National Crane NBT40-1 Series

Operator Manual

WARNING

California Proposition 65

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

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

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

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

California Spark Arrestor

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

The original language of this publication is English.

NATIONAL CRANE
by Manitowoc

OPERATOR MANUAL

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

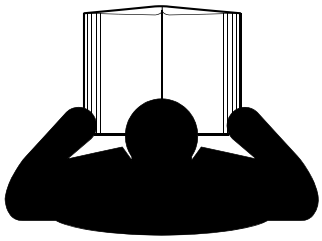
NBT40-1 Series Cranes and Aerial Lifts

This Manual is divided into the following sections:

NOTICE

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

The equipment serial number is identified on the builder's decal attached to the right side of the turret. ***Always furnish equipment serial number*** when ordering parts or communicating service problems with your distributor or the factory.



⚠DANGER

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

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

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SECTION 1
INTRODUCTION

SECTION CONTENTS

GENERAL

This manual has been compiled to assist you in properly operating and maintaining your Model NBT40-1 SERIES National Crane (Figure 1-1). The NBT40-1 series includes crane models NBT36-1, NBT40-1, and NBT45-1.

Before placing the equipment in service, all operators and persons working around the equipment must thoroughly read and understand the contents of this manual pertaining to ***Safety, Operation and Maintenance.*** Before moving a vehicle equipped with the crane, information relating to transporting the vehicle must be read and observed.

This manual must be retained with the machine for use by subsequent operating personnel.

Information in this manual does not replace federal, state or local regulations, safety codes or insurance requirements.

For detailed information concerning the operation and maintenance of the RCL system installed on the equipment, see the manufacturer's manual supplied with the equipment. Manufacturers of rated capacity limiters may refer to them in their manuals as a load moment indicator (LMI), a hydraulic capacity alert system (HCAS), National Crane refers to these systems as a rated capacity limiter (RCL) throughout its *Operator* and *Service Manuals*.)

The NBT40-1 SERIES has been designed for maximum performance with minimum maintenance. With proper care, years of trouble-free service can be expected.

National Crane and our Distributor Network wants 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.

Supplemental Information

Supplemental Information regarding Safety & Operation, Specifications, Service & Maintenance, Installation, and parts for options such as remote controls, augers, varying control configurations, platforms, grapples, etc. are included in separate manuals. Most optional content is being added to this standard manual such as the platform and remotes. The RCL and optional the hydraulic pressure intensifier are included as separate manuals.

Whenever a question arises regarding your National Crane product or this publication, please consult your National Crane distributor for the latest information. Your National Crane distributor is equipped with the proper tools, necessary parts, and trained personnel to properly maintain and service your equipment.

A Safety Compact Disc or a USB flashdrive which includes sections on Operation, Service and a Safety Video for National Crane operators and owners is supplied when the equipment is purchased new. Additional copies are available from your local distributor.

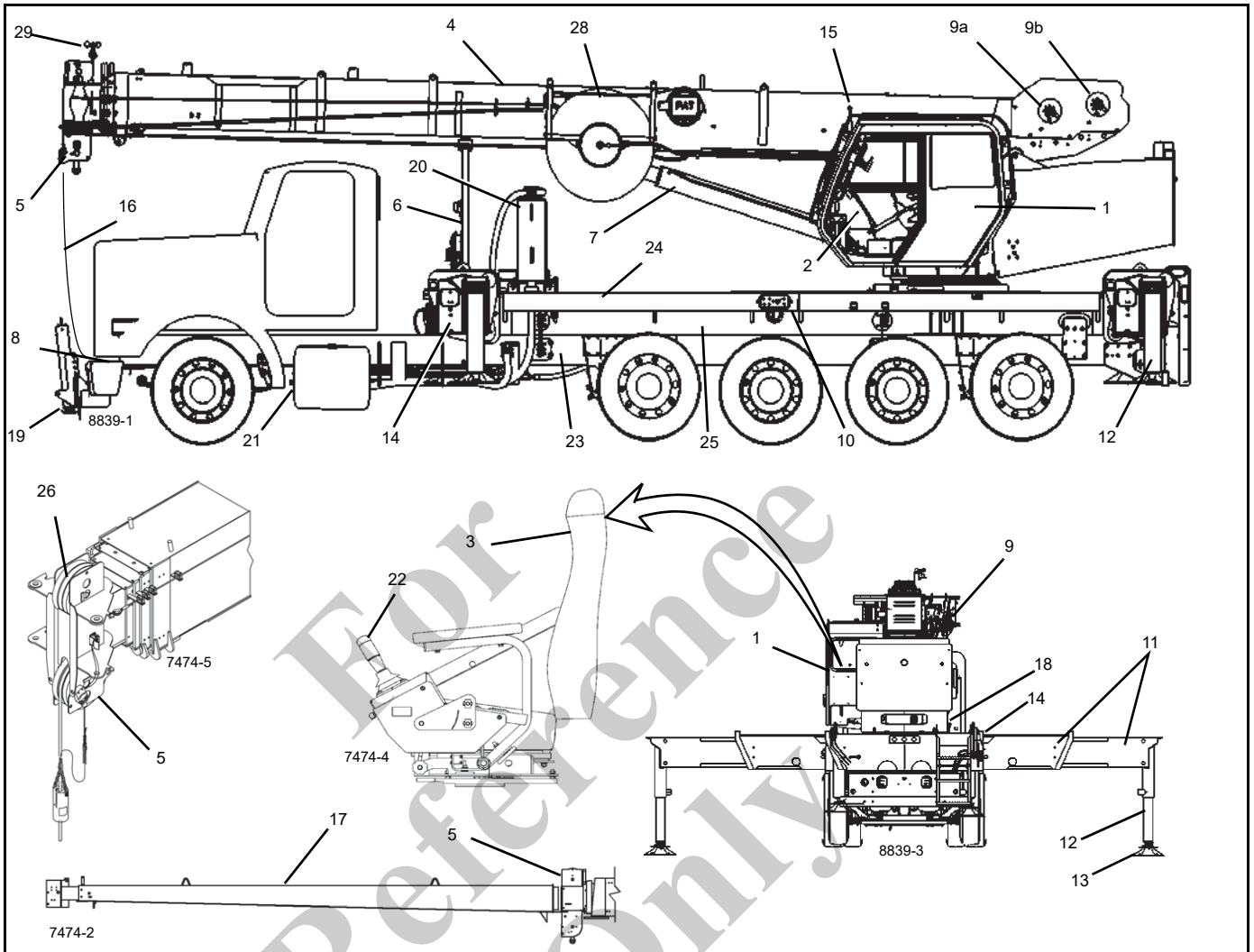
New Owner

If you are the new owner of a National crane, please register it with Manitowoc Crane Care so we have the ability to contact you if the need arises. Go to: https://www.manitowoccranes.com/en/services/crane-care/service-and-tech-support/Change-of-Ownership-Form

Basic Nomenclature

The nomenclature used to describe parts of a National Crane are described in Figure 1-2. This nomenclature is used throughout this manual.

FIGURE 1-1



Item	Component
1	Crane Cab/Cab Controls
2	Crane Cab - Front Console
3	Operator's Seat
4	Boom
5	Boom Nose
6	Boom Rest
7	Lift Cylinder
8	Downhaul Weight, Hook Block
9	Hoist, Hoist (9a Auxiliary, 9b Main)
10	Outrigger Control Panel
11	Outrigger Beam
12	Outrigger Jack
13	Outrigger Float
14	Outrigger Box
15	Boom Angle Indicator

Item	Component
16	Hoist Cable, Wire Rope
17	Jib
18	Turret
19	Stabilizer Front Outrigger (SFO), Front Outrigger Jack
20	Hydraulic Tank
21	Hydraulic Pump (not shown)
22	Joystick - Controller
23	Truck Frame
24	Truck Bed/Decking
25	Torsion Box Frame, T-Box Frame
26	Sheave
27	Aerial Platform - Optional (not shown)
28	Hydraulic Tool Circuit Reel-Optional
29	Windspeed Indicator-Optional

FIGURE 1-2

NOTICE TO OWNER/USER

IMMEDIATELY report all accidents, malfunctions, and equipment damages to your local National Crane distributor. Following any accident or damage to equipment, the local National Crane distributor must be immediately advised of the incident and consulted on necessary inspections and repairs. Should the distributor not be immediately available, contact should be made directly with Manitowoc Crane Care. The equipment 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 local National Crane distributor or Manitowoc Crane Care.

SECTION 2
SAFETY PRECAUTIONS - CRANE

SECTION CONTENTS

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 equipment 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. The decals shown in this section are examples. Consult the *Parts Manual* for specific decals installed on the equipment.

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

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

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

ACCIDENTS

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

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

Grove U.S. L.L.C
1565 East Buchanan Trail
Shady Grove, PA 17256-0021

Phone: 888-777-3378 (888-PSR.DEPT)
Fax: 717-593-5152
E-mail: product.safety@manitowoc.com

OPERATOR INFORMATION

You must **read** and **understand** this *Operator Manual* and the *Load Chart* before operating your new equipment. 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 equipment is in use.

The *Operator Manual* supplied with and considered part of your equipment must be read and completely understood by

each person responsible for assembly, disassembly, operation and maintenance of the equipment.

No personnel shall be allowed to climb onto the equipment or enter the equipment 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 equipment while the equipment is operating or moving, unless they are seated in a two-man cab.

Keep clear of moving outriggers to avoid crushing hazards. Contact with moving components could result in death or serious injury.

Example decal. For reference only.
8819

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

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

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

OPERATOR QUALIFICATIONS

A **qualified person** is defined as one who by reason of knowledge, training and experience is thoroughly familiar with equipment operations and the hazards involved. Such a person shall meet the operator qualifications specified in Occupational Safety and Health Administration (OSHA) Regulations (United States Federal Law), in ASME B30.5 American National Standard, or in any other applicable federal, state or local laws.

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

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

You must be familiar with the regulations and standards governing this equipment 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.

Example decal. For reference only.
8788

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

You must not operate this equipment unless:

- You have been trained in the safe operation of this equipment.
- 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 equipment 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 equipment unless you are trained and thoroughly familiar with all operational functions. Controls and design may vary from equipment to equipment; therefore, it is important that you have specific training on the particular equipment you will be operating.

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

You must be mentally and physically fit to operate the equipment. Never attempt to operate equipment 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 equipment, 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 equipment or that take control of particular functions without action of the operator when a limiting condition is sensed, as stated in the latest revision of the ASME B30.5, and ASME B30.8 standards. Examples of such devices include, but are not limited to, the following: anti-two-block device, rated capacity indicator, rated capacity limiter, boom angle or radius indicator, boom length indicator, equipment level indicator, hoist drum rotation indicator, load indicator, and wind speed indicator.

National Crane remains committed to providing reliable products that enable users and operators to safely lift and position loads. National Crane has been an industry leader in the incorporation of operational aids into the design of its equipment. Federal law requires that equipment be properly maintained and kept in good working condition. The manuals that National Crane provides that are specific for each equipment and the manufacturer's manuals for the operational aids shall be followed. If an operational aid should fail to work properly, the equipment 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 equipment when operational aids are inoperative or malfunctioning, the following requirements shall apply for continued use or shutdown of the equipment:

- 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 equipment 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 equipment.

Rated Capacity Limiter (RCL) Systems

Your equipment is equipped with an RCL system which is intended to aid the operator. An RCL is a device that automatically monitors radius, load weight, and load rating and prevents movements of the equipment, 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 equipment as shown on the *Load Chart* before making any lifts.

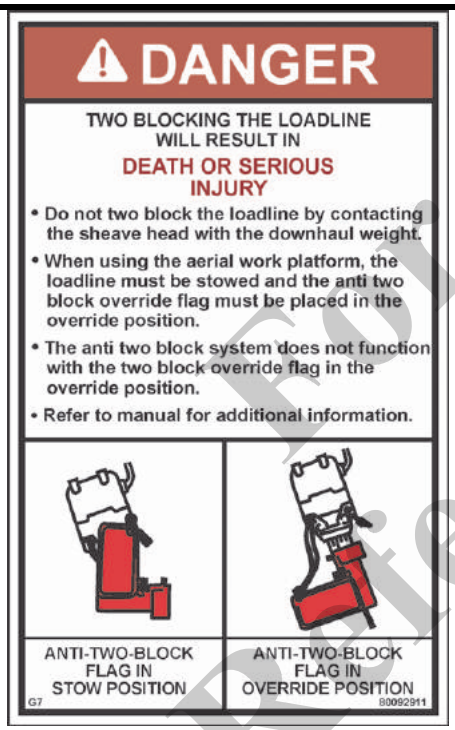
NEVER exceed the rated capacity shown on the *Load Chart*. Always check the *Load Chart* to make sure that the load to be lifted at the desired radius is within the rated capacity of the equipment.

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

Anti-Two-Blocking Device

This equipment 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, downhaul weight, rigging, etc.) comes into physical contact with the boom (boom nose, sheaves, jib, 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 rope may fail allowing the load, block, etc. to fall.



9250 **Example decal. For reference only.**

Two-blocking is more likely to occur when both the main and auxiliary hoist lines are reeved over the main boom nose and jib 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 jib 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 equipment 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 equipment operating practices, experience and good operator judgments.

EQUIPMENT STABILITY/STRUCTURAL STRENGTH

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

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

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

Read and follow the following safety decal for equipment with a single front outrigger.

9120 **Example decal. For reference only.**

Carefully follow the procedures in this Operator Manual when extending or retracting the outriggers. Death or serious injury could result from improper equipment 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, consult the Load Chart for any boom angle or boom length restrictions.

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 equipment stability before lifting loads. Make sure that the outriggers (or tires if lifting on rubber) are firmly positioned on solid surfaces. Make sure that the equipment 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.

Outrigger beams and jack cylinders (plus single front outrigger, if equipped) must be properly extended and set to provide precise leveling of the equipment. 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 equipment 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 equipment 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 equipment.

Work Site

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

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

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 equipment.

Wind can have a significant effect on loads that may be lifted by equipment. Wind forces act differently on the equipment 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. National Crane recommends that a lift not be made if the wind can cause a loss of control in handling the load.

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

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

Table 2-1 Beaufort Wind Scale

		Maximum Wind Speed			
Beaufort Number	**Description**	**m/s**	**km/h**	**mph**	**Visible Indicator Effects of wind as observed on land**
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 equipment operation site. For lift planning purposes only, the 3-second wind gust speed, ***V(z)***, may be calculated based on mean wind speed reported at http://www.windfinder.com “Super Forecast”.

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

a) If ***V(z)*** is ≤ 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 ≤ 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).

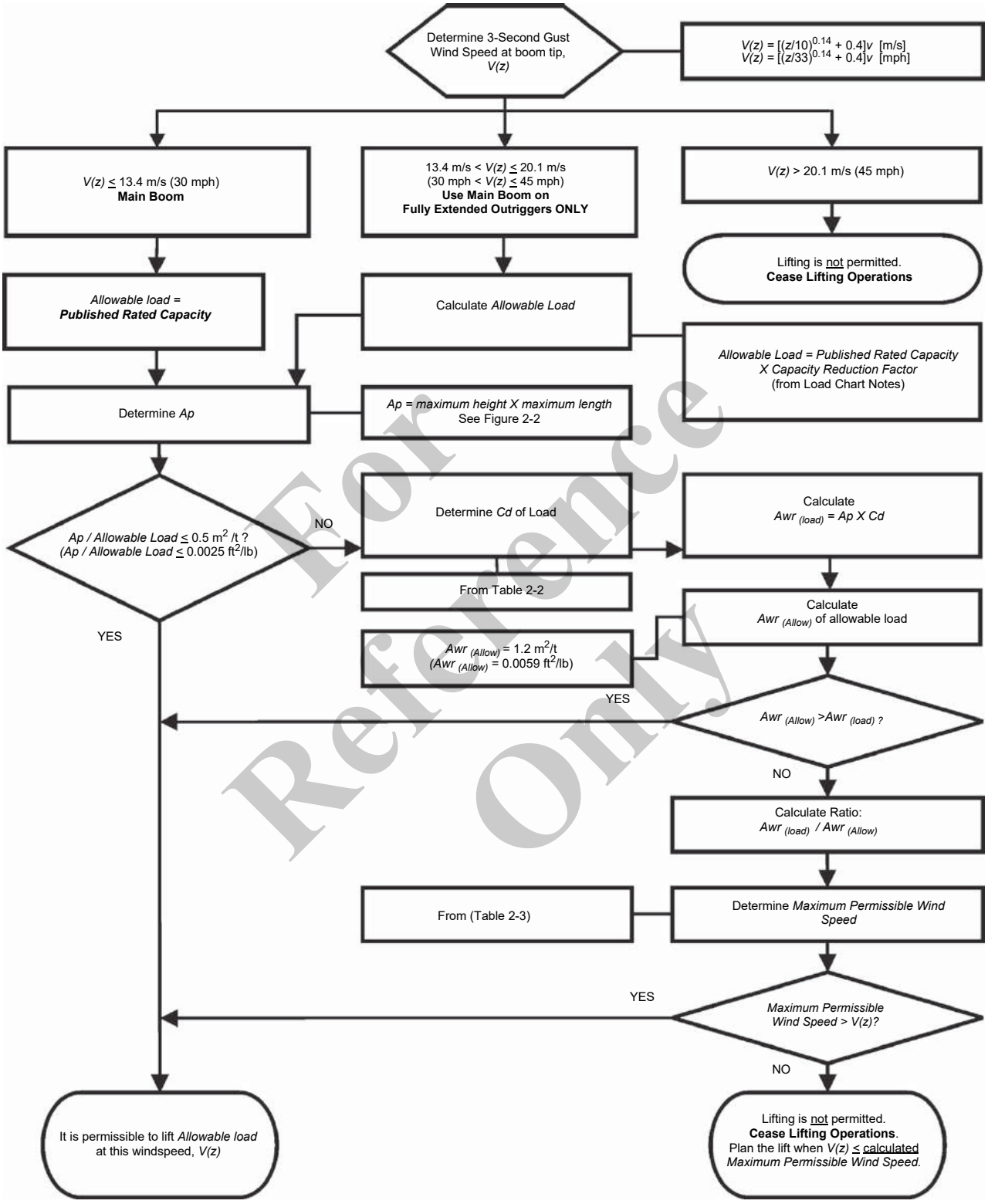
NOTE: This condition is limited to operation with the main boom on fully extended outriggers only.

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 ***Ap*** and by the wind drag coefficient ***Cd***: This limit can be determined by comparing the **Actual** wind resistance area with the **Allowable** wind resistance area.

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

Simplified Method to Determine Maximum Permissible Wind Speed



V(z) = 3 second gust wind speed at boom tip, m/s (mph)
Ap = Projected Wind Area of Load, m^2 (ft^2)

Awr (load) = Actual Wind Resistance Area for the Load, m^2(ft)
Awr (Allow) = Allowable Wind Resistance Area of the Load, m^2 (ft2
Cd = air drag coefficient of load

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 equipment operation site:

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

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

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

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

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

where:

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

Example: Suppose you want to lift the load with the maximum boom tip height of 30 m (100 ft) and the recorded mean wind speed by the device located at the equipment 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 m/s (17.7 mph)

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

then:

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

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

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

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

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

Size and Shape of the load:

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

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

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

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

where:

$Awr_{(load)}$ [m^2] [ft^2] - Wind resistant area of the load

Ap [m^2] [ft^2] - projected wind area,

Cd - wind drag coefficient.

Ap is determined by using the calculation of maximum height x maximum length (see Figure 2-3).

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

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

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

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

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

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

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

Calculation of Projected Wind Area (Ap):

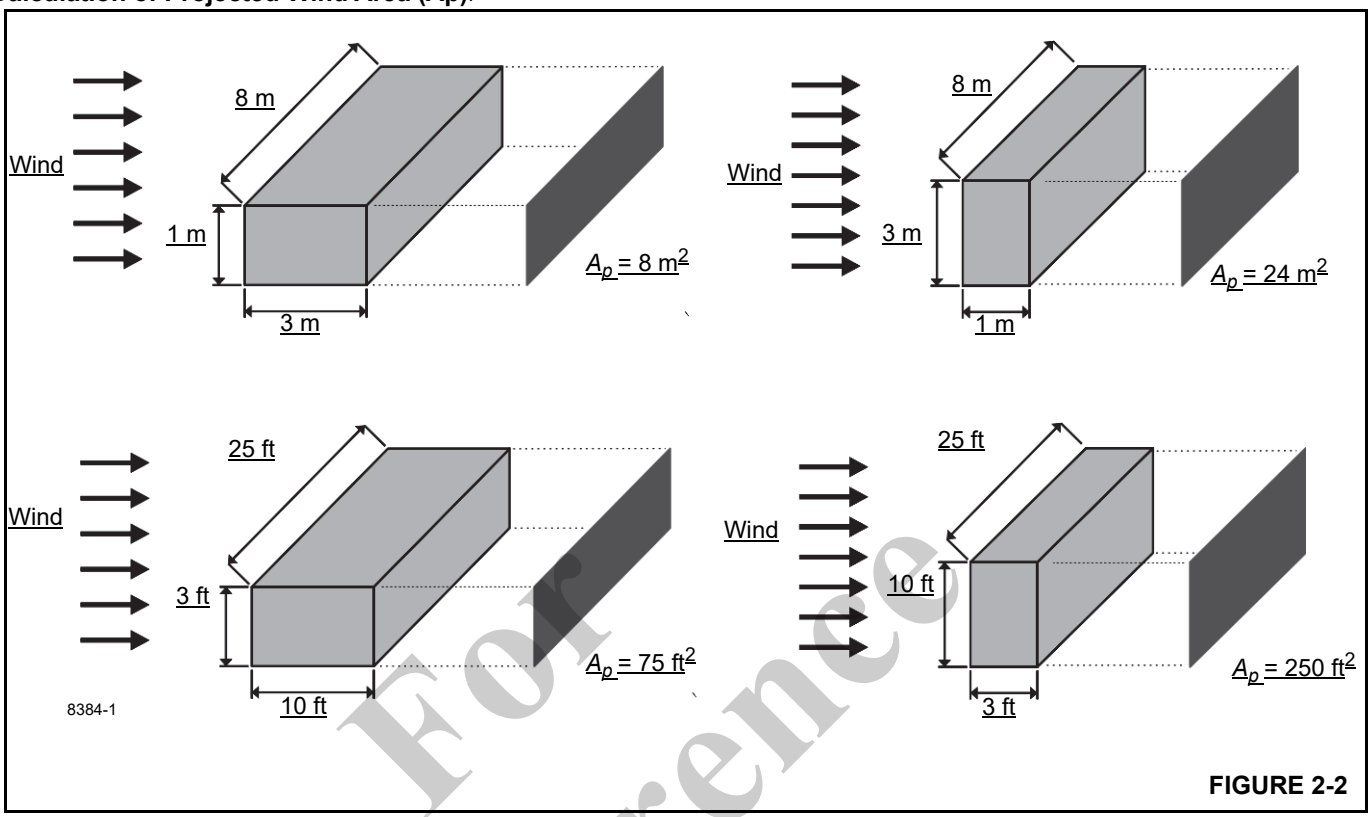


FIGURE 2-2

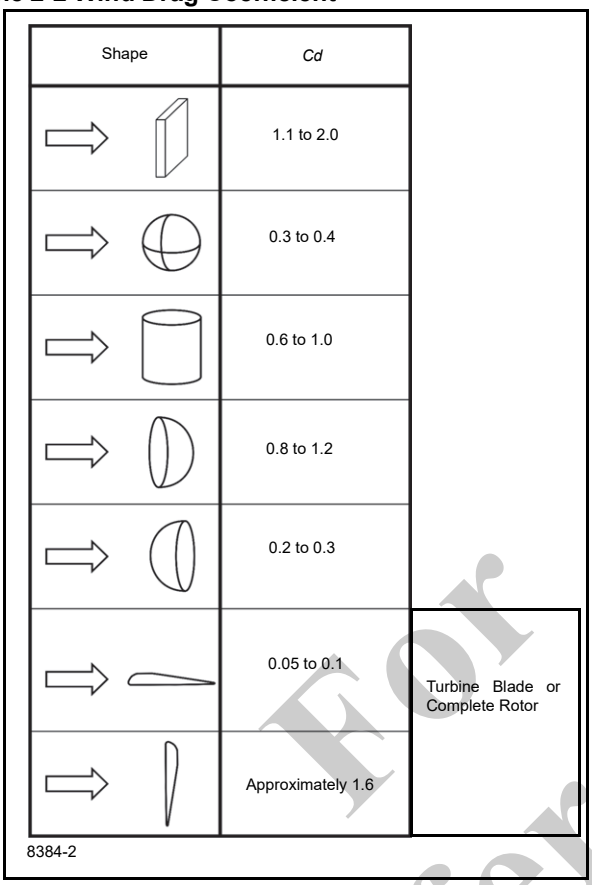
Determining Wind Drag Coefficient (Cd)

Table 2-2 shows the typical Shapes and corresponding Wind Drag Coefficient *(**Cd**)* 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 *(**Cd**)* = 2.4.

Table 2-2 Wind Drag Coefficient



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.

2

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

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	#0001								
	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 (8)			
6	32,950 (50.5)	32,925 (55.5)	32,825 (63.5)	28,350 (68.5)	18,225 (72)	18,2 (7)	*18,225 (78)		
7	28,325 (42.5)	28,300 (49)	28,225 (59)	26,250 (65)	18,225 (69)	225 ( )	18,225 (74.5)	*16,725 (78)	*11,400 (78)
8	24,150 (32.5)	24,150 (42)	23,975 (54.5)	23,275 ( )	225 ( )	225 (69.5)	16,575 (72)	15,250 (74.5)	11,400 (76)
9	20,600 (16.5)	20,550 (33.5)	20,375 (49.5)	20,25 ( )	18,2 (63)	16,575 (67)	15,050 (70)	13,875 (72.5)	11,400 (74.5)
10		17,200 (20.5)	17 (4	17, 5 (54)	17,325 (60)	15,125 (6)	13,725 (67.5)	12,700 (70.5)	11,400 (72.5)
12			0.07 (3	225 (45.5)	12,575 (53.5)	12, 5	11,600 (63)	10,725 (66.5)	10,050 (69)
14				9,000 (35)	9,360 (6)	9,730 (53.5)	9,955 (58.5)	9,205 (62)	8,620 (65)
16				6,75 (19)	7, (37.5)	7 5 (47)	7,920 (53)	7,980 (57.5)	7,470 (61.5)
18					5 ( )	5,960 (39.5)	6,340 (47.5)	6,525 (53)	6,530 (57.5)
20						4,755 (30.5)	5,145 (41)	5,320 (48)	5,495 (53)
22						3,790 (16.5)	4,210 (33.5)	4,380 (42.5)	4,545 (48.5)
24							3,435 (23.5)	3,620 (36)	3,780 (43.5)
26								2,975 (28)	3,150 (37.5)
28								2,400 (16)	2,620 (31)
30									2,135 (22)
Minimum boom angle (°) for indicated length (no load)									0
Maximum boom length (m) at 0° boom angle (no load)									33.5

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

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

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

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FIGURE 2-3

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

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

For wind speed ***V(z)*** (3-second gust speed at boom tip height) ***V(z)*** > 13.4 m/s ≤ 20.1 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 m/s ≤ 20.1 m/s	10.9	12.2	15.2	18.4	21.3	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, $Awr_{(allow)}$ = 0.0012 x 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 equipment Operator Manual.

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

Note: Permissible and rated wind speeds in this table are the 3-second gust wind speeds at boom tip height.					
Ratio:	1.2	1.4	1.6	1.8	2
	Maximum Permissible Wind Speed (m/s)				
For Rated Capacity at 13.4 m/s	12.2	11.4	10.6	10.0	9.5
For Allowable Capacity at 20.1 m/s	18.3	17.0	15.9	15.0	14.2

Example and Sample Calculations (metric)

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

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

Example 1: Equipment Configuration:

- boom length = 27.4 m,
- load radius = 9 m,
- wind speed is measured at ***V(z)*** ≤ 20.1 m/s.

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

The maximum allowable wind resistance area of load is :

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

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

Lifting Limits at wind speed V(z) ≤ 13.4 m/s at this configuration:

- Maximum load 15,050 kg
- Maximum wind resistance area of load 18.06 m^2

For the allowable wind speed > 13.4 m/s and ≤ 20.1 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:

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

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

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

Lifting Limits at wind speed V(z) > 13.4 m/s **and ≤ 20.1 m/s,** at this configuration:

- Maximum load 12,040 kg
- Maximum wind resistance area of load 14.45 m^2

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^2.

Refer to the information from the above 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^2,
- Wind Drag Coefficient ***Cd*** = 1.5

wind resistance area of load can be estimated as

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

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

- Is the load to be lifted less than allowable load?
  11,200 kg ≤ 12,040 kg YES
- Is $Awr_{(load)}$ less than $Awr_{(allow)}$?
  13.8 m^2 ≤ 14.45 m^2 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^2,
- Wind Drag Coefficient ***Cd*** = unknown

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

- the wind resistance area of load can be estimated as
  $Awr_{(load)} = Ap \times Cd = 5.45 \times 2.4 = 13.08\ m^2$

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

- Is the load to be lifted less than allowable load?
  10,000 kg ≤ 12,040 kg YES
- Is $Awr_{(load)}$ less than $Awr_{(allow)}$?
  13.08 m^2 ≤ 14.45 m^2 YES

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

Load example 1.3a:

With large wind resistance area of the load $Awr_{(load)}$,

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

the wind resistance area of load can be estimated as:

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

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

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

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

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

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

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

- Is $Awr_{(load)}$ less than $Awr_{(allow)}$?
  26.22 m^2 ≤ 18.06 m^2 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 $Awr_{(load)}$,

- Load to be lifted of 8,000 kg,
- Projected Wind Area ***Ap*** = 15.25 m^2,
- Wind Drag Coefficient ***Cd*** = 1.3

the wind resistance area of load can be estimated as

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

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

- Is the load to be lifted less than allowable load?
  8,000 kg ≤ 12,040 kg YES
- Is $Awr_{(load)}$ less than $Awr_{(allow)}$?
  19.83 m^2 ≤ 14.45 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:

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

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

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

2

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 than 30 mph ≤ 45 mph, the Reduced Capacity shall be calculated by multiplying the Published Rated Capacity by the following factors:

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

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

Maximum allowable wind resistance area in ft², $Awr_{(allow)}$ = 0.0059 x calculated reduced capacity in lb.

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

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

Rated Load Chart Example - Non-metric

RATED LIFTING CAPACITIES IN POUNDS
36 FT. - 110 FT. BOOM

ON OUTRIGGERS FULLY EXTENDED - 360°

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

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

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

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

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FIGURE 2-4

Example and Sample Calculations (Non-metric)

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

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

Example 2:

Equipment is configured with:

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

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

The maximum allowable wind resistance area of load is:

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

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

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

- Maximum load 25,200 lb
- Maximum wind resistance area of load 149 ft^2

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

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

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

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

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

- Maximum load 20,160 lb
- Maximum wind resistance area of load 119 ft^2

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^2.

Refer to the above equipment 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^2,
- Wind Drag Coefficient ***Cd*** = 1.5

then the wind resistance area of load can be estimated as

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

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

- Is the load to be lifted less than allowable load?
  19,500 lb ≤ 20,160 lb YES
- Is $Awr_{(load)}$ less than $Awr_{(allow)}$?
  105 ft^2 ≤ 119 ft^2 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^2,
- Wind Drag Coefficient ***Cd*** = unknown

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

the wind resistance area of load can be estimated as

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

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

- Is the load to be lifted less than allowable load?
  18,000 lb ≤ 20,160 lb YES
- Is $Awr_{(load)}$ less than $Awr_{(allow)}$?
  108 ft^2 ≤ 119 ft^2 YES

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

Load example 2.3a:

With large wind resistance area of the load $Awr_{(load)}$,

- Load to be lifted of 22,000 lb,
- Projected Wind Area ***Ap*** = 180 ft^2,
- Wind Drag Coefficient ***Cd*** = 1.2

the wind resistance area of load can be estimated as:

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

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

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

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

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

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

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

- Is $Awr_{(load)}$ less than $Awr_{(allow)}$,?
  $216\ ft^2 \leq 149\ ft^2$. . . . . 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.

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

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 $Ap = 125\ ft^2$,
- Wind Drag Coefficient $Cd = 1.3$

the wind resistance area of load can be estimated as:

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

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

- Is the load to be lifted less than allowable load?
  12,000 lb ≤ 20,160 lb YES
- Is $Awr_{(load)}$ less than $Awr_{(allow)}$,?
  $162\ ft^2 \leq 119\ ft^2$ 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 equipment on a firm surface, properly extend and set the outriggers, and level the equipment. Depending on the nature of the supporting surface, adequate cribbing may be required to obtain a larger bearing surface.

The equipment is equipped with a bubble level that should be used to determine whether the equipment is level. The load line can also be used to estimate the levelness of the equipment 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 jib, 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 equipment configuration. Refer to the RCL operator manual supplied with the equipment.

Verify the equipment'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, jib, 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 equipment's *Load Chart*.

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

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

The equipment can tip over or fail structurally if:

- The load and equipment'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 intermediate positions, the outriggers must also be pinned when operating from the intermediate position.
- Cribbing under the outrigger pads is inadequate.
- The equipment is improperly operated.

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

Make sure that the hoist line is vertical before lifting. Do not subject the equipment to side loading. A side load can tip the equipment 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 equipment will lean toward the boom and the load will swing out, increasing the load radius. Make sure that the equipment'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 equipment from service if the boom is damaged.

Never push or pull with the boom.

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

Using only one hoist at a time when lifting loads is recommended. See "Tilt-Up Panel Lifting" 2-20 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.

Counterweight

On equipment that features 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. [OSHA 29CFR 1926.1434]

Outrigger Lift Off

Regarding "lifting" of an outrigger pad during loaded equipment functions, be advised that the rated loads for these equipment, as indicated on the *Load Chart*, do not exceed 85% of the tipping load on outriggers as determined by SAE J765 JUNE2017 "Equipment's Stability Test Code." An outrigger pad may lift off the ground during operation of the equipment within the capacity limits of the *Load Chart*, yet the equipment will not have reached instability. The "balance point" for stability testing according to SAE and National Crane criteria is a condition of loading wherein the load moment acting to overturn the equipment is equal to the maximum moment of the equipment available to resist overturning. This balance point or point of instability for equipment 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 equipment'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 equipment is properly set up, the equipment is in good working condition, that all operator's aids are properly programmed and setup, that the qualified operator adheres to the instructions found in the applicable *Load Chart*, *Operator Manual* and decals on the equipment, the equipment should not be unstable.

Multiple Equipment Lifts

Multiple equipment lifts are not recommended.

Any lift that requires more than one equipment must be precisely planned and coordinated by a qualified person. If it is necessary to perform a multi-equipment 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 equipment so equipped.
- Calculate the amount of weight to be lifted by each equipment 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 equipment to the other.
- Do not travel. Lift only from a stationary position.

Tilt-Up Panel Lifting

Requirements and recommendations regarding operation and use of National Crane equipment are stated on decals and in the Operator Manual provided with each specific model. Using the subject equipment 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 equipment to be used to perform tilt-up panel lifting using the equipment equipped with two hoists:

- The equipment must be set up and operated in accordance with National Crane's instructions in the Operator Manual, Load Capacity Chart, and decals affixed to the equipment.
- 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 the equipment and the auxiliary hoist line connected to the end farthest from the equipment.
- 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 equipment.
- 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 equipment 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 equipment are properly trained and thoroughly familiar with operational functions of the equipment and safe operating and work practices. Personnel should be thoroughly familiar with regulations and standards governing equipment 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.

PILE DRIVING AND EXTRACTING

National Cranes are not approved and shall not be used in vibratory or pile driving applications. Vibratory or pile driving applications will significantly increase load cycle and promote early fatigue and/or premature failure of components.

ELECTROCUTION HAZARD

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

United States federal law prohibits the use of equipment 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, National Crane recommends that all parts of the equipment, boom, and load be kept at least 6 m (20 ft) away from all electrical power lines and equipment less than 350 kV.

NOTE: For detailed guidelines on operating near power lines, refer to the current edition of OSHA 29CFR1926.1408 and ASME B30.5 American National Standard.

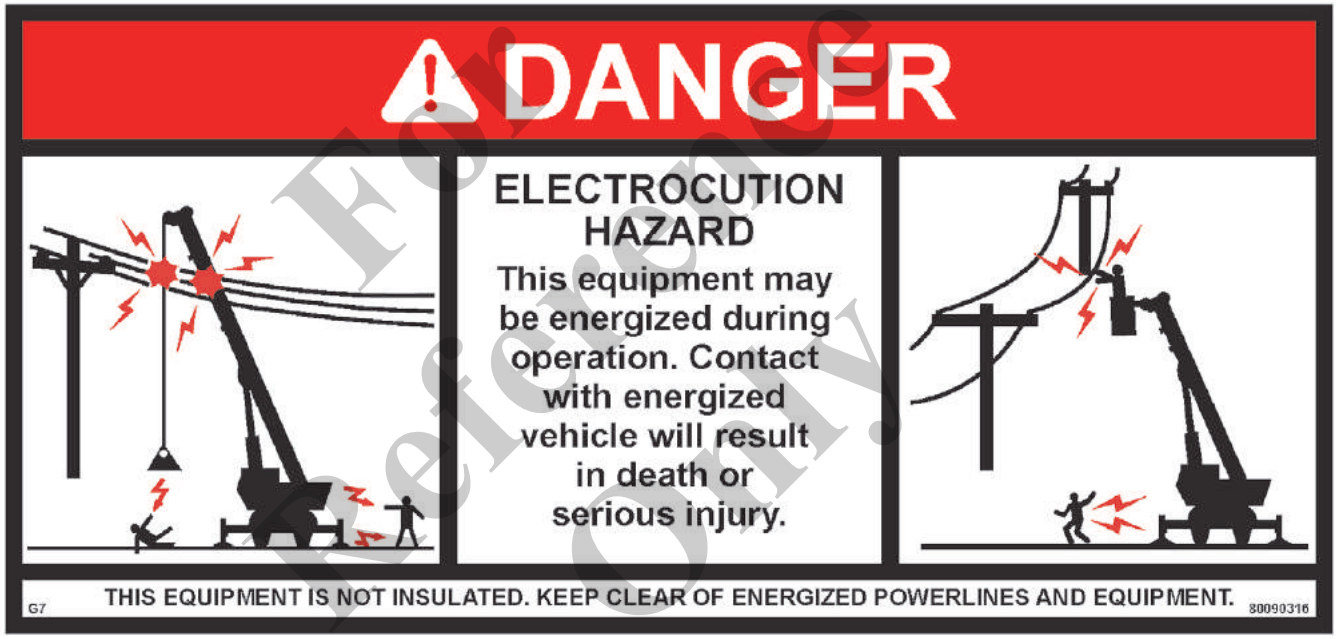
DANGER

Electrocution Hazard!

National Crane equipments are not equipped with all features required to operate within OSHA 29CFR1926.1408, 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 equipment.



8822 **Example decal. For reference only.**

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

Before operating this equipment 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 equipment is **not insulated**. Always consider all parts of the load and the equipment, 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 equipment while operating. Permit no one to lean against or touch the equipment. 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 equipment contacts or comes too close to an electrical power source, everyone in, on, and around the equipment 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 equipment boom if it comes too close to an electrical power source. Low voltages can also be dangerous.

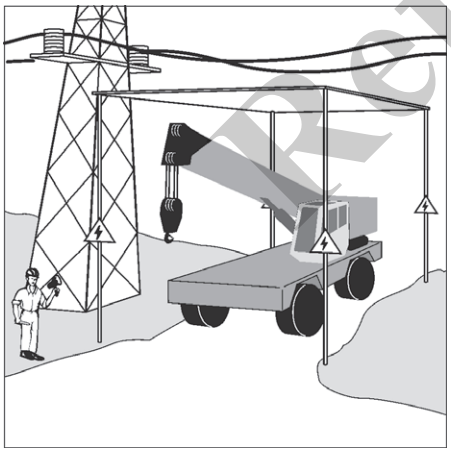
Set-Up and Operation

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

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

A suitable barricade should be erected to physically restrain the equipment 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.



8823

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 equipment or load moves near a power source. This person shall have no other duties while the equipment 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 equipment has 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 equipment 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 the equipment 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 equipment should come in contact with an energized power source, you must:

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

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

Following any contact with an energized electrical source, the National 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 equipment. Should the distributor not be immediately available, contact Manitowoc Crane Care. The equipment 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 National Crane distributor or Manitowoc Crane Care.

Special Operating Conditions and Equipment

Never operate the equipment during an electrical thunderstorm.

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

- The transmitter shall be deenergized OR,
- Tests shall be made to determine if an electrical charge will be induced into the equipment or load.
- The equipment 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 equipment 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 equipment 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 Equipment

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

WARNING

Risk of accidents due to electric shock!

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

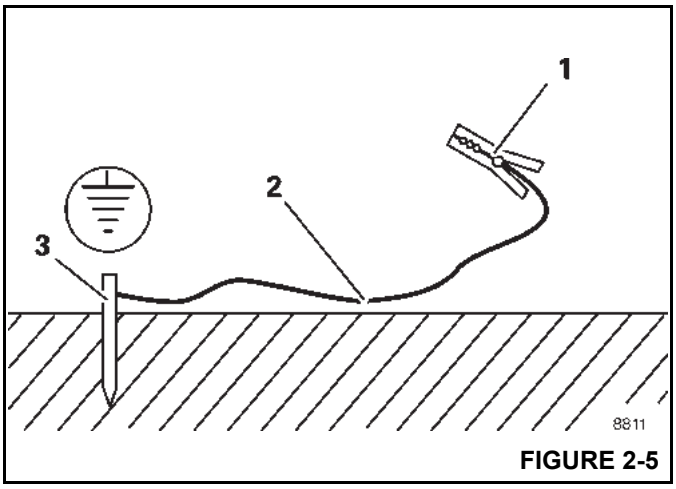


FIGURE 2-5

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

For equipment that is Dual-Rated as both a crane and an aerial lift, refer to the Safety Precautions - Aerial Lift section. Also see the optional equipment manual titled Personnel Basket Manual which addresses safety, inspection, testing, operation, installation, and lubrication.

The following information is for machines that are not Dual Rated.

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

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

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

> General requirements. The use of 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 equipment 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 National Crane equipment 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 the equipment to handle personnel is the least hazardous means to perform the work.
- The equipment operator shall be qualified to operate the specific type of hoisting equipment used in the personnel lift.
- The equipment operator must remain at the equipment controls at all times when personnel are off the ground.
- The equipment operator and occupants have been instructed in the recognized hazards of personnel platform lifts.
- The equipment is in proper working order.
- The equipment must be equipped with a boom angle indicator that is visible to the equipment operator.
- The equipment'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 equipment.
- The equipment is level within one percent of level grade and located on a firm footing. Equipment with outriggers shall have them all deployed following manufacturer's specifications.
- The equipment'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 equipment is equipped with a hook that can be closed and locked, eliminating the throat opening.
  - The equipment is equipped with a functional anti-two-block device.
  - The platform is properly attached and secured to the load hook.
- For boom mounted platforms:
  - On equipment that features a boom mounted personnel platform, use only a platform approved by National Crane.
  - The platform is properly attached and secure.

To avoid death or serious injury:

- NEVER use this equipment 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 moving equipment.
- NEVER allow anyone on the hoist access platform while traveling.

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

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

  - or - check online at:

  https://www.asme.org/codes-standards/find-codes-standards
- *US DOL/OSHA Rules and Regulations* are available by mail from the Superintendent of Documents, PO Box 371954, Pittsburgh, PA, 15250-7954.

ENVIRONMENTAL PROTECTION

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

Potentially harmful waste used in National Crane equipment 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 equipment 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 equipment must be inspected prior to use on each work shift. The owner, user, and operator must make sure that routine maintenance and lubrication are being dutifully performed. **Never** operate damaged or poorly maintained equipment.

National Crane continues to recommend that equipment be properly maintained, regularly inspected and repaired, as necessary. National Crane reminds equipment owners to make sure that all safety decals are in place and legible. National Crane continues to urge equipment owners to upgrade their equipment with a Rated Capacity Limiter (RCL) and control lever lockout systems for all lifting operations.

Shut down the equipment 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 equipment maintenance, as well as equipment operations.

Keep the equipment 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 the equipment 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 National 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 equipment 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 National Crane distributor for assistance.

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

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

All replacement parts must be National Crane approved.

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

Hydraulic Fluid:

- Do not use your hand or any part of your body to check for hydraulic fluid leaks when the engine is running or the hydraulic system is under pressure. Fluid in the hydraulic system can be under enough pressure that it will penetrate the skin, causing serious injury or death. Use a piece of cardboard, or piece of paper, to search for leaks. Wear gloves to protect your hands from spraying fluid.
- If any hydraulic fluid is injected into the skin, obtain medical attention immediately or gangrene may result.
- Do not attempt to repair or tighten any hydraulic hose or fitting while the engine is running, or when the hydraulic system is under pressure.
- Never disconnect any hydraulic lines unless the boom is fully lowered, the engine is shut off, and the hydraulic pressure is relieved. To relieve hydraulic pressure, stop the engine, turn the ignition switch to RUN, and move the hydraulic controls in both directions several times.
- 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 the equipment.
- Pinch points, which result from relative motion between mechanical parts, are areas of the equipment that can cause personal injury or death. Do not place limbs or your body in contact with pinch points either on or around the equipment. Care must be taken to prevent motion between pinch points when performing maintenance and to avoid such areas when movement is possible.
- Do not allow persons to stand near extending or lowering outriggers. Foot crushing could occur

Before maintenance or repairs:

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

- 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 equipment if it is **tagged-out** nor attempt to do so until it is restored to proper operating condition and all tags have been removed by the person(s) who installed them.

After maintenance or repairs:

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

Lubrication

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

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

Make sure that all lug nuts are properly torqued.

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

HOIST ROPE

Synthetic Hoist Rope

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

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

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

During regular inspections, operator shall make sure that equipment 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 National Crane as indicated on the equipment *Load Chart*. Substitution of an alternate hoist rope may require the use of a different permissible line pull and, therefore, require different reeving.

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

Wire Rope

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

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

- Wire ropes wear out. The strength of a rope begins to decrease when the rope is put to use and continues to decrease with each use. Rope will fail if worn-out, overloaded, misused, damaged or improperly maintained.
- The nominal strength, sometimes called catalog strength, of a wire rope applies only to a new, unused rope.
- The nominal strength of a rope should be considered the straight line pull which will actually break a new unused

rope. The nominal strength of a rope should never be used as its working load.

- Each type of fitting attached to a rope has a specific efficiency rating which can reduce the working load of the rope assembly or rope system.
- If an operator hoists the hook block up or down too fast when reeved with multiple parts-of-line and no hook load, the wire rope can bird cage and damage the rope.
- Never overload a rope. This means never use the rope where the load applied to it is greater than the working load determined by the rope manufacturer.
- Never “shock load” a rope. A sudden application of force or load can cause both visible external and internal damage. There is no practical way to estimate the force applied by shock loading a rope. The sudden release of a load can also damage a rope.
- Lubricant is applied to the wires and strands of a wire rope when it is manufactured. The lubricant is depleted when the rope is in service and should be replaced periodically. Refer to the *Service Manual* for more information.
- In the U.S.A., regular inspections of the rope and keeping of permanent records signed by a qualified person are required by OSHA for almost every 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 wire rope with bare hands.

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

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

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

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

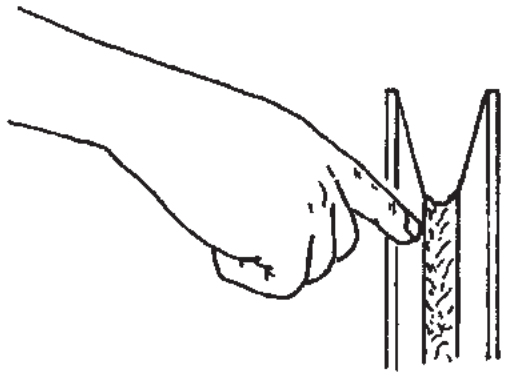
Installing a new rope:

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

When using a wedge socket:

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

Sheaves



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

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

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

The use of nylon (polyamide) sheaves, as compared with metallic sheaves, may change the replacement criteria of rotation-resistant wire 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.
- 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.
- Maintain battery electrolyte at the proper level. Check the electrolyte with a flashlight.
- If applicable to your equipment, 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.

Engine

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

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 equipment that features intake manifold grid heaters.

TRANSPORTING THE EQUIPMENT

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

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

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

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

Do not use the dead end lug on the boom nose for tying down the boom during transport. Damage to the lug and boom can result from usage as a tie down point.

Before transporting the equipment 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 downhaul weight may be reeved over the main boom nose or auxiliary boom nose; the other must be removed. If the hook block or downhaul weight remains reeved on the boom, it must be secured at the tie down on the carrier to prevent swinging.

When using hook block 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 hook block 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 equipment function is being performed while the cable is hooked into the hook block tie down.

TRAVEL OPERATION

Only the equipment operator shall occupy the equipment when traveling.

When traveling, the boom should be completely retracted and lowered to the travel position. If equipped with boom rest, lower the boom into the boom rest and engage the turntable swing lock pin and/or 360 degree swing lock.

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

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.

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

Follow the instructions in this manual when preparing the equipment 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 equipment, make sure that the cab is level, if equipped with a tilting cab.

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

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 with equipment, check suitability of proposed route with regard to equipment height, width, and length.

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

On equipment that features air-operated brakes, do not attempt to move the equipment until brake system air pressure is at operating level.

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

If it is necessary to take the equipment 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 equipment carefully, obeying speed limits and highway regulations.

Stay alert at the wheel.

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

Slopes:

- 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.

Equipment Access

WARNING

Fall Hazard!

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

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

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

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

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

Do not make modifications or additions to the equipment access system that have not been evaluated and approved by National Crane.

Do not step on surfaces on the equipment that are not approved or suitable for walking and working. All walking and working surfaces on the equipment 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 equipment.

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 equipment cab/operator's station or climbing onto the equipment superstructure. Excessive dirt and debris on the handholds, access steps, or walking/working surfaces could cause a slipping accident. A shoe that is not clean might slip off a control pedal during operation.

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

Job Preparation

Before equipment use:

- Barricade the entire area where the equipment is working and keep all unnecessary personnel out of the work area.
- Make sure that the equipment 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 (e.g., RCL).
- Check all braking (e.g., wheel, hoist, and swing brakes) and holding devices before operation.

You must make sure that the outriggers and jack cylinders are properly extended and set before performing any lifting operations. On models equipped with outriggers that can be pinned at the mid-extend position(s), 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 equipment 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 equipment functions in a controlled manner. Lift operations shall resume only after safety concerns have been addressed or the continuation of equipment operations is directed by the lift supervisor.

Know the location and function of all equipment controls.

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

Sparks from the equipment electrical system and/or engine exhaust can cause an explosion. **Do not** operate this equipment 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 equipment.

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

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

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

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

8820 **Example decal. For reference only.**

Keep unauthorized personnel clear of the working area during operation.

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

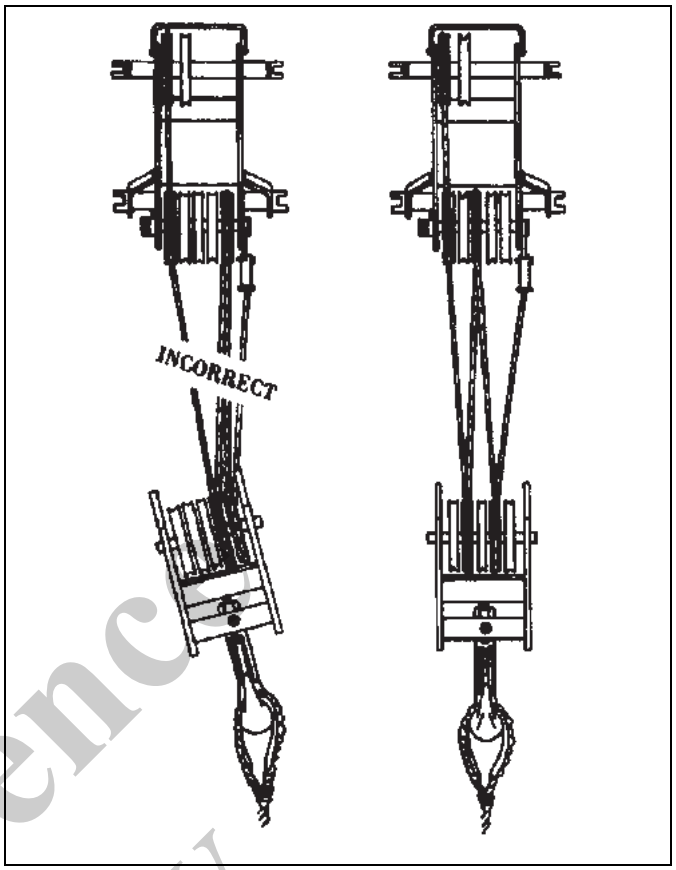
You must always be aware of everything around the equipment while lifting or traveling. If you are unable to clearly see in the direction of motion, you must post a look out or signal person before moving the equipment or making a lift. Sound the horn to warn personnel.

Operate the equipment from the operator's control station. Do not reach in a window or door to operate any controls.

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

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

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



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

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

Make sure that 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 equipment 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.

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

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

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

Watch the path of the boom and load when swinging. Avoid lowering or swinging the boom and load into ground personnel, equipment, or other objects.

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 equipment rated capacity.

Never leave the equipment with a load suspended. Should it become necessary to leave the equipment, lower the load to the ground and stop the engine before leaving the operator's station.

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

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 equipment. 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 equipment boom; never drag a load.

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

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

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

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

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

Make sure that everyone is clear of the equipment 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 equipment operator cannot clearly see the load at all times.
- Moving the equipment in an area or direction in which the operator cannot clearly see the path of travel.

At all times use standardized hand signals (Figure 2-6) - that have been previously agreed upon and completely understood by the operator and signal person.

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

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

Obey a signal to stop from anyone.

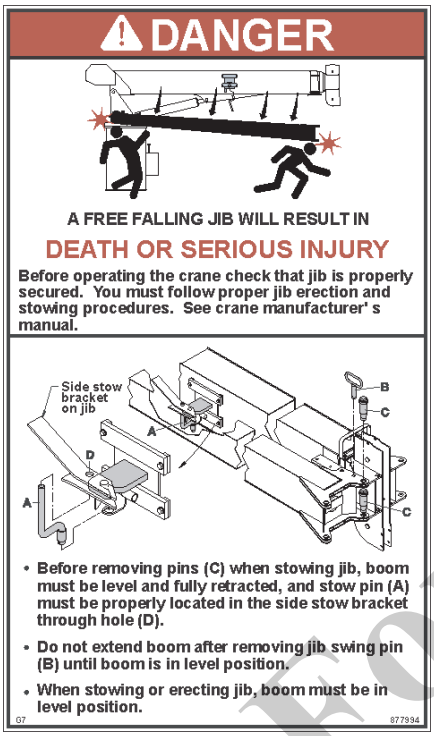
JIB

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

Install and secure all pins properly.

Control movement of the jib at all times.

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



9023-48 **Example decal. For reference only.**

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

Properly inspect, maintain, and adjust jib and mounting.

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

Stay outside of jib sections and lattice work.

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

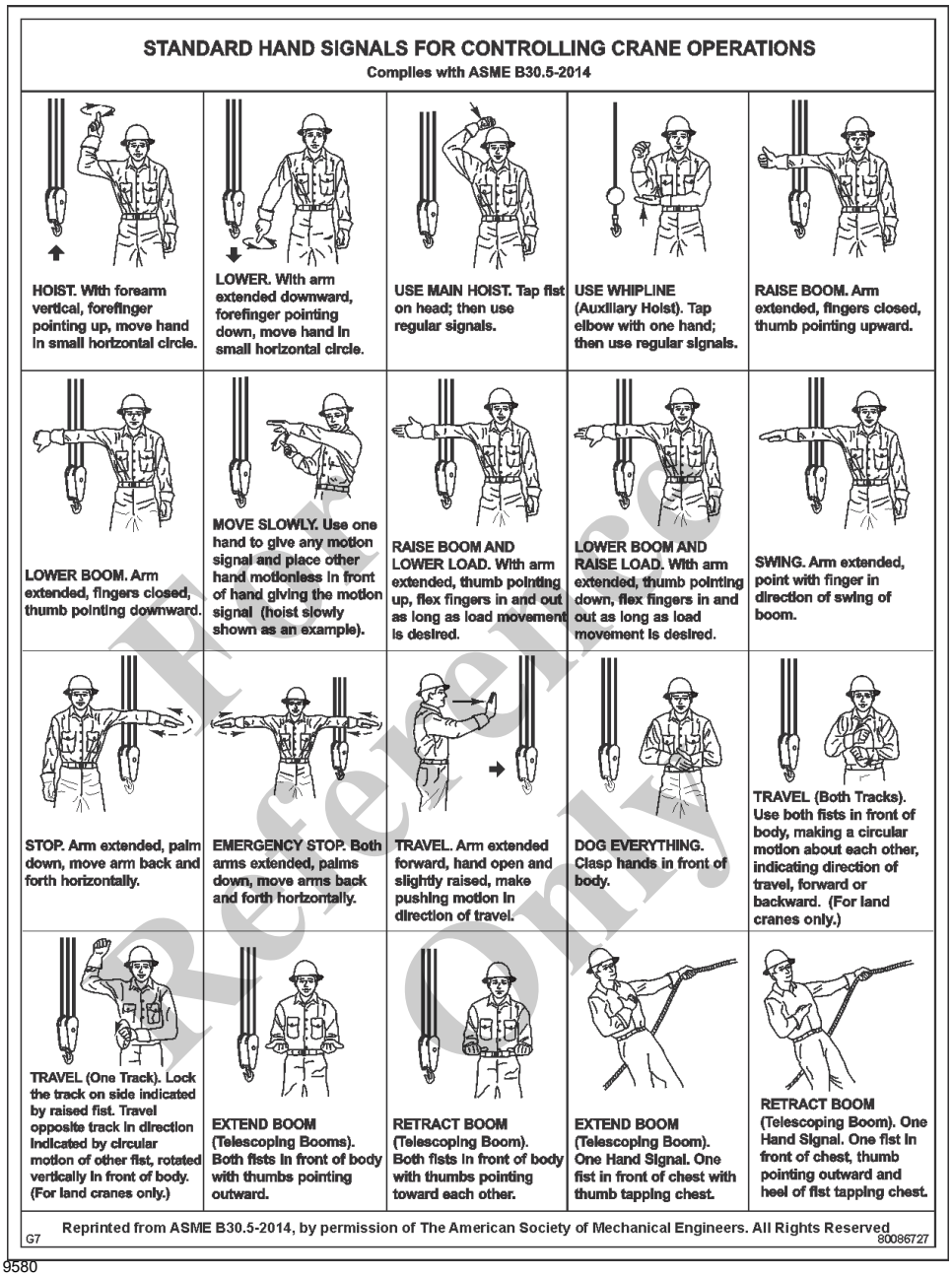


FIGURE 2-6

PARKING AND SECURING

⚠ WARNING

Tipping Hazard!

When parking the equipment and leaving it unattended follow the instructions for the Controls and Operating Procedures 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.

The Controls and Operating Procedures section of this manual provides instructions for parking and securing the equipment when it is to be left unattended. These instructions are intended to allow the equipment to be placed in the most stable and secure position. However, National Crane recognizes that certain jobsite conditions may not permit the boom and jib of the equipment 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 equipment should be left in the smallest, most stable, valid operational configuration that the job site practically allows.
- The equipment cannot be left running, with a load on the hook, or with the jib deployed, or in wind conditions in excess of allowed values.
- The boom should be retracted as far as is practical, the equipment configured in as stable a configuration as possible (boom angle, superstructure orientation, jib angle, etc.)
- In high winds the boom and jib 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 the equipment when it is to be left unattended.

SHUT-DOWN

Use the following steps when shutting down the equipment:

- Engage the parking brake.
- Fully retract and lower the boom.
- Engage the swing lock pin or 360 degree swing lock.
- Place controls in neutral position.
- Shut down the engine and remove the ignition key.
- 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 equipment of all ice and snow.

Allow ample time for hydraulic oil to warm up.

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

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

Never store flammable materials on the equipment.

National Crane recommends use of cold weather starting aids that are provided on your equipment. The use of aerosol spray or other types of starting fluids is prohibited.

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 cm^3 per cm^3 of volume for 1°C of temperature change (0.00043 in^3 per in^3 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 2-8]. A cylinder extended 1.5 m (5 ft) in which the oil cools 15.5°C (60°F) would only retract approximately 38 mm (1 1/2 in). 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 the equipment 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.

NOTE: Operators and service personnel must be aware that load movement, as a result of this phenomena, can be easily mistaken as leaking cylinder seals or faulty holding valves.

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

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

Length change in inches = Stroke (Ft.) X Temperature Change (°F) X Coeff. (in^3/in^3/ °F) X 12 in/ft

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

Coeff. =	0.000774	(1/ °C)			*Metric*						
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 National Crane.

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

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

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

WARNING

Overload Hazard!

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

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

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

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

Boom Inspection

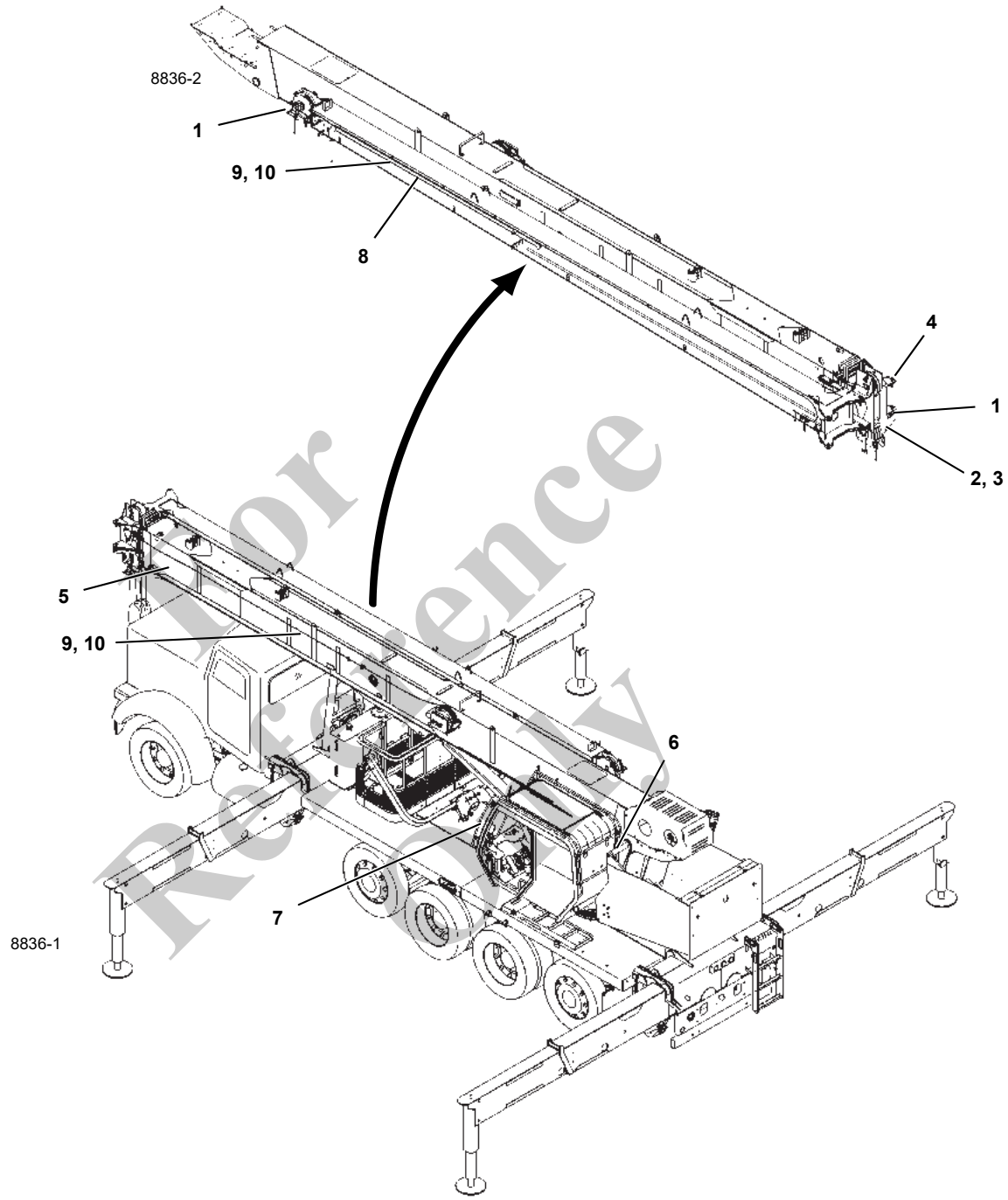


Illustration for reference only.
Your crane may be different.

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

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

Superstructure Inspection

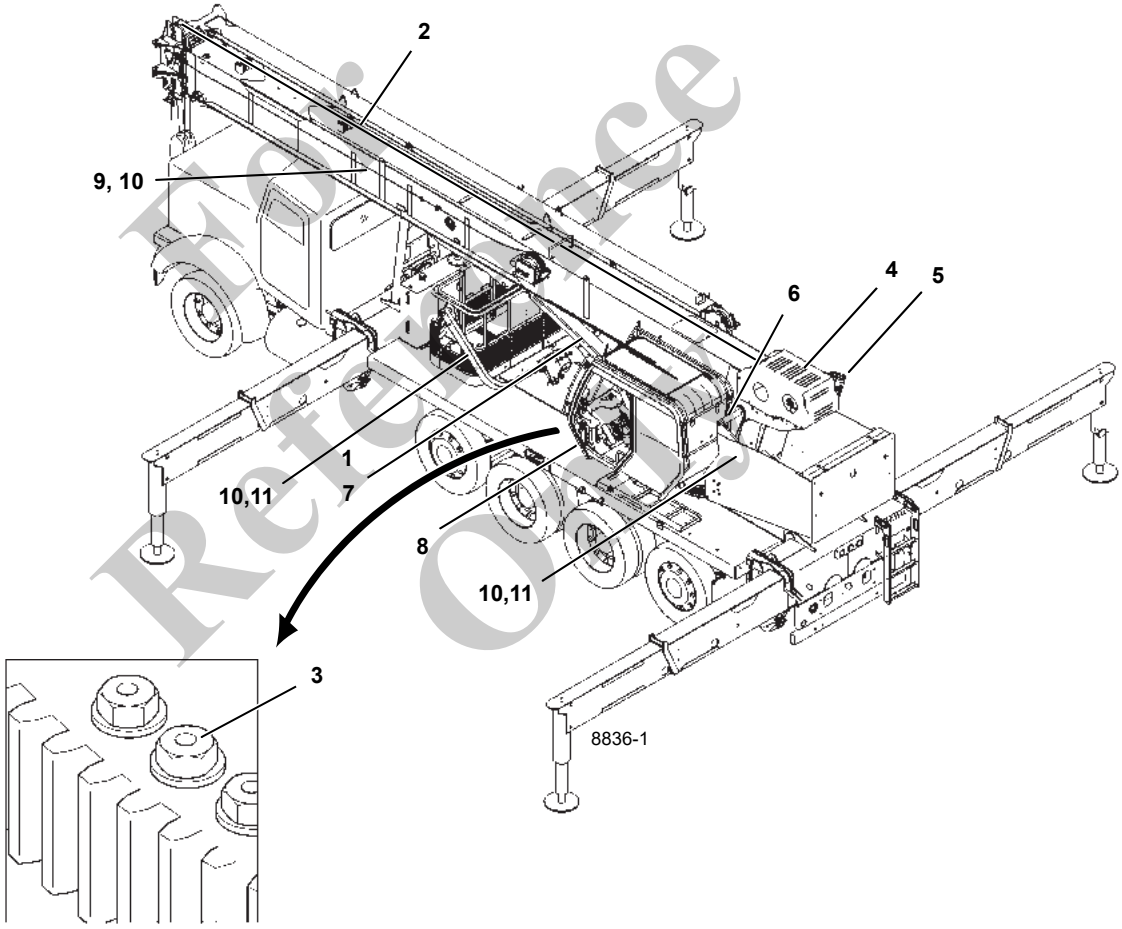


Illustration for reference only.
Your crane may be different.

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

Overload less than 25%			
1	Lift Cylinder	Inspect for leaks.	
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.
Overload from 25% to 49%			
1	Lift Cylinder	Inspect for leaks.	
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

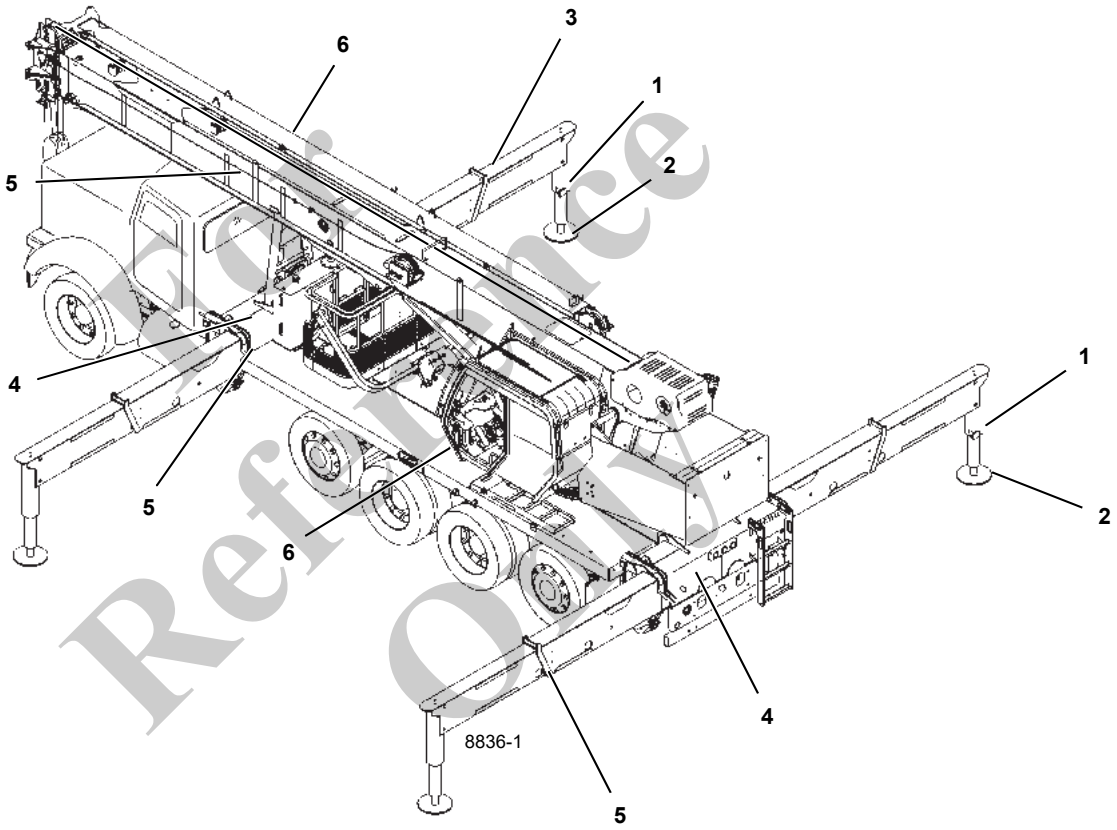


Illustration for reference only.
Your crane may be different.

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

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

SECTION 3
SAFETY PRECAUTIONS - AERIAL LIFT

SECTION CONTENTS

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 aerial lift 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, refer to Appendix A.

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**.

The owner/user/operator of the aerial lift should not accept operating responsibilities until this manual has been read and understood and operation of the aerial lift, under the supervision of an experienced and qualified person has been completed. Owner/user/operator must be familiar with CSA C225-10 Standard, Sections 8, 9, 10 and 11 of ANSI A92.2-2015 Standard for Vehicle-mounted Elevating and Rotating Work Platforms. These sections contain the responsibilities of the owner, users, operators, lessors and lessees concerning safety, training, inspection, maintenance, application and operation of the aerial lift. If there is a question concerning application and or operation, consult Manitowoc Crane Care.

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

Refer to Appendix A of this manual for specific warning and information signs.

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 aerial lift 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**.

Modification or alteration of the aerial lift shall be made only with prior written permission of Grove U.S. L.L.C., Inc.

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

ACCIDENTS

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

If this aerial lift becomes involved in a property damage and/or personal injury accident, **immediately** contact your National 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, PA 17256-0021

Phone: 888-777-3378 (888-PSR.DEPT)
Fax: 717-593-5152
E-mail: product.safety@manitowoc.com

OPERATOR INFORMATION

You must **read** and **understand** this *Operator Manual* and the *Reach Diagram* before operating the aerial lift. This manual must be readily available to the operator at all times and must remain in the cab (if equipped) or operator's station while the aerial lift is in use.

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

No personnel shall be allowed to climb onto the aerial lift or enter the aerial lift 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 aerial lift while operating or moving, unless they are in a two-man platform. Keep clear of moving outriggers to avoid crushing hazards. Contact with moving components could result in death or serious injury.

8819 **FIGURE 3-1**

Do not remove the *Load Chart/Reach Diagram*, this *Operator Manual*, or any decal from this aerial lift.

Inspect the aerial lift 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 aerial lift. 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 aerial lift operations and the hazards involved. Such a person shall meet the operator qualifications specified in CSA C225-10 Standard and Occupational Safety and Health Administration (OSHA) Regulations (United States Federal Law), in ANSI A92.2-2015, American National Standard for Vehicle-mounted and Rotating Work Platforms, or in any other applicable federal, state or local laws.

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

Refer to the *Appendix, A of this Manual* for the locations of safety decals.

You must be familiar with the regulations and standards governing aerial lifts 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.

8788 **FIGURE 3-2**

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

You must not operate this aerial lift unless:

- You have been trained in the safe operation of this aerial lift.
- 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 aerial lift has been inspected and maintained in accordance with the manufacturer's manuals and is operating properly.
- You are sure that all safety signs, guards, and other safety features are in place and in proper condition.

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

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

You must be mentally and physically fit to operate an aerial lift. Never attempt to operate an aerial lift 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 aerial lift, 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 an aerial lift 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: rated capacity indicator, rated capacity limiter, boom angle or radius indicator, boom length indicator, aerial lift level indicator and wind speed indicator.

National Crane remains committed to providing reliable products that enable users and operators to safely lift personnel. National Crane has been an industry leader in the incorporation of operational aids into the design of its aerial lifts. Federal law requires that aerial lifts be properly maintained and kept in good working condition. The manuals that National Crane provides that are specific for each aerial lift and the manufacturer's manuals for the operational aids shall be followed. If an operational aid should fail to work properly, the aerial lift 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 aerial lift when operational aids are inoperative or malfunctioning, the following requirements shall apply for continued use or shutdown of the aerial lift:

- 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 aerial lift shall be shut down until repairs can be made. When a *Boom Angle* or *Radius Indicator* is inoperative or malfunctioning, the radius or boom angle shall be determined by measurement.
- When a *Level Indicator* is inoperative or malfunctioning, other means shall be used to level the aerial lift.

Rated Capacity Limiter (RCL) System

Your aerial lift is equipped with an RCL system which is intended to aid the operator. An RCL is a device that automatically monitors radius, work platform capacity and prevents movements of the aerial lift 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 Chart*/*Reach Diagrams* and operating instructions. Sole reliance upon these electronic aids in place of good operating practices can cause an accident.

Know the load in the work platform is within the capacity of the aerial lift before operation.NEVER exceed the rated capacity of the aerial lift. Always check the *Reach Diagram* to ensure the desired platform reach or platform height is within the capability of the aerial lift.

For detailed information concerning the operation and maintenance of the RCL system installed on the aerial lift, see the RCL manufacturer's manual supplied with the aerial lift. Manufacturers of rated capacity limiters may refer to them in their manuals as a load moment indicator (LMI), a hydraulic capacity alert system (HCAS), a safe load indicator (SLI); National Crane refers to these systems as a rated capacity limiter (RCL) throughout its *Operator* and *Service Manuals*.)Never interfere with the proper functioning of operational aids or warning devices.

Working Area Limiter (If Equipped)

This aerial lift 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 aerial lift operating practices, experience and good operator judgments.

AERIAL LIFT STABILITY/STRUCTURAL STRENGTH

To avoid death or serious injury, ensure that the aerial lift is on a firm surface.Ensure all pins and floats are properly installed and outrigger beams are properly extended before operating the aerial lift. Use adequate cribbing under outrigger floats to distribute weight over a greater area. Check frequently for settling.

Read and follow the safety decals and instructions for aerial lifts with a single front outrigger.

Carefully follow the procedures in this Operator Manual when extending or retracting the outriggers. ("Outrigger Controls" 4-2) Death or serious injury could result from improper aerial lift setup on outriggers.

Do not swing the superstructure over the side when the outriggers are not fully extended. Check aerial lift stability. Ensure the outriggers are firmly positioned on solid surfaces. Ensure the aerial lift is level before beginning operation. Outrigger beams and jack cylinders (plus single front outrigger, if equipped) must be properly extended and set to

provide precise leveling of the aerial lift. Tires must be clear of the ground before operation.

Work Site

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

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

Wind Forces

Wind can have a significant effect on an aerial lift. (See "Wind Forces" on page 2-6.) Wind forces act differently on an aerial lift depending upon the direction from which the wind is blowing (for example, 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.). To assist you in determining prevailing wind conditions, refer to Table 3-1.

Wind forces can exert extreme dynamic loads on the aerial lift. **National Crane recommends that a personnel lift not be made if the wind can cause a hazard such as inadequate clearance from a structure or encroachment of a minimum safe approach distance to a powerline.** National Crane recommends that if the wind speed (velocity) is in excess of 24 km/hr (15 mph) at the raised platform height when using the main boom or the jib, operation of the aerial lift must cease.

Table 3-1 Beaufort Wind Scale

Wind Force		Wind Velocity km/h (mph)	Visible Indicator Effects of wind as observed on land
Beaufort Scale	Designation		
Zero (0)	Calm	less than 1 (<1)	Calm; smoke rises vertically
1	Light Air	1.1-5.5 (1-3)	Smoke drift indicates wind direction. Leaves and wind vanes are stationary.
2	Light Breeze	5.6-11 (4-7)	Wind felt on exposed skin. Leaves rustle. Wind vanes begin to move.
3	Gentle Breeze	12-19 (8-12)	Leaves/small twigs constantly moving. Light flags extended.
4	Moderate Breeze	20-28 (13-17)	Dust and loose paper raised. Small branches begin to move.
Reduce equipment load ratings and operating parameters at 32 km/h (20 mph)			
5	Fresh Breeze	29-38 (18-24)	Branches of a moderate size move. Small trees in leaf begin to sway.
6	Strong Breeze	39-49 (25-30)	Large branches in motion. Whistling heard in overhead wires. Umbrella use becomes difficult. Empty plastic bins tip over.
Cease all craning operations at 48 km/h (30 mph); lower & retract boom			
7	Moderate Gale	50-61 (31-38)	Whole trees in motion. Effort needed to walk against the wind.

Aerial Lift Operations

Before operation, read and understand this manual.

Never use the aerial lift for any purpose other than positioning personnel, their tools and equipment. Use of the aerial lift as a crane is prohibited. See "Safety Precautions - Crane" 2-1.

DANGER

Aerial Lift Hazard!

To avoid death or serious injury, never lift a load with hoist line while operating aerial Lift platform.

Ensure a daily inspection and functional check of the aerial lift is performed prior to placing it into operation.

Never operate a malfunctioning aerial lift. If a malfunction occurs, shut the aerial lift down, red tag it and notify the proper personnel of the malfunction.

Do not modify or disable any safety device or system on the aerial lift. Doing so may cause death or serious injury to the operator or major equipment damage.

Be familiar with the location and operation of the ground station controls of the aerial lift.

Always use three point contact when entering or exiting the aerial lift. Three point contact means that two hands and one foot or one hand and two feet are in contact with the aerial lift at all times during mount and dismount.

Before operation, position the aerial lift on a firm surface, fully extend and set the outriggers, and level the aerial lift. Depending on the nature of the supporting surface, adequate cribbing may be required to obtain a larger bearing surface.

The aerial lift is equipped with a bubble level and an electronic level sensor to monitor outrigger system levelness of aerial lift. See“Leveling of Equipment” 4-5. If the boom extension is to be used, ensure the RCL electrical cable is properly installed and the Rated Capacity Limiter (RCL) is programmed for the appropriate aerial lift configuration. Refer to the RCL operator manual supplied with the aerial lift.

Verify the aerial lift’s capacity by checking the manufacturer’s serial number plate.

OSHA requires that all persons in the work platform wear lanyards with an approved fall protection device.

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.

Secure lanyard to a designated lanyard attachment point on the work platform. Keep the work platform gate closed at all times.

Belting off to an adjacent pole, structure or equipment while working from the aerial lift work platform is prohibited.

DANGER

Aerial Lift Hazard!

To avoid death or serious injury, never belt off to an adjacent pole, structure or equipment while working from the aerial lift work platform.

Climbers shall not be worn while performing work from the aerial lift.

DANGER

Aerial Lift Hazard!

To avoid death or serious injury, never open platform gate while operating aerial Lift platform.

To avoid falling - use extreme caution when entering or exiting the work platform above ground. Enter or exit through the gate only. The work platform's floor must within 1 foot (30cm) of an adjacent, safe and secure structure. Allow for work platform vertical movement as weight is transferred to the work platform.

Transfers between a structure and the aerial lift work platform expose operators to fall hazards.This practice should be discouraged wherever possible. Where transfer must be accomplished to perform the job two lanyards with an approved fall protection device will be used. One lanyard should be attached to the aerial lift work platform. The other to the structure. The lanyard that is attached to the aerial lift work platform should not be disconnected until such time as the transfer to the structure is complete. Otherwise, do not step outside of platform.

Never position ladders, steps or similar items on the work platform or aerial lift to provide additional reach for any purpose.

When riding in or working from the work platform, both feet must be firmly position on the platform floor.

Do not overload the aerial lift. Death or serious injury could result from the aerial lift tipping over or failing structurally from overload.

WARNING

Tipping Hazard!

Do not overload the aerial lift.

Failure to comply with these instructions may cause death or serious injury or structural failure from overload.

The aerial lift can tip over or fail structurally if:

- The load and equipment's configuration is not within the capacity as shown on the applicable Reach Diagram and notes.
- The ground is soft and/or the surface conditions are poor.
- Outriggers are not fully extended and set.
- Cribbing under the outrigger pads is inadequate.
- The aerial lift is improperly operated.

If you should encounter a tipping condition, immediately retract or elevate the boom to decrease the work platform reach. Never lower or extend the boom; this will aggravate the condition.

Check clearances above, on sides, and below work platform when raising, lowering, swinging and telescoping the aerial lift boom.

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

Never push or pull with the aerial lift boom.

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

Do not carry material or equipment on the work platform railing unless approved by Manitowoc Crane Care.

Never use the aerial lift for any purpose other than positioning personnel, their tools and equipment. Use of the aerial lift as a crane is prohibited. See "Safety Precautions - Crane" 2-1.

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 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.

Counterweight

On aerial lift equipment with removable counterweights, ensure the appropriate counterweight sections are properly installed before performing operation.

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.

Outrigger Lift Off

The occurrence of an outrigger lifting from the ground is often attributed to the natural flex in the aerial lift's frame. This may happen in certain configurations within the capacity limits of the aerial lift *Reach Diagram* and is not necessarily an indication of an unstable condition.

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

Aerial Lift Inspection

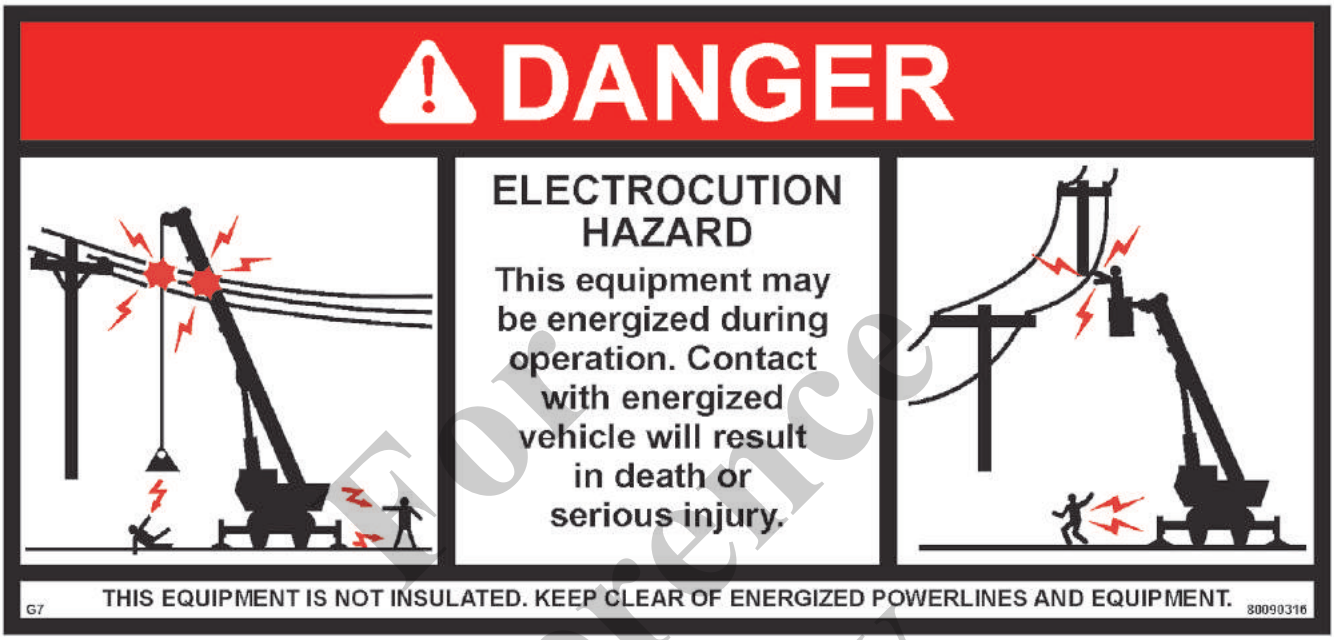
- In addition to the aerial lift's frequent and periodic inspections, dated daily records shall be maintained showing inspections were performed on the aerial lift. All RCL systems shall be inspected daily and verified to be functional. Refer to "Inspection And Maintenance" 9-1 for additional inspection information.

ELECTROCUTION HAZARD

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

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 aerial lift.



8822

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

Before operating this aerial lift 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 and grounded.

This aerial lift is **not insulated**. Always consider all parts of the aerial lift 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 aerial lift while operating. Permit no one to lean against or touch the aerial lift. If the work platform, boom, or any portion of the aerial lift contacts or comes too close to an electrical power source, everyone in, on, and around the aerial lift 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.

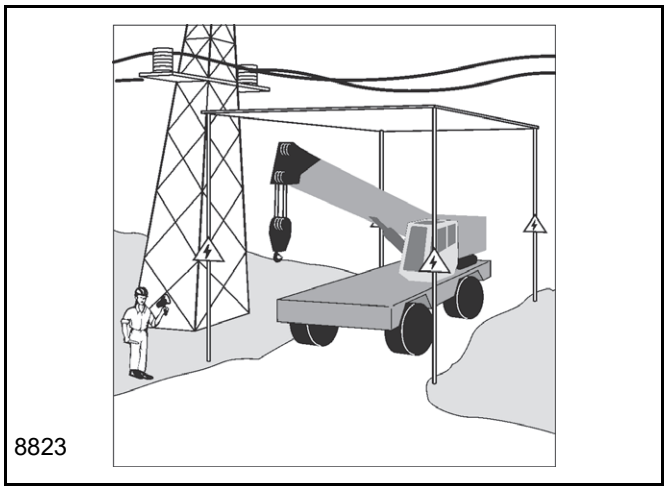
It is not always necessary to contact a power line or power source to become electrocuted. Electricity, depending on magnitude, can arc or jump to any part of the aerial lift boom if it comes too close to an electrical power source. Low voltages can also be dangerous.

Set-Up and Operation

During aerial lift operation, assume that every line is energized (**"hot" or "live"**) and take the necessary precautions.

A suitable barricade should be erected to physically restrain the aerial lift 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.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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 aerial lift near a power source. This person should have no other duties while the aerial lift is working.

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

Electrocution Hazard Devices

The use of insulated boom cages/guards, proximity warning devices, or mechanical limit stops 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 aerial lift is equipped with these devices.

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. 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 an aerial lift 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 aerial lift should come in contact with an energized power source, you must:

1. Stay in the aerial lift work platform. **Don't panic**.
2. Immediately warn personnel in the vicinity to stay away.
3. Attempt to move the aerial lift away from the contacted power source using the aerial lift's controls which are likely to remain functional.
4. Stay in the aerial lift until the power company has been contacted and the power source has been de-energized. **No one** must attempt to come close to the aerial lift until the power has been turned off.

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

Following any contact with an energized electrical source, the National Crane distributor must be immediately advised of the incident and consulted on necessary inspections and repairs. Thoroughly inspect all points of contact on the aerial lift. Should the distributor not be immediately available, contact Manitowoc Crane Care. The aerial lift 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 National Crane distributor or Manitowoc Crane Care.

Special Operating Conditions and Aerial Lift

Never operate the aerial lift during an electrical thunderstorm.

When operating near transmitter/communication towers where an electrical charge can be induced into the aerial lift:

- The transmitter shall be de-energized OR,
- Tests shall be made to determine if an electrical charge will be induced into the aerial lift.
- The aerial lift must be provided an electrical ground.
- 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.

Grounding the Aerial Lift

The aerial lift may become charged with a buildup of static electricity. This may occur especially when using synthetic material in the outrigger floats or cribbing such as plastic or when the outrigger floats are packed with insulating material (e.g. wooden planks).

WARNING

Risk of accidents due to electric shock!

Ground the aerial lift 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

The aerial lift may be grounded using electrically conducting material for grounding to prevent buildup of static electricity.

1. Hammer a metal rod (3, Figure 3-3) [length of approximately 2.0 m (6.6 ft)] at least 1.5 m (5 ft) into the ground.
2. Moisten the soil around the metal rod (3) for better conductivity.
3. Clamp an insulated cable (2) to the metal rod (3), cross-section of at least 16 mm² (0.025 inches²).
4. Connect the free end of the cable with a clamp (1) to a good electrically conductive location on the frame.

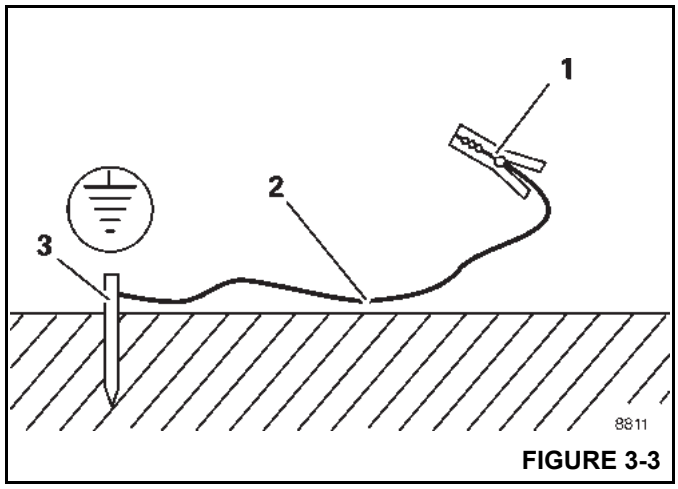


FIGURE 3-3

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.

ENVIRONMENTAL PROTECTION

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

Potentially harmful waste used in National Crane aerial lift 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 aerial lift 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 aerial lift 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 aerial lift.

National Crane recommends that aerial lift be properly maintained, regularly inspected and repaired as necessary. National Crane reminds aerial lift owners to ensure that all safety decals are in place and legible. Refer to the *Appendix, A of this Manual* for the locations of safety decals.

Shut down the aerial lift while making repairs or adjustments.

Always perform a function check after repairs have been made to ensure proper operation.Follow all applicable safety precautions in this manual when performing aerial lift maintenance as well as aerial lift operations.

Keep the aerial lift 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 aerial lift must be performed by a qualified person(s) according to the recommendations in the *National Crane Aerial Lift Care Maintenance and Inspection Manual*. Any questions regarding procedures and specifications should be directed to your National 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 aerial lift 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 National Crane distributor for assistance.

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

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

Any modification, alteration, or change to aerial lift which affects its original design and is not authorized and approved by National Crane is **strictly prohibited**. All replacement parts must be National 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 and move the hydraulic controls in both directions several times.
- 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 aerial lift.
- 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 aerial lift:

- 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 aerial lift if it is **tagged-out** nor attempt to do so until it is restored to proper operating condition and all tags have been removed by the person(s) who installed them.

After maintenance or repairs:

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

Lubrication

The aerial lift 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 aerial lift, 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 aerial lift with a tire and wheel assembly under inflated at less of its recommended pressure can cause the wheel and/or tire to fail.

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. When inflating tires, use a tire gauge, clip-on inflator, and extension hose which will permit standing clear of the tire while inflating.

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.
- 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.
- Maintain battery electrolyte at the proper level. Check the electrolyte with a flashlight.
- If applicable to your aerial lift, 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.

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/amperage surges in the electrical system.

The batteries should be completely disconnected from the crane electrical system and charged using a battery charger of appropriate voltage level or replace the batteries with fully charged batteries. Refer to *Charging the Batteries*, page 3-12.

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.

Engine

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

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 aerial lift equipped with intake manifold grid heaters.

WORK PRACTICES

Personnel Considerations

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.

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. A full-body harness with an appropriate lanyard, hard hat, safety shoes, ear protectors, reflective clothing, safety goggles, and heavy gloves may be required.

Aerial Lift 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 aerial lift. Falling from any elevation could result in serious injury or death.

Never exit or enter the aerial lift 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 aerial lift.

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

Do not make modifications or additions to the aerial lift's access system that have not been evaluated and approved by Manitowoc Crane Care.

Do not step on surfaces on the aerial lift that are not approved or suitable for walking and working. All walking and working surfaces on the aerial lift 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 aerial lift.

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 aerial lift cab/operator's station or climbing onto the aerial lift 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.

Job Preparation

Before aerial lift use:

- Barricade the entire area where the aerial lift is working and keep all unnecessary personnel out of the work area.
- Ensure that the aerial lift 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 (e.g. RCL).
- Check all braking (e.g. wheel, hoist, and swing brakes) and holding devices before operation.

You must ensure that the outriggers and stabilizers are properly extended and set before performing any operations.

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 aerial lift 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 aerial lift's functions in a controlled manner. Aerial lift operations shall resume only after safety concerns have been addressed.Know the location and function of all aerial lift controls.

Make sure all persons are away from the aerial lift and the Travel Select Lever is in the "N" (Neutral) position with the parking brake engaged before starting the engine.

Sparks from the aerial lift's electrical system and/or engine exhaust can cause an explosion. **Do not** operate this aerial lift 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 aerial lift.

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

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

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

Clear all personnel from the counterweight and superstructure area before removing the counterweight (if so equipped).

Keep unauthorized personnel clear of the working area during operation.

You must always be aware of everything around the aerial lift 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 aerial lift. Sound the horn to warn personnel of impending movement.

Only operate the aerial lift by using the designated operator's station controls. Do not reach over lift platform rails to operate any controls.

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

Become familiar with all factors peculiar to the job site before making a lift. Look before swinging your aerial lift. Even though the original setup may have been checked, situations do change.

Never push or pull loads with the aerial lift's boom; never drag a load.

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

Be sure everyone is clear of the aerial lift and work area before commencing operation.

DANGER

Aerial Lift Hazard!

To avoid death or serious injury, never lift a load with hoist line while operating aerial lift. All hoist lines should be removed or properly stowed before operating aerial lift.

Refuse to use any poorly maintained or damaged equipment:

- The aerial lift should be left in the smallest, most stable, valid operational configuration that the job site practically allows.
- The aerial lift can not be left running, or in erection mode, or in wind conditions in excess of allowed values.
- The boom should be retracted as far as is practical, the aerial lift configured in as stable a configuration as possible (boom angle, superstructure orientation, boom extension angle, etc.)
- In high winds the boom and boom extensions 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 an aerial lift when it is to be left unattended.

Emergency Lowering Procedure

The Emergency Lowering System may be used to move the aerial lift platform to a safe configuration in the event of an emergency situation if the platform is disabled in an extended configuration. The system can be controlled from (2) different locations. A ground operated control is located on the torsion box under fender decking near right side outrigger control station. There is also an enable button in the aerial work platform controller which may be used to activate this system. See “Emergency Lowering Procedure” 5-8.

PARKING AND SECURING

WARNING

Tipping Hazard!

When parking the aerial lift and leaving it unattended follow the instructions for the Controls and Operating Procedures 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.

These instructions are intended to allow the aerial lift to be placed in the most stable and secure position. However, National Crane recognizes that certain jobsite conditions may not permit the boom and boom extension of equipment 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 aerial lift should be left in the smallest, most stable, valid operational configuration that the job site practically allows.
- The aerial lift can not be left running, in erection mode, or in wind conditions in excess of allowed values.
- The boom should be retracted as far as is practical, the aerial lift configured in as stable a configuration as possible (boom angle, superstructure orientation, boom extension angle, etc.)
- In high winds the boom and boom extensions 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 aerial lift when it is to be left unattended.

SHUT-DOWN

Use the following steps when shutting down the aerial lift:

- Engage the parking brake.
- Fully retract and lower the boom.
- Remove and stow the aerial work platform.
- Engage the swing lock pin and/or 360 degree swing lock.
- Place controls in neutral position.
- Stow the outriggers.
- Shut down the engine and remove the ignition key.

- Chock the wheels, if not on outriggers.
- Lock the operator's cab (if applicable) and install vandal guards, if used.

TRANSPORTING AERIAL LIFT

Before transporting the aerial lift, check the suitability of the proposed route with regard to the aerial lift 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 aerial lift.

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

Ensure the aerial lift is adequately secured to the transporting vehicle.

Do not use the dead end lug on the boom nose for tying down the boom during transport. Damage to the lug and boom can result from usage as a tie down point.

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

TRAVEL OPERATION

When traveling, remove and stow the aerial work platform.

The boom should be completely retracted and lowered to the travel position. If equipped with boom rest, lower the boom into the boom rest and engage the turntable swing lock pin and/or 360 degree swing lock (if equipped).

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.

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

WARNING

Crushing Hazard!

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

Keep Clear of revolving tires.

Follow the instructions in this manual when preparing the aerial lift 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 aerial lift, ensure the cab is level, if equipped with a tilting cab.

Secure the hook block and other items before moving the aerial lift.

Stow the outriggers and engage locking pins (if equipped).

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 check suitability of proposed route with regard to aerial lift height, width, and length.

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

On aerial lift equipped with air-operated brakes, do not attempt to move the aerial lift 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 aerial lift's weight.

Check state and local restrictions and regulations before transporting the aerial lift on a road or highway.

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 aerial lift carefully obeying speed limits and highway regulations.

Stay alert at the controls.

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

Slopes:

- 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.

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 aerial lift of all ice and snow.

Allow ample time for hydraulic oil to warm up.

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

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

Never store flammable materials on the aerial lift.

National Crane recommends use of cold weather starting aids that are provided on your aerial lift. The use of aerosol spray or other types of starting fluids is prohibited.

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 3-2]. A cylinder extended 1.5 m (5 ft) in which the oil cools 15.5°C (60°F) would only retract approximately 38 mm (1 1/2 in). 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 equipment 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 3-2 and Table 3-3 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.

NOTE: Operators and service personnel must be aware that load movement, as a result of this phenomena, can be easily mistaken as leaking cylinder seals or faulty holding valves.

Table 3-2: Boom Drift Chart (Cylinder length change in inches)

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

Length change in inches = Stroke (Ft.) X Temperature Change (°F) X Coeff. (in^3/in^3/ °F) X 12 in/ft

Table 3-3 Boom Drift Chart (Cylinder length change in millimeters)

Coeff. =	0.000774	(1/ °C)			***Metric***							
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

SECTION 4
OPERATING CONTROLS - CRANE

SECTION CONTENTS

CONTROLS AND OPERATING PROCEDURES

This section contains information on controls and operating procedures to include:

- Chassis Cab Controls
- Outrigger Controls
- Equipment Controls
- Operating Procedures
- Outrigger Setup
- Hoist System Operation
- Work Site Location
- Load Chart/Reach Diagram
- Lifting the Load
- Shutdown and Preparation for Travel

CHASSIS CAB CONTROLS

Chassis cab controls described are those controls that are used in conjunction with equipment controls.

Chassis Cab Ignition Switch

Chassis cab ignition switch must be **OFF** in order for ground control ignition switch to be operable.

Power Take Off

Manual Shift Control

PTO is engaged when knob on dash or floor is pulled out and disengaged when knob is pushed in. Chassis gear shift lever must be in neutral and clutch depressed whenever knob is moved.

Air Shift Control

PTO is engaged when switch is moved to apply air to PTO and disengaged when switch is in **OFF** position. Chassis gear shift lever must be in neutral and clutch depressed when switch is moved. Transmission selector lever must be returned to "**N**" for stationary vehicle operation. Power take-off may be disengaged while in any transmission range provided that the load has first been removed from PTO.

Electric Shift Control

Full torque electric shift PTO's are controlled by a switch. To operate, disengage clutch, shift to fourth or fifth gear, and operate switch **DOWN** to engage PTO or **UP** to disengage PTO. Return gear shift to neutral and engage clutch.

Power Shift Control

If vehicle is equipped with automatic transmission, power take-off must be engaged with engine at idle. See transmission manufacturer's instructions for special procedures.

Park Brake

Chassis brake must be firmly set before leaving cab to begin operation. If ground surface is icy or slick or is sloped, you may be required to help immobilize chassis with wheel chocks.

Engine Speed Governor

Some diesel engines are equipped with a variable speed governor which overrides engine speed governor. If equipped, two knobs in the cab select between equipment operation and normal driving operation.

Neutral Start/Safety Switch

Chassis must be equipped with neutral/start safety switch on chassis transmission. Check occasionally to ensure it is working correctly and repair if it is not.

GROUND CONTROLS

Ground Controls are those controls located in equipment operator control station cab and ground station outrigger controls.

CRANE CAB CONTROLS

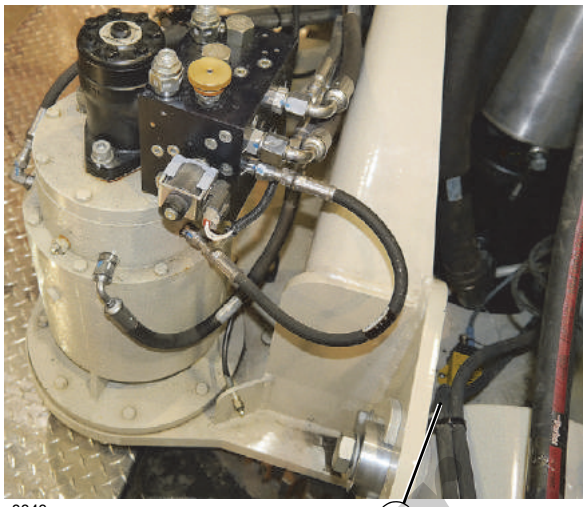
Crane cab controls are located in crane operator control station (cab) and are used for all crane functions. See (Figure 4-3) for control station identification. For best control response, run engine at governed RPM when operating equipment.

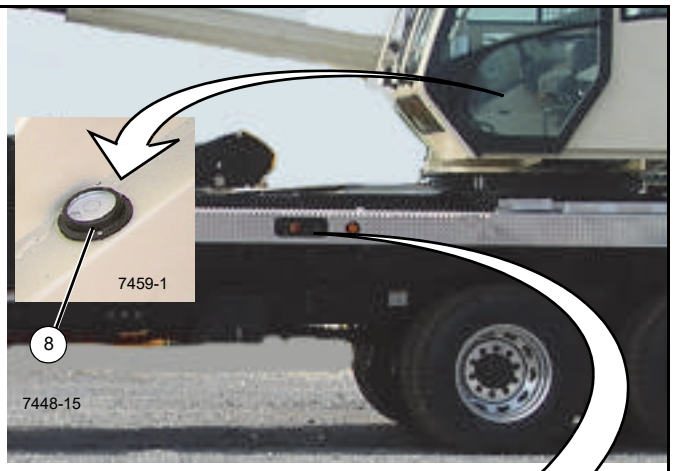
NOTE: Operator must be in crane cab seat and armrest must be lowered for crane ground controls to operate properly.

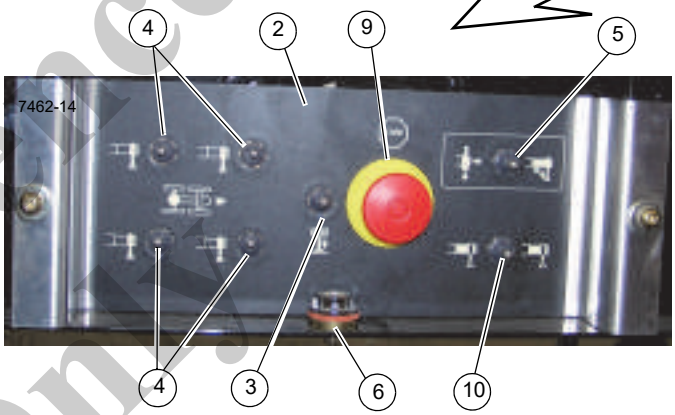
Outrigger Controls

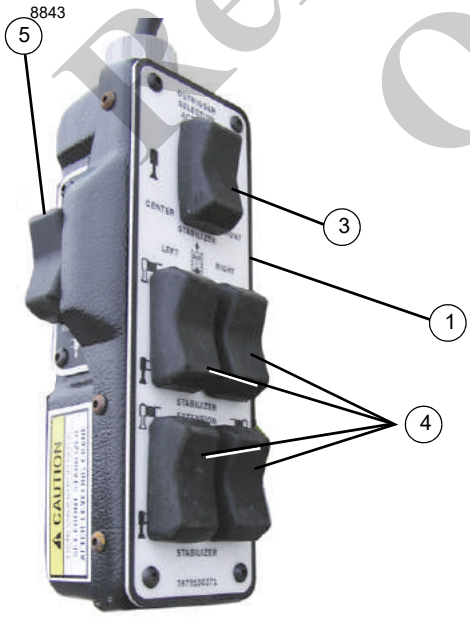
Outrigger Controls are used to set outriggers. There are three ground level control stations for operation of outriggers. One is a cab handheld outrigger control (1, Figure 4-1) located in the ground controls (operator control station cab) and two ground station outrigger controls (2) located on either side of equipment at ground level. Each

controller contains controls for extending and retracting outrigger beams, for raising and lowering stabilizer (jack) cylinders and for raising and lowering single front outrigger (if equipped). Cab Handheld Controller may be (optional) for some models.









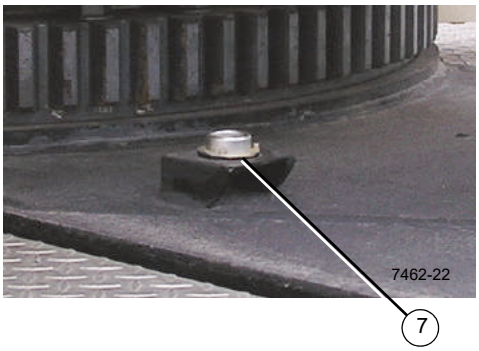


FIGURE 4-1

Item	Description
1	Hand Held Outrigger Control
2	Outrigger Control Panel
3	Front Center Stabilizer Switch
4	Outrigger Selector Switches
5	Extend/Retract Switch
6	Frame Level Indicator - Secondary
7	Level Indicator - Primary
8	Cab Level Indicator - Secondary
9	Emergency Stop Switch
10	Outrigger Beam Selector
11	Level Indicator - Electronic

Outrigger Control Panels

Outrigger control panels (2) are located on both lower sides of equipment (Figure 4-1) and contain outrigger controls.

Handheld Outrigger Control

Handheld outrigger control (1, Figure 4-3) is located in ground control cab. Crane control power switch must be **OFF**.

Extend/retract Switch

Extend/retract switch (5, Figure 4-1) is used in conjunction with the outrigger selector switches to control outrigger functions.

Outrigger Selector Switches

Outrigger selector switches (4, Figure 4-1) are used to select outrigger component. To extend or retract an outrigger component, first select component with outrigger selector switch, then select extend or retract with extend/retract switch.

Ground station outrigger beam selector switch (10, Figure 4-1) is used to operate front or rear outrigger beam on same side of equipment ground control is located.

NOTE: Dependent on carrier wheelbase, it may be necessary to remove rear outrigger pads prior to retracting outrigger beam.

Emergency Stop Switch

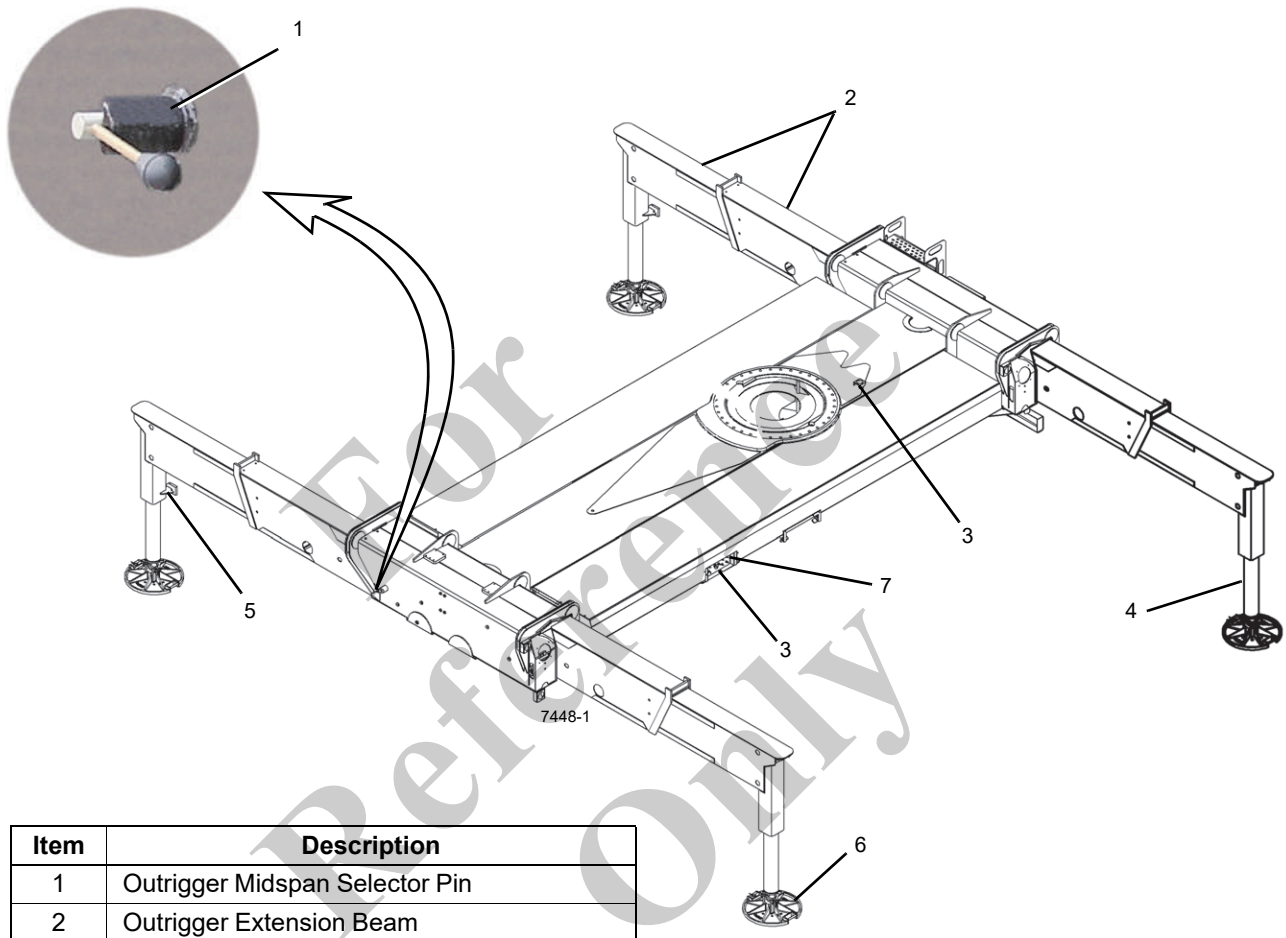
There is an emergency stop Switch (9, Figure 4-1) on outrigger control panels on each side of carrier. Pressing either switch shuts down engine.

NOTE: Only use emergency stop switch in case of an emergency to shut down engine; do not use emergency stop switch regularly as a means of turning off machine.

Single Front Outrigger Switch

Single Front Outrigger switch (3, Figure 4-1) is used to lower and raise single front outrigger. To operate single front outrigger, press single front outrigger switch and then press extend/retract switch.

NOTE: Single front outrigger automatically retracts if any other components are adjusted and must be reset if operation is to be continued.



Item	Description
1	Outrigger Midspan Selector Pin
2	Outrigger Extension Beam
3	Level Indicators
4	Outrigger Jack
5	Outrigger Float Stow Peg
6	Outrigger Float
7	Ground Station O/R Panel

FIGURE 4-2

Leveling of Equipment

If crane is not level to within 1% of grade, allowable capacities must be reduced. Therefore, when lifting on outriggers, it is essential that crane is level to within 1% of grade. Bubble level that is provided on the crane is calibrated to be accurate within 1% of grade. If equipment is out of level, an audible alarm will beep indicating releveling is necessary. To properly level equipment, refer to *Outrigger Setup*, page 4-16. An interlock will not allow crane functions to operate during set-up.

To properly level crane, boom must be positioned over front of crane, fully lowered to horizontal and fully retracted. Boom must be stowed onto boom rest to disengage interlocks to raise and level crane using outriggers.

Frequently check crane for level since working crane may settle during lifting operations. When rechecking crane for level, boom must also be positioned over front of crane, fully

lowered to horizontal and fully retracted and stowed onto boom rest.

Interlock alarm will beep if crane settles outside of 1% of grade during operations indicating releveling is necessary. Operating controls will continue to function while crane is re-leveled.

If necessary, relevel crane using procedures under *Outrigger Setup*, page 4-16.

Equipment Level Indicators

Equipment has one primary and three secondary level indicators. Primary level indicator is used to verify accuracy of secondary level indicators.

Primary level indicator (7, Figure 4-1) is located forward of turret bearing. Secondary level indicators are located in outrigger control panels (6, Figure 4-1) and in ground control cab (38, Figure 4-4).

There is an electronic level sensor located on top of turntable bearing plate near lift cylinder trunnion (11, Figure 4-1) which is used to monitor outrigger system levelness of equipment. If equipment is not level within 1%, outrigger motion alarm will sound until corrected and boom functions will be disabled, See“Leveling of Equipment” on page 2-5.

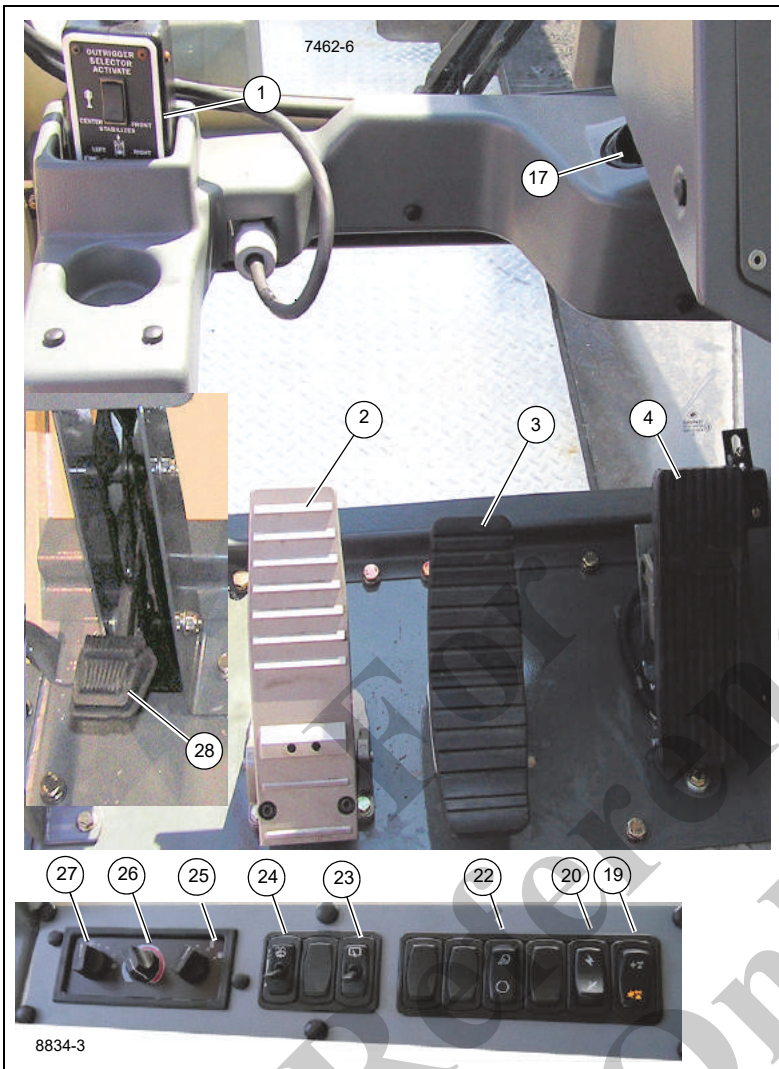
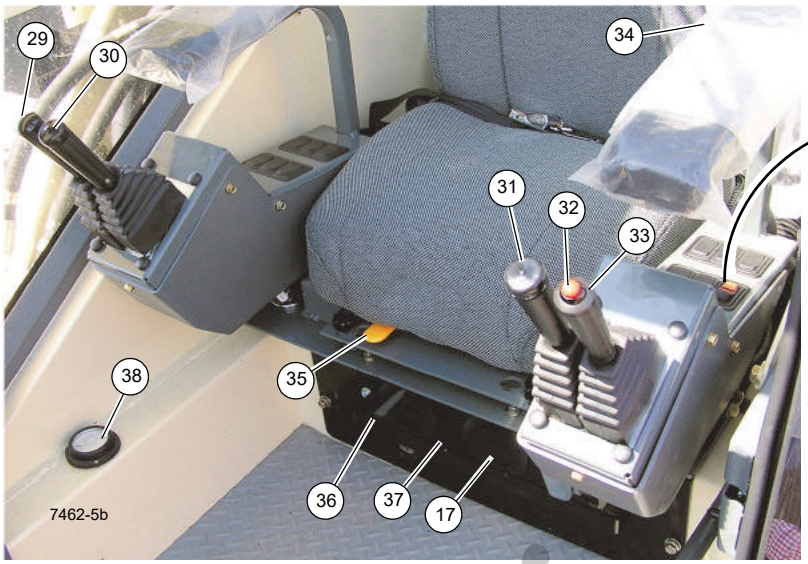


FIGURE 4-3

Item	Description
1	Handheld Outrigger Control
2	Swing Brake Pedal
3	Boom Telescope Pedal (if equipped)
4	Foot Throttle Pedal
5	RCL Display Panel
6	RCL Bypass Switch (Momentary)
7	Hydraulic Oil Indicator/Engine Warning
8	Not Used
9	Main Hoist Minimum Wrap Indicator
10	Main Hoist Speed Switch
11	Hand Throttle Control
12	Emergency Stop Switch
13	Operator Cab/Ground Control Ignition Switch
14	Hourmeter
15	Auxiliary Hoist Switch (Optional)

Item	Description
16	Auxiliary Hoist Minimum Wrap Indicator
17	AC/Heater Vent
18	Receptacle (12V)
19	Radio Remote /Aerial Power Switch (if equipped)
20	Crane Control Power Switch
21	Hydraulic Tool Circuit (if equipped)
22	Cab Worklight Switch
23	Skylight Wiper Switch
24	Windshield Wiper Switch
25	Heater/Air Conditioner Function Switch
26	Heater/Air Temperature Control
27	Heater/Air Fan Speed
28	360° Swinglock Pedal



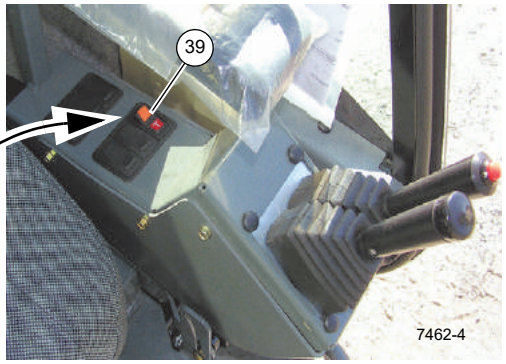


FIGURE 4-4

Item	Description	Item	Description
29	Boom Lift Control Lever	35	Seat Slide Handle
30	Hoist Up & Down Control (Rotation Indicator)	36	Seat Frame Slide Handle
31	Telescope Boom (Auxiliary Hoist Control)	37	Climate Control Unit
32	Warning Horn Button	38	Level
33	Turret Swing Control Lever	39	Swing Lock Control Switch
34	Seat Back Adjustment	40	House Lock (Figure 3-3)

Swing Brake Pedal

CAUTION

Do not actuate the Swing Control Lever while the Swing Brake is engaged, as the turret may push through the brake. Damage to the swing brake can occur.

Swing brake pedal (2, Figure 4-3) is located on the left side of the crane cab floor. Brake pedal is used to activate swing brake and momentarily hold turret in position.

Boom Telescope Pedal (if equipped)

Telescope foot pedal (3, Figure 4-3) is used to extend and retract boom when equipment is equipped with an auxiliary hoist. Rock pedal forward to extend boom and rock back to retract boom.

Foot Throttle Pedal

Foot throttle (4, Figure 4-4) is located on ground control cab floor and is used to control engine speed. Depress foot throttle to accelerate engine speed and release to return to idle.

Hand throttle (11, Figure 4-3) must be positioned as indicated in Figure 4-6 to operate foot throttle properly.

RCL Display

RCL Display (5 Figure 4-3) is for Rated Capacity Limiter (RCL), see operating instructions and screen displays in this manual.

RCL provides crane operator with information required for crane to perform safely within its design parameters. RCL displays information on length and angle of boom, working radius, rated load, and total weight being lifted.

RCL continuously monitors these parameters and provides operator with an updated readout of equipment status. If a nonsafe condition is approached, RCL warns operator with an alarm and locks out crane functions that can aggravate situation.

DANGER

RCL only aids operator when properly programmed with proper Load Chart/Reach Diagram and crane configuration. To prevent injury or death to personnel, be sure RCL is programmed before crane operation.

RCL and Minimum Wrap Bypass Switch

RCL bypass switch (6, Figure 4-3) is a *momentary* on-off switch, turn key to the **On** position (right) to disengage RCL controls and minimum wrap lockout controls. Releasing key allows RCL and minimum wrap controls to re-engage.

RCL and minimum wrap system will be bypassed only as long as switch is in the **On** position.

Turning key switch to **On** position re-engages boom down, telescope out and hoist controls. These functions were disabled when an overload condition was sensed by rated capacity limiter (RCL). It is important to read and understand RCL Override Warning information in RCL Operator Manual before using RCL Bypass switch (6) or RCL **ON/OFF** switch.

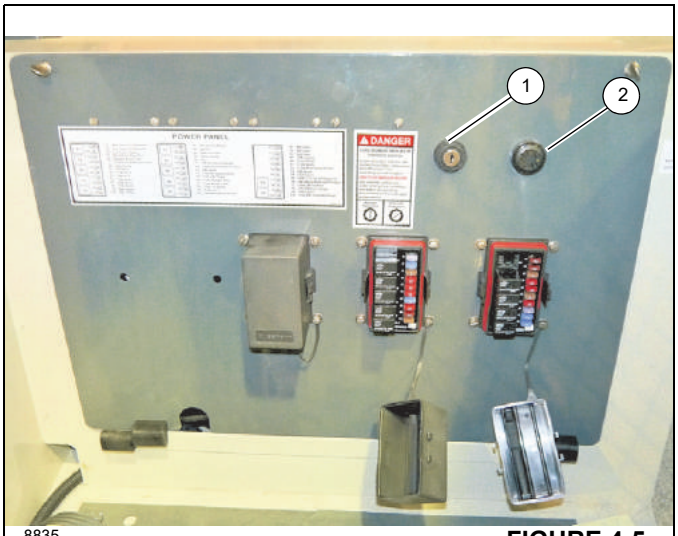
Bypass switch will also re-engage main and auxiliary hoist controls disabled by minimum wrap indicator sensor system.

RCL control can be turned completely off and back on using switch (1, Figure 4-5) located behind cab seat.

DANGER

Crane operation with the LMI system will prevent the LMI system from operating and will result in Death or Serious Injury.

Use override switch only under emergency conditions and follow all operating precautions on the crane and in the manual.



8835 **FIGURE 4-5**

Hydraulic Oil Indicator

Hydraulic oil temperature warning light (7, Figure 4-3) is located on ground control cab console and illuminates when hydraulic oil overheats. If overheating occurs, run equipment at idle with controls in neutral until light goes out.

NOTICE

Do not operate the equipment with overheated hydraulic oil or damage to seals in the hydraulic components may result.

Main Hoist Minimum Wrap Indicator

When main hoist is down to last rope layer minimum wrap indicator (9, Figure 4-3) will flash intermittent and minimum wrap buzzer (2, Figure 4-5) will sound intermittently.

When amount of rope left on hoist reaches minimum wrap; indicator light will be constant, buzzer will be constant and hoist will be disabled by minimum wrap sensor system.

Main Hoist Speed Switch

Main hoist speed selector switch (10, Figure 4-3) is located on console. It is a three position switch (**on-off-on**), placarded as rabbit (**fast**) hoist motor speed and turtle (**slow**) hoist motor speed.

Hand Throttle Control

Push/pull hand throttle (11, Figure 4-3) is located on ground control console and has following functions.

- Increase Engine Speed - Push in and hold center button (1, Figure 4-6); pull out on knob (2) to accelerate engine. Releasing button (1) will lock knob in place and maintain engine speed.

- Decrease Engine Speed - Push in and hold center button (1) push knob (2) in to slow engine speed.
- Incremental Speed Adjustment - Rotate knob (2) clockwise to increase speed and counterclockwise to decrease engine speed.

Hand throttle must be positioned as indicated in Figure 4-6 to operate foot throttle (4, Figure 4-4) properly.

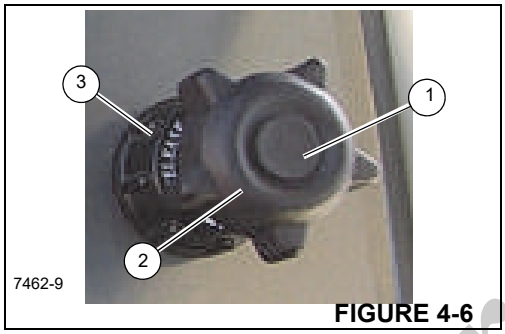


FIGURE 4-6

Emergency Stop Switch

Equipment emergency stop switch (12, Figure 4-3) is located on ground control console and is used to shut down chassis engine. Push red button in to shut down engine, rotate the knob and pull out to resume normal operation.

Operator Cab/Ground Control Ignition Switch

Operator Cab/Ground Control Ignition Switch (13, Figure 4-3) is located on cab control console and controls chassis engine and crane control power. The igniton switch has four positions. **OFF** shuts down engine and cab power, **ON** activates chassis engine ignition as well as all cab power, **ACC** is ground control power and **Start** is chassis engine start.

Chassis ignition key must be OFF before chassis engine can be started from crane cab.

Aux Hoist Speed (if equipped)

Auxiliary hoist speed selector switch (15, Figure 4-3) is located on left seat armrest. It is a three position switch (on-on-on), placarded as rabbit (fast) hoist motor speed and turtle (slow) hoist motor speed.

Auxiliary Hoist Minimum Wrap Indicator

When auxiliary hoist is down to last rope layer the minimum wrap indicator (16, Figure 4-3) will flash intermittent and minimum wrap buzzer (2, Figure 4-5) will sound intermittently.

When amount of rope left on hoist reaches minimum wrap; indicator light will be constant, buzzer will be constant and hoist will be disabled by minimum wrap sensor system.

AC/Heater Vent

The cab has air conditioner and heating vents (17, Figure 4-3), located on control panel, behind panel. and to left of operator.

Receptacle

This 12 volt accessory outlet (18, Figure 4-3) is located on lower part of front control panel and is designed to mate with most 12 volt adapter plugs.

Radio Remote/Aerial Power Switch (if equipped)

To operate controller, remote/aerial power switch (19) located on cab overhead console (Figure 4-3) must be activated. Crane control power switch (20) must be turned OFF. Operator cab/ground control Ignition Switch (13) and chassis igniton must all be OFF.

When radio remote control is activated, crane controls will be de-activated.

Crane Control Power Switch

Crane control power switch (20, Figure 4-3) is located on right overhead console. Switch has two positions: OFF de-activates all power from ground level controls on arm rests, cab outrigger controller, and from swing brake unlock (assuring brake stays locked). OFF position prevents inadvertent operation of these functions and assures swing brake is set when equipment is not powered. ON position will restore power to joy stick controllers, swing brake and cab outrigger hand controls.

Hydraulic Tool Circuit Switch (if equipped)

Hydraulic tool circuit switch (21, Figure 4-3) is a two position rocker switch, ON and OFF, located on the right overhead console. It enables power for optional tool circuit.

Cab Work Light Switch

Cab work light switch (22, Figure 4-3) is a two position rocker switch, **ON** and **OFF**, located on right overhead console. It turns on cab mounted work lights.

Skylight Wiper Switch

Skylight wiper switch (23, Figure 4-3) is located in overhead console. This is Hi - Lo toggle type switch with 6 intermittent positions, (intermittent timing is 2-15 seconds).

Windshield Wiper Switch

Windshield wiper switch (24, Figure 4-3) is located in overhead console. This is Hi - Lo toggle type switch with 6 intermittent positions, (intermittent timing is 2-15 seconds, wiper washer timing is 3 seconds).

Cab Climate Controls

Cab climate controls (25, 26, 27, Figure 4-3) are used to adjust heating and air conditioning for operator comfort.

360°Swinglock Pedal (if equipped)

Swinglock pedal (28) is located on left side of control cab floor. Apply pedal to lock turret, release pedal to unlock turret.

Boom Lift Control Lever

Boom lift control lever (29, Figure 4-4) is located on right armrest and is used to raise and lower boom. Push lever forward to lower boom and pull back to raise boom.

Hoist Control Lever

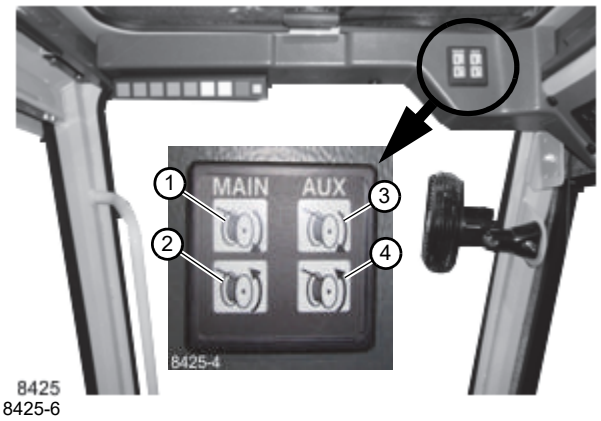
Hoist control lever (30, Figure 4-4) is located on right armrest. Positioning lever forward lets out hoist rope to lower load and pulling lever back will raise load.

⚠ DANGER

Payout loadline before extending boom. Failure to do so may cause loadline to break or damage equipment.

Hoist Rotation Indicator Display

Display is located in front overhead panel Figure 4-7. LED display illuminates to indicate current hoist in operation and which direction hoist is rotating.



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8425-6

Item	Description
1	Main Hoist UP (Clockwise)
2	Main Hoist DOWN (Counterclockwise)
3	Auxiliary Hoist UP (Clockwise)
4	Auxiliary Hoist DOWN (Counterclockwise)

FIGURE 4-7

Hoist Rotation Indicator

Hoist rotation indicator (RDI) is located on top of hoist control lever (30, Figure 4-3). Indicator is electronically driven by a signal from an electronic transmitter and sensor attached to hoist. A pulsating signal is sensed by operator's thumb during hoist operation.

Telescope Control Lever

When equipped *without* auxiliary hoist telescope boom control lever (31, Figure 4-4) is on left armrest. Push lever forward to extend boom and pull back to retract boom.

Auxiliary Hoist (Optional)

If equipped *with* an auxiliary hoist control lever (31, Figure 4-4) is on left armrest. Positioning lever forward lets out hoist rope to lower load and pulling lever back reels the rope in raising load.

Warning Horn Button

Warning horn button (32, Figure 4-4) is located on swing joy stick. Push switch to sound horn to warn personnel of pending movement of equipment.

Swing Control Lever

CAUTION

Do not actuate Swing Control Lever while Swing Brake is engaged, as turret may push through brake. Damage to swing brake can occur.

Swing control lever (33, Figure 4-4) is located on left armrest and controls turret rotation. Push lever forward to rotate turret clockwise and pull back to rotate turret counterclockwise.

Swing control lever can be used to slow and stop swing by moving control lever to opposite direction of swing. For example, if lever is pushed forward for a clockwise swing, pull lever back to slow and stop swing.

Seat Back Adjustment

To adjust back of seat press the seat back adjustment lever (34, Figure 4-4) located on lower left section of seat back and then adjust seat as needed.

Seat & Seat Frame Lever

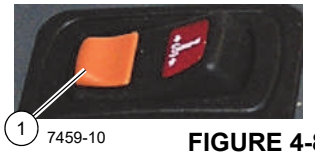
Moving seat slide lever (35, Figure 4-4) will slide seat either forward or backward, moving seat frame lever (36) slides seat and seat frame at same time.

Climate Control Unit

Air Conditioner and Heating of equipment cab is provided by climate control unit (37, Figure 4-4) located under cab seat.

Swing Brake Switch

Swing brake switch (39, Figure 4-4) is located on left hand armrest and is used to activate swing brake and park turret in position. Press switch to activate swing brake to keep turret from rotating. LED indicator illuminates when switch is activated. Back half of the switch (1, Figure 4-8) is designed with a locking mechanism to secure swing brake in locked position and prevent accidental movement of cab & superstructure.



7459-10 **FIGURE 4-8**

House Lock

House lock control (40, Figure 3-3) is a manually operated mechanical lock that when engaged prevents rotation of crane superstructure.

To engage lock center boom over front of the cab turn T-handle clockwise and push knob back into locked position and move superstructure left to right to align lock pin with the lock pin hole. To disengage, pull out on T- handle and turn counter clockwise to lock T- handle and pin in position.

Heater

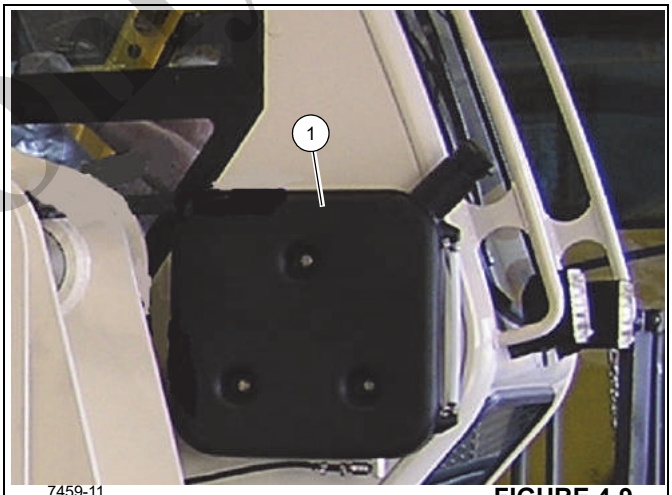
Diesel powered supplemental heater is stowed under cab support frame and supplies heat to crane cab (36, Figure 4-4). Heater controls temperature of crane cab by cycling coolant between heater and climate control unit located under cab seat. Controls (25, 26, 27, Figure 4-3) for heater are located on overhead control panel in crane cab.

⚠ WARNING

Do not mix gasoline with diesel fuel.

Heater Cold Weather Fuel Mixture

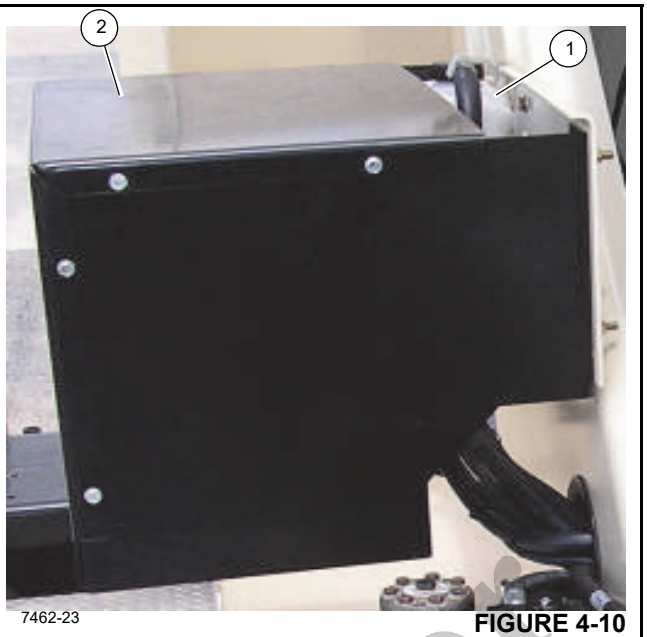
At temperatures below -7° C (20° F), add a cold weather additive or mix kerosene with diesel fuel at a 50/50 ratio, Add mixture to heater diesel fuel tank (1, Figure 4-9) located on outside of cab.



7459-11 **FIGURE 4-9**

Heater Coolant

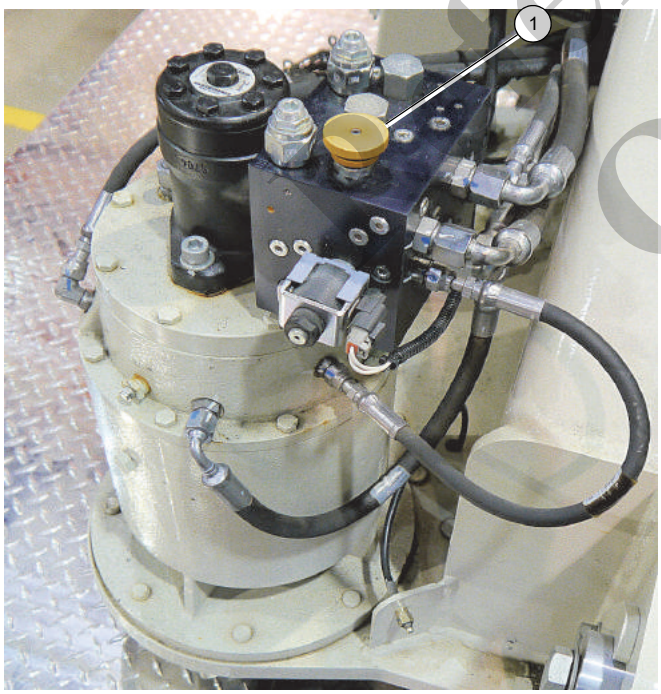
Heater coolant bottle (1, Figure 4-10) is mounted to turret and located inside a/c compressor enclosure (2). Coolant should contain at a minimum a mixture of water and enough antifreeze to prevent freezing or slushing.



7462-23 **FIGURE 4-10**

Adjustable Swing Speed Valve

Crane is equipped with an adjustable swing speed valve (1, Figure 4-11) that sets maximum swing speed of machine. Turn valve knob clockwise to increase and counterclockwise to decrease speed.



8766 **FIGURE 4-11**

OPERATING PROCEDURES

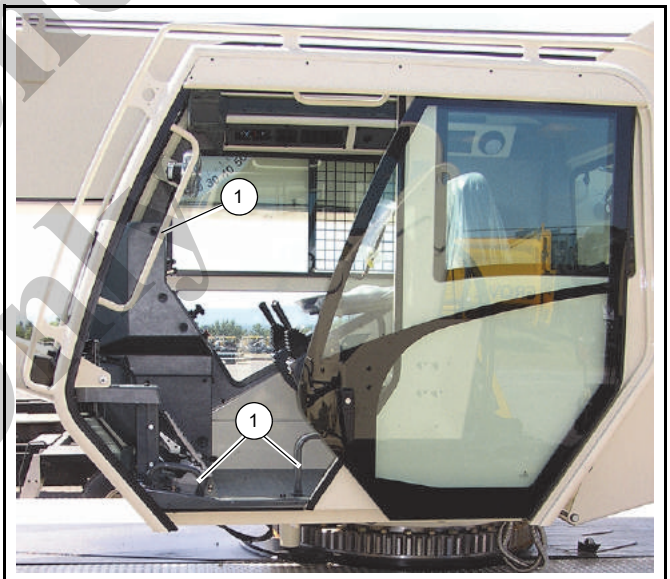
You need to be familiar with the safety precautions outlined in this manual before operating the crane.

Crane Familiarization

All members of crew should become familiar with location and operation of controls, correct operating procedure, the maximum lifting capacities, and Safety Precautions Section of this manual. Carefully follow operating procedures outlined below and information in *Load Chart/Reach Diagrams*. Wear approved personnel fall protection equipment and attach lanyard to anchor provided when working at elevated heights. Falling from any elevation can result in death or serious injury.

Crane Cab Access

To enter crane cab, pull ladder out from under cab door and use grab handles (1, Figure 4-12) inside cab to enter cab. Take all precautions not to fall off equipment. Falling from any elevation can result in death or serious injury.



7602-5 **FIGURE 4-12**

Crane Checks

Prior to placing the equipment in operation, do a complete walk-around visual inspection and look for structural damage, loose components, leaks, or other conditions that requires immediate correction for safe operation. The following checklist of items are suggested to ensure the equipment is prepared for performing work operations. Check the following:

- unusual conditions such as pools of hydraulic fluid or lubricating oil under chassis.
- outrigger which may have crept down or up.

- any signs of damage or improper maintenance.
- tires are inflated to proper pressure.
- level of hydraulic reservoir.
- operation of the “stop” and horn circuits.
- missing and loose bolts.
- damaged structural members and welds.
- all rope guides and cable keepers.
- all sheaves for free turning.
- hoist rope for kinks, broken strands or other damage in accordance with instructions on *Inspection And Maintenance*, page 9-1.
- hydraulic hoses and fittings are in good condition and show no signs of leaking.Hoses should be free from cuts and abrasions and there should be no evidence of binding. Any damage or leakage should be repaired immediately.
- RCL and anti-two-block system for proper operation.
- electrical wiring connecting various parts of system for physical damage.

NOTE: Consult chassis manufacturer’s manual for vehicle checks.

COLD WEATHER OPERATION

Following recommendations are for operating National Cranes in very low (i.e., sub-zero) temperatures.

Crane should have appropriate hydraulic oil, lubricants, and other auxiliary items required for operation in very cold temperatures. Operate individual crane functions to ensure they are sufficiently warmed prior to performing a lift.

Operation of crane at full rated capacities in temperatures between -9°C (15°F) and -29°C (-20°F) and -40°C (-40°F) or lower should be accomplished only by competent operators who possess the skill, experience, and dexterity to ensure smooth operation. Shock loading shall be avoided.

NOTE: Aerial Lift operation below -29°C (-20°F) is not recommended.

Operation Below -40°F

For crane operation below -40°F, capacities shall be derated 2 percent of the rated load shown on the capacity charts for each degree below -40°F.

CRANE WARM-UP PROCEDURES

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

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

Before starting crane, ensure appropriate lubricants are used to provide lubrication for prevailing ambient temperatures in which crane will operate in (a list of lubricants and their temperature ranges can be found in Lubrication section of your equipment’s *Operator Manual*, by contacting your local National Crane distributor, or by contacting Manitowoc Crane Care directly).

CAUTION

Crane Damage Hazard!

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

Always use Manitowoc recommended lubricants and fluids for 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

NOTE: For National Crane engine warm-up procedures, refer to chassis manufacturer’s manual.

Warm-up Procedures for All Temperature Ranges:

1. Upon startup, allow 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 engine speed to provide adequate lubrication to bearings and to allow oil pressure to stabilize.

Transmission

NOTE: For National Crane transmission warm-up procedures, refer to chassis manufacturer’s manual.

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

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

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 hoist function, warm hydraulic oil (see *Hydraulic Oil System*, page 4-15).
2. Once hydraulic system is warm, operate unloaded hoist, in both directions, at low speeds several times to prime all hydraulic lines with warm hydraulic oil and to circulate gear lubricant through the planetary gear sets.

Swing Drive and Turntable Bearing

Warm-up Procedures for Temperatures Above -7°C (20°F):

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

Warm-up Procedures for Temperatures Below -7°C (20°F):

1. Ensure boom is fully retracted and near maximum lift angle with no load applied.
2. Rotate superstructure at a speed of less than one-half RPM for at least two complete revolutions in one direction, then rotate superstructure at a speed of less than one-half RPM for at least two complete revolutions in opposite direction.

Axles

NOTE: For National Crane axle warm-up procedures, refer to chassis manufacturer's manual.

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 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 hydraulic system. If there is any unusual sound coming from crane's hydraulic pumps or motors, stop operation and engine immediately and contact a Manitowoc 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 crane's hydraulic oil cool by running engine at idle with no functions actuated.

Anti-two-block (A2B) Check

DANGER

The following tests must be performed with caution to prevent damage to machine or injury to personnel.

Check anti-two-block (A2B) alarm light and audible alarm by lifting (A2B) weight until switch is activated. To check anti-two-block switch:

- manually lift weight.
- slowly raise hoist rope.
- slowly extend (telescope) boom.

DANGER

If light and audible alarm do not function and hoist does not stop, system is not working properly and must be corrected before operating crane.

If crane is equipped with a jib that is deployed and rigged for work, repeat test procedure for jib anti-two-block switch.

RCL Check

Perform following checks to verify proper RCL operation.

- Check that display of main boom length agrees with the actual boom length.
- Check that display of main boom angle agrees with actual boom angles.
- Check that display of operating radius of crane agrees with actual radius.

Check load display by lifting a load of known weight. Accuracy of the load indication shall be within tolerance of SAE J159.

DANGER

A deviation between displayed and actual values indicates a malfunction and a RCL service representative shall be called for repair and/or recalibration of RCL system.

OUTRIGGER SETUP

DANGER

Do not operate outriggers unless they are visible to either operator or a designated signal person to avoid crushing injury. Contact with moving outriggers can result in death or serious injury.

Leveling of the Crane

It is essential that crane is level to within 1% of grade. If equipment is out of level, an audible alarm will beep indicating releveling is necessary. To properly level equipment, refer to *Outrigger Setup*, page 4-16. An interlock will not allow crane functions to operate during set-up.

Equipment Level Indicators Adjustment

Bubble level adjustment should be checked periodically; if it is suspected that the equipment level indicator is out of adjustment, verify and adjust the level indicator as follows:

1. Position crane on a firm, level surface.
2. Extend and set outriggers. Level crane, as indicated by level indicator, using outriggers.
3. Place a miracle pointer level, carpenter level, or similar type device on a machined surface such as turntable bearing or bearing mounting surfaces.
4. Using outriggers, level crane as indicated on leveling device used in previous step 3.
5. Using level indicator mounting screws, adjust level indicator to show level.

Setting the Outriggers

1. Position outrigger floats directly out from each outrigger to where outriggers will be properly extended.

DANGER

Do not operate outriggers unless they are visible to either operator or a designated signal person to avoid crushing injury. Contact with moving outriggers can result in death or serious injury.

CAUTION

Possible Equipment Damage!

Always depress one of the outrigger selector switches before positioning outrigger extend/retract switch to extend or retract. Failure to do this may cause a hydraulic lock against individual solenoid valves, preventing them from opening.

DANGER

Electrocution Hazard!

To avoid death or serious injury, keep all parts of this machine, rigging, and materials being lifted at least 20 feet away from electrical power lines and equipment.

2. If extending outrigger to mid-extend or fully extended position, depress desired outrigger selector switch and hold outrigger extend/retract switch to EXTEND. Appropriate outrigger beam begins to extend.

DANGER

Tipping Hazard!

All four outrigger beams must be deployed to one of three positions before beginning operation, which include fully retracted, mid-extend, or fully extended. Do not operate the aerial lift unless outriggers are fully extended.

NOTE: More than one outrigger beam can be extended at a time. However, to ensure that each outrigger is fully extended, repeat step 2 for each outrigger after a multi-outrigger extension.

3. After deploying four outrigger beams to one of three proper positions (fully retracted, mid-extend, fully extended), depress the desired Stabilizer Switch on the Outrigger Selector Panel and hold Outrigger Extension/ Retraction Switch to EXTEND. The appropriate stabilizer begins to move.

   Extend each jack, positioning float as necessary, until locking levers of float engage jack cylinder barrel.

NOTE: More than one stabilizer can be extended at a time.

4. With each jack float firmly touching ground, extend front stabilizers approximately 8 to 10 cm (3 to 4 in). Extend rear stabilizers approximately 8 to 10 cm (3 to 4 in).
5. Repeat step 4 until all wheels are clear of ground and crane is level as indicated by bubble level indicator (Figure 4-13). If it is suspected that bubble level

indicator is out of adjustment, verify and adjust bubble level using procedures under *Equipment Level Indicators Adjustment*, page 4-16.

Not Level

FIGURE 4-13

6. Lower the single front outrigger (optional) only after all other outriggers are set. Press the single front outrigger switch to activate and the extend/retract switch to extend. Hold the extend/retract switch for two seconds after the outrigger contacts the ground. The single front outrigger is automatically set at the correct ground pressure.

DANGER

After the single front outrigger is set, it automatically retracts if any other jack is adjusted. Reset the single front outrigger if this occurs.

DANGER

Tipping Hazard!

Mid-extend outrigger beam lock pin must be engaged before operating on any beam from mid-extend position.

Proper Load Chart/Reach Diagram and RCL program must be selected for current outrigger configuration.

Outrigger Monitoring System (OMS)

Outrigger Monitoring System (OMS) aids operator in accurately programming Rated Capacity Limiter (RCL) by automatically identifying position of each outrigger beam. OMS uses four sensors, one per outrigger beam, and an inclinometer located in aerial lift superstructure to identify when an outrigger beam is fully extended or an outrigger jack is extended. This system is standard equipment on all aerial lifts. Status will display on RCL screen in ground control cab (Figure 4-3) when an outrigger beam is positioned to one of pre-defined locations, including fully retracted, mid-extend, and fully extended.

Set up of outriggers is same for cranes equipped with OMS, (See “Setting the Outriggers” on page 4-16.)

If crane setup “On Outriggers” is chosen when programming the RCL, then OMS indicates to RCL the horizontal position of each of the four outrigger beams. Based on this information, RCL will default to most conservative outrigger beam configuration (i.e. If three outriggers are fully extended and one is retracted, RCL will select retracted as outrigger configuration). A confirmation of this configuration is all that is needed (see Figure 4-14). Refer to *Rated Capacity Limiter Operator’s Manual* for detailed instructions.

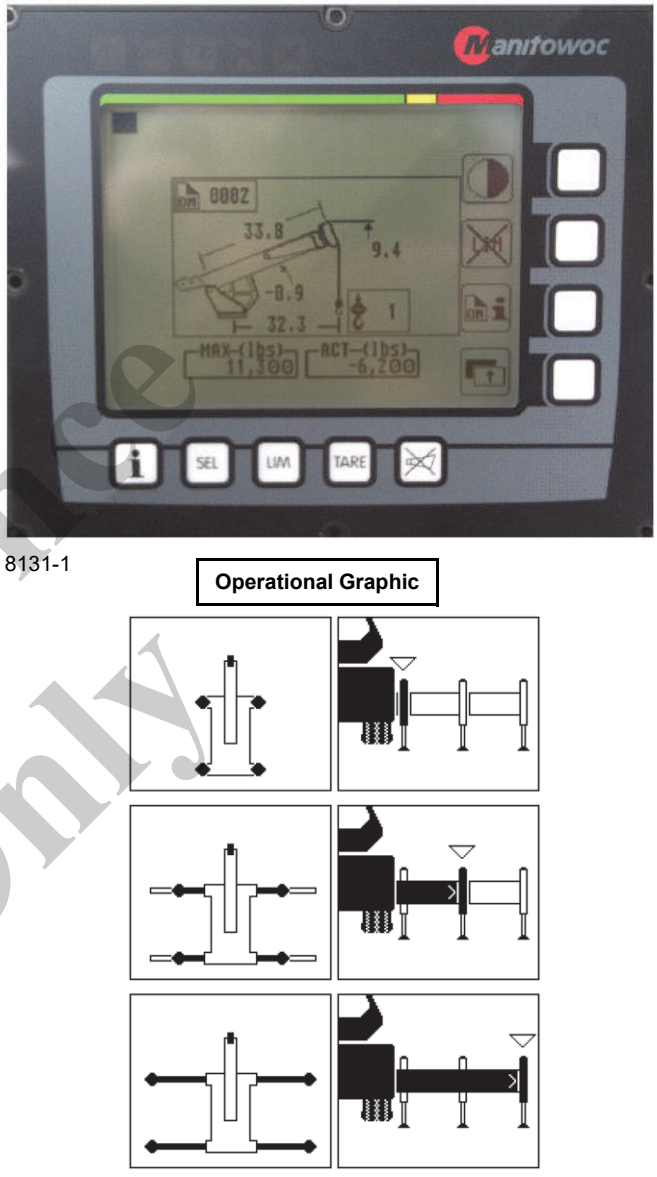


FIGURE 4-14

Outrigger Jack Monitoring

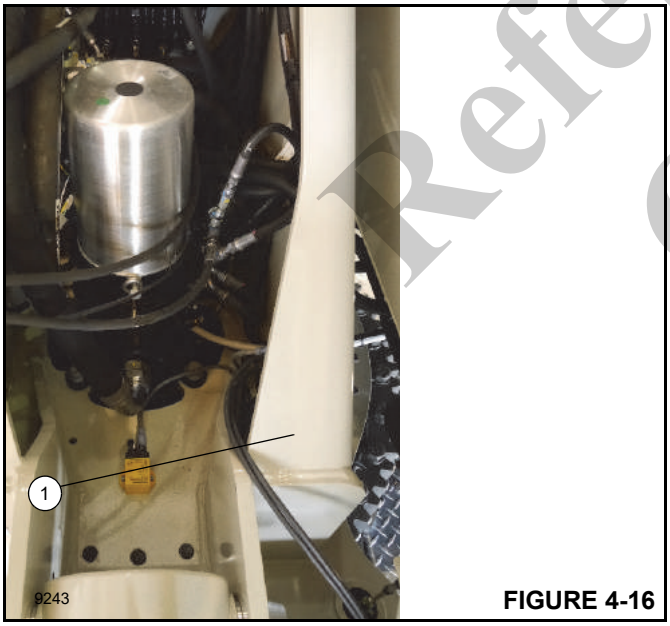
The following are also for use on cranes if Dual Rated as an aerial lift. The outrigger jack monitoring system works in conjunction with the standard outrigger monitoring systems (OMS) and senses the location of each outrigger beam, the position of each vertical jack, that the boom is stowed in the boom rest, the truck chassis park brake is set, and the levelness of the outriggers to permit operation within the allowable level specification.

This system is comprised of several sensors and modules located throughout the machine:

1. Outrigger string potentiometers are used in the standard outrigger monitoring system (OMS).
2. An aerial lift interlock module is located inside the torsion box near the passenger side outrigger controllers (See Figure 4-15.)

9242 FIGURE 4-15

3. A 3-axis inclinometer is located in the crane turret (See Figure 4-16).

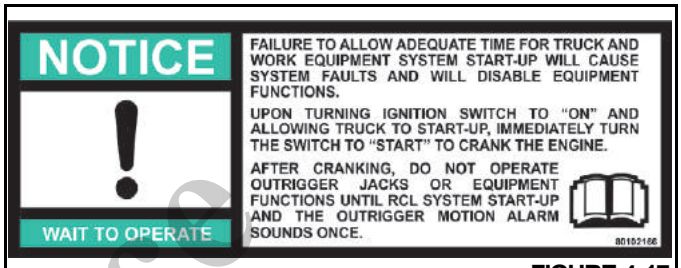


9243 FIGURE 4-16

4. Slew position sensor located internal to the electrical slip ring (See Figure 4-16).
5. Truck chassis parking brake switch located on the truck chassis (J1939 CANbus interface)
6. Outrigger motion alarm (OMA) located at the rear of the machine.
7. Boom angle sensor located internal to the RCL system length and angle cable reel on left side of boom.

Startup

Upon turning the operator cab keyswitch to the ignition position, the outrigger jack monitoring system begins to sense the configuration of the machine. The truck engine must be started within approximately 30 seconds of ignition position in order for all sensors to be powered up and communicating with the aerial lift interlock module Figure 4-17.



9241 FIGURE 4-17

After engine is running, the outrigger functions must not be operated until the RCL system has powered up and is ready to be configured. The outrigger motion alarm will sound once to indicate the system is operational. During this time, all boom functions are disabled until the outriggers are properly setup within specifications.

Outrigger Setup

The outriggers can be setup and leveled per operating instructions, and the RCL can be configured to match the actual configuration of the machine. The outrigger jack monitoring system will not allow operation of any crane functions until:

1. Outrigger jacks are extended
2. Boom is in the boom rest
3. Outriggers are leveled.

If operation is allowed, the outrigger motion alarm will activate and sound two low pitch tones followed by a single higher tone indicating the boom functions are permissible for operation.

During Operation

Once boom functions are permitted, the boom functions operate normally as per operating instructions. The outrigger jack monitoring system monitors the real-time status of the level sensor during operation and allows full range of operation. If the sensor indicates that the machine is not level according to the specifications, the outrigger motion alarm (OMA) will sound indicating an out of level condition. All boom functions will remain operational when alarm

sounds. Operator must immediately retract and lower boom and place the boom in the boom rest and relevel the crane.

HOIST SYSTEM OPERATION

Hoist operation is not permitted in Aerial Lift Platform Mode.

Hoist may have lifting capabilities greater than that of equipment limits. Therefore, care must be taken to ensure that load lifted is within crane's rating. General rules for hoist operation are:

- Unwind hoist when extending boom.
- Use anti-two-block system only as an aid.
- Make sure hoist rope is not twisted or kinked and that it is properly seated in hoist and in sheaves.
- Always have at least three full wraps of wire rope on hoist and eight full wraps of synthetic rope (if equipped) on hoist.
- Check hoist brake when approaching load limit of hoist. Raise load a few inches and return control to neutral to check brake.
- Do not drag load with hoist.
- Lift only freely suspended loads. Do not lift loads that may be frozen to or otherwise secured to the ground.
- Keep tension on rope to prevent it from becoming twisted, kinked, or improperly seated on hoist.

Hoist Two Speed Operation

High speed increases hoist line speed over normal operation. High speed mode is activated by a switch (10, Figure 4-3) located on crane operator's cab.

CAUTION

If high speed feature is run continuously or with an overload, crane damage could occur.

To start high speed, depress high speed switch and operate hoist lever on armrest. Refer to specification section of this manual and *Load Chart/Reach Diagram* for more allowable capacities.

COUNTERWEIGHT

NBT40-1 series is equipped with non-removable counterweights as standard equipment. NBT36-1 is equipped with a no-tailswing counterweight. Based on chassis configuration there is a rotating optional counterweight. See "Counterweight" on page 2-19.

WORK SITE LOCATION

Select a location that is firm, level, and dry. Avoid uneven, rocky or muddy terrain, steep grade or locations with overhead obstructions. Outrigger stabilizers must be supported on a firm level surface at fully retracted, mid-span, or fully extended positions. Avoid overhead power lines.

Before Leaving the Chassis Cab

- Position crane so that outriggers can be extended with no obstructions.
- Position chassis transmission to neutral.
- Set chassis park brake. Wheel chocks may also be required.
- Engage power takeoff.
- Turn chassis cab switch to OFF.

DANGER

Chassis must be in neutral when starting engine from operator's control cab to avoid sudden potential movement of chassis.

Stowing and Parking

DANGER

Tipping Hazard!

Never park crane near holes, or on rocky or extremely soft surfaces. This may cause the crane to overturn.

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

When parking, crane should be left in smallest, most stable, valid operational configuration the job site practically allows, do following:

1. Park crane on a stable surface.
2. Remove load.
3. Stow swingaway boom extension, if erected.
4. Fully retract boom and position it in normal travel position, then perform following and proceed to Step 6:
   a. Engage swing brake and/or swing lock pin.
   b. Retract all jack cylinders and outrigger beams.
5. If it is not practical to fully retract the boom and place it in travel position, then perform following and proceed to Step 6:

a. Make crane as stable as possible, including, boom angle, superstructure orientation, jib angle, etc. In high winds, boom and jibs should be lowered or secured.

b. Engage swing brake and/or swing lock pin.

6. Apply parking brake.

7. Put all operating controls in neutral position.

8. Position Crane Function switch to OFF.

9. Shut down engine following proper procedures specified in this manual and applicable engine manual.

10. Remove keys.

CAUTION

To avoid possible engine fault codes and undesirable operation, ensure keyswitch has been off 2 minutes before disconnecting batteries.

11. Disconnect batteries, if crane will be inactive for over 24 hours.

12. Close and lock all windows, covers, and doors.

Unattended Equipment

DANGER

Tipping Hazard!

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

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

Configuration in which the crane should be left while unattended shall be determined by a qualified, designated individual familiar with job site, configuration, conditions, and limitations.

Before Performing the Lift

- Set outriggers as described in (*Setting the Outriggers*, page 4-16) section in this manual.
- Prior to any fully retracted outrigger (0% extended) operation, extend jack cylinders with outriggers fully retracted and level crane. Engage swing brake and raise boom out of boom rest until minimum boom angle for indicated boom length with no load is exceeded. DO NOT release swing brake with boom below minimum indicated boom angle.

DANGER

Tipping Hazard!

Serious injury or death could result from improper crane on fully retracted outriggers.

In fully retracted outrigger configuration, before slewing:

Ensure outriggers are properly set and crane is level per operator manual.

Set swing brake to locked position.

Raise boom to exceed minimum boom angle for given boom length at no load as indicated on Load Chart/Reach Diagram

DO NOT release swing brake with boom below minimum indicated boom angle.

- Program the RCL as specified in RCL Operator Manual which is located in crane cab.
- Check all controls for proper operation. If any abnormal operations are detected, the condition must be corrected before continuing.
- Check the work area for electric power lines.

LOAD CHART

Load chart is stored in a pocket in crane's operator control station. Load chart contains lifting capacities of crane in all allowable lifting configurations.

Crane is designed to provide satisfactory service if it is not loaded in excess of maximum rated loads specified in load chart. Overloading can create safety hazards, cause structural damage, and shorten service life of crane.

You must understand how to use load charts located in cab. Make sure load, working area, and crane configuration are within load limit specified in load chart.

NOTE: Weight of load handling devices (hook blocks and slings) are considered part of load.

Using the Load Chart

NOTE: One of the most important tools of every crane is the load chart found in crane operator's station.

NOTE: Refer to Figure 4-18 for terms to know in determining lifting capacities.

Load charts contains a large amount of information, which must be thoroughly understood by operator.

Load charts contains outrigger capacity charts for fully extended, mid extended, outriggers for the main boom and

boom extension, and fully retracted outrigger beams for main boom only.

Prior to any fully retracted outrigger (0% extended) operation, extend jack cylinders with outriggers fully retracted and level crane. Engage swing brake and raise boom out of boom rest until the minimum boom angle for indicated boom length without load is exceeded. DO NOT release swing brake with boom below minimum indicated boom angle.

This condition is applicable when load chart does not provide a maximum boom length at 0 degree boom angle in a no load situation. This is designated by “N/A”.

DANGER

Tipping Hazard!

Serious injury or death could result from improper crane on fully retracted outriggers.

In fully retracted outrigger configuration, before slewing:

Ensure outriggers are properly set and crane is level per operator manual.

Set swing brake to the locked position.

Raise boom to exceed minimum boom angle for given boom length at no load indicated on load chart.

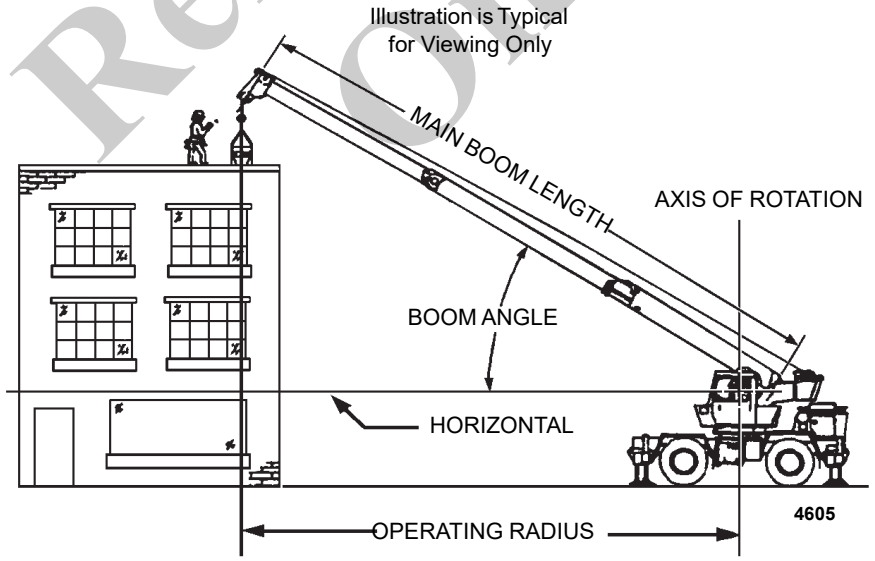
DO NOT release swing brake with boom below minimum indicated boom angle.

The load chart contains crane lifting capacities in all allowable lifting configurations and must be thoroughly understood by the operator.

The left column is the load radius, which is the distance from axis of crane rotation to load center of gravity. The top row lists various boom lengths from fully retracted to fully extended (with swingaway boom extension). The number at the intersection of the left column and top row is the total load limit for that load radius and boom length. The number in parentheses below the total load limit is required boom angle (in degrees) for that load.

Another important section is the range diagram. The range diagram shows operating radius and tip height that can be achieved at a given boom length and angle. If the operator knows radius and tip height required for a specific lift, the angle and boom length can quickly be determined from the range diagram. Or, if an operator knows boom length and angle, they can quickly determine tip height and operating radius.

4



TERMS TO KNOW

FIGURE 4-18

A lifting diagram is included for over-side, over-rear, and over-front lifting areas. The lifting area diagram shows locations of the outrigger jack cylinders in full extended position are used to mark lifting area boundaries.

Another section contains notes for lifting capacities. Be sure to read and understand all notes concerning lifting capacities.

The load chart also gives weight reductions for load handling devices such as hook blocks, overhaul balls, boom extension sections, etc., which must be considered as part of the load. Weight of any other load handling devices such as chains, slings, or spreader bars must also be added to the weight of the load.

NOTE: Information in the following paragraph is an example only of how to compute a lift. Numbers may not match load chart in the crane cab.

Example: A concrete beam weighing 2268 kg (5000 lb) needs to be lifted to a height of 9.1 m (30 ft) at a radius of 15.2 m (50 ft) (maximum). The range diagram indicates the boom must be extended to 18.9 m (62 ft) to reach a height of 9.1 m (30 ft) at a radius of 15.2 m (50 ft).

First check the crane for load handling devices. In our example, the crane is equipped with a auxiliary boom nose (rooster sheave) and a five ton overhaul ball. The rooster sheave is 50 kg (110 lb), and the overhaul ball is 78 kg (172 lb) for a total of 128 kg (282 lb). The lift requires slings and spreader bars weighing 159 kg (350 lb) which makes the total weight for the load handling devices 286 kg (632 lb).

A check of the load chart for a 15.2 m (50 ft) radius and 19.5 m (64 ft) of boom length shows a capacity of 3601 kg (7940 lb) on outriggers over-front and 2254 kg (4970 lb) on outriggers 360 degrees.

Subtract load handling weight of 632 lb from load capacity of 3601 kg (7940 lb) and 2254 kg (4970 lb). The result is a weight capacity of 3315 kg (7308 lb) over-the-front and 1968 kg (4338 lb) for 360 degrees.

We are restricted in making the lift over-front only, with a boom angle of about 29 degrees.

LIFTING THE LOAD

The following general guidelines outline proper procedure for making a lift after crane has been properly set up.

1. Position crane in work area and set outriggers. See *Outrigger Setup*, page 4-16 for outrigger setup.
2. Program RCL. Use load chart to estimate values.
3. Position boom nose over load. Do not try and drag load with boom or hoist.
4. Perform lift. Meter controls when moving the load to avoid sudden stops.
5. Retract and lower boom after lift is complete.

SHUT DOWN AND PREPARATION FOR ROAD TRAVEL

CAUTION

Disengage hydraulic pumps for extended traveling, cold weather starting, or engine checks.

Check cold tire pressure prior to extended travel. Refer to tire inflation on crane.

CAUTION

Machine Damage Hazard!

Do not travel with an empty hook in a position where it can swing freely. Either remove the hook block and/or overhaul ball from the hoist rope(s) and stow securely or make sure the hook block or overhaul ball is properly secured to the tie down provided for that purpose.

Fully retract the outrigger jacks and properly store the floats.

1. Ensure swingaway, if so equipped, is properly stowed and secured or removed from crane.

DANGER

Do not travel with swingaway extended to prevent damage to crane.

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

2. Retract and place boom in boom rest.
3. Ensure single front outrigger is fully retracted, if equipped. Ensure outrigger beams and jacks are fully retracted with floats properly stowed.
4. Engage mechanical travel lock (if equipped) at each outrigger beam.
5. Engage swing brake.
6. Engage swing lock.
7. Either hook block may be reeved over main boom nose or overhaul ball may be reeved over main boom nose or auxiliary boom nose; the other must be removed and stowed securely before traveling. If hook block or overhaul ball remains reeved on boom, it must be secured at tie down on carrier provided for that purpose.
8. Secure hook block and anti-two-block (A2B) weight:

a. Slowly hoist up until there is a slight tension on hoist rope. It may be necessary to override A2B function to tension rope.

b. A2B weight needs to be resting on wedge socket so that there is slack in anti-two-block-chain.

NOTE: There needs to be enough slack in A2B chain so that A2B switch does not switch between open and close during travel.

If chain is too tight, road bounce causes A2B switch to open and close numerous times and this can damage switch.

9. Turn off ignition and all other switches at ground control.

10. Close and/or secure all windows and doors.

11. Exit cab, lock door, and stow access ladder.

12. Secure any loads or lifting devices on chassis bed or body.

13. Ensure tires are properly inflated.

14. Disengage Power Take Off (PTO) and start engine from chassis cab.

15. Release park brake before moving equipment.

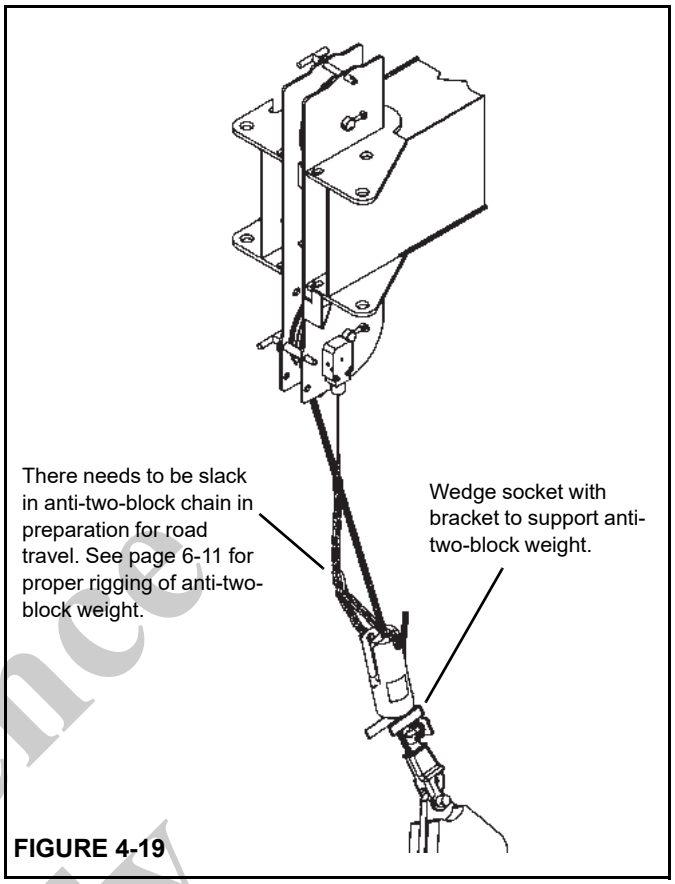


FIGURE 4-19

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SECTION 5
OPERATING CONTROLS - AERIAL LIFT

SECTION CONTENTS

CONTROLS AND OPERATING PROCEDURES

This section contains information for the controls and operating procedure for operation of the Aerial Lift Platform.

For information on the chassis and ground station controls refer to *Operating Controls - Crane*, page 4-1.

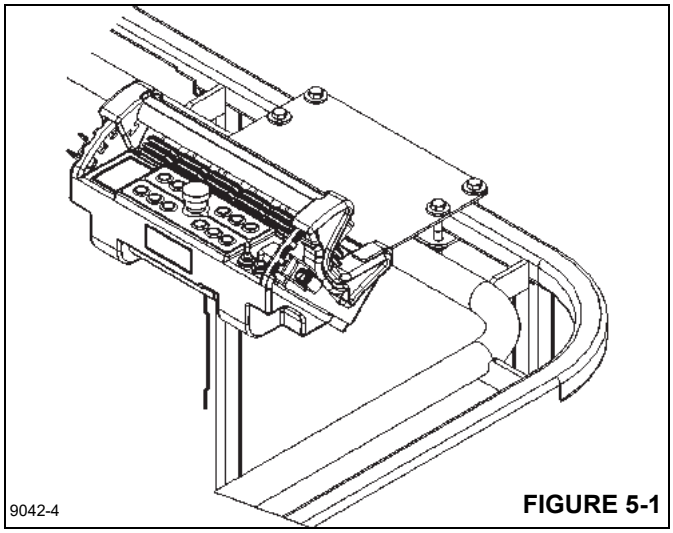
Aerial Lift Controls

The controls described here are those controls that are used in conjunction with the aerial lift equipment controls. The Aerial Lift Platform movements are controlled by two separate control systems - Aerial Lift Platform Controls (primary) Figure 5-1 and Ground Controls (secondary) Figure 5-2.

When operating the aerial lift controls make sure there are no personnel, obstructions or equipment around or under the work platform.

Do not operate the aerial lift if any of the control levers, joysticks or switches controlling the boom or aerial platform are loose, broken or do not return to the **OFF** position when released.

Chassis cab ignition switch must be **OFF** in order for ground control ignition switch to be operable.



9042-4 **FIGURE 5-1**

Power Take Off

The power take off (PTO) must be engaged for aerial lift operations. For operation instructions refer to, *Power Take Off*, page 4-2.

OUTRIGGERS

Outrigger Controls - Aerial Lift

The Outrigger Controls are used to set the outriggers. Outriggers must be controlled from ground stations. For operation instructions of the Outrigger Controls refer to, (*Outrigger Controls*, page 4-2.)

DANGER

Tipping Hazard!

To avoid death or serious injury ensure that the aerial lift is level in order to maintain stability.

Position aerial lift on a firm surface, fully extend outriggers and level equipment. All four outrigger beams must be deployed to fully extended; do not operate the aerial lift with the outriggers in any other position.

Outrigger Monitoring System (OMS)

The Outrigger Monitoring System (OMS) aids the operator in accurately programming Rated Capacity Limiter (RCL) by automatically identifying position of each outrigger beam. OMS uses four sensors, one per outrigger beam, and an inclinometer located in the aerial lift superstructure to identify when an outrigger beam is fully extended or an outrigger jack is extended. This system is standard equipment on all aerial lifts. Status will display on the RCL screen in ground control cab (Figure 4-3) when an outrigger beam is positioned to one of pre-defined locations, including fully retracted, mid-extend, or fully extended.

Set up of the outriggers is same for cranes equipped with OMS, (See “Setting the Outriggers” on page 4-16.)

Outrigger Jack Monitoring System

The outrigger jack monitoring system is equipped with the Aerial Lift option and is functional during both crane and aerial lift operating modes. Refer to, (*Outrigger Jack Monitoring*, page 4-17.)

Leveling of the Aerial lift

It is essential that the aerial lift is level to within 1% of grade. The bubble level that is provided on the aerial lift is calibrated to be accurate within 1% of grade. If equipment is out of level, an audible alarm will beep indicating releveling is necessary. To properly level the aerial lift, refer to *Leveling of Equipment*, page 4-5.

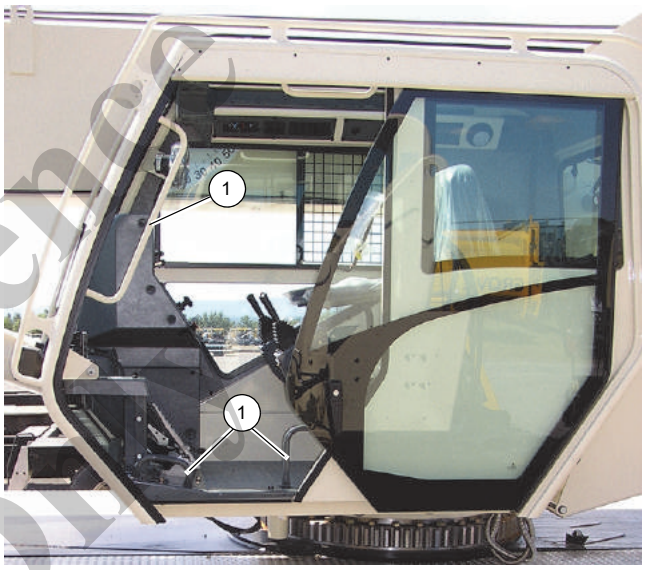
A working aerial lift may settle during operations. Frequently check the aerial lift for level. When rechecking the aerial lift for level, the boom must be positioned over the front of the aerial lift, fully lowered to horizontal and fully retracted. For an aerial lift fitted with a boom rest, the boom shall be stowed onto the boom rest.

Equipment Level Indicators

For leveling operation instructions refer to,*Equipment Level Indicators*, page 4-6.

EQUIPMENT GROUND CONTROLS

The equipment ground controls are located in the Ground Controls station (operator’s cab) Figure 5-2 and are used for equipment functions.



7602-5

FIGURE 5-2

See (Figure 4-3) for component identification. For best control response, run the engine at governed RPM when operating the equipment.

NOTE: The crane control power switch (20, Figure 4-3) located on the right overhead console must be activated.

NOTE: When the radio remote control is activated, all crane ground controls will be deactivated.

The ground controls are designed to override the boom and work platform positioning functions of the aerial platform controls. The ground controls are used to setup the outriggers and to position the boom to equip either the personnel platform or jib for use.

Perform all pre-start inspections and test from the ground controls, (Reference *Pre-Start Functional Test*, page 9-2) except inspection and test of platform controls.

Do not operate aerial lift from the ground controls without permission of the work platform occupant(s) except in the case of emergency such as a disabled operator.

Before operation of any controls, make sure you have read and understood the information provided in the manual. Information concerning operation of ground controls which are active for aerial lift functions can be found on Operator Manual pages:

Swing Brake Pedal (page 4-8)

Boom Telescope Pedal (page 4-8)

Foot Throttle Pedal (page 4-8)

RCL Display (page 4-8)

Hand Throttle Control (page 4-7)

Emergency Stop Switch (page 4-7)

Operator Presence Footswitch (page 5-11)

Operator Cab/Ground Control Ignition Switch (page 4-10)

Boom Lift Control Lever (page 4-11)

Telescope Control Lever (page 4-11)

Swing Control Lever (page 4-12)

PLATFORM CONTROLS

The Platform Controls for the aerial lift are provided by a Radio Remote Controller and Radio Remote Transmitter.

Radio Remote Controller

Operation of the aerial lift is controlled by the Radio Remote Controller. (For additional information, reference Radio Remote Manual.) The Remote/Aerial Power Switch (19) and Crane Control Power Switch (20) located on the cab overhead console (Figure 4-3) must be properly **OFF** in order to activate the aerial lift platform.(See “RCL Check” on page 5-14.)

When the radio remote control is activated, all crane ground controls will be deactivated.

The following procedure should be used to begin platform operation:

1. Position equipment at job site, set park brake, and shift transmission to neutral.
2. Start engine from either chassis cab or lower control station (operator’s cab).
3. Set outriggers and level the equipment.

NOTE: Boom functions will operate only when outriggers are fully extended and equipment is leveled as per operator manual instructions.

4. Check that the platform is properly attached to the boom or if needed, attach the aerial lift platform following the operator manual instructions per “Aerial Lift Platform” on page 6-12.
5. Turn ignition switch for chassis and lower control station to the **OFF** position.
6. Secure the upper platform radio remote controller to mounting bracket attached to the platform railing (See Figure 5-1.)
7. Attach aerial lift platform Operator Presence Footswitch harness to the A2B switch at the boom nose tip.

WARNING

To avoid death or serious injury do not remove, modify or disable the Operator Presence Footswitch by blocking or any other means.

Always keep platform floor clean and free of debris which may interfere with Operator Presence Footswitch operation.

8. Configure the RCL for the aerial lift platform configuration matching actual setup.
9. Turn **ON** lower control power switch located on lower control station overhead console.
10. Set the platform on the ground.
11. Turn **OFF** the lower control power switch, Turn **ON** the Remotes Power Switch located on overhead console to begin “Reconfiguration for Aerial Lift:” on page 5-9.

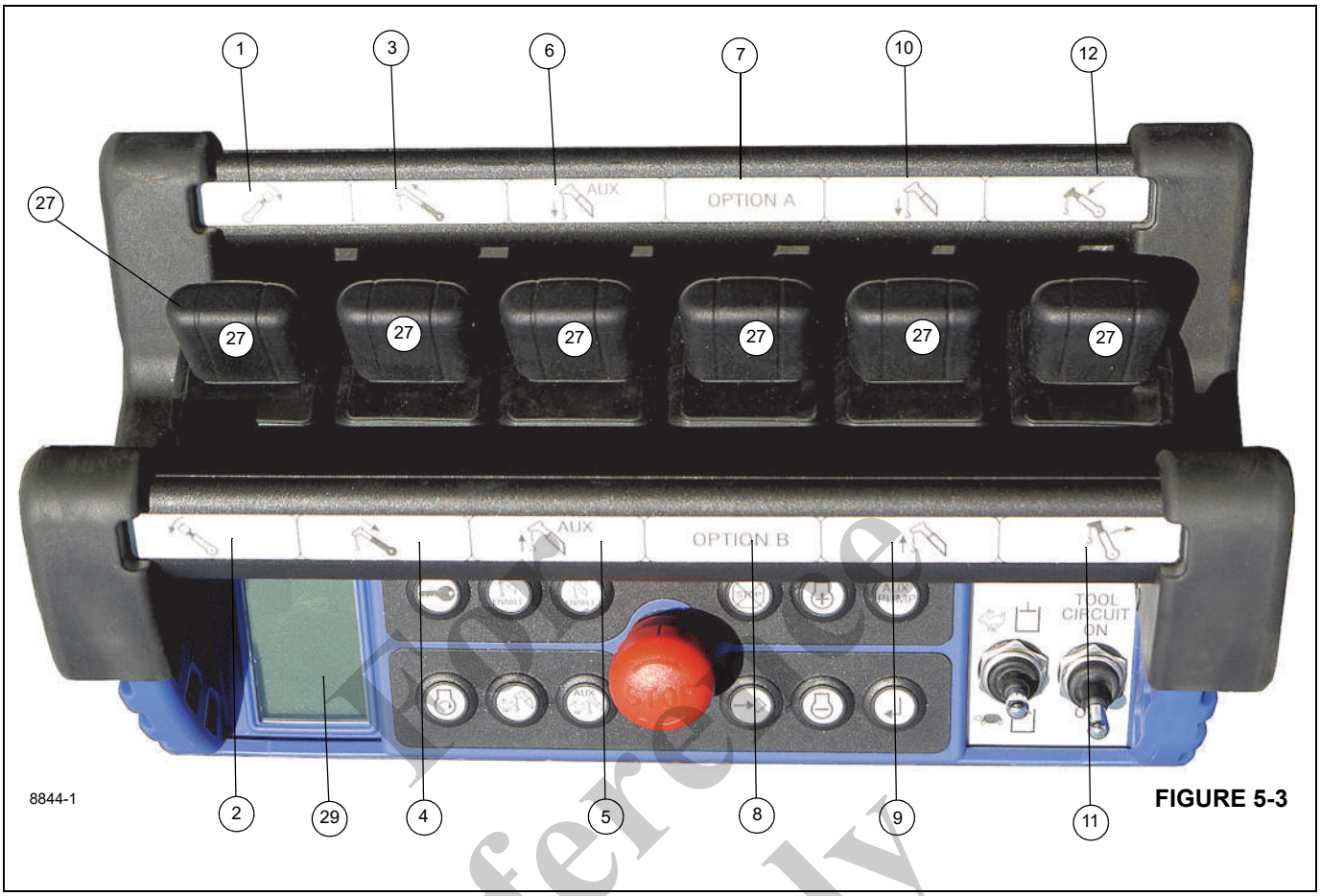


FIGURE 5-3

Radio Remote Transmitter

Item	Symbol/Icon	Function	Operation Type	Logic
1		Swing Clockwise	Proportional Joystick	
2		Swing Counterclockwise	Proportional Joystick	
3		Telescope Extend	Proportional Joystick	

Radio Remote Transmitter

Item	Symbol/Icon	Function	Operation Type	Logic
4		Telescope Retract	Proportional Joystick	
5		Auxiliary Hoist Up	Proportional Joystick	Default is to OFF upon remote initialization in aerial mode.
6		Auxiliary Hoist Down	Proportional Joystick	Default is to OFF upon remote initialization in aerial mode.
7	Option A	Option A (Unused)	Proportional Joystick	Non-functional in any mode.
8	Option B	Option B (Unused)	Proportional Joystick	Non-functional in any mode.
9		Main Hoist Up	Proportional Joystick	Default is OFF upon remote initialization in aerial mode.
10		Main Hoist Down	Proportional Joystick	Default is OFF upon remote initialization in aerial mode.
11		Boom Up	Proportional Joystick	
12		Boom Down	Proportional Joystick	
13		Horn/Enable button	Momentary button	
14		Engine Start	Momentary button	

5

Radio Remote Transmitter

Item	Symbol/Icon	Function	Operation Type	Logic
15		Main Hoist Enable	Latching button	Default is OFF upon remote initialization in aerial mode.
16		Main Hoist High Speed	Latching button	Default is OFF upon remote initialization in aerial mode.
17		Auxiliary Hoist Enable	Latching button	Default is OFF upon remote initialization in aerial mode.
18		Auxiliary Hoist High Speed	Latching button	Default is OFF upon remote initialization in aerial mode.
19		RCL Override (Not functional for aerial mode)	Momentary button	Non-functional in aerial mode.
20			Momentary Frequency Change button	
21		Frequency Change/ Programming	Latching button	
22		Engine RPM Decrement	Latching button	
23		Auxiliary Pump Enable		
24		Enter/toggle		Scroll through all available RCL screens on the remote. One button press advances one screen.

Radio Remote Transmitter

Item	Symbol/Icon	Function	Operation Type	Logic
25		Speed Selection (100%/50%/Low Flow)	3-position latching toggle switch	
26		Tool Circuit	2-position, latching toggle switch	Default is OFF when remote is enabled even if this switch is in the ON position.
27	Figure 5-3	Function Joysticks (x6)	Proportional Joystick	
28		Emergency Stop	2-position latching switch	
29	Figure 5-9	Operator feedback information	LCD screen	

Aerial Functions

The activation of the swing, telescope, and boom functions are controlled using their corresponding joystick control. The swing, telescope and boom functions are permitted for use throughout the published reach diagram. Upon initial power up of the Radio Remote Transmitter, both the main and auxiliary hoist functions are disabled and will not operate during aerial mode.

Set function operating speed options on the platform controls such as engine RPM (reference item 21 & 22) and hydraulic speed (reference item 25) as desired. Depending on the skill level of the operator and the aerial lift application, activation of more than one control at a time is permissible. To assure smooth operation of the aerial lift, always return Platform Control levers to neutral and function stops before moving the lever in the opposite direction.

Perform pre-start inspection and test, (Reference *Pre-Start Functional Test*, page 9-2) of the aerial lift platform controls.

Before operation of any platform control function make sure you have read and understood the information provided in this manual.

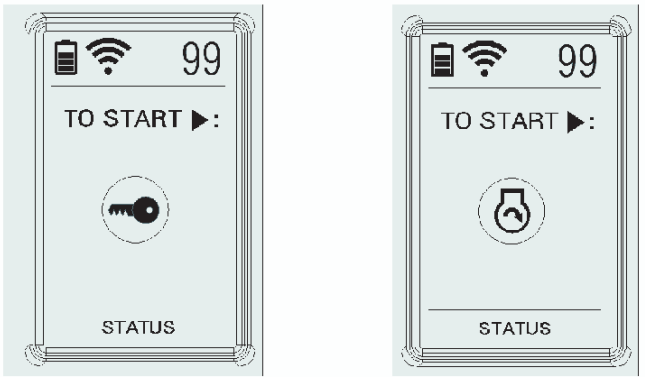
Activation of the Platform Controls

In order to activate the Platform Controls:

1. The red Emergency Stop button (Item 28) must be twisted clockwise which will release the Emergency Stop button and turn ON the Radio Remote Transmitter.

Operator information is shown on LCD display upon releasing the ESTOP switch (Refer to Figure 5-4).

The transmitter LCD display screen (Item 29) will first show the LEFT screen, followed by the RIGHT screen after the corresponding button is depressed.



8844-4

FIGURE 5-4

2. The momentary HORN/ENABLE button (Item 13) must be depressed.
3. Depress the ENGINE START button (Item 14) to start the truck engine.
4. Set function operating speed options on the upper control transmitter (Throttle, 50% / 100% or turtle as desired.
5. Verify the float selector is in the raised position and brake selector is in the clockwise (CW) position.
6. Slowly move joystick in desired direction until desired speed is obtained.
7. Slowly move joystick back to neutral (center) position to decrease the function's operation speed.
8. Stow equipment when operation is finished.
9. Depress the Emergency Stop button to shut off engine and upper control transmitter.
10. Turn remote switch **OFF** in lower control station (operators cab).
11. Refer to securing instructions. See"Ending Operation Mode:" on page 5-10.

Emergency Lowering Procedure

Emergency Ground Control Operation

The following procedure should be used to operate the emergency lowering system:

1. Enable the ground level controls per normal operating instructions.

DANGER

Tipping Hazard!

To avoid death or serious injury and overturning of equipment fully retract boom before lowering boom to ground level.

2. Operator Cab/Ground Control Ignition Switch must be on without truck engine running. Engaging the switch to the auxiliary pump will enable the ground controls to RETRACT and LOWER the boom to the ground.
3. Activate the emergency lowering system by turning ON the AUX PUMP switch located under the right fender decking near the ground level right side outrigger control panel.

NOTE: This procedure is taxing of the batteries when using the Auxiliary pump. When the boom has been lowered, turn off the switch to conserve the batteries.

4. This system will be activated for a maximum of 2 minutes allowing operation at reduced speeds until timeout. The emergency lowering switch can be turned OFF by pressing the AUX PUMP switch again. The lowering system can not be re-reactivated for 5 minutes after activation to prevent damage to the system. The Emergency Lowering System can be activated again once the disable time has elapsed.

FIGURE 5-5

5. Fully retract the boom.
6. Lower the boom to ground level.
7. Stow equipment when operation is finished.
8. Turn ground controls (function enable) switch OFF in lower control station (operators cab).
9. Stow outriggers using lower control station (operator's cab) or ground level controls.
10. Refer to the operator's manual for securing instructions (See "Operational Procedure:" on page 5-9.)

Emergency Aerial Lift Platform Control Operation

The following procedure should be used to operate the Emergency Lowering System from the Aerial Lift Platform control station.

1. Enable the primary controls in the platform per normal Aerial Lift Platform Operating Instructions.
2. Activate the emergency lowering system by pressing and holding the aux pump button on the remote control transmitter.

NOTE: This procedure is taxing of the batteries when using the Auxiliary pump. When the boom has been lowered, turn off the switch to conserve the batteries.

3. The system will be activated for a maximum of 2 minutes allowing operation at reduced speeds until timeout. The system can be turned OFF by releasing the Aux Pump button. The emergency lowering system cannot be re-activated for 5 minutes after activation to prevent damage to the system. The Emergency Lowering System can be activated again once the disable time

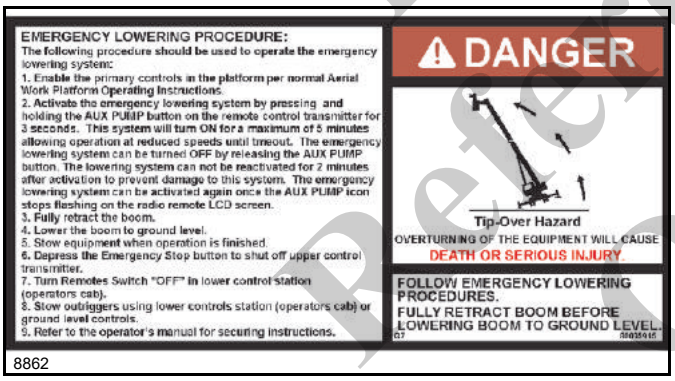
has elapsed and the AUX PUMP icon on the Radio Remote Transmitter's display stops flashing.

DANGER

Tipping Hazard!

To avoid death or serious injury and overturning of equipment fully retract boom before lowering boom to ground level.

4. Fully retract the boom.
5. Lower the boom to ground level.
6. Stow equipment when operation is finished.
7. Depress the Emergency Stop button to shut off upper Radio Remote Transmitter.
8. Turn remote switch OFF in lower control station (operators cab).
9. Stow outriggers using lower control station (operator's cab) or ground level controls.
10. Refer to the operator's manual for securing instructions (See "Operational Procedure:" on page 5-9.)



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Operational Procedure:

You must be familiar with the safety precautions outlined in this manual before operating the aerial lift.

The following procedures should be used to operate this aerial work platform:

Setup:

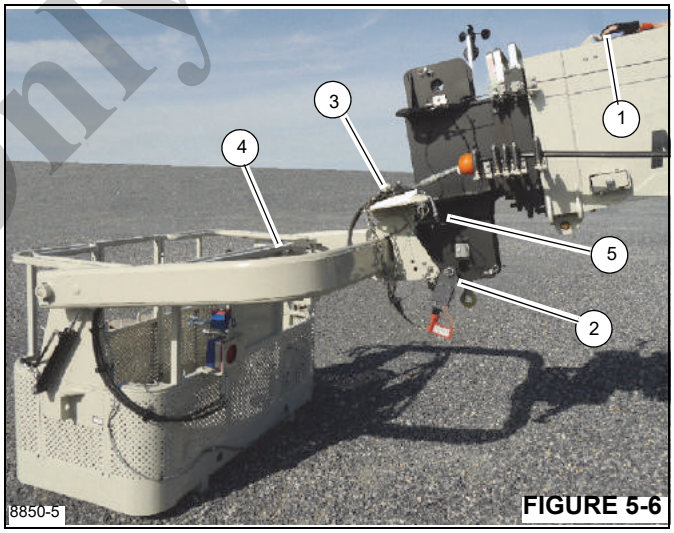
1. Position equipment at jobsite on level ground allowing appropriate distance to allow attachment to boom or jib, set park brake, shift transmission to neutral, and turn **OFF** truck engine.
2. Start engine from lower control station (operators cab).
3. Set outriggers and level the equipment.

NOTE: Boom functions will operate only when equipment is leveled as per operators manual instructions.

4. Configure **RCL** for crane operation, turn **ON** lower control power switch on overhead console and position platform on the ground.
5. Turn **OFF** lower control power switch on overhead console, Turn **ON** remotes power switch on overhead console to begin reconfiguration to aerial lift operation.

Reconfiguration for Aerial Lift:

1. Attach aerial lift platform per "Aerial Lift Platform" on page 6-12.
2. Turn **ON** radio remote controller by twisting Emergency STOP knob clockwise and following the on-screen instructions to restart truck engine.
3. Using radio remote controller, stow hoist rope (1) on stow pegs located on top of boom. (See Figure 5-6.)
4. Remove and reconfigure A2B switch (2). Refer to Figure 6-12.
5. Stow A2B weight and chain (3) for future re-installation.



8850-5 **FIGURE 5-6**

6. Secure remote control to platform control station mounting bracket (4).(See Figure 5-7).

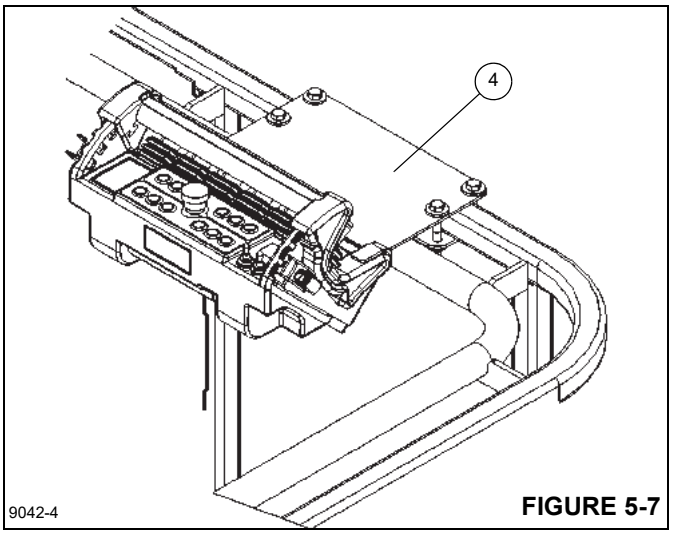


FIGURE 5-7

7. Connect footswitch harness to A2B harness connector (5) at tip of boom nose.

NOTE: In order to operate remote controller from ground position during platform configuration only, disconnect footswitch harness connector (5) at tip of boomnose.

CAUTION

Use caution when operating platform remote controller from ground position with footswitch disconnected To avoid serious injury.

8. Configure RCL for aerial lift configuration matching “Setup:” on page 5-9.
9. Perform Pre-start Inspection And Test, (Reference “Pre-Start Functional Test” on page 9-2) of Aerial Lift Platform Controls.

Operating Mode:

CAUTION

Boom tip attachment can contact jib in stowed position when boom is fully retracted. Contact can cause damage to boom extension system and jib stow system. Boom must be left extended .2m (.5 ft) to prevent contact. Boom attachment must be removed for retracted boom lifting operations.

DANGER

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.

1. Open gate and enter personnel platform and attach safety harness per operator manual instructions.
2. Verify that float selector is in raised/up position and brake selector is in clockwise (CW) position. This allows platform to rotate freely and remain level as it is raised to working position. See “Platform Brake Operation” on page 6-17.
3. Depress footswitch. See“Operator Presence Footswitch” on page 5-11.
4. Slowly move joystick, in desired function direction, until desired speed is obtained. (Reference Figure 5-8).
5. Immediately after platform is raised to working position, lock brake by following platform brake instructions. This prevents free-swing during operation.

Ending Operation Mode:

1. When operation is complete, return the aerial lift platform to ground level.
2. Remove and stow the radio remote transmitter from the platform controls station.
3. Detach safety harness and exit personnel platform per operators manual instructions.

Reconfiguration for Crane:

1. Configure the RCL for crane mode to stow the aerial lift platform.
2. Using remote controller, detach the aerial platform per platform mounting instructions.

NOTE: In order to operate remote controller from ground position during platform configuration, disconnect footswitch harness connector (5) at tip of boomnose.

CAUTION

Use caution when operating platform remote controller from ground position with footswitch disconnected to avoid serious injury.

NOTE:

3. Stow jib, unstow loadline(s) and reeve hookblock(s) and A2B weight(s) as needed.
4. Stow aerial lift platform and place boom in boomrest.
5. Turn remote power switch OFF and then press Radio Remote Transmitter's Emergency STOP switch to turn OFF transmitter.
6. Stow outriggers using ground control stations.
7. See Operators Manual for securing instructions.

Operator Presence Footswitch

An integral part of the Platform Control system is the Operator Presence Footswitch. The footswitch is permanently located on the aerial lift work platform floor. This feature makes it necessary to depress the Operator Presence Footswitch to allow operation of the Platform Controls.

DANGER

To avoid serious injury Do Not remove modify or disable the operator presence footswitch by blocking or any other means. Always keep work platform floor clean and free of debris which may interfere with operator presence Footswitch operation.

NOTE: In order to activate the Platform Controls the red Emergency Stop button must be pulled to activate the radio remote transmitter.

If a platform function is not activated within 10 seconds, the platform controls are deactivated. The operator must step off the operator presence footswitch, then depress it again to activate the platform controls. (Reference Figure 5-8).

FIGURE 5-8

Operator Feedback Screen

The LCD screen on the platform controls aides in operation by displaying important information that can be toggled to monitor the current configuration of the controls and the operating state of the aerial lift. Figure 5-9 shows a sample screen with the various icons that can be displayed in real time on the screen and how to interpret this information.

Operator Feedback Screen

Item	Symbol/Icon	Function	Description
1	Figure 5-9	Battery indicator	Real-time display of the rechargeable battery. Audible alarm on the platform controls will indicate when critically low battery level.
2	Figure 5-9	Signal strength	Signal strength of the wireless communication between the wireless receiver and the transmitter.
3	Figure 5-9	Wireless Channel	Indicates the current channel being used for the wireless transmission.
4	Figure 5-9	Status	Indicates the operational status of the remote system, software version, etc.
5	Figure 5-9	RCL info display	This area shows all available RCL info and can be toggled using the button matching the symbol shown here (Reference item 24 in Radio Remote Transmitter).
6	Figure 5-9	Main Hoist Enabled & speed selection	Shown when the Main Hoist is enabled. If high-speed mode is selected, a rabbit icon is beside the hoist icon.
7	Figure 5-9	Aux Hoist Enabled & speed selection	Shown when the Aux Hoist is enabled. If high-speed mode is selected, a rabbit icon is beside the hoist icon.
8	Figure 5-9	Aux pump	Shown when the Aux Pump circuit is turned ON. Shown FLASHING for 2 minutes after use to allow the pump to cool.
9	Figure 5-9	Aerial Work Platform	Shown to indicate that the RCL has been setup in an aerial mode and communicating with the platform controls.
10	Figure 5-9	Footswitch	Shown as a FLASHING icon when in Aerial Work Platform mode but the switch is not depressed. Icon disappears when the footswitch is depressed. Functions must be activated within 10 seconds of depressing the footswitch or this will timeout and the icon will again FLASH.

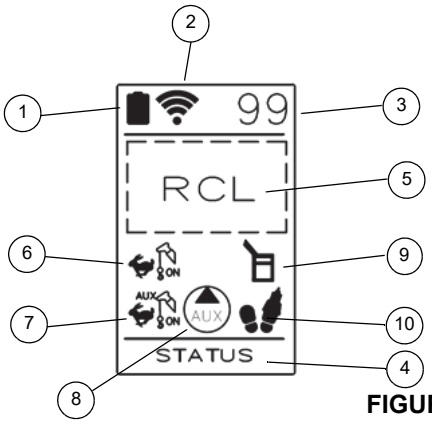


FIGURE 5-9

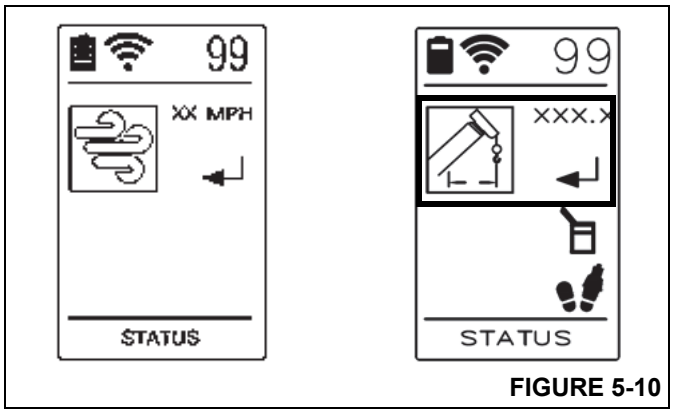


FIGURE 5-10

RCL Information Screen Example (Radius)

Item	Symbol/Icon	Function	Description
1	USAGE XXX%	Aerial Reach Utilization	Actual percent of max usable platform reach being used (%).
2	XXX.X	Radius	Actual radius (feet) from centerline of rotation to the center of the boom nose lower sheaves.
3	XXX.X	Boom Length	Actual extended boom length (feet) from center of boom pin attachment to the rope groove of the boom nose lower sheaves.
4	XX.X	Boom Angle	Actual boom angle (degrees).
5		Windspeed	Displays windspeed force at boom tip

RCL Display

The RCL display (5 Figure 4-3) is for the Rated Capacity Limiter (RCL), see operating instructions and screen displays in this manual.

The RCL provides the equipment operator with the information required for the equipment to perform safely within its design parameters. The RCL displays information on length and angle of boom, platform height, and platform reach.

The RCL continuously monitors these parameters and provides the operator with an updated readout of the equipment status. If an operational limitation condition is approached, the RCL warns the operator with an alarm and locks out the equipment functions that can aggravate the situation.

DANGER

The RCL aids the operator when properly programmed with the proper equipment configuration. To prevent injury or death to personnel, be sure the RCL is programmed before equipment operation.

RCL Check

Perform the following checks to verify proper RCL operation.

- Check that the display of the main boom length agrees with the actual boom length.
- Check that the display of the main boom angle agrees with the actual boom angles.
- Check that the display of the platform reach of the equipment agrees with the actual reach.

DANGER

A deviation between displayed and actual values indicates a malfunction and a RCL service representative shall be called for repair and/or recalibration of RCL system.

Radio Remote/Aerial Power Switch

Operation of the aerial lift is controlled by the radio remote controller, (Reference *Radio Remote/Aerial Power Switch (if equipped)*, page 4-10). To operate the controller, the remote/aerial power switch (19) located on the cab overhead console (Figure 4-3) must be activated. The crane control power switch (20) must be turned OFF. The Operator Cab/Ground Control Ignition Switch (13) and chassis igniton must all be OFF.

NOTE: When the radio remote control is activated, all crane ground controls will be deactivated.

Reach Diagram

The *Load Chart/Reach Diagram* is located in a pocket in the ground station control cab. A reach diagram decal is located on the aerial work platform. The *Reach Diagram* contains platform reach, platform height, and important information regarding allowable platform operating configurations.

Hydraulic Tool Circuit - Option

Hydraulic Intensifier Valve

The hydraulic intensifier valve is compatible with high pressure hydraulic equipment to meet most tooling requirements. It provides a single/double acting 3-way control (Advance, Neutral, and Retract) valve direct from high pressure source and allows return oil to bypass the hydraulic intensifier and return to tank line. Reference 9828221048 Valve Intensifier manual.

Hose Installation

1. Ensure power is *OFF* and oil has cooled.
2. Ensure valve is in *Retract* position.
3. Connect hose to hydraulic supply.
4. Connect hose to *Pressure Port* on valve, then connect to *Port* on tool.

Disconnecting hose

1. Turn Off hydraulic source
2. Ensure valve handle is in *Retract* position and oil has cooled before disconnecting.
3. Disconnect hose from valve before disconnecting tool.
4. Disconnect pressure hose from *pressure "P"* port on valve.
5. Disconnect *Return* hose from return "T" port on valve.
6. Disconnect hose from *Return* port (*Tank*) on source.
7. Install dust caps on all connectors to prevent dirt and contaminants from entering hydraulic system.

DANGER

Failure to comply with these warnings may result in severe bodily injury. Do not connect or disconnect tool, hoses, or fittings while tool is running, hot, or under pressure. Serious injury or burns could result.

Operation

1. Ensure valve is in *Retract* position before initiating hydraulic power source.
2. Activate valve by moving handle to left in the *Advance* position. The tool operation will begin immediately.

NOTE: Moving handle to *Hold (center)* position will stop tool action allowing for confirmation and repositioning as needed. When relief valve popping occurs, desired pressure has been achieved and operation should be complete. Repeat as necessary.

NOTE: Holding valve handle in *Advance* position after relief valve has popped will cause unnecessary wear on relief valve and pump assembly.

3. Move valve to *Retract* and allow tool to return fully.
4. Valve should be in *Retract* position when not in use.

Equipment Familiarization

All members of the crew should become familiar with the location and operation of the controls, the correct operating procedure, the maximum working range, and the Safety Precautions in manual. Carefully follow the operating procedures outlined below and the information in the *Load Chart/Reach Diagrams*. Wear approved personnel fall protection equipment and attach lanyard to the anchor provided when working at elevated heights. Falling from any elevation can result in death or serious injury.

HOIST SYSTEM OPERATION

Hoist operation is not permitted in Aerial Lift Mode.

Refer to See “Hoist System Operation” on page 4-19..

WORK SITE LOCATION

Select a location that is firm, level, and dry. Avoid uneven, rocky or muddy terrain, steep grade or locations with overhead obstructions. The outrigger stabilizers must be supported on a firm level surface at the fully extended positions. Avoid overhead power lines.

Before Leaving the Chassis Cab

- Position the equipment so that the outriggers can be extended with no obstructions.
- Position the chassis transmission to neutral.
- Set the chassis park brake. Wheel chocks may also be required.
- Engage the power takeoff.
- Turn the chassis cab ignition switch to OFF.

Before Performing the Aerial Lift

- Set the outriggers as described in the *Equipment Level Indicators*, page 5-2 section in this manual.

DANGER

Tipping Hazard!

Serious injury or death could result from improper set-up on outriggers. Ensure outriggers are properly set and equipment is level per operator manual.

- Program the RCL as specified in the Operator Manual which is located in the crane cab.
- Check all controls for proper operation. If any abnormal operations are detected, the condition must be corrected before continuing.
- Check the work area for electric power lines.

DANGER

Chassis must be in neutral when starting engine from ground control to avoid sudden potential movement of chassis.

Pre-use Inspection

Prior to placing the equipment in operation each day at start of work shift, do a complete walk-around visual inspection and look for structural damage, loose components, leaks, or other conditions that requires immediate correction for safe operation. The following checklist of items are suggested to ensure the aerial lift is prepared for performing work operations. Check the following:

- unusual conditions such as pools of hydraulic fluid or lubricating oil under the chassis.
- outrigger which may have crept down or up.
- any signs of damage or improper maintenance.
- tires are inflated to the proper pressure.
- level of the hydraulic reservoir.
- operation of the “stop” and horn circuits.
- missing and loose bolts.
- damaged structural members and welds.
- no visible damage such as dents or cracks.
- hydraulic hoses and fittings are in good condition and show no signs of leaking. The hoses should be free from cuts and abrasions and there should be no evidence of binding. Any damage or leakage should be repaired immediately.
- electrical wiring connecting the various parts of the system for physical damage.
- battery condition.

Aerial Lift Platform Controls

- remote control attached to platform railing mount.
- proper function of platform controls.
- switches/levers return to neutral and properly secured.
- no loose or missing parts.
- no visible damage such as dents or cracks.
- decals, placards and control markings are secure and legible.
- RCL system for proper operation.

Aerial Lift Platform Attachment Structure

- no loose or missing parts.
- no visible damage such as dents or cracks.
- platform leveling cylinder.
  - properly lubricated.
  - attachment pins secure.
  - no visible damage or leakage.
  - no evidence of debris or obstructions.
- operator footswitch and wiring.

NOTE: Consult the chassis manufacturer's manual for vehicle checks.

Function Check

Start aerial lift to perform following function instructions:

- set-up aerial lift for operation.
- deploy outriggers.
- cycle each aerial device for operation through complete range of motion.
- check functionality of emergency controls.

Pre-start Functional Test

Functional test of all systems and functions of the aerial lift must be performed after the pre-start inspection is completed and using appropriate personal protection equipment.

- properly set up aerial lift on outriggers.
- check all aerial lift functions controlled by the ground controls.
- using the platform control station check all aerial lift functions controlled by platform controls.
- platform footswitch/ground controls enable system.
  - verify boom functions - lift, telescope and swing - will NOT function unless footswitch or ground enable systems are activated.
  - verify boom functions - lift, telescope and swing stop immediately upon release of the footswitch.

COLD WEATHER OPERATION

Equipment should have appropriate hydraulic oil, lubricants, and other auxiliary items required for operation in temperatures below -9°C (15°F). Operate individual equipment functions to ensure they are sufficiently warmed prior to performing a lift.

Operation of equipment at full rated capacities in temperatures between -9°C (15°F) and -29°C (-20°F) should be accomplished only by competent skilled operators who possess the skill, experience, and dexterity to ensure smooth operation. Shock loading shall be avoided.

NOTE: Aerial Lift operation below -29°C (-20°F) is not recommended.

Reference *Cold Weather Operation*, page 4-14 for additional information.

EQUIPMENT WARM-UP PROCEDURES

Properly warm the different equipment components before operating the equipment. Before starting the equipment, ensure the appropriate lubricants are used to provide lubrication for the prevailing ambient temperatures in which the equipment will operate, Reference *Crane Warm-up Procedures*, page 4-14 for additional information.

STOWING AND PARKING

DANGER

Tipping Hazard!

Never park the equipment near holes, or on rocky or extremely soft surfaces. This may cause the equipment to overturn.

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

When parking, the equipment should be left in the smallest, most stable, valid operational configuration that the job site practically allows, do the following:

1. Park the equipment on a stable surface.
2. Exit the platform and remove the payload.
3. Stow the swingaway boom extension, if erected.
4. Fully retract the boom and position it in the normal travel position, then perform the following and proceed to Step 6:
   a. Engage the swing brake and/or swing lock pin.
   b. Retract all jack cylinders and outrigger beams.
5. If it is not practical to fully retract the boom and place it in the travel position, then perform the following and proceed to Step 6:
   a. Make the equipment as stable as possible, including, boom angle, superstructure orientation, jib angle, etc. In high winds, the boom and jibs should be lowered or secured.
   b. Engage the swing brake and/or swing lock pin.
6. Apply the parking brake.

7. Put all operating controls in the neutral position.
8. Position the Radio Remote/Aerial Power Switch (19) (Figure 4-3) to OFF.
9. Shut down the engine following the proper procedures specified in this manual and the applicable engine manual.
10. Remove the keys.

CAUTION

To avoid possible engine fault codes and undesirable operation, ensure the keyswitch has been off 2 minutes before disconnecting batteries.

11. Disconnect batteries, if equipment will be inactive for over 24 hours.
12. Close and lock all windows, covers, and doors.

Unattended Equipment

DANGER

Tipping Hazard!

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

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

The configuration in which the equipment should be left while unattended shall be determined by a qualified, designated individual familiar with the job site, configuration, conditions, and limitations.

PREPARATION FOR JOB-SITE TRAVEL

The aerial lift may be transported on a limited basis on a job-site with the platform attached to main boom nose only. The boom **MUST** be in the boom rest, and fully retracted.

DANGER

Do not travel with aerial work platform attached to the jib to prevent damage to equipment. Failure to comply with these instructions may cause death or serious injury.

If the jib is stowed on the side of boom, caution must be taken to avoid contact between the platform mounting bracket and the jib attaching pin holes.

Ensure the sheave case is properly secured to the attachment point on the truck chassis bumper. The amount of front or rear bumper overhang varies from state to state. Check your state requirement and ensure this limit is not exceeded.

CAUTION

Disengage the hydraulic pumps for extended traveling, cold weather starting, or engine checks.

Check cold tire pressure prior to extended travel. Refer to tire inflation on equipment.

CAUTION

Machine Damage Hazard!

Fully retract the outrigger jacks and properly store the floats.

1. Ensure the aerial work platform is properly stowed and secured or removed from equipment.
2. Ensure the swingaway, if so equipped, is properly stowed and secured or removed from equipment.

DANGER

Do not travel with swingaway erected to prevent damage to equipment.

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

3. Retract and place the boom in boom rest.
4. Ensure the single front outrigger is fully retracted, if equipped.
5. Ensure the outrigger beams and jacks are fully retracted and secured with the floats properly stowed.
6. Engage the travel lock at each outrigger beam (if equipped).
7. Engage the swing brake.
8. Engage the swing lock.
9. Ensure the A2B weight is properly secured.

SHUT DOWN AND PREPARATION FOR ROAD TRAVEL

CAUTION

Disengage the hydraulic pumps for extended traveling, cold weather starting, or engine checks.

Check cold tire pressure prior to extended travel. Refer to tire inflation on equipment.

CAUTION

Machine Damage Hazard!

Fully retract the outrigger jacks and properly store the floats.

1. Ensure the aerial work platform is properly stowed and secured or removed from equipment.
2. Ensure the swingaway, if so equipped, is properly stowed and secured or removed from equipment.

DANGER

Do not travel with swingaway erected to prevent damage to equipment.

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

DANGER

Do not travel with aerial work platform attached to the boom or jib to prevent damage to equipment. Failure to comply with these instructions may cause death or serious injury.

3. Retract and place the boom in boom rest.
4. Ensure the single front outrigger is fully retracted, if equipped.
5. Ensure the outrigger beams and jacks are fully retracted and secured with the floats properly stowed.

CAUTION

Ensure outrigger beams are retracted and secured during travel.

6. Engage the travel lock at each outrigger beam (if equipped).
7. Engage the swing brake.
8. Engage the swing lock.
9. Ensure the A2B weight is properly secured.
10. Turn off the ignition and all other switches at the ground control.
11. Close and/or secure all windows and doors.
12. Exit the cab, lock the door, and stow the access ladder.
13. Secure any loads or lifting devices on chassis bed or body.
14. Ensure tires are properly inflated.
15. Disengage the Power Take Off (PTO) and start engine from the chassis cab.
16. Release the park brake before moving equipment.

SECTION 6
EQUIPMENT SET-UP

SECTION CONTENTS

This section contains information on how to perform the following tasks:

- Erect the jib.
- Stow the jib.
- Remove the jib.
- Use multi-part reeving.
- Install the hoist cable.
- Install the anti-two-block weight.
- Install a wedge socket.
- Counterweight.
- Aerial Platform Installation.

⚠ DANGER

Do not operate outriggers unless they are visible to either the operator or a designated signal person to avoid crushing injury.

JIB SAFETY INFORMATION

1. The anti-two-block (A2B) switch weight and cord must be attached to the jib when deployed.

2. Operate with jib by radius when main boom is fully extended. If necessary, increase boom angle to maintain loaded radius.

When radius is between points listed on capacity chart, the load shown at the next longer radius shall be used.

3. Operate with jib by boom angle when main boom is not fully extended. Do not exceed rated jib capacities at any reduced boom lengths.

When angle is between points listed on capacity chart, the load shown at next lower boom angle shall be used.

4. Ensure jib is stowed correctly (Figure 6-1):

a. Removal of swing around pins (C1, Figure 6-1), without proper installation of stow pin A and jib swing pin B, may allow jib to fall off.

b. Extending boom with jib stowed and failure to remove swing pins (C1, Figure 6-1), will damage unit upon extension.

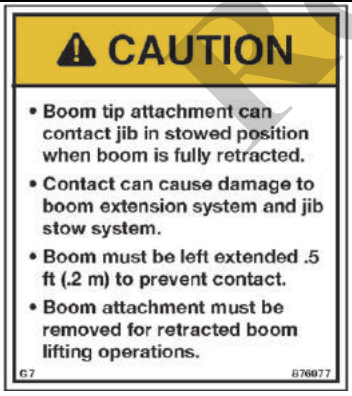
5. Only swing jib into working or stowed position when boom is horizontal, stow pin (A, Figure 6-1) and jib swing

pin B, are removed and swing pins (C1) are in place. Jib could swing uncontrollably if boom is not horizontal.

6. Equipment shall be fully set up according to proper set-up procedures outlined previously when stowing or unstowing jib.
7. Operate boom and swing functions very slowly and carefully when using jib since jibs can increase boom length by 50%.
8. Area where jib swings around must be clear of obstructions and power lines when stowing and unstowing jib.
9. Use safety glasses when pounding pins with hammer.
10. Do not extend/retract boom unless boom is horizontal when stow pin (A, Figure 6-1) and jib swing pin (B) are removed during stowing or unstowing procedures.
11. Always put spring clips in pins to ensure that they will stay in place.
12. When the jib is stowed, the boom can not be fully retracted if a boom tip attachment option is installed.

CAUTION

Boom tip attachment can contact jib in stowed position when boom is fully retracted. Contact can cause damage to boom extension system and jib stow system. Boom must be left extended .2m (.5 ft) to prevent contact. Boom attachment must be removed for retracted boom lifting operations.



Also, on manually extendable jib options:

1. Extension retaining pin (E) must always be installed when operating.
2. All swing around (stow and unstowing) operations shall be done with jib retracted and pinned.
3. Extendable section may slide out of 1st section jib when pin (E) is removed. Keep personnel clear of area.

JIB OPERATION

Deployment Procedure

1. Using boom telescope function, fully retract boom.
2. Using lift function, lower boom so that jib deployment pins (C1, Figure 6-1) and (C2, Figure 6-1) are easily accessible from the ground.

NOTE: When lowering the boom below horizontal, the operator may require the aid of an assistant while operating the controls to retract the boom. With the telescope control in neutral, the boom may creep out when below horizontal.

3. Install pins (C1, Figure 6-1) in upper and lower jib ears and secure with retainer spring clips. These pins are used as a pivot point to swing jib into the deployed position.

NOTE: A slight hammer strike may be necessary to install pins. Always use proper eye protection during this step.

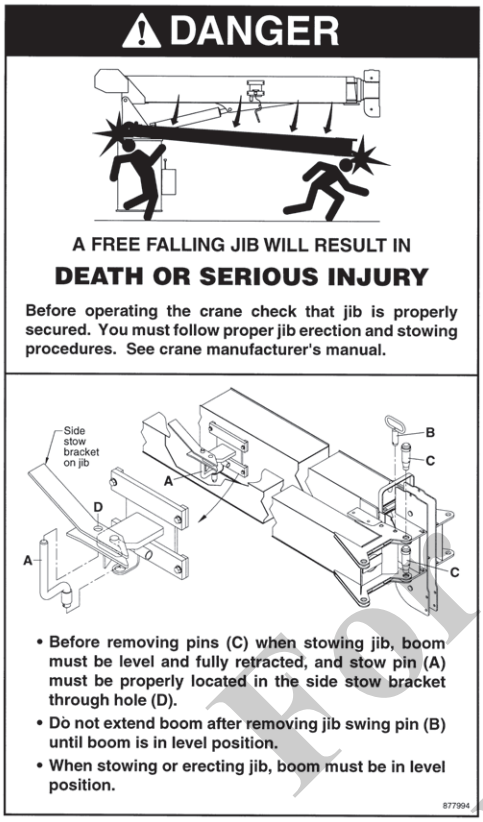
4. Locate the stowed position of pins (C2, Figure 6-1). If in jib attachment holes or boom sheave case jib holes, remove pins from storage location.
5. Remove jib swing Pin (B, Figure 6-1) from top ear of jib.
6. Remove stow Pin (A, Figure 6-1) and stow in hook bracket (D), secure with spring clip.
7. Attach tag line to sheave case end of jib.
8. Using the lift function, raise the boom to the horizontal position.
9. Using telescope function, slowly extend boom approximately one foot. This procedure will pull the jib out of the jib stow bracket (H,Figure 6-1).

CAUTION

Use caution during this step. The jib is free to swing away from the boom upon boom extension.

10. Using tag line, swing jib into deployed position.
11. Remove cable keeper pins from boom sheave case and jib. Remove hook block. Pivot jib slightly to allow for loadline to be removed from boom sheave case. Remove loadline from boom sheave case and place in an area to minimize possible damage.
12. Pivot jib into place, visually aligning the upper (C2, Figure 6-1) pin holes. Install upper (C2) pin and spring clip.

NOTE: A slight hammer strike may be necessary to install pins. Always use proper eye protection during this step.



13. Use the jib jack (F, Figure 6-1) to align lower (C2) pin.

- **a.** Remove the jack handle (G, Figure 6-1) from the boom stowage bracket and check that the jack release valve is closed.
- **b.** Extend the jack (F, Figure 6-1) so that the lower (C2) pin holes are aligned.
- **c.** Install the lower (C2, Figure 6-1) pin and spring clip.
- **d.** Open the jack release valve and retract the jack (F, Figure 6-1.

14. Using hoist function, un-spool enough loadline to reeve loadline over jib sheave case. Keep slight tension on loadline to avoid bird caging of loadline on hoist drum.

15. Route loadline over jib sheave and install keeper. Install line block to end of loadline.

16. Remove anti-two-block switch and weight/chain assembly and install on jib tip, see Figure 6-10. Be certain to use keeper provided with switch.

17. Disconnect anti-two- block cord going to boom anti-two-block switch and attach to quick coupler on jib anti-two-block wire on rear of jib between the upper and lower jib ears.

18. Install jib swing pin (B, Figure 6-1) and spring clip into jib ears.

19. For manually extendable jibs, pull extension retaining pin (E, Figure 6-1), and extend second section out by pulling on sheave case. The second section jib, as it extends, will hit a mechanical stop that allows for extension pin (E) installation. Install pin (E) and spring clip.

20. Make ATB cord connections as required.

Stowing Procedure

Depending on the length of the jib extension being used; the equipment can be equipped with either a two section or one section jib. Certain stowing instructions may only be applied to one or the other.

DANGER

Visually check all pin positions when stowing the jib and ensure the jib is fully engaged into the side stow brackets, jib stow attachment is secure, and all pins and spring clips are in their proper locations. Failure to properly secure the jib during stowing and erecting may allow the jib to fall. Serious personal injury or death could result.

When jib is stowed, do not remove stow pin A unless both C1 pins are properly in place through mating holes on the boom.

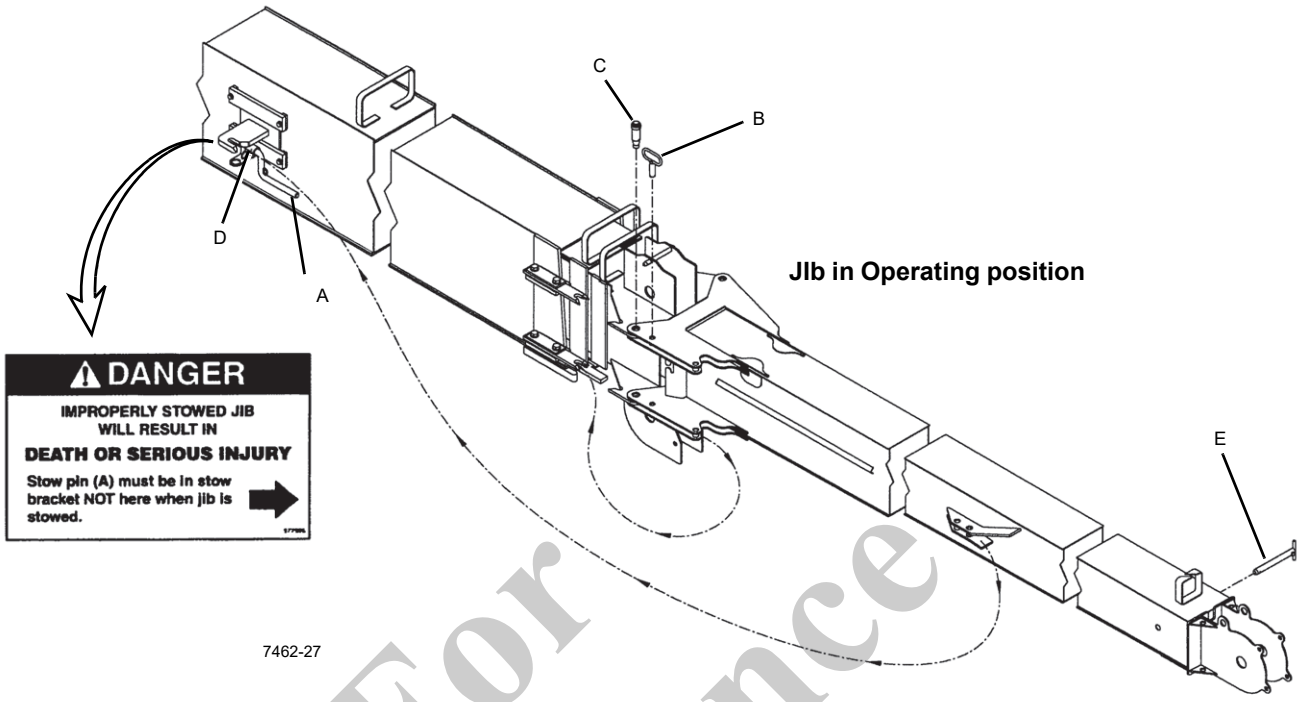
Always have at least one, if not both of the following in place at all times:

- Side stow bracket must be completely engaged into stow hook with stow pin A properly in place.
- Both pins C1, Figure 6-1 in upper and lower jib holes must be properly in place through mating holes on boom tip.
- Do not remove C1 pins from boom nose unless jib is properly stowed and stow pin A is properly engaged and secured.

1. Using lift function, lower boom so that jib deployment pins (C1, Figure 6-1) and (C2, Figure 6-1) are easily accessible from the ground.

NOTE: When lowering the boom below horizontal, the operator may require the aid of an assistant while operating the controls to retract the boom. With the telescope control in neutral, the boom may creep out when below horizontal.

2. Two section jib - For manually extendable jibs, pull extension retaining pin (E, Figure 6-1) and fully retract extendable 2nd section jib into the 1st section. Retraction of 2nd section may be facilitated by attaching loadline wedge socket to jib nose. Slowly activate the hoist up function until the 2nd section is fully retracted.



Jlb in Operating position

A	Stow Pin
B	Jib Swing Pin
C	Jib Deployment Pins
D	Hook Bracket
E	Extension Retaining Pin
F	Jib Jack
G	Jack Handle
H	Jib Stowage Bracket

Jib in Stow Position

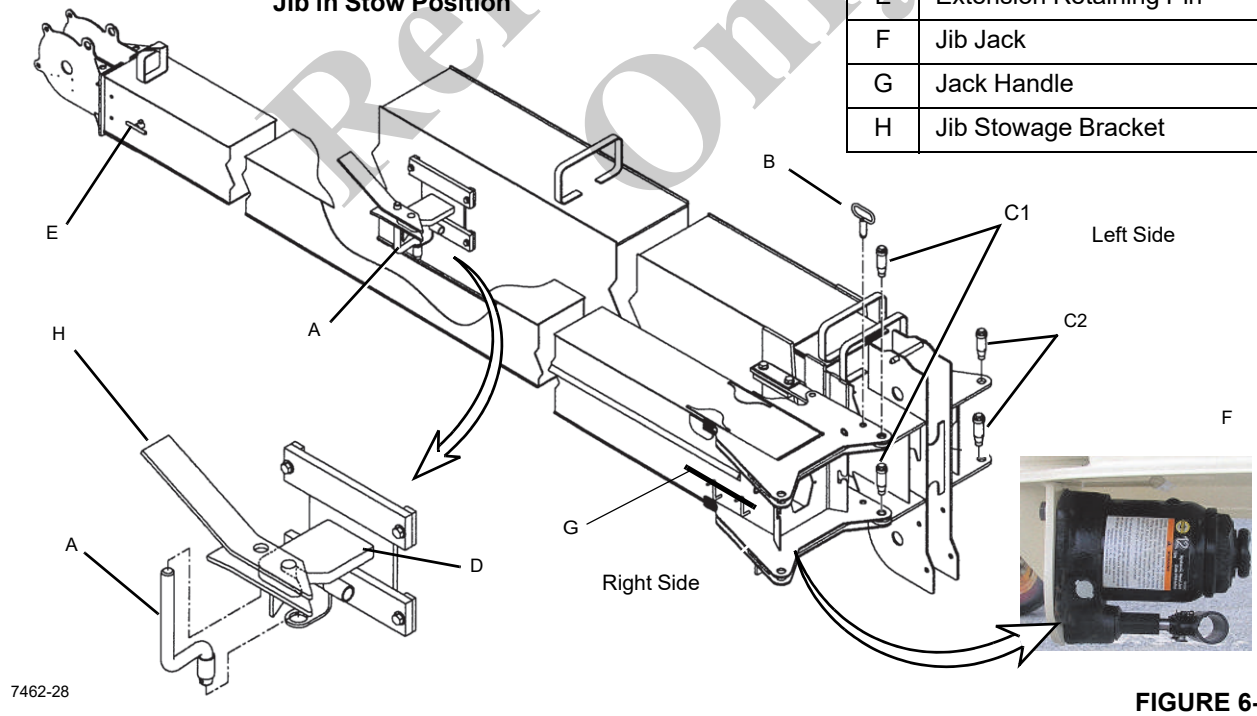


FIGURE 6-1

3. Two section jib - Install extension retaining pin (E, Figure 6-1 through the 1st and 2nd section jib assembly and install spring clip.
4. Remove loadline from jib sheave case. Place loadline in area to avoid possible damage from stow procedure.
5. Disconnect anti-two-block wire connector at rear of the jib extension. Re-connect anti-two-block switch connector on boom tip. Move weight/chain assembly to boom tip see Figure 6-10.
6. Attach tag line to sheave case end of jib.
7. Remove spring clips from pins (C2, Figure 6-1) on both upper and lower jib ears.
8. Remove jib swing pin (B, Figure 6-1) from the boom nose.
9. Remove pins (C2, Figure 6-1) from upper and lower jib ears. Do not remove (C1) pins at this time. C1 pins will be used as a pivot point to swing jib into stow position. A slight hammer strike may be necessary to remove pins. Always use proper eye protection during this step.
10. Raise the boom to the horizontal position.
11. Extend boom approximately 1 foot (.3m).
12. Using tag line attached to jib sheave case, slowly swing jib into stow position (parallel with 1st section boom), Pins (C1, Figure 6-1) are the jib pivot points during this operation.

CAUTION

Use caution when swinging jib to avoid unnecessary impact with 1st section boom.

13. Install jib swing pin (B, Figure 6-1) with spring clip through jib ear and boom sheave case holes. This pin will keep the jib assembly in line (parallel) with the I st section boom.

NOTE: Jib swing pin (B, Figure 6-1) does not retain the jib in its stowed position on the I st section boom.

14. Using boom telescope function, slowly retract boom.

    The jib stow bracket (H, Figure 6-1) on the side of the jib will engage the side stow bracket (D) on the side of the 1st section boom; first lifting the jib and then engaging the jib side stow bracket (H) and the stow bracket (D) completely upon full retraction of the boom.
15. Install stow pin (A, Figure 6-1) with spring clip into the jib stow bracket (H) on the jib. Complete engagement of stow brackets and proper installation of pin A is critical for secure jib stow attachment.
16. Remove pins (C1 Figure 6-1) from upper and lower jib ears.

NOTE: A slight hammer strike may be necessary to install pins. Always use proper eye protection during this step.

17. Reinstall loadline over boom sheave case.

JIB REMOVAL

Should jib removal from the boom become necessary, proceed as follows:

1. Unstow and swing jib into position on the boom tip according to Steps 1 - 10 in the preceding jib deployment section.
2. Using an assist crane, support and raise the jib at its balance point and remove the two swing around pins. Jib is now free of boom.
3. To install, proceed in reverse order of removal.

When the jib is stowed on side of crane, always leave the ram and handle sleeve of the jib jack pushed all the way down to reduce exposure to rusting.

Jib Maintenance

1. Lubricate as outlined in SECTION 5.
2. Check for free rotation of jib sheave daily when using jib.

ROPE INSTALLATION-HOIST

Synthetic Rope

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

Wire Rope

NOTE: The wire rope should preferably be straightened before installation on the hoist drum.

CAUTION

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

Install wire rope on the hoist drum in accordance with the following procedure.

1. Position the rope over the boom nose sheave and route to the hoist drum.
2. Position the hoist drum with the rope anchor slot on top.
3. Insert the rope through the slot and position around the anchor wedge (1) Figure 6-2.

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

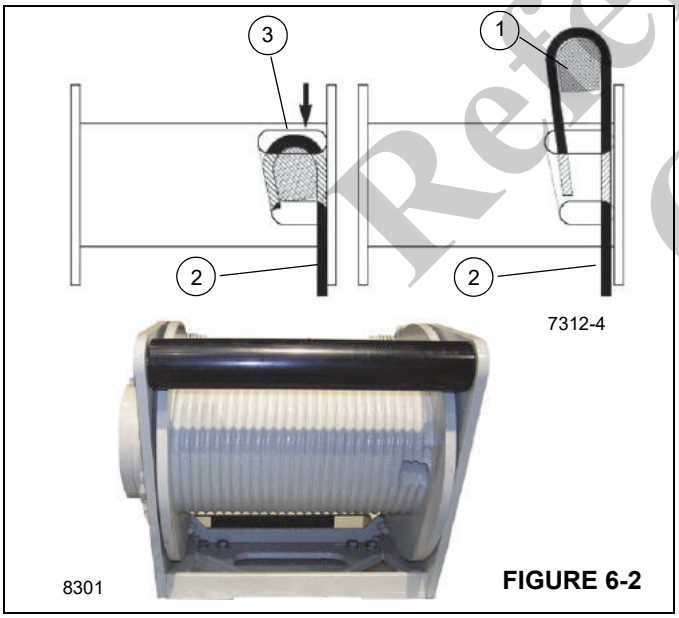


FIGURE 6-2

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

FIGURE 6-3

5. Slowly rotate the drum, ensuring the first layer of rope is evenly wound onto the drum.
6. Start winding the rope onto the hoist drum. Maintain about 250 kg (500 pounds) of tension on the rope.
7. Keep the rope wraps tight against each other when the first half of the bare hoist is filling. The second half of the hoist should wrap tightly because the fleet angle of the rope tends to pull the rope to the center of the drum thus wrapping tightly.
8. Continue winding the rope on the second, third and fourth layer of the hoist. Keep the rope paying in straight to the boom to avoid side loading the boom. The preceding layers will wrap smoothly guided by the first layer wrapping.
9. Install the remainder of the rope, as applicable.
10. Attach the wedge socket to the free end of the rope as shown in (Figure 6-5). If you are using a terminator wedge socket, see Figure 6-4.
11. Torque the clamp on the dead end of the rope to 95 ft-lb (128 Nm).

NOTE: The torque must be rechecked after the initial operation of the equipment. Be sure the clamp is attached to the dead end of the rope only.

MULTI-PART LINES

Multi-part line reeving enables greater loads to be lifted than can be lifted with single part line. However, loads are limited by the stability and structural integrity of the equipment. The load must be within the limits contained in the load chart. For detailed information concerning synthetic hoist rope, refer to K100™ Synthetic Crane Hoist Line Manual P/N 9828100734 available by contacting Manitowoc Crane Care.

Refer to “Multiple Part Line Reeving” 10-8 for additional information.

WEDGE SOCKETS

To install a wedge socket:

- Make sure the wedge socket is the proper size for the rope.

- Do not mix components of different wedge socket manufacturers.
- The wedge socket must meet the requirements of the wedge socket and wire rope manufacturers.

State and local laws may vary and require different attachment methods depending upon work conditions. The user is responsible for alternate attachment methods.

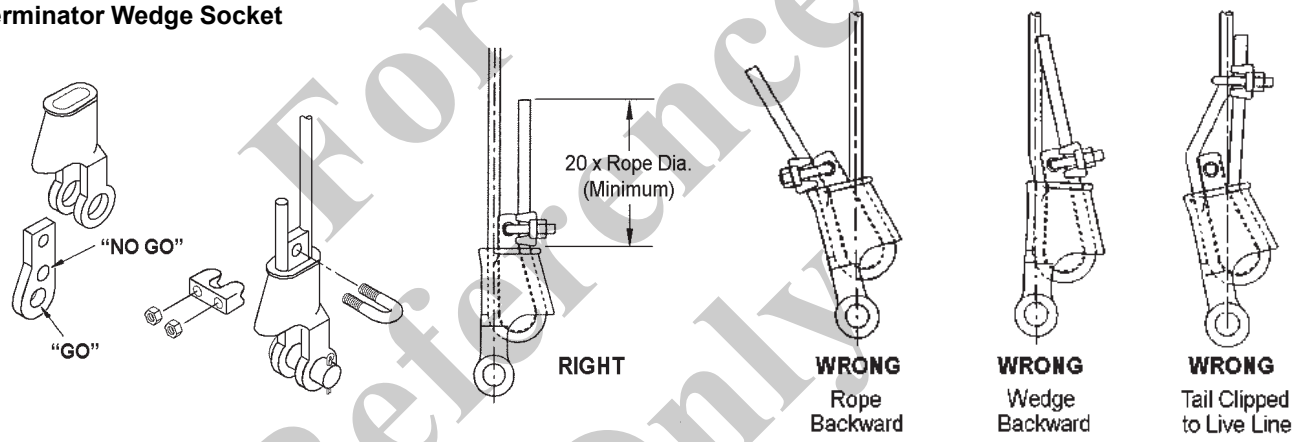
Terminator Wedge Installation

Terminator wedge socket is the preferred type of socket (Figure 6-4). Other wedge socket types are shown on page 6-7.

To attach a terminator wedge, use the following procedure:

1. Match the socket, wedge, and clip to the wire rope and size the rope with the go and no go hole in the socket.
   - The wire rope must pass through the “go” hole and not pass through the “no go” hole.
   - If the wire rope passes through the “no go” hole, the wedge is the wrong size.
   - If the wire rope does not pass through the “go” hole, the wedge is the wrong size.
2. Align the live end of rope, with center line of pin.
3. Secure dead end section of rope.
4. Tighten nuts on clip to recommended torque.
5. Do not attach dead end to live end or install wedge backwards.
6. Use a mallet to seat Wedge and Rope as deep into socket as possible before applying first load.

Terminator Wedge Socket



Torque Value Table

Rope Size (inches)	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1-1/8	1-1/4
Torque ft/lbs	45	65	65	95	95	130	225	225	225	360

Torque values shown are based upon clean dry threads free of lubrication.

FIGURE 6-4

Wedge Socket Installation

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 6-5) 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.

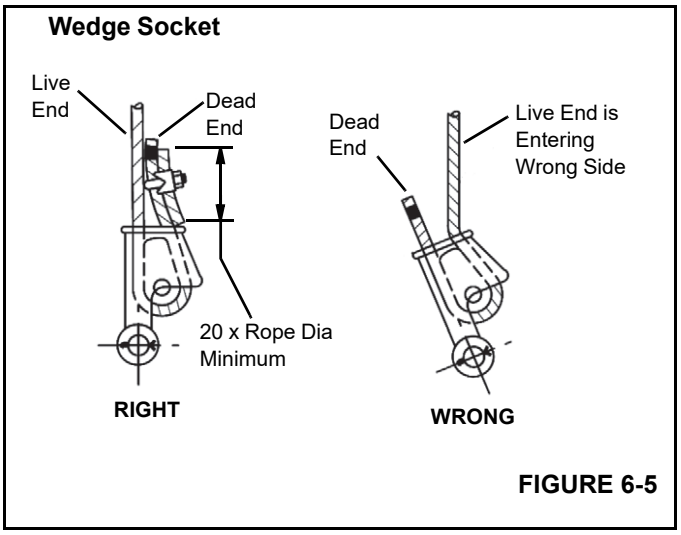


FIGURE 6-5

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 6-5) 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 equipment's hoist to first apply a slight 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 equipment 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 overhaul ball or hook block striking the ground, etc; refer to "Dead-end Rigging" 6-8.

Dead-end Rigging

Sketches A through F (Figure 6-6) 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 equipment transport and with the anti-two block system and other components during use of the equipment.

Of the methods shown below, Manitowoc 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 wedge. Typically, it is recommended that the tail length of the dead-end should be a minimum of 6 rope diameters but not less that 15.2 cm (6 in) for standard 6 to 8 strand ropes and 20 rope diameters but not less than 15.2 cm (6 in) for rotation resistant wire ropes.

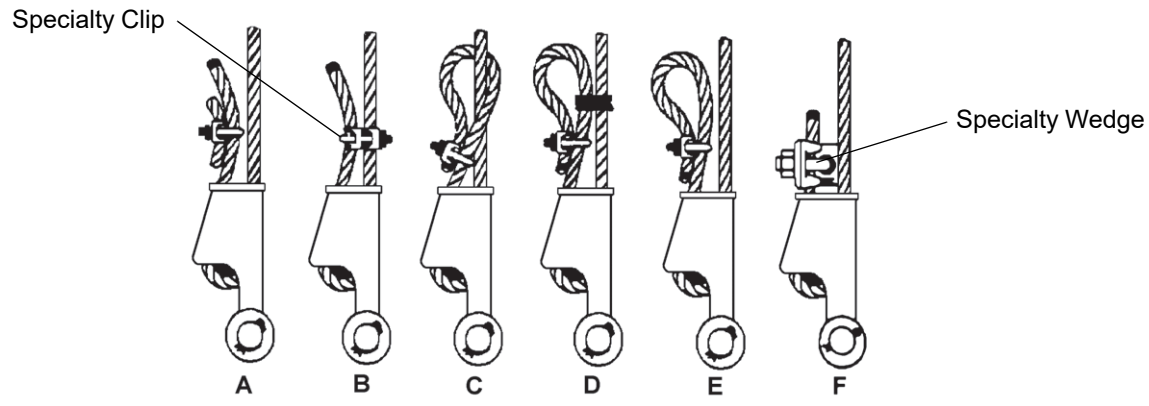
When using method A, place a wire rope clip around the dead end by clamping a short extra piece of rope to the rope dead end. DO NOT CLAMP THE LIVE END. The U-bolt should bear against the dead end. The saddle of the clip should bear against the short extra piece. Torque the U-bolts according to the table titled Wire Rope Clip Torque Values (Table 6-1).

Other sources for information with which equipment 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 cable ways, 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 equipment 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 6-1

Wire Rope Clip Torque Values			
Clip Sizes		Torque	
mm	Inches	Nm	lb-ft
3.18	1/8	6	4.5
4.76	3/16	10	7.5
6.35	1/4	20	15
7.94	5/16	40	30
13.28	3/8	60	45
11.11	7/16	90	65
12.70	1/2	90	65
14.29	9/16	130	95
15.88	5/8	130	95
19.05	3/4	175	130
22.23	7/8	300	225
25.40	1	300	225
28.58	1-1/8	300	225
31.75	1-1/4	490	360
38.68	1-3/8	490	360
38.10	1-1/2	490	360

Hoist Loadline Tie Down



Wedge Socket

FIGURE 6-6

HOIST ROPE TIE DOWN

Hoist Rope Tie Down - Boom Mounted Hoist

1. Remove the hook block (4, Figure 6-7) from the wedge socket (3) and feed the loadline rope back through the boom nose until the wedge socket (3) has cleared the boom nose.

NOTE: A single reeved hook block (4) is shown, your machine may be reeved differently.

2. Connect the wedge socket (3) to the boom tie down anchor peg on top of boom (1).

3. Slowly rewind the hoist loadline (2) until any remaining slack is removed and the loadline is snug.

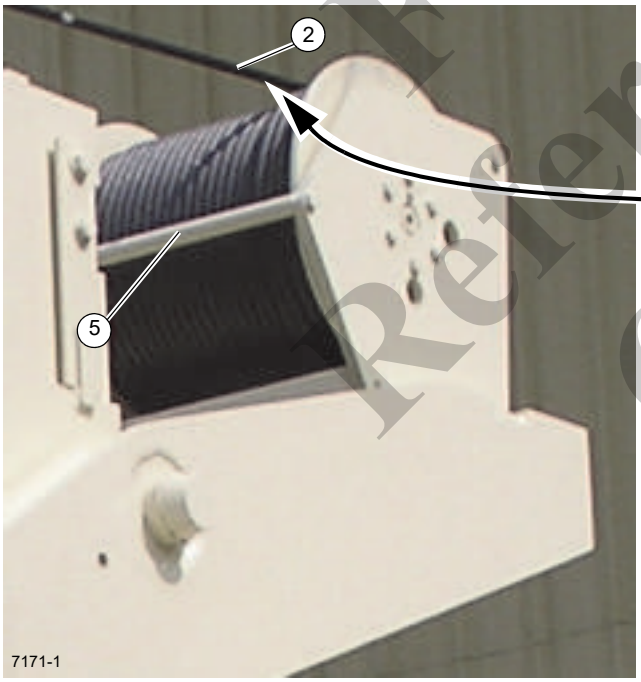


FIGURE 6-7

STOW PEGS FOR HOIST ROPE

This is the recommended stowage location for the hoist ropes and must be used when reconfiguring for Aerial Lift Platform use. Stow pegs located on top of the boom keep the hoist ropes secure when not reeved over the boom nose. The main hoist rope is stowed on the right peg and the auxiliary hoist rope is stowed on the left peg as viewed from the back of the boom.

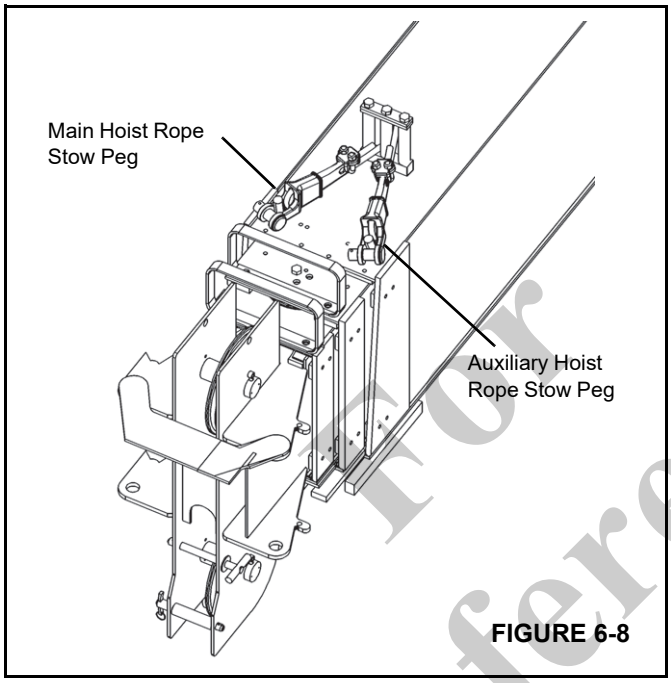


FIGURE 6-8

The hoist rope must be secured to the boom stow pegs. See the instructions for a boom mounted hoist “Hoist Rope Tie Down” 6-9.

A2-B WEIGHT INSTALLATION AND STOWAGE

To prevent the hoist rope from slipping out of the A2B weight, rig the weight as shown in Figure 6-9.

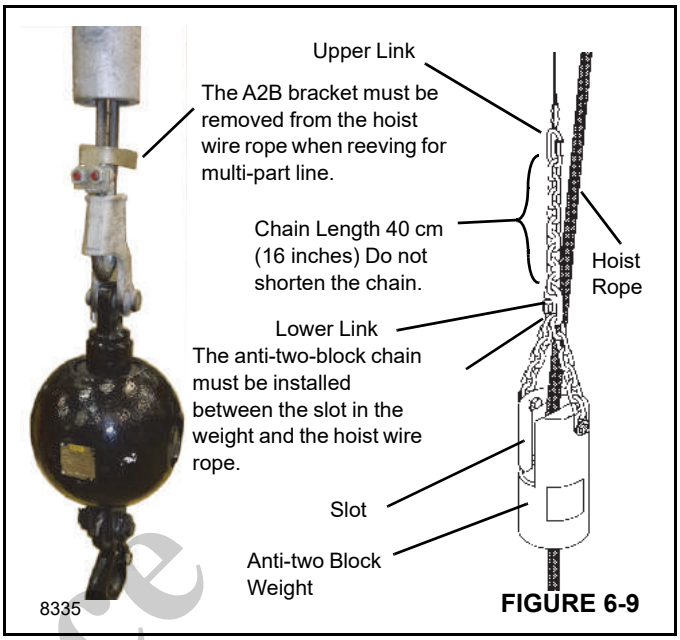


FIGURE 6-9

Wire Rope

The A2B bracket is for single part line with wire rope use only. Remove the A2B bracket shown in Figure 6-9 from the hoist wire rope when changing from a single part line to a multiple part line to allow the hoist wire rope and wedge socket to reeve through the sheaves on the boom nose and the hookblock. Re-install the clamp and nuts to the wire rope before performing a lift.

Synthetic Rope

Ensure the synthetic rope is rigged through the slot in A2B weight as shown in Figure 6-9. Do not use A2B bracket and wedge assembly when equipped with synthetic rope.

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

AERIAL LIFT PLATFORM

An Aerial Lift Platform is available for National Cranes. The platform can be attached to either the tip of the boom or the tip of the jib for the purpose of lifting personnel and their work equipment to elevated working heights. The occupancy rating is two person maximum.

NOTE: Where no capacity ratings are shown on the load chart,i.e. at below 0° boom angle, operation is allowable with the boom fully retracted.

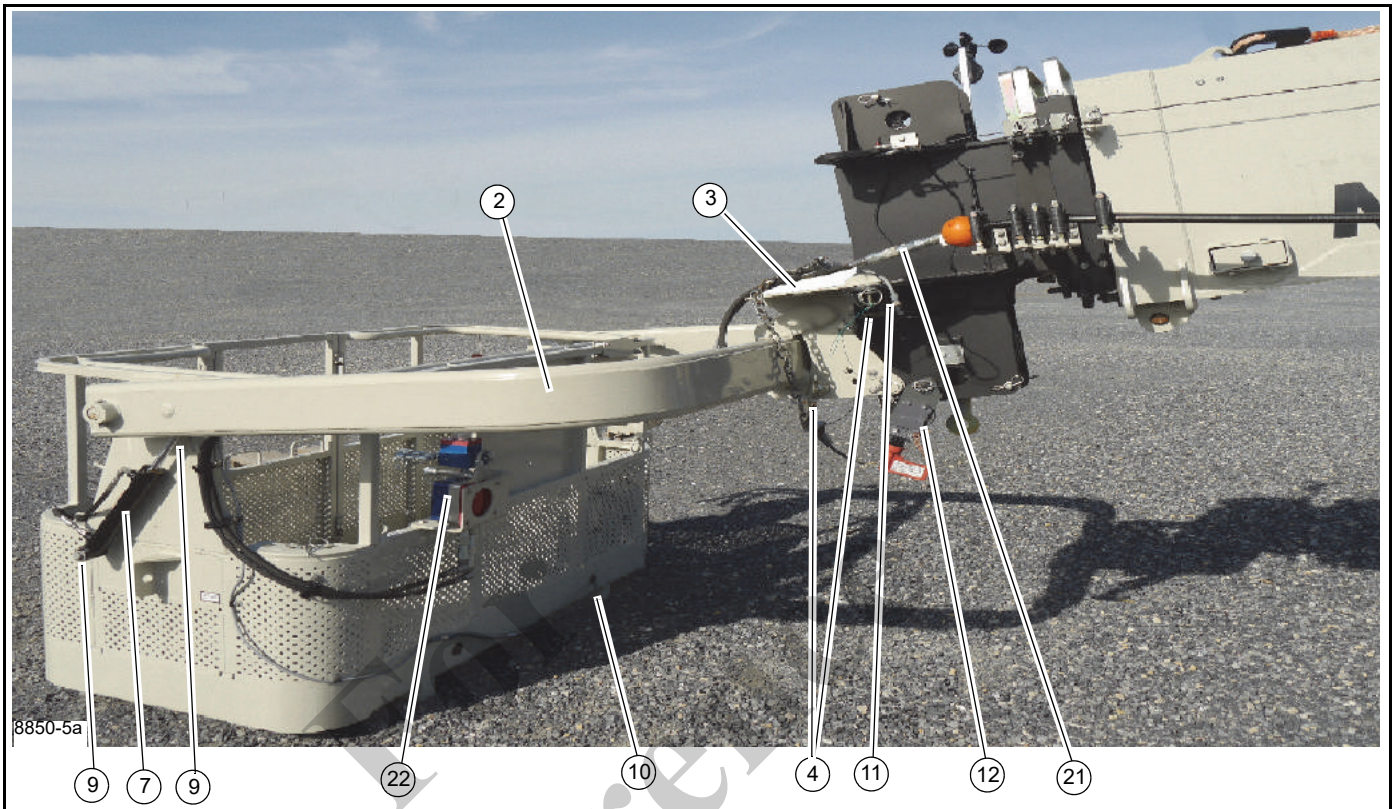
Hydraulic tools can be operated from the Aerial Lift Platform using the optional Hydraulic Power Intensifier (Figure 6-10). Reference 9828221048 Valve Intensifier manual.

The platform is equipped with a manually applied brake to keep platform from swinging when the platform is being loaded or after the desired work position is reached. The brake is intended to be disengaged when the platform is raised to the work position so that the platform hangs freely within 10 degrees of level until the work position is reached.

A gate is located at the front of the platform for ease of entrance and exit to the platform. The gate must be in the closed position when the platform is occupied.

A safety harness is required for the platform occupant and is secured to a harness attachment link located on platform.

Operation of the Aerial Lift Platform is controlled by the Radio Remote Controller.



Illustrations may appear slightly different than on crane

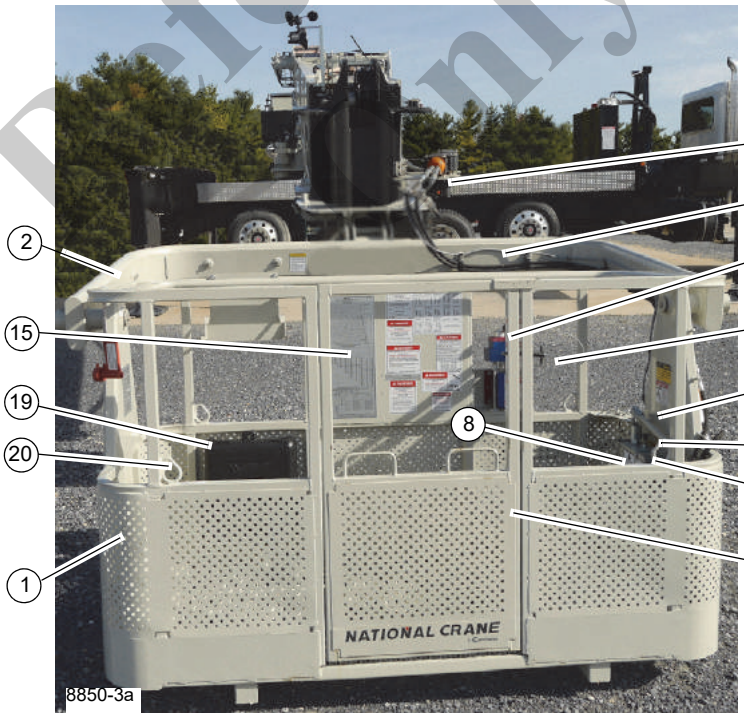


FIGURE 6-10

Item No.	Description
1	Platform
2	Yoke
3	Adapter
4	Attaching Pin
5	Gate
6	Gate Latch
7	Leveling Cylinder
8	Leveling Valve
9	Grease Fitting
10	Foot Switch
11	Foot Switch Harness
12	A2B Switch

Item No.	Description
13	A2B Weight
14	A2b Weight and Chain
15	Operation Chart
16	Float Selector
17	Brake Selector
18	Hand Pump
19	Manual Holder
20	Safety Harness Anchor
21	Quick Disconnect
22	Hydraulic Power Intensifier Valve (if equipped)

FIGURE 6-11

AERIAL LIFT PLATFORM INSTALLATION

Platform Mounting

Prior to mounting the platform to the boom or jib tip, the equipment must be properly setup to install the attaching hardware by doing the following:

1. Place platform assembly on level ground at an appropriate distance to allow attachment to the boom nose or jib.
2. Remove the anti-two-block (A2B) weight from the loadline (See Figure 6-12).
3. Stow and secure the A2B weight and chain in storage area or cab.
4. Override the A2B system with A2B flag.
5. Disconnect A2B harness connector.
6. Remove the hook block or downhaul weight from the load line.
7. Stow the end of the load line to either top of the boom or at the hoist depending on hoist mounting (See “Hoist Rope Tie Down” on page 9.)
8. Install the yoke adapter to tip of the boom or jib. See “Platform Quick Attachment” on page 15.
9. Attach the platform to the tip of the boom or jib. See Figure 6-10.

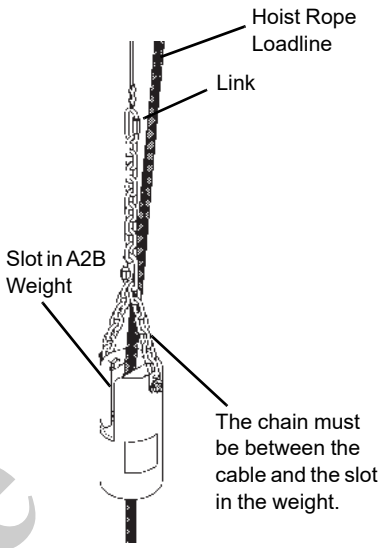


FIGURE 6-12

Platform Quick Attachment

The platform assembly uses a three point quick attaching system to attach the platform to the tip of the boom or jib. See Figure 6-13.

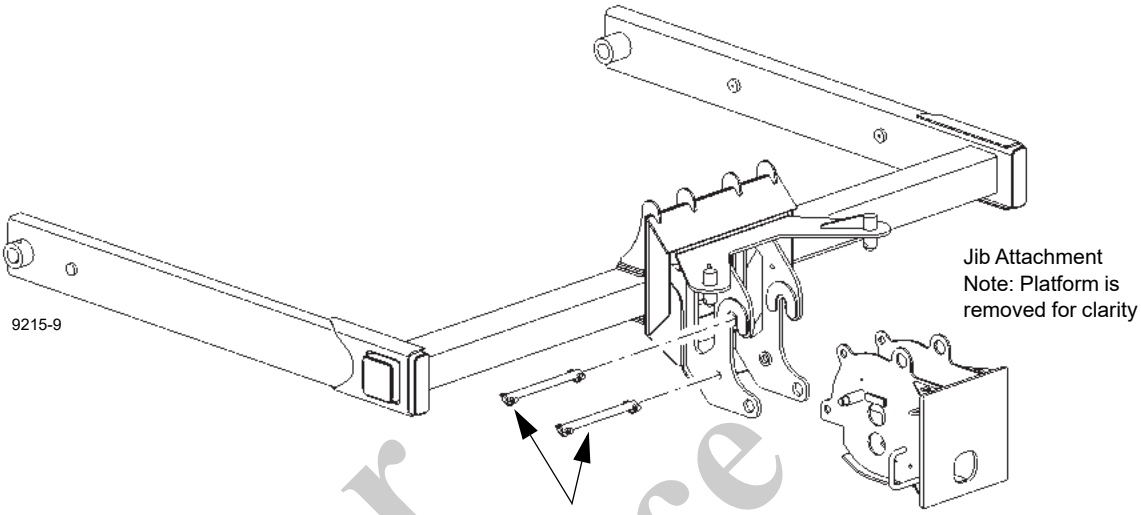
1. Reference (“Jib Operation” 6-2) for jib configuration prior to attaching aerial platform to jib.
2. For platform attachment to boom, remove and stow the jib deployment pin (If equipped with a jib) from the lower ear on the boom nose.
3. Extend boom in order to dis-engage boom from jib attaching point.
4. Position the required platform attaching hardware on either the tip of the boom or jib.

CAUTION

Keep hands, fingers and body parts clear of the mounting attachment points. Serious bodily injury may result

5. Insert pins through the hole in the attaching hardware.

Platform Attachment - Boom and Jib



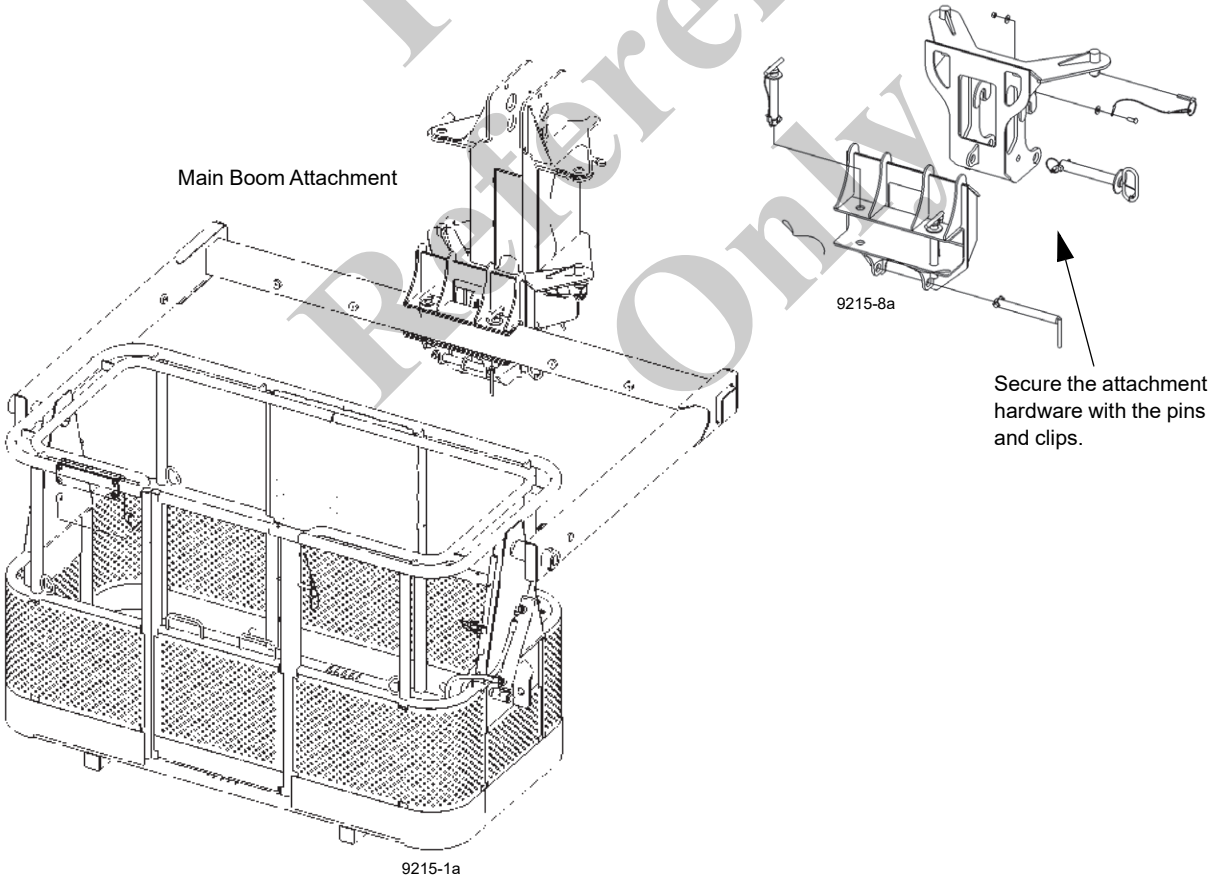


FIGURE 6-13

⚠ CAUTION

- **Boom tip attachment can contact jib in stowed position when boom is fully retracted.**
- **Contact can cause damage to boom extension system and jib stow system.**
- **Boom must be left extended .5 ft (.2m) to prevent contact.**
- **Boom attachment must be removed for retracted boom lifting operations.**

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Platform Mounting and Installation

The following operating instructions explain how to raise the platform assembly to the level necessary to attach the platform adapter to the boom nose.

1. If the platform yoke is raised higher than required during installation, it can be lowered by *SLOWLY* pulling up on the float selector (1, Figure 6-15). Use caution when lowering the yoke in this manner. Pulling the float selector (1) out to fast and to far will lower the yoke at a very fast rate.
2. If the platform yoke needs to be raised; return the float selector to the down position and use the hand pump to raise the yoke to the desired position.
3. Insert pins through hole in attaching hardware and tip of boom or jib as shown in Figure 6-13.

Platform Operation

Perform the Installation instructions beginning on page 12 before starting these operating instructions.

1. To enter the platform, remove the gate locking pin (1, Figure 6-14), pull up on the grab handle (2) and swing the gate (3) open.

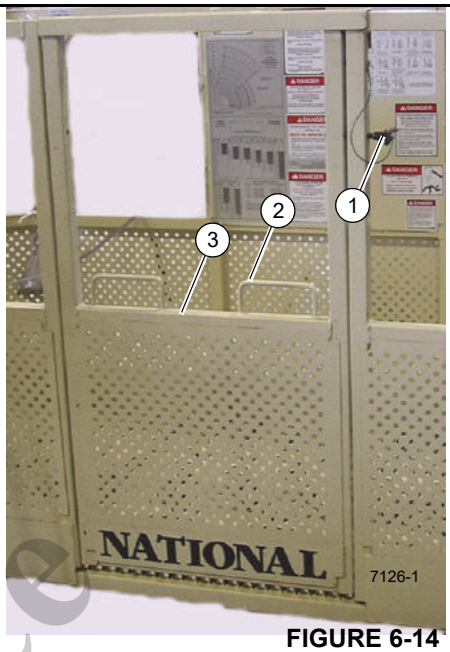


FIGURE 6-14

2. Connect the safety harness to the anchor point. Close the platform gate (3, Figure 6-14) by lifting up on the gate grab handle (2) and move the gate to the closed position, reinstall the safety pin (1).

Platform Brake Operation

The platform cylinder and brake manifold internal to the platform is used to raise and lower the yoke for installation and stowage as well as locking the platform position when in use after mounting of the platform to the boom or jib tip.

1. Verify the float selector (1, Figure 6-15) is positioned to the raised/up position and the brake selector (2) is in the CW (clockwise) position. This allows the platform to swing freely as the platform is raised to the work location.

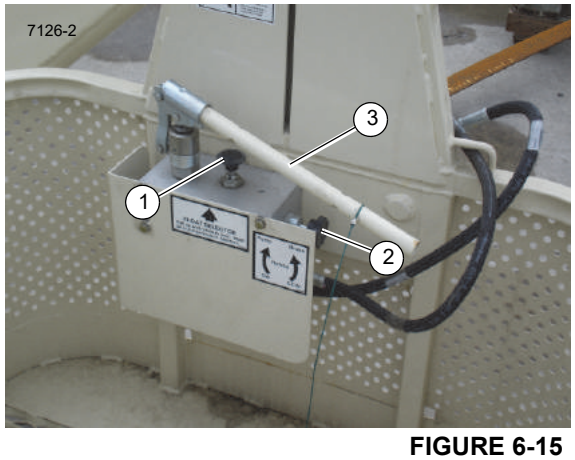


FIGURE 6-15

6

2. After the platform is raised to the working position; rotate the brake selector (2, Figure 6-15) (counterclockwise) position to lock the brake.

   This locks the yoke assembly into position and prevents free-swing when the platform is attached to the boom nose or jib tip.

CAUTION

Rotate the brake selector to brake position **immediately** after raising the yoke assembly to the proper height. The brake selector must be in the *LOCK* position before continuing or using the platform during normal operation.

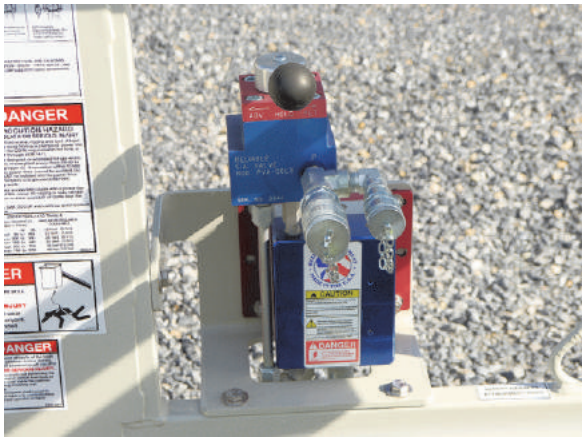
CAUTION

Rotate the brake selector (2, Figure 6-15) to the CCW (counterclockwise) brake position **immediately** after raising the yoke assembly to the proper height (step 2 above). The brake selector must be in the *LOCK* position before continuing or using the platform during normal operation.

NOTE: The platform hand pump (3, Figure 6-15) should not be used when the crane is in operation. The hand pump is to be used *only* when installing the yoke to the boom or jib tip.

Hydraulic Tool Connection - Optional

Hydraulic tools can be operated from the Aerial Lift Platform by connecting to the optional hydraulic power intensifier valve connections (Figure 6-16). The intensifier will increase line pressure to a maximum of 689 bar (10,000 psi) and is compatible with all high pressure hydraulic equipment. Reference 9828221048 Valve Intensifier manual.



9076 **FIGURE 6-16**

Safety Harness

A safety harness (Figure 6-17) is required for the platform occupant with a harness attachment link located near the platform pivot point and the platform corners.

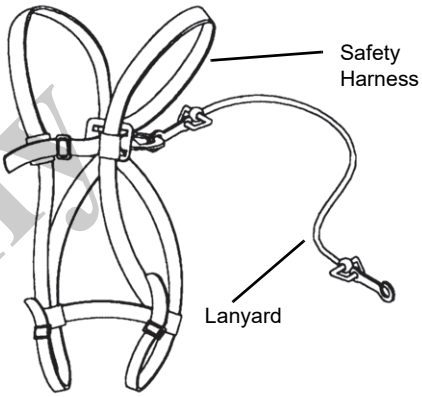


FIGURE 6-17

SECTION 7
LUBRICATION

SECTION CONTENTS

GENERAL

Following the designated lubrication procedure is important in ensuring maximum equipment lifetime and utilization. The procedures and lubrication charts in this section include information on the types of lubricants used, the location of the lubrication points, the frequency of lubrication, and other information. The information included in this section does not include lubrication requirements for the truck chassis. Refer to appropriate truck manufacturer's manual for this information.

ENVIRONMENTAL PROTECTION

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

Potentially harmful waste used in Manitowoc equipment 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 equipment 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.

The service intervals specified are for normal operation where moderate temperature, humidity, and atmospheric conditions prevail. In areas of extreme conditions, the service periods and lubrication specifications should be altered to meet existing conditions. For information on extreme condition lubrication, contact your local National Crane Distributor or Manitowoc Crane Care.

Lubricants

Specific recommendations of brand and grade of lubricants are not made here due to regional availability, operating conditions, and the continual development of improved

products. Where questions arise, contact your National Crane Distributor or Manitowoc Crane Care.

Arctic Conditions Below -9°C (15°F)

In general, petroleum based fluids developed especially for low temperature service may be used with satisfactory results. However, certain fluids, such as halogenated hydrocarbons, nitro hydrocarbons, and phosphate ester hydraulic fluids, might not be compatible with hydraulic system seals and wear bands. If you are in doubt about the suitability of a specific fluid, check with your authorized National Cranes distributor or Manitowoc Crane Care.

NOTE: All fluids and lubricants may be purchased by contacting the Manitowoc Crane Care Parts Department.

Regardless of temperature and oil viscosity, always use suitable startup procedures to ensure adequate lubrication during system warm-up.

Chassis Grease

CAUTION

Do not use air pressure devices to apply chassis grease otherwise damage to sealed fittings may result.

Lubricating grease of proper consistency is to be applied periodically at relatively frequent intervals with grease guns through grease fittings. Minimum apparent viscosity of 300 SUS (Saybolt Universal Seconds) at 38°C (100°F)

is recommended.

CAUTION

The multipurpose grease installed during manufacture is of a lithium base. Use of a non-compatible grease could result in damage to equipment.

Low Temperature Grease

This special grease for low temperature remains plastic at -51° C (-60° F) with melting point of 138°C (280°F). The grease is a heavy duty extreme pressure type lubricant (Lubricate Low Temp or equal).

Extreme Pressure Multipurpose Gear Lubricant (EPGL)

This gear lubricant is compounded to achieve high load carrying capacity and meet the requirements of either API-GL-5 or MIL-L-2105C. Unless otherwise specified, SAE 80W-90 viscosity may be used for year round service. Low temperature usage is restricted as follows:

SAE Viscosity Number	Minimum Ambient Temperature C (F)	
75W	-40°C	(-40°F)
80W	-2°C	(-15°F)
85	-12°C	(+10°F)
90	-7°C	(+20°F)
140	+5°C	(+40°F)
250	+10°C	(+50°F)

Open Gear Lubricant

This is a special high-graphite adhesive lubricant that helps to eliminate fretting corrosion, is water resistant, and forms a dry lubrication film which does not attract dust. Lubricant meets NLGI Class 1-2 specifications.

Antifreeze/Coolant (for Cab Heater)

The standard antifreeze/coolant filled from the factory is intended to provide protection against freeze-up down to -36° C (-34° F) and boil-over up to 129° C (265° F) using a 15 psi pressure cap.

Anti-wear Additives

Excessive wear in the system may cause a loss in volumetric efficiency and cause shutdowns for maintenance. An efficient anti-wear oil protects the components against rusting, resists oxidation and helps prevent wear.

Hydraulic Oil

Oil in a hydraulic system serves as the power transmission medium, system lubricant and coolant. Selection of the proper oil is essential to ensure satisfactory system performance and life. The most important factors in selecting an oil for hydraulic service are viscosity and anti-wear additives.

CAUTION

Operation of the equipment with incorrect hydraulic oil in sub freezing temperature (below 0° C,32° F) can cause damage to the extend cylinder.

NOTE: When operating the equipment in temperatures -9°C (15°F) and below, follow the procedures in the section titled “Arctic Conditions Below -9°C (15°F)” on page-2.

Standard Hydraulic Oil

Temperature Above -9°C (15°F)

The factory fill standard hydraulic oil is ISO grade 46/68 Hydraulic Oil. This fluid is acceptable for operating temperatures above -9°C (15°F).

CAUTION

Operation of the equipment with incorrect hydraulic oil in sub freezing temperature below 0°C (32°F) can cause damage to the extend cylinder.

Arctic Hydraulic Oil

Temperature Down to -9°C (15°F) to -29°C (-20°F)

For colder operating conditions, the standard fluid may be replaced with a petroleum based fluid developed especially for colder environments.

Temperature Down to -40°C (-40°F) and Below

Petroleum based fluids developed especially for low temperature service may be used with satisfactory results. However, certain fluids, such as hologenated hydrocarbons, nitro hydrocabons and phosphate ester hydraulic fluids might not be compatible with hydraulic system seals and wear bands. Arctic hydraulic oil is not recommended for service in ambient temperatures above 0°C (32°F).

If you are in doubt about the suitability of a specific fluid, check with your authorized National Crane distributor or Manitowoc Crane Care.

NOTE: All fluids and lubricants may be purchased by contacting the Manitowoc Crane Care Parts Department.

Hydraulic Oil Inspection

Environmental and other conditions can dramatically affect the condition of hydraulic oil and filters. Therefore, specific intervals for servicing/changing hydraulic oil, filters and hydraulic tank breathers cannot be set. However, it is imperative for the continued satisfactory performance that inspections be performed on the basis of how and where each equipment is used. Air borne and ingested contaminants can significantly reduce the life of oil and the condition of hydraulic oil filters and tank breathers.

Under normal operating conditions, it is recommended that hydraulic oil, filter and breathers be inspected at least every three to six months and more frequently for severe operating conditions. The inspections should be for air borne and/or ingested particles and water that deteriorate and contaminate the oil. For example, if oil appears “milky” or no longer has a transparent clear to amber color. The return filter by-pass indicator should be observed daily to determine if contaminant content is high. If the indicator reaches the red zone or indicates a by-pass condition, the hydraulic oil must be sampled. The hydraulic tank breather should also be inspected to assure that it is not restricting air flow into and out of the reservoir.

To inspect the hydraulic oil, fill a small glass container with a sample of the reservoir oil and another glass container with fresh oil. Let the samples stand, undisturbed, for one or two hours. Then, compare the samples. If the reservoir oil is heavily contaminated with water, the sample will appear “milky” with only a small layer of transparent oil on top. If the “milky” appearance is due to air foaming, it will dissipate and the oil should closely match the fresh oil. Remember, replacement oil must meet ISO 17/14 or better cleanliness level and must meet John Deere Standard JDM J20C. Contact your National Crane distributor or Manitowoc Crane Care if you have any questions.

LUBRICATION

A regular frequency of lubrication must be established based on component operating time. The most efficient method of keeping track of lube requirements is to maintain a job log of equipment usage.

⚠ DANGER

Do not, under any circumstances, work at an elevated height without using proper fall protection as required by local, state or federal regulations.

CAUTION

Lubrication intervals are to be used only as a guide. Actual intervals should be formulated by the operator to correspond accordingly to conditions such as continuous duty cycles and/or hazardous environments.

All oil levels are to be checked with the equipment parked on a level surface in transport position, and while the oil is cold, unless otherwise specified. On plug type check points, the oil levels are to be at the bottom edge of the fill port.

Over lubrication of non-sealed fittings will not harm the fittings or components, but under lubrication shortens lifetime.

Worn grease fittings that do not hold a grease gun, or those that have a stuck check ball, must be replaced.

When wear pads or rotation bearings are lubricated, cycle the components and lubricate again to ensure complete lubrication of the entire wear area.

CAUTION

Lubrication intervals are to be used only as a guide. Actual intervals should be formulated by the operator to correspond accordingly to conditions such as continuous duty cycles and/or hazardous environments.

The following describe the lubrication points and gives the lube type, lube interval, lube amount, and application of each. Each lubrication point is numbered, and this number corresponds to the index number shown on the Lubrication Chart (Figure 7-3). Lube description and symbols are found in tables below.

Table 7-1

Symbol	Description	Manitowoc Lube Specification	
		Standard	Cold Weather - 40°C (-40°F)
AFC	Antifreeze/Coolant (for Cab Heater)	6829101130	6829104212
EP-MPG	Extreme Pressure Multipurpose Grease	6829003477	6829104275
GL-5	GL-5 Gear Lubricant	6829012964	6829014058
HYDO	Hydraulic Oil	6829006444	6829006993
EP-OGL	Open Gear Lubricant, CEPLATTYN 300 Spray, NLGI Grade 1-2	6829102971	6829102971
AGMA EP-4	Extreme Pressure Gear Lubricant.	6829100213	6829103636
WRL	Wire Rope Lubricant	6829015236	6829010993
EO-20W-20	Engine Oil (Light non-EP Oil), Mil-L-46152	6829005570	-
TES 295	TES295 Compliant Fluid	-	6829101690
NOTE: Cold weather lubricants are not sufficient for temperatures below 40° C (-40° F). Use hydraulic tank heaters and insulate where appropriate.			

LUBRICATION POINTS

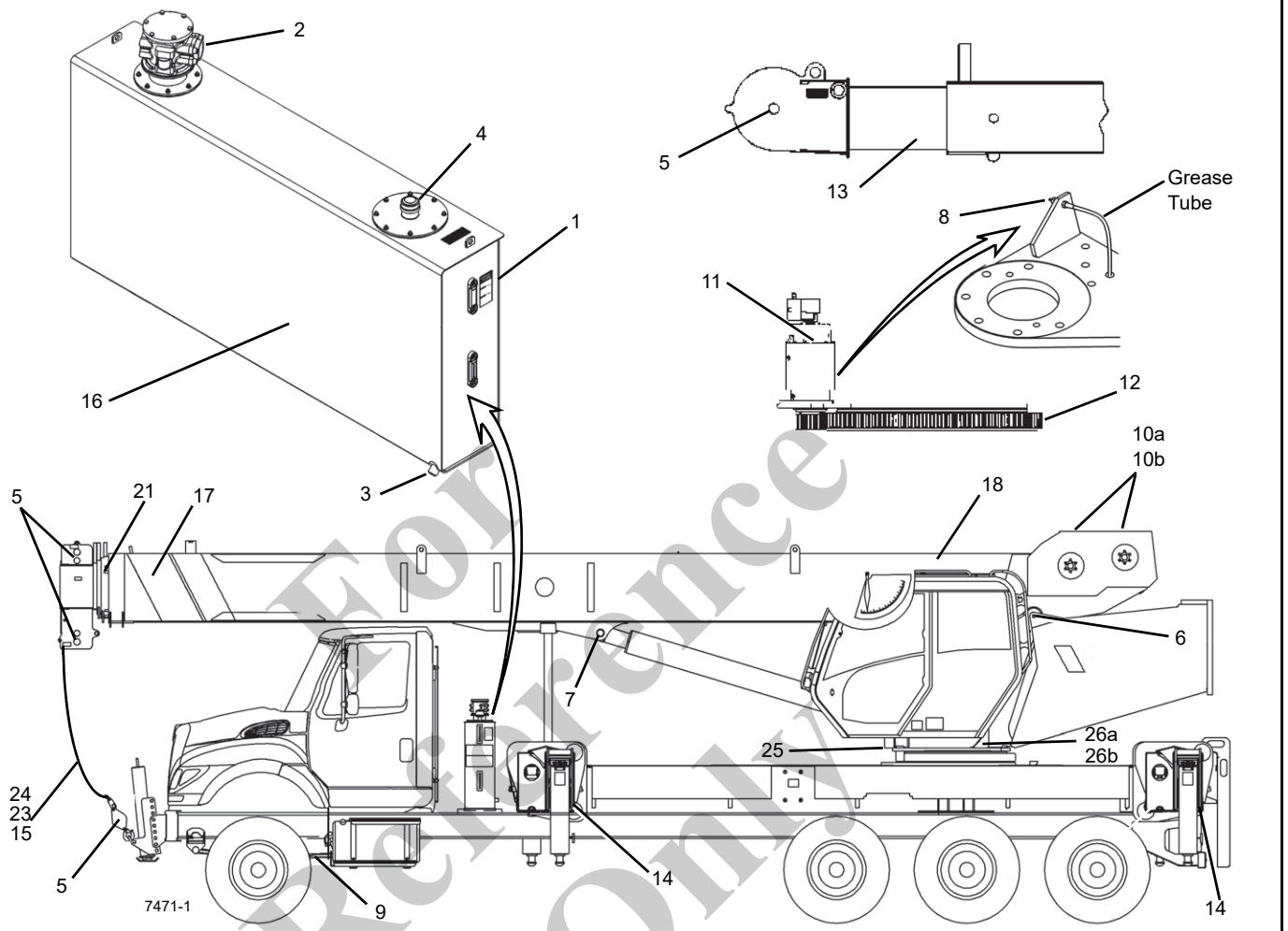


FIGURE 7-1

Table 7-2

Item	Application	Recommended Lubricant	Procedure	Frequency
1	Hydraulic oil reservoir	Hydraulic Oil	Check fill change	Weekly As Required Semi-Annually
2	Oil filter, Hydraulic oil reservoir		Change or clean	After first 40 Hrs. As indicated by gauge thereafter.
3	Magnetic Plug, Hydraulic oil reservoir		Clean	At oil filter service interval.
4	Breather, Hydraulic oil reservoir		Clean	Monthly
5	Sheave pins: boom nose (5 points), jib (1 plc), hook block (1 point), Aux Boom Nose (1 point	EP-MPG	Grease gun	Weekly
6	Boom pivot pin	EP-MPG	Grease gun	Monthly
7	Lift cylinder pins - 2 ea.	EP-MPG	Grease gun	Monthly

Item	Application	Recommended Lubricant	Procedure	Frequency
8	Turntable bearing	EP-MPG	Grease gun	Weekly
9	Pump Drive U-Joint - 2 ea. (If Equipped) or Pump Spline Shaft (Direct Mount)	Chassis Grease Coupling Lube Spline Lubricant	Change Check and Fill Change	After First 100 Operating Hours Weekly Semi-Annually
10a	Main and Auxiliary Hoist gearbox.	GL-5	Check and Fill Change	Check and Fill: As part of daily crane inspection, check the gearbox for visible leaks. Change: Every 1000 hours or 6 months of usage.
10b	Hoist brake	EO-20W-20 or TES295	Check and Fill Change	Check and Fill: As part of daily crane inspection, check the gearbox for visible leaks. Change: Every 1000 hours or 6 months of usage.
11	Swing drive gearbox	GL-5	Change	After 100 operating hours
12	Swing gear teeth	EP-OGL	Spray Can	Monthly
13	Boom Jib	EP-MPG	Brush, roller, or grease gun	Monthly or as required
14	Outrigger beams, bottom, sides	EP-MPG	Brush or roller	Monthly or as Required
15	Wire rope	EP-OGL	Brush or spray	Semi-Annually
16	Diffuser strainer, Hydraulic oil reservoir		Clean	Semi-Annually with Oil Change
17a	Extend Sheaves: 2nd Section 127 ft and 142 ft booms each Side	Chassis Grease #200S Silver Streak Special Multi-Lube (light)	Grease Gun	Weekly
17b	Extend Sheaves: 4th Section 127 ft and 142 ft booms, each side	Chassis Grease #200S Silver Streak Special Multi-Lube (light)	Grease Gun	Weekly
18	Retract Sheaves - extend boom until retract sheave zerks are visible through access holes at center of boom.	Chassis Grease #200S Silver Streak Special Multi-Lube (light)	Grease Gun	Weekly
19	Wire Rope Jib Extension Cables (Not Shown)	WRL	Spray or Brush	Any Time Boom is Disassembled or 5 Years
20	Boom Wear Pads (Not Shown)	EP-MPG	See Boom Lubrication	Monthly or as Required
21	Wire or Hose Rollers	SAE 10	Oil Can	Quarterly
21	Wire or Hose Rollers	SAE 10	Oil Can	Quarterly
22	Cab Heater Reservoir	AFC	Check/Fill/Drain	Weekly/As Required/Semi-Annually
23	Hook Block Swivel Bearing	EP-MPG	Grease gun	Monthly
24	Hook Block Sheaves	EP-MPG	Grease gun	Monthly
25	Turntable Swing Lockpin	EP-MPG	Spray	Monthly
26a	Air Conditioning	Pag Oil	Check & fill w/ 4 ounces above 6 ounces in compressor	Any Time A/C is Disconnected or Serviced
26b	Air Conditioning Refrigerant	134a	2 lbs	@ start-up

Item	Application	Recommended Lubricant	Procedure	Frequency
27	Platform Cylinder	EP-MPG	See Platform Lubrication	Monthly or as Required

NOTE: Lubricate items more frequently than interval indicated in table if environmental conditions and/or operating conditions necessitate.

BOOM LUBRICATION

Internal Cable Sheave Lubrication

DANGER

Do not, under any circumstances, work at an elevated height without using proper fall protection as required by local, state or federal regulations.

Lubrication of the extend and retract sheaves is as follows:

1. Locate the fittings as listed in the table above.
2. Lubricate the pins until a small amount of grease extrudes from the pin.

Side and Bottom Boom Wear Pad Lubrication

DANGER

Do not, under any circumstances, work at an elevated height without using proper fall protection as required by local, state or federal regulations.

Recommended lubricant is EP-3MG grease.

1. Fully extend and set the outriggers.
2. Lower the boom to horizontal.
3. Fully extend the boom and apply grease to all wear pad contact surfaces at the side and bottom of all boom sections with a brush or a 3 inch putty knife.
4. Raise the boom to 75° and retract the boom.
5. Extend and retract the boom several times until the grease is evenly spread.
6. Repeat as necessary.

Top Boom Wear Pad Lubrication

DANGER

Do not, under any circumstances, work at an elevated height without using proper fall protection as required by local, state or federal regulations.

Recommended lubricant is EP-3MG grease.

1. Fully extend and set the outriggers.
2. Lower the boom to horizontal.
3. Remove access plate at top rear of the base section.
4. Extend the boom until wear pads are centered in access opening and apply grease to all wear pads and contact surfaces at the top of all boom sections with a grease gun or a brush.
5. Raise the boom to 75°.
6. Extend and retract the boom several times until the grease is evenly spread.
7. Repeat as necessary.

Outrigger Beam Lubrication

DANGER

Do not, under any circumstances, work at an elevated height without using proper fall protection as required by local, state or federal regulations.

Recommended lubricant is EP-3MG grease.

1. Fully extend and set the outriggers. Refer to (Figure 7-2.)
2. Apply grease to all wear pads and contact surfaces at the side and bottom of all beam sections and lower surface of the stabilizer/jacks with a suitable brush or putty knife.
3. Extend and retract the outriggers several times until the grease is evenly spread.
4. Repeat as necessary.

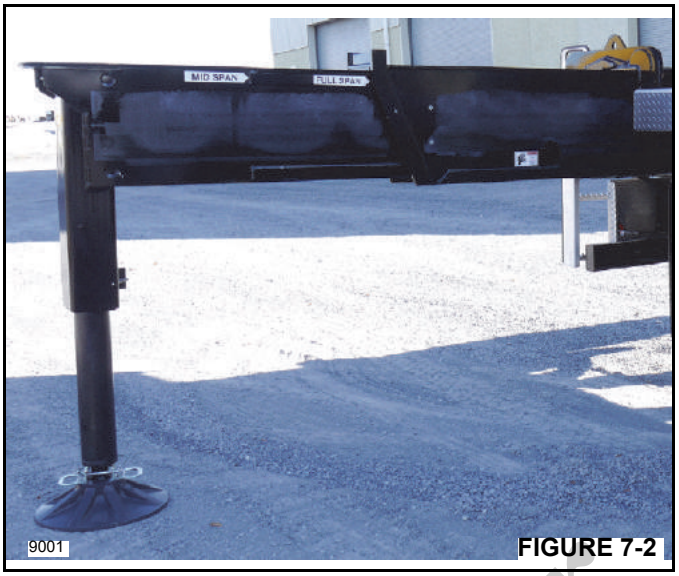


FIGURE 7-2

Hoist Brake Oil

DANGER

Do not, under any circumstances, work at an elevated height without using proper fall protection as required by local, state or federal regulations.

Check Hoist Brake Oil

To check the hoist brake oil, remove the inspection plug (2, Figure 7-3) and visually inspect the oil level. The oil should be level with the bottom of the inspection hole. If more oil is needed, add through the vent/fill (1) plug hole until oil is at the bottom level of the inspection hole.

Drain /Add New Hoist Brake Oil

To drain and add new oil:

- Remove the drain plug (3), (Figure 7-3.) the inspection plug (2) and the vent plug (1).
- Drain the brake oil.
- Reinstall drain plug (3) and add oil at the brake oil vent hole (1) until oil is at the bottom level of the inspection hole (2). See (Table 7-2). The hoist brake fill capacity is 0.23 liter (.25 quart).
- Install the inspection plug (2) and the oil vent and fill plug (1).

NOTE: Brake lubricants are satisfactory for operation in temperatures from -23° C to 66° C (-10° F to +150° F). For operation outside this range, contact Manitowoc Crane Care for recommendations.

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DANGER

Do not use EP type gear lubes in the brake section. This may prevent proper operation and cause the load to fall resulting in serious injury or death.

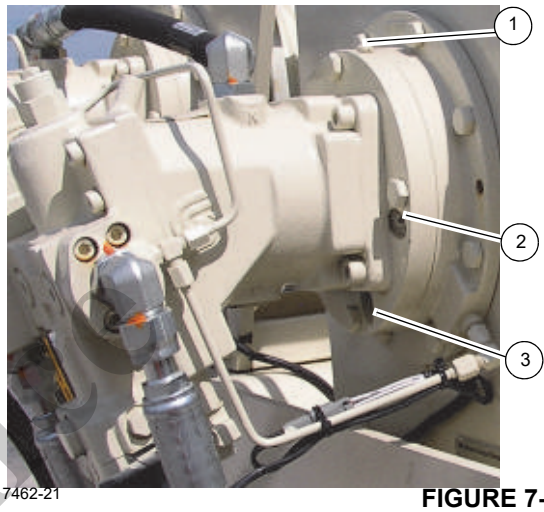


FIGURE 7-3

Hoist Gearbox Oil

Check hoist gearbox oil level:

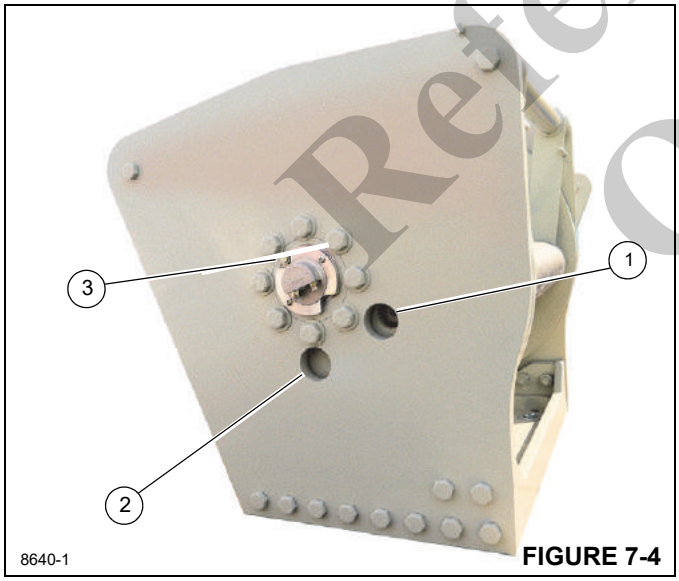
- Rotate the drum until the oil fill/level plug (1, Figure 7-4) is visible in the inspection hole.
- Remove the fill/level plug (1) and visually inspect the oil level. The oil should be level with the bottom of the inspection/fill hole. If more oil is needed, add oil (See Table 7-2).
- Re-install fill/level plug.
- To drain and add new oil, remove the vent plug (3, Figure 7-4) and then screw a 1” pipe into the drain plug hole (2) to allow the oil to drain. Remove the drain plug (2) with a hex head socket and drain hydraulic oil. Remove the 1” drain pipe and install drain plug (2).

Fill Hoist Gearbox with Oil.

- To fill with oil, rotate the drum so the gearbox fill/level port (1, (Figure 7-4) is visible through the upper hole.
- Remove fill/level plug (1) with a hex socket.
- Install a 1” pipe with elbow into the fill hole (1) to assist with adding oil.
- Remove the vent plug (3) to assist with adding the oil.
- Fill gear box with 3.3 l (3.50 qt) of oil or until oil is at the bottom level of the inspection hole with gear lube oil. See (Table 7-2).

- ***Drain and Fill Hoist Gearbox with Oil.***
- To drain and add new oil, remove the vent plug (3, Figure 7-4) to assist with draining the oil.
- Remove fill/level plug (1) with a hex socket.
- Remove the drain plug (2) with a hex head socket.
- Screw a 1” pipe into the drain plug hole to assist with draining the oil.
- Drain the oil.
- Remove the 1” drain pipe.
- Install oil drain plug (2).
- Install a 1” pipe with elbow into the fill hole (1) to assist with adding oil.
- Fill gear box with 3.3 l (3.50 qt) of oil or until oil is at the bottom level of the inspection hole with gear lube oil. See (Table 7-2).
- Remove the 1” fill pipe.
- Install the inspection plug (1).
- Install the vent plug (3)

Hoist gear lubricants are satisfactory for operation in temperatures from -23° C to 66° C (-10° F to +150° F). For operation outside this range, contact Manitowoc Crane Care for recommendations.



8640-1 **FIGURE 7-4**

Swing Gearbox and Brake Oil

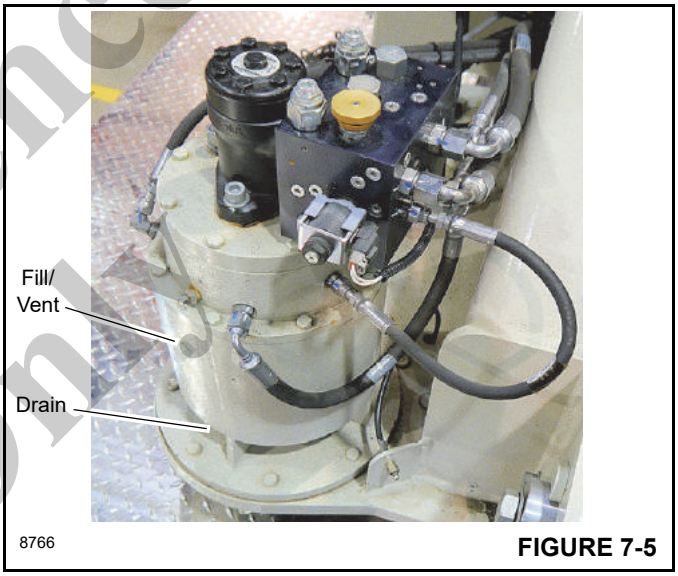
Check Swing Gearbox oil level:

The oil in the gearbox and brake sections is recommended to be changed after first 50 hours of operation and every 1000 hours or 6 months of usage. Gearbox oil is drained by removing the drain plug and removing the fill/vent plug for ease of draining.*(Figure 7-5)*

1. Examine the used oil for signs of significant metal deposits and then dispose of it in a proper manner.
2. Replace the drain plug.
3. Fill the swing gearbox with the appropriate amount and type of oil and replace fill/vent plug. *See “Lubrication” on page 7-3 of this manual.*

Gearbox oil level inspection is achieved by removing the gearbox fill/vent plug and visually inspecting the oil level. Maximum oil level is to be 1” below the port for this gearbox with 3.3 l (3.50 qt) of gear lube oil.

Gearbox lubricants are satisfactory for standard operation in temperatures from -23° C to 82° C (-10° F to +180° F). For operation outside this range, contact Manitowoc Crane Care for recommendations.



8766 **FIGURE 7-5**

Hydraulic Oil Reservoir Level

The hydraulic oil reservoir has a sight gauge (1, Figure 7-6) located on the side of the reservoir. The oil in the hydraulic reservoir is sufficient when the level is between the High and Low marks on the sight gauge with the equipment parked on a level surface in the transport position and the oil cold.

If the oil level is to low, add the recommended hydraulic oil until the oil level is even with the upper mark. If the oil level is high, drain oil until the oil level is even with the upper mark.

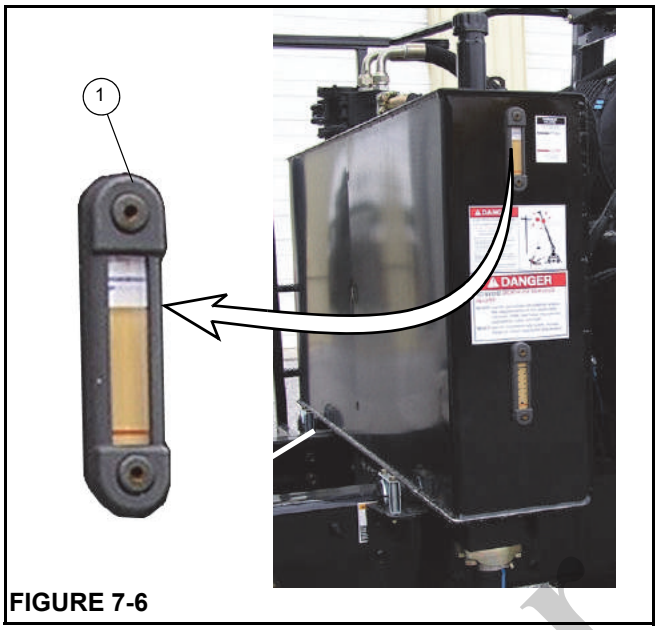


FIGURE 7-6

AIR CONDITIONING

When servicing air conditioner, evacuate system prior to disconnecting any components connected to the pressurized lines. Follow the specifications listed on section titled *Air Conditioner*, page 10-6.

After servicing ensure air conditioning system is re-charged with refrigerant and oil according to specifications listed on (Table 7-2 on page 5).

WIRE ROPE LUBRICATION

Wire rope is lubricated during manufacture and the lubricant applied does not last the life of the rope. The wire rope must be lubricated as part of a regularly scheduled maintenance program. The lubricant applied must be compatible with the original lubricant and not hinder visual inspection of the rope. Consult the rope manufacturer for proper lubricant. The sections of rope which are located over sheaves or otherwise hidden during inspection and maintenance procedures require special attention.

The object of rope lubrication is to reduce internal friction and to prevent corrosion. The type and amount of lubrication applied during manufacture depends on the rope size, type, and anticipated use. This lubrication provides the finished rope with protection for a reasonable time if the rope is stored under proper conditions. When the rope is put into service, periodic applications of a suitable rope lubricant are necessary. Characteristics of a good wire rope lubricant are that it should be:

- free from acids and alkalis.
- have sufficient adhesive strength to remain on the rope.
- of a viscosity capable of penetrating the interstices between wires and strands.
- not be soluble in the medium surrounding it under the actual operating conditions (i.e. Water).
- have a high film strength.
- resistant to oxidation.

Before applying lubrication, accumulations of dirt or other abrasive material should be removed from the rope. Clean with a stiff wire brush and solvent, compressed air, or live steam. Lubricate the rope immediately after the rope is cleaned. Techniques that can be used include:

- bath
- dripping
- pouring
- swabbing
- painting
- pressure spray

Whenever possible, the lubricant should be applied at the top of a bend in the rope, because at that point the strands are spread by bending and are more easily penetrated. There should be no load on the rope while it is being lubricated. The service life of wire rope is directly proportional to the effectiveness of the method used and amount of lubricant that reaches the working parts of the rope.

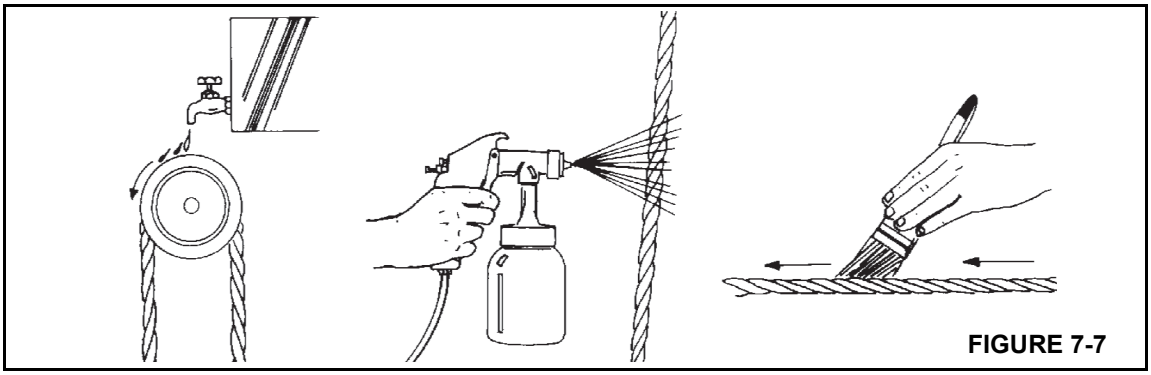


FIGURE 7-7

AERIAL LIFT PLATFORM LUBRICATION

Aerial Lift Platform moving components are lubricated during manufacture. The only lubrication points required are the leveling cylinder grease fittings requiring EP-MPG grease monthly or as required (See Figure 7-8).

FIGURE 7-8

CARWELL® RUST INHIBITOR

Protecting Cranes From Rusting

Manitowoc Crane Group's cranes are manufactured to high quality standards, including the type of paint finish demanded by today's industry. In partnership with our paint supplier, we are also doing our part to help prevent premature corrosion of cranes.

National 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 National 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 29CFR 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, National 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 National 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, cased by minor incidents or moving components;
- Damage caused by personal abuse, such as using the decks to transport rigging gear, tools, or cribbing; and
- Exposure to harsh environmental hazards such as alkaline, acids, or other chemicals that can attack the crane's paint finish.

While the surfaces of the crane that are easily seen have the biggest impact on the appearance of the crane, particular attention should be given to the undercarriage of the crane to minimize the harmful effects of corrosion.

Exercise special care and increase the frequency of cleaning if the crane is operated:

- on roads where large quantities of salt or calcium are applied to treat icy and snowy road surfaces;
- in areas that use dust control chemicals;
- anywhere there are increased levels of wetness - especially near salt water;
- during prolonged periods of exposure to damp conditions (e.g., moisture held in mud), where certain crane parts may become corroded even though other parts remain dry; or
- in high humidity, or when temperatures are just above the freezing point.

Cleaning Procedures

DANGER

Do not, under any circumstances, work at an elevated height without using proper fall protection as required by local, state or federal regulations.

To help protect against corrosion of National cranes, Manitowoc Crane Care recommends washing the crane at least monthly to remove all foreign matter. More frequent cleaning may be needed when operating in harsh environmental conditions. To clean the crane, follow these guidelines:

- High pressure water or steam is effective for cleaning the crane's undercarriage and wheel housings. Keeping these areas clean will not only help retard the effects of corrosion, but will also improve the ability to identify potential issues before they grow into larger problems.

CAUTION

High pressure water can be forced into spaces and infiltrate beyond seals. Avoid pressure washing in the vicinity of electrical controls, panels, wiring, sensors, hydraulic hoses and fittings, or anything that can be damaged by high pressure cleaning/spraying.

- Rinse the dirt and dust off before washing the crane. Dirt can scratch the crane's finish during washing/cleaning.
- Hard to clean spots caused by road tar or bugs should be treated and cleaned after rinsing and prior to washing. Do not use solvents or gasoline.
- Wash using only soaps and detergents recommended for automotive paint finishes.
- Rinse all surfaces thoroughly to prevent streaking caused by soap residue.
- Allow the crane to dry thoroughly. You can accelerate drying by using compressed air to remove excess water.

NOTE: Polishing and waxing (using an automotive-type wax) is recommended to maintain the original paint finish.

Inspection and Repair

- Immediately following cleaning, Manitowoc Crane Care recommends an inspection to detect areas that may have become damaged by stone chips or minor mishaps. A minor scratch (one that has not penetrated to the substrate surface) can be buffed with an automotive-type scratch remover. It is recommended that a good coat of automotive wax be applied to this area afterwards.
- All identified spots and/or areas that have been scratched through to the metal should be touched up and repaired as soon as possible to prevent flash rusting. To repair a major scratch (down to bare metal) or minor damage, follow these procedures:

NOTE: Manitowoc Crane Care recommends that a qualified body repairman prepare, prime and paint any major scratch(es) or minor damage.

CAUTION

To the extent any damage is structural in nature, Manitowoc Crane Care must be contacted and consulted as to what repairs may be required.

- For scratches and marks in highly visible areas:
- Sand to remove the scratch and feather outward from the mark to blend the repair into the original surface. Body putty may be applied as necessary to hide the defect; then sand smooth.
- Cover all bare metal with a primer that is compatible with the original paint finish
- and allow to dry thoroughly.
- Prepare the surface prior to applying the finish coat of paint.
- Apply a finish coat 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 primered and painted areas for at least 48 hours after paint is properly dried and cured. For minor touch up areas a 24 hour period is needed for cure time before applying treatment.

NOTE: Unit must be completely dry before applying treatment.

- Do not allow product to puddle or build-up on weather stripping, rubber gaskets, etc. Unit should not have puddles or runs evident anywhere.
- To ensure proper coverage of treatment, the product needs to be fogged on the unit.
- Use of pressure pots to apply the treatment to the unit being processed is recommended.
- Carwell® treatment is available in 16 ounce spray bottles from Manitowoc Crane Care (order part number 8898904099).
- After application of the treatment is complete, wash or clean film residue from lights, windshield, grab handles, ladders/steps and all access areas to crane, as necessary.

Please contact Manitowoc Crane Care should you have any questions.

Areas of Application

Refer to Figure 7-9

- 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.
- Superstructure applications are; hose end and fittings, wire rope on hoist roller tensioning springs on hoists, all unpainted fasteners and hardware, valves, slew ring fasteners and all bare metal surfaces.
- Boom applications areas are; pivot pins, hose end and fittings, jib pins and shafts, all bare metal surfaces, overhaul ball pins/ hook block pins and fasteners.
- All hardware, clips, pins, hose connections not painted will have treatment applied.

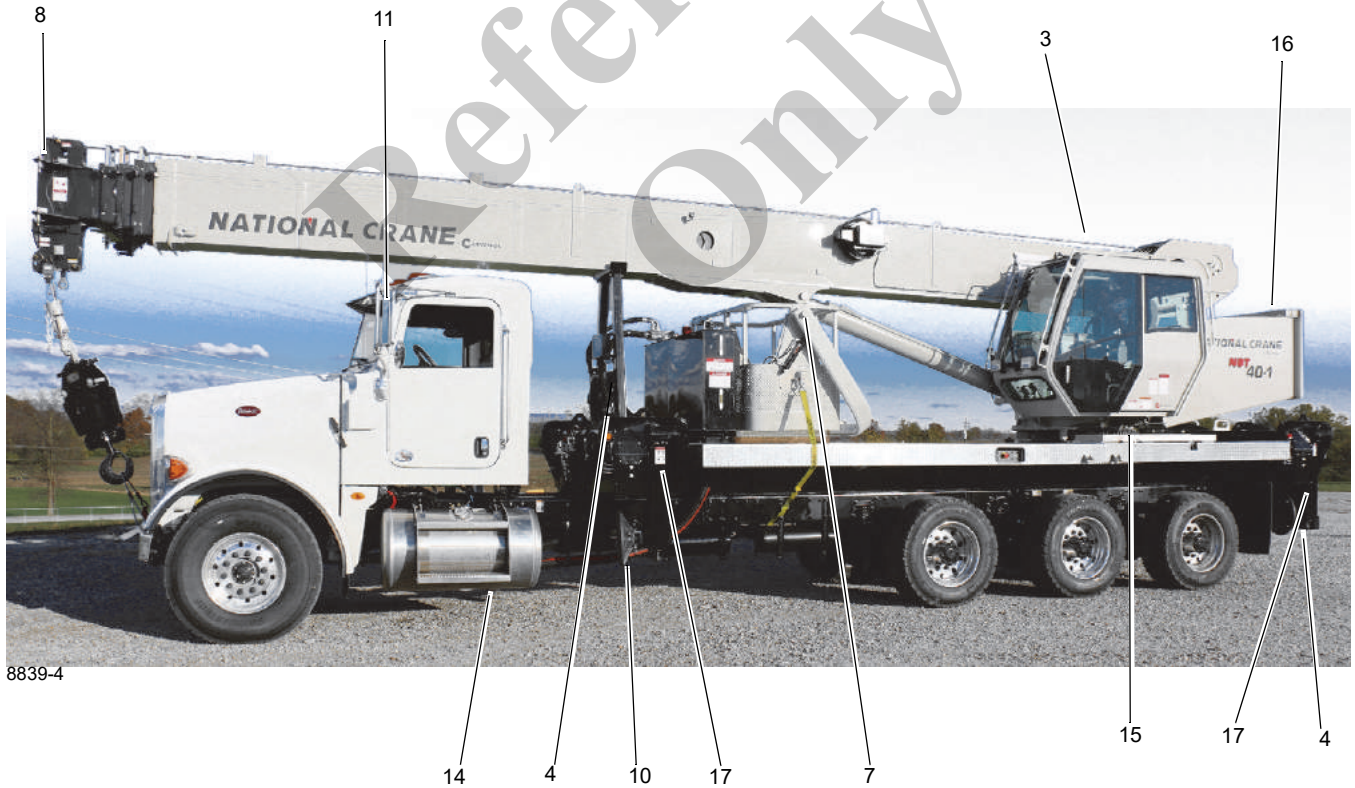


FIGURE 7-9

Item	Description
1	Hoist Plumbing Connections
2	Tension Spring
3	Counterweight Pins
4	All Hardware, Clips, Pins, Hose Connections not painted O/R Pins, Clips
5	Valvebank, Hose Connections inside turntable
6	Boom Extension Hardware (Optional)
7	Pivot Shaft
8	Boom Nose Pins, Clips

Item	Description
9	Overhaul Ball/Hook block
10	O/R Pins, Clips
11	Mirror Mounting Hardware
12	Powertrain Hardware
13	O/R Hose Connections
14	Entire underside of unit
15	Turntable Bearing Fasteners
16	Wire Rope
17	Outrigger Beam Hardware

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SECTION 8
MAINTENANCE CHECKLIST - CRANE

SECTION CONTENTS

INSPECTION AND MAINTENANCE

Regularly scheduled inspection and maintenance intervals are required to keep the crane in peak operating condition. The following pages outline the inspection and maintenance intervals.

Refer to *Maintenance Checklist - Aerial Lift*, page 9-1 for additional information relating to Aerial Lift ANSI/SAIA A92.2-2015 inspections and maintenance intervals.

Refer to the Service Manual for complete instructions on performing maintenance on this crane.

⚠ WARNING

Fall Hazard!

Do not, under any circumstances, work at an elevated height without using proper fall protection as required by local, state or federal regulations

General Inspections

All inspection and maintenance testing must be accomplished by trained and qualified personnel in accordance Sections 9 and 10 of this National Cranes and Aerial Lifts Operator Manual and Service Manuals.

The inspection intervals listed below are to be conducted on the equipment to ensure safe and proper operation. Refer to the *Service Manual* when installing missing or loose fasteners. Should a deficiency be found, a determination must be made as to whether the deficiency is a safety hazard or though not yet a safety hazard, needs to be monitored in the monthly inspections.

The inspections are separated into the following frequency classifications:

- Daily inspections - performed by the operator at the start of the day.
- Weekly inspections - performed by the operator.
- Monthly inspections - performed by maintenance personnel.
- Periodic inspections - performed by maintenance personnel at least every three months and includes all items listed under daily, weekly, and monthly inspections. Federal Laws through OSHA and ASME B30.5 require that dated and signed records of these periodic inspections be kept. An inspection log book is available from your National Crane distributor or Manitowoc Crane Care.

⚠ WARNING

If any deficiency determined during the inspection is a safety hazard the machine must be removed from service and the deficiency corrected.

Daily Inspections/Pre-use

Check the following items:

1. Engine oil level.
2. Hydraulic oil level.

3. Radiator coolant level.
4. Loose parts or damage to structures or welds.
5. Operation of lights, safety equipment and gauges.
6. Condition of tires and suspension.
7. Condition of hoist rope and end attachment for corrosion, severe kinking, crushing, cutting, or slippage of rope clamps or wedge socket.
8. Loose parts or damage to rope centering hook blocks.
9. Position of rope with guides and on sheaves.
10. Free turning of sheaves.
11. Lubrication as specified by the *Lubrication*, Section 7.
12. Evidence of oil leaks from hoses, gearboxes, or swivel.
13. Hand and foot controls for malfunction or incorrect adjustment.
14. Truck parking brake operation.
15. Boom proportioning to insure that all boom sections extend and retract equally.
16. All securing hardware such as cotter pins, snap rings, hairpins, pin keepers, and capscrews for proper installation.
17. Proper condition and operation of RCL and anti-two-block systems to include the anti-two-block switch weight and chain at the boom tip (and extension tip if equipped), power cords, audible alarms, and indicator lights on the console.
18. Proper operation of the load hook safety latch.
19. Hooks and latches for excessive wear, cracks or damage from heat or chemicals.
20. Drain holes at rear of the first section of the boom are clear of all obstructions.
21. All fasteners retaining the rope centering block are in place and tight.
22. All safety covers for proper installation.
23. Boom lift and outrigger holding valves for proper operation.
24. Outrigger floats and cribbing.
25. Hoist brake for proper operation at hoist capacity load.
26. Control and drive mechanisms for excessive wear and/or contamination from lubricants, water or other foreign matter.

Weekly Inspections

Check the following items:

1. Battery water level.
2. Tire pressure.
3. Lubrication as specified by the *Lubrication*, Section 7.
4. Inspect the T-box mounting bolts during the first month of operation and periodic inspections thereafter.
5. Torque the swing bearing mounting bolts during the first month of operation and periodic inspections thereafter.
6. Torque the boom wear pad retaining bolts during first month of operation, and monthly thereafter.
7. Check to see that equipment's *Operator Manual* is with the equipment. If the manual is missing, obtain the serial number of the equipment and order an operator manual immediately.

Monthly Inspections

Check the following items:

1. All cylinders and valves for improper operation or signs of leaks.
2. Lubrication as specified by the *Lubrication*, page 7-1.
3. Load hook for cracks or having more than 15 percent normal throat opening or 10 degree twist.
4. All structural members (boom, sub-base, frame, turret, and outriggers) for bends, cracks, or broken members.
5. All welds for breaks or cracks.
6. All pins for proper installation.
7. All control, safety, and capacity placards for readability and secure attachment.
8. Rope clip bolts above wedge socket at end of loadline should be properly torqued, refer to the *Service Manual*.
9. All boom wear pad retaining bolts.
10. Boom extension cables for proper tension or evidence of abnormal wear.
11. Sheaves and cable drums for wear and cracks.
12. Unwind the loadline and check according to rope maintenance procedure.

Periodic/Annual Inspection

Check the following items:

1. All items listed under daily, weekly, and monthly inspections.
2. Loose bolts and fasteners in all areas. Torque pin retainer bolts.
3. All pins, bearings, shafts, and gears for wear cracks or distortion to include all pivot, outrigger and sheave pins, and bearings.

4. Boom angle and boom length indicator for accuracy over full range.
5. Hydraulic systems for proper operating pressure.
6. Outrigger pads for excessive wear or cracks.
7. Check cylinders for following:
   a. Damaged rods
   b. Dented barrels
   c. Drift from oil leaking by piston
   d. Leaks at rod seals, welds, or holding valves.
8. PTO drive line system for proper alignment, lubrication and tightness.
9. Hydraulic hose and tubing for evidence of damage such as blistering, crushing, or abrasion.
10. Top and bottom boom wear pads for excessive wear.
11. Inspect all electrical wires and connections for worn, cut or deteriorated insulation and bare wire. Replace or repair wires as required.
12. Extend and retract cables, sheaves, pins, and bearings for wear or abrasion.
13. Main frame and jack mounting bolts for proper torque, refer to the *Service Manual*.
14. Rotation bearing and gearbox mounting bolts for proper torque, refer to the *Service Manual*.
15. Missing or unreadable warning labels.
16. Missing or unusable/unsafe condition of steps, ladders, handrails, guards or seat.

Special Boom Inspection

If the boom has not been disassembled and inspected in the last seven years or 3,000 hours of use, the boom is to be completely torn down to allow a thorough inspection of the extend and retract cables, sheaves, and pins.

Stability

Stability of unit throughout working area. Check the stability procedure in Installation Section of the *Service Manual* annually or when any changes are made to lifting equipment or truck chassis.

Hoist Rope Inspection And Maintenance

Crane may be equipped with synthetic hoist rope or wire rope.

NOTE: Hoist rope may be purchased through Manitowoc Crane Care.

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

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

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.

⚠ WARNING

Worn or Damaged Equipment Hazard!

Never use a worn or damaged hoist rope. Death or serious injury could result from using worn or damaged hoist rope.

Hoist rope should be inspected daily at each shift, monthly and annually using a comprehensive inspection in accordance with the following information excerpted from a National Consensus Standard as referenced by Federal Government Agencies. Recommended inspection intervals may vary from machine to machine and may vary based on environmental conditions, frequency of lifts, and exposure to shock loads. The inspection time intervals may also be predetermined by state and local regulatory agencies.

Any deterioration observed in the hoist rope should be noted in the equipment inspection log and an assessment concerning hoist rope replacement should be made by a qualified person.

Keeping Records

A signed and dated report of the hoist rope's condition at each periodic inspection must be kept on file at all times. The report must cover all inspection points listed in this section. The information in the records can then be used to establish data which can be used to determine when a hoist rope should be replaced.

It is recommended that the hoist rope inspection program include reports on the examination of hoist rope removed from service. The information can be used to establish a relationship between visual inspection and the rope's actual internal condition at the time of removal from service.

Environmental Conditions

The life expectancy of rope may vary due to the degree of environmental hostility and other conditions to which these mechanical devices are subjected. Variation in temperature, continuous excessive moisture levels, exposure to corrosive chemicals or vapors or subjecting the rope to abrasive material may shorten normal rope life. Frequent/periodic inspections and maintenance of rope is recommended for

preventing premature wear and to insure long-term satisfactory performance.

NOTE: Refer to *Wire Rope Lubrication*, page 7-10 for wire rope lubrication requirements.

Dynamic Shock Loads

Subjecting rope to abnormal loads beyond the endurance limit will shorten the rope life expectancy. Examples of this type of loading are listed below.

- High velocity movement, for example; hoisting or swinging of a load followed by abrupt stops.
- Suspending loads while traveling over irregular surfaces such as railroad tracks, potholes, and rough terrain.
- Lifting a load that is beyond the rated capacity of the lifting mechanism, such as overloading.

Precautions and Recommendations During Inspection

- Always use safety glasses for eye protection.
- Wear protective clothing, gloves, and safety shoes as appropriate.
- Measure the rope's diameter across crowns of the strands when determining if rope has become damaged, refer to Figure 8-1.

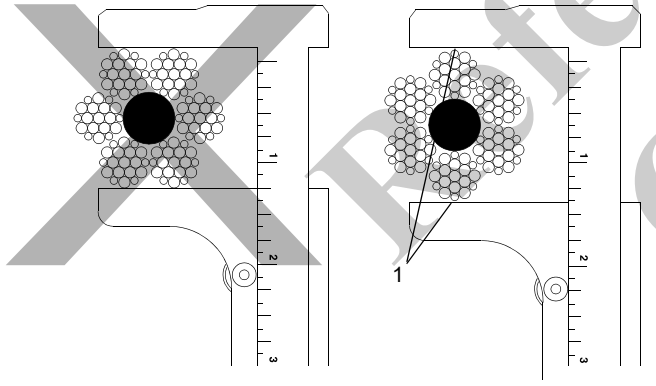


FIGURE 8-1

Inspection

All hoist rope in service needs to be inspected on a daily, monthly, and quarterly basis. Rope which has been idle for a period of a month or more must be given a thorough inspection before it is placed in service. These inspections should cover all types of deterioration including:

- Distortion such as kinking, crushing, un-stranding, bird caging, main strand displacement or core protrusion.
- Loss of rope diameter in a short rope length or unevenness of outer strands indicates the rope needs to be replaced.
- Significant corrosion.
- Broken or cut strands.
- Number, distribution and type of visible broken wires.
- Core failure in rotation resistant ropes.
- Prior electrical contact with a power line or other electric arc damage.
- Significantly corroded, cracked, bent, or worn end connections.

Only inspect the outer surface of a rope. Never attempt to open the rope.

Pay particular attention to areas of the rope where wear and other damage is likely to occur:

- Pick-up Points: Sections of wire rope that are repeatedly stressed during each lift, such as those sections in contact with sheaves.
- End Attachments: The point where a fitting is attached to the wire rope or the point where the wire rope is attached to the hoist drum.
- Abuse Points: The point where the wire rope is subjected to abnormal scuffing and scraping.

Daily Inspections

All rope in continuous service must be inspected at the beginning of each work day. Inspect the eye end and length of rope that is used in daily operation. The end should be inspected for abrasion, corrosion, broken wires, and loose or broken servings. Inspect the remainder of the rope length used for daily operations for points showing kinks, sharp bends, or any other evidences of damage or excessive wear.

Monthly Inspections

Inspect the eye end and length of rope normally used in daily operations. Examine the rest of the cable for kinked, crushed or otherwise damaged points.

Periodic Inspections

All rope should be inspected periodically/annually, or at a shorter time interval, if necessitated by environmental or other adverse conditions, and shall cover the entire length of the rope. Periodic inspection should include all previous items listed under Inspection, plus the following:

- Inspect for severely corroded or broken wires at end connections.
- Inspect rope in areas subjected to rapid deterioration such as:

- Sections in contact with saddles, equalizer sheaves, or other sheaves where rope travel is limited.
- Sections of rope at or near terminal ends where corroded or broken wires may protrude.

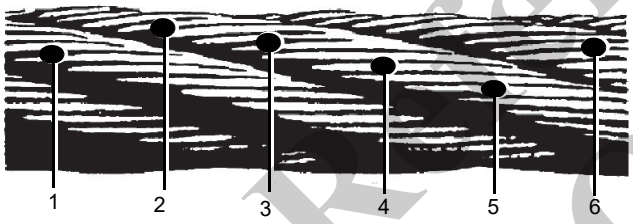
• Inspect boom nose sheaves, hook block sheaves, boom extension/extension sheaves, auxiliary boom nose sheaves, and hoist drums for wear. Damaged sheaves or hoist drums can accelerate wear and cause rapid deterioration of the rope.

Inspect the eye end of the rope for greater wear than the rest of the rope. If the rope is in good condition, reverse the rope on the drum so that the wear is equalized along the total length of the rope.

Wire Rope Replacement

It is difficult to determine the exact time for replacement of wire rope (hoist rope) since many variable factors are involved. Proper determination of the condition of a rope depends upon the judgment of an experienced person. The following reasons are sufficient for consideration of rope replacement:

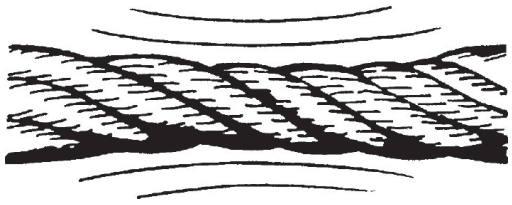
• Six randomly distributed broken wires in one rope lay or three broken wires in one strand in one lay. The rope is unsafe for further use if there are either three broken wires in one strand (Breaks 2, 3, 4) or a total of six broken wires in all strands in any one lay.



• In rotation resistant ropes: two randomly distributed broken wires in six rope diameters or four randomly distributed broken wires in 30 rope diameters

• Wear of one-third the original diameter of outside individual wires. Worn rope, usually indicated by flat spots on the outer wires is unsafe for further use when less than two-thirds the thickness of the outer wire remains.

• Necking down of the rope indicates core failure.



• Kinking, crushing, bird caging, or any other damage resulting in distortion of the rope structure.

• Evidence of heat damage.

• Reductions from nominal diameter of more than:

- 0.0156 in (.4 mm) for rope diameters to 0.313 in (8 mm)
- .8 mm (0.031) for rope diameters 9.5 mm (0.375 in) to 12.7 mm (0.50 in)
- 1.2 mm (0.047 in) for rope diameters 14.3 mm (0.561 in) to 19.1 mm (0.75 in)
- 1.6 mm (0.063) for rope diameters 22.2 mm (0.875 in) to 28.6 mm (1.125 in).

• One outer wire broken at its point of contact with the core of the rope which has worked its way out of, and protrudes or loops out from the rope structure.

Care of Wire Rope

Handle wire rope with care to prevent damage to the individual wires which affect the overall strength and performance of the rope. Do not allow the formation of kinks, because this displaces the strands of wire from their original position and relation to each other causing severe bending and unequal tensions in the strands. This distortion and wire displacement cannot be corrected even under high tension and a permanent weak point remains in the rope. Displaced or raised wires indicate a previous kink, but does not show the damaged condition of the inner rope wires.

Never pull wire rope over a non-rotating support such as a spindle bar, a pin, or an inoperative sheave. This practice causes severe abrasion to the outer strand wires. A properly operating sheave or snatch block is essential to safety and long service life of the rope.

Do not use worn sheaves or sheaves with flat grooves because they do not provide sufficient support to prevent the distortion and flattening of the rope. Sheaves with nicked or broken flanges can cut or otherwise damage the rope.

An even distribution of rope coils over the hoist drum is essential to smooth operation. This prevents the rope from cutting down through or crushing other coils on the drum resulting in damage to and difficulty in unwinding the rope.

REPLACEMENT CABLE

If the hoist cable needs to be replaced, care should be taken in selecting a suitable replacement cable. The cable strength requirements are shown on the equipment load chart. The types of cable are optional with 6 x 25 and Dyform being the most common. A high strength, rotation resistant cable is preferred and is furnished as standard by National Cranes. This cable eliminates single part line load spin and prolongs cable life. It also eliminates load block spin up when multi-part reeving is used.

EQUIPMENT ADJUSTMENTS AND REPAIRS

Before adjustments and repairs are started on equipment, read and be familiar with the safety information outlined under *Maintenance*, page 2-25.

Boom Extension Cable

If a cable replacement is required for the boom extension system, the replacement cable must be obtained through the Manitowoc Crane Care. Extension cables are pre-stretched and have special connections for proper operation.

NOTE: Manitowoc recommends that boom extension cables be replaced every seven (7) years.

Jib Jack Service and Maintenance

Important: Use only a good grade hydraulic jack oil, transmission oil, or turbine oil. Avoid mixing types of oil. Do not use brake fluid, alcohol, glycerin, detergent motor oil, or dirty oil. Improper fluid can cause serious internal damage to the jack rendering it inoperative.

Adding Oil to the Jib Jack

To add oil to the jib jack, do the following:

1. Set the jack in an upright level position.
2. Lower the saddle and make sure the piston is fully depressed.
3. Remove the oil filler plug.
4. Fill until the oil is level with the filler plug hole.

Changing the Jib Jack Oil

For best performance and longest life, replace the oil at least once a year. To change oil, do the following:

1. Remove the filler plug.
2. Lay the jack on its side and drain the oil into a suitable drain pan. The oil will run slowly because air must enter as oil drains out.
3. Be careful to prevent dirt or foreign matter from entering the system.
4. Replace with proper oil as described above.

Lubrication

Add proper lubrication oil to all pivoting sections every three months.

Rust Prevention

Check the ram every three months for any sign of rust or corrosion. Clean as needed and wipe with an oil saturated cloth.

NOTE: When not in use, always leave the saddle and ram all the way down.

HYDRAULIC SYSTEM

Oil Cooler

The heat exchanger must be kept clean for efficient operation of the hydraulic cooler system. Wash the heat exchanger core frequently to eliminate oil film, road dirt, and other foreign object buildup on the heat exchanger fins.

Frequent inspection and tightening of hose clamp eliminates the possibility of end connection failure due to back pressure from a cold startup.

If the cooler system fails to provide adequate performance, reduced air or oil flow through the heat exchanger is the probable cause. Inspect the cooling fan for proper operation. Any obstructions to air flow should be corrected (cooler too close to other truck components, foreign matter in heat exchanger fins, etc.) All hydraulic lines should be periodically checked for obstructions, hose kinks or other flow restrictions.

Hydraulic System Trouble Diagnosis

The following chart lists malfunctions which may occur during equipment operation, followed immediately by possible cause and possible solution. These are not all inclusive but are designed to help isolate the problem and should be checked before calling the factory Service Department.

Condition	Possible Cause	Possible Solution
No response to control	RCL system inoperative.	Insure the RCL system is working properly and the anti-two-block solenoid is powered.
	Load too heavy.	Check load chart.
	PTO not engaged.	Engage PTO.
	Low hydraulic fluid supply.	Check and fill as required.
	Suction line blocked.	Drain tank and hose and remove blockage.
	Broken hydraulic pressure line.	Replace as required.
	Defective hydraulic pump.	See Pump Service Manual.
	Incorrect relief valve setting.	Adjust relief).
	Relief valve sticking.	Clean relief.
Poor hydraulic system performance	Pump not operating at proper speed.	Check PTO ratio, pump size and engine speed for proper oil flow.
	Low hydraulic fluid supply.	Check and fill as required.
	Relief valve sticking.	Remove and clean.
	Relief setting too low.	Readjust to proper setting.
	Worn pump, motor or cylinder.	Replace bad part.
	Plugged filter.	Change filter.
	Boom holding valves out of adjustment.	Adjust or clean as required.
	Oil temperature too high.	Run engine at idle with controls in the neutral position until hydraulic oil light goes out.
	Hydraulic oil too cold or dirty.	Warm oil or use less viscous oil.
	Line restricted.	Check lines; clean and repair as required.
	Internal control valve crack.	Replace valve.
	Load too heavy.	Check load chart and reduce load.
Swing moves erratic or sloppily (Standard system).	Loose turntable bearing.	Torque bearing mounting bolts.
	Loose swing gearbox mounting bolts.	Tighten bolts.
	Worn gears or bearing.	Replace worn parts or adjust gearbox spacing.
	Operator control of lever too erratic.	Operate controls smoothly.
	Motor counterbalance valves dirty or not set properly.	Clean or replace counterbalance valves.
	Brake not holding properly.	Replace worn brake parts or shim brake to proper torque.
	Brake releasing at wrong time or erratically.	Bleed air from brake with bleed screw on side of brake.
	Swing speed adjustment set too low.	Adjust or clean brake for proper release.
		Adjust valve on turn motor.

Condition	Possible Cause	Possible Solution
Swing will not turn (Standard System)	Turn circuit relief valves sticking.	Clean and check circuit pressure.
	Turntable bearing drag.	Lubricate thoroughly as rotating boom.
	Brake not releasing properly.	Check brake pilot pressure. Clean pilot line or adjust motor counterbalance valves.
	Swing speed adjustment set too low.	Adjust or clean brake for proper release.
		Adjust valve on turn motor.
Excessive pump noise during operation.	Excessive pump speed.	Adjust foot throttle or check for too high PTO ratio.
	Low oil temperature.	Allow unit to warm up.
	Low hydraulic oil supply.	Check and fill.
	Suction line kinked, collapsed or blocked.	Clear blockage.
	Hydraulic oil too thick.	Warm oil or use oil more applicable to environment.
	Relief valve chattering.	Dirt in relief valve or damaged relief.
	Hydraulic tubing vibration.	Check for loose tubing.
	Tank breather plugged.	Clean breather.
Cylinders drift	Not getting oil to cylinders.	Clean and replace as required.
	Worn or damaged piston seals.	Replace as required.
	Air in hydraulic oil.	Cycle equipment cylinder to remove air.
	Loose holding valve.	Tighten valve.
	Dirt in holding or check valve.	Clean valve.
Hoist will not lift or hold load.	Load too heavy.	Check load and change to applicable multipart reeving.
	Relief valve setting too low.	Check and adjust if required.
	Motor worn excessively.	Replace motor.
	Counterbalance valve defective or leaking.	Clean and replace as necessary.
	Anti-two-block system defective.	Repair anti-two-block system.
	Brake worn out.	Repair or replace brake.
Hoist gearbox heats.	Gearbox grease low.	Check and fill as required.
	Duty cycle too high.	Reduce cycle time or speed of Hoist.
Boom chatters during extension/retraction or doesn't proportion properly.	Boom sections need lubrication.	Grease boom.
	Wear pads not shimmed correctly.	Re-shim as described in boom assembly section.
	Worn wear pads.	Replace pads.
	Extension cables out of adjustment.	Readjust cables and tension properly.
	Extend or retract cables broken.	Disassemble, inspect, and replace cables.
Boom will not extend.	Proportioning cables not attached.	Reconnect, replace and/or adjust cables.
	Anti-two-block system shut down.	Lower hook, and extend load.
	Defective anti-two-block system	Repair ATB if defective.

Condition	Possible Cause	Possible Solution
System is in a state of constant cut-out.	Blown fuse.	Check fuse at equipment cab console. Replace if necessary.
	ATB switch open.	Ensure that ATB switch is closed.
System cuts out too early or too late.	RCL programmed wrong.	Reprogram RCL with correct lift values.
Jib Jack Troubleshooting		
Will not lift load.	No oil in system. Release valve not closed.	Add oil to reservoir. Turn handle clockwise tightly.
Will lift load only part way.	Oil level low.	Add oil to reservoir tank.
Will lift load but will not hold.	The following valve or valves leaking. a. Suction valve b. Delivery valve c. Release valve	Replace jack
	Packings worn or damaged.	Replace jack
Jack will not lower.	Release valve stuck, probably dirt or foreign matter.	Transfer load then replace dirty oil, flush oil reservoir with non-flammable solvent.
Poor lifting.	Dirty oil. Air in hydraulic system.	Change oil. Purge air from system.
Poor pumping action.	Oil seal for pump unit worn in out or damaged.	Replace jack.

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SECTION 9
MAINTENANCE CHECKLIST - AERIAL LIFT

SECTION CONTENTS

INSPECTION AND MAINTENANCE

Regularly scheduled inspection and maintenance intervals are required to keep the equipment in peak operating condition. The following pages outline the inspection and maintenance intervals for Aerial Lift ANSI/SAIA A92.2-2015.

Refer to *Maintenance Checklist - Crane*, page 8-1 for information relating to ASME B30.5 Crane Lifting inspections and maintenance intervals.

Refer to the Service Manual for complete instructions on performing maintenance on this equipment.

General Inspections

1. All maintenance, inspection and testing must be accomplished by trained and qualified personnel in accordance with ANSI/SAIA A92.2-2015, Sections 8 and 10 of this National Cranes and Aerial Lifts Operator Manual and Service Manuals.
2. Inspection requirements for owners and operators of aerial lifts are defined and set forth in Sections 8 and 10 of ANSI/SAIA A92.2-2015 Standard for Vehicle-Mounted Elevating and Rotating Aerial Devices.
   a. Pre-start or Frequent Inspection and Test - to be performed by the operator daily or at the start of each shift.
   b. Periodic Inspection and Test - to be performed by the owner of the aerial lift at one to twelve month intervals depending upon its activity, severity of service, and environment. This inspection shall include the requirements of the pre-start or frequent inspection test.
3. Inspection and test requirements are found in ANSI/SAIA A92.2-2015 Sections 8.2.3, 8.2.4, 8.2.5 and 10.8.1 as well as applicable portions of SECTION 5 of this National Cranes and Aerial Lifts Operator Manual.
4. In addition to the above inspection and test requirements, a Post Event Inspection and Test shall be performed after any reported event during which structural members of the aerial lift or mobile unit are suspected of being subjected to loading or stresses in excess of design stress such as after an accident involving overturning of the mobile unit or application of unintended external mechanical or electrical forces to the aerial lift. The aerial lift shall be removed from service and subjected to the applicable periodic inspection requirements defined in ANSI/SAIA A92.2-2015 and National Cranes and Aerial Lifts Operator Manual. In addition to the periodic inspection, supplemental non-destructive examination procedures or other tests to assist in detecting possible structural damage to the aerial device may be required.
5. All damaged items shall be replaced or repaired before the aerial lift is returned to service. Return to service shall be approved by an authorized Manitowoc distributor and/or Manitowoc Crane Care.
6. Since Manitowoc has no direct control over field inspection, testing and maintenance, safety while accomplishing these procedures is the responsibility of the owner/operator. For questions concerning maintenance, inspection or testing, contact your local Manitowoc distributor or Manitowoc Crane Care.

DANGER

Fall Hazard!

Do not, under any circumstances, work at an elevated height without using proper fall protection as required by local, state or federal regulations

WARNING

If any deficiency or malfunction during these inspections or tests is discovered, the aerial lift must be removed from service until the deficiency or malfunction is corrected.

To avoid injury, do not operate a malfunctioning aerial lift.

Pre-Start or Frequent Inspections

1. It is the operator's responsibility to inspect the aerial lift at the start of each work day or at the start of each work shift.
2. Inspection requirements for the pre-start inspection for the aerial lift are found in Section 10.8.1 of ANSI/SAIA A92.2-2015 Responsibilities Manual provided with the aerial lift.
3. Inspection requirements for the aerial lift pre-start or frequent inspection are found in this manual under Daily Inspection/Pre-Use and Weekly Inspections.
4. In addition to the above, the following require inspection:
   a. Aerial lift work platform:
      - Integrity of platform floor and railing system - no loose or missing parts or no visible damage. Security of lanyard attachment points.
      - Footswitch in good working order, not modified, disabled or blocked.
      - All decals and placards in place and legible.
      - Operator's Manual and ANSI/SAIA A92.2 - 2015 Responsibilities Manual in place in manual storage container and legible.
      - Gate latching mechanism operating properly and undamaged.
      - Platform floor clean and free of obstructions.
   b. Aerial Lift Work Platform Controls:
      - Remote control attached to platform railing.
      - Switches return to neutral and properly secured.
      - No loose or missing parts, no visible damage.
      - Decals, placards and control markings secure and legible.
      - RCL system operating properly.
   c. Aerial Lift Work Platform Attachment Structure:
      - No loose or missing parts, no visible damage such as dents or cracks.
      - Platform leveling cylinder - properly lubricated, attachment pins secure, no visible damage or leakage, no evidence of debris or obstructions.

Pre-Start Functional Test

1. Functional test of all systems and functions of the aerial lift must be performed after the pre-start or frequent inspection is completed, in an area free of overhead and ground level obstructions:
   a. Properly set up aerial lift on fully extended outriggers.
   b. Using the ground control station, check all aerial lift functions controlled by the ground controls.
   c. Using the platform control station and using all appropriate personal protection equipment, check all aerial lift functions controlled by the platform controls.
   d. Platform footswitch/ground controls enable system.
      - Verify that boom functions - lift, telescope and swing - will not function unless the footswitch or ground enable systems are activated.
      - Verify that boom functions - lift, telescope and swing stop immediately upon release of the footswitch.

Periodic Inspection and Test:

1. It is the owner's responsibility to inspect and test the aerial lift at one to twelve month service intervals depending upon its activity, severity of service and environment.
2. Inspection requirements for the periodic inspection or test for the aerial lift are found in Section 8.2.4 of ANSI/SAIA A92.2-2015 Manual of Responsibilities provided with the aerial lift.
3. This inspection shall include all of the requirements of the pre-start or frequent inspection and test.

Inspections

The inspection intervals listed below are to be conducted on the equipment to ensure safe and proper operation. Refer to the *Service Manual* when installing missing or loose fasteners. Should a deficiency be found, a determination must be made as to whether the deficiency is a safety hazard or though not yet a safety hazard, needs to be monitored The inspections are separated into the following frequency classifications:

- Daily inspections - performed by the operator at the start of the day.
- Periodic inspections - performed by maintenance personnel at least every three months and includes all items listed under daily, weekly, and monthly inspections. Federal Laws through and ANSI/SAIA A92.2-2015 require that dated and signed records of these periodic inspections be kept. An inspection log book is available from your National Crane distributor or Manitowoc Crane Care.

⚠ WARNING

If any deficiency determined during the inspection is a safety hazard the machine must be removed from service and the deficiency corrected.

Daily Inspections/Pre-use

Check the following items:

1. Loose parts or damage to structures or welds.
2. Operation safety equipment.
3. Lubrication as specified by the *Lubrication*, Section 7.
4. Evidence of oil leaks from hoses.
5. Hand and foot controls for malfunction or incorrect adjustment.
6. Boom proportioning to insure that all boom sections extend and retract equally.
7. All securing hardware such as cotter pins, snap rings, hairpins, pin keepers, and capscrews for proper installation.
8. Proper condition and operation of RCL and anti-two-block systems power cords, audible alarms, and indicators on the Remote Controller.
9. Control and drive mechanisms for excessive wear and/or contamination from lubricants, water or other foreign matter.

Weekly Inspections

Refer to *Maintenance Checklist - Crane*, page 8-1 for information relating to additional inspections and maintenance intervals.

Monthly Inspections

Refer to *Maintenance Checklist - Crane*, page 8-1 for information relating to additional inspections and maintenance intervals.

Periodic/Annual Inspection

Refer to *Maintenance Checklist - Crane*, page 8-1 for information relating to additional inspections and maintenance intervals.

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SECTION 10
SPECIFICATIONS

SECTION CONTENTS

10

Dimensional Drawing

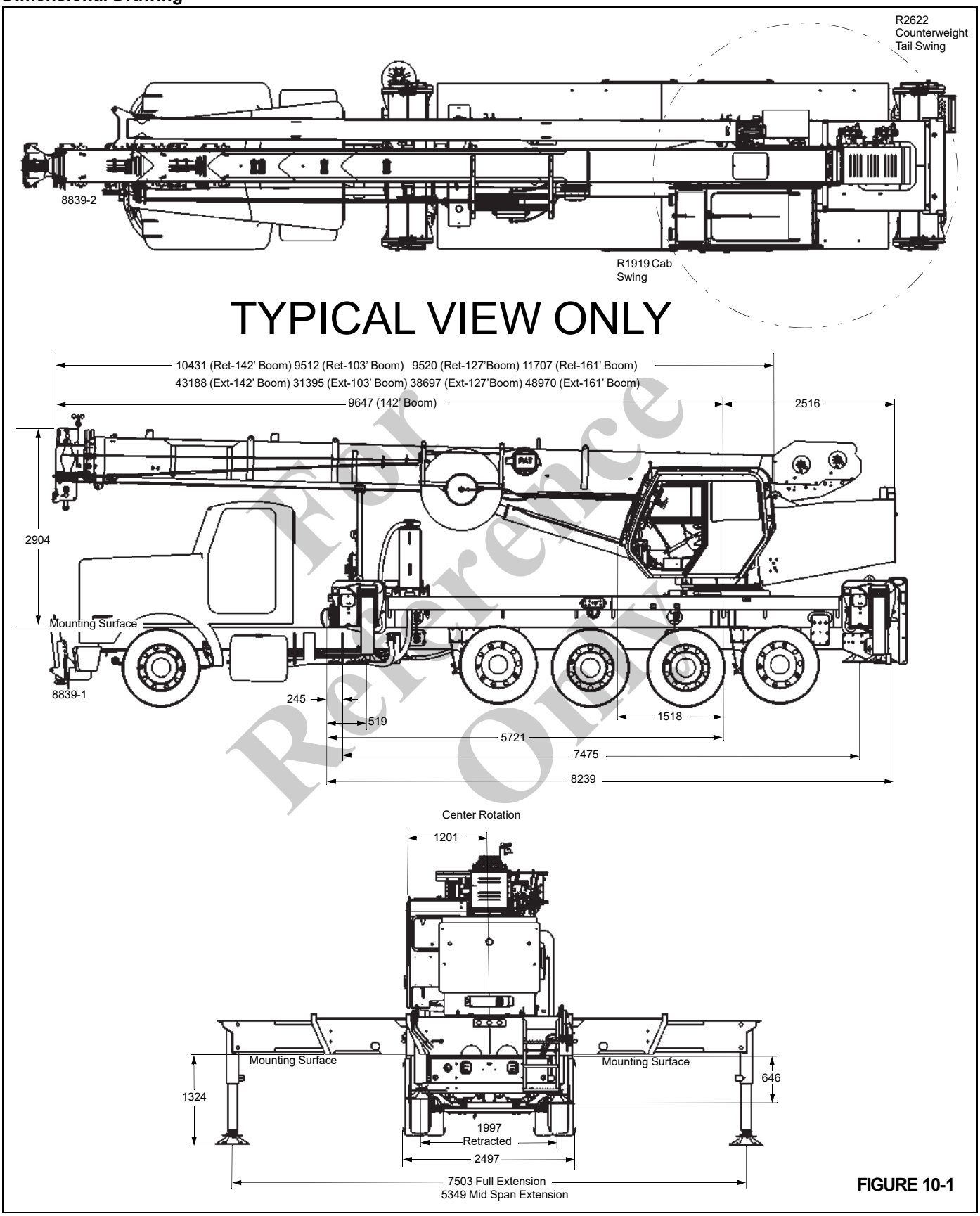

FIGURE 10-1

TIRE LOAD AND INFLATION TABLE

Definite tire inflation pressures are established for each tire size depending upon the load imposed on the tires. For greater stability, riding comfort and prolonged tire life, tires should be inflated for the loads carried. The “Load and inflation Table” shown below indicates the proper inflation pressure.

NOTE: The values in the tables below are as published by the Tire and Rim Association 2005. Your vehicle may be equipped with other tire sized or the same size tires rated differently. Always check the tire sidewalls to verify the maximum capacity and inflation. Inflation pressure and loading must not exceed the values shown on the wheel or rim.

Tire and Load Inflation Tables

Letters in parenthesis denote the load range for which the bold face loads are a maximum. International load index numbers are shown after the load range. The load range letters and corresponding ply rating are shown below.

D = 8 ply • E = 10 ply • F = 12 ply • G = 14 ply
H = 16 ply • J = 18 ply • L = 20 ply • M = 22 ply • N = 24 ply

Radial Ply Metric Tires for Trucks, Busses, and Trailers Used in Normal Highway Service
Radial Ply Tires Mounted on 15° Drop Center Rims
Tire and Rim Association Standard

TABLE TBM-2R

TIRE SIZE DESIGNATION	USAGE	TIRE LOAD LIMITS (kg/lbs.) AT VARIOUS COLD INFLATION PRESSURES (kPa/psi)											
		450 *65*	480 *70*	520 *75*	550 *80*	590 *85*	620 *90*	660 *95*	690 *100*	720 *105*	760 *110*	790 *115*	830 *120*
295/60R22.5	DUAL	1750 *3860*	1830 *4040*	1930 *4245*	2000 *4410*	2030 *4480*	2120 *4665*	2240 *4940*	2280 *5025*	2360 *5195*	2430 *5355*	2510 *5535*	**2575**(H) 141 ***5675***(H)
	SINGLE	1850 *4080*	1950 *4300*	2050 *4515*	2120 *4675*	2230 *4925*	2330 *5125*	2430 *5355*	2500 *5520*	2590 *5710*	2650 *5840*	2760 *6085*	**2800**(H) 144 ***6175***(H)
225/70R19.5	DUAL	**1180**(D) 114 ***2600***(D)	1230 *2720*	1300 *2860*	**1360**(E) 119 ***3000***(E)	1410 *3115*	1470 *3245*	**1550**(F) 123 ***3415***(F)	1580 *3490*	1640 *3615*	**1700**(G) 126 ***3750***(G)		
	SINGLE	**1250**(D) 116 ***2755***(D)	1310 *2895*	1380 *3040*	**1450**(E) 121 ***3195***(E)	1500 *3315*	1570 *3450*	**1650**(F) 125 ***3640***(F)	1690 *3715*	1740 *3845*	**1800**(G) 128 ***3970***(G)		
245/70R19.5	DUAL				1550 *3415*	1590 *3515*	1660 *3655*	**1750**(F) 127 ***3860***(F)	1790 *3940*	1850 *4075*	**1950**(G) 131 ***4300***(G)	1970 *4345*	**2060**(H) 133 ***4540***(H)
	SINGLE				1650 *3640*	1700 *3740*	1770 *3890*	**1850**(F) 129 ***4080***(F)	1900 *4190*	1970 *4335*	**2060**(G) 133 ***4540***(G)	2095 *4620*	**2180**(H) 135 ***4805***(H)
265/70R19.5	DUAL				1700 *3750*	1780 *3930*	1860 *4095*	1950 *4300*	2000 *4405*	2000 *4415*	**2120**(G) 134 ***4675***(G)		
	SINGLE				1800 *3970*	1900 *4180*	1970 *4355*	2060 *4540*	2130 *4685*	2200 *4850*	**2300**(G) 137 ***5070***(G)		
305/70R19.5	DUAL				2060 *4540*	2120 *4670*	2200 *4860*	2300 *5070*	2370 *5230*	2450 *5410*	**2575**(H) 141 **5675**(H)	2620 *5770*	**2725**(J) 143 ***6005***(J)
	SINGLE				2240 *4940*	2330 *5130*	2420 *5340*	2500 *5510*	2610 *5745*	2700 *5945*	**2800**(H) 144 ***6175***(H)	2870 *6340*	**3000**(J) 146 ***6610***(J)

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Radial Ply Metric Tires for Trucks, Busses, and Trailers Used in Normal Highway Service
Radial Ply Tires Mounted on 15° Drop Center Rims
Tire and Rim Association Standard

TABLE TBM-2R Continued

TIRE SIZE DESIGNATION	USAGE	TIRE LOAD LIMITS (kg/lbs.) AT VARIOUS COLD INFLATION PRESSURES (kPa/psi)											
		450 *65*	480 *70*	520 *75*	550 *80*	590 *85*	620 *90*	660 *95*	690 *100*	720 *105*	760 *110*	790 *115*	830 *120*
255/70R22.5	DUAL				1800 *3970*	1860 *4110*	1940 *4275*	2000 *4410*	2020 *4455*	2090 *4610*	**2120(G)** [134] ***4675(G)***	2230 *4915*	**2300(H)** [137] ***5070(H)***
	SINGLE				1900 *4190*	1980 *4370*	2060 *4550*	2120 *4675*	2220 *4895*	2300 *5065*	**2360(G)** [138] ***5205(G)***	2450 *5400*	**2500(H)** [140] ***5510(H)***
305/75R22.5	DUAL				2360 *5205*	2440 *5375*	2540 *5595*	2560 *5840*	2730 *6025*	2830 *6235*	**3000(H)** [146] ***6610(H)***	3010 *6640*	**3150(J)** [148] ***6940(J)***
	SINGLE				2575 *5675*	2680 *5905*	2790 *6150*	2900 *6395*	3000 *6620*	3110 *6850*	**3250(H)** [149] ***7160(H)***	3310 *7300*	**3450(J)** [151] ***7610(J)***
315/80R22.5	DUAL				2575 *5675*	2650 *5840*	2750 *6070*	**2900(G)** [145] ***6395(G)***	2970 *6545*	3070 *6770*	**3150(H)** [148] ***6940(H)***	3270 *7210*	**3450(J)** [151] ***7610(J)***
	SINGLE				2800 *6175*	2910 *6415*	3030 *6670*	**3150(G)** [148] ***6940(G)***	3260 *7190*	3370 *7440*	**3450(H)** [151] ***7610(H)***	3590 *7920*	**3750(J)** [154] ***8270(J)***
305/85R22.5	DUAL				2430 *5355*	2520 *5550*	2620 *5780*	2725 *6005*	2820 *6215*	2920 *6435*	**3075(H)** [147] ***6780(H)***	3110 *6860*	**3250(J)** [149] ***7160(J)***
	SINGLE				2650 *5840*	2770 *6100*	2880 *6350*	3000 *6610*	3100 *6830*	3210 *7070*	**3350(H)** [150] ***7390(H)***	3420 *7540*	3550(J) [152] ***7830(J)***

Radial Ply Metric Tires for Trucks, Busses, and Trailers Used in Normal Highway Service
Radial Ply Tires Mounted on 15° Drop Center Rims
Tire and Rim Association Standard

TABLE TBM-1R

TIRE SIZE DESIGNATION	USAGE	TIRE LOAD LIMIT AT VARIOUS COLD INFLATION PRESSURES											
		kPa *psi*	480 *70*	520 *75*	550 *80*	590 *85*	620 *90*	660 *95*	690 *100*	720 *105*	760 *110*	790 *115*	830 *120*
245/75R22.5 235/80R22.5	DUAL	kg *lbs.*	1430 *3160*	1500 *3315*	1600 *3525*	1640 *3615*	1710 *3765*	1800 *3970*	1840 *4055*	1900 *4195*	**1950(G)** [131] ***4300(G)***		
	SINGLE	kg *lbs.*	1570 *3470*	1650 *3645*	1750 *3860*	1800 *3975*	1880 *4140*	1950 *4300*	2020 *4455*	2090 *4610*	**2120(G)** [134] ***4675(G)***		
265/75R22.5 255/80R22.5	DUAL	kg *lbs.*	1600 *3525*	1680 *3705*	1750 *3860*	1830 *4040*	1910 *4205*	2000 *4410*	2050 *4525*	2130 *4685*	**2180(G)** [135] ***4805(G)***		
	SINGLE	kg *lbs.*	1760 *3875*	1850 *4070*	1950 *4300*	2010 *4440*	2100 *4620*	2180 *4805*	2260 *4975*	2340 *5150*	**2360(G)** [138] ***5205(G)***		
295/75R22.5 275/80R22.5	DUAL	kg *lbs.*	1860 *4095*	1950 *4300*	2060 *4540*	2130 *4690*	2220 *4885*	**2300(F)** [137] ***5070(F)***	2390 *5260*	2470 *5440*	**2575(G)** [141] ***5675(G)***	2630 *5795*	**2725(H)** [143] ***6005(H)***
	SINGLE	kg *lbs.*	2040 *4500*	2140 *4725*	2240 *4940*	2340 *5155*	2440 *5370*	**2500(F)** [140] ***5510(F)***	2620 *5780*	2710 *5980*	**2800(G)** [144] ***6175(G)***	2890 *6370*	**3000(H)** [146] ***6610(H)***
285/75R24.5 275/80R24.5	DUAL	kg *lbs.*	1870 *4135*	1970 *4340*	2060 *4540*	2150 *4740*	2240 *4930*	**2360(F)** [138] ***5205(F)***	2410 *5310*	2490 *5495*	**2575(G)** [141] ***5675(G)***	2660 *5860*	**2800(H)** [144] ***6175(H)***
	SINGLE	kg *lbs.*	2060 *4545*	2160 *4770*	2240 *4940*	2360 *5210*	2460 *5420*	**2575(F)** [141] ***5675(F)***	2650 *5835*	2740 *6040*	**2800(G)** [144] ***6175(G)***	2920 *6440*	**3075(H)** [147] ***6780(H)***

Metric Wide Base Tires for Trucks, Busses, and Trailers Used in Normal Highway Service
Tires Used as Singles Mounted on 15° Drop Center Rims
Tire and Rim Association Standard

TABLE MWB-1	Tire Load Limits at Various Cold Inflation Pressures											
TIRE SIZE DESIGNATION	kPa *psi*	480 *70*	520 *75*	550 *80*	590 *85*	620 *90*	660 *95*	690 *100*	720 *105*	760 *110*	790 *115*	830 *120*
445/65R19.5	kg *lbs.*	3410 *7540*	3610 *7930*	3750 *8270*	3960 *8680*	4100 *9040*	4250 *9370*	4410 *9730*	4540 *10100*	**4750(J)** 162 ***10500*(J)**		
385/65R22.5	kg *lbs.*	2880 *6380*	3060 *6720*	3150 *6940*	3350 *7350*	3470 *7650*	3650 *8050*	3740 *8230*	3850 *8510*	4000 *8820*	4100 *9050*	**4250(J)** 158 ***9370*(J)**
425/65R22.5	kg *lbs.*	3430 *7590*	3640 *7990*	3750 *8270*	3980 *8740*	4130 *9100*	4250 *9370*	4440 *9790*	4580 *10100*	**4750(J)** 162 ***10500*(J)**	4880 *10700*	**5000(L)** 164 ***11000*(L)**
445/65R22.5	kg *lbs.*	3720 *8230*	3950 *8660*	4125 *9090*	4320 *9480*	4470 *9870*	**4625(H)** 161 ***10200*(H)**	4820 *10600*	4960 *11000*	5150 *11400*	5290 *11700*	**5600(L)** 168 ***12300*(L)**

Radial Ply Tires for Trucks, Busses, and Trailers Used in Normal Highway Service
Radial Ply Tires Mounted on 15° Drop Center Rims
Tire and Rim Association Standard

TABLE TTB-3R		TIRE LOAD LIMITS (kg/lbs.) AT VARIOUS COLD INFLATION PRESSURES (kPa/psi)										
TIRE SIZE DESIGNATION	USAGE	480 *70*	520 *75*	550 *80*	590 *85*	620 *90*	660 *95*	690 *100*	720 *105*	760 *110*	790 *115*	830 *120*
8R19.5	DUAL	1120 *2460*	1170 *2570*	**1215(D)** 115 ***2680*(D)**	1260 *2785*	1310 *2890*	**1360(E)** 119 ***3000*(E)**	1410 *3100*	1460 *3200*	**1500(F)** 122 ***3305*(F)**		
	SINGLE	1150 *2540*	1220 *2680*	**1285(D)** 117 ***2835*(D)**	1340 *2955*	1400 *3075*	**1450(E)** 121 ***3195*(E)**	1500 *3305*	1550 *3415*	**1600(F)** 124 ***3525*(F)**		
8R22.5	DUAL	1250 *2750*	1300 *2870*	**1360(D)** 119 ***3000*(D)**	1410 *3100*	1460 *3200*	**1500(E)** 122 ***3305*(E)**	1570 *3455*	1640 *3605*	**1700(F)** 126 ***3750*(F)**		
	SINGLE	1290 *2840*	1360 *2990*	**1450(D)** 121 ***3195*(D)**	1500 *3305*	1550 *3415*	**1600(E)** 124 ***3525*(E)**	1670 *3675*	1740 *3825*	**1800(F)** 128 ***3970*(F)**		
9R22.5	DUAL	1480 *3270*	1550 *3410*	1610 *3550*	1670 *3690*	**1750(E)** 127 ***3860*(E)**	1820 *4005*	1890 *4150*	**1950(F)** 131 ***4300*(F)**	2010 *4425*	2070 *4550*	**2120(G)** 134 ***4675*(G)**
	SINGLE	1530 *3370*	1610 *3560*	1690 *3730*	1760 *3890*	**1850(E)** 129 ***4080*(E)**	1920 *4235*	1990 *4390*	**2060(F)** 133 ***4540*(F)**	2120 *4675*	2180 *4810*	**2240(G)** 136 ***4940*(G)**
10R22.5	DUAL	1750 *3860*	1830 *4045*	1910 *4230*	**2000(E)** 132 ***4410*(E)**	2080 *4585*	2160 *4760*	**2240(F)** 136 ***4940*(F)**	2300 *5075*	2360 *5210*	**2430(G)** 139 ***5355*(G)**	
	SINGLE	1850 *4080*	1940 *4280*	2030 *4480*	**2120(E)** 134 ***4675*(E)**	2200 *4850*	2280 *5025*	**2360(F)** 138 ***5205*(F)**	2430 *5360*	2500 *5515*	**2575(G)** 141 ***5675*(G)**	
11R22.5	DUAL	1990 *4380*	2080 *4580*	2160 *4760*	2250 *4950*	**2360(F)** 138 ***5205*(F)**	2460 *5415*	2560 *5625*	**2650(G)** 142 ***5840*(G)**	2680 *5895*	2710 *5950*	**2725(H)** 143 ***6005*(H)**
	SINGLE	2050 *4530*	2160 *4770*	2260 *4990*	2370 *5220*	**2500(F)** 140 ***5510*(F)**	2600 *5730*	2700 *5950*	**2800(G)** 144 ***6175*(G)**	2870 *6320*	2940 *6465*	**3000(H)** 146 ***6610*(H)**
11R24.5	DUAL	2110 *4660*	2210 *4870*	2300 *5070*	2390 *5260*	**2500(F)** 140 ***5510*(F)**	2580 *5675*	2660 *5840*	**2725(G)** 143 ***6005*(G)**	2820 *6205*	2910 *6405*	**3000(H)** 146 ***6610*(H)**
	SINGLE	2190 *4820*	2300 *5070*	2410 *5310*	2520 *5550*	**2650(F)** 142 ***5840*(F)**	2770 *6095*	2890 *6350*	**3000(G)** 146 ***6610*(G)**	3080 *6790*	3160 *6970*	**3250(H)** 149 ***7160*(H)**
12R22.5	DUAL	2170 *4780*	2260 *4990*	2350 *5190*	2440 *5390*	**2575(F)** 141 ***5675*(F)**	2630 *5785*	2680 *5895*	**2725(G)** 143 ***6005*(G)**	2840 *6265*	2960 *6525*	**3075(H)** 147 ***6780*(H)**
	SINGLE	2240 *4940*	2360 *5200*	2470 *5450*	2580 *5690*	**2725(F)** 143 ***6005*(F)**	2820 *6205*	2910 *6405*	**3000(G)** 146 ***6610*(G)**	3120 *6870*	3240 *7130*	**3350(H)** 150 ***7390*(H)**
12R24.5	DUAL	2300 *5080*	2400 *5300*	2500 *5520*	2600 *5730*	**2650(F)** 142 ***5840*(F)**	2770 *6095*	2890 *6350*	**3000(G)** 146 ***6610*(G)**	3080 *6790*	3160 *6970*	**3250(H)** 149 ***7160*(H)**
	SINGLE	2380 *5240*	2500 *5520*	2630 *5790*	2740 *6040*	**2900(F)** 145 ***6395*(F)**	3020 *6650*	3140 *6910*	**3250(G)** 149 ***7160*(G)**	3350 *7380*	3450 *7600*	**3550(H)** 152 ***7830*(H)**

SPECIFICATIONS

PTO

PTO Minimum Torque Rating	644 Nm (475 lb-ft)
PTO Minimum Horsepower Rating	67 kW (90 hp) per 1,000 rpm of PTO shaft speed 148 KW (199hp) per 2,200 rpm of PTO shaft speed

Hydraulic

Hydraulic Pump	286 lpm (75.5 gpm) at 2,200 rpm, Variable displacement, axial piston with load sense
Displacement	130 cc/rev (7.93 in^3/rev)
Pressure Rating (rated)	320 bar (4,600 psi)
Pressure Rating (peak	345 bar (5,000 psi)
Case Refill Capacity	1.40 L (0.37 gal)
Minimum Operating Speed	600 rpm
Outrigger System	224 bar +/- 6.9 bar (3,250 psi +/-100 psi)
Boom Up	132.4 lpm at 314 bar (35 gpm at 4,550 psi)
Boom Down	64 lpm at 69 bar (17 gpm at 1,000 psi)
Telescope Extend	132.4 lpm at 200 bar (35 gpm at 2,900 psi)
Telescope Retract	64 lpm at 155.1 bar (17 gpm at 2,250 psi)
Aux/Main Hoist System & Relief	132.4 lpm at 296 bar (35 gpm at 4,300 psi)
Swing	68 lpm at 214 bar +13.7/-00 bar (18 gpm at 3,100 psi +200/-00 psi)
Swing Park Brake	Hydraulic released disc, released at 12 bar (175 psi)

Hydraulic Reservoir

Reservoir- Standard Capacity	379 L (100 gal)
Reservoir- XL Capacity	414.8 L (109.6 gal)
Reservoir Return Filter	5 micron
Reservoir Suction Filter	25 micron

Hydraulic Intensifier Valve - Optional

Hydraulic System	Open or Closed Center
Operating Pressure	96.5,-138 bar (1,400-2,000psi)
Flow Range	15-26.5 lpm (4-7 gpm)
Optimum Operating Pressure	.124 bar @ 22.7 lpm (1,800 psi @6 gpm)

Air Conditioner

Air Conditioner Hydraulic System Pressure	241 bar +/- 6.9 bar (3,500 +/-100 psi)
Minimum Evacuation Time	30 minutes
Refrigerant Charge Level	0.9 (+/-0.014)kg (2 lb(+/- 0.5 oz)
Refrigerant Type	R134a
Air Conditioner Lubrication Type	Polyalkylene Glycol (PAG)
Air Conditioner Compressor Lubrication Capacity	170.1 g (6 oz)
Air Conditioning Total System Lubrication Capacity	283.5 g (10 oz)

Hoist System

Wire Rope:	
Length	137 m (450 ft)
Diameter (Rotation Resistant)	16 mm (5/8 in)

Nominal Breaking Strength .....25,582 kg (56,400 lb)
Operating Pressure .....303.4 +/- 6.9 bar (4,400 +/-100 psi)
Flow .....132.4 lpm (35 gpm)

Hoist Line Pull/Layer		
Layer	**Low Speed kN (lb)**	**High Speed kN (lb)**
1	66.7 (15,000)	33.4 (7,516)
2	60.2 (13,529)	30.1 (6,765)
3	54.7 (12.299)	27.4 (6,150)
4	50.2 (11,275)	25.1 (5,637)
5	46.3 (10,407)	23.1 (5,204)

Line Speed (no load at high engine idle speed)		
Layer	**Low Speed m/sec (ft/sec)**	**High Speed m/sec (ft/sec)**
1	43.9 (144)	87.5 (287)
2	48.5 (159)	97.2 (319)
3	53.3 (175)	107.0 (351)
4	58.2 (191)	116.7 (383)
5	63.1 (207)	126.5 (415)

Equipment Operating Speeds

(Performance based on full governed rpm and 37.8°C (100°F) hydraulic reservoir temperature.)
Rotation 360° .....30 ± 7 sec (1.8 ± 0.2 rpm) Adjustment Knob Closed
Boom up -10° to 80° .....34 ± 5 sec
Boom Down 80° to -10° .....34 sec ± 5 sec
Boom Telescope.....(See Boom Telescope Speed Table)

Boom Telescope Speed (Angle 60°- no load at high engine speed)		
Boom Length	**Extend**	**Retract**
9.44 - 31.39m (31 - 103ft)	105 sec (± 10 sec)	105 sec (± 10 sec)
9.44 - 38.70m (31 - 127ft)	120 sec (± 10 sec)	120 sec (± 10 sec)
10.36 - 43.28m (34 - 142ft)	135 sec (± 10 sec)	135 sec (± 10 sec)
11.88 - 49.07m (39 - 161ft)	150 sec (± 10 sec)	150 sec (± 10 sec)

Outrigger Beam Extend.....10 sec ±3 sec
Outrigger Beam Retract .....10 sec ±3 sec
Outrigger Jack Extend.....10 sec ±3 sec
Outrigger Jack Retract .....10 sec ±3 sec

Counterweight

NBT36-1 Counterweight Slab .....N/A
NBT40-1 Standard Counterweight .....454 kg (1,000 lb)
NBT40-1 + 1000 lb Option Counterweight .....907 kg (2,000 lb)
NBT45-1 Standard Counterweight .....2041 kg (4,500 lb)
NBT45-1+ 1000 lb Option Counterweight .....2,494 kg (5,500 lb)
NBT45-1 TM.....454 kg (1,000 lb)

General

NBT36-1 ..... 32.6 metric tons (36 tons) at 2.13 m (7 ft) radius
NBT40-1 ..... 36.3 metric tons (40 tons) at 2.13 m (7 ft) radius
NBT45-1 ..... 40.8 metric tons (45 tons) at 2.13 m (7 ft) radius
*NBT36-1 103ft. Boom ..... 14,203 kg (31,313 lb), -205.5 cm (-80.9 in) HCG
*NBT36-1 127 ft Boom ..... 14,798 kg (31,623 lb), -214.1 cm (-84.3 in) HCG
*NBT40-1 103 ft Boom ..... 15,109 kg (33,441 lb), -179.3 cm (-70.6 in) HCG
*NBT40-1 127 ft Boom ..... 15,763 kg (34,751 lb), -188.7 cm (-74.3 in) HCG
*NBT40-1 142 ft Boom ..... 16,350 kg (36,046 lb), -210.8 cm (-83.0 in) HCG
*NBT40-1 103 ft EXTB ..... 15,727 kg (34,672 lb), -202.7 cm (-79.8 in) HCG
*NBT40-1 127 ft EXTB ..... 16,321 kg (35,982 lb), -210.8 cm (-83.0 in) HCG
*NBT40-1 142 ft EXTB ..... 16,909 kg (37,277 lb), -231.4 cm (-91.1 in) HCG
*NBT45-1 103 ft Boom ..... 16,741 kg (36,908 lb), -139.7 cm (-55.0 in) HCG
*NBT45-1 127 ft Boom ..... 17,335 kg (38,218 lb), -149.4 cm (-58.8 in) HCG
*NBT45-1 142 ft Boom ..... 17,922 kg (39,513 lb), -170.9 cm (-67.3 in) HCG
*NBT45-1 161 ft Boom ..... 18,401 kg (40,567 lb), - 205.2 cm (-80.8 in) HCG
*NBT45-1 103 ft EXTB ..... 17,300 kg (38,139 lb), -162.0 cm (-63.8 in) HCG
*NBT45-1 127 ft EXTB ..... 17,894 kg (39,449 lb), -170.7 cm (-67.2 in) HCG
*NBT45-1 142 ft EXTB ..... 18,481 kg (40,744 lb), -191.0 cm (-75.2 in) HCG
*NBT45-1 161 ft EXTB ..... 18,959 kg (41,798 lb), -224.0 cm (-88.2 in) HCG

NOTE: *The weights includes only the super structure, boom, counterweight t-box (EXTB= extended t-box), decking, lift cylinder, hydraulic reservoir and full fluids. Horizontal CG is measured from the centerline of the crane rotation (negative number indicates the HCG is towards the boom nose, not the hoists).

Boom Weight - including hoist/rope

103 ft Boom ..... 5,869 kg (12,940 lb)
127 ft Boom ..... 6,504 kg (14,339 lb)
142 ft Boom ..... 6,849kg (15,100 lb)
161 ft Boom .....7,854kg (17,315 lb)

MULTIPLE PART LINE REEVING

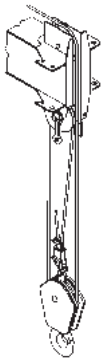
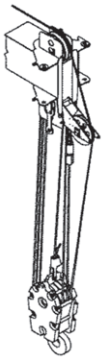
The hoist data chart provides information for pull limitations on the hoist with various multi-part reevings. These ratings are based on providing the proper operating safety factor on the rope supplied with the machine. Therefore, any replacement rope must meet the rope specification in this manual (*General*, page 10-8.)

All pulls shown in the following table are on the fourth layer. The line pulls increase and the speed decreases on the third, second, and first layers.

NOTE: Keep at least three wraps of wire rope and eight wraps of synthetic rope loadline on the drum at all times.

Do not deadhead hook block against boom tip when extending the boom.

Refer to load charts for all layers and rope capacities.

1 Part Line	2 Part Line	3 Part Line	4 Part Line	5 Part Line	6 Part Line	7 Part Line	8 Part Line
							
Maximum Pull Normal Speed 11,250 Lbs 191 fpm High Speed 5,000 Lbs 383 fpm	Maximum Pull Normal Speed 22,500 Lbs 95 fpm High Speed 10,000 Lbs 191 fpm	Maximum Pull Normal Speed 33,750 Lbs 63 fpm High Speed 15,000 Lbs 127 fpm	Maximum Pull Normal Speed 45,000 Lbs 47 fpm High Speed 20,000 Lbs 95 fpm	Maximum Pull Normal Speed 56,250 Lbs 38 fpm High Speed 25,000 Lbs 76 fpm	Maximum Pull Normal Speed 67,500 Lbs 31 fpm High Speed 30,000 Lbs 63 fpm	Maximum Pull Normal Speed 78,750Lbs 27 fpm High Speed 35,000 Lbs 54 fpm	Maximum Pull Normal Speed 90,000Lbs 23 fpm High Speed 40,000 Lbs 47 fpm
The hook block must be sized to the number of line parts. For example, do not use a six part line hook block on a three part line reeving. Contact your National Crane Distributor or Manitowoc Crane Care to order the proper hook block.							

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SECTION 11
SAFETY DECALS

SECTION CONTENTS

GENERAL

Capacity Chart

The capacity chart is stored in the crane's operator control station. The capacity chart contains lifting capacities of the crane in all allowable lifting configurations.

Safety Information

Information regarding Safety, Operation and Specifications Decals installation are included in the following section of this manual.

You must read and understand operator manual and all safety instructions.

It is the user's responsibility to follow manufacturer's instructions on machine operation, application, and observe pertinent laws and regulations and capacity charts before operating machine.

The machine is provided with specific warning and information signs.j

- Operating this equipment without all safety and control decals in place can be hazardous. Do not remove the signs.
- Refer to decals on equipment and operator manual for proper setup.
- Ensure that all signs and labels are undamaged and legible.
- Clean soiled labels with soap and water if necessary, do not use fuel or solvents.
- Replace damaged, scratched or illegible signs and labels.
- Signs and labels are available from Manitowoc CraneCare (see Spare parts catalog).

Warnings and Information Signs

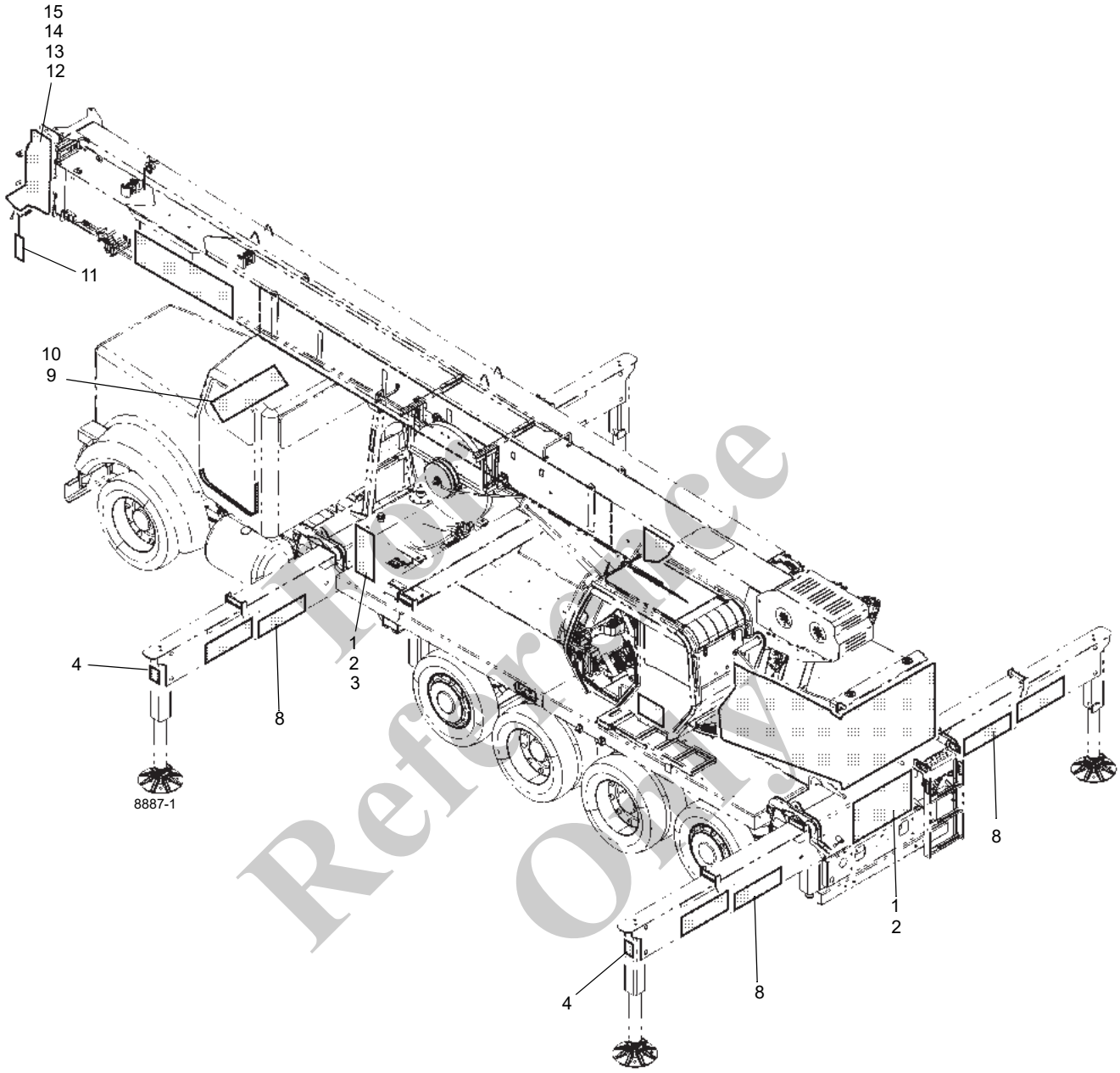


FIGURE 11-1

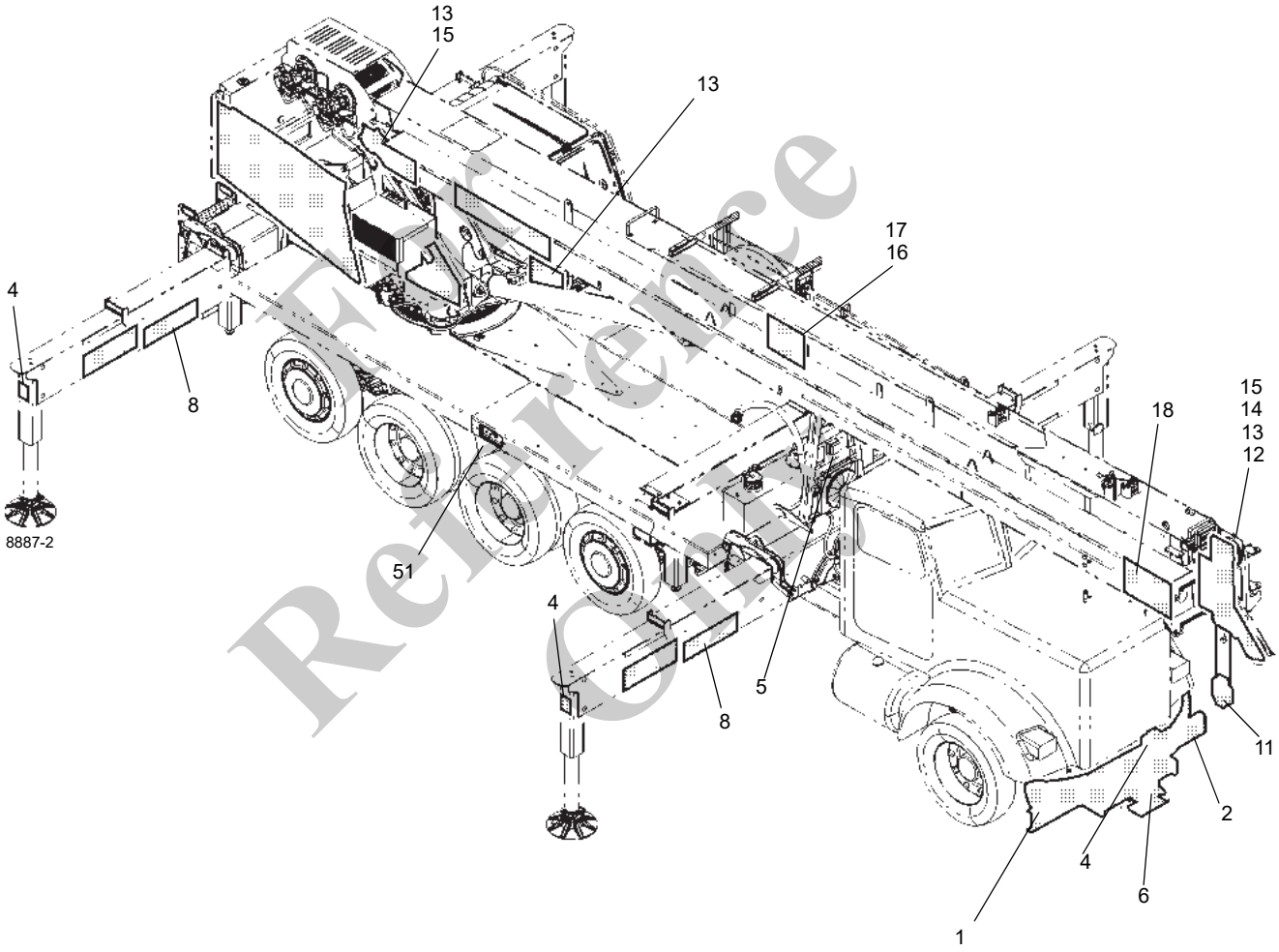
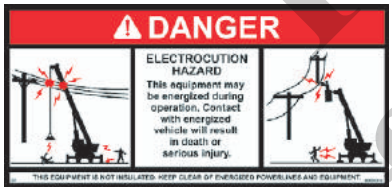
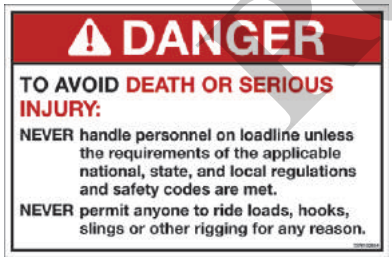
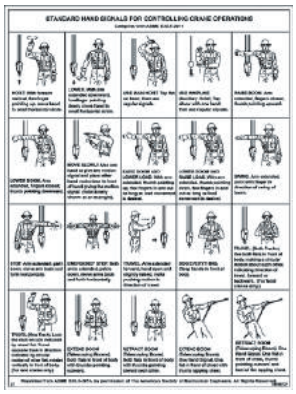


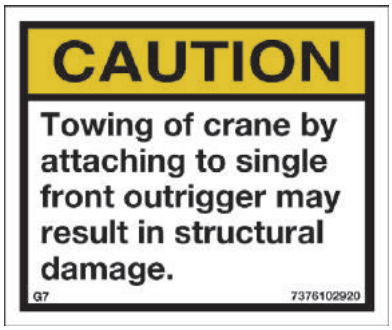
FIGURE 11-1

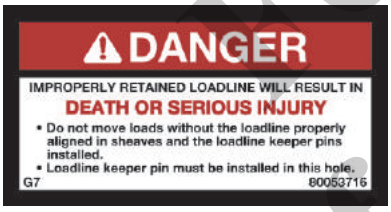
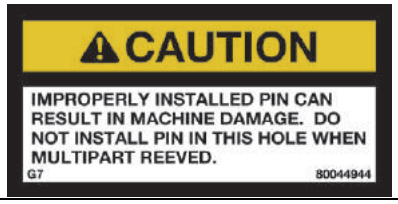
Item	Description
1	Decal-Danger Electrocution
2	Decal-Danger-Hoisting Personnel
3	Decal-Hand Signal
4	Decal-Danger-Crushing
5	Decal Caution-Powerwash
6	Decal-Caution
7	Decal-Danger S/S Crush
8	Decal-Danger Outrigger Crush
9	Decal-Danger Boom Transport

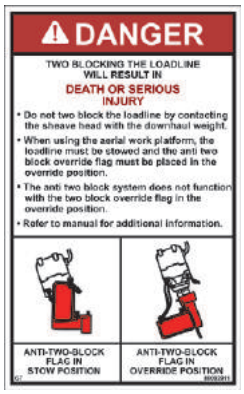
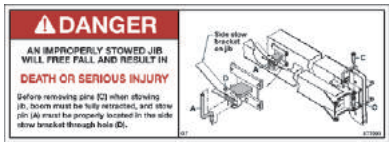
Item	Description
10	Decal-Danger Backup Alarm
11	Decal-Supporting Chain
12	Decal-Danger Loadline
13	Decal-Safety Harness
14	Decal-Caution-No Pin
15	Decal-Danger A2B Override
16	Decal-Boom Extension Fall
17	Decal-Boom Extension Pin Stowage
18	Decal-Boom Extension Crushing

Item	Decal	Explanation of Decal
1		**DANGER** **Electrocution Hazard** **This equipment may be energized during operation. Contact with energized vehicle will result in Death or Serious Injury**
2		**DANGER** **To Avoid Death or Serious Injury: Never handle personnel on loadline unless the requirements of the 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.**

Item	Decal	Explanation of Decal
3		**Hand Signals for Controlling Crane Operations**
4		**DANGER** **Crushing Hazard** **Contact with moving outriggers can result in Death or Serious Injury.** **Keep Clear of Outriggers.**
5		**CAUTION** **Do not power wash this unit with High Pressure Spray.** **Electronic equipment will be damaged.**

Item	Decal	Explanation of Decal
6		**CAUTION** **Towing of crane by attaching front outrigger may result in structural damage.**
7		**DANGER** **Swinging upper structure will cause Death or Serious Injury.** **Keep clear of upper structure.**
8		**DANGER** **Crushing Hazard** **Contact with a moving outriggers will cause Serious Crushing Injury.** **Keep Clear of Outriggers.**
9		**DANGER** **Failure to secure boom in boom rest during transport will result in Death or Serious Injury or property damage.** **Consult owners manual for proper storage information.**

Item	Decal	Explanation of Decal
10		**DANGER** **Failure to maintain the backup alarm will result in Death or Serious Injury.** **This vehicle is equipped with a backup alarm.** • **Alarm must sound when backing.** • **It is the driver's responsibility to operate this vehicle in a safe manner and keep alarm in operable condition.**
11		**Support Chain** **Rig supporting chain so loadline cannot come out of slot.**
12		**DANGER** **Improperly retained loadline will result in to avoid Death or Serious Injury** • **Do not move loads without the loadline properly aligned in sheaves and the loadline keeper pins installed.** • **Loadline keeper pin must be installed in this hole.**
13		**Safety Harness Attachment Point**
14		**Caution** **Improperly installed pin can result in Machine damage.** **Do not install pin in this hole when multi-part reeved.**

Item	Decal	Explanation of Decal
15		**DANGER** **Two Blocking the loadline will result in Death or Serious Injury** • **Do not two block the loadline by contacting the sheave head with the downhaul weight.** • **When using the aerial work platform, the loadline must be stowed and the anti-two-block override flag must be placed in the override position.** • **The anti two block system does not function with the two block override flag in the override position.** • **Refer to manual for additional information.**
16		**DANGER** **A free falling jib will result in Death or Serious Injury** • **Before operating the crane check that jib is properly secured. You must follow proper jib erection and stowing procedures. See crane manufacturer's manual.** • **Before removing pins (C) when stowing jib, boom must be level and fully retracted, and stow pin (A) must be properly located in the side stow bracket through hole (D).** • **Do not extend boom after removing jib swing pin (B) until boom is in level position.** • **When stowing or erecting jib, boom must be in level position.**
17		**DANGER** **Improperly stowed jib will result in Death or Serious Injury** Stow pin (A) must be in stow bracket NOT here when jib is stowed.
18		**DANGER** **An improperly stowed jib will result in Death or Serious Injury** **Before removing pins (C) when stowing jib, boom must be fully retracted, and stow pin (A) must be properly located in the side stow bracket through hole (D).**

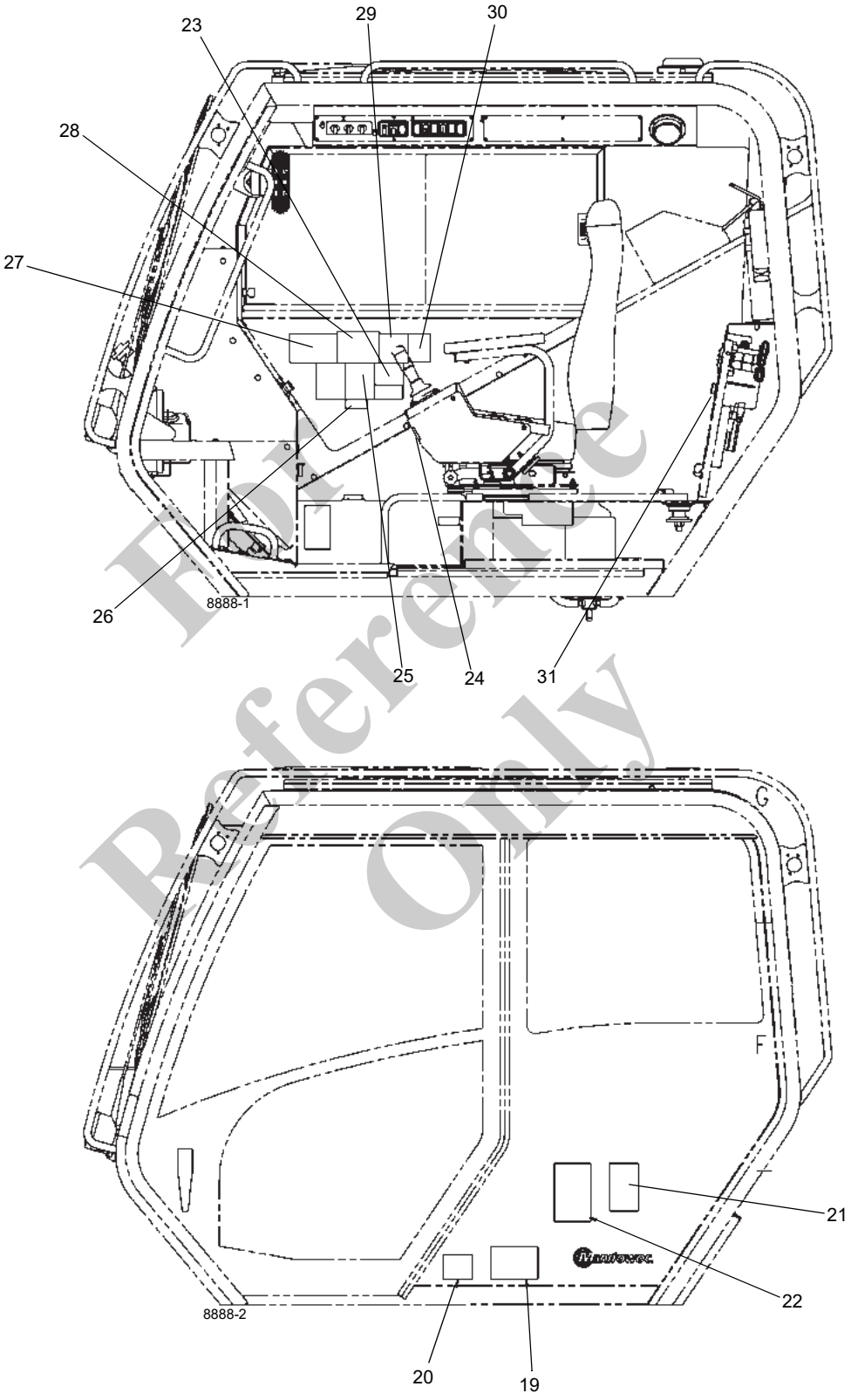
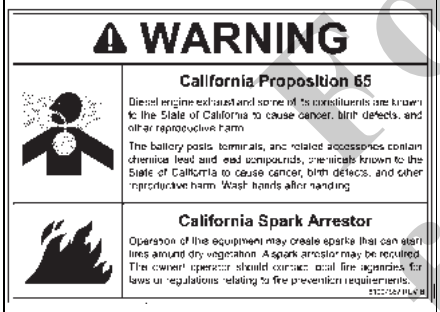
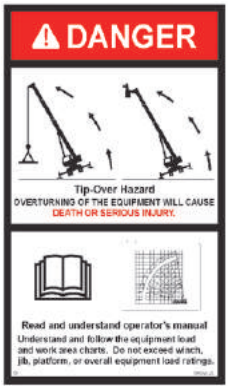


FIGURE 11-2

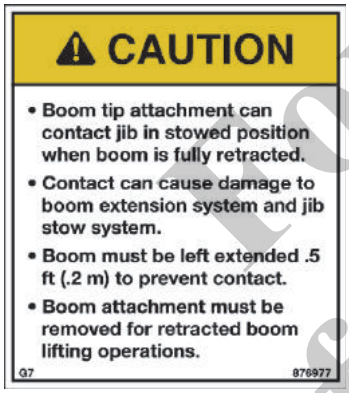
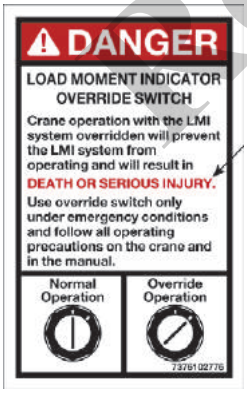
Item	Description
19	Decal-Warning California Proposition 65
20	Decal-Danger S/S Swing Crush
21	Decal-Danger Tip Over Hazard
22	Decal-Danger-A2B Override
23	Decal-Danger-O/R Crush
24	Decal-Caution Armrest Position
25	Decal-Danger Operator

Item	Description
26	Decal-Caution Stabilizer-Front
27	Decal-Electrocution
28	Decal-Danger A2B
29	Decal-Danger Tipping
30	Decal-Caution- Boom Attach
31	Decal-Danger LMI Override
32	Decal-Danger Swing S/S

Item	Decal	Explanation of Decal
19		**WARNING** **California Proposition 65** **California Spark Arrestor**
20		**DANGER** **Swinging upper structure will cause Death or Serious Injury.** **Keep clear of upper structure.**

Item	Decal	Explanation of Decal
21		**DANGER** **Tip - Over Hazard.** **Overturning of equipment will cause Death or Serious Injury.** **Read and understand operator's manual.** **Understand and follow the equipment load and work area charts.** **Do not exceed winch, jib, platform, or overall equipment load ratings.**
22		**DANGER** **Two Blocking the loadline will result in Death or Serious Injury.** **Do not two block the loadline by contacting the sheave head with the downhaul weight.** **When using the aerial work platform, the loadline must be stowed and the anti two block flag must be placed in the override position.** **Refer to manual for additional information.** **Read and understand operating manual.**
23		**DANGER** **A moving outrigger will cause Death or Serious Crushing Injury.** **Do not operate any outrigger unless you or a signal person can see that all personnel are clear of the outrigger and its ground contact point.**
24		**CAUTION** **Seat back must be in full upright position and left armrest must be rotated back to non-operational position before entering or leaving cab.**

Item	Decal	Explanation of Decal
25		**DANGER** **An untrained operator of equipment subjects himself and others to Death or Serious Injury.** **You must not operate this equipment unless:** • **You are trained and familiar with the safe operation of this equipment.** • **You read and understand and follow the safety and operating recommendations contained in the equipment manufacturer's manuals, your employer's work rules and applicable government regulations.** • **You are sure that all safety signs, guards and other safety features are in place and in proper condition.**
26		**CAUTION** **Front Stabilizer Operation** **Set Front Stabilizer After Leveling Crane**
27		**DANGER** **Electrocution Hazard** **To Avoid Death or Serious Injury keep all parts of the equipment, rigging and load at least 20 feet (6 meters) away from any energized power line. You must follow the OSHA requirements set forth in 29CFR1926.1407 through 1926.1411.** **This equipment is not designed or equipped for use within 10 feet (3 meters) of energized power lines. [Refer to 29CFR1926.1410 Table A]. If operation within 10 feet (3 meters) or any power lines cannot be avoided, the power utility MUST be notified and the power lines Must be de-energized and grounded before performing any work.** **If contact is ever accidentally made with a power line and any part of this equipment, its rigging or load, NEVER touch the equipment or even approach or come near the equipment.** **Electrocution can occur even without direct contact with the equipment.**
28		**DANGER** • **Failure to maintain the anti-two-block System will Result in Death or Serious Injury** • **The anti-two block system on this crane must be tested daily for proper operation, see owners manual for detail.** • **When the anti-two-block system is activated the boom telescope and winch up function will cease operation. To restore normal functioning the winch down function or boom retract function must be operated until the loadline block allows the anti-two block sensing weight at the sheave case to hang freely.**

Item	Decal	Explanation of Decal
29		**DANGER** **Tipping Hazard** **Death or Serious Injury could result from improper crane operation on fully retracted outriggers.** **In fully retracted outrigger configuration, before slewing:** **1. Ensure outriggers are properly set and crane is level per operators manual.** **2. Set swing brake to the locked position.** **3. Raise boom to exceed minimum boom angle for given boom length at no load indicated on load chart.**
30		**CAUTION** • **Boom tip attachment can contact jib in stowed position when boom is fully retracted.** • **Contact can cause damage to boom extension system and jib stow system.** • **Boom must be left extended .5 ft (.2 m) to prevent contact.** • **Boom attachment must be removed for retracted boom lifting operations.**
31		**DANGER** **Load Moment Indicator Override Switch** **Crane operation with the LMI system will prevent the LMI system from operating and will result in Death or Serious Injury.** **Use override switch only under emergency conditions and follow all operating precautions on the crane and in the manual.**

Item	Decal	Explanation of Decal
32		**DANGER** **Crushing Hazard** **Death or Serious Injury could result from being crushed by moving machinery.** **Before actuating swing or any other function, sound horn and verify that all personnel are clear of rotating and moving parts.**

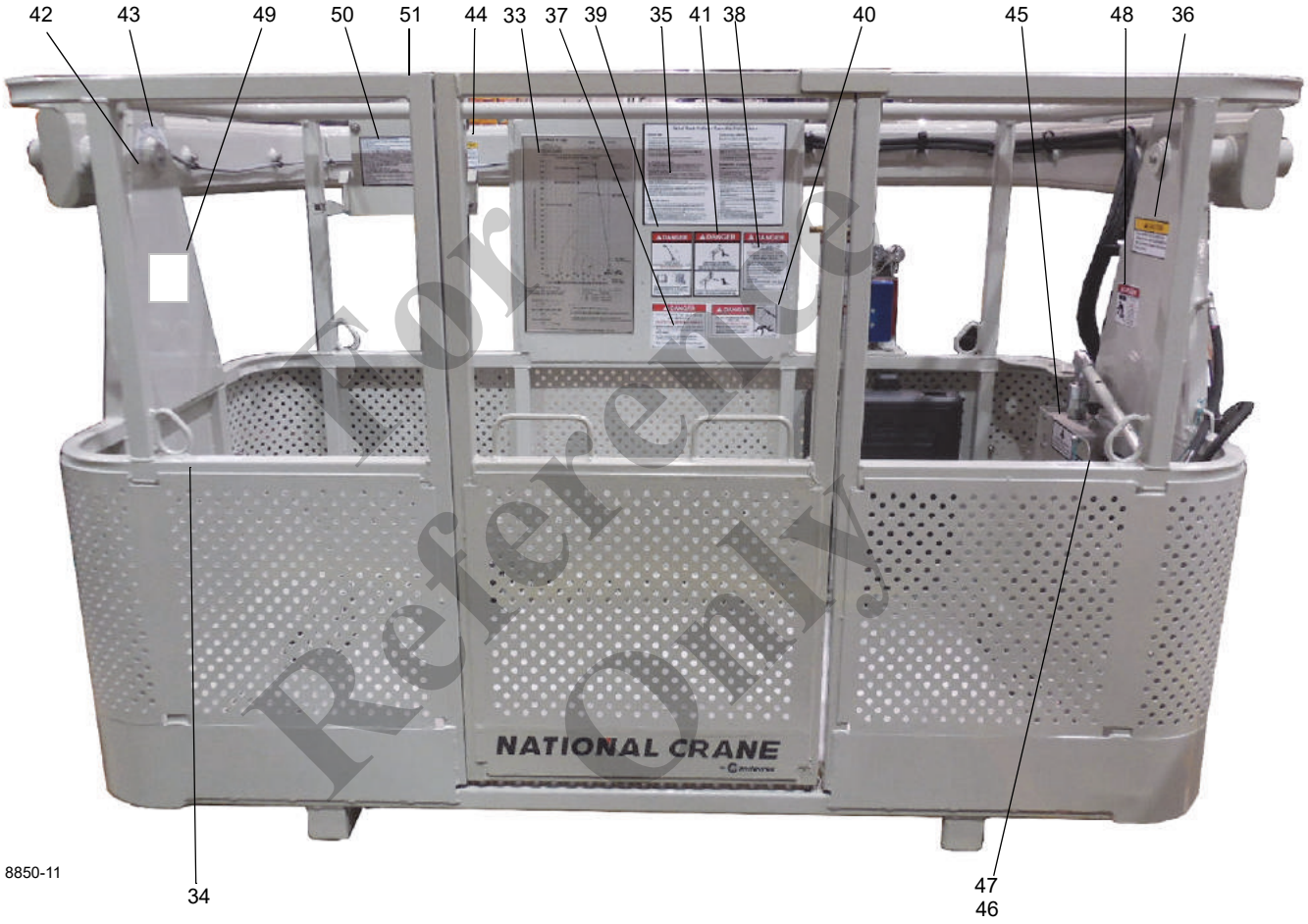
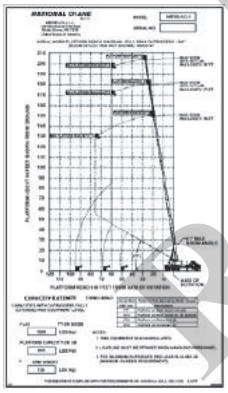
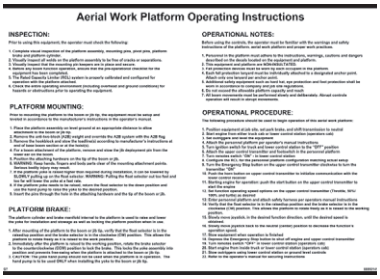


FIGURE 11-3

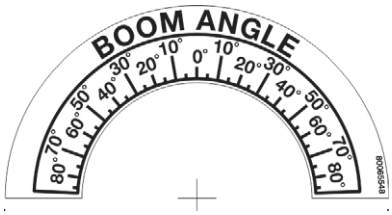
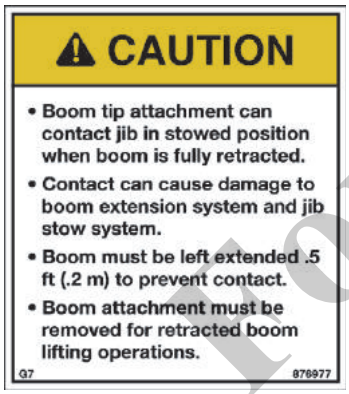
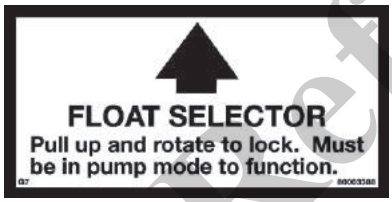
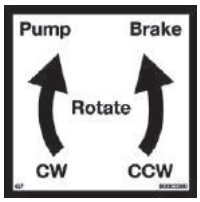
Item	Description
33	Range Diagram (See Load Chart Manual)
34	Decal-Safety Harness
35	Decal-Aerial Work Operator Instruction
36	Decal-Caution Rotational Brake
37	Decal-Danger Overload
38	Decal-Danger Untrained Operator
39	Decal-Danger Tip Over Hazard
40	Decal-Danger Fall Hazard
41	Decal-Electrocution Hazard
42	Panel-Calibrate Pointer

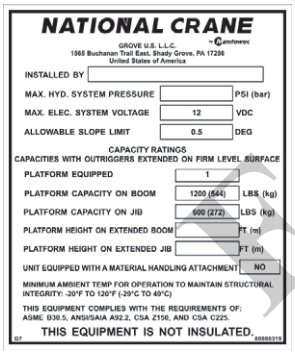
Item	Description
43	Decal-Boom Angle Indicator
44	Decal-Boom Attachment
45	Decal-Float Selector
46	Decal-Oil Level
47	Decal-Pump Brake
48	Decal-Danger Basket Brake
49	Panel-Basket Registration Plate
50	Decal-Danger Emergency Lowering
51	Decal-Danger Emergency Lowering

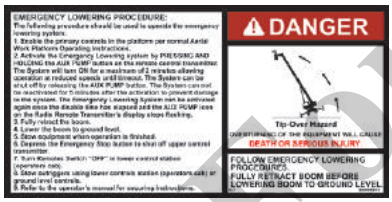
Item	Decal	Explanation of Decal
33		**Range Diagram**
34	SAFETY HARNESS ATTACHMENT POINT 874423	**Safety Harness Attachment Point**

Item	Decal	Explanation of Decal
35		**Aerial Work Platform Operating Instructions**
36		**CAUTION** **Upon reaching working position the rotational brake must be activated before work is initiated. Release brake before lowering boom.**
37		**DANGER** **Overloading the equipment will result in Death or Serious Injury.** • Before installing platform, verify the reach diagram matches the equipment model and boom length. • Do not exceed the allowable platform capacity stated on the reach diagram. • Refer to manual for additional information.
38		**DANGER** **An untrained operator subjects himself and others to Death or Serious Injury.** **You must not operate this equipment unless:** • **You are trained and familiar with the safe operation of this equipment.** • **You read and understand and follow the safety and operating recommendations contained in the equipment manufacturer's manuals, your employer's work rules and applicable government regulations.** • **You are sure that all safety signs, guards and other safety features are in place and in proper condition.**

Item	Decal	Explanation of Decal
39		**DANGER** **Tip - Over Hazard.** **Overturning of equipment will cause Death or Serious Injury.** **Read and understand operator's manual.** **Understand and follow the equipment load and work area charts.** **Do not exceed winch, jib, platform, or overall equipment load ratings.**
40		**DANGER** **Falling from platform will result in Death or Serious Injury.** **You must not operate this equipment unless:** **Platform personnel must wear a safety harness with a lanyard, attached to anchor provided.**
41		**DANGER** **Electrocution Hazard** **This platform is not insulated. Contact with or inadequate clearance to electrical power lines will result in Death or Serious Injury.** **Maintain safe clearance of 10 ft. (3.0m) from electrical power lines in accordance with applicable government regulations. Allow for boom and electrical line sway.**
42		**Calibrate pointer each time basket is attached to crane.**

Item	Decal	Explanation of Decal
43		**Boom Angle indicator - Basket**
44		**CAUTION** • **Boom tip attachment can contact jib in stowed position when boom is fully retracted.** • **Contact can cause damage to boom extension system and jib stow system.** • **Boom must be left extended .5 ft (.2 m) to prevent contact.** • **Boom attachment must be removed for retracted boom lifting operations.**
45		**Float Selector** **Pull up and rotate to lock.** **Must be in pump mode to function.**
46		**Oil Level** **Fill with ATF only.**
47		**Pump Brake**

Item	Decal	Explanation of Decal
48		**DANGER** **Releasing the brake will result in Death or Serious Injury.** • **Do not leave basket with hanger positioned or elevated above basket when basket is not attached to boom or jib.** • **Do not release brake lever without firmly supporting hanger.**
49		**Panel Basket Registration Plate**

Item	Decal	Explanation of Decal
50		**DANGER** Tip - Over Hazard. Overturning of equipment will cause Death or Serious Injury. Follow Emergency Lowering Procedure. Fully retract boom before lowering boom to ground level. Emergency Lowering Procedure: The following procedure should be used to operate the emergency lowering system: **1.** Enable the primary controls in the platform per normal Aerial Work Platform Operating Instructions. **2.** Activate the Emergency Lowering system by Pressing and Holding the Aux Pump button on the remote control transmitter. The system will turn ON for a maximum of 2 minutes allowing operation at reduced speeds until timeout. The system can be shutoff by releasing the Aux Pump button. The system can not be reactivated for 5 minutes after the activation to prevent damage to the system. The Emergency Lowering System can be activated again once the disable time has elapsed and the Aux Pump icon on the Radio Remote Transmitter's display stops flashing. **3.** Fully retract the boom. **4.** Lower the boom to ground level. **5.** Stow equipment when operation is finished. **6.** Depress the Emergency Stop button to shut off upper control transmitter. **7.** Turn Remotes SwitchOff" in lower control station (operators cab). **8.** Stow outriggers using lower controls station (operators cab) or ground level controls. **9.** Refer to the operator's manual for securing instructions.
51		**DANGER** **Do not operate ground level controls (Cab Controls) when platform is occupied unless operator is unable to use primary controls.** **Failure to do so may result in Death or Serious Injury.** **Follow Emergency Lowering Procedure.** **Fully retract boom before lowering boom to ground level.** **Refer to Emergency Lowering procedure in the Aerial Lift Safety Precautions section of the operator's manual.**

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