- 4 | Pivot Lock Pin with Safety Pin

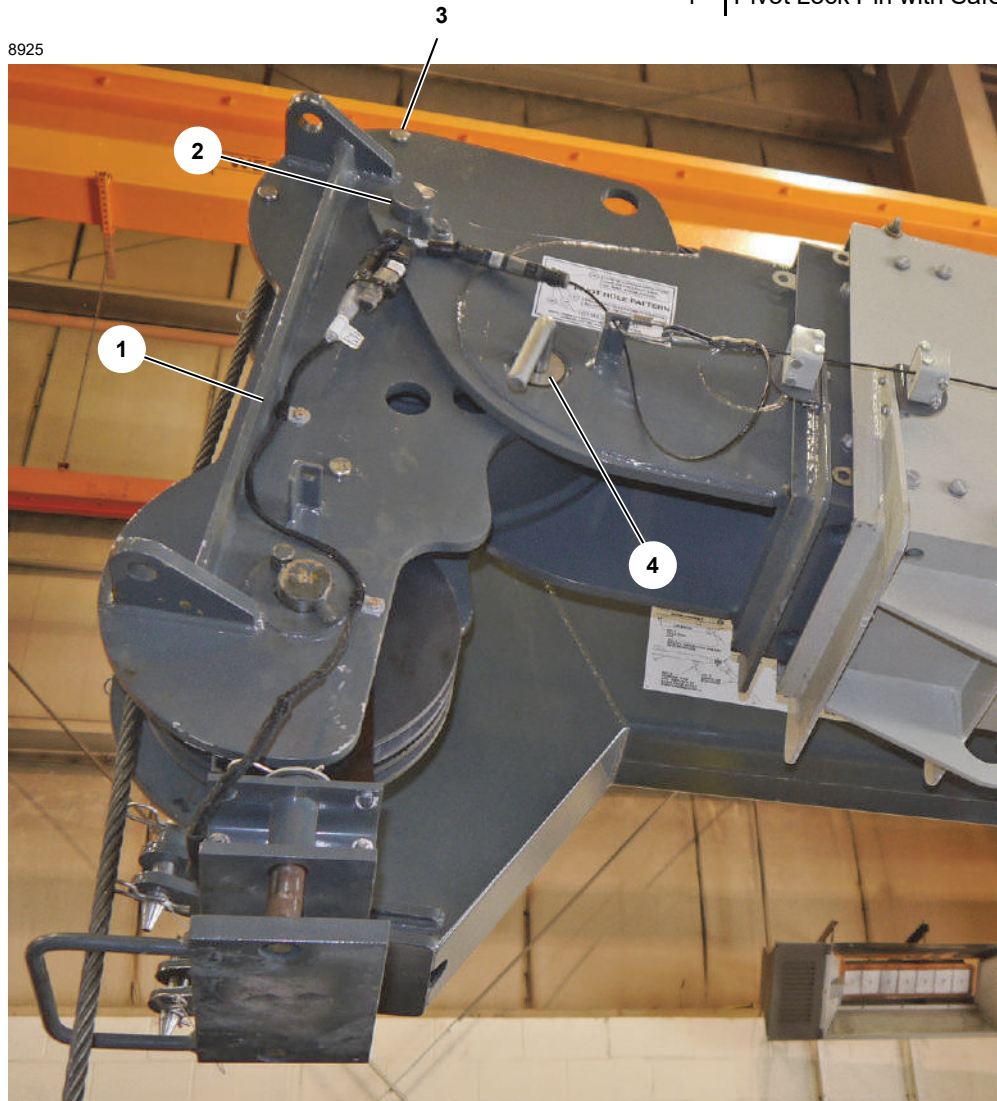


FIGURE 5-5

## PIVOTING BOOM HEAD

### Boom Head Positions

The pivoting boom head can be positioned at the angles given in View A, Figure 5-5 and operated within the specified limitations.

### Changing the Boom Head Position (without Boom Extension)

Refer to Figure 5-5, View B for the following procedure.

1. Completely retract the boom sections and lower the boom to its horizontal position.
2. Lower the hook block or the downhaul weight to the ground to take the weight off of the hoist wire rope and the boom head.

---

 **WARNING**  
**Crushing Hazard!**

The boom head is very heavy. Use another crane or hoist to support the boom head so it cannot rotate freely when the pivot lock pin is removed to change the offset angle.

Otherwise, serious injury or death may occur.

- 
3. Remove the pivot lock pin (4).
  4. Rotate the boom head so the desired hole in the boom head, 0°, +40°, or +80°, is aligned with the pivot lock pin holes.
  5. Install and secure the pivot lock pin (4).
  6. For the +80° position, remove and store the rope retention pin (3) so the hoist wire rope is not kinked against the pin.

7. Using the hoist control, raise the hook block or downhaul weight off of the ground. Check that the hoist wire rope is properly engaged with all the sheaves.

### Changing the Boom Extension Offset

---

 **WARNING**  
**Crushing Hazard!**

The boom extension is very heavy. Use another crane or hoist to support the boom extension so it cannot fall when the pivot lock pin is removed to change the offset angle.

Otherwise, serious injury or death may occur.

---

With the boom extension attached, it is necessary to raise or lower both the boom extension and the boom head simultaneously.

1. Completely retract the boom sections and lower the boom to its horizontal position.
2. Lower the downhaul weight to the ground to take the weight off of the hoist wire rope and the boom extension.
3. Attach adequate support to the end of the boom extension. Use another crane or hoist to support the boom extension.
4. With the boom extension supported, remove the pivot lock pin (4). It will be necessary to remove the weight on the pin in order to remove it.
5. Raise or lower the main boom until the desired offset hole in the boom head (0°, -15°, or -30°) is aligned with the pivot lock pin hole.
6. Install and secure the pivot lock pin (4).
7. Using the hoist control, raise the downhaul weight off of the ground. Check that the hoist wire rope is properly engaged with all the sheaves.

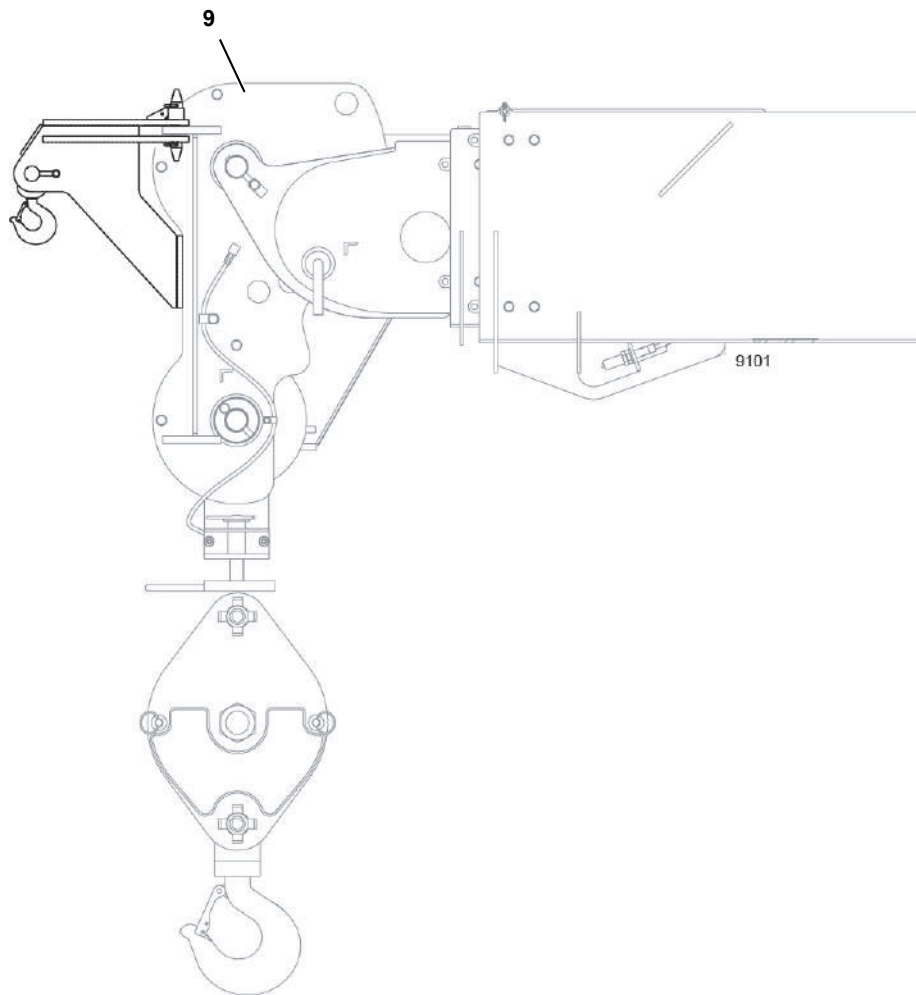
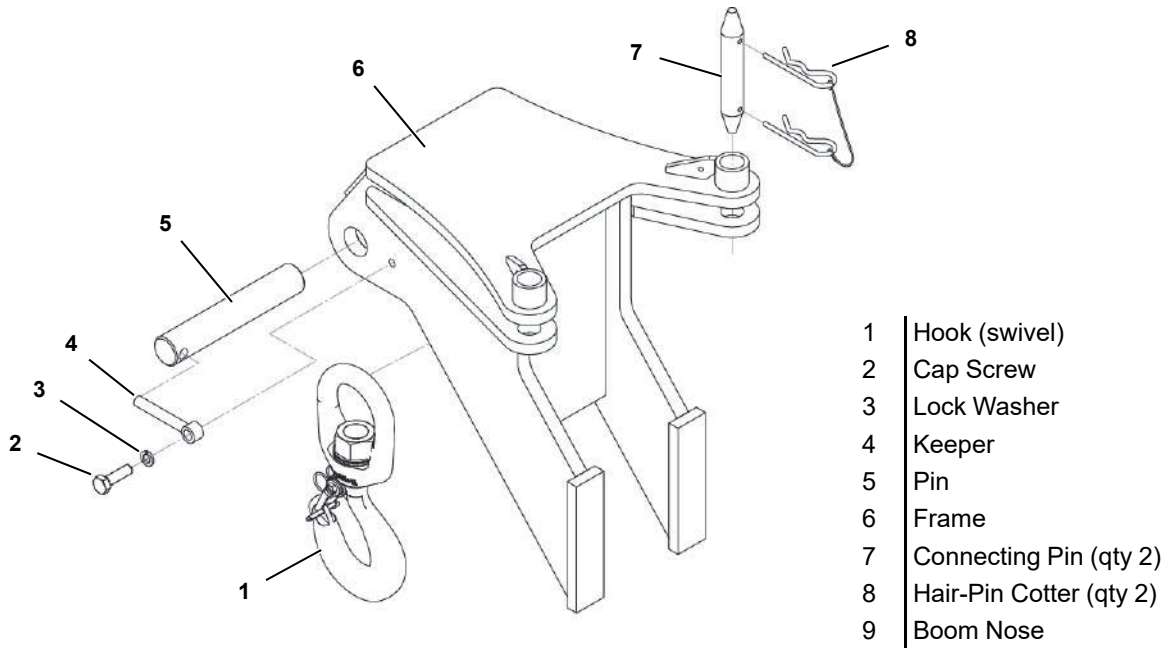


FIGURE 5-6



## SEARCHER HOOK ASSEMBLY

The searcher hook assembly mounts on the boom nose as shown in Figure 5-6.



### CAUTION

Searcher hook maximum capacity: 2722 kg (6000 lb).

Do not exceed crane stability rating shown on load chart in cab.

## Installation

1. If not already done, assemble the hook (1) to the searcher hook frame (6) with the pin (5) and the keeper hardware provided.
2. Using a suitable lifting device, lift the searcher hook assembly into position at the end of the boom nose and align the mounting lugs on the frame (6) with the lugs on the boom nose (9).
3. Install the connecting pins (7) and secure with them with the hair-pin cotters (8).

## Removal

Reverse the installation steps. Store the connecting pins (7) and hair-pin cotters (8) in the mounting lugs on the frame (4).

## INSTALLING CABLE ON THE HOIST

### CAUTION

If cable is wound from the storage drum, the reel should be rotated in the same direction as the hoist.

**NOTE:** The cable should preferably be straightened before installation on the hoist drum.

Install cable on the hoist drum in accordance with the following procedure.

1. Position the cable over the boom head sheave and route the cable to the hoist drum.
2. Position the hoist drum with the cable anchor slot on top.
3. Insert the cable through the slot and position around the anchor wedge (1) Figure 5-7.

**NOTE:** The end of the cable should be even with the bottom of the slot for the anchor wedge.

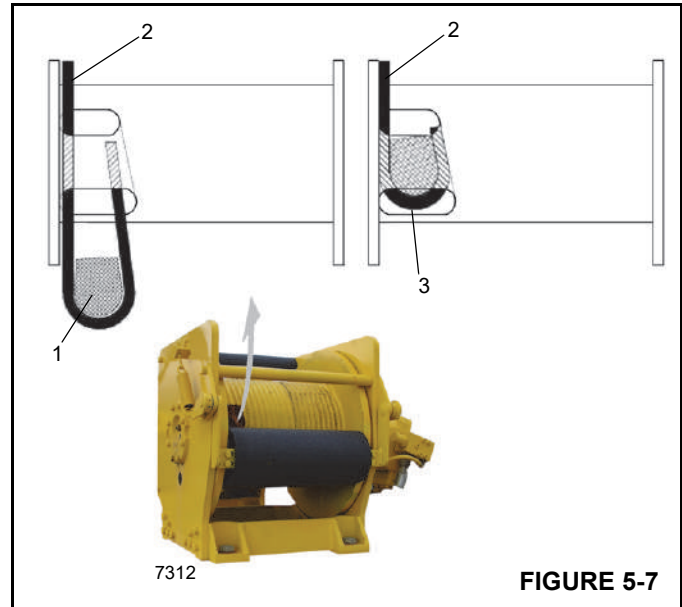
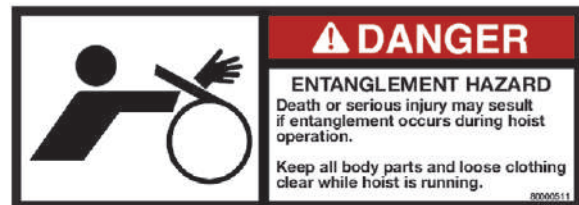


FIGURE 5-7

4. Position the anchor wedge in the drum slot; pull firmly on the free end (2) of the cable to secure the wedge.

**NOTE:** If the wedge does not seat securely in the slot, carefully tap (3) the top of the wedge with a mallet.



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5. Slowly rotate the drum, ensuring the first layer of cable is evenly wound onto the drum.
6. Install the remainder of the cable, as applicable.

## WIRE ROPE WEDGE SOCKET

1. Inspect the wedge and socket. Remove any rough edges and burrs.
2. The end of the wire rope should be seized using soft, or annealed wire or strand. If the end of the rope is welded, the welded end should be cut off. Do not weld on size 6X37 rope. This will allow the distortion of the rope strands, caused by the bend around the wedge, to adjust themselves at the end of the line. Refer to SECTION 1 - INTRODUCTION in the Service Manual for wire rope procedures.
3. Make sure the live-end (Figure 5-8) 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.

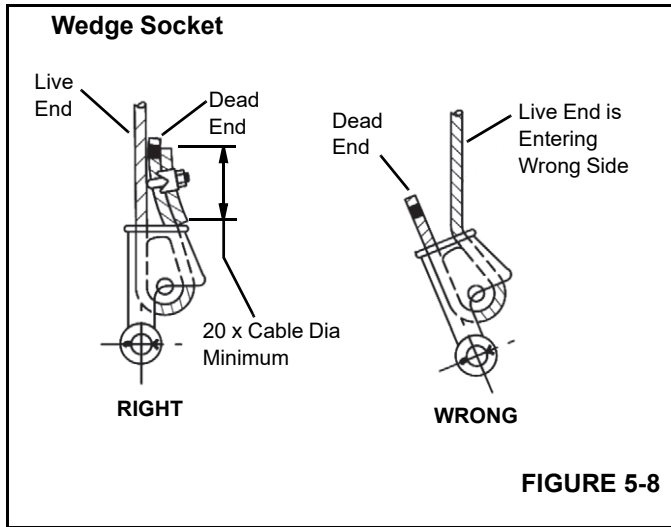


FIGURE 5-8

4. Insert the end of the wire rope into the socket, form a loop in the rope, and route the rope back through the socket allowing the dead-end (Figure 5-8) to protrude from the socket. Ensure 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-end.
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. The dead-end treatment is used to restrain the wedge from becoming dislodged from the socket should the rope suddenly become unloaded due to the hook block or the downhaul weight striking the ground, etc.

Sketches A through F (Figure 5-9) illustrate various ANSI approved 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, i.e., clipping a short piece of wire rope to the dead-end or using a commercially available specialty clip or wedge. Typically, it is recommended that the tail length of the dead-end should be a minimum of 6 rope diameters but not less than 6 in (15.2 cm) for standard 6 to 8 strand ropes and 20 rope diameters but not less than 6 in (15.2 cm) for rotation resistant wire ropes.

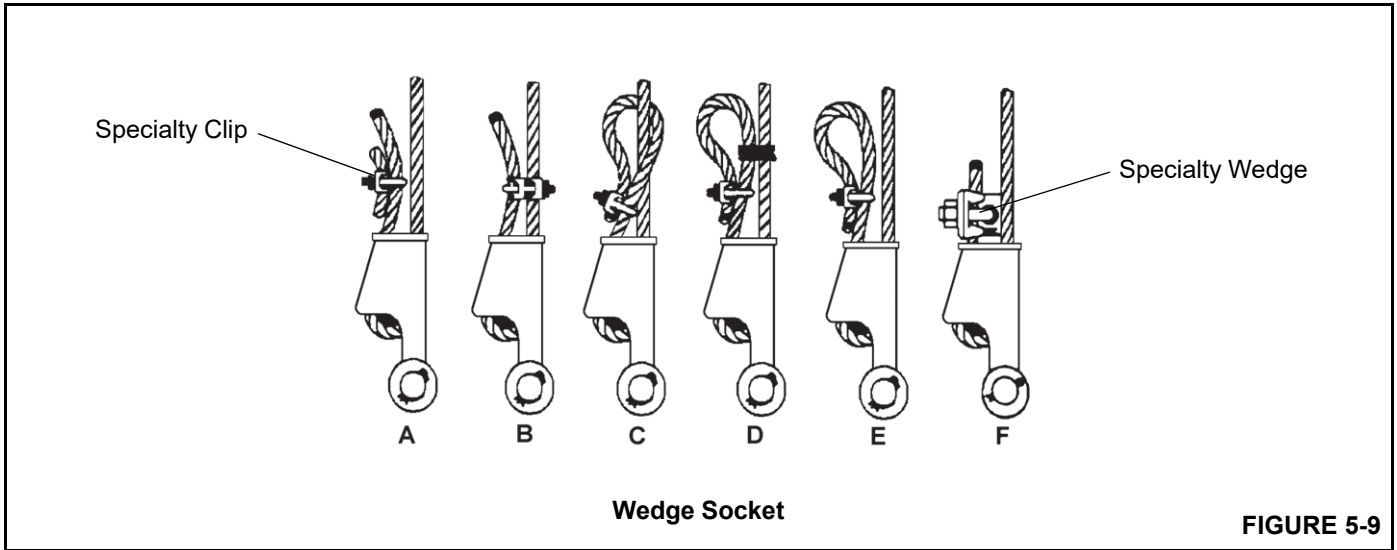
When using method A, place a wire rope clip around the dead end by clamping a short extra piece of rope to the rope dead end. **DO NOT CLAMP THE LIVE END.** The U-bolt should bear against the dead end. The saddle of the clip should bear against the short extra piece. Torque the U-bolts according to the table 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 manufacture.” Wire ropes are addressed in ASME B30.5, section 5-1.7.2, ROPES, it states, in pertinent part, “(a) The ropes shall be of a construction recommended by the rope or crane manufacturer, or person qualified for that service.” Additional information is published by the Wire Rope Technical Board in the Wire Rope Users Manual, latest revised edition.

Table 5-1

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





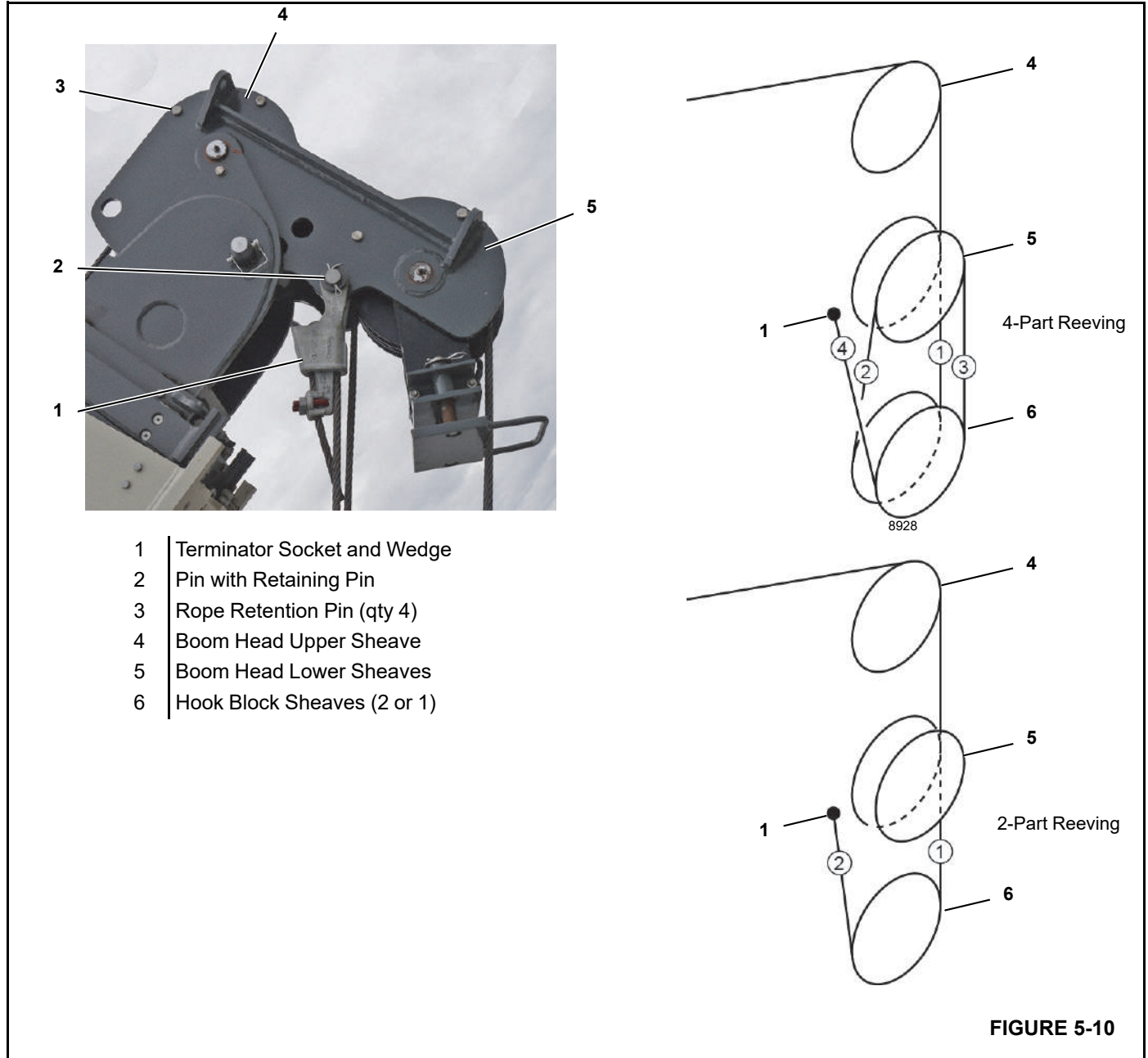
**4 PART WIRE ROPE REEVING**

Route the wire rope from the hoist over the boom head and hook block sheaves as shown in Figure 5-10.

It may be easier to route the wire rope over the sheaves if you remove the rope retention pins (1) from the boom head

and hook block. Install the pins after the wire rope is installed.

Dead end the wire rope to the boom head with the socket and wedge (1).



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## SECTION 6 MAINTENANCE

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**INTRODUCTION**

**NOTE:** Do not use gasoline or other flammable fluids to clean component parts. Fire or explosion may occur causing bodily burns.

Use eye protection when performing service or maintenance tasks. Propelled and/or dropped items can cause eye injury.

If maintenance or adjustments must be performed with the engine running, have a person at the controls while another person performs the work to inhibit accidental movement which could cause injury or death.

Preventive maintenance is necessary to keep the crane in good condition as long as possible. Adjust the maintenance schedule to your operation, according to the type of work, size of loads, temperature conditions and frequency of equipment use.

The intervals in the Maintenance Schedule are for average operating conditions, and must be understood as the **MINIMUM** maintenance necessary for the machine. Decrease these intervals if the machine is operated in conditions that are below average (for example, in dust, in high or low temperatures, with heavy loads or frequent starting and stopping.

Use the hourmeter and a calendar to make sure that all necessary maintenance is done according to the schedule.

**NOTE:** When performing service on the crane, put a tag on the key switch or remove the key to prevent operation of the crane.

**Spark Arresting Mufflers**

**NOTE:** Codes of some states or provinces may require that this crane be equipped with a **SPARK ARRESTING MUFFLER**. The State of California, as an example, is one state which has such regulations for agricultural and forestry application, plus a regulation for construction applications in

forest covered, brush covered, or grass covered lands.

**Safety List**

Inspect the following safety equipment daily:

**SAFETY BELT** - Check for frayed or cut webbing, damaged buckles or loose mounting hardware.

**SAFETY DECALS** - Check condition of decals. Replace if worn, damaged or missing.

**COVERS** - Keep all protective covers in place.

**PARKING BRAKE** - Check operation. Have unit repaired if required.

**ENGINE** - Check operation. Remove all dirt or debris, and all flammable materials before running engine.

**LUBRICANTS**

It is not the policy of The Manitowoc Company, Inc. to publish lists of approved lubricants or guarantee lubricant performance. The responsibility for the quality of the lubricants rests completely with the distributor or manufacturer of the lubricant.

In various paragraphs in this maintenance section, statements may be found, “use (lubricant brand name) or equivalent.” This statement does not constitute an unconditional guarantee of performance of the brand of lubricant mentioned. It is intended only as a guide to the type of lubricant recommended for a given application.

**MAINTENANCE RECORDS**

Dated records must be kept for inspection of critical components such as, brakes, crane hooks, wire ropes, hydraulic cylinders and relief valve pressure settings. These records must be kept where they can be easily obtained and reviewed.

## MAINTENANCE

### Preparation

Before maintenance, adjustments and repairs are started on a crane, the following precautions shall be taken as applicable:

- Place a warning tag in a conspicuous location at the controls stating that the machine requires adjustment or repair before it can be operated.
- Park the crane where it will cause the least interference with other equipment or operations in the area.
- Place all controls at the off position and set the brakes to prevent inadvertent motion.
- Disable all methods used to start the crane's engine.
- Lower the boom to the ground or otherwise secured against dropping.
- Lower the hook block to ground or otherwise secured against dropping.
- Relieve the hydraulic pressure from all hydraulic circuits before loosening or removing hydraulic components.

After maintenance, adjustments and repairs have been made, do not return the crane to service until all guards have been reinstalled, trapped air removed from the hydraulic system if required, safety devices reactivated, and maintenance equipment and all warning tags removed.

Maintenance, adjustments and repairs shall be done only by designated personnel who are properly trained. Use only Product Support supplied parts to repair the crane.

### Hydraulic System Maintenance Precautions

Contaminants in a hydraulic system affect operation and result in serious damage to the system components. Dirty hydraulic systems are a major cause of component failures.

If evidence of foreign particles is found in the hydraulic system, flush the system.

Disassemble and reassemble hydraulic components on a clean surface.

Clean all metal parts in a nonflammable cleaning fluid. Then lubricate all components to aid in assembly.

Inspect all sealing elements (O-ring, gaskets, etc.) when disassembling and assembling the hydraulic system components. Installation of new sealing elements is always recommended.

When installing metal hydraulic tubes, tighten all bolts finger tight. Then, in order, tighten the bolts at the rigid end, the adjustable end, and the mounting brackets. After tubes are mounted, install the hoses. Connect both ends of the hose with all bolts finger tight. Position the hose so it does not rub

the machine or another hose and has a minimum of bending and twisting. Tighten bolts in both couplings.

Due to manufacturing methods, there is a natural curvature to a hydraulic hose. The hose should be installed so any bend is with this curvature.

In case of replacement hoses with angled stem reusable fittings, the hose curvature must be taken into consideration when assembling and positioning the angled stem.

### Label Parts when Disassembling

When removing or disconnecting a group of wires or cables, tag each one to ensure proper identification during re-assembly.

When shims are removed, tie them together and identify them as to location. Keep shims clean and flat until they are reinstalled.

### Hydraulic Oil Recommendations

For the hydraulic oil specifications, Reference the CD15 Service Manual.

### Draining and Flushing

If a component has been changed because of a failure that might allow metal or abrasive particles to enter the system, all systems must be thoroughly checked, drained, and flushed.

1. Remove the hydraulic tank drain plug. Allow about three minutes after hydraulic oil stops flowing from the drain port for the side walls to drain.
2. Clean and install the hydraulic tank plug and fill the hydraulic tank with a 50/50 mixture of fuel oil and clean hydraulic oil.
3. Cycle the crane through all functions several times. Then return the crane to its stowed position and turn the front and rear wheels to the extreme left. Shut down the engine.
4. Remove the hydraulic tank drain plug and drain the hydraulic tank. Clean and install the drain plug and fill the hydraulic tank with clean hydraulic oil.

**NOTE:** Hydraulic oil supply lines must be connected to the cylinders when flushing the system.

Draining the various components will be aided by connecting a drain line in place of the disconnected return line.

5. Disconnect the return line from the lift cylinder and raise the boom to maximum elevation.
6. Connect the cylinder return line and lower the boom to its stowed position. Replenish the hydraulic tank hydraulic oil level as required.

7. Disconnect the return line from an outrigger cylinder and fully extend the outrigger.
8. Connect the outrigger return line and retract the outrigger. Replenish the hydraulic tank oil level as necessary.
9. Repeat Steps 7 and 8 for the remaining outriggers.

---

### CAUTION

When draining the outrigger cylinders, always operate either both front or both rear cylinders together to prevent twisting the crane.

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10. Disconnect the return line from the telescope cylinder and fully extend the boom.
11. Connect the return line and retract the boom. Replenish the hydraulic tank oil level as necessary.
12. Disconnect the return lines from steer cylinders and turn the wheels to the extreme right.
13. Connect the return lines and turn the wheels to the extreme left and then back to center. Replenish the hydraulic tank oil level as necessary.
14. Raise the crane on outriggers.
15. Disconnect the return line from the main hoist motor and fully hoist up the hoist.
16. Connect the return line to the main hoist motor and fully hoist down the hoist, then hoist up again. Replenish the hydraulic tank oil level as necessary.
17. Disconnect one of the lines from the swing motor and drive the motor in the direction it will go.
18. Connect the line to the swing motor, then drive the swing motor in the opposite direction until the boom is centered and forward. Replenish the hydraulic tank oil level as necessary.

---

### CAUTION

When hydraulic oils are changed or added, ensure that hydraulic oils of different manufacturers are of the same specifications, however, discoloration (milky) may occur. Mixing incompatible hydraulic oils may result in improper operation or damage to the machine.

---

When hydraulic oils are changed, recheck the hydraulic tank oil level after brief system operation and add hydraulic oil as required. Ensure the crane is level and in the travel mode of operation when the hydraulic system is being filled. The system must be filled with all cylinders retracted. Fill the hydraulic tank to the full mark on the sight gauge. After the hydraulic tank is filled, operate all circuits and recheck the sight gauge. Add hydraulic oil as required.

## Removing Air From the Hydraulic System

Air entering the hydraulic oil will normally be removed automatically by passage of the hydraulic oil over the baffles in the hydraulic tank. If a component has been replaced, the hydraulic tank level is too low, or a leak develops in the suction lines to the pumps, air can enter the system. If air becomes entrapped in the hydraulic oil, it may be detectable in pumps and motor operated components such as the swing mechanism and hoist(s), because it can cause these units to become noisy during operation. If noisy operation occurs, first check the level of the hydraulic tank and replenish as necessary. Then inspect for leaks in the suction lines leading to the pumps.

Minute leaks may be hard to locate. If a leak is not readily detectable, use the following way to check for it:

- Seal all normal openings in the hydraulic system and the hydraulic tank. Using a positive means to control the pressure (like a regulator), pressurize the hydraulic system to 0.138 to 0.276 bar (2 to 4 psi) and inspect all joints and fittings for evidence of leaks. A soap solution applied to the fittings and joints may also prove helpful in detecting minute leaks while the system is pressurized. Remove the pressure, repair any leaks found, and reopen any openings (such as a vent) closed for inspection. Refill the hydraulic tank after completing any repairs or service. Operate all hydraulic circuits several times in both directions.
- This action should return any entrapped air to the hydraulic tank where it can be removed from the hydraulic oil by the baffles.



### CAUTION

Always locate the machine on a firm supporting surface, extend the outriggers and level the machine and position the boom over the front to extend the boom at low angles. Injury or damage to the machine may result if this caution is not followed.

---

- To remove entrapped air from telescope cylinders, lower the boom to below horizontal and fully telescope the boom in and out several times.
- If the air is not readily removed, lower the boom to below horizontal, extend the telescope cylinders as far as practicable, and allow the boom to remain in this position overnight. This should allow entrapped air to find its way to the holding valve so that telescoping the boom IN the next morning should force the air back to the hydraulic tank. Ensure the boom is first telescoped IN (not OUT) in the morning. Telescoping OUT may cause air to be forced back into the cylinder.



**CAUTION**

Do not attempt to loosen fittings in pressurized lines or while the hydraulic pumps are in operation.

Extreme care must be used when removing any plugs or restrictions from a hydraulic system suspected to have entrapped air that may be pressurized. Moderate to minor injury may result from pressurized air in a hydraulic system.

- Entrapped air may be removed from cylinders having wet rods by cycling. On certain cylinders, a plugged port is provided on the rod end to bleed off entrapped air.
- In the event that air entrapment should persist, bleeding of air by loosening various clamp and screw type fittings may become necessary.
- If the above procedures fail to eliminate air entrapment, contact your authorized Grove distributor.

**Parts Replacement**

Parts found damaged or out of tolerance when maintenance is being performed should be replaced. Refer to the Grove Parts Catalog for proper replacement parts.

**SPECIAL MAINTENANCE****Delivery Inspection**

## Fuel Tank

- Fill with correct fuel.

## Engine

- Check oil in crankcase
- On diesel engines remove water from fuel filters and sediment bowl.

## Cooling system

- Check coolant level. Fill if level is low.

## Hydraulic Tank

- Check oil level. Fill if level is low.

## Drive Axles

- Check axle housing lubricant level and wheel hub lubricant level. Fill if levels are low.

## Hoist Gearbox

- Check oil level. Fill if level is low.

## Tires

- Check for correct air pressure.

## Wire rope cable clamps and connections

- Check for loose or missing parts.

## Anti-Two Blocking System

- Check that the system is working properly.

## Controls

- Check that all controls are working properly.

**After First 50 Hours of Operation (New Cranes)**

## Engine

- Change the engine oil and filter.

## Swing Gearbox

- Check and tighten mounting bolts.

## Hoist Gearbox

- Check and tighten mounting bolts.

## Swing Gear Pinion and Swing Gear

- Lubricate.

## Grease Fittings

- Apply grease to all grease fittings.

## Boom Slides

- Lubricate.

## Wheel Mounting Nuts

- Check Torque.

**After First 100 Hours of Operation (New Cranes)**

## Transmission

- 4WD – Replace oil, replace filter, and clean strainer (see page 6-26)
- 2WD – Replace oil and filter (see page 6-26)

**Cranes Not In Regular Use**

A crane which has been idle for a period of one month or more, but less than six months, must be given an inspection by a qualified person. This person should use the daily through monthly inspections.

A crane which has been idle for a period of over 6 months must be given a complete inspection covering all inspections through one year, by a qualified person.

Standby cranes must be inspected using the daily through monthly inspection, by a qualified person.

**PREVENTIVE MAINTENANCE**

**Maintenance Schedule and Checklist**

**NOTE:** Hour intervals in each maintenance chart show the correct time for service. The hourmeter located in the operator’s cab indicates the total hours the crane has been running.

In addition to the following scheduled maintenance, perform the scheduled maintenance suggested in the engine manual furnished with the crane.

When performing maintenance, do the required maintenance interval as well as all previous interval maintenance. For example, when performing the 250 hour (monthly) maintenance interval, perform all the tasks required for daily, 50 hour and 100 hour maintenance.

**ENVIRONMENTAL PROTECTION**

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

Potentially harmful waste used in Industrial 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.

Service Check	Daily before operation	50 Hours Weekly	100 Hours Two Weeks	175 Hours	250 Hours Monthly	500 Hours Three Months	1000 Hours Six Months	2000 Hours Yearly
Inspect the anti-two blocking system	x							
Inspect the wire rope	x							
Inspect reeving, clamps and connections	x							
Inspect the lifting hook	x							
Inspect safety devices	x							
Check controls operation	x							
Check engine crankcase oil level	x							
Check transmission oil level	x							
Check engine coolant level	x							
Check fuel level	x							
Check tire pressure	x							
Drain water from engine fuel filter	x							
Service air cleaner	x							
Check hydraulic oil level	x							
Inspect wire rope and sheaves		x						
Apply grease to all lubrication fittings		x						
Lubricate the boom slides		x						
Lubricate the boom cables		x						
Clean air cleaner duct cup		x						
Lubricate parking brake fitting		x						

Service Check	Daily before operation	50 Hours Weekly	100 Hours Two Weeks	175 Hours	250 Hours Monthly	500 Hours Three Months	1000 Hours Six Months	2000 Hours Yearly
Inspect engine fan belts			X					
Check wheel nut torque			X					
Replace the transmission oil and filter and clean the 4WD strainer *			X					
Replace engine crane oil and filter (dual-fuel engine)				X				
Lubricate the swing gear and pinion					X			
Lubricate the drivelines					X			
Lubricate the wire rope					X			
Inspect the boom cables					X			
Inspect all hydraulic hoses					X			
Replace engine crankcase oil **					X			
Replace engine oil filter **					X			
Clean radiator fins and core					X			
Clean battery and connections					X			
Torque critical bolts					X			
Check axle wheel hub lubricant level (4)						X		
Check axle housing lubricant level (2)						X		
Check hoist gearbox and brake oil level						X		
Lubricate the outrigger slides						X		
Add grease to swing gearbox						X		
Lubricate the drivelines						X		
Replace fuel filter elements (diesel)						X		
Replace fuel filter (dual fuel)						X		
Inspect the parking brake pads						X		
Inspect tires for damage						X		
Add rust inhibitor to engine cooling system						X		
Replace transmission oil filter						X		
Check swing gear to pinion backlash							X	
Replace the transmission oil and filter							X	
Clean 4WD transmission strainer							X	
Replace the axle wheel hub lubricant							X	
Replace the axle housing lubricant							X	
Replace the hoist gearbox lubricant							X	
Replace the hydraulic oil							X	
Replace the hydraulic oil filter							X	

<b>Service Check</b>	<b>Daily before operation</b>	<b>50 Hours Weekly</b>	<b>100 Hours Two Weeks</b>	<b>175 Hours</b>	<b>250 Hours Monthly</b>	<b>500 Hours Three Months</b>	<b>1000 Hours Six Months</b>	<b>2000 Hours Yearly</b>
Replace the engine coolant								X
Inspect the crane structure and boom for damage								X
Test the Rated Capacity Limiter (RCL)- optional								X

Maintenance should be performed using either the hourly or calendar dates, whichever occurs first.

\* = Service after first 100 hours of operation only.

\*\* = May require replacement more often under extremely dirty conditions.

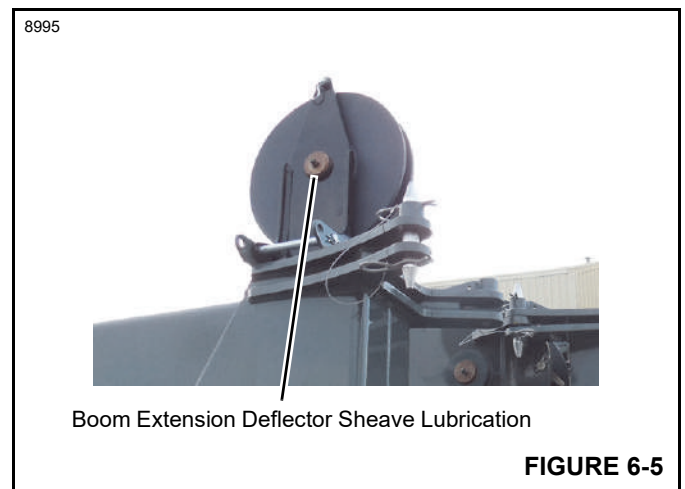
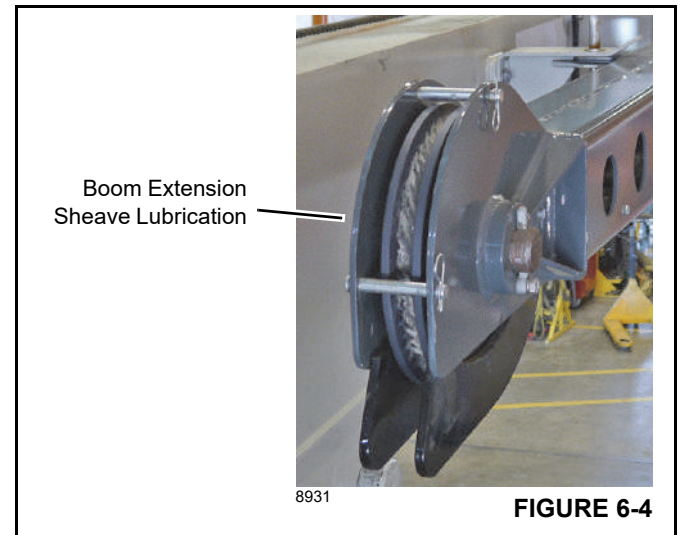
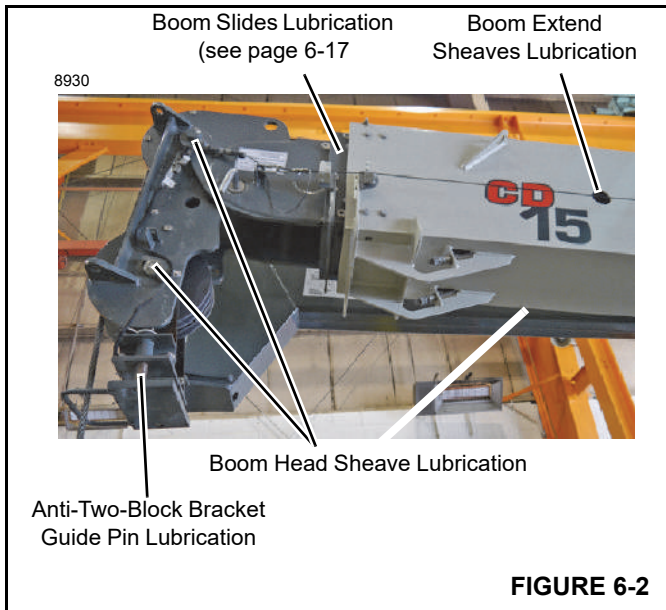
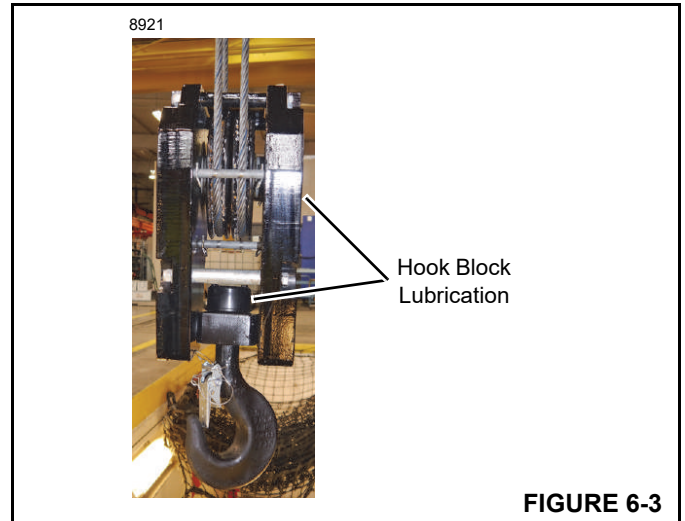
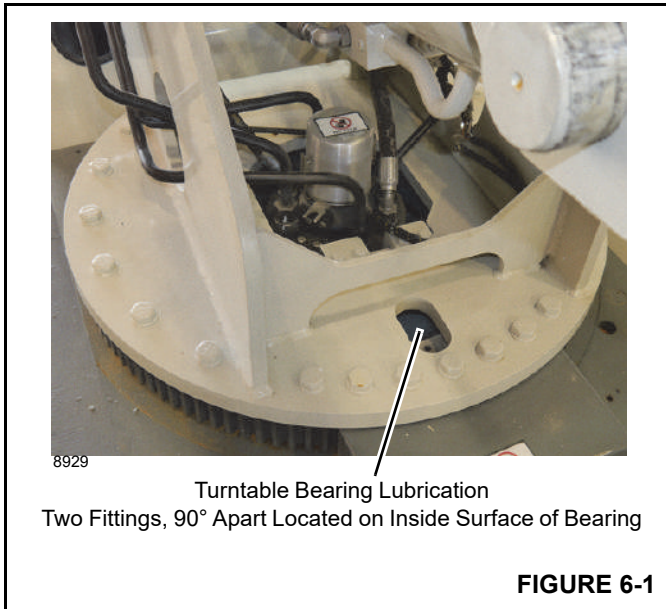
**Lubrication Points**

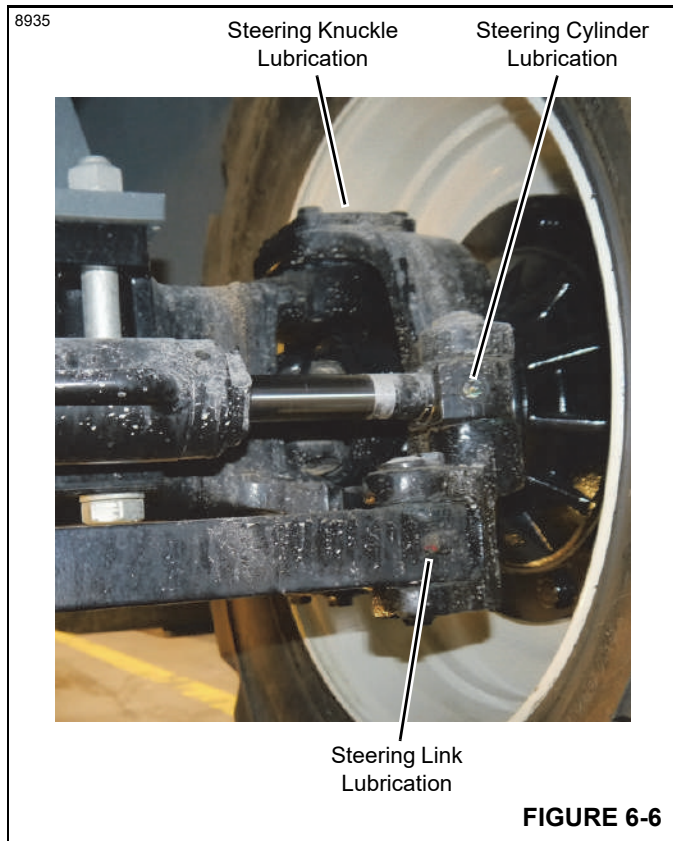
Apply grease to the following fittings after the first 20 hours of operation. Thereafter every 50 hours of operation. Use a Lithium Based, EP2 grease, or equivalent. Apply enough grease to remove the old grease.

<b>Boom and Main Frame</b>	
<b>Location</b>	<b>QTY</b>
Turntable Bearing (Figure 6-1)	2
Boom Head Sheaves (Figure 6-2)	2
Boom Extend Sheave (Figure 6-2)	1

<b>Drive Train</b>	
<b>Location</b>	<b>QTY</b>
Steering Knuckles (Figure 6-6)	2 Each Knuckle
Steering Link (Figure 6-6)	2 each Link
Steering Cylinder Pivot Pins (Figure 6-6)	2 each Cylinder
Rear Axle Pivot Pin (Figure 6-6)	2

<b>Optional Equipment and Accessories</b>	
<b>Location</b>	<b>QTY</b>
Hook Block (see Figure 6-3)	As Required (if equipped)
Boom Extension Sheave (see Figure 6-4)	1
Boom Extension Deflector Sheave (see Figure 6-5)	1
Anti-Two-Block Bracket Guide Pins (Figure 6-2)	2 (coat with anti-seize compound)





### Inspect the Anti-Two Blocking System

Test the anti-two blocking system daily before beginning operation to make sure it is functioning properly.

Raise the drop block until it hits the anti-two blocking bracket under the boom head. An alarm should sound and the raising of the hoist block should stop.

Lower the hoist block and the alarm will stop.

If there is a malfunction in the system, **DO NOT** operate the crane. Have the malfunction corrected.

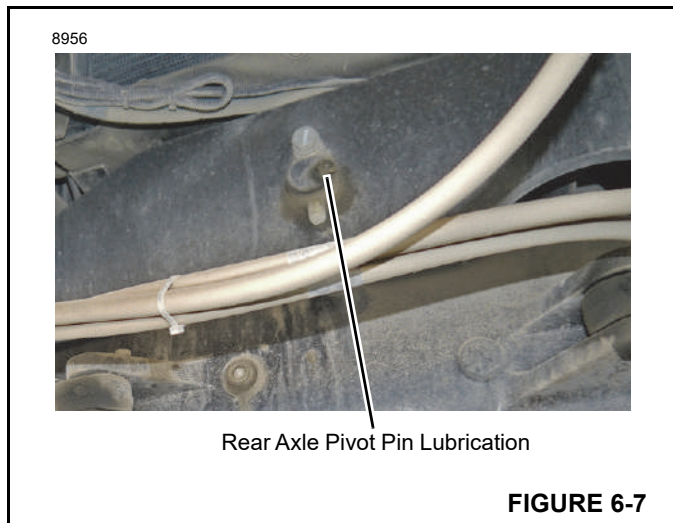
If necessary, apply anti seizing compound to the anti-two-block bracket guide pins

### Inspect the Wire Rope

Each day before beginning operation, visually inspect the wire rope for damage. See Wire Rope Inspection on page 6-16 for examples of damage that can be visually inspected for. If any damage is found, do not operate the crane. The wire rope must be replaced with a new rope before operation can resume.

### Inspect Reeving, Clamps and Connections

Each day before beginning operation, inspect for correct reeving of the boom and drop block. Inspect the terminal ends of the wire rope for damaged parts, loose clamps or wrong installation.



## DAILY WALK-AROUND INSPECTION

**NOTE:** You must read and understand the warnings and basic safety rules, found in Section 2 of this manual, before performing any operation or maintenance procedures.

For additional engine maintenance guidelines, see the engine manual furnished with this crane.

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### **WARNING**

Loads may fall if the wedge and socket is not installed properly or has damage. A falling load can injure or kill.

---

**DO NOT** operate the crane if any of the above are found. Only after correcting the problem should the crane be put back in service.

### Inspect the Lifting Hook

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### **WARNING**

Loads may fall if the lifting hook is damaged or loose. A falling load can injure or kill.

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Daily before beginning operation, inspect the lifting hook for damage; cracks, deformation, loose retaining hardware, etc. If any damage is found, **DO NOT** operate the crane until the damage is repaired.

### Inspect All Safety Devices

Daily before beginning operation, check all safety devices for proper operation. Examples of safety devices include, backup alarms, horn and beacon lights.

If any is found to be malfunctioning, correct the problem before placing the crane in service.

### Check Controls Operation

Each control should be checked for proper operation after the above inspections have been completed. Do not place the crane in service if any control is not functioning properly.

## COMPONENT/SYSTEM CHECKS

### Check Diesel or Gasoline Fuel Level

Check the fuel level daily before operation. Turn the ignition key to the ON position and view the fuel gauge on the instrument panel. If necessary, fill the tank (Figure 6-12) with recommended fuel.

Engine fuel is flammable and can cause a fire and/or explosion. Avoid personal injury or death by keeping sparks, open flames, and smoking materials away from the crane and fuel during refueling or fuel system servicing. Know the location of the fire extinguishers on the job site and how to use them.



Maintain control of the hose nozzle when filling the fuel tank. Do not allow fuel to spill. Clean up spilled fuel immediately. Dispose of clean up materials properly.



Do not fill the fuel tank to capacity. Allow room for fuel expansion.

### Check LP Gas Fuel Level

The LP gas tank is owner supplied. The crane owner should purchase a tank equipped with a fuel gauge. Check the fuel level daily before operation.

### Check the Engine Crankcase Oil Level

1. Level the crane, engage the parking brake and stop the engine.

#### 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.

2. Open the engine compartment cover.
3. Remove the engine oil dipstick (see Figure 6-8) and check the oil level. Oil should be visible within the crosshatched mark area on the dipstick.
4. If the oil is low, add recommended oil to bring the level up to the crosshatch area of the dipstick. When full, install the dipstick and close the engine compartment cover.

### Check the Transmission Oil Level

1. Check the oil level when the oil is cold. Level the crane, engage the parking brake and stop the engine.

#### CAUTION

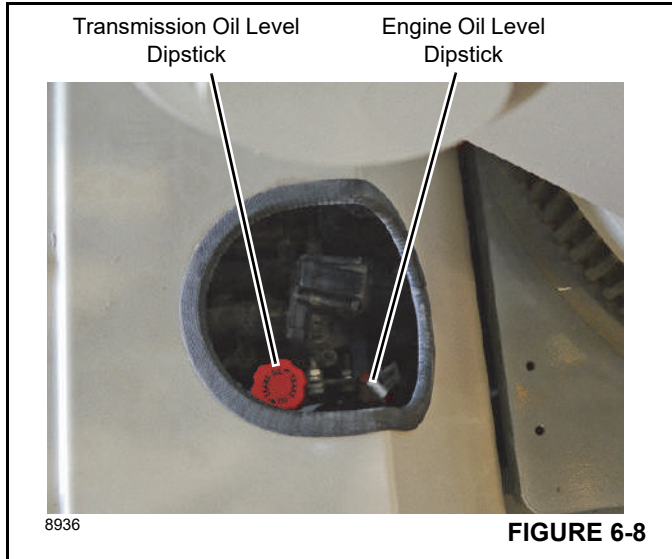
##### Avoid Crane Damage!

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

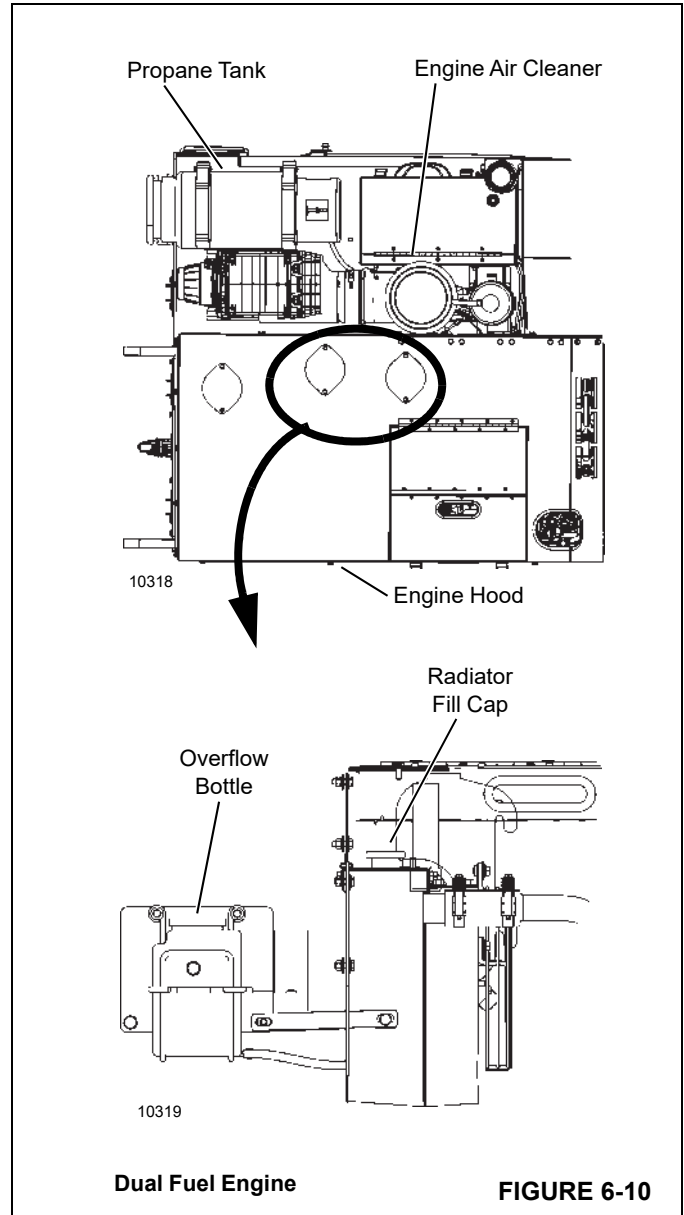
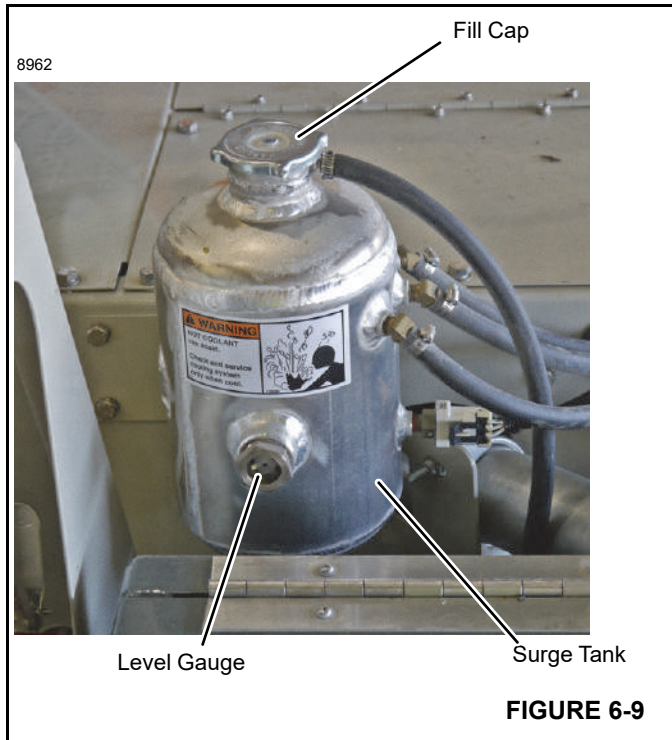
Disengage the parking brake before driving. Damage to the crane can occur.



2. Open the engine compartment cover. Remove the dipstick (Figure 6-8) and check the oil level. Oil should be visible on the dipstick between the minimum and maximum marks with the oil cold.
3. If oil is low, add recommended oil to bring the level between the marks. **DO NOT OVERFILL.** Install the dipstick. Close the cover.



**Check Engine Coolant Level**



<p><b>WARNING</b></p> <p><b>HOT COOLANT</b> can scald.</p> <p>Check and service cooling system only when cool.</p>	
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**Never** remove the fill cap while the cooling system is hot. Check the coolant level only when the coolant temperature is

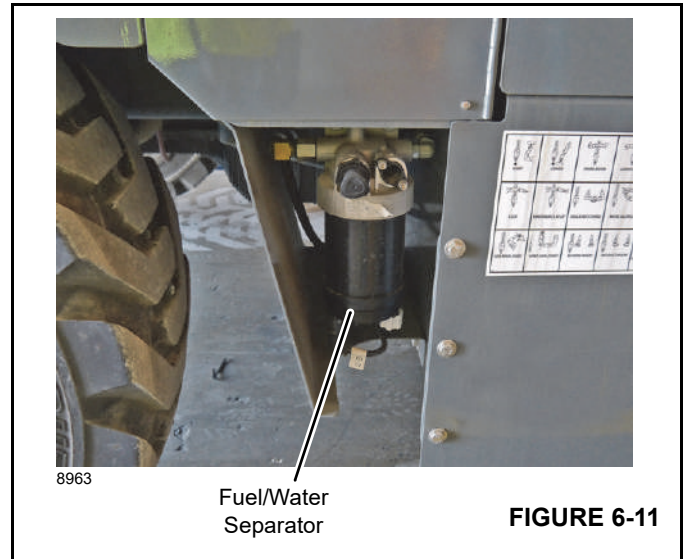
below 50°C (120°F). The system is under pressure and the coolant can cause severe burns or eye injury. Wear protective clothing and safety glasses. Always turn the cap slowly to the first stop and allow the pressure to escape before removing the cap completely.

1. Level the crane, engage the parking brake, and stop the engine.
2. For Diesel Engine (Figure 6-9):
  - a. Check the coolant level in the overflow bottle. It should be half way up the sight gauge.
  - b. If the level is low, **BE SURE THE ENGINE IS COOL —below 50° C (120° F)**, then slowly loosen the fill cap to the first stop. Allow all pressure to release. Completely remove the fill cap.
  - c. Add a 50/50 mixture of glycol antifreeze and water to the proper level. Do not add only water as this could cause rust to form in the radiator and engine.
  - d. Securely reinstall the fill cap.
3. For Dual Fuel Engine (Figure 6-10):
  - a. **BE SURE THE ENGINE IS COOL —below 50° C (120° F)**, then slowly loosen the fill cap to the first stop. Allow all pressure to release. Completely remove the fill cap.
  - b. The coolant level should be up to the cool fill line on the overflow bottle.
  - c. If the level is low, add a 50/50 mixture of glycol antifreeze and water to the proper level. Do not add only water as this could cause rust to form in the radiator and engine.

**NOTE:** For more details on proper radiator checking and maintenance procedures, refer to the engine manual that came with your crane.

### Drain Water from Engine Fuel Filter

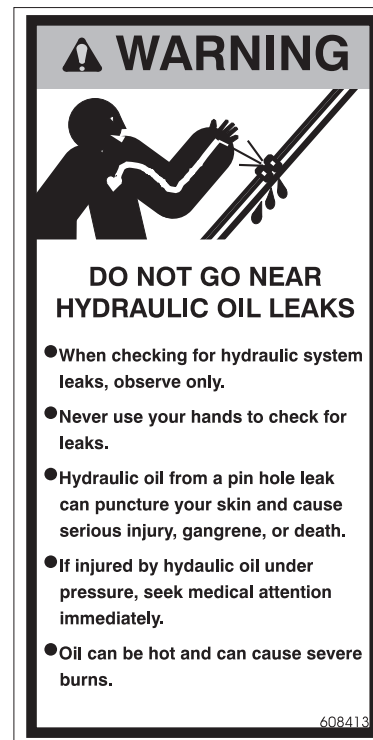
1. Engage the parking brake and stop the engine.
2. See the engine manual furnished with the crane and follow the water draining instructions from the fuel/water separator (Figure 6-11).



**FIGURE 6-11**

### Check Hydraulic Oil Level

If the hydraulic oil is consistently low, check for leaks in the hydraulic system.



1. Be sure the boom is fully retracted and lowered and the outriggers are retracted and up.
2. Level the crane, engage the parking brake and stop the engine.
3. Visually check the oil level on the hydraulic oil level sight gauge (Figure 6-12). The hydraulic oil should be 3 mm (0.125 in) from the top of the sight gauge. If low, fill tank with clean recommended hydraulic oil (Section 8).

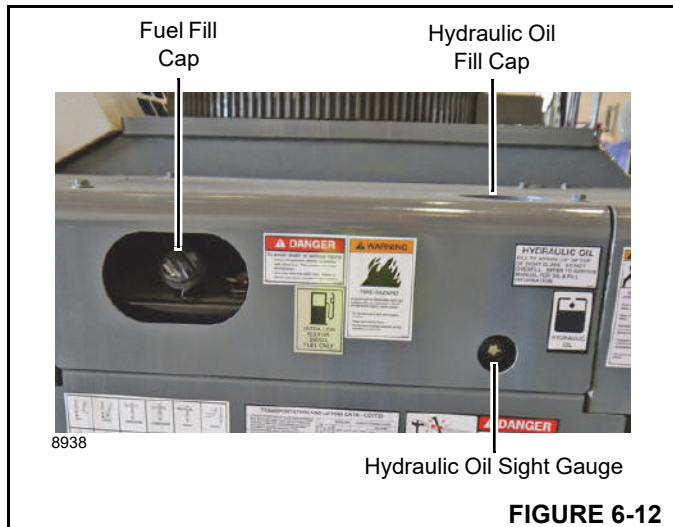


FIGURE 6-12

### Service Dual-Fuel Engine Air Cleaner

#### Inspecting Air Cleaner Indicator

The Tier 3 and dual-fuel air cleaner is equipped with a restriction indicator (1, Figure 6-13) that gives a visual indication when it is time to change the air cleaner elements.

Check the indicator with the engine running. The yellow stem in the indicator window extends as the air cleaner elements become plugged. Change the air cleaner elements when the yellow stem reaches the red zone of the window.

The yellow stem remains locked in place when the engine is stopped. The reset button on the top of the indicator can be pressed at any time. When the engine is started, the indicator stem returns to the proper reading.

Do not remove the elements for inspection. This will do more harm than good. Ridges of dirt on the gasket sealing surface can drop onto the clean filter side when the gasket is released.

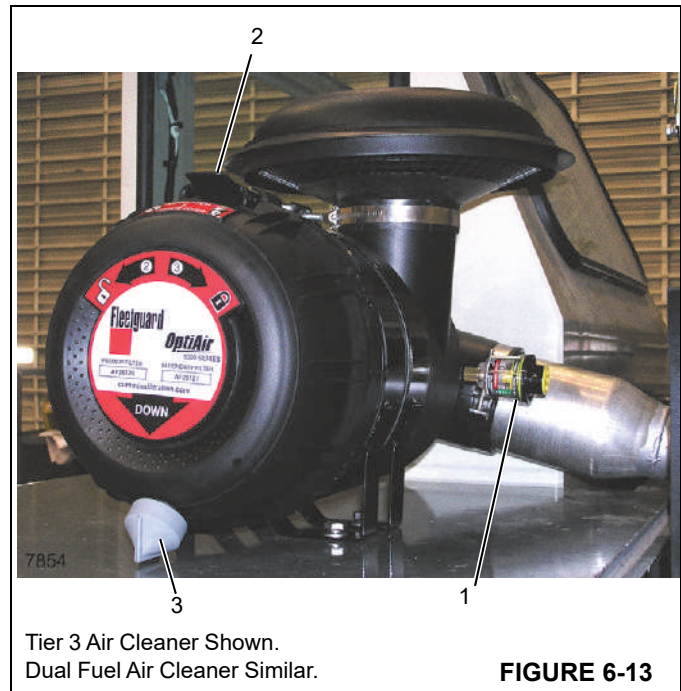


FIGURE 6-13

#### Removing Air Cleaner Elements

**NOTE:** Service the air cleaner only with the engine off. Dirt and debris can enter the engine and cause damage if the engine is operated with the air cleaner element removed.

1. Release the latch (2) to unlock the air cleaner cover.
2. Rotate the cover counterclockwise and remove it.
3. Remove the primary element as gently as possible until you get it outside of the housing.
4. Remove the secondary element.
5. Clean the inside of the housing carefully. Any dirt left inside the housing could cause damage to the engine. Use a clean, water-dampened cloth to wipe every surface clean. Check it visually to make sure it is clean before installing new elements.
6. Always clean the gasket sealing surfaces of the housing. An improper gasket seal is one of the most common causes of engine contamination. Make sure all hardened ridges are completely removed.

#### Installing Air Cleaner Elements

1. Install the secondary element into the housing and slide it all the way in.
2. Install the primary element and slide it all the way in.
3. Make sure the gasket is seating evenly. If you don't feel the gasket is seating evenly for a perfect seal, you won't have protection. Recheck to see if the sealing surface in



the housing is clean, or if the element is the right model number. It may be too short for the housing.

4. Install the air cleaner housing cover.
5. Reset the restriction indicator (Figure 6-13) by pushing in the reset button.

### Service Tiers 3 and 4 Engine Air Cleaner

The Tier 4 engine has the Cummins AIRM communications system. The AIRM calculates real-time air filter restriction at operational flow rate using the temperature and pressure input from the TBAP sensor (Figure 6-14).

Fault code (FC 5576) is initiated at the dirty filter restriction level, generating a blinking “Check Engine” light for 30 seconds at every key on until the intake air restriction drops below the dirty filter restriction threshold.

Severe warning fault code (FC 3341) is initiated if the maintenance condition degrades to a severe restriction level for a given time period, generating a solid amber “Check Engine” light and initiating a progressive engine derate to protect the engine from damage until the intake restriction drops below the dirty filter restriction threshold.

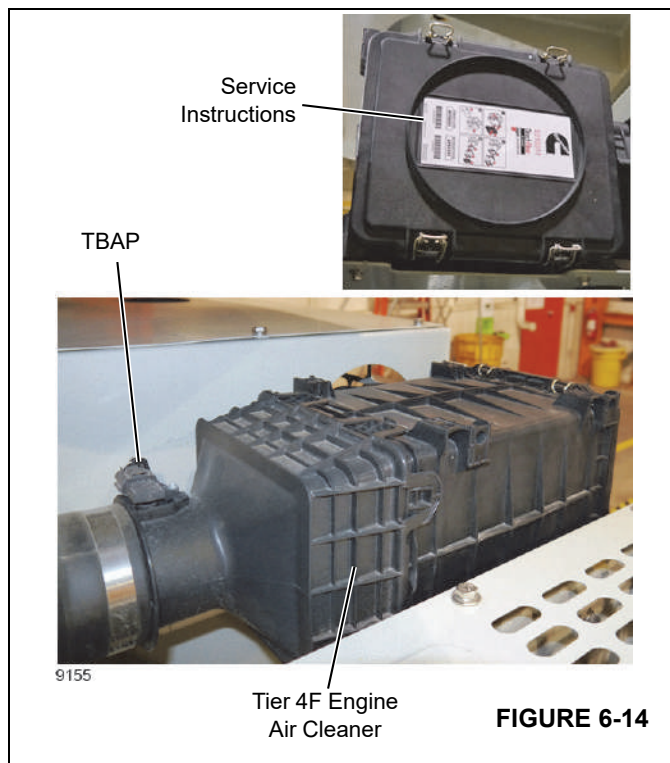


FIGURE 6-14

#### Removing Air Cleaner Elements

See Figure 6-14.

**NOTE:** Service the air cleaner only with the engine off. Dirt and debris can enter the engine and cause damage if the engine is operated with the air cleaner element removed.

1. Release the four latches to unlock the air cleaner cover.
2. Remove the primary element as gently as possible until you get it outside of the housing.
3. Remove the secondary element.
4. Clean the inside of the housing carefully. Any dirt left inside the housing could cause damage to the engine. Use a clean, water-dampened cloth to wipe every surface clean. Check it visually to make sure it is clean before installing new elements.
5. Always clean the gasket sealing surfaces of the housing. An improper gasket seal is one of the most common causes of engine contamination. Make sure that all hardened ridges are completely removed.

#### Installing Air Cleaner Elements

1. Install the secondary element in the housing and slide it all the way in.
2. Install the primary element and slide it all the way in.
3. Make sure the gasket is seating evenly. If you don't feel the gasket is seating evenly for a perfect seal, you won't have protection. Recheck to see if the sealing surface in the housing is clean.
4. Install the air cleaner housing cover.

#### Check Tire Pressure

Check the air pressure in the crane's four tires. Correct pressure is 125 psi (9 bar).

Also, check for broken studs, rim damage, loose nuts, cracks and other tire damage.

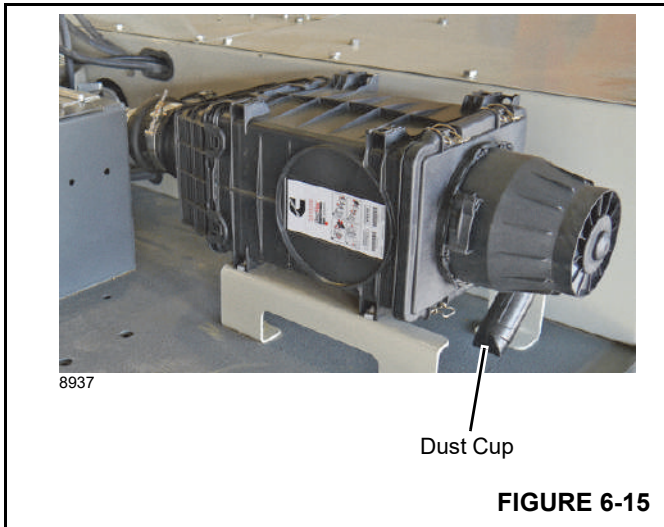
#### 50 HOURS OF OPERATION (WEEKLY)

**NOTE:** You must read and understand the warnings and basic safety rules, found in Section 2 of this manual, before performing any operation or maintenance procedures.

For additional engine maintenance guidelines, see the engine manual furnished with this crane.

#### Clean the Air Cleaner Dust Cup

Squeeze the dust cup (Figure 6-15) to remove any accumulation of dust or debris.



**Inspection**

Inspections should be carried out by a person who has learned through special training or practical experience what to look for, and who knows how to judge the importance of any abnormal conditions they may discover. It is the inspector's responsibility to obtain and follow proper inspection criteria for each application inspected.

If you are not familiar with wire rope inspection, information on how to inspect wire rope, sheaves and drums is available from your distributor. Order Wireco Report No. 107.

**General Inspection**

**NOTE:** Always wear gloves when working with wire rope to inhibit hand injuries.

1. **Wire Rope** - Inspect for damage, rust or wear to the wire rope. Keep a record of each inspection. Replace the wire rope if any of the conditions in Figure 6-16 are present.
2. **Sheaves** - Inspect sheaves for damage and/or wear. The sheave grooves must be smooth and a little larger than the wire rope. Use a sheave gauge to check the size of the sheave groove. Rough edges, narrow or worn grooves will cause damage to the wire rope. Replace any worn or damaged sheaves.

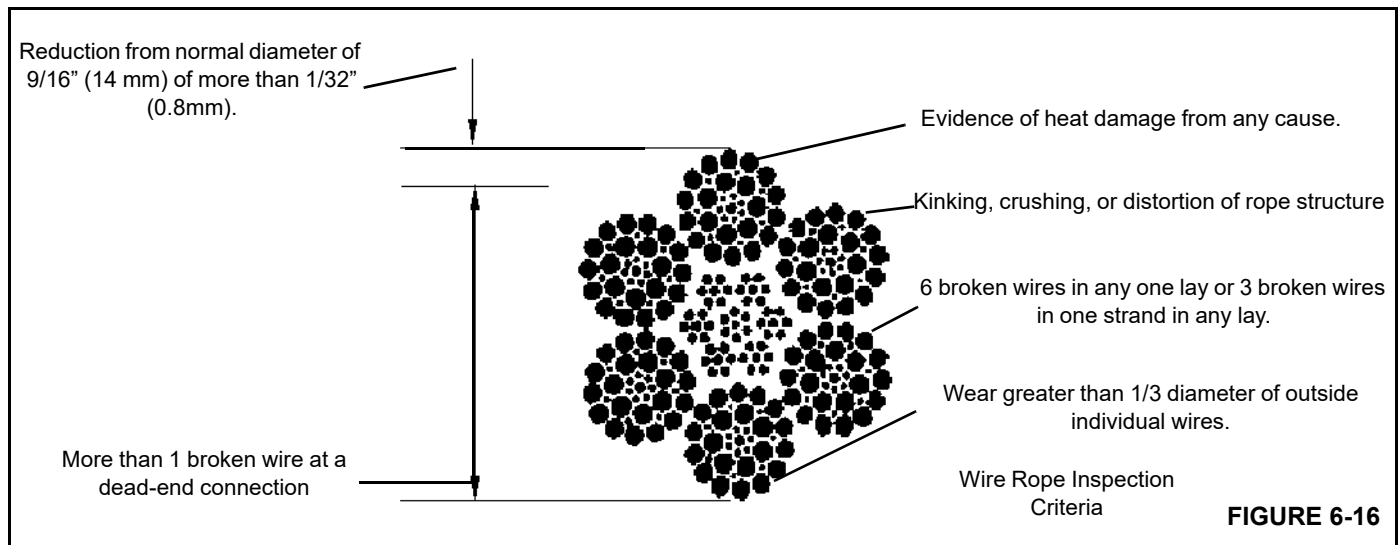
**NOTE:** As a sheave wears, the groove for the wire rope becomes smaller. The tracks on the sheave are caused by the wire rope. Yet, the wire rope will continue to engage these tracks, for example a chain engaging a sprocket. As the wire rope turns and twists on the sheave, the wire rope will move out of the worn track. This will cause increased wear on the wire rope.

**Wire Rope Inspection**

All wire ropes wear out eventually and lose work capability throughout their service life. That's why periodic inspections are critical. SAE J959, Lifting Crane, Wire-Rope Strength Factors, requires that a thorough inspection be performed and recorded on the wire rope not less often than weekly when the crane is in continuous service.

Regular inspection of wire rope and equipment should be performed for three good reasons:

- It reveals the rope's condition and indicates the need for replacement.
- It indicates if you are using the most suitable type of rope.
- It makes possible the discovery and correction of faults in equipment or operation that can cause costly accelerated rope wear.



**Grease Fittings**

Lubricate all points indicated under the heading Lubrication Points on page 6-8.

**Lubricate Parking Brake**

Apply grease to the fitting on the parking brake (Figure 6-17).

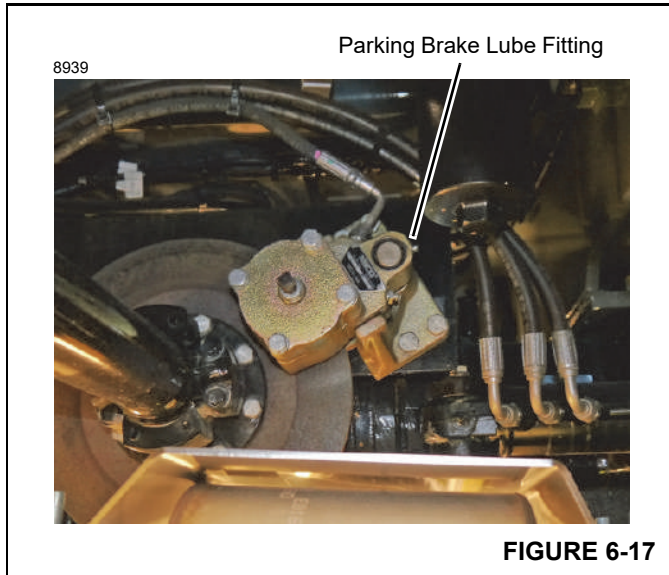


FIGURE 6-17

**Lubricate the Boom Slides**

1. Extend the outriggers. Lower the boom and then extend it to its maximum out position.
2. Engage the parking brake and stop the engine.
3. Clean the old lubricant from the boom sections.
4. Brush Lithium Based, EP2 grease, or equivalent, to the sliding surfaces (Figure 6-18) on all boom sections. Only use a small amount of lubricant for best results.

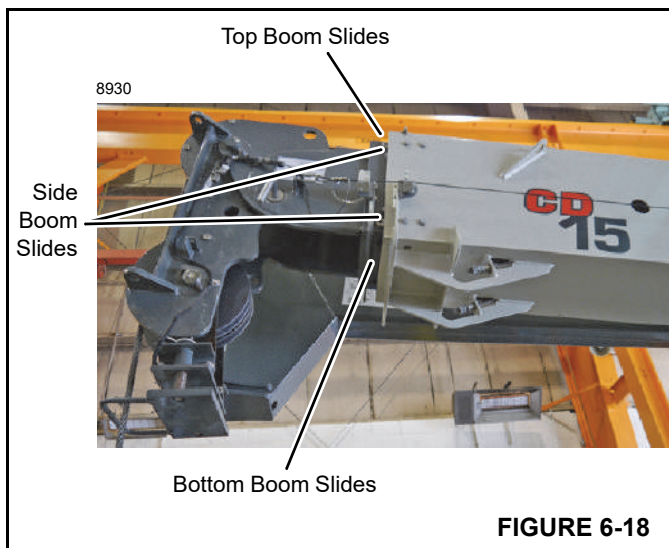


FIGURE 6-18

**100 HOURS OF OPERATION (TWO WEEKS)**

**NOTE:** You must read and understand the warnings and basic safety rules, found in Section 2 of this manual, before performing any operation or maintenance procedures.

For additional engine maintenance guidelines, see the engine manual furnished with this crane.

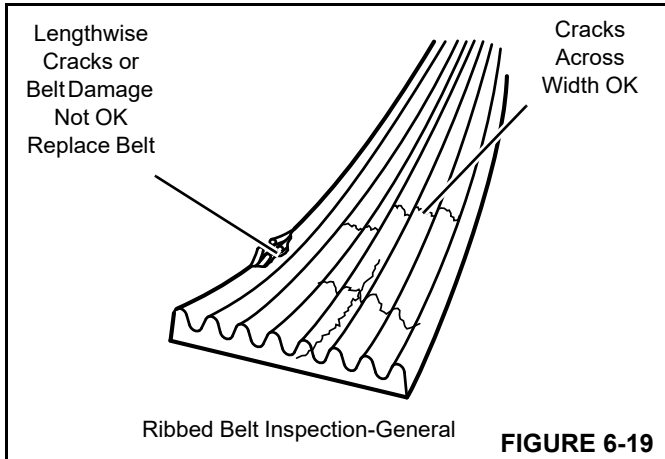
**Inspect the Fan Belts**

Keep the engine and accessory belts properly tensioned for maximum engine performance and fuel economy. Proper belt tension minimizes slippage and increases belt life.



A belt that is too loose will see excessive vibration and increased wear. A belt that is too tight produces wear on the belt and the bearings of the pulleys it travels around.

Check ribbed belts for intersecting cracks. Cracks across the belt are acceptable. Cracks along the length of a ribbed belt are not acceptable. Ribbed belts with cracks along their length should be replaced. See Figure 6-19.



Any ribbed belt showing signs of wear or that has material missing should be replaced. When a belt is replaced, check its tension again after 30 minutes of operation. New belts will stretch with use.

**Check Wheel Nut Torque**

Check the torque on each wheel nut in crisscross pattern. Wheel nut torque should be 500 lb-ft. (680 Nm).

**175 HOURS OF OPERATION**

If equipped with a dual fuel engine, replace the engine oil and filter as instructed in the engine manufacturer’s manual.

**250 HOURS OF OPERATION (MONTHLY)**

**Inspect the Hydraulic Hoses**

Inspect hydraulic hose assemblies for leaks, damaged fittings and worn exterior. Do not use your hands to check for hydraulic leaks. Hydraulic oil under pressure can cause serious injury or possible death. Use a piece of cardboard or other material as a deflector to detect leaks. Replace any problem hose before beginning work.

**Check hoses carefully. Do not use your bare hands to check for leaks. Tighten all connections to recommended torque. Replace if any of the following are found:**

- End fittings damaged or leaking.
- Outer covering chafed or cut and wire reinforcing exposed.
- Outer covering ballooning locally.
- Hose shows evidence of kinking or crushing.

**WARNING**

**DO NOT GO NEAR HYDRAULIC OIL LEAKS**

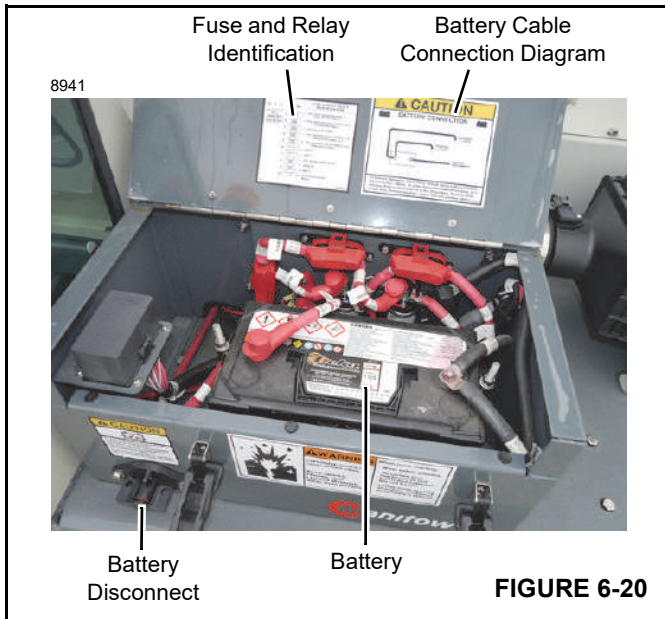
- When checking for hydraulic system leaks, observe only.
- Never use your hands to check for leaks.
- Hydraulic oil from a pin hole leak can puncture your skin and cause serious injury, gangrene, or death.
- If injured by hydraulic oil under pressure, seek medical attention immediately.
- Oil can be hot and can cause severe burns.

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### Clean Battery and Cables

1. Open the battery box cover (Figure 6-20).



2. Tighten all battery hardware to keep the battery securely in place.
3. Disconnect the battery cables.
4. Sprinkle the batteries with baking soda to neutralize the acid. Rinse with water. Be careful not to get water inside the battery.
5. Coat the battery posts and the battery cable connections with battery-terminal protector and reconnect the battery cables.
6. Coat the frame grounds, the starter connections, and the alternator connections battery-terminal protector.
7. Close and latch the battery box cover.

### Clean the Radiator

**NOTE:** To inhibit personal injury, always wear safety glasses when using compressed air.

Clean the radiator fins by using compressed air or a water hose to remove all foreign materials. If these materials are

not removed, the engine may over heat due to blocked air through the radiator fins and core.

### Lubricate the Wire Rope

Apply lubricant to the hoist wire rope to inhibit rust, corrosion and wear.

1. Unwind the wire rope from the hoist drum.
2. Thoroughly clean the wire rope prior to application of any lubricant. Use a wire brush and compressed air to remove all foreign matter and old lubricant.

**NOTE:** To inhibit personal injury from compressed air, always wear safety glasses when using compressed air for cleaning.

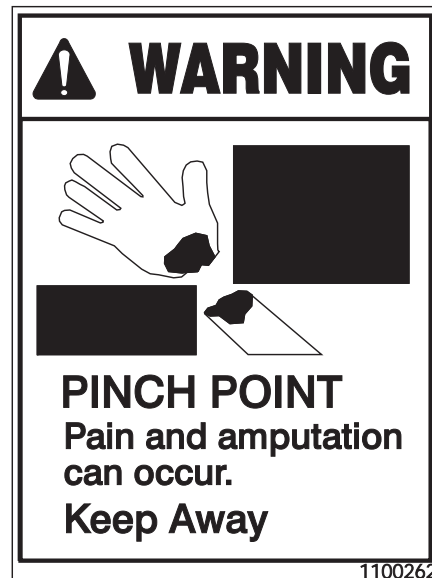
3. After cleaning the wire rope, apply a good grade of wire rope lubricant, to the entire length of the wire rope. Or, apply a light weight oil that has been preheated to a temperature between 60° and 100°F (18° to 36° C). Use a brush or cloth to apply the oil.

**NOTE:** Be sure the lubricant enters the strands of the wire rope for proper lubrication. Do not use grease to lubricate the wire rope.

### Lubricate the Swing Gear and Pinion

1. Engage the parking brake and stop the engine.
2. Remove the guard covering the swing pinion.

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**Rotating gears can cause injury. Keep hands clear of rotating pinion and gear while the mast is rotating.**

3. Using a brush, apply open gear lube to the pinion and swing gear teeth (Figure 6-21).

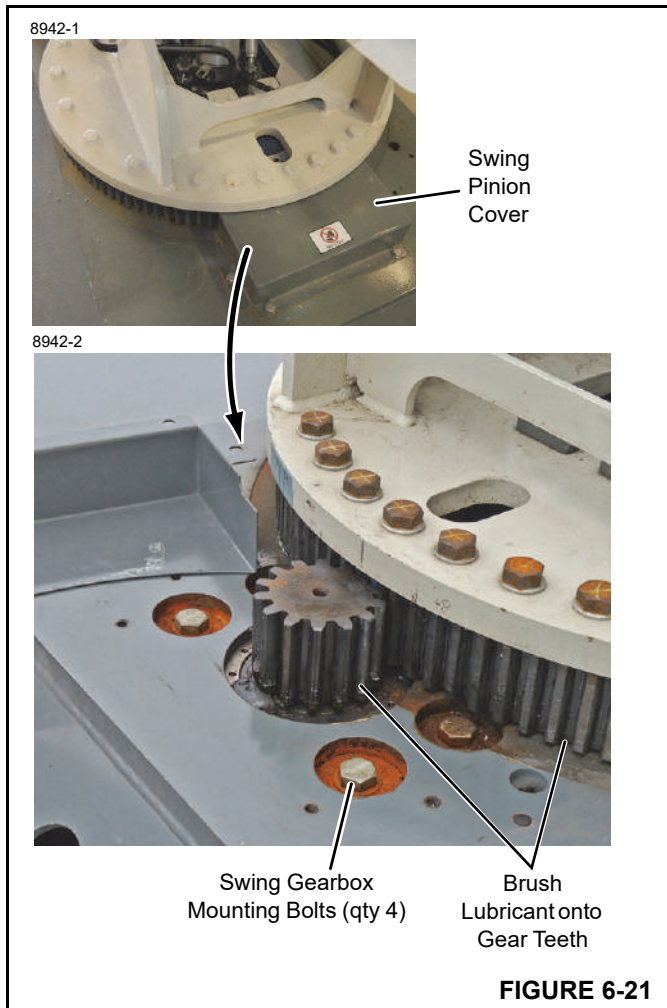


FIGURE 6-21

4. Start the engine and rotate the mast until a non-lubricated portion of the swing gear is exposed. Keep hand away from rotating pinion and gear.
5. Stop the engine.
6. Using a brush, apply open gear lube to the swing gear teeth.
7. Repeat steps 4, 5 and 6 until the complete swing gear is lubricated.

**Replace the Crankcase Oil and Filter**

Change the engine oil more frequently if operating under difficult conditions, for example in high or low temperatures, dusty surroundings or frequent starting and stopping.

**NOTE:** If it is necessary to climb under the crane to change the engine oil and replace the engine oil filter, be sure engine is shut off, the ignition key is removed and chock blocks are in place before climbing under the crane.

Drain the engine oil only when it is hot and the contaminants are in suspension.

Hot oils can cause personal injury.

1. Operate the engine until the water temperature reaches 140° F (60° C).
2. Stop the engine
3. Place a suitable container under the engine drain plug. Remove the oil drain plug (see Figure 6-33).
4. Clean the area around the engine oil filter head.
5. Remove the filter and clean the gasket surface of the filter head.

**NOTE:** The O-ring can stick on the filter head. Make sure it is removed before installing the new filter.

6. Fill the new filter with clean recommended lubricating oil (See engine operator’s manual furnished with the crane).
7. Apply a small amount of clean engine oil to the gasket of the new oil filter. Turn the filter clockwise to tighten it until the gasket makes contact. Then, tighten the filter 1/2 to 3/4 turn to get correct seal.
8. Fill the engine crankcase with clean recommended lubricating oil to the proper mark on the dipstick (see Figure 6-8).
9. Operate the engine at idle and inspect for leaks at the filter and drain plug.

**Torque Critical Bolts**

**NOTE:** Maintain correct torque on all bolts. Failure to do so may result in severe damage to the machine.

**Hoist Gearbox Mounting Bolts**

See Figure 6-22.

Apply medium strength thread locking compound to all threads.

- Torque the M16 mounting bolts to 247 Nm.
- Torque the M20 mounting bolts to 483 Nm.

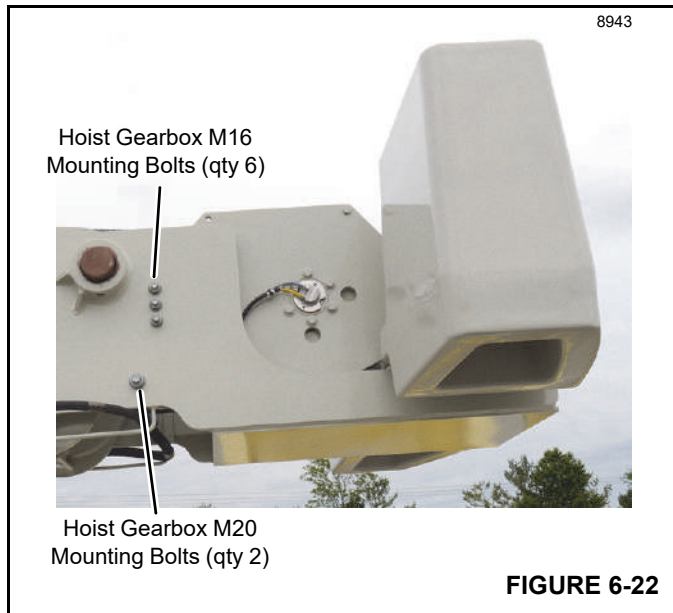


FIGURE 6-22

### Swing Gearbox Mounting Bolts

Apply medium strength thread locking compound to all threads.

Torque the 3/4 in swing gearbox mounting bolts (Figure 6-21) to 202±5 lb-ft. If the bolts are loose, check gear backlash.

### Mast Mounting Bolts

Because of the cyclic loading on the mast bolts, it is important that these bolts be checked at regular intervals. Refer to the Service Manual for the proper bolt torque procedure.

Make a record of any loose bolts. If any bolt does not hold to correct torque after the second check, remove and replace the bolt. A loose bolt indicates possible failure of the bolt.

The correct torque on each mast bolt (inner and outer) is be 727±29 Nm.

**NOTE:** Use only M20 x 2.5 Class 12.9 (black finish) replacement bolts. Order the bolts from your distributor. See your parts manual.

If a broken bolt is found, replace the bolt and also replace the bolt on each side of the broken bolt.

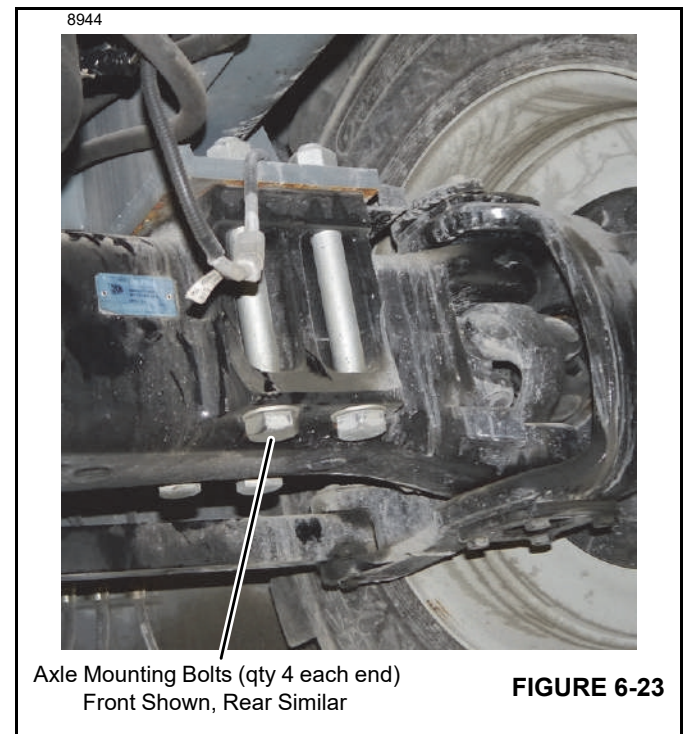
The proper bolt torque will not be obtained without the hardened steel washers under the bolt heads.

### Front Axle Mounting Bolts

Torque the 1 in front axle mounting bolts to 689±17 lb-ft. See Figure 6-23.

### Rear Axle Mounting Bolts

Torque the M20 rear axle mounting bolts to 339±8 Nm (drive and non-drive axle). See Figure 6-23.



Axle Mounting Bolts (qty 4 each end)  
Front Shown, Rear Similar

FIGURE 6-23

### 500 HOURS OF OPERATION (3 MONTHS)

**NOTE:** You must read and understand the warnings and basic safety rules, found in Section 2 of this manual, before performing any operation or maintenance procedures.

For additional engine maintenance guidelines, see the engine manual furnished with this crane.

### Replace the Transmission Filter

- 4WD – Replace the oil filter (see page 6-26)
- 2WD – Replace the oil filter (see page 6-26)

### Inspect the Tires

Inspect the tires for any signs of damage, such as cracks, large gouges, deterioration, etc. If damage is found, it must be carefully analyzed to determine if the tire is safe to use. Replace all tires that are unsafe.

### Inspect Parking Brake Pads

**NOTE:** It is necessary to climb under the crane to check the parking brake pads. Be sure engine is shut off, the ignition key is removed and chock blocks are in place before climbing under the crane.



Inspect the thickness of the brake pads (Figure 6-24). Replace the brake pads if they are 0.028 inches (0.71 mm) thick or less.

Check the surface condition of the brake disc. Replace the disc if badly warped, pitted or out of tolerance.

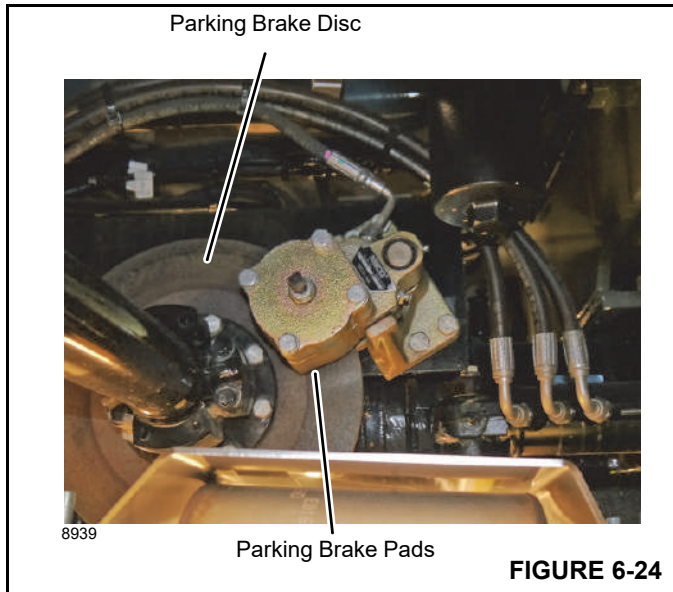


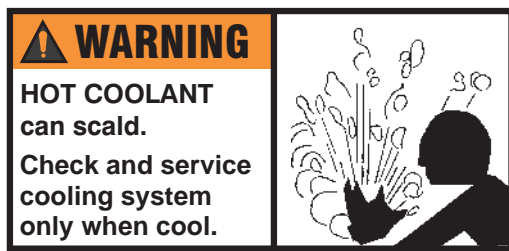
FIGURE 6-24

### Replace Fuel Filter

See the engine operator's manual furnished with the crane and follow the replacement procedures.

**NOTE:** If the filter is not filled with fuel prior to installation, the engine will not start due to air in the fuel system. The fuel system will have to be bled as instructed in the engine operator's manual furnished with the crane.

### Add SCA to Engine



For maximum protection of the engine, add Supplemental Coolant Additive to the cooling system as instructed in the Engine Manual.

### Lubricate the Outrigger Slides

1. Lower the outriggers.
2. Clean the tops of the outriggers with a suitable solvent.
3. Apply Lithium Based, EP2 grease, or equivalent to the areas shown in Figure 6-25. Do not over lubricate. Raise and lower the outriggers several times to spread the grease.

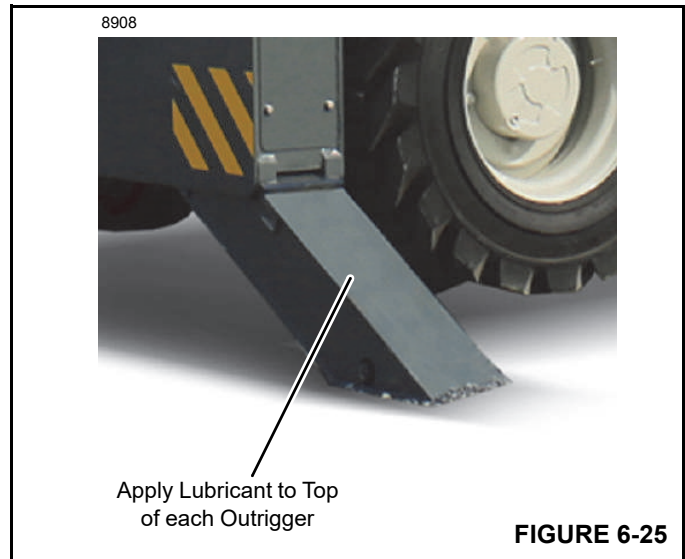


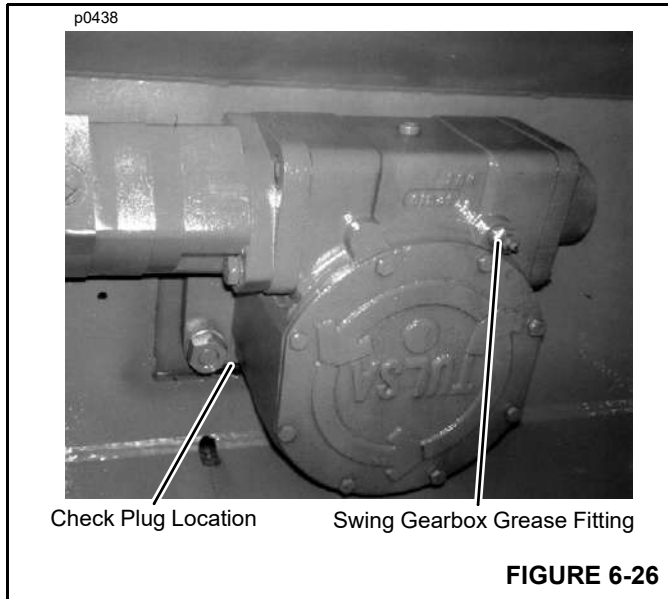
FIGURE 6-25

### Add Grease to the Swing Gearbox

**NOTE:** It is necessary to climb under the crane to add grease to the swing gearbox. Be sure engine is shut off, the ignition key is removed and chock blocks are in place before climbing under the crane.

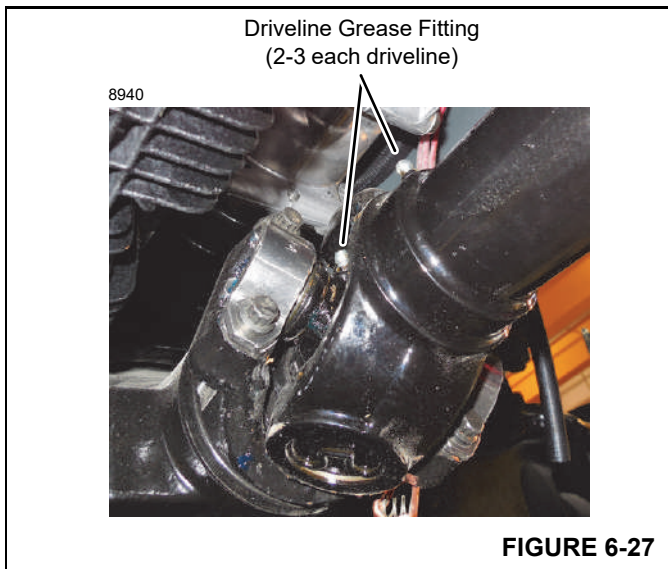
The grease fitting for adding grease to the swing gearbox can only be reached from under the crane. It will be necessary to use a light to see the fitting.

1. Engage the parking brake and stop the engine. Remove the ignition key.
2. Clean the grease fitting and check plug (Figure 6-26).
3. Remove the check plug.
4. Apply Lithium Based, EP2 grease, or equivalent to the fitting. Fill gear box until grease exits the check plug hole. Install the check plug.



**Lubricate Drivelines**

1. Engage the parking brake and stop the engine. Remove the ignition key.
2. Clean the grease fittings (Figure 6-27).
3. Apply Lithium Based, EP2 grease or equivalent to the fittings.

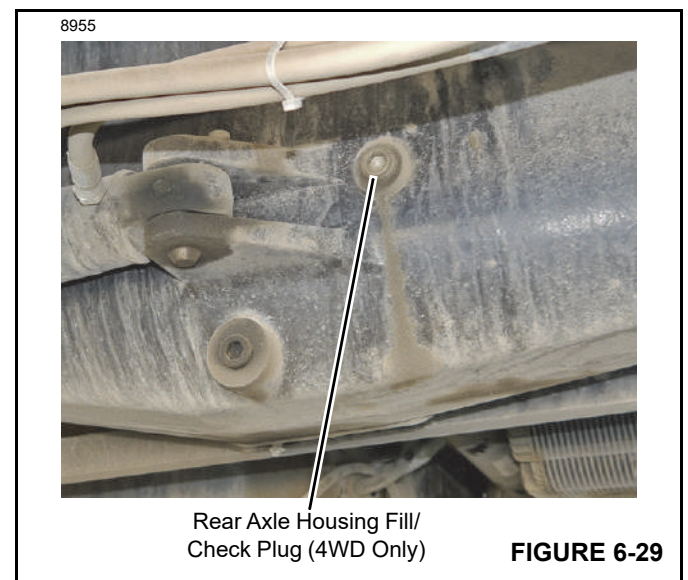
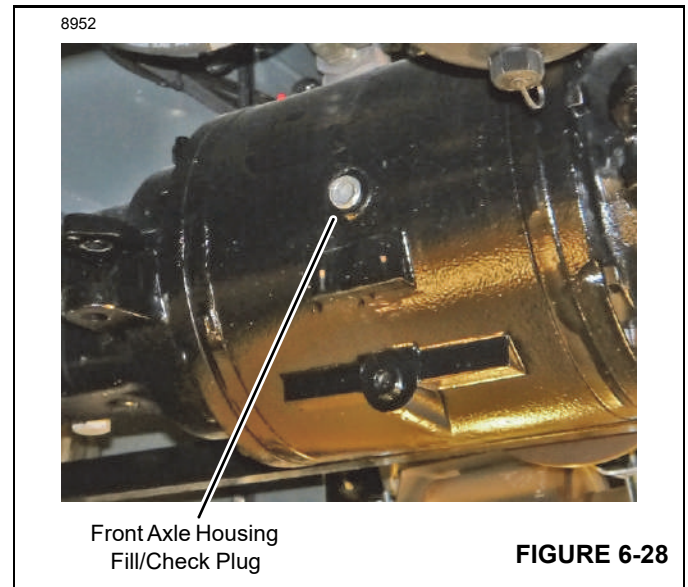


**Check Axle Housing Lubricant Level**

It is necessary to climb under the crane to check the axle housing lubricant. Be sure engine is shut off, the ignition key

is removed, and chock blocks are in place before climbing under the crane.

1. At either axle, clean around the axle housing fill/check plug (Figure 6-28 or Figure 6-29) and remove it.



2. Check the lubricant level. It should be even with the bottom of the plug hole.
3. If necessary, add the proper type of oil (specified in Section 8 of this manual) until the oil is even with the bottom of the plug hole.
4. Repeat the steps for the other axle.

### Check Wheel Hub Lubricant Level

1. Using the outriggers, raise the tires slightly off of the ground.
2. Place the transmission in neutral and release the parking brake.

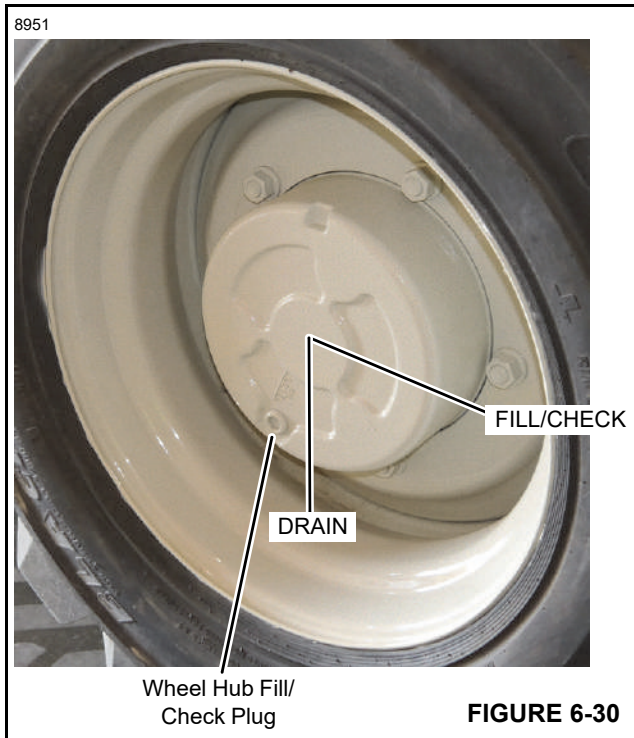
#### CAUTION

##### 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.

3. Turn one of wheel hubs until the fill/check plug is horizontal with the ground (Figure 6-30).

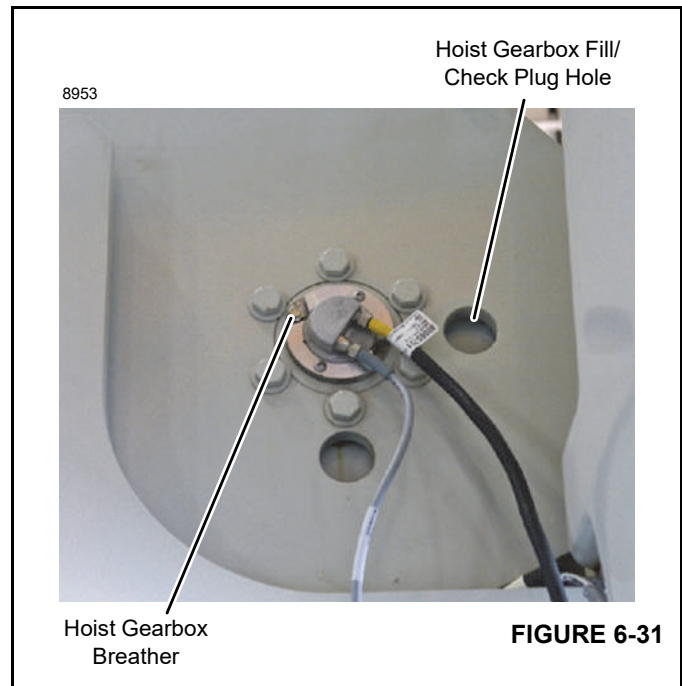


4. Clean around the fill/check plug and remove it.
5. Check the lubricant level. It should be even with the bottom of the plug hole.

6. If necessary, add the proper type of oil (specified in Section 8 of this manual) until the oil is even with the bottom of the plug hole.
7. Reinstall the plug.
8. Repeat the steps for the other three wheel hubs.

### Check Hoist Gearbox and Brake Lubricant Levels

1. Lower the boom to its lowest position.
2. Service the hoist gearbox as follows:
  - a. Rotate the hoist drum until the plug (Figure 6-31) is in the fill/check hole in the hoist frame.
  - b. Engage the parking brake and stop the engine
  - c. Clean the area around the plug and remove it.
  - d. Check the lubricant level. It should be even with the bottom of the plug hole.
  - e. If necessary, add the proper type of oil (specified in Section 8 of this manual) until the oil is even with the bottom of the plug hole.
  - f. Reinstall the plug.





3. Service the hoist brake as follows:
  - a. Clean the around of the brake breather/check/fill plug (Figure 6-32) and remove it.
  - b. Check the lubricant level. It should be even with the bottom of the plug hole.

**! WARNING**

**DO NOT** use EP type gear lubes in the brake section of this hoist. EP lubes may prevent the clutch from locking up, causing the load to fall and resulting in property damage, personal injury or death.

- c. If necessary, add the proper type of oil (specified in Section 8 of this manual) until the oil is even with the bottom of the plug hole.
- d. Install the breather/fill/check plug.

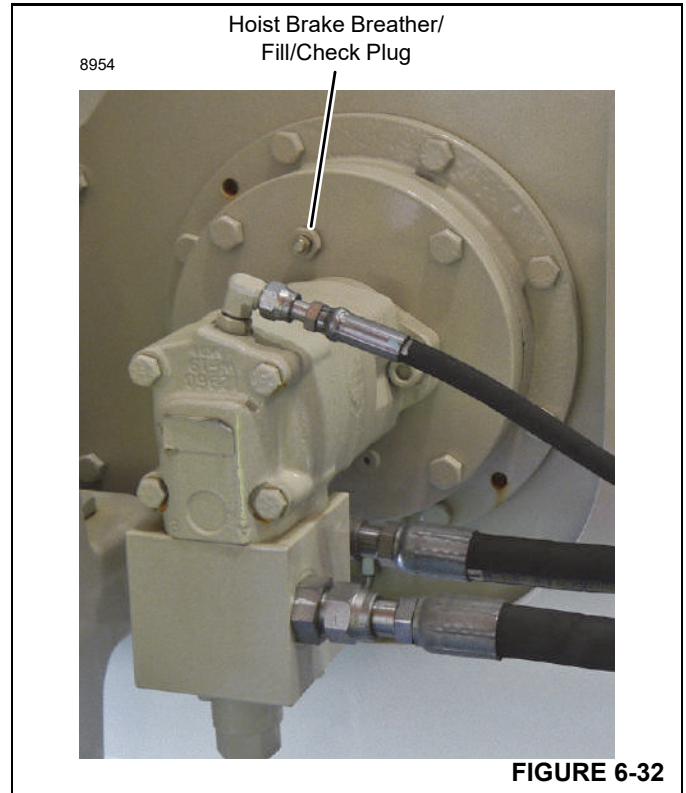


FIGURE 6-32

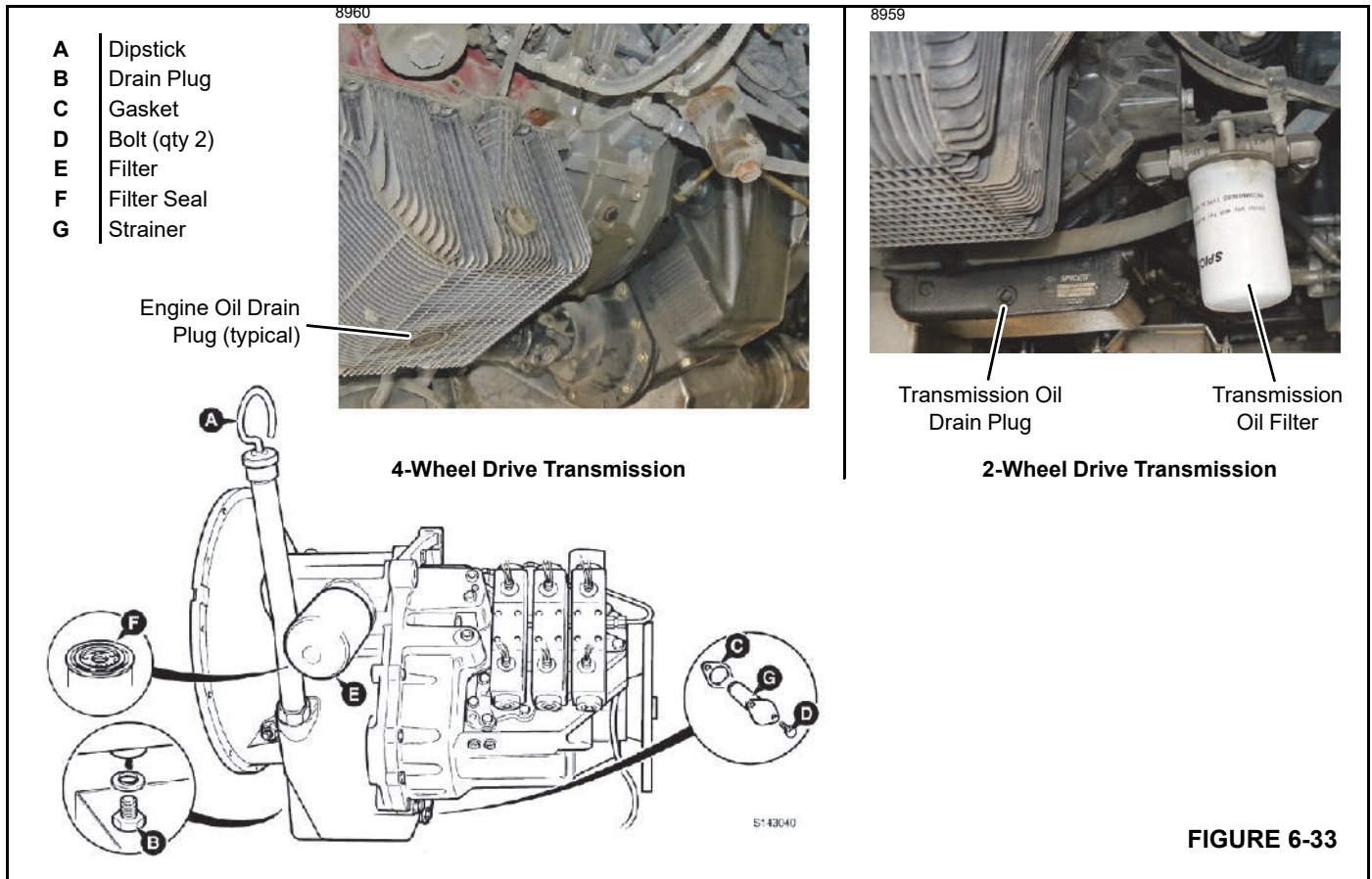


FIGURE 6-33



## 1000 HOURS OF OPERATION (6 MONTHS)

**NOTE:** You must read and understand the warnings and basic safety rules, found in Section 2 of this manual, before performing any operation or maintenance procedures.

For additional engine maintenance guidelines, see the engine manual furnished with this crane.

### Replace the Transmission Oil and Filter — 4WD

**NOTE:** It is necessary to climb under the crane to drain the transmission oil (Figure 6-33). Be sure the parking brake is engaged, the engine is off, the ignition key is removed, and chock blocks are in place before climbing under the crane.

When the strainer (G) is loosened/removed, oil will gush out. Keep to one side when you remove the strainer.

Before removing the strainer, be sure you have a new strainer gasket. The old strainer gasket will be damaged during removal of the strainer, and if it is installed with the strainer, leakage will occur. It is recommended that three gaskets be kept in supply at all times. This will cover a years maintenance and one for emergency maintenance.

1. Place a suitable container under the strainer (G). Remove the strainer and gasket and drain the oil into the container. Discard the gasket.
2. Place the container under the drain plug (B), remove the drain plug, and drain any oil left in the transmission into the container.
3. Securely reinstall the drain plug (B).
4. Clean the strainer in a suitable solvent.
5. Install the cleaned strainer and new gasket. Tighten the strainer mounting bolts to a torque of 7.4 lb-ft. (10 Nm).
6. Remove the transmission oil filter (E) by unscrewing it from the filter housing. The filter is mounted remotely.
7. Properly discard the filter.
8. Coat the seal (F) of the new filter with clean transmission oil.
9. Screw on the transmission filter until it touches the filter head. Then, turn the filter another 3/4 of a turn minimum to seat the seal.
10. Fill the transmission through the dipstick tube (Figure 6-8) with the proper type and amount of oil specified in Section 8 of this manual.
11. Fill the transmission to the high mark on the dipstick.

12. Start the engine and let it run at idle speed for a period not exceeding five minutes to fill the transmission filter, the torque converter, and the hoses with oil.
13. Stop the engine, wait approximately one minute and then check the oil level. If low, add oil to high mark on the dipstick. **DO NOT OVERFILL.**

### Replace the Transmission Oil and Filter — 2WD

**NOTE:** It is necessary to climb under the crane to drain the transmission oil (Figure 6-33). Be sure the parking brake is engaged, the engine is off, the ignition key is removed, and chock blocks are in place before climbing under the crane.

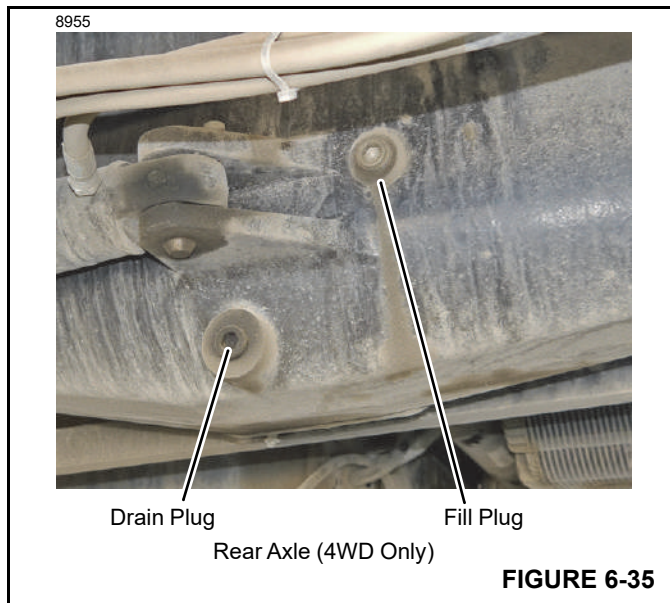
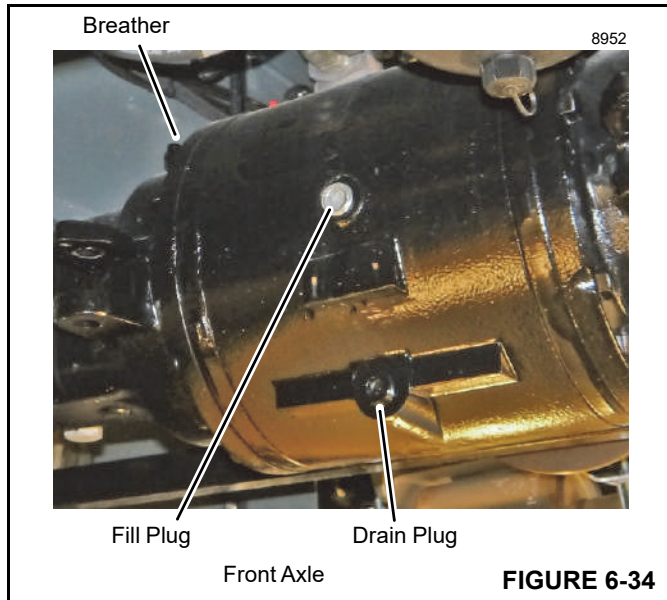
1. Place a suitable container under the drain plug, remove the drain plug, and drain the oil into the container.
2. Securely reinstall the drain plug.
3. Remove the transmission oil filter by unscrewing it from the filter housing. The filter is mounted remotely.
4. Properly discard the filter.
5. Coat the seal of the new filter with clean transmission oil.
6. Screw on the transmission filter until it touches the filter head. Then, turn the filter another 3/4 of a turn minimum to seat the seal.
7. Fill the transmission through the dipstick tube (Figure 6-8) with the proper type and amount of oil specified in Section 8 of this manual.
8. Fill the transmission to the low mark on the dipstick.
9. Start the engine and let it run at idle speed to fill the transmission filter, torque converter, and hoses with oil.
10. Recheck the level with the engine running at low idle and bring the oil to the low mark on the dipstick.
11. Once the oil is hot — 180 to 200°F (82 to 93°C), bring the oil to high mark on the dipstick. **DO NOT OVERFILL.**

### Replace the Axle Housing Oil

**NOTE:** It is necessary to climb under the crane to drain the axle housing lube. Be sure the parking brake is engaged, the engine is off, the ignition key is removed, and chock blocks are in place before climbing under the crane.

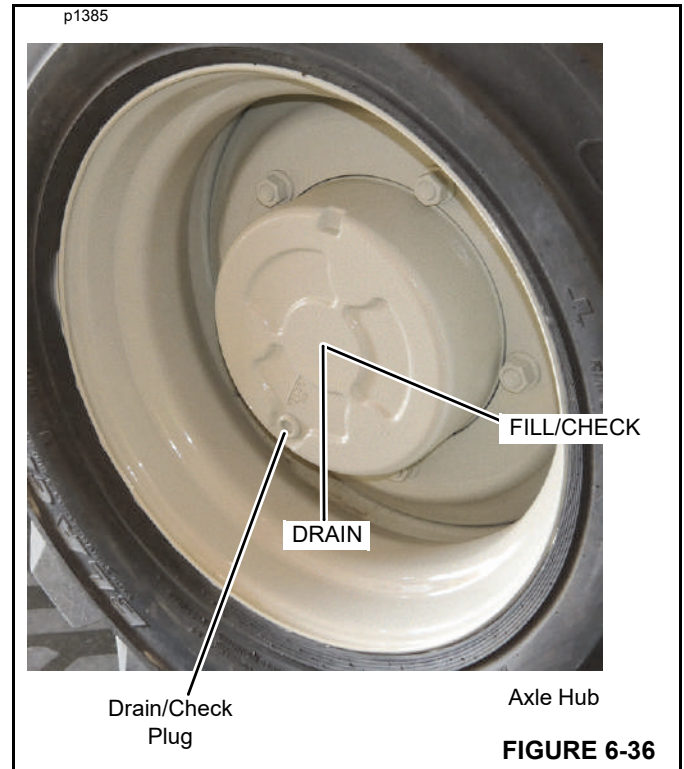
1. Clean around the fill plug (Figure 6-34 or Figure 6-35) and remove it.
2. Place a suitable container under the drain plug, remove the drain plug, and drain the oil into the container.
3. Install the drain plug.

4. Clean the front axle breather (Figure 6-34) with a suitable solvent. Be sure that the hole in the breather tube is facing toward the axle hub (toward the right).



5. Fill the axle housing with the proper type and amount of oil (specified in Section 8 of this manual) until the oil is even with the bottom of the fill plug hole.
6. Install the fill plug.

7. Repeat the steps at both axles.



### Replace Axle Wheel Hub Lubricant

1. Using the outriggers, raise the tires slightly off of the ground.
2. Place the transmission in neutral and release the parking brake.
3. Turn one of the axle wheel hubs (Figure 6-36) until the drain plug is located at the bottom of the wheel hub.
4. Place a suitable container under the drain plug.
5. Clean around the drain plug, remove it, and drain the wheel hub oil into the container.
6. Turn the wheel hub until the drain/check hole is horizontal (Figure 6-36).
7. Fill the wheel hub with the proper type and amount of oil (specified in Section 8 of this manual) until the oil is even with the bottom of the plug hole.
8. Install the drain/check plug.
9. Repeat the above steps for the other three wheel hubs.

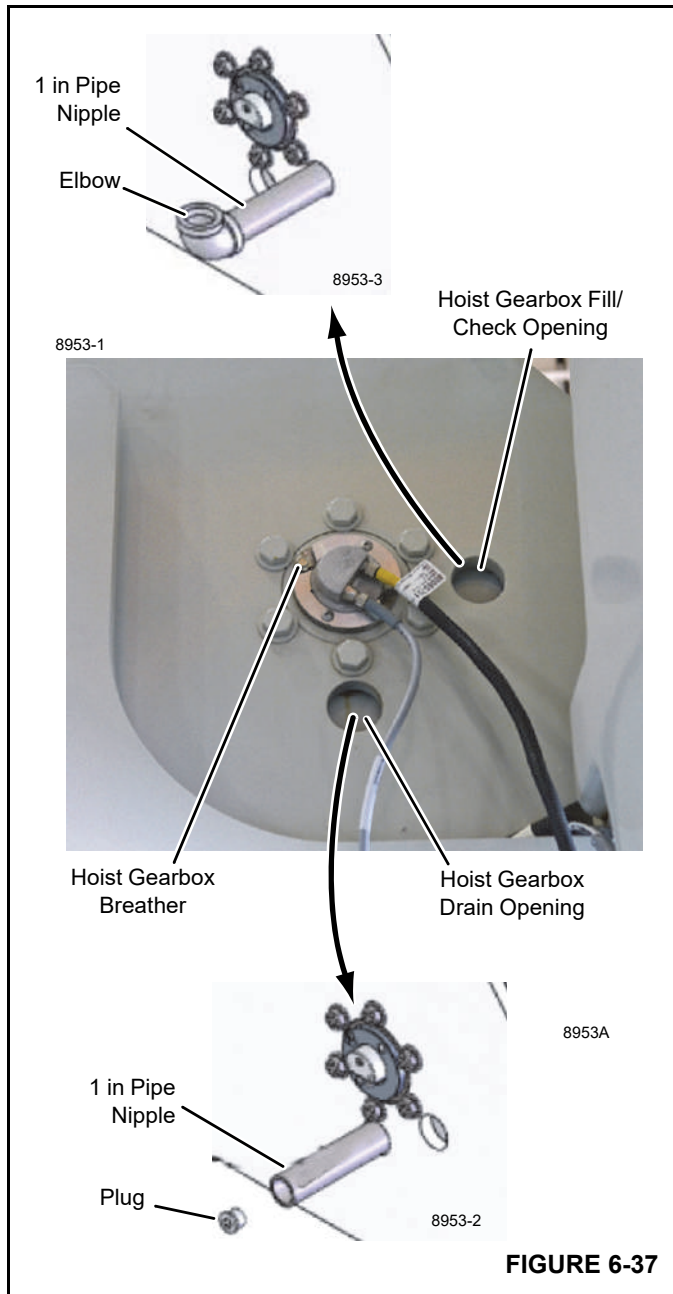


FIGURE 6-37

**Replace the Hoist Gearbox Oil**

1. Lower the boom to its lowest position, engage the parking brake.
2. Rotate the hoist drum (Figure 6-35) so the plug in the drum is visible through the drain opening in the hoist frame.
3. Screw a 1 inch pipe nipple into the hole in the hoist drum.
4. Place a suitable container under the pipe nipple.

5. Using a hex wrench with an extension, remove the plug through the pipe nipple.
6. Allow the oil to drain into the container. Examine the oil for signs of significant metal particles. If any particles are found, the gearbox may require disassembly and repair.
7. Remove the pipe nipple.
8. Rotate the drum so the plug hole is visible through the fill/check opening in the hoist frame.
9. Screw the pipe nipple and an elbow into the hole in the hoist drum.
10. Fill the hoist drum with the proper type and amount of oil (specified in Section 8 of this manual) until the oil is even with the bottom of the plug hole.
11. Remove the elbow and pipe nipple.
12. Make sure the o-ring on the plug is not damaged (replace if necessary) and install the plug.
13. Remove and clean the hoist gearbox breather with a suitable solvent. Then reinstall it.

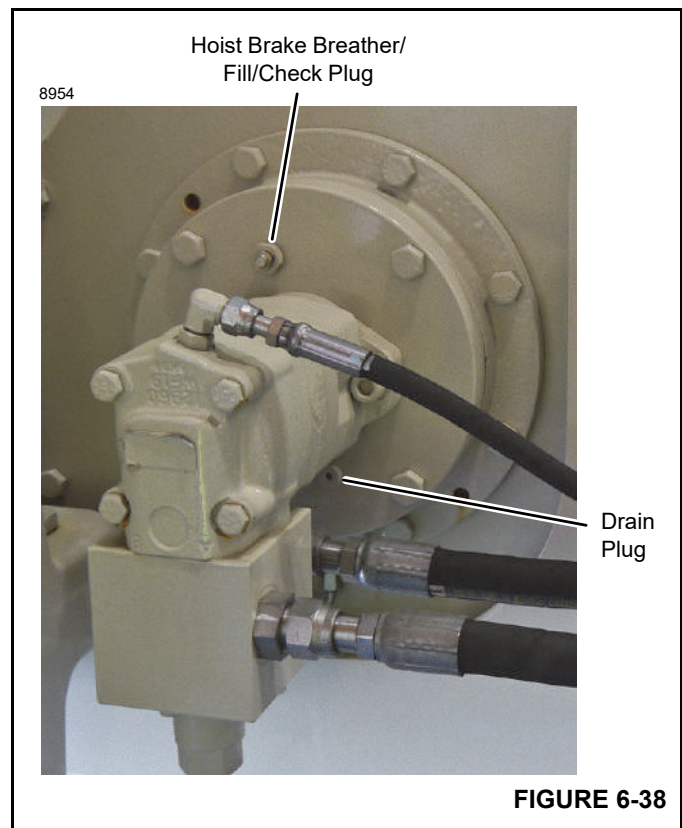


FIGURE 6-38

**Replace the Hoist Brake Oil**

1. Lower the boom to its lowest position and engage the parking brake. Leave the engine running.
2. Clean around the hoist brake breather/fill/check plug (Figure 6-36) and remove it.

3. Place a suitable container under the hoist brake drain plug.
4. Remove the drain plug to drain the oil.
5. Install the drain plug.
6. Clean the breather with a suitable solvent.
7. Fill the hoist brake with the proper type and amount of oil (specified in Section 8 of this manual) until the oil is even with the bottom of the plug hole.
8. Install the breather/fill/check plug.

### Replace the Hydraulic Oil

**NOTE:** ISO (International Standards Organization) #46/68 Hydraulic Oil (Mobil Fluid #424) is recommend for year-round use in the hydraulic system.

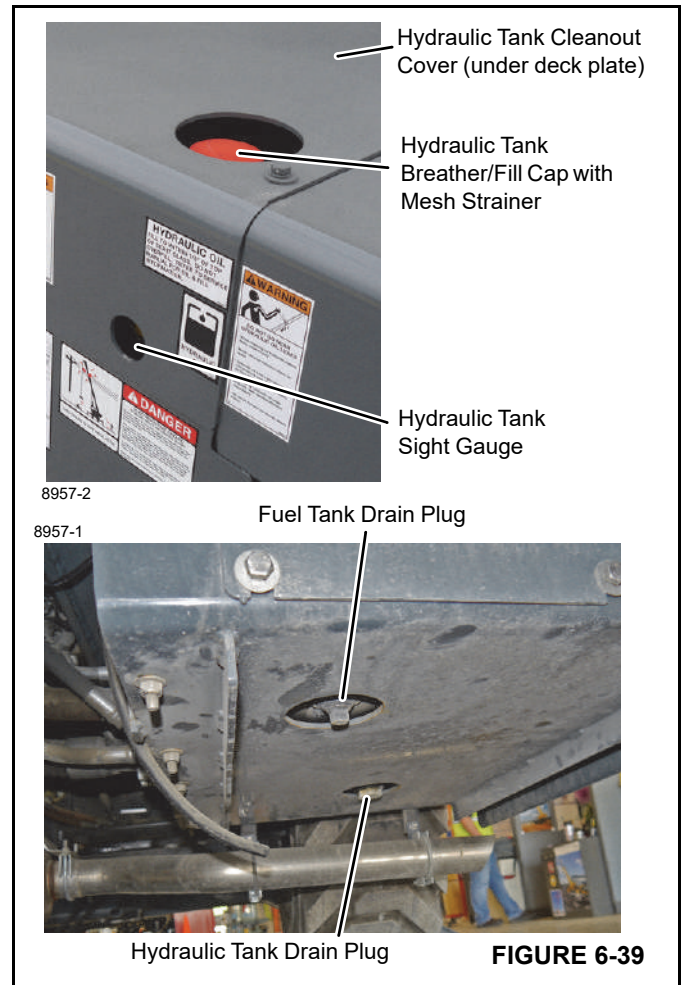
In very cold temperatures, SAE 5W or SAE 5W-20 oils can be used if the viscosity of the oil will not be less than 60 SUS (Saybolt Universal Seconds) at maximum operating temperature. It may be necessary to use a pre-heater and a longer than normal warming period at low operating speed to heat the oil to operating temperature.

To change the hydraulic oil:

1. Fully retract and lower the boom.
2. Retract all outriggers.
3. Operate the hydraulic system until the hydraulic oil is warm.

**NOTE:** It is necessary to climb under the crane to drain the hydraulic oil. Be sure engine is shut off, the ignition key is removed and chock blocks are in place before climbing under the crane.

4. Level the crane, engage the parking brake, stop the engine and remove the ignition key.
5. Place a suitable container under the hydraulic tank drain plug (Figure 6-39).



**FIGURE 6-39**

6. Remove the drain plug and drain the hydraulic tank.
7. Install the drain plug.
 

If the oil/tank is extremely dirty, the tank can be flushed and cleaned by removing the cleanout cover from the top of the tank. It will be necessary to remove the deck plate to perform this step.
8. Replace the hydraulic oil filter.
9. Remove the breather and fill the hydraulic tank with the proper type and amount of oil (specified in Section 8 of this manual) to 3 mm (0.125 in) from the top of the sight gauge.
10. Discard the breather and install a new one.
11. After the tank is filled, start the engine and operate each function until all of the cylinders and lines are filled.
12. Fully retract and lower the boom and retract the outriggers. Check the hydraulic oil level. The oil must be 3 mm (0.125 in) from the top of the sight gauge. Add hydraulic oil if necessary.
13. Visually check for leaks.



### Replace the Hydraulic Oil Filter

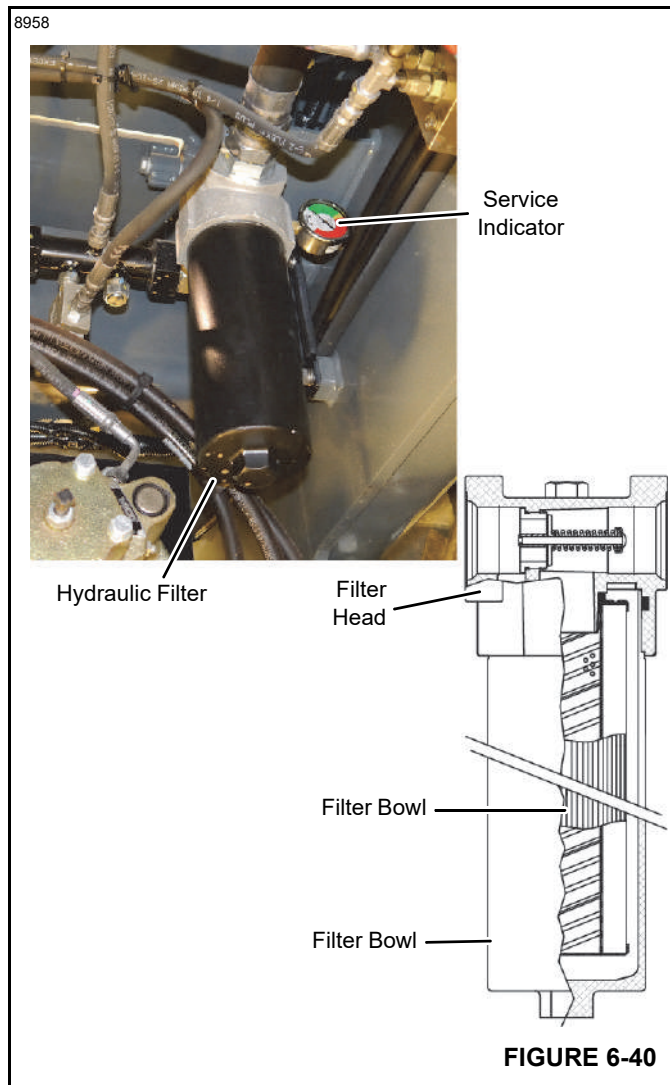


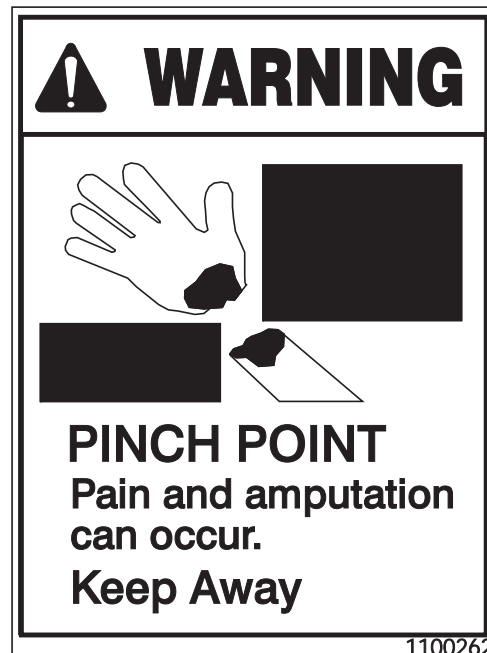
FIGURE 6-40

1. Replace the hydraulic filter element (Figure 6-40) when the service indicator is in the red area.
  2. Engage the parking brake and stop the engine.
- NOTE:** It is necessary to climb under the crane to replace the hydraulic oil filter. Be sure engine is off, the ignition key is removed, and chock blocks are in place before climbing under the crane.
3. Locate the hydraulic oil filter under the crane.
  4. Place a suitable container under the filter to catch oil.
  5. Replace the filter element:
    - a. Using a wrench, turn the filter bowl off the head.
    - b. Remove and properly discard the filter element.

- c. Clean the filter bowl and the mounting surface on the filter.
- d. Make sure the seal in the filter head and on the new element are not damaged.
- e. Apply a small amount of clean hydraulic oil to the seals.
- f. Install the new filter element on the filter head.
- g. Install and tighten the filter bowl to 40 ft-lbs (54 Nm).
- h. Start the engine and check for leaks around the filter.

### Check Swing Gear/Pinion Backlash

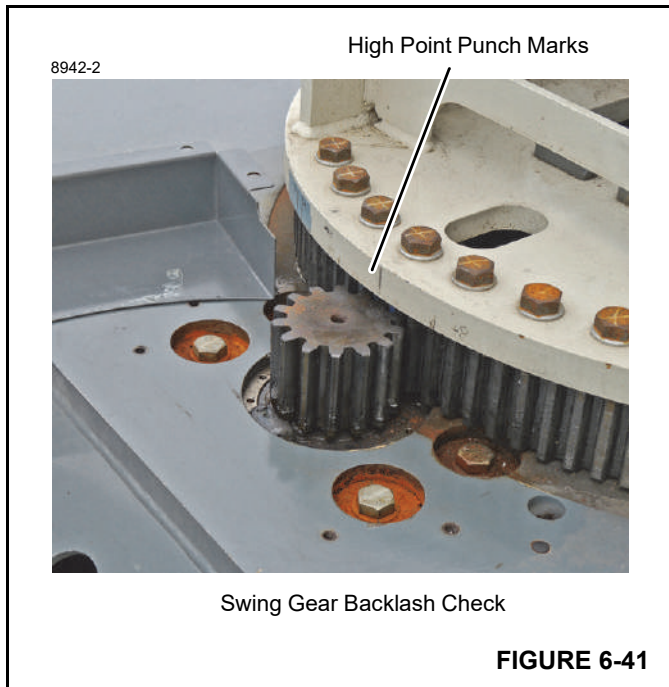
1. Remove the cover to expose the swing pinion and ring gear.



**Rotating gears can cause injury. Keep hands clear of rotating pinion and gear while the mast is rotating.**

Start the engine and rotate the mast until the high point on the swing gear is in alignment with the pinion. The high point is punch-marked on the mast plate (Figure 6-41).

2. Using a feeler gauge, check the backlash between the gear and pinion. There should be no clearance between the swing gear tooth and the pinion tooth. If there is any clearance, adjust the backlash as instructed in the CD15 Service Manual.



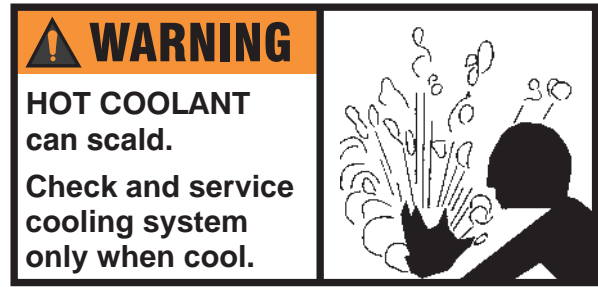
**2000 HOURS OF OPERATION (YEARLY)**

**NOTE:** You must read and understand the warnings and basic safety rules, found in Section 2 of this

manual, before performing any operation or maintenance procedures.

For additional engine maintenance guidelines, see the engine manual furnished with this crane.

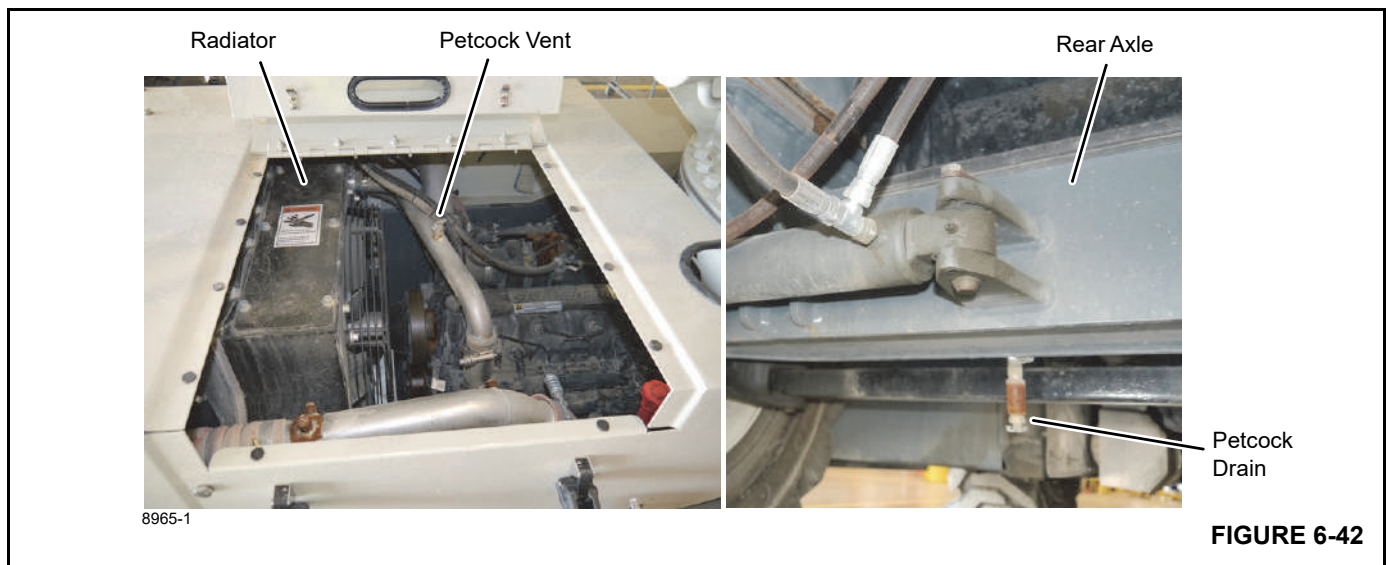
**Replace the Engine Coolant**



1. Open the engine compartment cover.
2. **BE SURE THE ENGINE IS COOL** and follow the cooling system draining and filling procedures in the engine manual furnished with the crane.

See Figure 6-42 for the location of the vent and drain petcocks.

3. After the coolant is replaced, close the engine compartment cover.



**Inspect the Crane Structure and Boom for Damage**

Thoroughly inspect the crane structure and boom for the following:

1. Inspect for loose mounting hardware. Tighten any loose hardware.
2. Inspect for cracked or broken welds. Do not operate the crane if a critical weld is cracked or broken until the weld is repaired. Contact your Grove distributor.
3. Inspect for missing or unreadable warning decals. Replace if necessary.

4. Inspect for excessive rust or corrosion on crane structure and boom. Paint any areas with excessive rust or corrosion.
5. Inspect for missing items. Replace if necessary.
6. Inspect the crane for any damage that might inhibit safe operation of the crane. Repair any damage.

### Testing the Rated Capacity Limiter (Optional)

See the Rated Capacity Limiter manual furnished with this crane and test the indicator according to instructions in the manual.

## MISCELLANEOUS MAINTENANCE

### Batteries/Charging System

**NOTE:** Lead-acid batteries produce flammable and explosive gases. To avoid personal injury, when checking, testing or charging batteries:

- **DO NOT** use smoking materials near batteries.
- Keep arcs, sparks and flames away from batteries.
- Provide ventilation and wear safety glasses.
- Never check battery charge by placing a metal object across the posts. The sparks could explode battery gases and cause injury or death. Use a voltmeter or hydrometer.



### Checking the Charging System

Check the voltmeter reading on the instrument panel. Normal voltmeter readings are as follows:

#### Normal Operating Ranges

- Engine above idle - 14 to 16 volts
- Engine stopped - 10 to 14 volts

A reading of less than 10 volts with the engine at low idle indicates a low battery charge.

A reading of less than 14 volts with the engine speed above low idle indicates a problem in the charging system. The system should be checked out by a qualified service technician.

### Charging the Battery

Under normal conditions, the engine's alternator will have no problem keeping a charge on the batteries. The only condition in which the battery(s) may cause a problem is when they have been completely discharged for a long period of time. Under this condition the alternator may not be able to recharge the battery(s) and a battery charger will be required for charging the battery(s).

Before using a battery charger, an attempt can be made to recharge the battery using the engine alternator by first jump starting the crane (See *Jump Starting*, in Section 3) and letting the engine run.

**DO NOT** charge a frozen battery; it may explode and cause injury. Let the battery warm up before attaching a charger.

Charging rates between 3 to 50 amperes are satisfactory if no excessive gassing or spewing of electrolyte occurs or the battery does not feel excessively warm (over 125° F [52° C]). If spewing or gassing occurs or temperatures exceed 125° F (52° C), the charging rate must be reduced or temporarily stopped to permit cooling.

### Replacing the Battery

**NOTE:** The fluid in electric storage batteries contains sulfuric acid, which is **POISON** and can cause **SEVERE CHEMICAL BURNS**. Avoid all contact of fluid with eyes, skin or clothing. Use proper protective gear when handling batteries. **DO NOT** tip any battery beyond a 45° angle in any direction. If fluid contact does occur, follow the First Aid suggestions that follows.

### Battery Electrolyte First Aid

- **External Contact** - Flush with water.
- **Eyes** - Flush with water for at least 15 minutes and get immediate medical attention.
- **Internal** - Drink large quantities of water. Follow with milk of magnesia, beaten egg or vegetable oil. Get immediate medical attention.

**NOTE:** In case of internal contact, **DO NOT** give fluids that would induce vomiting.

Remove the battery very carefully to avoid spillage of battery fluid. Properly dispose of the battery.



## Fuel System



## Fuel Storage

Storage of fuel for an extended period causes accumulation of sediment, dirt, water and other foreign materials in the fuel. Many engine problems are caused by dirty fuel and long storage periods.

Keep fuel in an outside location. Use a shelter to keep the fuel as cool as possible. The water from condensation must be removed at regular intervals from the storage tank.

## Fuse Replacement

Refer to Figure 6-43 for the location of the fuses on this crane.

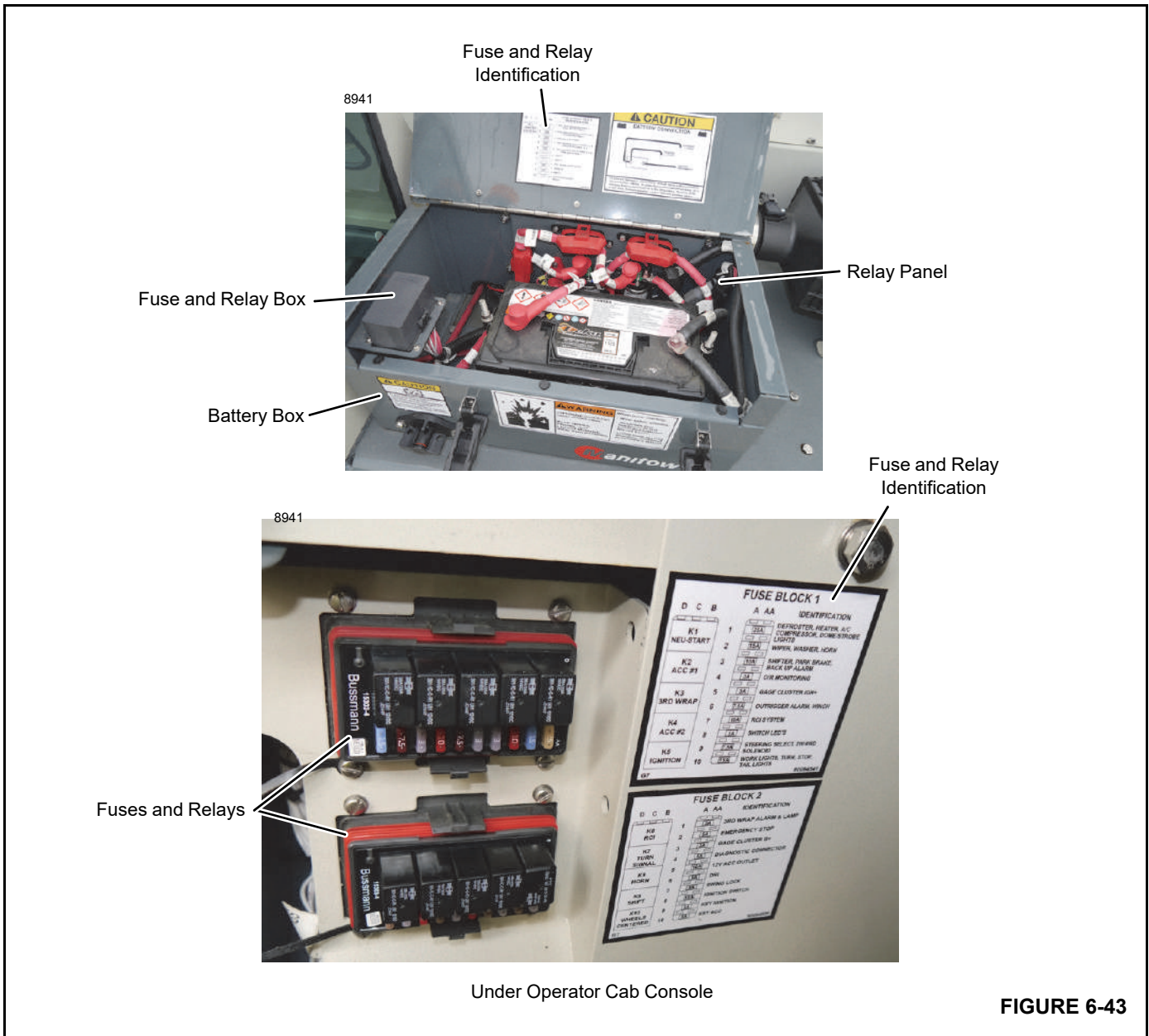


FIGURE 6-43

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## CARWELL® RUST INHIBITOR

### Protecting Cranes From Rusting

Industrial 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.

Industrial 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 Industrial 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 29 CFR 19 10.1200. The product is a liquid blend of petroleum derivatives, rust inhibitors, water-repelling and water-displacing agents.

Special equipment is used to spray a light film onto the entire undercarriage and various other areas of each new crane prior to shipment. When applied the product has a red tint to allow applicators to view coverage during application. This red tint will turn clear on its own within approximately 24 hours after application.

Once applied, treatment can appear to leave a slightly "oily" residue on painted surfaces and until the red tinting fades could initially be mistaken for a hydraulic oil leak. While the product is not harmful to painted surfaces, glass, plastic or rubber, it must be removed using standard steam-cleaning techniques.

This treatment works in various ways: (1) it eliminates the moisture containing salt, dirt and other pollutants by lifting and removing them from the metal surface; (2) the film creates a barrier to repel further moisture from coming in contact with the metal; and (3) it penetrates crevices.

In addition to the factory-applied treatment, Industrial 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 Industrial 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 cleanings 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 Industrial cranes, Product Support recommends washing the crane at least monthly to remove all foreign matter. More frequent cleanings may be needed when operating in harsh environmental conditions. To clean the crane, follow these guidelines:

- High pressure water or steam is effective for cleaning the crane's undercarriage and wheel housings. Keeping these areas clean will not only help retard the effects of corrosion, but will also improve the ability to identify potential issues before they grow into larger problems.



#### CAUTION

High pressure water can be forced into spaces and infiltrate beyond seals. Avoid pressure washing in the vicinity of electrical controls, panels, wiring, sensors, hydraulic hoses and fittings, or anything that can be damaged by high pressure cleaning/spraying.

- Rinse the dirt and dust off before washing the crane. Dirt can scratch the crane's finish during washing/cleaning.
- Hard to clean spots caused by road tar or bugs should be treated and cleaned after rinsing and prior to washing. Do not use solvents or gasoline.
- Wash using only soaps and detergents recommended for automotive paint finishes.
- Rinse all surfaces thoroughly to prevent streaking caused by soap residue.
- Allow the crane to dry thoroughly. You can accelerate drying by using compressed air to remove excess water.

**NOTE:** Polishing and waxing (using an automotive-type wax) is recommended to maintain the original paint finish.

## Inspection and Repair

- Immediately following cleaning, 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:

**NOTE:** Product Support recommends that a qualified body repairman prepare, prime and paint any major scratch(es) or minor damage.



### CAUTION

To the extent any damage is structural in nature, 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:** Crane must be completely dry before applying treatment.

- Do not allow product to puddle or build-up on weather stripping, rubber gaskets, etc. Crane should not have puddles or runs evident anywhere.
- To ensure proper coverage of treatment, the product needs to be fogged on the crane.
- Use of pressure pots to apply the treatment to the crane being processed is recommended.
- Carwell treatment is available in 16 ounce spray bottles from 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.

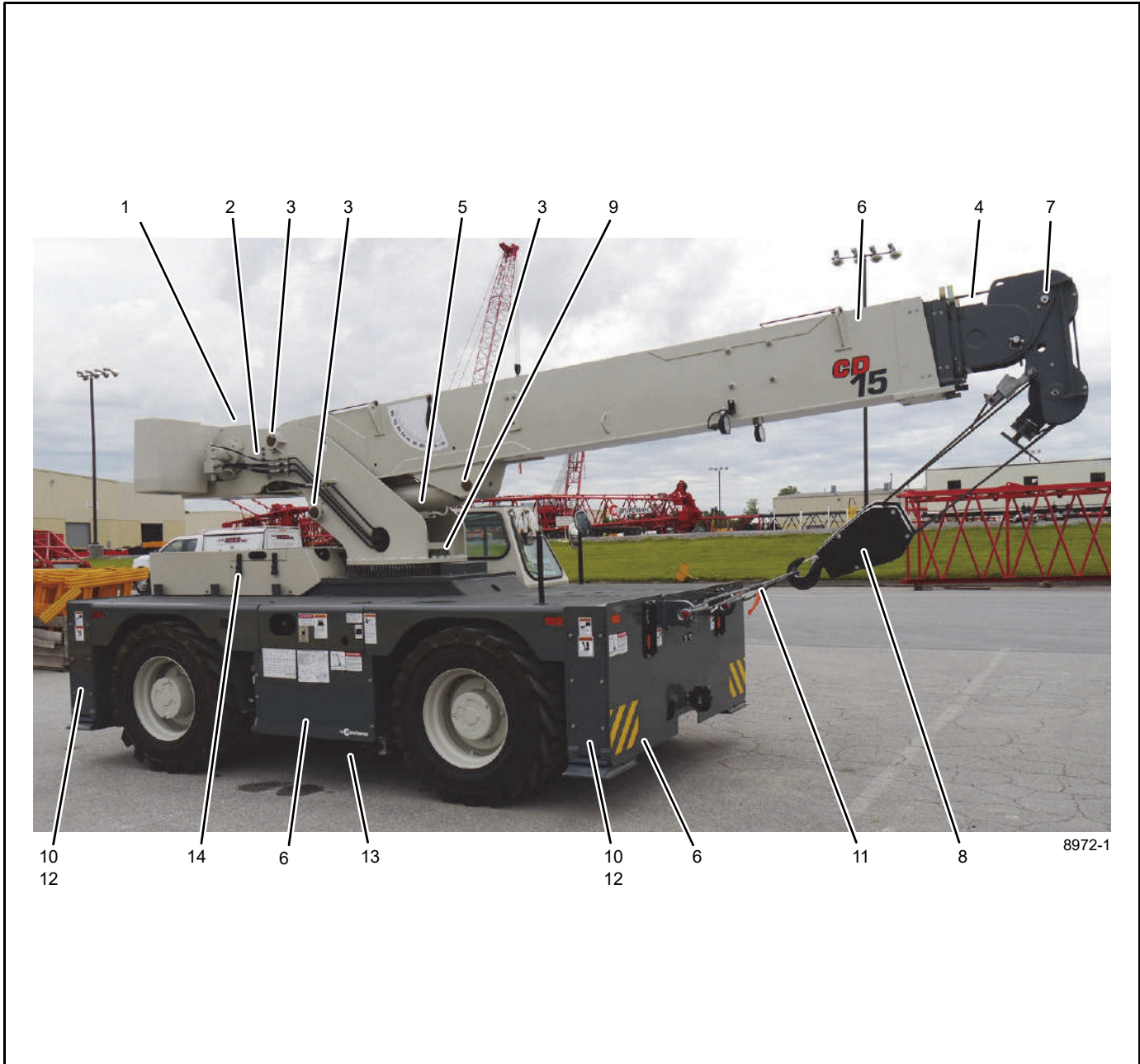
Please contact Product Support should you have any questions.

## Areas of Application

Refer to Figure 6-44

- 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 end 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.
- Mast applications are; hose ends and fittings, wire rope on hoist roller tensioning springs on hoists, all unpainted

- fasteners and hardware, valves, slew ring fasteners and all bare metal surfaces.
- All hardware, clips, pins, hose connections not painted will have treatment applied.
- Boom application areas are; pivot pins, hose ends and fittings, jib pins and shafts, all bare metal surfaces, downhaul weight pins/ hook block pins and fasteners.



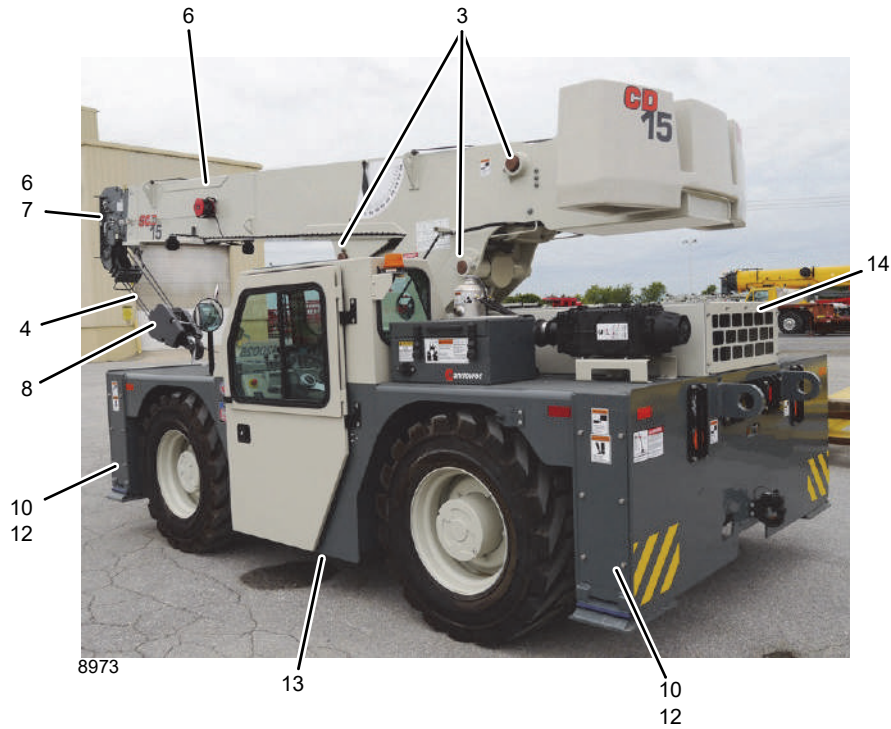


FIGURE 6-44

Item	Description
1	Hoist Tension Spring
2	Hoist Hose Connections
3	Pivot Shaft
4	Wire Rope
5	Hose Connections inside turntable
6	All Hardware, Clips, Pins, Hose Connections not painted O/R Pins, Clips
7	Boom Nose Pins, Clips

Item	Description
8	Downhaul Weight/Hook Block
9	Turntable Bearing Fasteners
10	O/R Pins, Clips
11	Hook block Tie Down Cable
12	O/R Hose Connections
13	Entire underside of Unit
14	Power Train Hardware Inside Compartment
15	Boom Extension Pins, Clips - Option
16	Boom Extension Hanger Hardware - Option



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## SECTION 7 ADJUSTMENTS

All adjustments must be performed by a qualified mechanic.  
Refer to the CD15 Service Manual for the proper procedures.

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**SECTION 8  
SPECIFICATION**

**SECTION CONTENTS**

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LUBRICATION SCHEMATIC

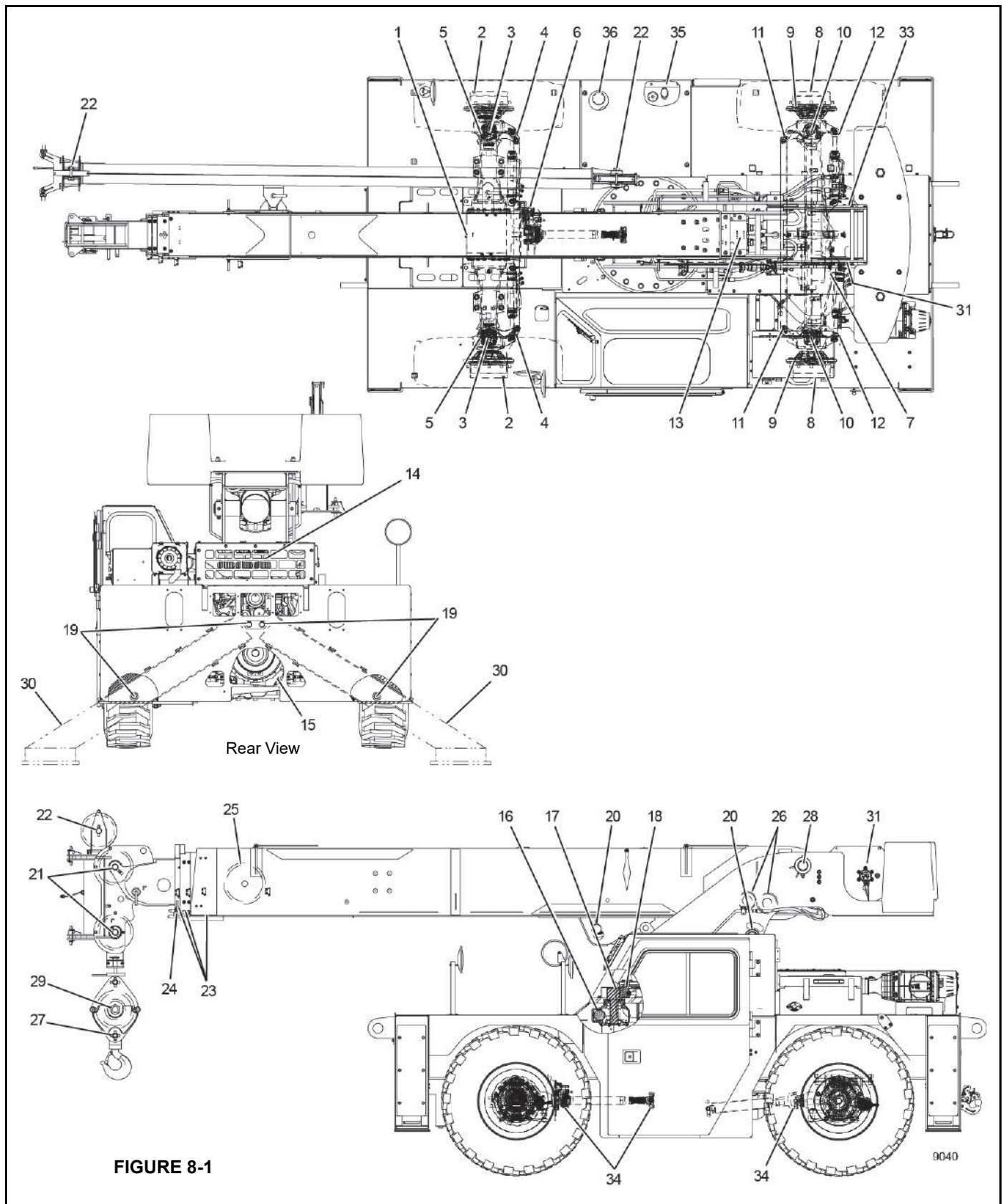


FIGURE 8-1

## Lubrication Symbols

Lube Symbol	Description	Grove Spec
EP-MPG	EP-MPG- Multipurpose Grease	A6-829-003477
AFC	AFC- Anti-freeze/coolant	A6-829-101130
HYDO	Hydraulic Oil	A6-829-006444
HTF	Hydraulic Transmission Fluid	80057784
EO-15W-40	Engine Oil Tier 3	A6-829-003483
EO-15W-40	Engine Oil Tier 4	A6-829-104182
EO-10W-30	Engine Oil Dual Fuel	A6-829-003480
ASC	Anti-Seize Compound	A6-829-003689
EP-OGL	Open Gear Lube (Ceplattyn 300 Spray)	A6-829-102971
EPGL-5	EPGL-Gear Lubricant	A6-829-003479
TransSynd	Synthetic Transmission Fluid	A6-829-101690

## Lubrication Legend

Item	Location Nam	Capacity	Lube Symbol	Instruction
<b>Front Drive/steer Axle</b>				
1	Differential	16.0 L (4.2 gal)	HYDO	
2	Planetary Hub Gears	2.0 L (2.1 qt)	HYDO	
3	Kingpin Bearings		EP-MPG	
4	Steer Cylinder Bearing		EP-MPG	
5	Universal Joints		EP-MPG	
6	Brake Caliper		EP-MPG	
<b>Rear Drive/Steer Axle</b>				
7	Differential	18.0 L (4.8 gal)	HYDO	See Note 1
8	Planetary Hub Gears	2.0 L (2.1 qt)	HYDO	
9	Hub Bearings		EP-MPG	
10	Kingpin Bearings		EP-MPG	
11	Steer Linkage Bearing		EP-MPG	
12	Steering Cylinder		EP-MPG	
<b>Engine &amp; Trans.</b>				
13	Engine Crankcase Tier 3 and 4	5.5-7.0 L (5.8-7.4 qt)	EO-15W-40	See Note 2
13	Engine Crankcase KEM-4.3L Dual Fuel	4.3 L (4.5 qt)	EO-10W-30	See Note 2
14	Engine Coolant Tier 3	22.8 L (6.0 gal)	AFC	See Notes 2, 3, 4
14	Engine Coolant Tier 4	20.0 L (5.3 gal)	AFC	See Notes 2, 3, 4
14	Engine Coolant KEM-4.3L Dual Fuel	16.3 L (4.3 gal)	AFC	See Notes 2, 3, 4
15	Transmission 4 Wheel Drive	20.8 L (5.5 gal)	HTF	
15	Transmission 2 Wheel Drive	16.6 L (4.4 gal)	HYDO	



Item	Location Nam	Capacity	Lube Symbol	Instruction
<b>Turntable</b>				
16	Swing Gear Box		EP-MPG	
17	Swing Gear & Pinion		EP-OGL	
18	Turntable Bearing		EP-MPG	
<b>Cylinders</b>				
19	Outrigger Cylinder Pins		ASC	See Note 5
20	Boom Lift Cylinder Pins		ASC	See Note 5
<b>Boom</b>				
21	Boom Nose Sheaves		EP-MPG	
22	Boom Extension Sheaves		EP-MPG	
23	Boom Sections		EP-MPG	See Note 6
24	Telescope Cylinder Wear Pads		EP-MPG	
25	Boom Extend Sheave		EP-MPG	
26	Boom Retract Sheave		EP-MPG	
27	Hook Block Swivel Bearing		EP-MPG	
28	Boom Pivot Pin		ASC	See Note 5
29	Hook Block Sheaves		EP-MPG	
<b>Outriggers</b>				
30	Outrigger Box		EP-MPG	See Note 7
<b>Hoist</b>				
31	Hoist Gearbox	1 L (1 qt)	EPGL-5	
32	Hoist Brake	0.24 L (0.25 qt)	TranSynd	
33	Not Used			
<b>Misc.</b>				
34	Driveline Joints		EP-MPG	
35	Fuel Tank	104.4 L (27.6 gal)		
36	Hydraulic Tank	130.6 L (34.5 gal)	HYDO	See Notes 2 & 8

**Lubrication Notes**

- |   |   |
|---|---|
| <p><b>1</b> 4 wheel drive option only.</p> <p><b>2</b> Adjust final fluid levels using dipsticks, level gauges, markings, or filler plugs.</p> <p><b>3</b> Use a mixture of 50% AFC and 50% water.</p> <p><b>4</b> Engine coolant capacity listed is the combined capacity for coolant in the engine and radiator.</p> <p><b>5</b> Apply to pins prior to assembly.</p> | <p><b>6</b> Lubricate all surfaces in contact with wear pads.</p> <p><b>7</b> Apply to all sides.</p> <p><b>8</b> Make sure hydraulic oil meets or exceed Grove cleanliness spec 6829014631;</p> <p><b>9</b> Oil or grease all points requiring periodic lubrication as required during assembly.</p> <p><b>10</b> Lubricate all movable control links and clevis pins during assembly.</p> |
|---|---|

## ENGINE OIL SPECIFICATIONS

Refer to the Engine Manual for engine oil specifications.

## FUEL TYPES

The Cummins Diesel Engine operates most efficiently with No. 2 diesel fuel in temperatures above 32°F (0°C). When operating in temperatures below 32°F (0°C), use No. 1 diesel fuel, or a blend of No. 1 and No. 2 diesel fuels, most commonly known as “Winterized” No. 2 diesel. Use ASTM No. 2 diesel fuel with a minimum Cetane number of 40. No. 2 diesel fuel gives the best economy and performance under most operating conditions. Fuels with Cetane numbers higher than 40 may be needed in high altitudes or extremely low ambient temperatures to prevent misfires and excessive smoke.

For dual fuel engines, use gasoline and LP gas grades specified in the engine manual that came with your crane.

## ENVIRONMENTAL PROTECTION

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

Potentially harmful waste used in Industrial 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.

**RELIEF VALVE SETTINGS**

<b>Relief Valve</b>	<b>Pressure Setting</b>
Pump Margin (stand-by)	350 ±25 psi (24 ±1.7 bar)
Load Sense	3500 ±50 psi (241 ±3.5 bar)
Priority Flow Load Sense	2500 ±100 psi (172 ±7.0 bar)
Accumulator Cutout - High Charge	2000 +100 psi - 0 psi (138 +7.0 bar -0 bar)
Accumulator Cutout - Low Charge	1600 ±100 psi (110 ±7.0 bar)
Boom Telescope Extend	3250 +50 psi - 0 psi (224 +3.5 bar -0 bar)
Boom Telescope Retract	2200 ±100 psi (152 ±7.0 bar)
Swing	2400 ±150 psi (165 ±10.2 bar)
Swing Lock (option)	2400 ±150 psi (165 ±10.2 bar)
Under Deck Winch (option)	2500 ±50 psi (172 ±3.5 bar)

**GENERAL SPECIFICATIONS**

**Boom**

3 Section Boom.....	12.5 m (41 ft)
4 Section Boom.....	15.4 m (50 ft)
Boom Extension (optional).....	4.6 m (15 ft)
Boom Elevation.....	0° to 72°

**Electrical System**

Rating .....	12 VDC negative ground
Battery rating (qty 1, maintenance free).....	1000 CCA @ -18°C (0°F)
Alternator T3 .....	135 amp
Alternator T4 and Dual Fuel .....	145 amp

**Engine**

**Tier 4 Diesel Engine**

Make and model .....	Cummins QSF3.8L-4 Cyl. Diesel Tier 4F
Type of aspiration.....	Turbocharged
Horsepower .....	74 hp @ 2200 rpm
Low idle engine speed .....	900 rpm
No load engine speed .....	2350 rpm
Full load engine speed.....	2200 rpm

**Tier 3 Diesel Engine**

Make and model .....	Cummins QSF3.8L-4 Cyl. Diesel
Type of aspiration.....	Turbocharged
Horsepower .....	99 hp @ 2200 rpm
Low idle engine speed .....	900 rpm
No load engine speed .....	2350 rpm
Full load engine speed.....	2200 rpm

**Dual Fuel (Gasoline/LP) Engine**

Make and model.....	GM 4.3L EFI V-6
Horsepower (Gasoline) .....	90 hp @ 2200 rpm
Horsepower (LP).....	87 hp @ 2200 rpm
Low idle engine speed.....	900 rpm
Maximum engine speed .....	2200 rpm

**Fuel Tank**

Capacity .....	100 L (26.4gal)
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**Hydraulic System**

Primary Pump .....	Axial Piston 65 cc - CW for 2-wheel drive 65 cc - CCW for 4-wheel drive
Swing Motor .....	Single section, geroler-type
Hoist Motor.....	Single section, geroler-type
Hydraulic Filter .....	One 5-micron in-line return
Hydraulic Cylinders .....	Double-acting cylinders for lift, telescope, steering and outriggers
Hydraulic Tank.....	130.6 L (34.5 gal), steel construction with internal baffle

**Mast**

Rotation.....	360°
Mast Bearing (Diameter) .....	860.65 mm (33.884 in)
Swing Drive Mechanism.....	Hydraulic motor driven gearbox
Swing Speed .....	2.1 rpm

**Outriggers**

Type .....	Hydraulic Cylinder each Corner
Construction.....	Oblique, Welded box

**Tires**

Size .....	385/65 D22.5
Air pressure.....	9 bar (125 psi)
Wheel nut torque .....	500 ft-lb (680 Nm)

**Travel Speeds (approximate)**

***2-Wheel Drive, Two-Wheel Steer***

1st gear forward .....	4.0 km/hr (2.5 mph)
2nd gear forward .....	8.9 km/hr (5.5 mph)
3rd gear forward .....	17.7 km/hr (11 mph)
4th gear forward .....	27.0 km/hr (16.8 mph)
1st gear reverse .....	4.0 km/hr (2.5 mph)
2nd gear reverse .....	8.7 km/hr (5.4 mph)
3rd gear reverse.....	17.2 km/hr (10.7 mph)

**Weight (GVW)**

Two Wheel Drive, 41' Boom, 15' Extension, Downhaul Weight, Hook Block, Enclosed Operator's Cab with A/C, and Driver:  
 with T4 Engine ..... 11,771 kg (25,950 lbs)  
 with Tier 3 Engine..... 11,673 kg (25,735 lbs)  
 with Dual Fuel Engine ..... 11,609 kg (25,594 lb)

**Wire Rope**

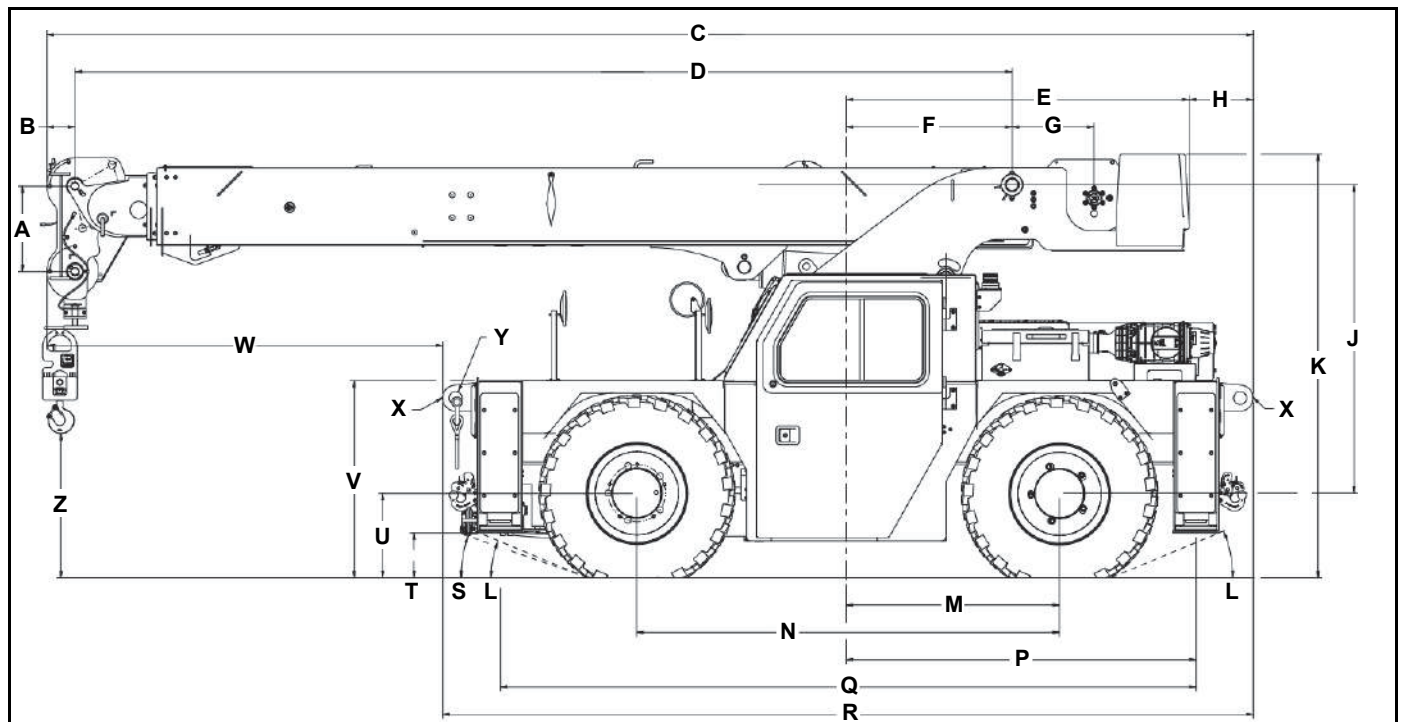
**Main Hoist:**

Size ..... 14 mm (9/16 in) 6 x 19 EEIPS-IWRC  
 Length (41-ft boom) ..... 72 m (235 ft)  
 Length (50-ft boom) ..... 84.7 m (278 ft)  
 Line Pull ..... 3856 kg (8,500 lb)

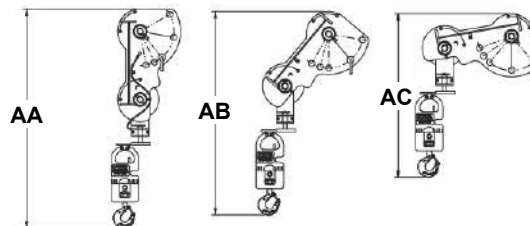
**Optional Below Deck Winch:**

Diameter ..... 11.1 mm (7/16 in)  
 Length..... 35.1 m (115 ft)  
 Max Working Load ..... 4536 kg (10,000 lb)

DIMENSIONS (SIDE VIEW)



Item	mm	ft	in	Comments
A	500	1	8	
B	165	0	7	
C	7066 6853	23 22	2 6	41 ft Boom Retracted 50 ft Boom Retracted
D	5489 12500 5277 15253	18 41 17 50	0 0 4 1	41 ft Boom Retracted 41 ft Boom Extended 50 ft Boom Retracted 50 ft Boom Extended
E	2009	6	7	
F	972	3	3	
G	480	1	7	
H	376	1	3	
J	1805	5	11	
K	2481	8	2	
L	22°			
M	1250	4	1	
N	2476	8	2	
P	2050	6	9	
Q	4075	13	5	
R	4747	15	7	
S	19°			Optional
T	262	0	11	
U	494	1	8	
V	1154	3	10	
W	2319	7	7	
X				
Y	76	0	3	4 lifting holes
Z	846	2	10	
AA	1613	5	4	0° Boom Head
AB	1495	4	11	40° Boom Head
AC	1200	3	11	80° Boom Head



**NOTE 1:** Lifting of the crane must be accomplished utilizing the specified fittings indicated at "X".

**NOTE 2:** Rigging personnel shall be responsible for proper selection and placement of all slings and load handling devices.

**NOTE 3:** Dimensions and heights shown are for largest configuration available.

**NOTE 4:** Rigging personnel shall verify dimensions required for clearance.

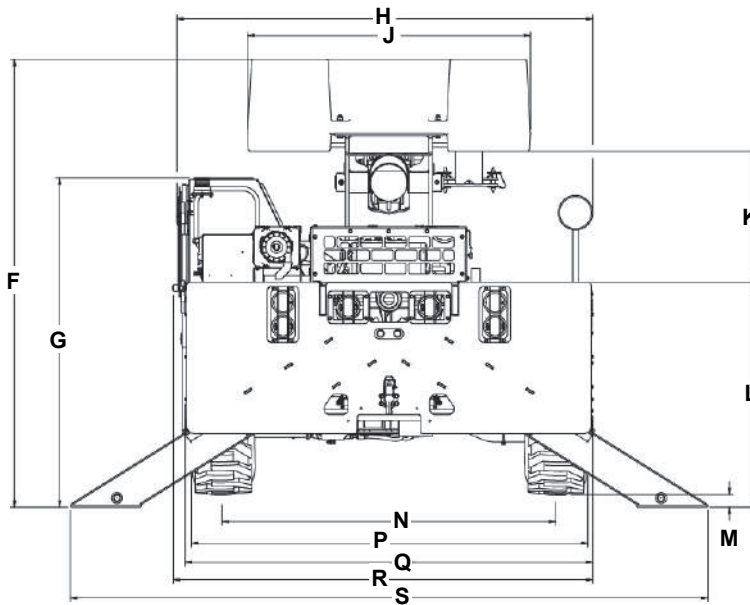
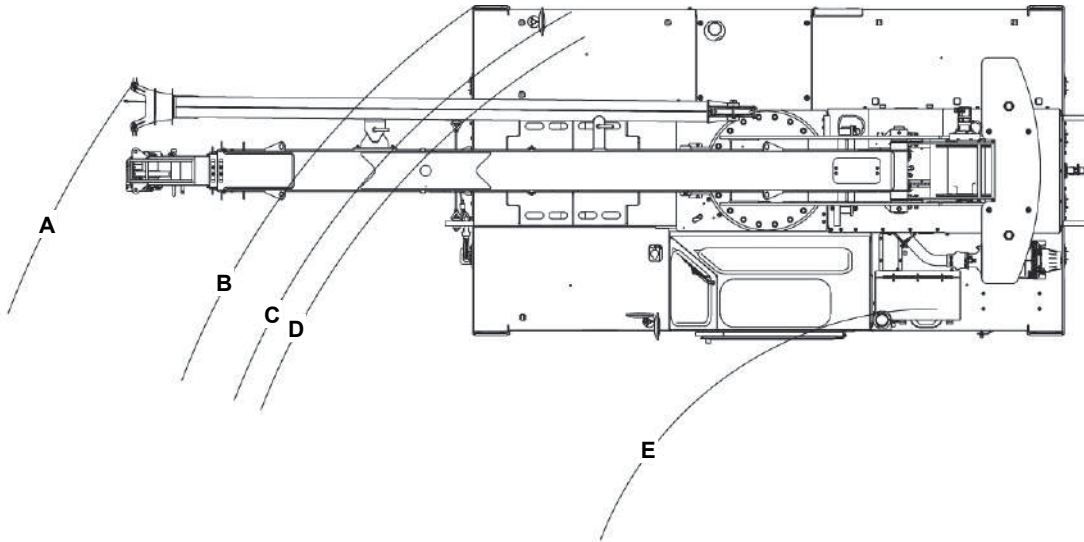
**NOTE 5:** Do not use pintle hooks or counterweight lugs for lifting or tie down of the crane.

Item	Qty	Lift	Tow	Tie Down	Capacity – Metric Ton (US Ton)				
					Lift	Tow	Tie Down		
							Fore Aft	Side	Down
X	4	OK	OK	OK	25.4 (28)	25.4 (28)	25.4 (28)	7.3 (8)	25.4 (28)



DIMENSIONS (TOP VIEW AND REAR VIEW)

Tire Size	Radius mm (ft-in)									
	A Boom Clearance	B Carrier Clearance	C Curb Clearance	D Outside Turn	E Inside Turn	A Boom Clearance	B Carrier Clearance	C Curb Clearance	D Outside Turn	E Inside Turn
385/65D22.5	7307 (24-0)	5939 (19-6)	5526 (18-2)	5318 (17-6)	2647 (8-8)	5210 (17-1)	3606 (11-10)	3175 (10-5)	2856 (9-5)	2068 (6-10)
	Two-Wheel Steer					Four-Wheel Steer				



Item	mm	ft	in
F	2635	8	8
G	1938	6	5
H	2444	8	0
J	1662	5	6
K	771	2	7
L	1325	4	4
M	74	0	3
N	1963	6	6
P	2329	7	8
Q	2396	7	11
R	2465	8	1
S	3747	12	4

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