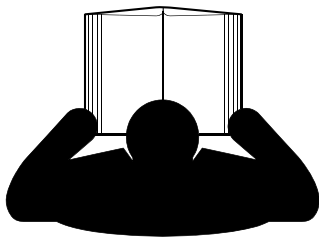


OPERATOR MANUAL

Supplement

Crane Warm-up Procedures

For Reference Only



DANGER

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

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

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Crane Warm-up Procedures..... 1

 Engine..... 1

 Transmission 1

 Hoist 1

 Swing Drive and Turntable Bearing 1

 Axles..... 2

 Hydraulic Oil System 2

For
Reference
Only

This Supplement provides information regarding the proper warm-up procedures for operating the crane in colder temperatures. The information provided here supplements the *Operator* and *Service Manuals* and must be used in conjunction with these manuals.

CRANE WARM-UP PROCEDURES

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

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

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

CAUTION

Crane Damage Hazard!

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

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

Engine

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 the engine to idle for 3 to 5 minutes before operating with a load.
2. Cold Engine Startup: After allowing the engine to warm by idling it for 3 to 5 minutes, slowly increase the engine speed to provide adequate lubrication to the bearings and to allow the oil pressure to stabilize.

Transmission

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

Warm-up Procedures for Rough Terrain (RT) and Industrial Cranes:

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

Alternate Warm-up Procedures for Rough Terrain (RT), Truck Mount (TM/TMS), and Industrial Cranes:

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

Hoist

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

Warm-up Procedures:

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

Swing Drive and Turntable Bearing

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

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

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

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

Axles

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

Warm-up Procedures for Temperatures Below -35°C (-30°F):

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

Hydraulic Oil System

Operating Limits and Warm-up Procedures:

- **From 4°C to -10°C (40°F to 15°F):** Crane operation without a load is allowed with medium engine RPM and medium function speed (joystick position) until the fluid reaches at least 10°C (50°F). It is then recommended that all crane functions be cycled to remove cold fluid from all components and cylinders of the hydraulic system. If there is any unusual sound coming from the crane's hydraulic pumps or motors, stop the operation and engine immediately and contact a 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 the crane's hydraulic oil cool by running the engine at idle with no functions actuated.

Grove TMS800E13

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.

OPERATOR MANUAL

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

TMS800E13

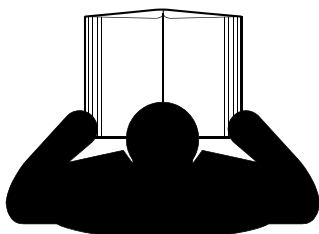

This Manual is divided into the following sections:

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

NOTICE

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

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

	<div data-bbox="732 1360 1279 1444"><h2> DANGER</h2></div> <p data-bbox="589 1465 1372 1528">An untrained operator subjects himself and others to death or serious injury. Do not operate this crane unless:</p> <ul data-bbox="589 1543 1414 1890" style="list-style-type: none">• You are trained in the safe operation of this crane. Manitowoc is not responsible for qualifying personnel.• You read, understand, and follow the safety and operating recommendations contained in the crane manufacturer's manuals and load charts, your employer's work rules, and applicable government regulations.• You are sure that all safety signs, guards, and other safety features are in place and in proper condition.• The Operator's Manual and Load Chart are in the holder provided on crane.
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For
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SECTION 1
INTRODUCTION

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GENERAL

This manual provides important information for the operator of the TMS800E13 Series Grove Crane.

Before placing the crane in service, take time to thoroughly familiarize yourself with the contents of this manual. After all sections have been read and understood, retain the manual for future reference in a readily accessible location.

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

Constant improvement and engineering progress makes it necessary that we reserve the right to make specification and equipment changes without notice.

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

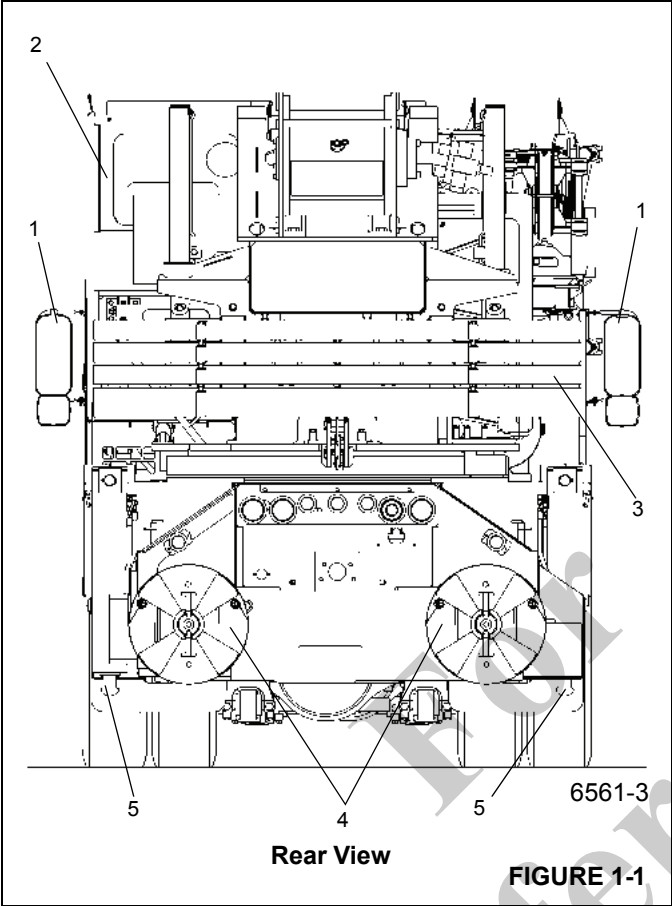
Engine operating procedures and routine maintenance procedures are supplied in a separate manual with each crane, and should be referred to for detailed information.

NOTE: Throughout this manual, reference is made to left, right, front, and rear when describing locations. These reference locations are to be considered as those viewed from the operator's seat with the superstructure facing forward over the front of the carrier frame.

The mobile crane carrier incorporates an all welded steel frame. The 8x4x4 carrier utilizes two drive axles and two steer axles. Steering is provided by a power steering pump, gearbox and control valve. The engine is mounted in the front of the carrier and provides power through a 11 speed forward and 3 speed reverse manual transmission.

Hydraulic, two stage double box telescopic beams with inverted stabilizer (jack) cylinder outriggers are integral with the carrier frame. The outriggers are utilized in three positions; fully extended, intermediate (50%) extended, and fully retracted. The carrier is also equipped with a center front stabilizer that has a permanently attached pad.

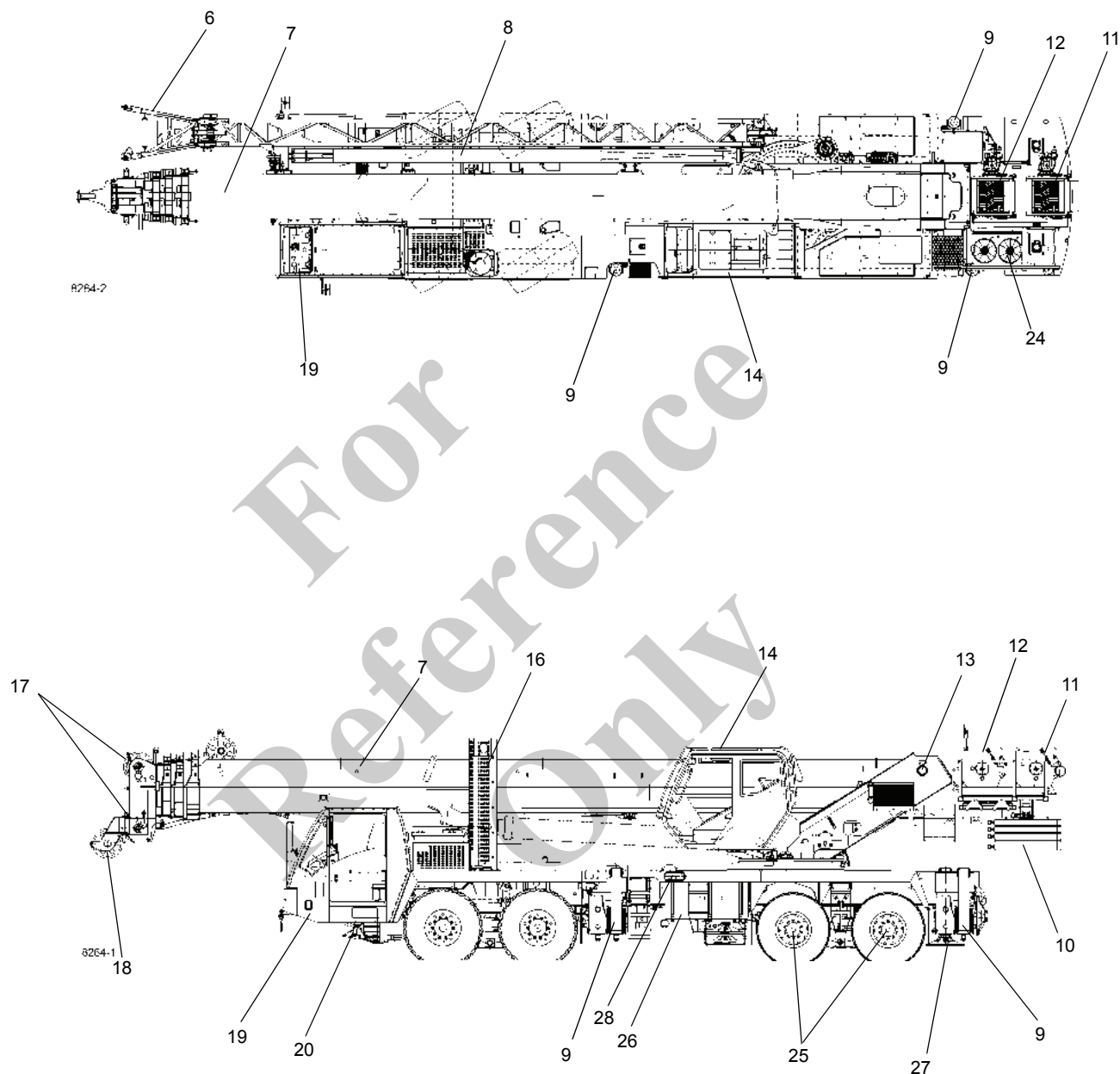
The superstructure is capable of 360° rotation in either direction. All crane functions, with the exception of counterweight removal, are controlled from the fully-enclosed cab mounted on the superstructure. The crane is equipped with a four-section boom. Additional reach is obtained by utilizing an optional bi-fold jib. Lifting is provided by a main hoist and an optional auxiliary hoist. For basic crane component locations, see Figure 1-1.



Item	Description
1	Rear View Mirror
2	Crane Cab
3	Counterweight
4	Outrigger Float
5	Outrigger Jack Cylinder

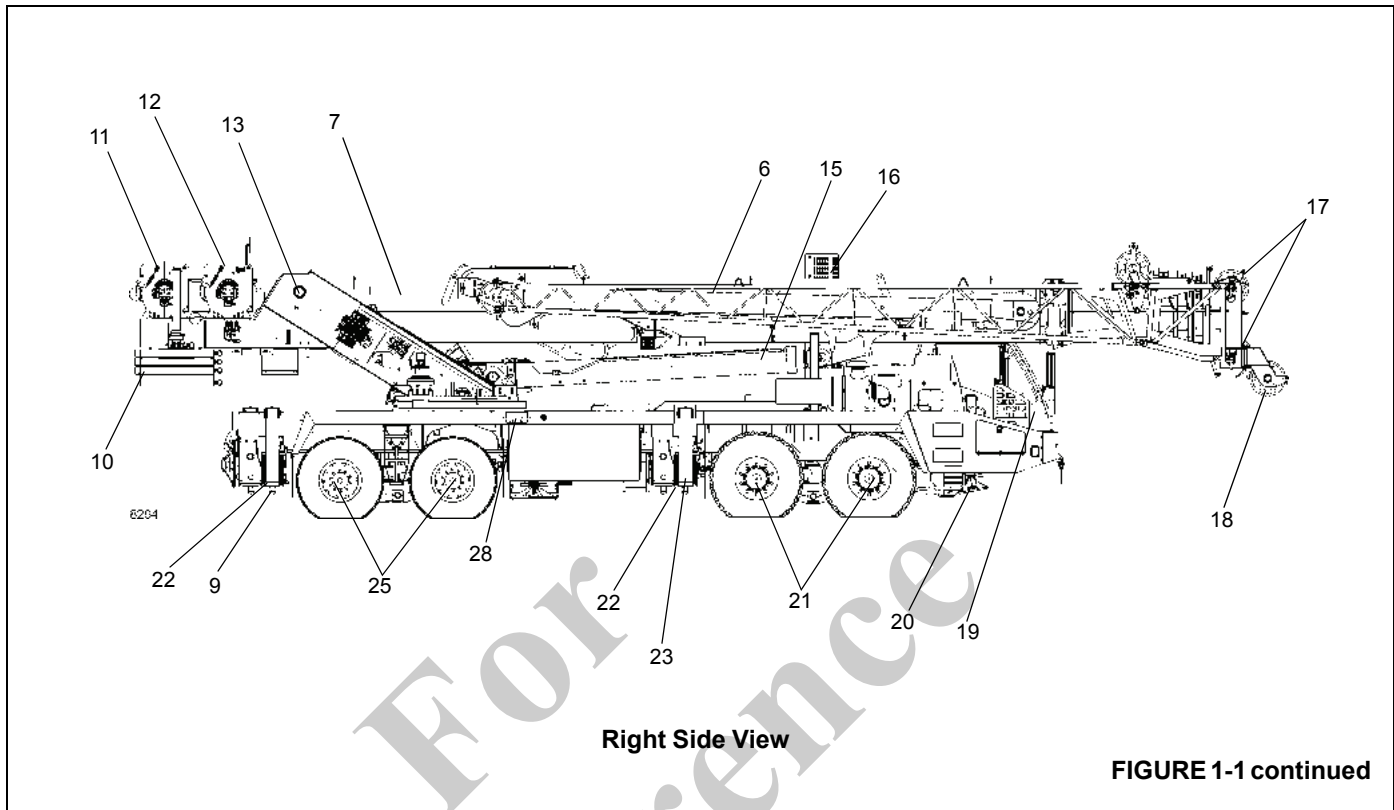
NEW OWNER

If you are the new owner of a Manitowoc crane, please register it with Manitowoc Crane Care so we have the ability to contact you if the need arises. Go to: www.manitowoccranes.com/MCG_CARE/Includes/EN/changeOfOwnership.cfm and complete the form.



Left Side View

FIGURE 1-1 continued



Item	Description
6	Folding Jib
7	Boom
8	Stinger
9	Outrigger Stabilizer Cylinder
10	Removable Counterweights
11	Auxiliary Hoist
12	Main Hoist
13	Boom Pivot
14	Superstructure Cab
15	Lift Cylinder
16	Exhaust System
17	Boom Nose Sheaves

Item	Description
18	Auxiliary Boom Nose
19	Carrier Cab
20	Center Front Stabilizer
21	Front Axles
22	Outrigger Beam
23	Outrigger
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SAFETY MESSAGES

General

The importance of safe operation and maintenance cannot be overemphasized. Carelessness or neglect on the part of operators, job supervisors and planners, rigging personnel,

and job site workers can result in their death or injury and costly damage to the crane and property.

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

Safety Alert Symbol



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

Signal Words



DANGER

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



WARNING

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



CAUTION

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

CAUTION

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

NOTE: Emphasizes operation or maintenance procedures.

GENERAL

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

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

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

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

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

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

ACCIDENTS

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

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

The Manitowoc Company, Inc.

1565 East Buchanan Trail
Shady Grove, PA 17256-0021

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

Fax: 717-593-5152

E-mail: product.safety@manitowoc.com

OPERATOR'S INFORMATION

You must **read** and **understand** this *Operator's Manual* and the *Load Chart* before operating your new crane. You must also **view** and **understand** the supplied safety video. This manual and *Load Chart* must be readily available to the operator at all times and must remain in the cab (if equipped) or operator's station while the crane is in use.

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

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

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



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

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

If adjustments or repairs are necessary, the operator shall notify the next operator.

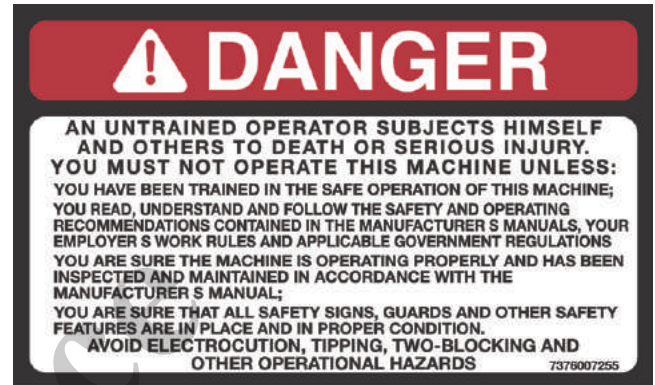
OPERATOR'S QUALIFICATIONS

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

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

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

You must be familiar with the regulations and standards governing cranes and their operation. Work practice requirements may vary slightly between government regulations, industry standards, and employer policies so a thorough knowledge of all such relevant work rules is necessary.



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

You must not operate this crane unless:

- You have been trained in the safe operation of this crane.
- You read, understand, and follow the safety and operating recommendations contained in the manufacturer's manuals, your employer's work rules, and applicable government regulations.
- You are sure the crane has been inspected and maintained in accordance with the manufacturer's manuals and is operating properly.
- You are sure that all safety signs, guards, and other safety features are in place and in proper condition.

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

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

You must be mentally and physically fit to operate a crane. Never attempt to operate a crane while under the influence of medication, narcotics, or alcohol. Any type of drug could impair physical, visual and mental reactions, and capabilities.

As operator of this crane, you are granted the authority to stop and refuse to lift loads until safety is assured.

OPERATIONAL AIDS

Operational aids are accessories that provide information to facilitate operation of a crane or that take control of particular functions without action of the operator when a limiting condition is sensed, as stated in the latest revision of the ASME B30.5, and ASME B30.8 standards. Examples of such devices include, but are not limited to, the following: anti-two-block device, rated capacity indicator, rated capacity limiter, boom angle or radius indicator, boom length indicator, crane level indicator, hoist drum rotation indicator, load indicator, and wind speed indicator.

Manitowoc remains committed to providing reliable products that enable users and operators to safely lift and position loads. Manitowoc has been an industry leader in the incorporation of operational aids into the design of its cranes. Federal law requires that cranes be properly maintained and kept in good working condition. The manuals that Manitowoc provides that are specific for each crane and the manufacturer's manuals for the operational aids shall be followed. If an operational aid should fail to work properly, the crane user or owner must assure that repair or recalibration is accomplished as soon as is reasonably possible. If immediate repair or recalibration of an operational aid is not possible and there are exceptional circumstances which justify continued short-term use of the crane when operational aids are inoperative or malfunctioning, the following requirements shall apply for continued use or shutdown of the crane:

- Steps shall be taken to schedule repairs and recalibration immediately. The operational aids shall be put back into service as soon as replacement parts, if required, are available and the repairs and recalibration can be carried out. Every reasonable effort must be made to expedite repairs and recalibration.
- When a *Load Indicator*, *Rated Capacity Indicator*, or *Rated Capacity Limiter* is inoperative or malfunctioning, the designated person responsible for supervising the lifting operations shall establish procedures for determining load weights and shall ascertain that the weight of the load does not exceed the crane ratings at the radius where the load is to be handled.
- When a *Boom Angle* or *Radius Indicator* is inoperative or malfunctioning, the radius or boom angle shall be determined by measurement.
- When an *Anti-Two-Blocking Device*, *Two-Blocking Damage Prevention Device* or *Two-Block Warning Device* is inoperative or malfunctioning, the designated person responsible for supervising the lifting operations shall establish procedures, such as assigning an additional signal person to furnish equivalent protection.

This does not apply when lifting personnel in load-line supported personnel platforms. Personnel shall not be lifted when anti-two-block devices are not functioning properly.

- When a *Boom Length Indicator* is inoperative or malfunctioning, the designated person responsible for supervising the lifting operations shall establish the boom lengths at which the lift will be made by actual measurements or marking on the boom.
- When a *Level Indicator* is inoperative or malfunctioning, other means shall be used to level the crane.

Rated Capacity Limiter (RCL) Systems (If Equipped)

Your crane may be equipped with an RCL system which is intended to aid the operator. An RCL is a device that automatically monitors radius, load weight, and load rating and prevents movements of the crane, which would result in an overload condition.

Test daily for proper operation. Never interfere with the proper functioning of operational aids or warning devices.

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

Know the weight of all loads and always check the capacity of the crane as shown on the *Load Chart* before making any lifts.

NEVER exceed the rated capacity shown on the *Load Chart*. Always check the *Load Chart* to ensure the load to be lifted at the desired radius is within the rated capacity of the crane.

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

Anti-Two-Blocking Device

This crane should have a functional Anti-Two-Block and Control Lock-Out System. Test daily for proper operation.

Two-blocking occurs when the load block (hook block, headache ball, rigging, etc.) comes into physical contact with the boom (boom nose, sheaves, boom extension, etc.). Two-blocking can cause hoist lines (wire rope), rigging, reeving, and other components to become highly stressed and overloaded in which case the wire rope may fail allowing the load, block, etc. to free fall.

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

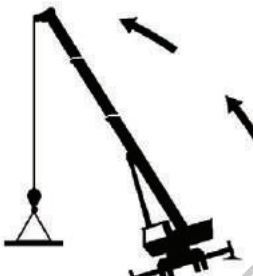

Never interfere with the proper functioning of operational aids or warning devices.

Work Area Definition System (WADS) (If Equipped)

If your crane is equipped with a WADS, you must read and understand the manufacturer's *Operator's Manual* before operating the system. Become familiar with all proper operating procedures and with the identification of symbol usage.

The work area definition system is intended as an aid to the operator. It is not a substitute for safe crane operating practices, experience and good operator judgements.

! DANGER

	<p style="text-align: center;">TIPPING HAZARD</p> <p>To avoid death or serious injury, ensure load and crane's configuration are within capacity as shown on crane's load rating chart and notes.</p> <p>This crane should have a functional load moment indicator and control lock-out system. Test daily for proper operation.</p> <p style="text-align: center;">POSITION CRANE ON FIRM SURFACE. EXTEND OUTRIGGERS AND LEVEL CRANE.</p>
	<p style="text-align: center;">TWO-BLOCKING HAZARD</p> <p>To avoid death or serious injury, keep load handling devices away from boom/jib tip when extending or lowering the boom and when hoisting up.</p> <p>This crane should have a functional anti-two-block and control lock-out system. Test daily for proper operation.</p> <p style="text-align: center;">DO NOT PASS LOADS OR BOOM OVER GROUND PERSONNEL.</p>

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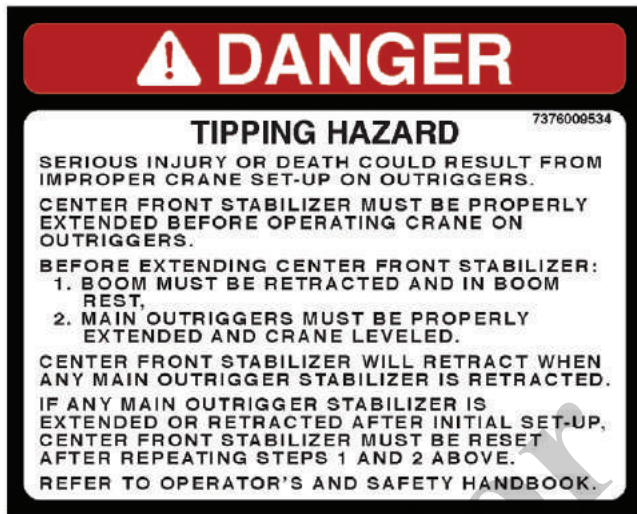
CRANE STABILITY/STRUCTURAL STRENGTH

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

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

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

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



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

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

Before swinging the superstructure over the side when the outriggers are retracted, check the *Load Chart* for backwards stability.

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

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

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



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

Load Charts

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

Load Chart capacities are based on freely suspended loads.

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

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

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

Work Site

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

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

Wind Forces

Wind can have a significant affect on loads that may be lifted by a crane. Wind forces act differently on a crane depending

upon the direction from which the wind is blowing (e.g., wind on the rear of the boom can result in decreased forward stability, wind on the underside of the boom can result in decreased backward stability, wind on the side of the boom can result in structural damages, etc.). To assist you in determining prevailing wind conditions, refer to Table 2-1.

Wind forces can exert extreme dynamic loads. **Manitowoc recommends that a lift not be made if the wind can cause**

a loss of control in handling the load. Manitowoc recommends that, if the wind speed (velocity) is between 32 km/h (20 mph) to 48 km/h (30 mph), the load capacities shall be reduced to account for the size and shape of the load and the wind direction in relation to the machine for all boom and boom extension lengths. Further, operation of the crane in wind velocities over 48 km/h (30 mph) is not recommended.

Table 2-1 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 crane 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.

Lifting Operations

Before lifting, position the crane on a firm surface, properly extend and set the outriggers, and level the crane. Depending on the nature of the supporting surface, adequate cribbing may be required to obtain a larger bearing surface.

The crane is equipped with a bubble level that should be used to determine whether the crane is level. The load line can also be used to estimate the levelness of the crane by checking to be sure it is in-line with the center of the boom at all points on the swing circle.

If the boom extension, or auxiliary boom nose is to be used, ensure the electrical cable and the weight for the Anti-Two-Block Switch are properly installed and the Rated Capacity Limiter (RCL) is programmed for the crane configuration. Refer to the RCL operator's manual supplied with the crane.

Verify the crane's capacity by checking the *Load Chart* against the weight of the load. Then, lift the load slightly at first to ensure stability before proceeding with the lift.

Be sure the load is properly rigged and attached. Always determine the weight of the load before you attempt to lift it and remember that all rigging (slings, etc.) and lifting devices (hook block, boom extension, etc.) must be considered part of the load.

Measure the load radius before making a lift and stay within approved lifting areas based on the range diagrams and working area diagrams on the crane's *Load Chart*.

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

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

The crane can tip over or fail structurally if:

- The load and crane's configuration is not within the capacity as shown on the applicable *Load Chart* and notes.

- The ground is soft and/or the surface conditions are poor.
- Outriggers are not properly extended and set. On models equipped with outriggers that can be pinned at the mid-extend position, the outriggers must also be pinned when operating from the mid-extend position.
- Cribbing under the outrigger pads is inadequate.
- The crane is improperly operated.

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

Be sure the hoist line is vertical before lifting. Do not subject the crane to side loading. A side load can tip the crane or cause it to fail structurally.

Load Chart capacities are based on freely suspended loads. Do not pull posts, pilings, or submerged articles. Be sure the load is not frozen or otherwise attached to the ground before lifting.

If you should encounter a tipping condition, immediately lower the load with the hoist line and retract or elevate the boom to decrease the load radius. Never lower or extend the boom; this will aggravate the condition.

Use tag lines whenever possible to help control the movement of the load.

When lifting loads, the crane will lean toward the boom and the load will swing out, increasing the load radius. Ensure the crane's capacity is not exceeded when this occurs.

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

Never push or pull with the crane boom.

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

Use only one hoist at a time when lifting loads.

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 wire rope.

Counterweight

On cranes equipped with removable counterweights, ensure the appropriate counterweight sections are properly installed for the lift being considered.

Do not add material to the counterweight to increase capacity. United States Federal law prohibits modification or additions which affect the capacity or safe operation of the equipment without the manufacturer's written approval. [29CFR 1926.1434]

Outrigger Lift Off

Regarding "lifting" of an outrigger pad during craning activities, be advised that the rated loads for these cranes, as indicated on the crane's *Load Chart*, do not exceed 85% of the tipping load on outriggers as determined by SAE J765 OCT90 "Cranes Stability Test Code." An outrigger pad may lift off the ground during operation of the crane within the capacity limits of the *Load Chart*, yet the crane will not have reached instability. The "balance point" for stability testing according to SAE and Manitowoc criteria is a condition of loading wherein the load moment acting to overturn the crane is equal to the maximum moment of the crane available to resist overturning. This balance point or point of instability for a crane does not depend on "lifting" of an outrigger but rather on comparison of the "opposing" load moments.

The occurrence of an outrigger lifting from the ground is often attributed to the natural flex in the crane's frame. This may happen when lifting a load in certain configurations within the capacity limits of the *Load Chart* and is not necessarily an indication of an unstable condition.

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

Multiple Crane Lifts

Multiple crane lifts are not recommended.

Any lift that requires more than one crane must be precisely planned and coordinated by a designated person. If it is necessary to perform a multi-crane lift, the operator shall be responsible for assuring that the following minimum safety precautions are taken:

- Secure the services of a designated person to direct the operation.
- Use one qualified signal person.
- Coordinate lifting plans with the operators, designated person, and signal person prior to beginning the lift.
- Maintain communication between all parties throughout the entire operation. If possible, provide approved radio equipment for voice communication between all parties engaged in the lift.
- Use outriggers on cranes so equipped.
- Calculate the amount of weight to be lifted by each crane and attach slings at the correct points for proper weight distribution.

- Ensure the load lines are directly over the attach points to avoid side loading and transfer of loading from one crane to the other.
- Do not travel. Lift only from a stationary position.

ELECTROCUTION HAZARD

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

United States federal law prohibits the use of cranes closer than 20 ft (6 m) 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, Manitowoc recommends that all parts of crane, boom, and load be kept at least 20 ft (6 m) 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, subpart CC and ASME B30.5 American National Standard.



WARNING

Electrocution Hazard!

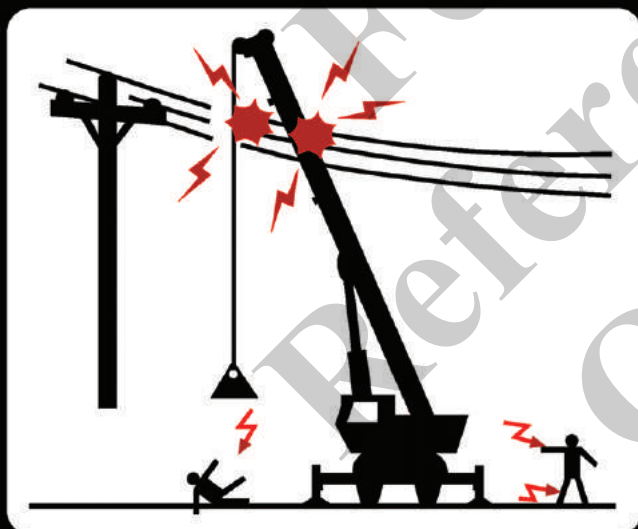
Manitowoc cranes are not equipped with all features required to operate within OSHA 29CFR1926.1408, Table A clearances when the power lines are energized.

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

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

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

2



! DANGER

**ELECTROCUTION HAZARD
TO AVOID DEATH OR SERIOUS INJURY**

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

This crane is not designed or equipped for use within 10 feet (3 meters) of energized power lines [Refer to 29CFR1926.1410 Table A]. If operation within 10 feet (3 meters) of any power lines cannot be avoided, the power utility MUST be notified and the power lines MUST be de-energized and grounded BEFORE performing any work.

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

Electrocution CAN OCCUR even without direct contact with the crane.

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THIS CRANE IS NOT INSULATED.

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

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

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

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

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

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

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

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

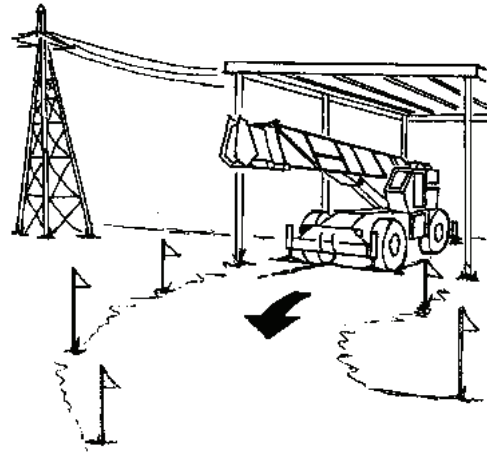
Set-Up and Operation

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

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

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

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



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

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

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

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

Electrocution Hazard Devices

The use of insulated links, insulated boom cages/guards, 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 crane is equipped with these devices.

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

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

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

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

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

Some variables you must know and understand are:

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

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

Electrical Contact

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

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

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

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

Special Operating Conditions and Equipment

Never operate the crane during an electrical thunderstorm.

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

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

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

PERSONNEL HANDLING

The American Society of Mechanical Engineers issued a new American National Standard entitled, *Personnel Lifting Systems*, ASME B30.23-2011:

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

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

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

Use of a Manitowoc crane to handle personnel is acceptable provided:

- The requirements of the applicable national, state and local regulations and safety codes are met.
- A determination has been made that use of a crane to handle personnel is the least hazardous means to perform the work.
- The crane operator shall be qualified to operate the specific type of hoisting equipment used in the personnel lift.
- The crane operator must remain at the crane controls at all times when personnel are off the ground.
- The crane operator and occupants have been instructed in the recognized hazards of personnel platform lifts.
- The crane is in proper working order.
- The crane must be equipped with a boom angle indicator that is visible to the crane operator.
- The crane's *Load Chart* is affixed at the operator's station and readily accessible to the operator. The total weight of the loaded personnel platform and related rigging shall not exceed 50 percent of the rated capacity for the radius and configuration of the crane.

- The crane is level within one percent of level grade and located on a firm footing. Cranes with outriggers shall have them all deployed following manufacturer's specifications.
- The crane's *Operator's 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 wire rope suspended platforms:
 - The crane is equipped with a hook that can be closed and locked, eliminating the throat opening.
 - The crane is equipped with a functional anti-two-block device.
 - The platform is properly attached and secured to the load hook.
- For boom mounted platforms:
 - The platform is properly attached and secure.

To avoid death or serious injury:

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

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, 0700-2900
- *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 Manitowoc cranes includes — but is not limited to — oil, fuel, grease, coolant, air conditioning refrigerant, filters, batteries, and cloths which

have come into contact with these environmentally harmful substances.

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

When filling and draining crane components, observe the following:

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

MAINTENANCE

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

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

Shut down the crane while making repairs or adjustments.

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

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

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

Routine maintenance and inspection of this crane must be performed by a qualified person(s) according to the recommendations in the *Manitowoc Crane Care Maintenance and Inspection Manual*. Any questions regarding procedures and specifications should be directed to your Manitowoc dealer.

Service and Repairs



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

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

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

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

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

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

Hydraulic Fluid:

- Do not use your hand or any part of your body to check for hydraulic fluid leaks when the engine is running or the hydraulic system is under pressure. Fluid in the hydraulic system can be under enough pressure that it will penetrate the skin, causing serious injury or death. Use a piece of cardboard, or piece of paper, to search for leaks. Wear gloves to protect your hands from spraying fluid.
- If any hydraulic fluid is injected into the skin, obtain medical attention immediately or gangrene may result.
- Do not attempt to repair or tighten any hydraulic hose or fitting while the engine is running, or when the hydraulic system is under pressure.
- Never disconnect any hydraulic lines unless the boom is fully lowered, the engine is shut off, and the hydraulic pressure is relieved. To relieve hydraulic pressure, stop the engine, turn the ignition switch to RUN and move the hydraulic controls in both directions several times.
- Hot hydraulic fluid will cause severe burns. Wait for the fluid to cool before disconnecting any hydraulic lines.

- Hydraulic fluid can cause permanent eye injury. Wear appropriate eye protection.

Moving Parts:

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

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

- The boom should be fully retracted and lowered and the load placed on the ground.
- Do not get under a raised boom unless the boom is blocked up safely. Always block up the boom before doing any servicing that requires the boom to be raised.
- Stop the engine and disconnect the battery.
- Controls should be properly tagged. Never operate the crane if it is **tagged-out** nor attempt to do so until it is restored to proper operating condition and all tags have been removed by the person(s) who installed them.

After maintenance or repairs:

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

Lubrication

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

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

- Follow the manufacturer's recommendations when adding oil to the system. Mixing the wrong fluids could destroy seals, causing component failure.

- Be certain all lines, components, and fittings are tight before resuming operation.

Tires



WARNING

Possible equipment damage and/or personal injury!

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

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

Ensure all lug nuts are properly torqued.

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

Wire Rope

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

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

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. Wire rope shall be taken out of service when any of the following conditions exist:

- For rotation-resistant running ropes: more than two (2) broken wires in a length of rope equal to six (6) times the rope diameter, or more than four (4) broken wires in a length of rope equal to thirty (30) times the rope diameter.
- For running ropes other than rotation resistant: six (6) broken wires in one rope lay or three (3) broken wires in one strand.
- One valley break where the wire fractures between strands in a running rope is cause for removal.
- Abrasion of the rope resulting in a 5% reduction in the original wire diameter.

- Any kinking, bird caging, crushing, corrosion, or other damage resulting in distortion of the rope structure.
- Rope that has been in contact with a live power line or has been used as a ground in an electric circuit (eg. welding) may have wires that are fused or annealed and must be removed from service.
- In standing ropes, more than three (3) breaks in one rope lay in sections beyond the end connection or more than two (2) broken wires at an end connection.
- Core deterioration, usually observed as a rapid reduction in rope diameter, is cause for immediate removal of the rope.

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

- Wire ropes wear out. The strength of a wire rope begins to decrease when the rope is put to use and continues to decrease with each use. Wire 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 wire rope should be considered the straight line pull which will actually break a new unused rope. The nominal strength of a wire rope should never be used as its working load.
- Each type of fitting attached to a wire rope has a specific efficiency rating which can reduce the working load of the wire rope assembly or rope system.
- Never overload a wire rope. This means never use the wire rope where the load applied to it is greater than the working load determined by the rope manufacturer.
- Never “shock load” a wire 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 wire 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 wire rope and keeping of permanent records signed by a qualified person are required by OSHA for almost every wire rope application. The purpose of the inspection is to determine whether or not a wire 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 wire 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 wire rope and must be avoided.
- Wire ropes are damaged by knots. Wire 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 wire rope inspection procedure is given in the *Service Manual*.

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

When installing a new rope:

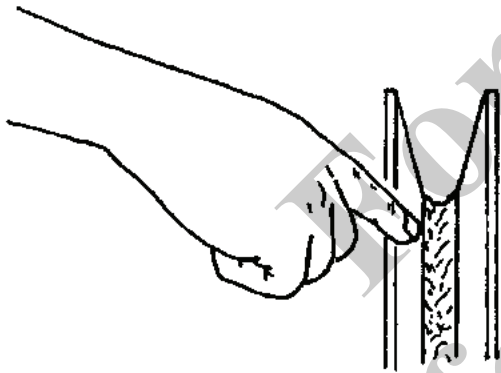
- Keep all parts of your body and clothing away from rotating hoist drums and all rotating sheaves.
- Never handle the wire rope with bare hands.
- Follow proper instructions for removing rope from a reel.
- Apply back tension to the storage/payoff reel of the new rope to insure tight, even spooling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

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

When using a wedge socket:

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

Sheaves



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

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

To attain maximum wire 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 wire rope. However, conventional rope retirement criteria based only upon visible wire breaks may prove inadequate in predicting rope failure. The user of cast nylon sheaves is therefore cautioned that a retirement criteria should be established based

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

Batteries

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

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

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

Engine

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

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

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

Shut down the engine and disconnect the battery before performing maintenance. If unable to do so for the task

required, keep hands clear of the engine fan and other moving parts while performing maintenance.

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

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

TRANSPORTING THE CRANE

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

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

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

Ensure the crane is adequately secured to the transporting vehicle.

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

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

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

TRAVEL OPERATION

Only the crane operator shall occupy the crane when traveling.

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

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

RT and Shuttlelift cranes are manufactured with no axle suspension system. Traveling at high speeds, especially on

rough ground, may create a bouncing affect that can result in loss of control. If bouncing occurs, reduce travel speed.

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

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

Follow the instructions in this manual when preparing the crane for travel.

If using a boom dolly/trailer, thoroughly read and understand all the steps and safety precautions in this manual for setup and travel.

When driving the crane, ensure the cab is level, if equipped with a tilting cab.

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

Watch clearances when traveling. Do not take a chance of running into overhead or side obstructions.

When moving in tight quarters, post a signal person to help guard against collisions or bumping structures.

Before traveling a crane, check suitability of proposed route with regard to crane height, width, and length.

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

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

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

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

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

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

Stay alert at the wheel.

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

Slopes:

- Pick and carry on level surfaces only.
- Refer to the *Operation Section* for more detailed information on traveling on slopes.
- Driving across a slope is dangerous, as unexpected changes in slope can cause tip over. Ascend or descend slopes slowly and with caution.

- When operating on a downhill slope, reduce travel speed and downshift to a low gear to permit compression braking by the engine and aid the application of the service brakes.

WORK PRACTICES

Personal Considerations

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

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

Crane Access



WARNING

Fall Hazard!

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

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

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

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

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

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

Do not step on surfaces on the crane that are not approved or suitable for walking and working. All walking and working surfaces on the crane should be clean, dry, slip-resistant, and have adequate supporting capacity. Do not walk on a surface if slip-resistant material is missing or excessively worn.

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

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

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

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

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

Job Preparation

Before crane use:

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

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

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

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

Working

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

Know the location and function of all crane controls.

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

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

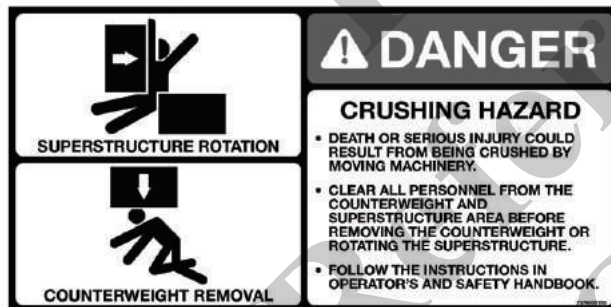
Carbon monoxide fumes from the engine exhaust can cause suffocation in an enclosed area. Good ventilation is very important when operating the crane.

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

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

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

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



Keep unauthorized personnel clear of the working area during operation.

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

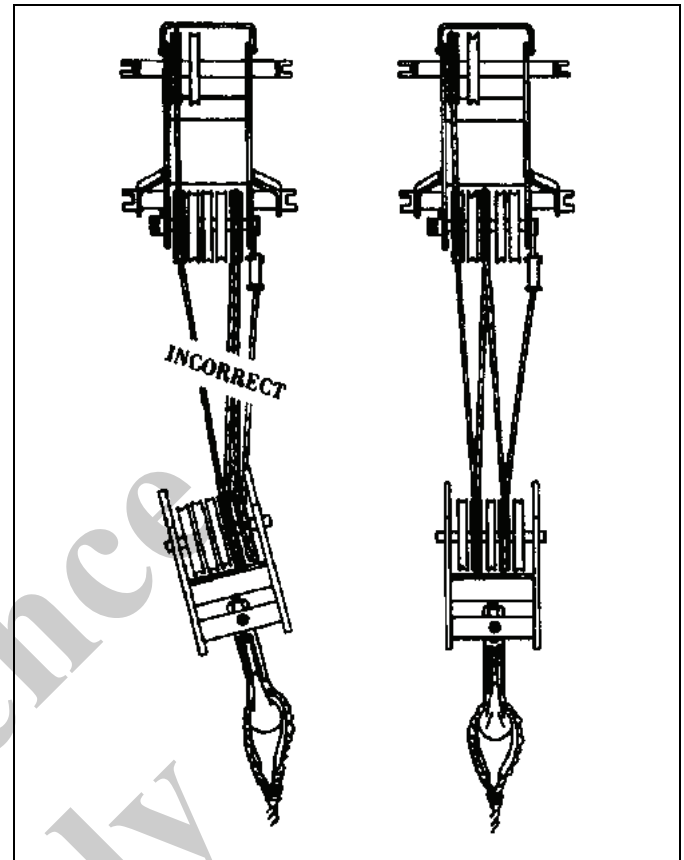
You must always be aware of everything around the crane while lifting or traveling. If you are unable to clearly see in the direction of motion, you must post a look out or signal person before moving the crane or making a lift. Sound the horn to warn personnel.

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

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

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

Ensure the wire 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 wire rope or hoist. **No less than three wraps** of wire rope should remain on the hoist drum. When slings, ties, hooks, etc., are used, make certain they are correctly positioned and secured before raising or lowering the loads.

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

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

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

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

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

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

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

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

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

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

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

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

Stop the hook block from swinging when unhooking a load.

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

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

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

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

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

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

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

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

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

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

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

Hand Signals

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

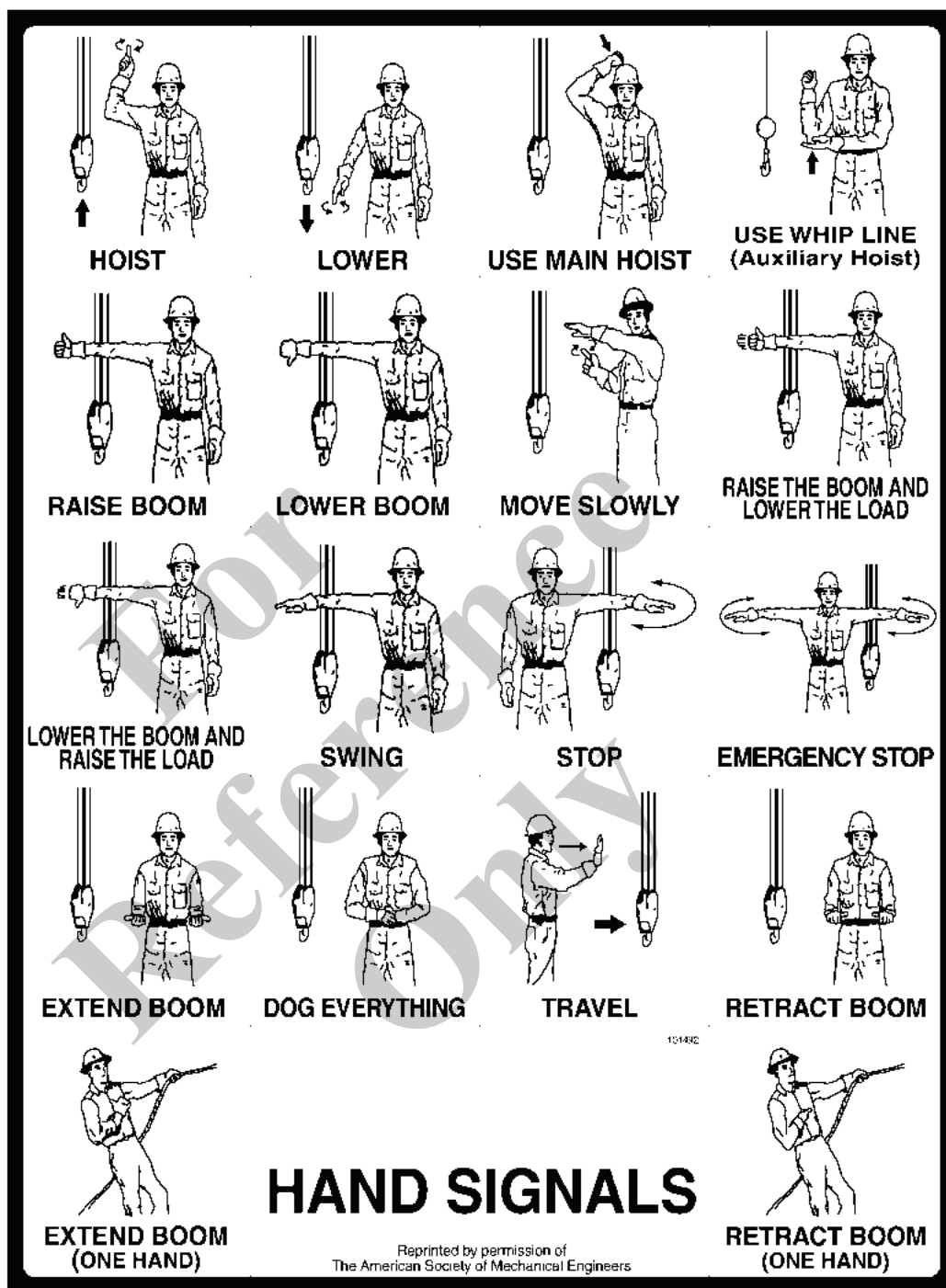
- Working in the vicinity of power lines.
- The crane operator cannot clearly see the load at all times.
- Moving the crane in an area or direction in which the operator cannot clearly see the path of travel.

At all times use standardized hand signals - previously agreed upon and completely understood by the operator and signal person.

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

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

Obey a signal to stop from anyone.



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.

PARKING AND SECURING



WARNING

Tipping Hazard!

When parking the crane and leaving it unattended follow the instructions in Section 3 of this manual.

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

When parking on a grade, apply the parking brake and chock the wheels.

Section 3 of this manual provides instructions for parking and securing a crane when it is to be left unattended. These instructions are intended to allow the crane to be placed in the most stable and secure position. However, Manitowoc recognizes that certain jobsite conditions may not permit the boom and boom extension of a crane to be fully lowered to

the ground. When a qualified person at a jobsite determines that it is not practical to lower the boom to the ground, we recommend the following additional instructions be followed:

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

SHUT-DOWN

Use the following steps when shutting down the crane:

- Engage the parking brake.
- Fully retract and lower the boom.
- Engage the swing lock pin or 360 degree swing lock (if equipped).
- Place crane function power switch to OFF (if equipped).
- Place controls in neutral position.
- Shut down the engine and remove the ignition key.
- Chock the wheels, if not on outriggers.
- Lock the operator's cab (if applicable) and install vandal guards, if used.

COLD WEATHER OPERATION

Cold weather operation requires additional caution on the part of the operator.

Check operating procedures in this manual for cold weather starting.

Don't touch metal surfaces that could freeze you to them.

Clean the crane of all ice and snow.

Allow ample time for hydraulic oil to warm up.

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

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

If applicable to your crane, always handle propane tanks according to the supplier's instructions.

Never store flammable materials on the crane.

If cold weather starting aids are provided on your crane, use them. The use of aerosol spray or other types of starting fluids containing ether/volatiles can cause explosions or fire.

TEMPERATURE EFFECTS ON HOOK BLOCKS

The following information applies to Gunnebo Johnston crane hook blocks:

"Never use a crane block in extreme temperatures...Sudden failure can occur.

Crane blocks shall not be heated above 82°C (180°F). Craneblock Working Load Limit is valid between 82°C (180°F) and service temperature given on the identification tag with normal lifting precautions.

Additional lifting precautions are required below the service temperature given on the identification tag because cold temperature begins to affect the crane block material properties.

Lifting above 75% of the Working Load Limit (WLL), at temperatures between the service temperature given on the identification tag and -40°C (-40°F), must (be) done at a slow and steady rate to avoid stress spikes common in normal hoisting dynamics.

75% of the WLL 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 0.00043 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 25 ft in which the oil cools 60°F would retract

approximately 7 3/4 in (see Table 2-2). A cylinder extended 5 feet in which the oil cools 60°F would only retract approximately 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 a crane is set up in the morning with cool oil and the daytime ambient temperature heats the oil, the cylinders will extend in similar proportions.

Table 2-2 and Table 2-3 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. If leaking seals or faulty holding valves are suspected to be the problem, refer to Service Bulletin dealing with testing telescope cylinders. (*Service Bulletin 98-036* applies to TMS700 and *Service Bulletin G06-005A* applies to RT890 and RT9130.

Table 2-2: 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 2-3 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											

MODEL SPECIFIC INFORMATION

Access Platform Hand Rail



DANGER

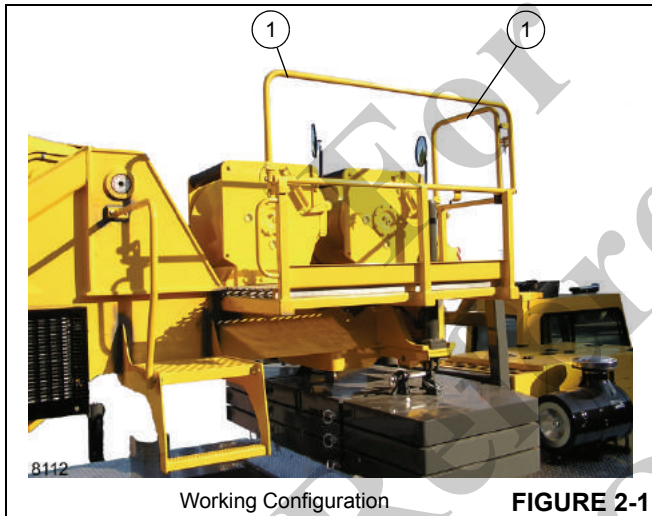
Falling Hazard!

Position superstructure to allow access to hoist platform from decking.

Do not go beyond hoist access platform railing, death or serious injury could occur.

To gain access to the hoists deploy the hoist access platform.

Remove pins from hand rails (1) (Figure 2-1) and rotate up into the working position, reinstall pins.

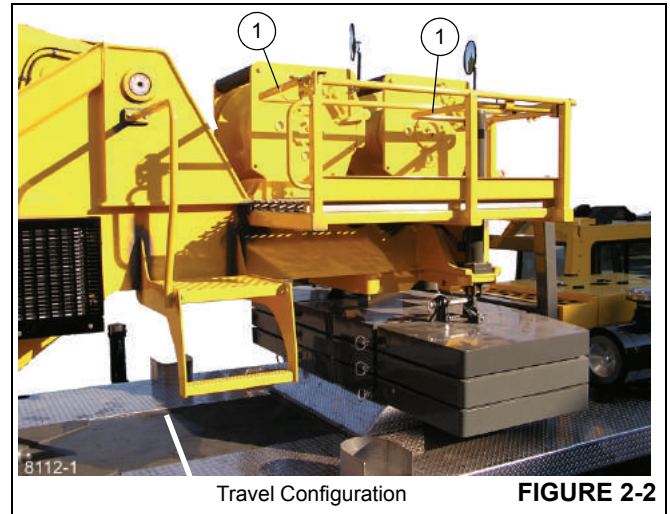


Working Configuration

FIGURE 2-1

Before Traveling ensure that the hoist access platform hand rails (1) (Figure 2-2) are in the travel configuration.

Remove pins from hand rails and rotate down into the travel position, reinstall pins.



Travel Configuration

FIGURE 2-2

OVERLOAD INSPECTION

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

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

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



WARNING

Overload Hazard!

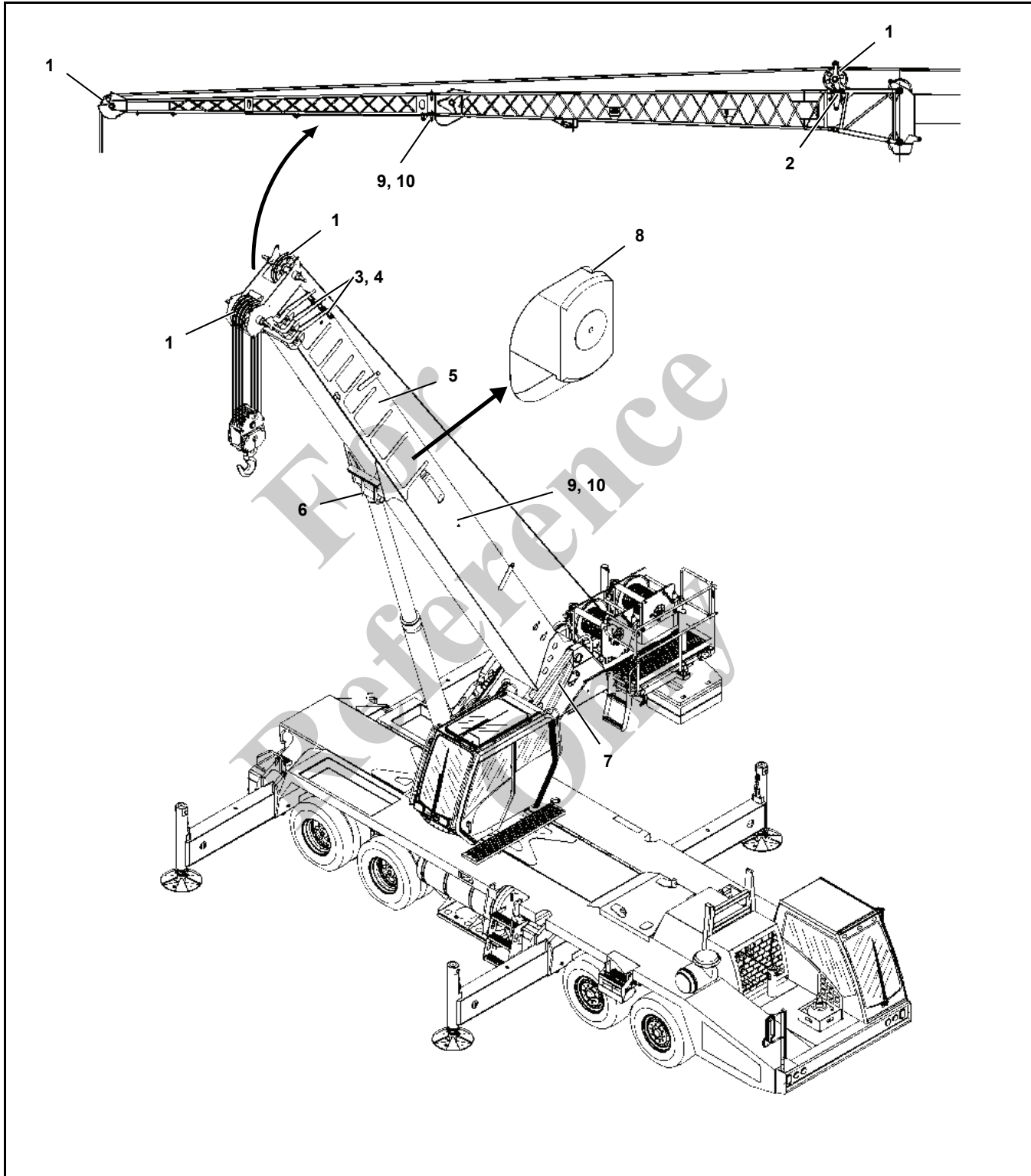
To avoid an accident caused by overload damage to your crane:

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

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

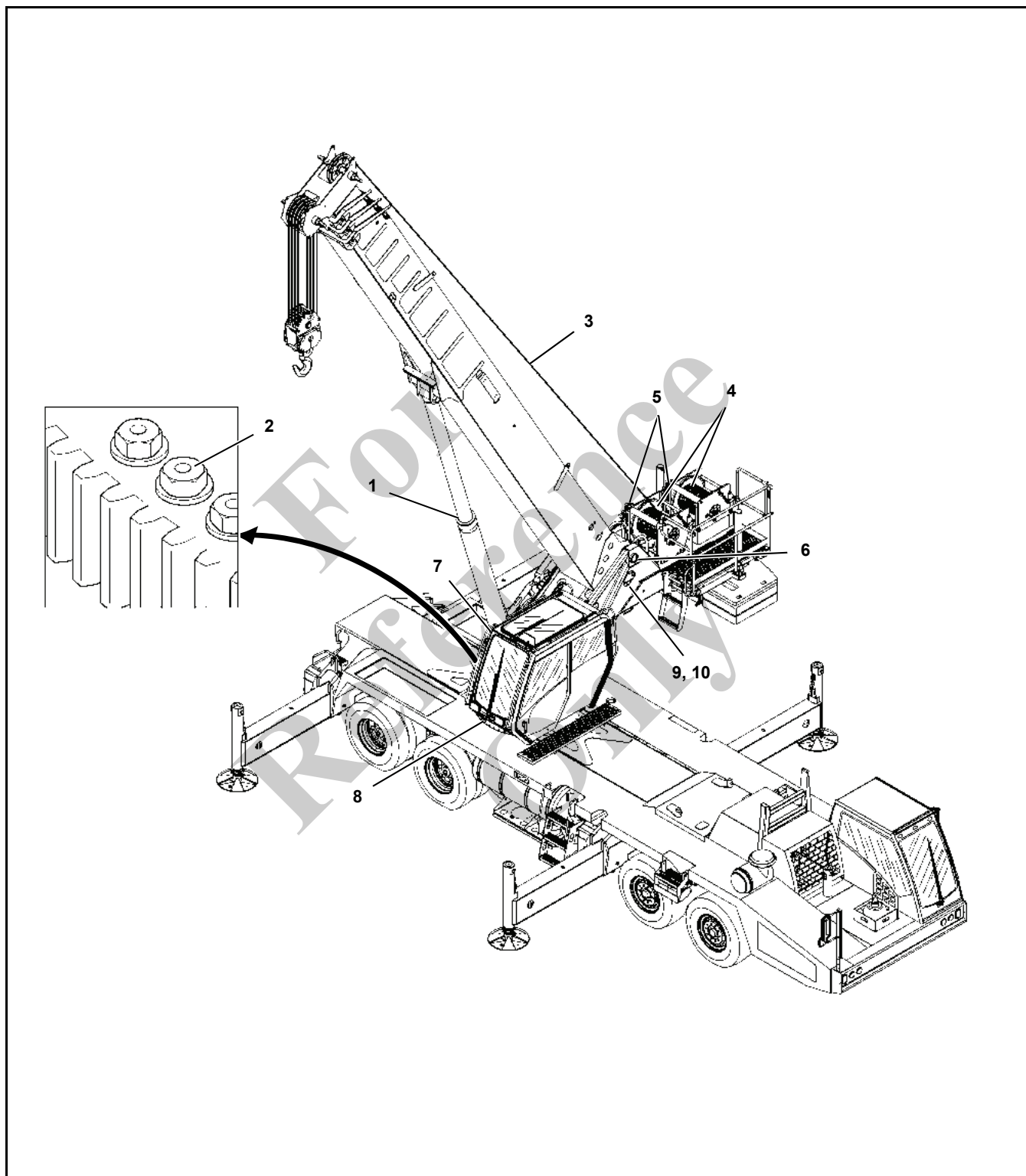
Overload warnings do NOT indicate real time events! Warnings could be sent 24 hours (or more) after the actual event.

Boom Inspection



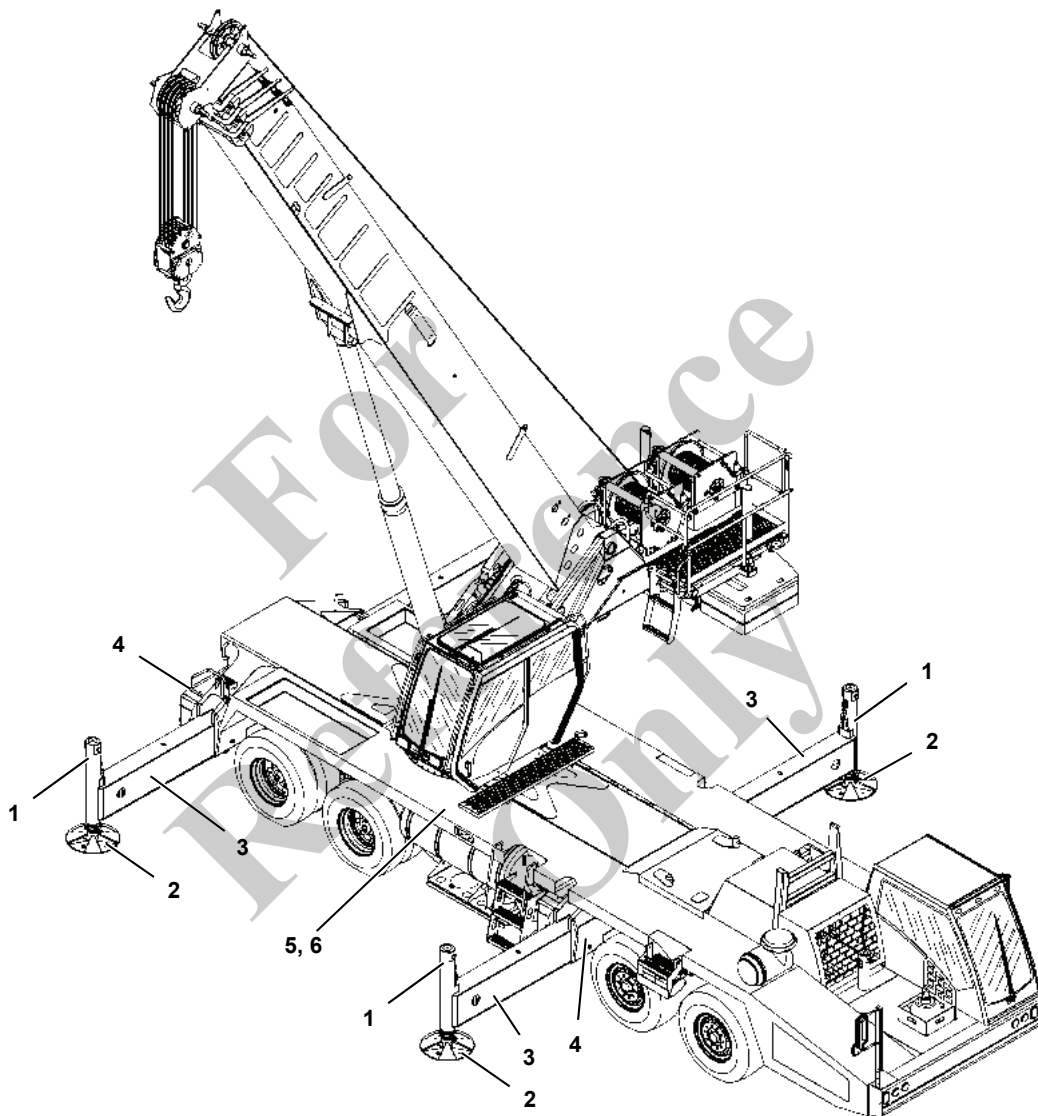
Overload less than 25%			
1	Sheaves	Inspect all for damage.	
2	Luffing Mechanism/ Cylinder	Inspect for damage/leaks.	
3	Collar-wear pads	Inspect all for damage.	
Overload from 25% to 49%			
1	Sheaves	Inspect all for damage.	
2	Luffing Mechanism/ Cylinder	Inspect for damage/leaks.	
3	Collar-wear pads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

Superstructure Inspection



Overload less than 25%			
1	Lift Cylinder	Inspect for leaking.	
2	Turntable Bearing	Check bolts for proper torque.	See topic in Swing section of Service Manual.
3	Wire Rope	Inspect all for damage.	See topic in Introduction section of Service Manual.
Overload from 25% to 49%			
1	Lift Cylinder	Inspect for leaking.	
2	Turntable Bearing	Check bolts for proper torque.	See topic in Swing section of Service Manual.
3	Wire Rope	Inspect all for damage.	See topic in Introduction section of Service Manual.
4	Hoist/Drums	Inspect each for damage.	
5	Hoist Brakes	Brakes must hold rated line pull.	
6	Bearing Main Boom Pivot Pin	Inspect for deformation, cracked welds.	
7	Lift Cylinder-lower mount	Inspect pin and welds.	
8	Turntable	Inspect for deformation, cracked welds.	
9	Welds	Inspect for cracks.	
10	Paint	Inspect for cracked paint which could indicate twisted, stretched, or compressed members.	

Carrier Inspection



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

Reference Only

*For
Reference
Only*

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SECTION 3

OPERATING CONTROLS AND PROCEDURES

SECTION CONTENTS

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The crane is equipped with two cabs, a carrier cab and a superstructure cab. The carrier cab (see Figure 3-1) contains all controls and indicators necessary for crane traveling and parking. The superstructure cab (see Figure 3-16) contains all controls and indicators necessary to perform all craning operations. Both cabs utilize international symbols and English text to label the various controls. For detailed information on either cab, refer to either "Carrier Cab" on page 3-1 or "Superstructure Cab" on page 3-13 in this Section.

NOTE: The following paragraphs describe all the available (standard and optional) controls and indicators located in the cab. Some machines may not be equipped with the optional controls shown. The numbers in () represent the index number from Figure 3-1.

All rocker switches contain one or two LED's in the switch for illumination.

All indicators on the top row of the consoles will illuminate solid, all at the same time for approximately two seconds as a diagnostic test when the ignition switch is positioned to ON. If any indicator fails to illuminate, replace it immediately.

CARRIER CAB

Engine Controls and Indicators

Gauge Cluster

The gauge cluster (5) is located in the center of the front console assembly and contains a voltmeter, oil pressure gauge, water temperature gauge, and a fuel quantity gauge.

Voltmeter

The voltmeter (VOLTS) is located on the lower right of the gauge cluster. With the ignition switch in the RUN (between vertical and far right) position and before starting the engine, the voltmeter indicates the condition of the batteries. With the engine running, the voltmeter indicates output voltage of the alternator. The voltmeter scale is from 16 to 32 volts.

Engine Oil Pressure Gauge

The engine oil pressure (OIL) gauge is located on the upper right of the gauge cluster. The gauge indicates the engine oil pressure on a scale calibrated from zero (0) to 80 psi. It receives a signal from the crane's electronic operating system which receives the signal from the engine ECM via J1939.

Water Temperature Gauge

The engine coolant temperature (TEMP) gauge is located on the lower left of the gauge cluster. The gauge indicates the engine coolant temperature on a scale calibrated from 100 to 280°F. The gauge receives a signal from the crane's electronic operating system which receives the signal from the engine ECM via J1939.

Fuel Quantity Gauge

The fuel quantity (FUEL) gauge is located on the upper left of the gauge cluster. The gauge indicates the quantity of fuel in the tank and has a scale calibrated from empty (E) to full (F). The fuel gauge level is determined differently based on whether the crane is equipped with an ISX engine or a QSM engine. For units equipped with an ISX engine, the fuel level is determined based on a J1939 message sent from the engine's ECM which receives a J1939 message from a fuel level sensor located in the fuel tank. For units equipped with a QSM engine, the fuel level is determined based on a signal to the crane's electronic operating system from a fuel level sensor located in the fuel tank. In cranes with an ISX engine, **ONLY USE ULTRA LOW SULFUR DIESEL (ULSD) FUEL.**

Engine Stop/Module Off Line Indicator

The engine stop/module off line indicator (23) is located on the top left side of the front console. The top portion is the engine Red Stop Lamp or LED. It is controlled by the crane's electronic operating system based on a J1939 message received from the engine ECM. It will illuminate to notify the operator that a serious engine system error occurred or a SCR severe inducement has activated. When illuminated the vehicle and engine should be stopped as soon as safely possible. In addition, a warning buzzer will sound. It is also used to flash out active fault codes while the key is ON and the engine is not running.

The bottom portion is the module off line indicator. This indicator will come on solid whenever communication with one of the crane's electronics modules is lost. The vehicle should be stopped as soon as safely possible. The crane must be restored to proper condition before operating again.

Engine Warning/Electrical System Diagnostic Indicator

The engine warning/electrical system diagnostic indicator (24) is located at the top left side of the front console. The top portion is the Amber Warning Lamp or LED. It is controlled by the crane's electronic operating system based on a J1939 message received from the engine ECM. It will illuminate to notify the operator that a non-critical engine system error occurred or that an engine or aftertreatment maintenance event occurred. This engine issue should be corrected as soon as safely possible. It can also be used to flash out

active fault codes while the key is ON and the engine is not running.

If this light comes on while the regeneration exhaust filter indicator (58) is flashing, then regenerate the exhaust system immediately.

The bottom portion of this indicator is the electrical system diagnostic indicator. It will illuminate solid when the crane's electronic operating system detects a control module output error such as, open load, short to ground or short to battery. While this lamp is on, it is possible to determine which output is in error by accessing a system fault code on the superstructure cab operating display or by connecting a laptop loaded with service tool and diagnostic file. Contact Manitowoc Crane Care for appropriate service tool and files.

Regen Needed/Regen Inhibit Indicator (ISX Engine)

The Regen Needed lamp (58) (top half of indicator) illuminates when the exhaust system has not been able to regenerate under normal operating conditions and is in need of assistance in order to perform an active regeneration. There are three progressive stages of need for regeneration indicated by this light:

- On solid: Regeneration should be done within two to six hours of operation.
- Flashing: Regeneration needs to be done in the next one to two hours.
- Flashing w/Engine Warning Indicator illuminated: Regenerate immediately.

An immediate regeneration must be done while the crane is parked. **IF IGNORED, THE ENGINE STOP INDICATOR WILL COME ON.** For the other conditions (2 to 6 hours or 1 to 2 hours), regenerate the exhaust system while parked, or change to a more challenging duty cycle, like highway driving, for about 20 minutes to get the exhaust system hot enough to regenerate properly.

The bottom half of the indicator is the Regeneration Inhibited lamp.

For initiating or inhibiting regeneration, see the Engine Regen Initiate/Inhibit switch (60).

High Exhaust Temp Indicator (ISX Engine)

The high exhaust temp light (61) will illuminate (bottom half of indicator) when an active exhaust regeneration has been initiated and the exhaust temperatures will be elevated above normal levels for the vehicle operating conditions.



WARNING

While regenerating, ensure the exhaust is not aimed at any surface or material that will melt, burn, or explode.

Engine Coolant Temperature Indicator

The engine coolant temperature indicator (25) is located at the top left side of the front console. It illuminates amber to indicate high engine coolant temperature.

Tachometer

The tachometer (2) is located on the right side of the front console. The tachometer is calibrated in RPM x 100 with a range of zero (0) to 35. It is controlled by the crane's electronic operating system based on a J1939 message received from the engine ECM.

Engine Brake On/Off Switch

The engine brake on/off switch is located on the left center side of the front console. The two position (ON/OFF) switch (22) energizes the engine brake. When the top of the switch is pushed, the switch is in the ON position.

Engine Brake High/Low Switch

The two position engine brake high/low switch (20) controls the amount of engine braking.

When the top of the switch is pushed, the switch is in the HIGH position.

Ignition Switch

The ignition switch (14) is located on the right side of the front console. The switch is key operated with four positions: ACCESSORY (left position), OFF (vertical position), RUN (position between vertical and right), and START (right position).

With the ignition switches in both cabs in the OFF position, all electrical functions are disabled except for dome lights, work lights, headlights, tail/parking lights, brake lights, turn/hazard lights, gauge lights, 12V accessory outlets, and CraneStar, if equipped.

The ACCESSORY position allows functionality to all electrical components except for the engine ECM and cab buzzers.

The RUN position is the same for the ACCESSORY position except the engine ECM and cab buzzers are now functional.

The START position will energize the starter relay which in turn energizes the starter motor solenoid and cranking will begin (provided all necessary conditions are met to allow starting).

Throttle Pedal

The throttle pedal (38) is the right most pedal on the cab floor and is angled for increased operator comfort. It is used to control engine speed. The throttle pedal sends a PWM (pulse width modulated) signal, based on the pressure applied, to the crane's electronic operating system which in

turn sends a J1939 percent accelerator position message to the engine ECM.

NOTE: If crane is equipped with a hydraulic pump engage clutch and the hydraulic pump engage switch is in the "engaged" position throttle will be limited to idle.

Regen Initiate/Inhibit Switch

The switch (60) is a three position switch located on the left side of the carrier cab front console and is used to initiate or inhibit an active exhaust regeneration. The top portion of the switch is momentary. Pushing and releasing the top, will send a signal to the crane's electronic operating system which in turn sends a J1939 message to the engine ECM requesting to initiate the active regeneration. The bottom portion of the switch is maintained. Pushing the bottom, will send a signal to the crane's electronic operating system which in turn sends a J1939 message to the engine ECM requesting both active and passive regeneration be inhibited. When the switch is in the center position, the engine will perform passive regeneration as required.

To begin regeneration, the clutch, brake and throttle pedals must be released. If the crane is currently in the regeneration state, depressing the clutch, brake, or throttle pedal(s) will stop regeneration.

If all the conditions have been met to successfully initiate regeneration, the engine will automatically change speed as needed. The regeneration cycle may take approximately 20 minutes.

Engine Diagnostic/Idle Switch

The Engine Diagnostic/Idle Control Switch (36) is a two position maintained rocker switch used to access the engine fault codes or enable the control of the engine low idle function.

Diagnostic function - With the Ignition Switch in the RUN position and the engine off, press the top of the Engine

Diagnostic/Idle Control Switch to view the active engine fault codes flashing out on the Engine Stop lamp (23) and the Engine Warning Lamp (24). If there is more than one active engine fault code, use the Increment/Decrement Switch (35) to toggle forward and backward through the fault codes. If there are no active engine fault codes the engine stop and warning lamps will be on solid simultaneously.

Engine low idle function - With the engine running and the bottom of the Engine Diagnostic/Idle Control Switch pressed, the engine low idle may be adjusted using the Increment/Decrement Switch (35).

Engine Increment/Decrement Switch

The Increment/Decrement Switch (35) is a three position rocker switch with two momentary positions and a center off maintained position. Use this switch in conjunction with the Engine Diagnostic/Idle switch (36) to toggle forward and

backward through active engine fault codes or to adjust engine low idle.

Diagnostic function - With the Ignition Switch in the RUN position, the engine off, and the top of the Engine Diagnostic/Idle Switch (36) pressed, press the top or bottom of the Increment/Decrement Switch to toggle forward and backward through active engine fault codes.

Engine low idle function - With the engine running and the bottom of the Engine Diagnostic/Idle Switch (36) pressed, press the top or bottom of the Increment/Decrement Switch to increase or decrease the low engine idle.

Low Fuel Level Indicator

The Low Fuel Level Indicator (30) will illuminate solid amber when the fuel level reaches approximately an 1/8th of a tank.

Alternator Charge Indicator

This indicator (25) will illuminate red when any of the following conditions are met, key switch is OFF but the headlights or turn signals are left on, the key switch is turned to the accessory position, the key is turned to the run position and engine isn't running, the engine is running and the alternator charge signal is missing, or the system battery voltage or engine ECM voltage falls below 18V or goes above 30V.

Emergency Stop Indicator

The Emergency Stop Indicator (57) will illuminate red when any of three emergency stop switches are activated. There are two emergency stop switches on the carrier with one being located on each carrier outrigger control panel and one on the superstructure cab front console panel.

NOTE: Starting is disabled when any emergency stop switch is activated.

Pump Engage/Disengage Switch (ISX Engine)

The pump engage/disengage switch (62) is a two position maintained rocker switch located on the right hand control panel and is used to engage or disengage the hydraulic pump. Pushing the top of this switch will send a signal to the crane's electronic control system to engage the pump. Pushing the bottom of this switch will send a signal to the crane's electronic control system to disengage the pump.

To engage the pump, the key switch must be in the RUN position, the pump switch must be actuated to the engaged position, the engine must be off and sufficient air pressure (greater than 60 psi in the clutch circuit). Once all these conditions are met the crane may then be started, which should provide enough hydraulic pressure to fully engage the pump.

The hydraulic pump may be disengaged at any time by pushing the bottom of the switch to the disengage position.

Pump Engage Indicator (ISX Engine)

The Pump Engage Indicator (63) has three states, Off, On Solid and On Flashing.

Off - This indicator shall be off when the pump switch is in the disengaged position and the hydraulic pump engaged pressure switch input is Off.

Solid - This Indicator shall be on solid when the key switch is in the RUN position, and the pump switch is in and the engaged position and the hydraulic pump engaged pressure switch input is On.

Flashing - This lamp shall be on flashing if the pump switch is actuated to the engaged position while the engine is running or if the pump switch is actuated while there is not enough air pressure in the clutch circuit.

Crane System Diagnostic Connector

The crane system diagnostic connector (65) is an USB connector located on the Fuse and Relay Panel (54). This connector is used to download software and troubleshooting or monitoring inputs/outputs/settings.

Contact Manitowoc Crane Care for necessary tools including diagnostic cable and software.

Travel Controls and Indicators

Dual Air Pressure Gauge

The dual air pressure gauge (1) is located on the right side of the front console. The gauge is a direct reading pressure gauge with two indicating pointers, red for the primary system and green for the secondary system. The gauge has a dual scale calibrated from 100 to 1000 kPa and 0 to 150 psi. The gauge is connected to each air system separately through tubing.

Low Air Pressure/Tire Inflation On Indicator

The low air pressure/tire inflation on indicator (27) is located on the top left side of the front console. The top of the indicator illuminates red when the pressure in either or both air systems is below 517 kPa (75 psi). The indicator is controlled by two pressure switches electrically connected in parallel. To determine which system pressure is low, observe the dual air pressure gauge. In addition to illuminating the indicator, a warning buzzer will sound.

The bottom of the indicator illuminates amber when the pressure switch in the tire inflation system is activated. In addition to illuminating the indicator, a warning buzzer will sound.

Speedometer

The speedometer (4) is located in the center of the front console above the steering wheel. The speedometer

indicates road speed in both km/hr (kilometers per hour) and mph (miles per hour).

Odometer

There is an odometer (16) located at the bottom of the speedometer and shows total distance traveled.

Parking Brake Control

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

The parking brake control (12) is located on the right side of the front console. The control is a push-pull type air valve used to apply and release the parking brakes on all four rear wheels.

Park Brake Engaged Indicator

The park brake engaged indicator (29) is located at the top of the front console. The indicator illuminates red when the

crane parking brakes are applied. It is illuminated by a pressure switch on the parking brake valve.

The bottom of the indicator (if equipped with a trailing boom) illuminates red to warn the operator that the swing brake release pressure is not enough to hold the swing brake disengaged during trailing boom operation. In addition to illuminating the indicator, a warning buzzer will sound.

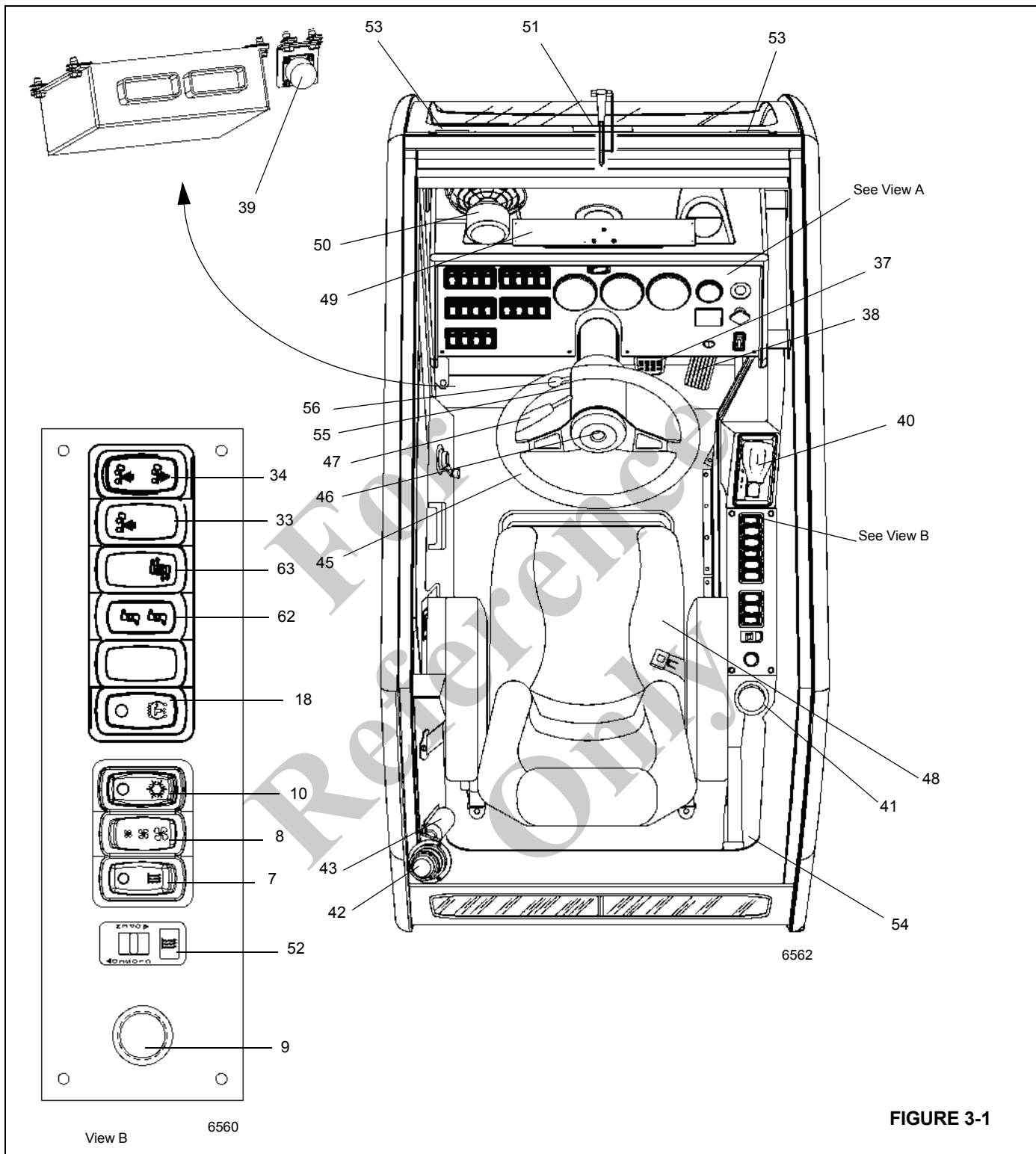
Cross-Axle Differential Locked Indicator (Optional)

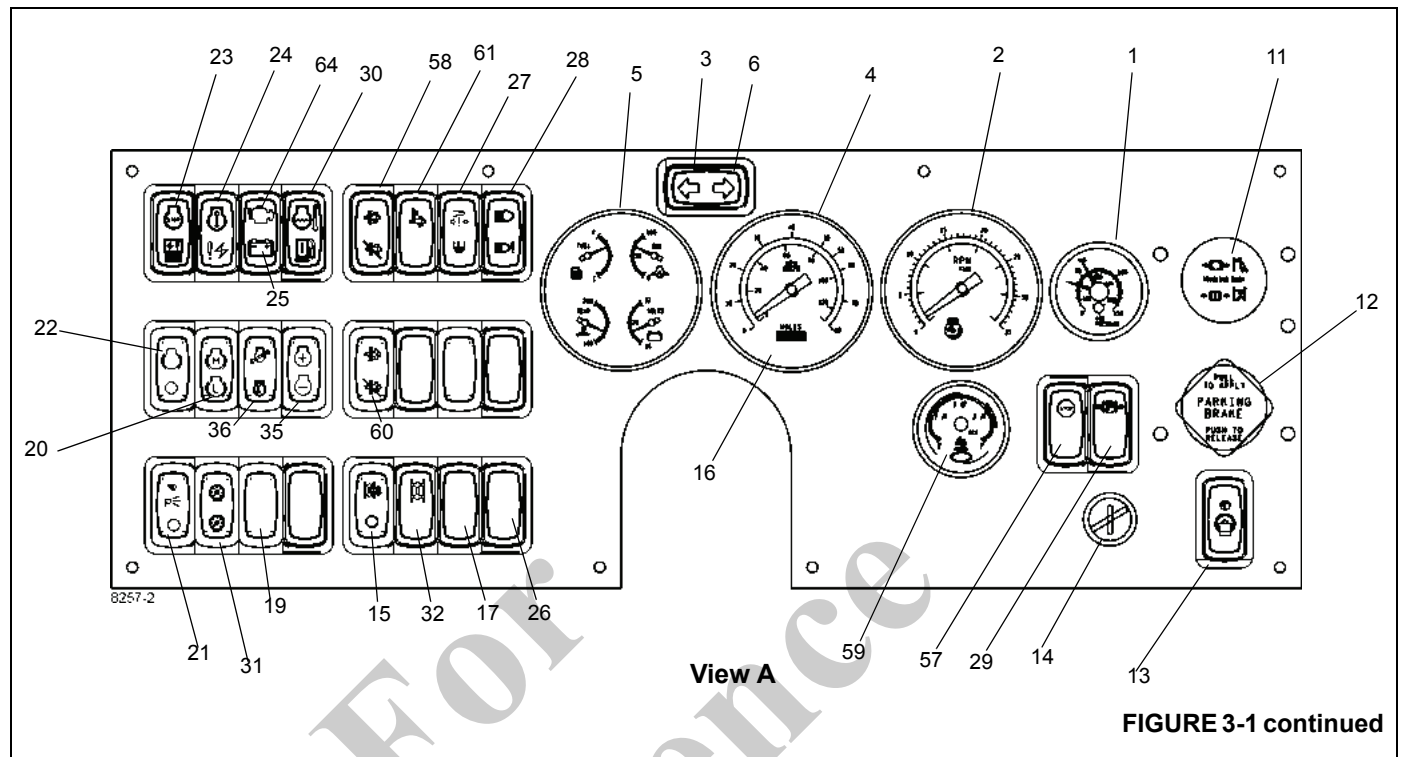
The cross-axle differential locked indicator (26) is located at the left center side of the front console. The amber indicator illuminates to show that the cross axle differential is locked.

CAUTION

Do not operate the cross axle differential lock or the inter-axle differential lock on dry roads.

For
Reference
Only





Item	Description	Item	Description
1	Dual Air Pressure Gauge	20	Engine Brake High-Low Switch
2	Tachometer	21	Headlights Switch
3	Left Turn Signal Indicator	22	Engine Brake On/Off Switch
4	Speedometer	23	Engine Stop/Module Off Line Indicator
5	Gauge Cluster (fuel, temperature, oil, volts)	24	Engine Warning/Electrical Diagnostic Indicator
6	Right Turn Signal Indicator	25	Alternator Charge Indicator
7	Heater On/Off Switch	26	Cross-Axle Differential Locked Indicator (Optional)
8	Heater/Air Conditioner Fan Switch	27	Low Air Pressure/Tire Inflation On Indicator
9	12 Volt Accessory Outlet	28	High Beam/Lamp Malfunction Indicator
10	Air Conditioner Switch (Optional)	29	Park Brake Engaged/Swing Brake Engaged Indicator (swing brake may be optional)
11	Trailing Boom Trailer Emergency Brake Control (Optional)	30	Engine Coolant Temperature/Low Fuel Level Indicator
12	Parking Brake Control	31	Dimmer Switch
13	Windshield Wiper/Washer Switch	32	Inter-Axle Differential Lock Indicator
14	Ignition Switch	33	Suspension Deflated Indicator
15	Inter-Axle Differential Lock Switch	34	Suspension Inflation Control Switch
16	Odometer	35	Engine Increment/Decrement Switch
17	Cross-Axle Differential Lock Switch (Optional)	36	Engine Diagnostic/Idle RPM Switch
18	Tire Inflation Switch	37	Brake Pedal
19	Beacon Light Switch (Optional)		

Item	Description
38	Throttle Pedal
39	Engine ECM Diagnostic Connector
40	Transmission Shift Lever
41	Ash Tray
42	Beacon Light (Optional)
43	Fire Extinguisher
44	Cab Dome Light (Not Shown)
45	Steering Wheel
46	Horn Button
47	Headlight Dimmer/Turn Signal Lever/Cruise Control
48	Seat
49	Sun Visor
50	Cab Circulating Fan
51	Windshield Defroster Air Outlet
52	Heater Control Switch
53	Cab Marker Lights
54	Fuse and Relay Panel (Not Shown)
55	Hazard Light Switch
56	Steering Column Tilt/Telescope Lever
57	Emergency Stop Indicator
58	Regen Needed/Regen Inhibited Indicator
59	Diesel Exhaust Fluid Level Gauge (ISX Only)
60	Regenerate/Inhibit Regenerate Switch (ISX Only)
61	High Exhaust System Temperature Indicator (ISX Only)
62	Pump Engage/Disengage Switch (ISX Only)
63	Pump Engage Indicator (ISX Only)
64	Malfunction Indicator Lamp (ISX Only)
65	Crane System Diagnostic Connector (Not Shown)

Cross-Axle Differential Lock Switch (Optional)

The cross-axle differential lock switch (17) is located on the left center side of the front console and is used to lock the right and left wheels in a tandem set. The cross-axle differential lock increases traction on slippery roads. It is a two position lock/unlock switch. Press top of switch for the lock position or bottom of switch for the unlock position.

CAUTION

Do not operate cross-axle differential lock while crane wheels are spinning or at speeds over approximately 16 km/h (10 mph). Release the throttle when locking or unlocking.

Inter-Axle Differential Lock Switch

The inter-axle differential lock switch (15) is located on the left center side of the front console. In the lock (press top of switch) position, both rear axles are locked together and turning at the same speed. In the unlocked (press bottom of switch) position, the axles operate independently of each other.

CAUTION

Do not operate inter-axle differential lock switch while crane wheels are spinning or at speeds over approximately 16 km/h (10 mph). Release the throttle when locking or unlocking.

Inter-Axle Differential Lock Indicator

The inter-axle differential lock indicator (32) is located on the left center side of the front console. The amber indicator illuminates when the inter-axle differential lock is engaged.

Brake Pedal

The brake pedal (37) is located on the cab floor, to the left of the foot throttle and is used to apply the service brakes.

Transmission Shift Lever

The transmission shift lever (40) is located on the right side of the cab. It is used to select the transmission gears. Refer to "Shifting Gears" on page 3-54 in this section for complete transmission operating instructions.

Trailing Boom Trailer Emergency Brake Control (Optional)

The trailing boom (trailer emergency) brake control (11) is a push-pull type air valve located on the right side of the front console. The control is used to set and release the brakes on the trailing boom trailer. Pull the control knob out to apply and push control knob in to release the trailing boom trailer brakes. If the air brake system pressure becomes low, the Emergency Brake Control knob will automatically return to the Emergency Brake "ON" position (control knob out).

Traveling without (Optional) Trailing Boom Trailer - If Equipped

Traveling without the optional trailing boom trailer attached and with the boom stowed in the carrier boom rest; the carrier parking brakes (12) must be released (control knob pushed in) and the trailing boom park brake control valve

(11) must be applied (control knob pulled out). If the Trailing Boom Trailer Emergency Brake Control is in the release position (pushed in), the air brake system pressure will be reduced and the Park and Trailing Boom Emergency Brake will automatically reset to the brake applied (ON) position.

Swing Brake Engaged Indicator (Optional)

Swing brake engaged indicator (29) is located on the top left side of the front console. The swing brake engaged indicator (bottom of the indicator) illuminates red to warn the operator that the swing brake release pressure is not enough to hold the swing brake disengaged during trailing boom operation. In addition to illuminating the indicator, a warning buzzer will sound.

Suspension Inflation Control Switch

The suspension inflation control switch (34) is located on the right side console. When positioned to the right to inflate, the suspension air bags are inflated. When positioned to the left to deflate, the suspension air bags are deflated.

NOTE: The suspension air bags should be inflated at all times except when on outriggers or in a pick and carry mode. Suspension air bags will deflate automatically when superstructure key switch is turned ON.

Suspension Deflated Indicator

The suspension deflated indicator (33) is located on the right side console. The amber indicator illuminates when the air is removed from the suspension air bags. It is controlled by four pressure switches connected in series.

Diesel Exhaust Fluid (DEF) Level Gauge (ISX Engine)

This gauge (59), located on the right center of the front control panel indicates the amount of fluid in the DEF tank.

Engine performance will be derated per the following conditions:

- 3% derated during inducement
- 5% derated during the warning level of the fluid
- 10% derated when the fluid level is low.

Accessory Controls and Indicators

High Beam/Lamp Malfunction Indicator

The headlight high beam/lamp malfunction indicator (28) is located at the top left of the center front console. The indicator is a blue light that illuminates when the headlights are on high beam or amber when there is a lamp malfunction.

Heater On/Off Switch

The heater on/off switch (7) is located on the right side console. Press the right side of the switch to ON for heat. Press the left side of the switch to turn the heater off.

Heater Control Switch

The heater control switch (52) is located on the right side console. Push the switch to the right to (OPEN) the valve for heat. Push the switch to the left to (CLOSE) the valve.

Heater/Air Conditioner Fan Switch

The heater/air conditioner fan switch (8) is located on the right side console. The switch controls the speed which in turn regulates the volume of air output of the heater and air conditioner fan by positioning switch to: low (switch positioned to left), medium (switch centered), and high (switch positioned to right).

NOTE: Either air conditioner or heater switch must be positioned to ON before the fan will become operational.

Air Conditioner Switch (Optional)

The air conditioning switch (10) is located on the right side console. The switch controls the operation of the optional air conditioning system in conjunction with the fan switch. Press the switch to the right to turn air conditioner on. Press the switch to the left to turn the air conditioner off.

Windshield Wiper/Washer Switch

The windshield wiper/washer toggle switch (13) is located on the lower right side of the front console. The switch is used for removing moisture from the windshield. The switch has an off and high position with six intermittent positions between high and off. Pushing the switch up from the off position energizes the wiper motor. Continue to push switch up for each intermittent position and the high position. Push the switch down to off to stop the motor and return the wiper blade to the parked position.

Push the very top of the switch to activate the washer switch to spray washer fluid on the windshield.

Headlights Switch

The headlights switch (21) is a three position switch located on the bottom left side of the front console. The bottom position is off. The center position will illuminate marker, clearance and gauge lights. The top position will turn on the headlights in addition to the marker, clearance and gauge lights.

Beacon Light Switch (Optional)

The beacon light switch (19) is a two position, on-off switch located on the left side of the front console that controls the beacon light (42) on the top of the carrier cab.

Dimmer Switch

The dimmer switch (31) is located on the left bottom side of the front console. The switch controls the brightness of the gauge lights.

NOTE: The headlight switch (21) must be in the center or top position before gauge lights will illuminate and the dimmer switch becomes functional.

Headlights Dimmer Switch

The headlights dimmer switch (47) is incorporated in the turn signal switch. It is located on the left side of the steering column. The switch is activated by pulling or pushing the turn signal lever toward you or away from you.

Turn Signal Lever

The turn signal lever (47) is located on the steering column. Positioning the lever down causes the indicator light on the console and the left front and left rear signals to flash. Positioning the lever up causes the indicator light on the console and the right front and right rear signals to flash.

Cruise Control

The cruise control (47) is incorporated in the turn signal lever located on the left side of the steering column. Push the switch to ON to turn the cruise control on. Accelerate to desired speed and push (SET COAST) button on end of lever.

If cruise is stopped by braking and switch is still positioned to ON, the switch can be pushed to (RESUME-ACCEL) to resume cruise speed. Position switch to OFF to turn the cruise control off.

Hazard Light Switch

The hazard light switch (55) is located on the steering column. Pulling on the switch (in the direction of the arrow) causes all the turn signals and the indicator lights on the console to flash.

Left Turn Signal Indicator

The left turn signal indicator (3) is located on the top left side of the front console. It is a green indicator light that flashes when the turn signal lever is pulled down or the hazard switch is activated.

Right Turn Signal Indicator

The right turn signal indicator (6) is located on the top right side of the front console. It is a green indicator light that flashes when the turn signal lever is pushed up or the hazard switch is activated.

Steering Column Tilt/Telescope Lever

The steering column tilt/telescope lever (56) is located on the steering column behind the turn signal lever. Pulling back on

the lever allows the steering column to be tilted, and pushing forward on the lever allows the steering column to be telescoped in and out.

Horn Button

The horn button (46) is located in the center of the steering wheel (45). Depressing the horn button energizes the circuit sounding the horn.

Fire Extinguisher

The fire extinguisher (43) is mounted on the left inside rear of the cab.

Cab Circulating Fan

The cab circulating fan (50) is mounted on the left front of the cab and is controlled by a two speed rocker switch on the base of the fan.

Tire Inflation Switch

The tire inflation switch (18) is located on the left side of the front console. It is a two position switch that activates the tire inflation system. Push the top of the switch to activate the tire inflation system. An amber indicator will illuminate and the warning buzzer will sound when the switch is in the on position.

12 V_{DC} Accessory Outlet

The 12 V_{DC} accessory outlet (9) is located on the right side console. It provides an outlet for the operator to plug in a 12 V_{DC} accessory. This outlet should be used only for components requiring 3 amps or less.

Cab Dome Light (Not Shown)

The cab dome light (44) is located in the center of the cab roof directly over the seat. It is controlled by a switch on the light and by a door switch that powers the light when the cab door is opened.

Air Horn (Not Shown)

A set of air horns are mounted on top of the cab and are controlled by a valve manually actuated by a cable inside the cab.

Fuse and Relay Panel (Not Shown)

The fuse and relay panel (54) is located in the rear right side of the cab underneath a removable cover. It contains 12 fuses used to protect cab wiring, 3 relays to control the wiper and heater motor, the cab warning buzzer and the electrical system diagnostic connector.

Engine ECM Diagnostic Connector

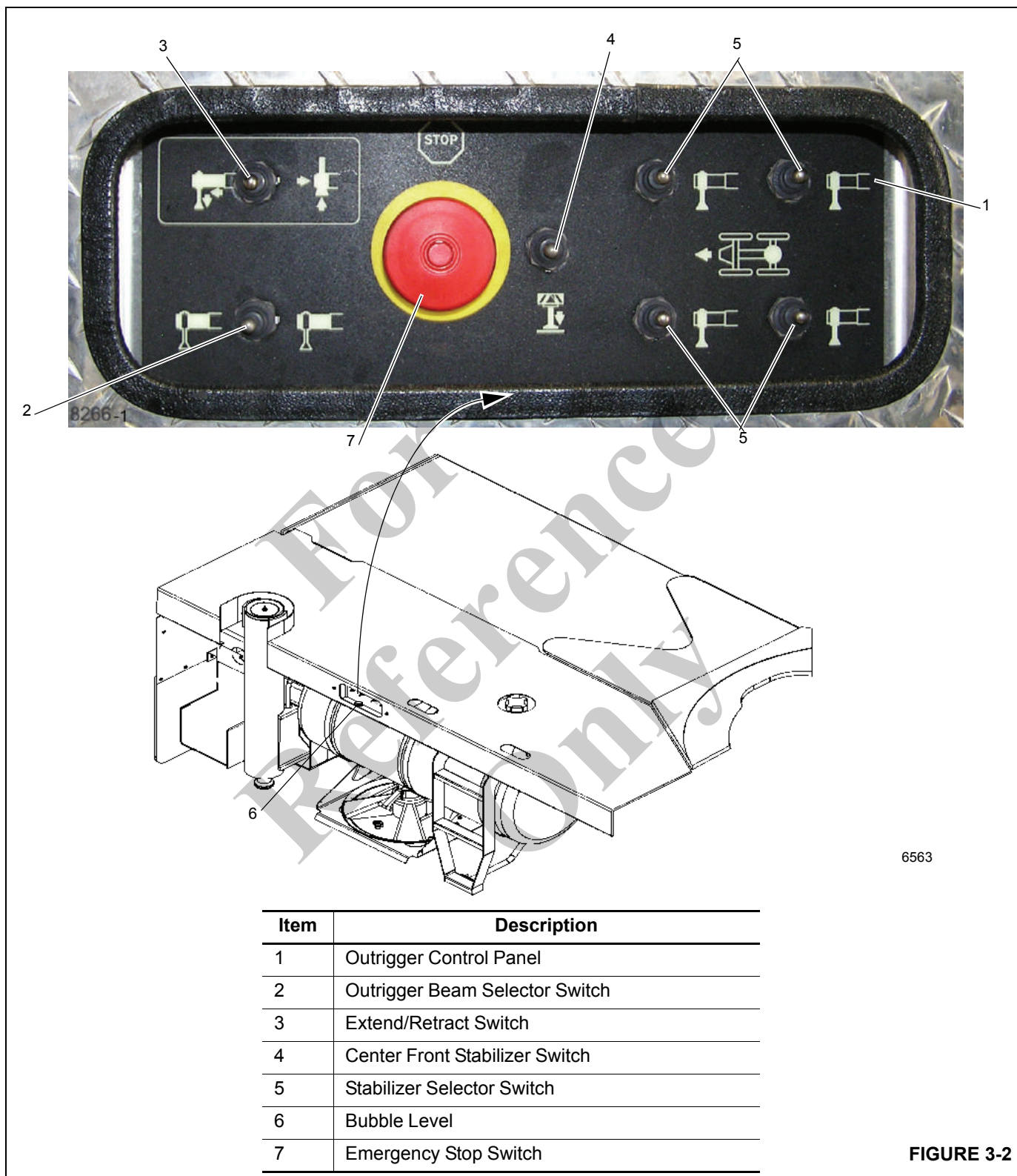
The engine ECM diagnostic connector (39) is located on the left side of the cab beneath the front console. It is used for servicing the engine ECM.

NOTE: A laptop computer with appropriate cable and engine or electrical system software are required.

Malfunction Indicator Lamp

The Malfunction Indicator Lamp (64) illuminates amber when there is an emission related system error. When this indicator illuminates have the crane serviced as soon as possible.

For
Reference
Only



6563

FIGURE 3-2

Additional Carrier Controls and Indicators

NOTE: The following paragraphs describe the additional controls and indicators located on the carrier to operate the outriggers. The numbers in parentheses () represent the index number from Figure 3-2.

Outrigger Control Summary

NOTE: The park brake and the hydraulic pump must be engaged for outrigger operation.

There is an outrigger control panel located on each side of the crane carrier. Each panel contains switches for extending and retracting the outrigger beams and for raising and lowering the outrigger stabilizer (jack) cylinders on all sides of the crane. Each control panel also contains a control switch for raising and lowering the center front stabilizer. The following paragraphs explain these controls.

Outrigger Control Panel

There is one outrigger control panel (1) on each side of the crane's frame. The panel on the right side operates the outrigger beams for that side only. The panel on the left side operates the outrigger beams for that side only. All the stabilizers may be operated from the left or right side of the crane.

Outrigger Beam Selector Switch

The outrigger beam selector switch (2) is used to indicate desired operation of the front or rear outrigger beam for the side of the crane the control panel is on.

Extend/Retract Switch

The extend/retract switch (3) will operate both the outrigger beams or the stabilizers. After positioning the desired selector switch, positioning the extend/retract switch energizes the control solenoid to allow hydraulic fluid to flow through the control solenoid valve and the individual solenoid valve and move the selected component in the desired direction. In addition, when the switch is positioned to either position, a signal is sent to the engine ECM to increase engine speed above idle for operation of the outriggers.

Center Front Stabilizer Switch

The center front stabilizer switch (4) is located in the center of the outrigger control panel. It must be used in conjunction with the extend/retract switch to control the operation of the center front stabilizer. The center front stabilizer will retract automatically when any of the other four stabilizers are retracted; therefore, it must be reset if any craning functions are to be continued.

Stabilizer Selector Switches

The Stabilizer Selector switches (5) when used in conjunction with the Extend/Retract switch (3) will control the desired stabilizer(s).

Emergency Stop Switch

The emergency stop switch (7) is located on the left center side of the outrigger panel. Push the switch to stop the engine.

Pull switch out to restart the crane and resume operation.

NOTE: If the emergency stop switch on either outrigger control panel or in the superstructure cab is not pulled out for normal operation, the emergency stop indicator in the carrier cab will illuminate red and engine will not start.

Daytime Running Lights

Daytime running lights is a feature in which the headlight low beams will come on automatically anytime the carrier ignition switch is in the on position, engine is running, and the park brake is released regardless of the position of the headlight switch.

SUPERSTRUCTURE CAB

Operator Display

The Operator Display (30) (Figure 3-3 through Figure 3-15) has various screens that show engine and system indicators. The display has five buttons that correspond to controls that are shown on the display.

Splash Screen

This screen (Figure 3-3) is visible after key on and will remain visible until the display has finished initializing.



FIGURE 3-3

Main Screen

This screen (Figure 3-4) is the operator's main screen and will be the first screen visible after the splash screen. It shows engine and crane system indicators and information.

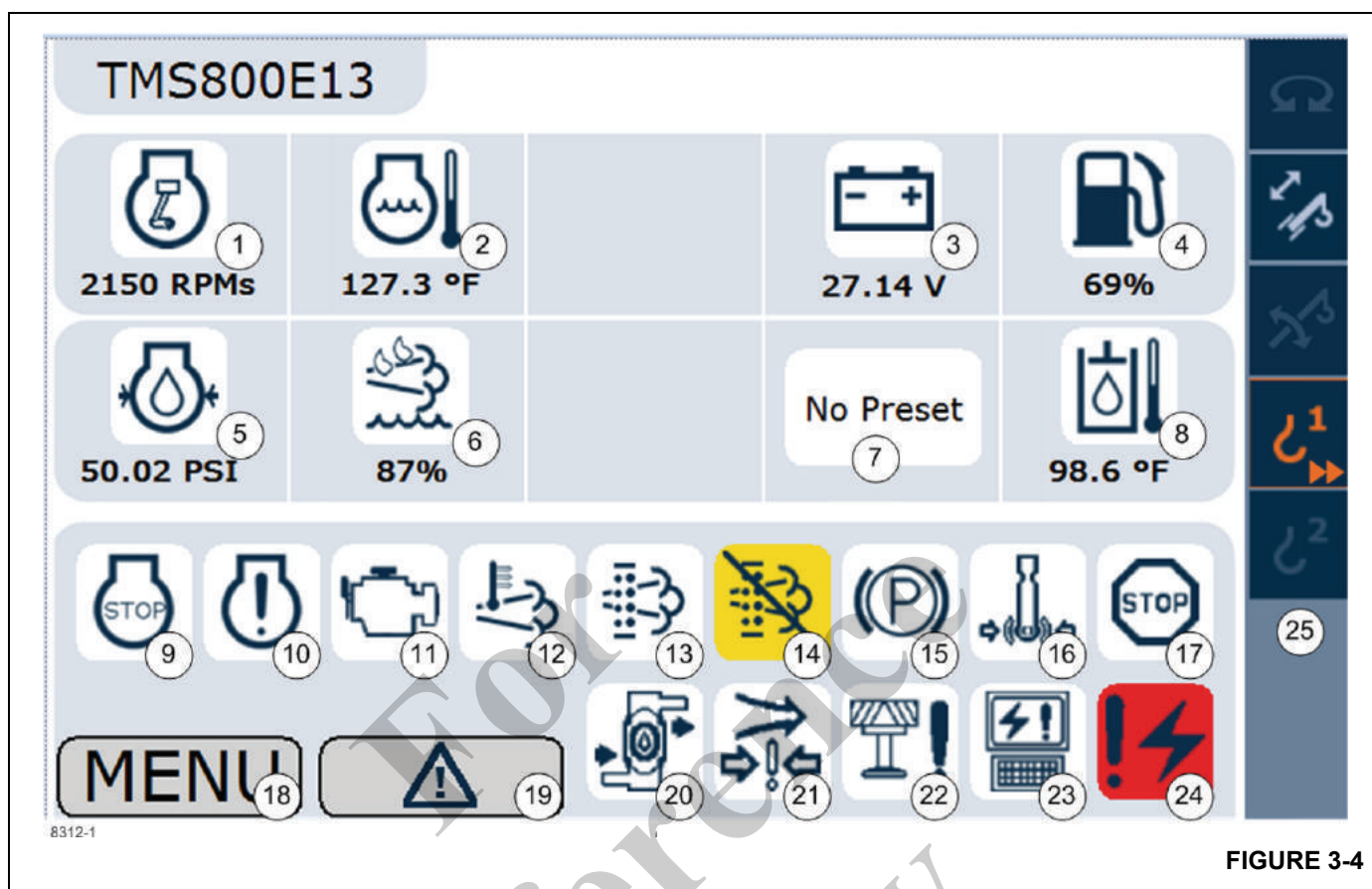


FIGURE 3-4

Item	Description
1	Engine RPM
2	Engine Coolant Temperature and High Coolant Temperature Indicator
3	Battery Voltage and Charge Indicator
4	Fuel Level and Low Fuel Indicator
5	Engine Oil Pressure and Low Oil Pressure Indicator
6	DEF Level and Indicator
7	Operator Presets Loaded Indicator
8	Hydraulic Oil Temperature and High Oil Temperature Indicator
9	Engine Stop Indicator
10	Engine Warning Indicator
11	Engine MIL (Malfunction Indicator Lamp)
12	High Exhaust System Temperature Indicator
13	Engine Regen Needed Indicator

Item	Description
14	Engine Regen Inhibit Indicator
15	Park Brake Indicator
16	Swing Brake Engaged Indicator
17	Emergency Stop (E-Stop) Indicator
18	Menu Selection Button
19	Fault Screen Shortcut Button
20	Hydraulic Pump Engaged Indicator
21	Low Air Pressure Indicator
22	Center Front Stabilizer Overload Indicator
23	Module Offline Indicator
24	Electrical Diagnostic Indicator
25	Crane Control Status Indicators

Engine RPM (1) (Figure 3-4)

The current speed of the engine as broadcasted by the Engine ECM.

Engine Coolant Temperature and High Coolant Temperature Indicator (2)

The coolant temperature of the engine broadcasted by the ECM. When a coolant temp fault is active, the indicator lamp will turn amber.

Battery Voltage and Charge Indicator (3)

When the engine is running, this is the voltage reading provided by the ECM, or it is provided by the Master Module of the crane control system. The indicator lamp will turn red whenever the engine is not running, the battery voltage is over 30 V_{DC}, or the battery voltage is under 18 V_{DC}.

Fuel Level and Low Fuel Indicator (4)

Fuel level as broadcasted by the ECM (ISX engines) or the fuel level sender in the fuel tank (QSM engines). The indicator lamp turns amber whenever the fuel level drops below 15% and will remain on until the fuel level increases above 20%.

Engine Oil Pressure and Low Oil Pressure Indicator (5)

The oil pressure is broadcasted by the ECM and the indicator lamp turns red whenever the pressure drops to below the accepted value and remains on until the oil pressure returns to normal.

DEF Level and Indicator (6)

The ECM sends the DEF level as well as the status for the indicator lamp. The lamp status can be off, on, or flashing depending on the message coming from the ECM.

Operator Presets Loaded Indicator (7)

This crane has the capability for the operator to set and save parameters to modify the default functionality of the crane functions, once the presets are loaded. The usage of presets will be defined in a following section, refer to *Load Presets Screen*, page 3-19.

Hydraulic Oil Temperature and High Oil Temperature Indicator (8)

The hydraulic oil temperature is monitored by a thermistor located in the oil tank. The indicator lamp turns red once the temperature is above 93.3°C (200°F).

Engine Stop Indicator (9)

Controlled by the Engine ECM and turns red when a serious engine problem exists that requires the vehicle and the engine to be stopped as soon as safely possible. In addition, a warning buzzer will also sound.

Engine Warning Indicator (10)

Controlled by the Engine ECM and turns amber when there is an engine problem which must be corrected.

Engine MIL (Malfunction Indicator Lamp) (11)

For the ISX Engine Only (Not present otherwise). Controlled by the Engine ECM and turns amber when there is an emission related system error. When this indicator illuminates have the crane serviced as soon as possible.

High Exhaust System Temperature Indicator (12)

For the ISX Engine Only (Not present otherwise). Controlled by the Engine ECM and turns amber when the exhaust temperature will be high during the regeneration process.

Engine Regen Needed Indicator (13)

For the ISX Engine Only (Not present otherwise). Controlled by the Engine ECM and turns amber when an engine regeneration is required.

Engine Regen Inhibit Indicator (14)

For the ISX Engine Only (Not present otherwise). Turns amber when the regen inhibit switch is active.

Park Brake Indicator (15)

Turns red when the park brake is engaged.

Swing Brake Engaged Indicator (16)

Turns red and disables swing functions when the swing brake engage switch is active.

Emergency Stop (E-Stop) Indicator (17)

Turns red and disables the engine if any of the E-Stop buttons are depressed (one in the superstructure cab and one each on the carrier outrigger control panels).

Menu Selection Button (18)

Accesses the menu screen where the operator will be able to view/change presets, change temperature units, view active faults, view the software versions, and check crane function usage time.

Fault Screen Shortcut Button (19)

This button provides instant access to the fault screen. Whenever a fault (engine or crane system) is active, this button will flash amber.

Hydraulic Pump Engaged Indicator (20)

For the ISX Engine Only (Not present otherwise). When the hydraulic pump engage switch (located in the carrier cab) is active, this indicator will flash amber as long as the pump is not engaged and will turn on solid once the pump is engaged. (NOTE: the pump will not be engaged until the engine is running, so the lamp will flash until that point).

Low Air Pressure Indicator (21)

For the ISX Engine Only (Not present otherwise). The indicator lamp will turn on red if the system air pressure drops below 75 PSI.

Center Front Stabilizer Overload Indicator (22)

The lamp will turn on red if the overload pressure switch is active high.

Module Offline Indicator (23)

This indicator lamp will turn on red whenever any module either loses power or communication with the Master Module. The lamp will also turn on if the Engine Fault Code Chart is not loaded on the crane.

Electrical Diagnostic Indicator (24)

This lamp will turn red whenever any output on the crane control system experiences an abnormal operating condition (such as, open, short to battery, short to ground, over current).

Crane Control Status Indicators (25)

The crane control status indicators located along the right-hand side have three possible states: function disabled (gray), function inactive (blue), and function active (orange). The functions listed from top to bottom are Swing, Tele, Lift, Main Hoist, and Aux Hoist (only visible if the Aux Hoist is enabled in the crane control EEPROMs). If the crane function enable switch is inactive, all statuses will show disabled.

Special Notes

Swing - Whenever the swing brake switch is active, swing function is disabled and the indicator reflects this status.

Main and Aux Hoist - If the hoist high speed switch is active and the hoist is active, high speed indication will be displayed as two right-facing arrows in the lower right corner of the indicator. Whenever the hoist is inactive or disabled, the high speed indication will not be visible.

For
Reference
Only

Menu Screen

The menu screen (Figure 3-5) allows the operator to view/change presets, change temperature units and brightness levels, view active faults, view the software versions, and check crane function usage time. Navigation of this screen is through the directional buttons at the bottom of the screen.

The currently active selection will be highlighted orange. Once a selection is made, the display proceeds to the next screen. In the case of the temperature units and brightness control, the highlighted icon will turn from orange to green and then further on-screen selections can be made.

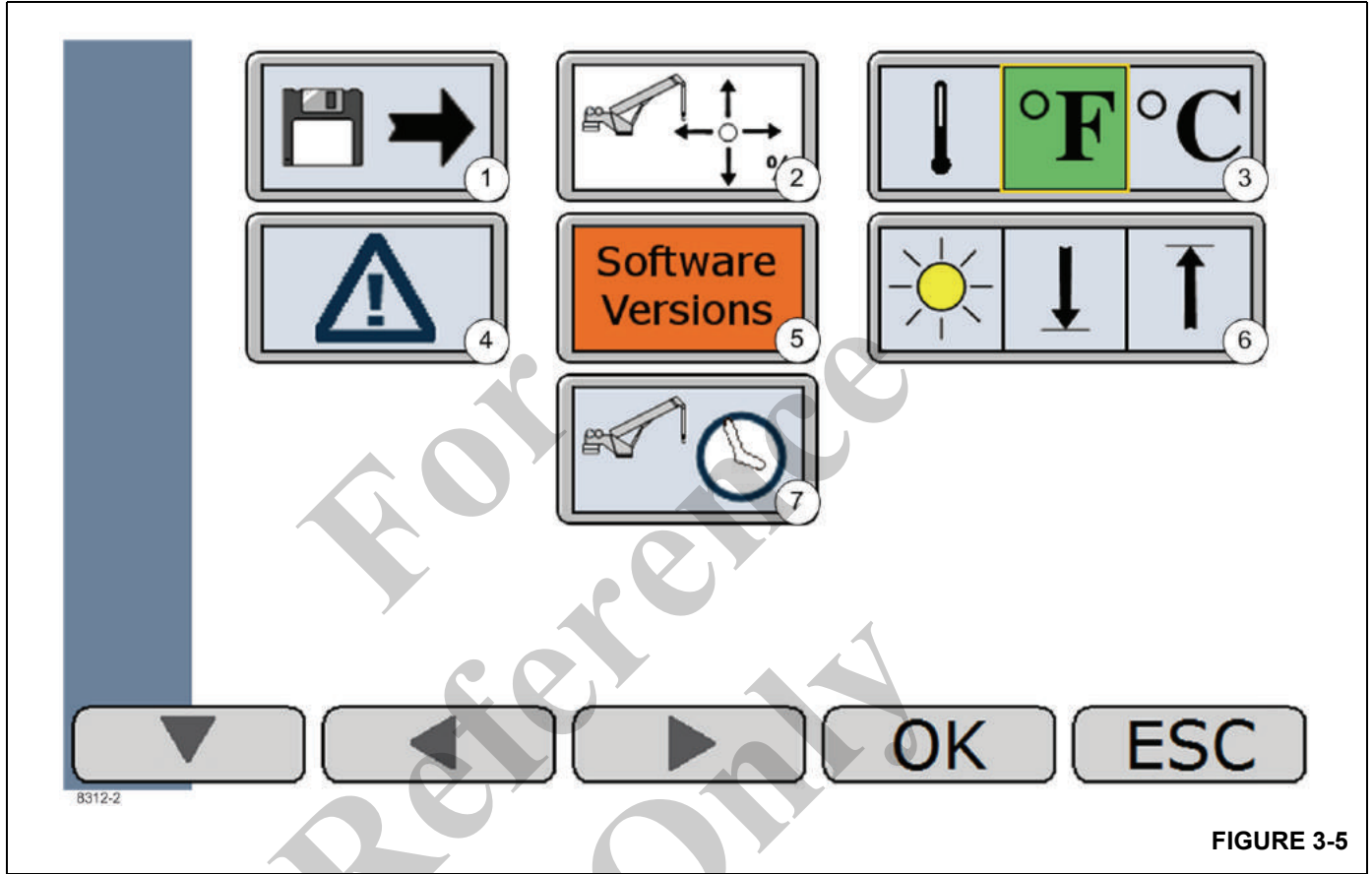


FIGURE 3-5

Item	Description
1	Load Operator Presets
2	Modify Operator Presets
3	Temperature Units
4	Faults
5	Software Versions
6	Display Brightness
7	Crane Function Hours

Load Operator Presets (1) (Figure 3-5)

Selection of this icon will navigate the operator to the load presets screen, where they will have the option to view/load from three different presets (labeled Preset 1, Preset 2, and Preset 3) or to load the “No Preset” option, which is the set of default values. These presets allow for certain output parameters for the crane functions (swing, tele, lift, and hoist)

to be changed per the operators preference for joystick control and hydraulic function performance. The presets will be defined in more detail in the modify presets screen.

Modify Operator Presets (2)

Selection of this icon (which is only possible once a preset is loaded, otherwise the icon is disabled and selection of this icon is not allowed) will navigate the operator to the modify presets screen. There they will have the option to modify or reset, then save the currently loaded preset.

Temperature Units (3)

The temperatures on the main screen can be depicted in units of either degrees Fahrenheit (°F) or degrees Celsius (°C). When the temperature icon (thermometer) is highlighted then selected, the icon turns green and the operator can now select the desired units by pressing either the left or right directional keys and then pressing OK. If the operator presses ESC while in this selection, no change will occur and the navigation of the menu screen can continue.

Faults (4)

Selection of this icon will navigate the operator to the faults screen, where the operator can view any active engine or crane system faults. Whenever a fault (engine or system) is active, this icon will flash amber.

Software Versions (5)

Selection of this icon will navigate the operator to the software versions screen, where the operator can view the firmware versions loaded on all control modules as well as the revision level of the master control software.

Display Brightness (6)

The brightness of the display can be modified from this icon. The brightness change only remains in effect while the

ignition key is on. Once the key is cycled to off, the brightness level returns to its default state (80%). When the brightness icon (sun) is highlighted then selected, the icon turns green and the operator can now select whether to increase or decrease the brightness units by pressing either the left or right directional keys and then pressing OK. The operator will need to continue pressing OK until the desired level is achieved. When done, the operator will press ESC to return to menu navigation.

Crane Function Hours (7)

Selection of this icon will navigate the operator to the function hours screen, where the operator can view the time the crane has spent performing each of the craning functions (swing, tele, lift, and hoist).

For
Reference
Only

Load Presets Screen

The load presets screen (Figure 3-6) allows the operator to view/load from three different presets (labeled Preset 1, Preset 2, and Preset 3) or to load the “No Preset” option,

which is the set of default values. If the ESC button is pressed at any time, no preset will be loaded and the operator will be returned to the menu screen.

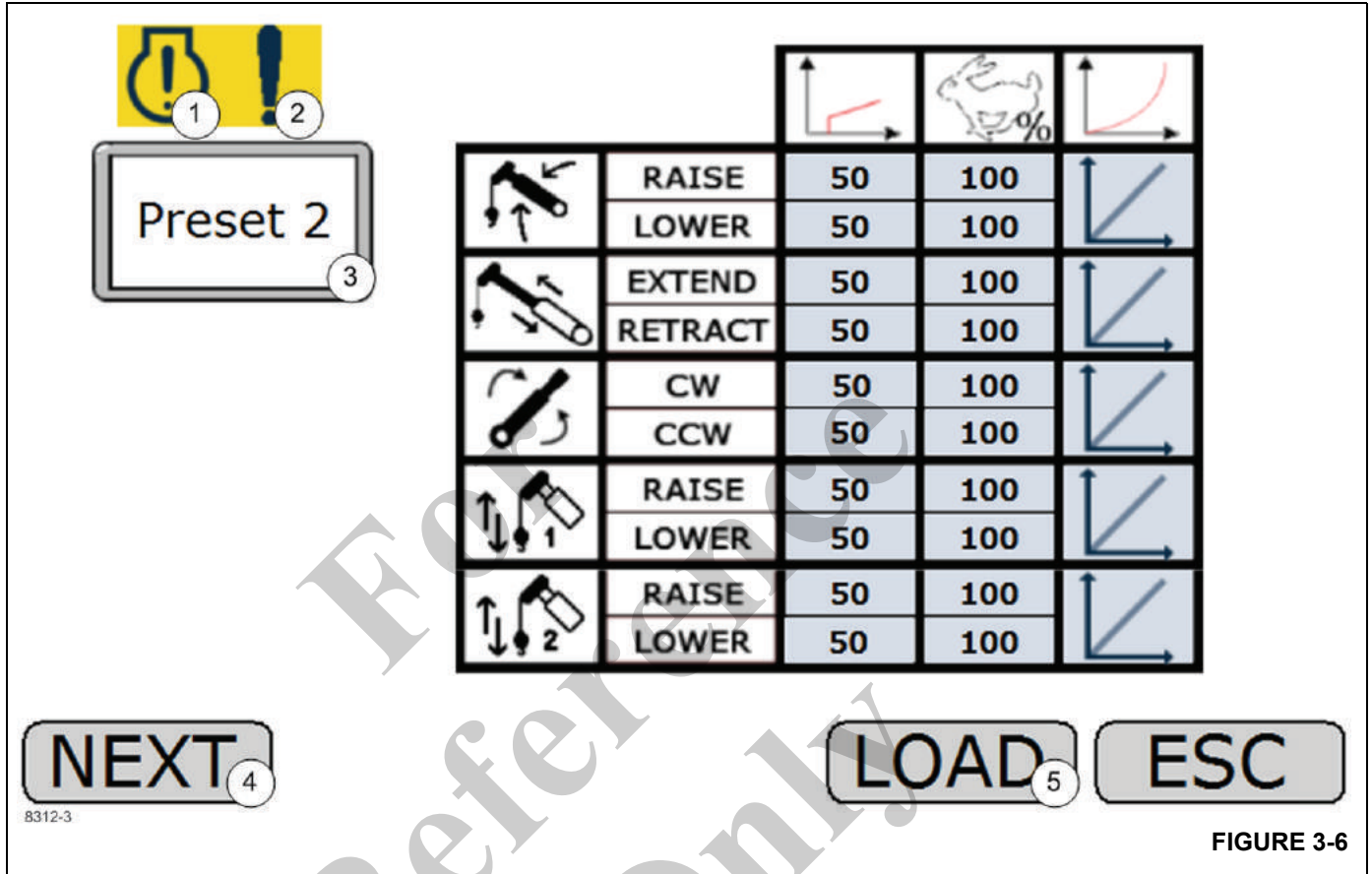


FIGURE 3-6

Item	Description
1	Engine Fault Active Indicator
2	System Fault Active Indicator
3	Current Visible Preset Selection
4	Display Next Preset Button
5	Load Current Preset Button

Engine Fault Active Indicator (1) (Figure 3-6)

This indicator will become visible whenever there is an active engine fault. The operator should return to the fault screen to view the active fault(s).

System Fault Active Indicator (2)

This indicator will become visible whenever there is an active system fault. The operator should return to the fault screen to view the active fault(s).

Current Visible Preset Selection (3)

Displays the name of the presets shown on-screen. Values can be Preset 1, Preset 2, Preset 3, or No Preset.

Display Next Preset Button (4)

Pressing this button cycles through the presets.

Load Current Preset Button (5)

Pressing this button will load the currently visible preset into memory and then return the operator to the main screen. This preset will be active until another preset (or the default) is loaded.

Modify Presets Screens

The modify presets screens allows the operator to modify or reset, then save the currently loaded preset. The presets are arranged in tabular format and are defined from top to bottom as: boom raise/lower, tele extend/retract, swing

clockwise (right)/counter-clockwise (left), main hoist raise/lower, and aux hoist raise/lower (NOTE: the aux hoist will only be visible if Aux Hoist is enabled in the crane control EEPROMs).

Modify Presets Screen 1 (Figure 3-7)

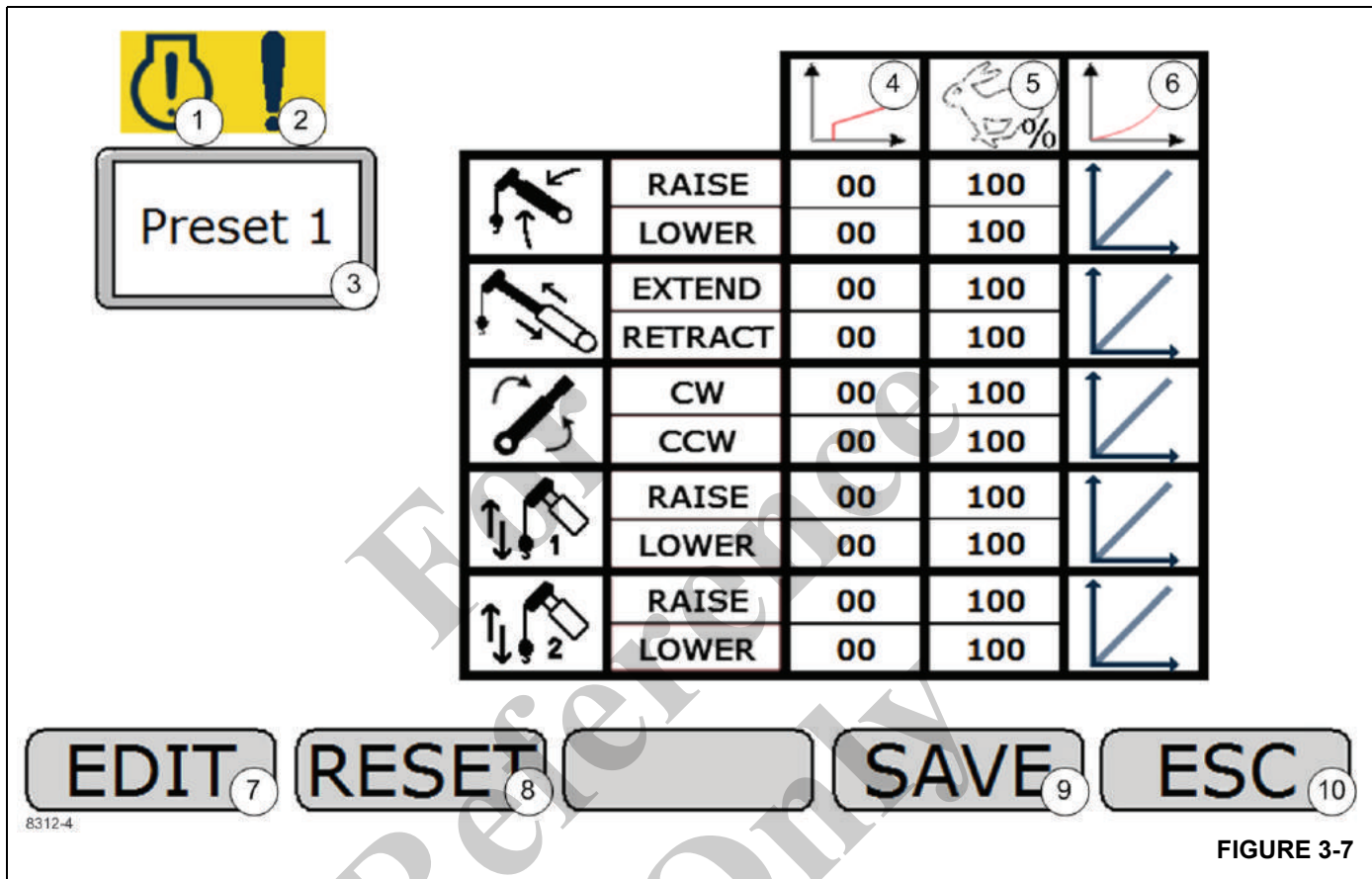


FIGURE 3-7

Item	Description
1	Engine Fault Active Indicator
2	System Fault Active Indicator
3	Currently Loaded Preset
4	Crane Function Threshold Offset
5	Crane Function Max Percent Output
6	Crane Function Curve Response
7	Edit Currently Loaded Presets
8	Reset Currently Loaded Presets
9	Save Currently Loaded Presets
10	Escape

Engine Fault Active Indicator (1) (Figure 3-7)

This indicator will become visible whenever there is an active engine fault. The operator should return to the fault screen to view the active fault(s).

System Fault Active Indicator (2)

This indicator will become visible whenever there is an active system fault. The operator should return to the fault screen to view the active fault(s).

Currently Loaded Preset (3)

The loaded presets that can be modified.

Crane Function Threshold Offset (4)

The threshold value is the point in joystick/pedal movement where the crane function starts moving. The range of this preset is from -50 to 50 with 0 being the default. A more negative number will result in the threshold value being achieved with more joystick/pedal movement while a more positive number will result in the opposite effect.

Crane Function Max Percent Output (5)

The maximum output percentage is 100% at full joystick/pedal deflection. The range of this preset is from 0 to 100%. Reduction of this preset results in the overall reduction in speed of the crane function.

Crane Function Curve Response (6)

There is a correlation in the software between joystick/pedal movement and how quickly the output is energized to meet the input stimulation. This response time is present to provide a smooth crane function regardless of how quickly the input is increased. This preset has five different states from a straight line (no modified response) increasing exponentially to a sharp response time. As the curve increases, the response time decreases.

Edit Currently Loaded Presets (7)

The operator will now be able to select a preset value(s) to modify. The screen will transition to "Modify Presets Screen 2".

Reset Currently Loaded Presets (8)

The preset values will be set back to the default values: 0 for threshold, 100 for max, and a flat line for the curve response. The operator will need to press the save button in order for the reset to be completed.

Save Currently Loaded Presets (9)

When this button is pressed all modified parameters will be saved to their designated EEPROM locations. The screen will transition to "Modify Presets Screen 4".

ESC (10)

Pressing the escape button at this point will return the operator to the menu screen. If the save button was not pressed prior to this button, any changes made to the presets will be ignored.

For
Reference
Only

Modify Presets Screen 2 (Figure 3-8)

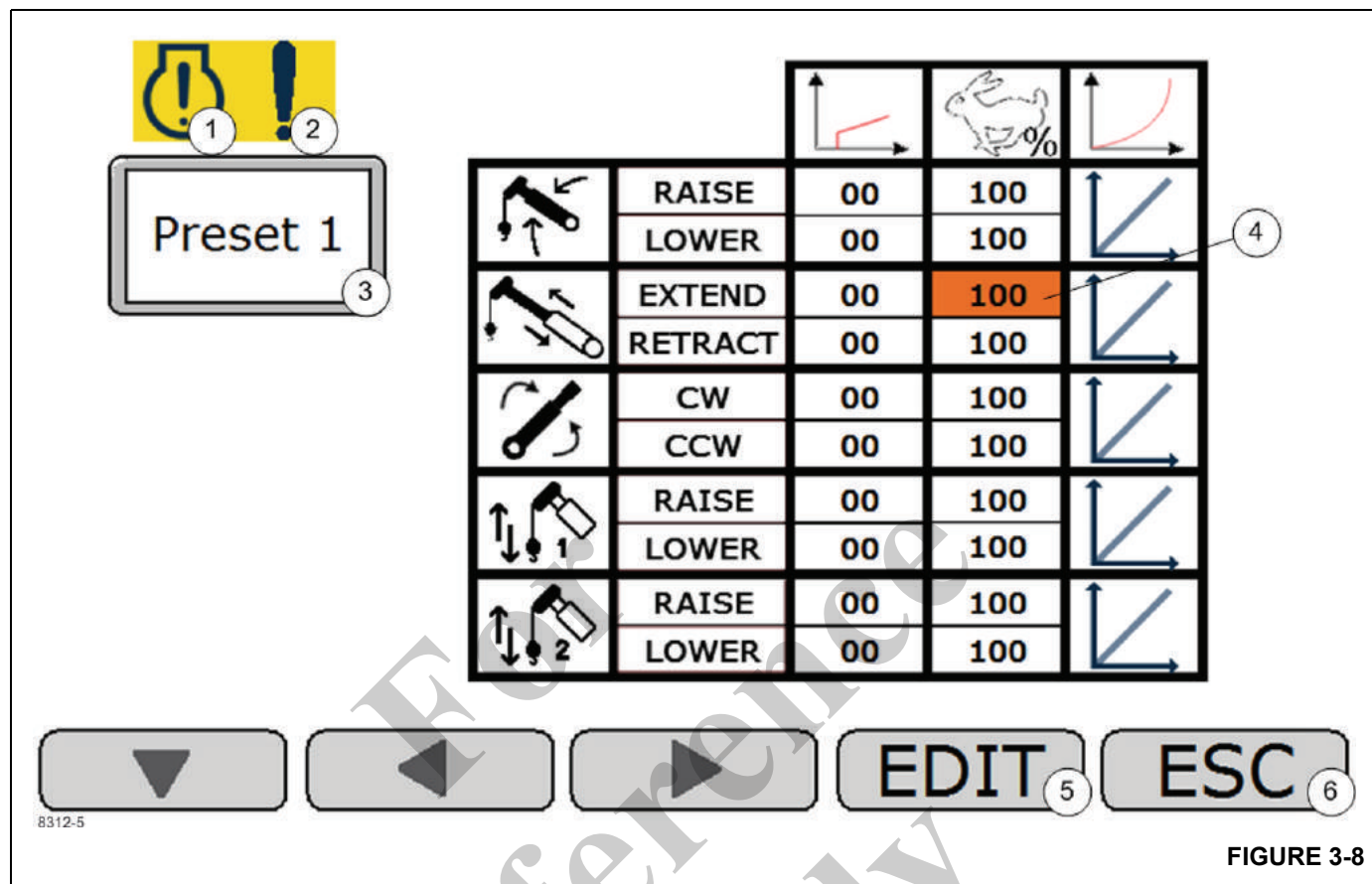


FIGURE 3-8

Item	Description
1	Engine Fault Active Indicator
2	System Fault Active Indicator
3	Currently Loaded Preset
4	Select Currently Highlighted Parameter
5	Edit Currently Highlighted Parameter
6	Escape

Engine Fault Active Indicator (1) (Figure 3-8)

This indicator will become visible whenever there is an active engine fault. The operator should return to the fault screen to view the active fault(s).

System Fault Active Indicator (2)

This indicator will become visible whenever there is an active system fault. The operator should return to the fault screen to view the active fault(s).

Currently Loaded Preset (3)

The loaded presets that can be modified.

Select Currently Highlighted Parameter (4)

The parameter ready to be edited will be highlighted orange. Only one parameter at a time will be active and able to be edited. In this navigation mode, all parameters (threshold, max, and curve response) can be edited.

Edit Currently Highlighted Parameter (5)

The operator will now be able to modify the preset value. The screen will transition to "Modify Presets Screen 3".

ESC (6)

Pressing the escape button at this point will return the operator to the main preset modification screen ("Modify Presets Screen 1"). No parameters will be highlighted and the operator will have the options to edit, reset, save, or escape to the menu screen.

Modify Presets Screen 3 (Figure 3-9)

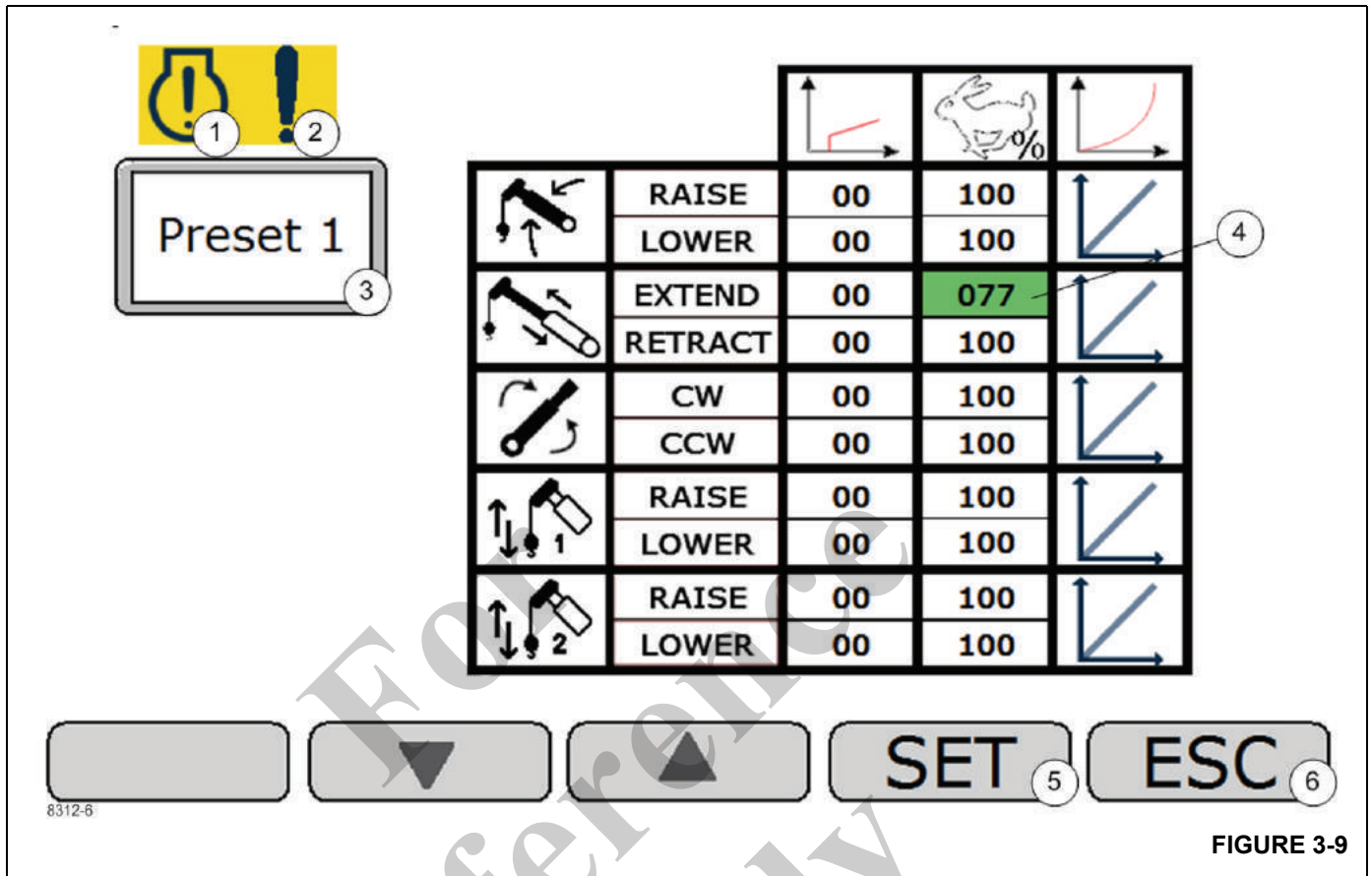


FIGURE 3-9

Item	Description
1	Engine Fault Active Indicator
2	System Fault Active Indicator
3	Currently Loaded Preset
4	Select Currently Highlighted Parameter
5	Edit Currently Highlighted Parameter
6	Escape

Engine Fault Active Indicator (1) (Figure 3-9)

This indicator will become visible whenever there is an active engine fault. The operator should return to the fault screen to view the active fault(s).

System Fault Active Indicator (2)

This indicator will become visible whenever there is an active system fault. The operator should return to the fault screen to view the active fault(s).

Currently Loaded Preset (3)

The loaded presets that can be modified.

Currently Highlighted Parameter (4)

The parameter being edited will be highlighted green. The operator can modify the preset using the up and down arrow buttons. Pressing and holding either of these buttons will increase the rate the parameter value changes.

Set Currently Highlighted Parameter (5)

The modified parameter will be temporarily stored and the screen will transition back to "Modify Presets Screen 2". The operator will be able to continue modifying parameters in this fashion until finished.

Cancel Parameter Edit (6)

Pressing the escape button at this point will ignore all modifications made to a parameter and return the operator to "Modify Presets Screen 2". The operator will be able to continue modifying parameters in this fashion until finished.

Modify Presets Screen 4 (Figure 3-10)

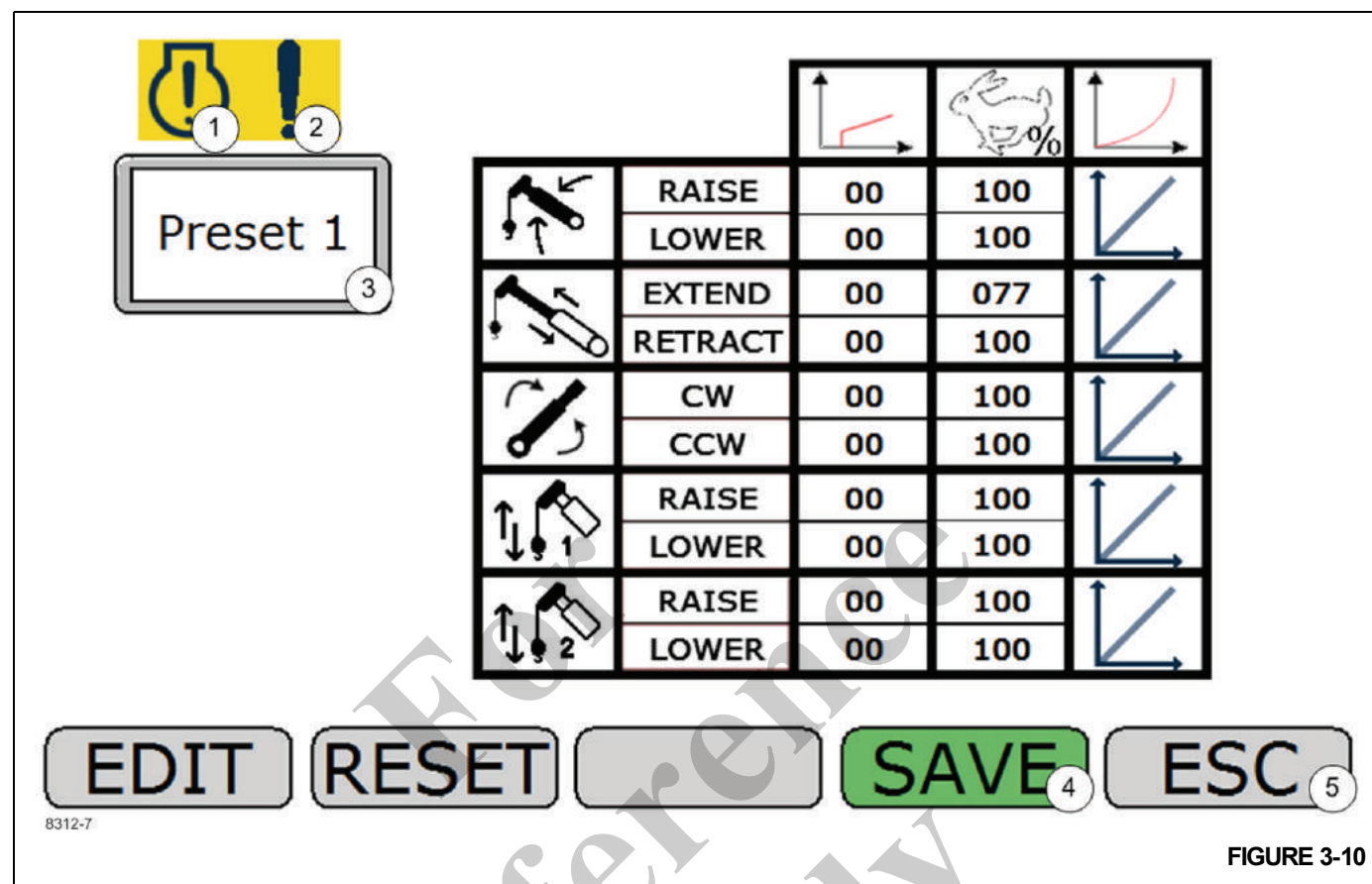


FIGURE 3-10

Item	Description
1	Engine Fault Active Indicator
2	System Fault Active Indicator
3	Currently Loaded Preset
4	Select Currently Highlighted Parameter
5	Escape

Engine Fault Active Indicator (1) (Figure 3-10)

This indicator will become visible whenever there is an active engine fault. The operator should return to the fault screen to view the active fault(s).

System Fault Active Indicator (2)

This indicator will become visible whenever there is an active system fault. The operator should return to the fault screen to view the active fault(s).

Currently Loaded Preset (3)

The loaded presets that can be modified.

Save Modified Parameters (4)

Once the operator has pressed the save button (when on "Modify Presets Screen 1"), all modified parameters will be saved to their respective EEPROM locations and the button will turn green to indicate the save is complete. The operator now has the options to edit the parameters again, reset the parameters, or escape back to the menu screen.

ESC (5)

Pressing the escape button at this point will return the operator to the menu screen. If the save button was not pressed prior to this button, any changes made to the presets will be ignored.

Faults Screen (Figure 3-11)

All active faults (whether engine or crane system related) will be available to view from this screen while the operator is running the crane from the superstructure cab. The fault

indication on the left side of the screen will be highlighted green to designate the faults the operator can currently cycle through.

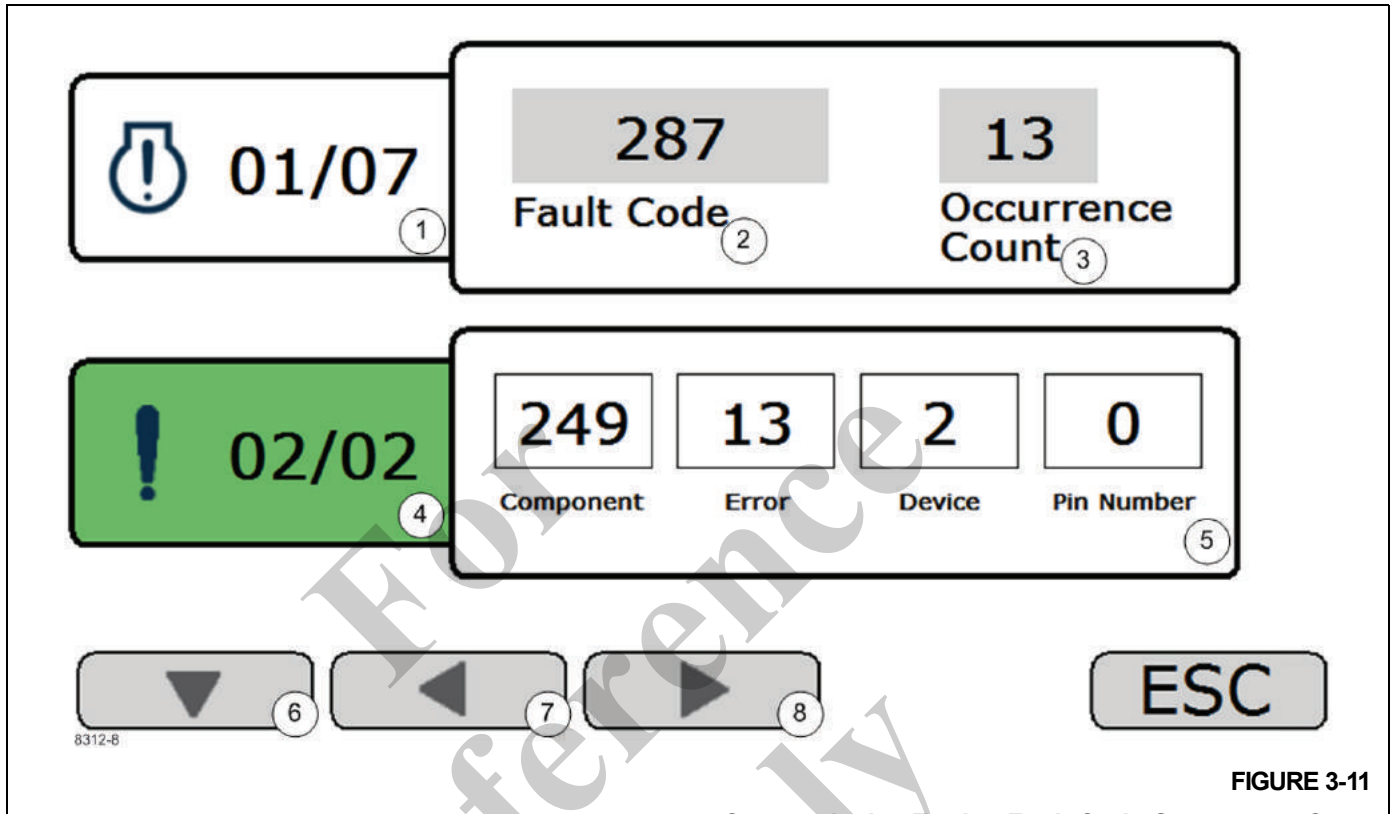


FIGURE 3-11

Item	Description
1	Active Engine Fault
2	Current Active Engine Fault Code
3	Current Active Engine Fault Code Occurrence Count
4	Active Crane System Fault
5	Active Crane System Fault Information
6	Toggle Between Fault Types
7	Cycle Up Through Active Faults
8	Cycle Down Through Active Faults

Active Engine Fault (1) (Figure 3-11)

The currently visible fault and the total number of faults will be displayed here (in this case the operator is looking at fault 1 of 7 total faults).

Current Active Engine Fault Code (2)

The fault code number broadcasted by the engine ECM over the J1939 CAN bus circuit.

Current Active Engine Fault Code Occurrence Count (3)

The number of times this fault has been logged by the engine ECM.

Active Crane System Fault (4)

The currently visible fault and the total number of faults will be displayed here (in this case the operator is looking at fault 2 of 2 total faults).

Active Crane System Fault Information (5)

The active fault is displayed as a four number combination that will be used to look up the fault information in a table. The four numbers are as follows from left to right: Component, Error, Device, and Pin Number.

Component - The part or sub-system experiencing the error.

Error - The error type occurring.

Device - The module in the control system where an output is connected to the component in error.

Pin Number - The physical pin on the module in the control system of the output connected to the component.

Toggle Between Fault Types (6)

Pressing this button cycles between the engine and system faults.

Cycle Up Through Active Faults (7)

If more than one fault is active, the display will go to the preceding fault or to the last fault in the list if on the first fault.

(Examples - for the engine faults, the viewable active fault will change from 1 to 7; for the system faults, from 2 to 1).

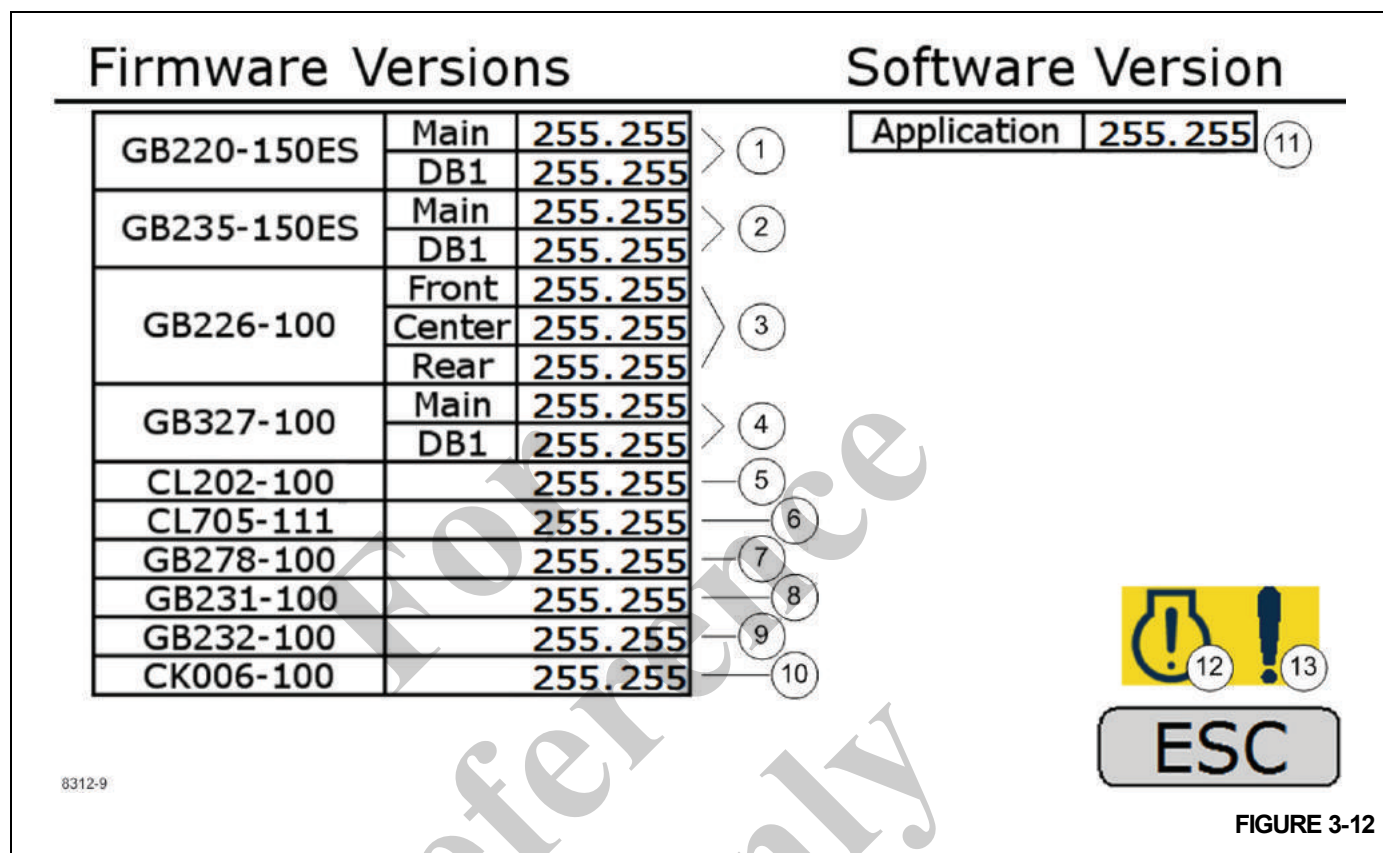
Cycle Down Through Active Faults (8)

If more than one fault is active, the display will go to the next fault or the first fault if at the end of the list. (Examples - for the engine faults, the viewable active fault will change from 1 to 2; for the system faults, from 2 to 1)

For
Reference
Only

Software Versions Screen (Figure 3-12)

The operator can view the firmware versions loaded on all control modules as well as the revision level of the master control software.



Item	Description
1	Master Module
2	Carrier Cab Console Module
3	Carrier Frame Modules Firmware
4	Super Cab Console Module Firmware
5	Super Cab Outrigger Control Module Firmware
6	Super Cab Display Module Firmware
7	Turntable Module Firmware
8	Power Control Module Firmware
9	Swing Control Module Firmware
10	Counterweight Removal Panel Firmware
11	Control System Software Version
12	Engine Fault Active Indicator
13	System Fault Active Indicator

Master Module (GB220-150ES) (1) (Figure 3-12)

Firmware, motherboard and daughter board.

Carrier Cab Console Module (GB235-150ES) (2)

Firmware, motherboard and daughter board.

Carrier Frame Modules (GB226-100) Firmware (3)

Three modules on carrier frame - front, center and rear.

Super Cab Console Module (GB327-100) Firmware (4)

Motherboard and daughter board.

Super Cab Outrigger Control Module (CL202-100) Firmware (5)**Super Cab Display Module (CL705-111) Firmware (6)****Turntable Module (GB278-100) Firmware (7)****Power Control Module (GB-231-100) Firmware (8)****Swing Control Module (GB232-100) Firmware (9)****Counterweight Removal Panel (CK006-100) Firmware (10)****Control System Software Version (11)****Engine Fault Active Indicator (12)**

This indicator will become visible whenever there is an active engine fault. The operator should return to the fault screen to view the active fault(s).

System Fault Active Indicator (13)

This indicator will become visible whenever there is an active system fault. The operator should return to the fault screen to view the active fault(s).

Crane Function Hours Screen (Figure 3-13)

The time the operator spends performing crane functions (swing, tele, lift, and hoist) is logged by the control system. This time, broken down into hours, minutes, and seconds is displayed on this screen.

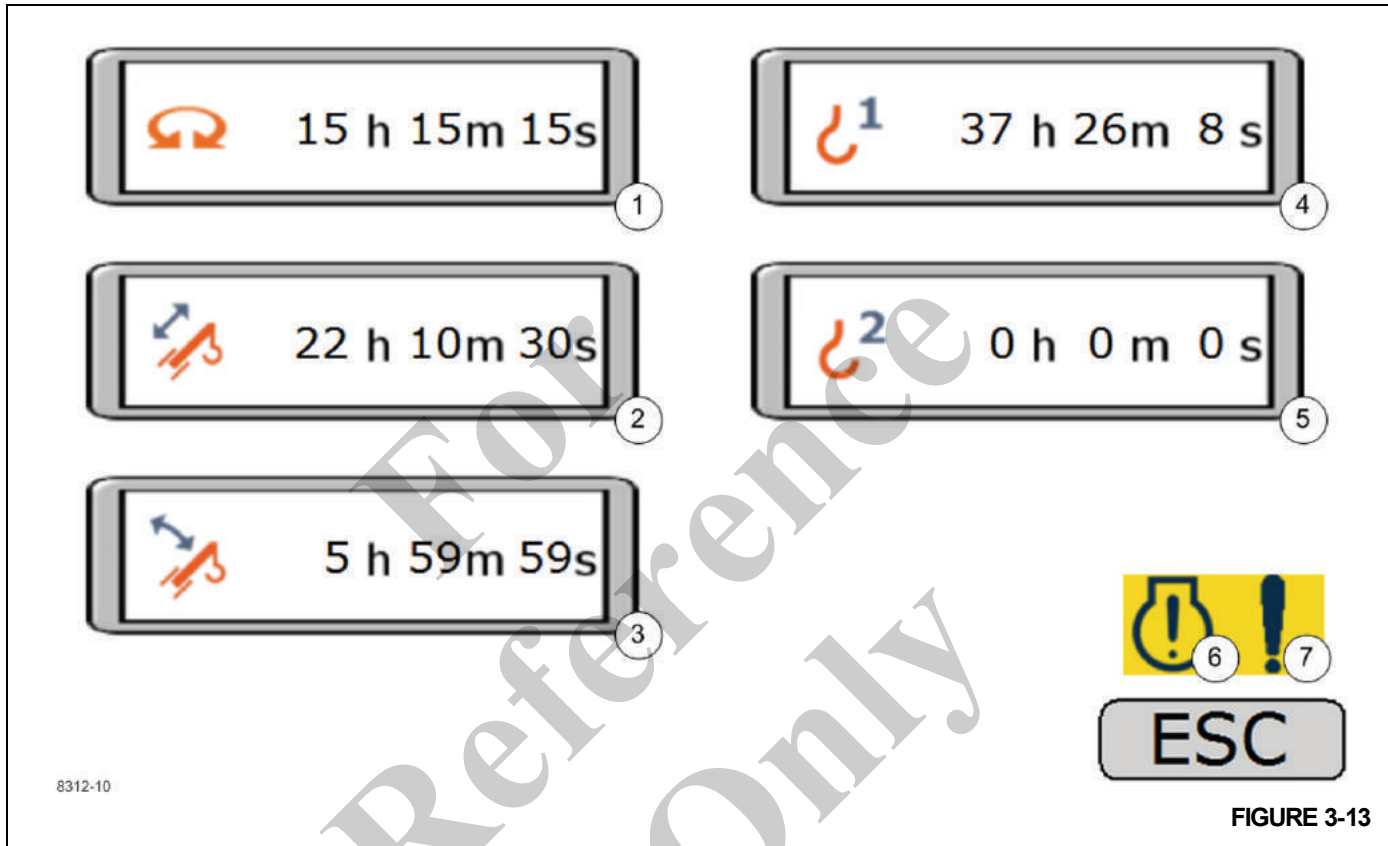


FIGURE 3-13

Item	Description
1	Swing Function Time
2	Telescope Function Time
3	Lift Function Time
4	Main Hoist Function Time
5	Aux Hoist Function Time
6	Engine Fault Active Indicator
7	System Fault Active Indicator

Swing Function Time (1) (Figure 3-13)

Telescope Function Time (2)

Lift Function Time (3)

Main Hoist Function Time (4)

Aux Hoist Function Time (5)

NOTE: only visible if the Aux Hoist is enabled in the crane control EEPROMs.

Engine Fault Active Indicator (6)

This indicator will become visible whenever there is an active engine fault. The operator should return to the fault screen to view the active fault(s).

System Fault Active Indicator (7)

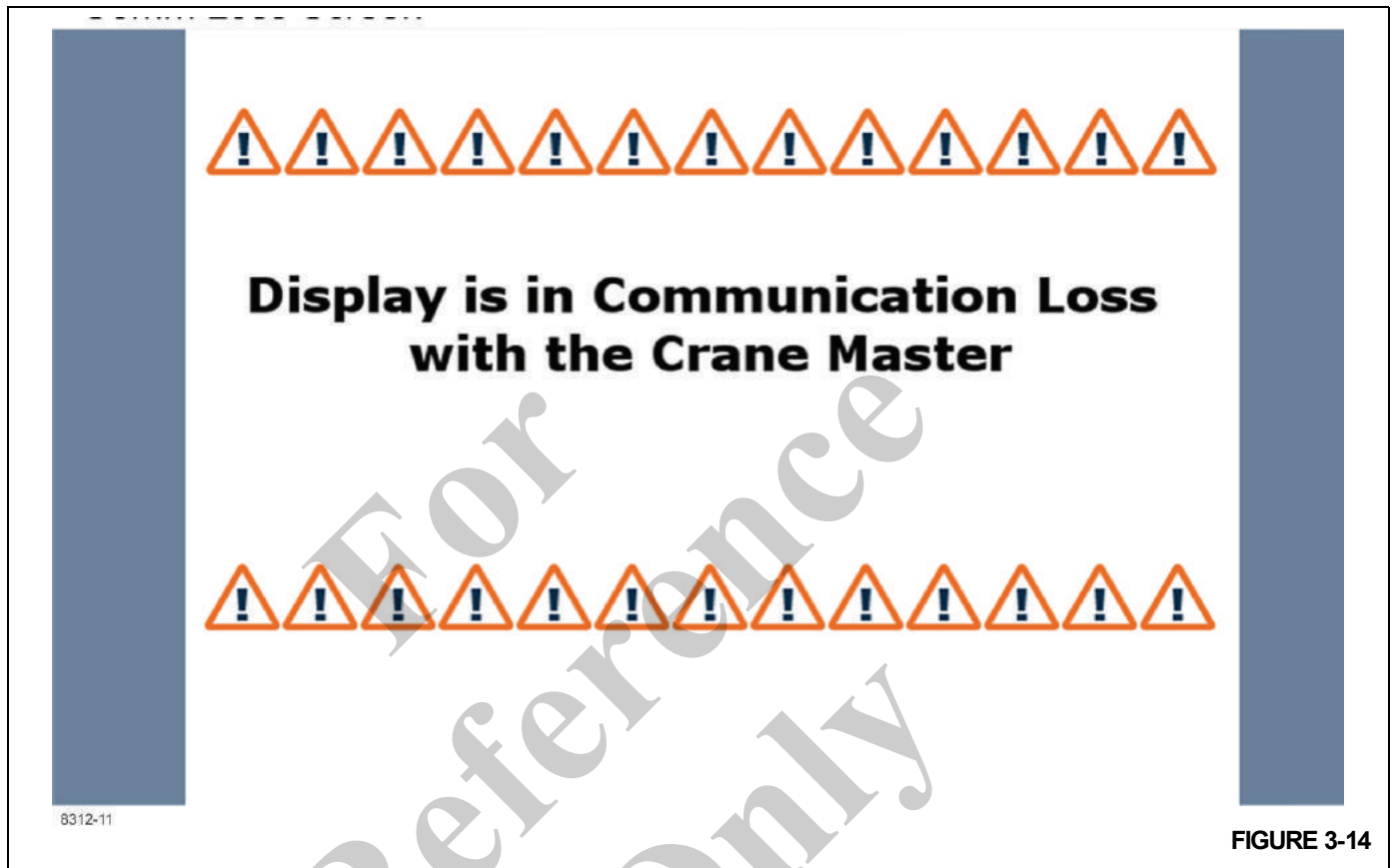
This indicator will become visible whenever there is an active system fault. The operator should return to the fault screen to view the active fault(s).

Display Error Screens

There are two screens that can appear when the display is in an error state. One is the communication loss screen and the other is the timestamp mismatch screen.

Communication Lost Screen (Figure 3-14)

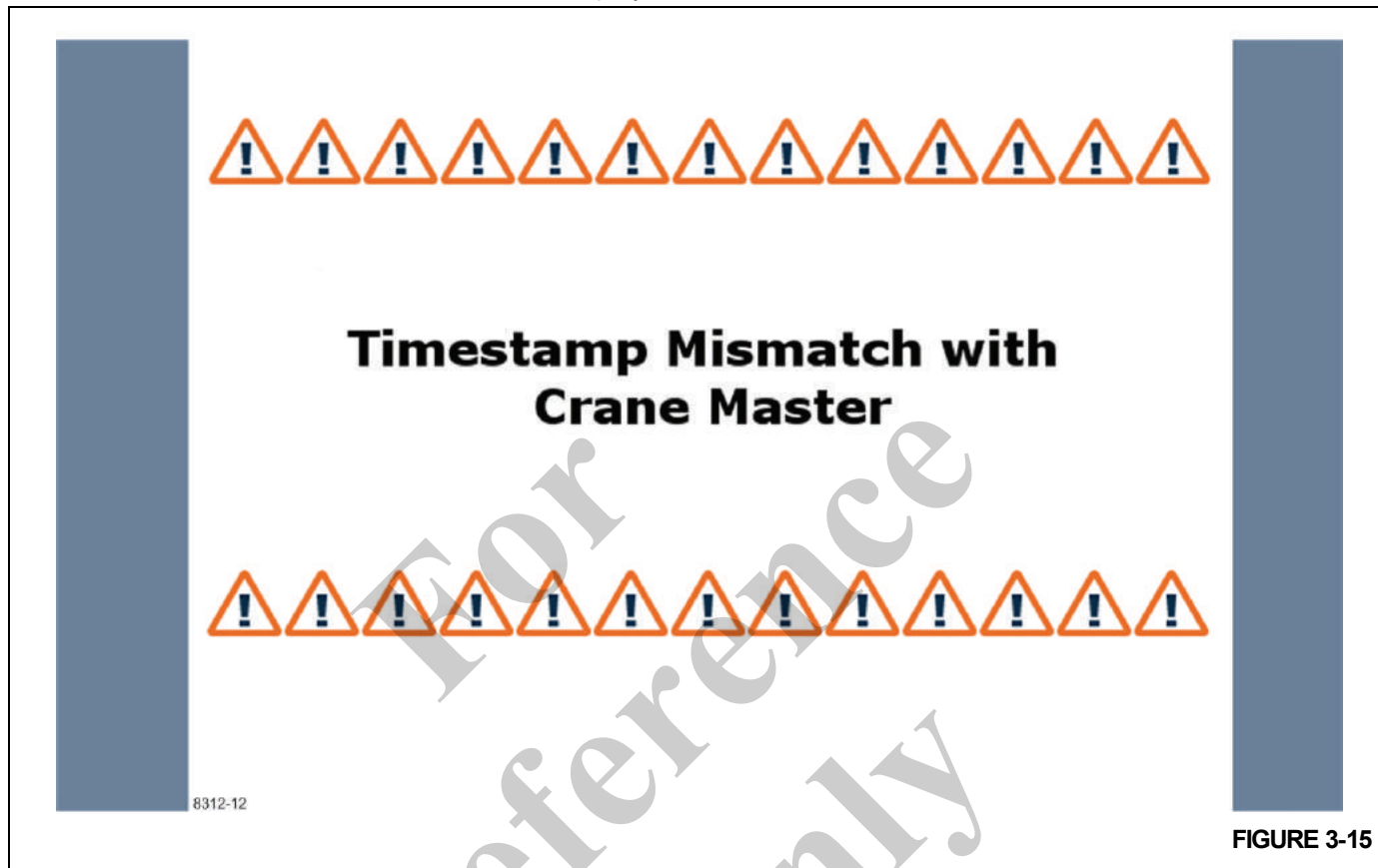
The communication loss screen will be present whenever the operator display loses communication with the master control module. The display will return to normal functionality once communications are restored.



Timestamp Mismatch Screen (Figure 3-15)

There is a timestamp embedded within the software and the display XML file to ensure compatibility between the display and the master control module. This screen is displayed

whenever those timestamps do not match. The display will return to normal functionality once the correct display software is loaded.



Engine Controls and Indicators

NOTE: The following paragraphs describe all the available (standard and optional) controls and indicators located in the superstructure cab. Some machines may not be equipped with the optional controls shown. The numbers in () represent the index number from Figure 3-16.

All rocker switches contain one or two LED's in the switch for illumination.

Engine Increment/Decrement Switch

The engine increment/decrement switch (31) located on the right side console is used to set the engine operating speed. It is a two position (+/-) momentary switch.

Pushing the top of the switch quickly increases (+) engine RPM to the maximum allowed operating speed. Pushing the bottom of the switch quickly decreases (-) engine RPM to idle speed. Pushing and holding either side of the switch will increase or decrease engine speed. Releasing the switch will hold the engine at the current speed. Pressing the foot pedal will increase engine speed above the "hold" speed. Releasing the foot pedal causes the engine to return to the "hold" speed.

Ignition Switch

The ignition switch (32) is located on the right side console. The switch is key operated with four positions: ACCESSORY (left position), OFF (vertical position), RUN (position between vertical and right), and START (right position). The switch is spring returned from START to RUN. In the OFF position, all electrical power in the superstructure is off except for the boom work lights, cab work lights, dome light, swing horn, and accessory outlet. In the ACCESSORY position, all electrical components are energized. Placing the switch in the START position energizes the starter motor solenoid for starting the engine. Releasing the switch will allow it to spring return to the RUN position. To shut down the engine, turn the switch to the OFF position.

Foot Throttle Pedal

The throttle pedal (4) is located on the cab floor and is angled for increased operator comfort. It is used to control engine speed. The throttle pedal sends a PWM (pulse width modulated) signal, based on the pressure applied, to the crane's electronic operating system which in turn sends a J1939 percent accelerator position message to the engine ECM.

Craning Controls and Indicators

Swing and (Aux Hoist or Telescope) Joystick (Left Hand Joystick)

The Swing and (Aux Hoist or Telescope) joystick is mounted on the seat's left hand armrest. It is used to control swing and

either auxiliary hoist (if installed) or telescoping (if auxiliary hoist is not installed) crane functions.

NOTE: If the crane has an auxiliary hoist installed than telescoping will be controlled by a tele pedal mounted on the cab floor.

Swing Function with Single Axis Joystick

The joystick handle (39) closest to the cab door will always be used for the swing function. Pushing this handle forward will rotate the superstructure in a clockwise direction. Pulling back on this handle will cause the superstructure to rotate in a counterclockwise direction. When the joystick is moved in either direction (off center) a control valve will be actuated, allowing 360° continuous rotation in the desired direction.

Swing Function with Dual Axis Joystick

Pushing this handle toward the right will rotate the superstructure in a clockwise direction. Pushing this handle to the left will cause the superstructure to rotate in a counterclockwise direction. When the joystick is moved in either direction (off center) a control valve will be actuated, allowing 360° continuous rotation in the desired direction.

Auxiliary Hoist (If Equipped) with Single Axis Joystick

The joystick handle closest to the cab seat will always be used for the auxiliary hoist function when the crane is equipped with an auxiliary hoist. Pushing this handle forward will let the hoist spool off cable and lowering the load. Pulling back on this handle will cause the hoist to reel in the cable thus raising the load. When the joystick is moved in either direction (off center) a control valve will be actuated, allowing hoisting in the desired direction.

Auxiliary Hoist (If Equipped) with Dual Axis Joystick

Pushing this handle forward will let the hoist spool off cable and thus lowering the load. Pulling back on this handle will cause the hoist to reel in the cable thus raising the load. When the joystick is moved in either direction (off center) a control valve will be actuated, allowing hoisting in the desired direction.

Telescoping (Aux Hoist Not Equipped) with Single Axis Joystick

The joystick handle closest to the cab seat will always be used for the telescoping function when the crane is not equipped with an auxiliary hoist. Pushing this handle forward will extend the boom. Pulling back on this handle will cause the boom to retract. When the joystick is moved in either direction (off center) a control valve will be actuated, allowing telescoping in the desired direction.

Telescoping (Aux Hoist Not Equipped) with Dual Axis Joystick

Pushing this handle forward will extend the boom. Pulling back on this handle will cause the boom to retract. When the

joystick is moved in either direction (off center) a control valve will be actuated, allowing telescoping in the desired direction.

Boom Lift and Main Hoist Joystick (Right Hand Joystick)

The Boom Lift (8) and Main Hoist (9) joystick is mounted on the seat's right hand armrest. It is used control boom lift and main hoist crane functions.

Boom Lift with Single Axis Joystick

The joystick handle closest to the cab seat will always be used for the boom lift function. Pushing this handle forward will lower the boom. Pulling back on this handle will raise the boom. When the joystick is moved in either direction (off center) a control valve will be actuated, allowing raising or lowering of the boom in the desired direction.

Boom Lift with Dual Axis Joystick

Pushing this handle toward the right will lower the boom. Pushing this handle to the left will raise the boom. When the joystick is moved in either direction (off center) a control valve will be actuated, allowing boom raise or lower in the desired direction.

Main Hoist with Single Axis Joystick

The joystick handle closest right hand cab wall will be used for the main hoist function. Pushing this handle forward will let the hoist spool off cable and thus lowering the load. Pulling back on this handle will cause the hoist to reel in the cable thus raising the load. When the joystick is moved in either direction (off center) a control valve will be actuated, allowing hoisting in the desired direction.

Main Hoist with Dual Axis Joystick

Pushing this handle forward will let the hoist spool off cable and thus lowering the load. Pulling back on this handle will cause the hoist to reel in the cable thus raising the load. When the joystick is moved in either direction (off center) a control valve will be actuated, allowing hoisting in the desired direction.

Swing Horn Button

The swing horn button (20) is located on the right side of the swing joystick and is used by the operator to provide a warning that the superstructure is rotating. Press in on the button to sound the swing horn.

Telescope Pedal (Only if Auxiliary Hoist is Installed)

The telescoping foot pedal (3) is a bi-directional electronic pedal that is mounted on the cab floor between the throttle pedal (4) and the swing brake pedal (22). This pedal is only installed when the crane is equipped with an auxiliary hoist. Push down on the top of the pedal to extend the boom and push down on the bottom of the pedal to retract the boom.

NOTE: If the crane does not have an auxiliary hoist installed then telescoping will be controlled by the left hand armrest joystick.

Main Hoist Speed Selector Switch

The three-position main hoist speed selector switch (10) is located on the right armrest. Select the top of the switch for high speed or the bottom of the switch for low speed. Position the switch in the center position to OFF to disable main hoist functions.

Auxiliary Hoist Speed Selector Switch (Optional)

The three-position auxiliary hoist speed selector switch (16) is located on the left armrest. Select the top of the switch for high speed and the bottom of the switch for low speed. Position the switch in the center to OFF to disable auxiliary hoist functions.

Hoist Rotation Indicators (Main and Auxiliary Hoist)

The hoist rotation indicators (35) are located on the top of the main and auxiliary hoist joysticks. The indicator is electronically driven by a sensor attached to the hoist. A pulsating signal is sensed by the operator's thumb during hoist operation.

Crane Function Switch

The crane function switch (37) is a two position (ON, OFF) rocker switch located on the right side of the overhead console.

Push the bottom of the switch to de-energize the pilot enable solenoid. With this solenoid de-energized, main craning functions (lift, hoist, swing & tele) are disabled. This will prevent accidental operation of these craning functions such as inadvertently bumping the joysticks.

Push the top of the switch to energize the pilot enable solenoid and allow main craning functions (lift, hoist, swing & tele).

NOTE: In addition pushing the top of the switch, the operator must also be in the seat with the left armrest down before the pilot enable solenoid will be energized.

Bubble Level Indicator

The bubble level indicator (5) is located on a bracket on the right side of the cab. The indicator provides the operator with a visual indication for determining the levelness of the crane.

Swing Brake Selector Switch

The swing brake selector switch (17) is located on the left armrest. This two-position switch (ON/OFF) is used to control a hydraulic valve that directs a regulated flow of pressure to and from the swing brake. Push the top of the switch to ON to apply the swing brake and push the bottom of the switch to OFF to release the swing brake.

Swing Brake Pedal

The swing brake pedal (22) is located on the left side of the cab floor. The swing brake pedal is used to actuate the swing brake to slow or stop swing motion. Braking is proportional to pedal depression.

With the pedal not depressed and the swing brake control valve disengaged, hydraulic pressure is applied to the brake, overcoming spring pressure and releasing the brake.

Depressing the pedal actuates a swing power brake valve to apply pressure to the brake assembly. This pressure aids the spring pressure to overcome the hydraulic pressure being applied to the brake release circuit and applies the spring brake according to the pressure from the swing power brake valve.

Swing Lock Control (Pin Type)

The pin swing lock control handle (6) is located on the right side of the cab. The purpose of the pin swing lock is to lock

the superstructure in position directly over the front or over the rear. When the control handle is pushed in, and the superstructure is directly over the front or rear, the swing lock pin drops into a socket on the carrier frame, locking the superstructure in place. When the control handle is pulled out, the pin is pulled out of the socket, unlocking the superstructure.

360° Swing Lock Control (Positive Lock Type) (Optional)

The 360 degree swing lock control pedal (25) is located on the left side of the cab floor. The purpose of the swing lock is to secure the superstructure in position in 2.7 degree increments in its 360 degree of rotation. The lock is engaged when the pedal is pushed down and disengaged when the pedal is up.

For
Reference
Only

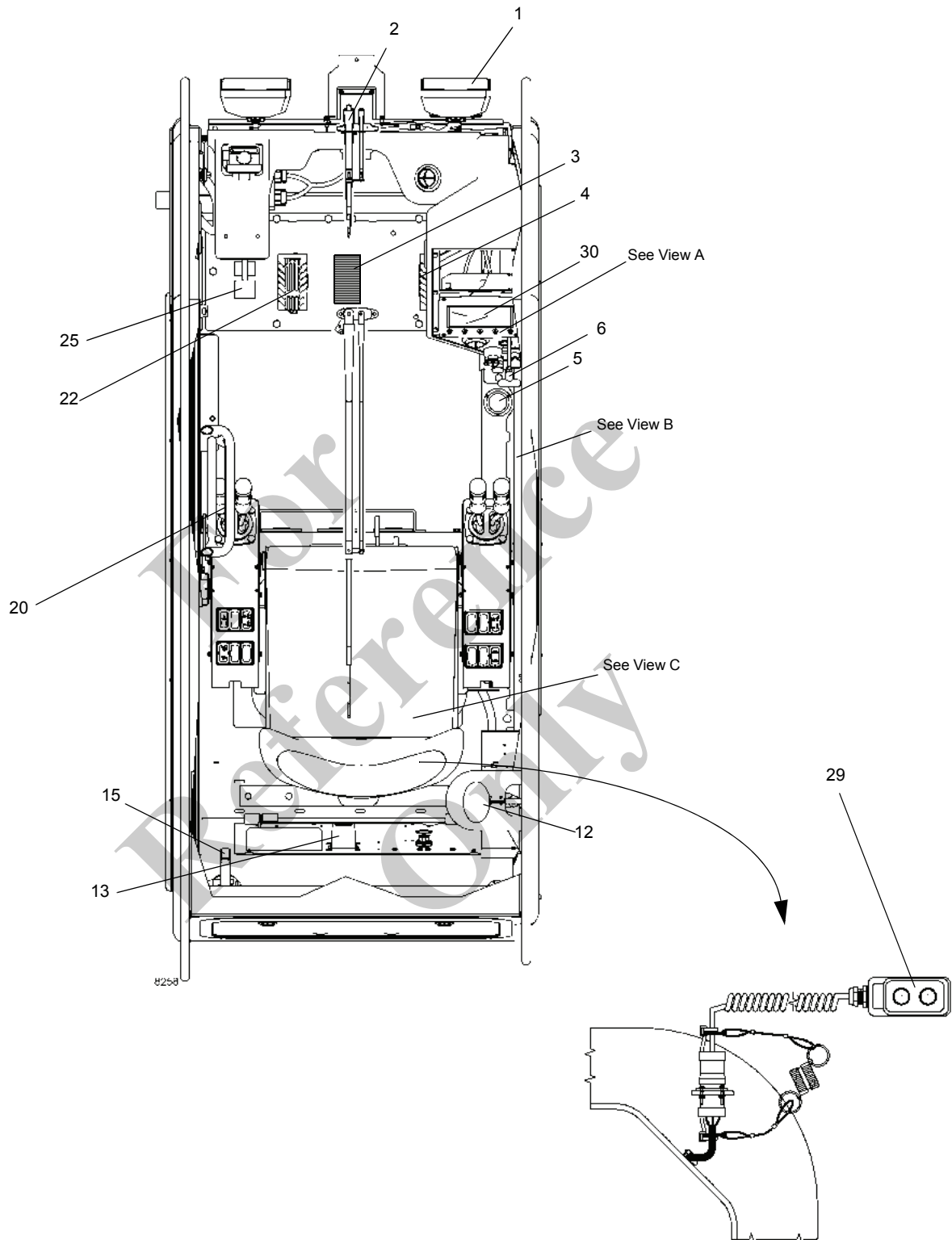


FIGURE 3-16

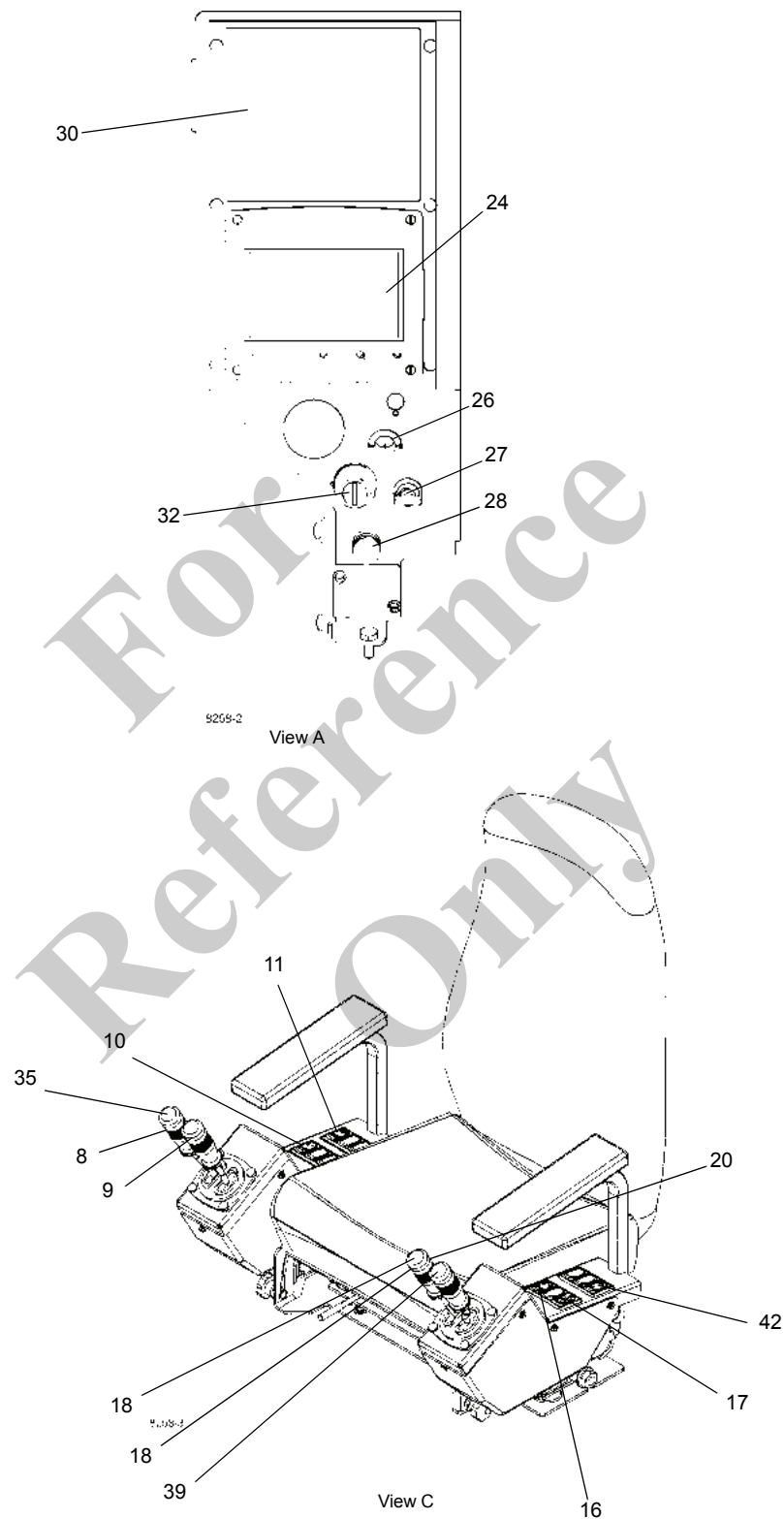


FIGURE 3-16 continued

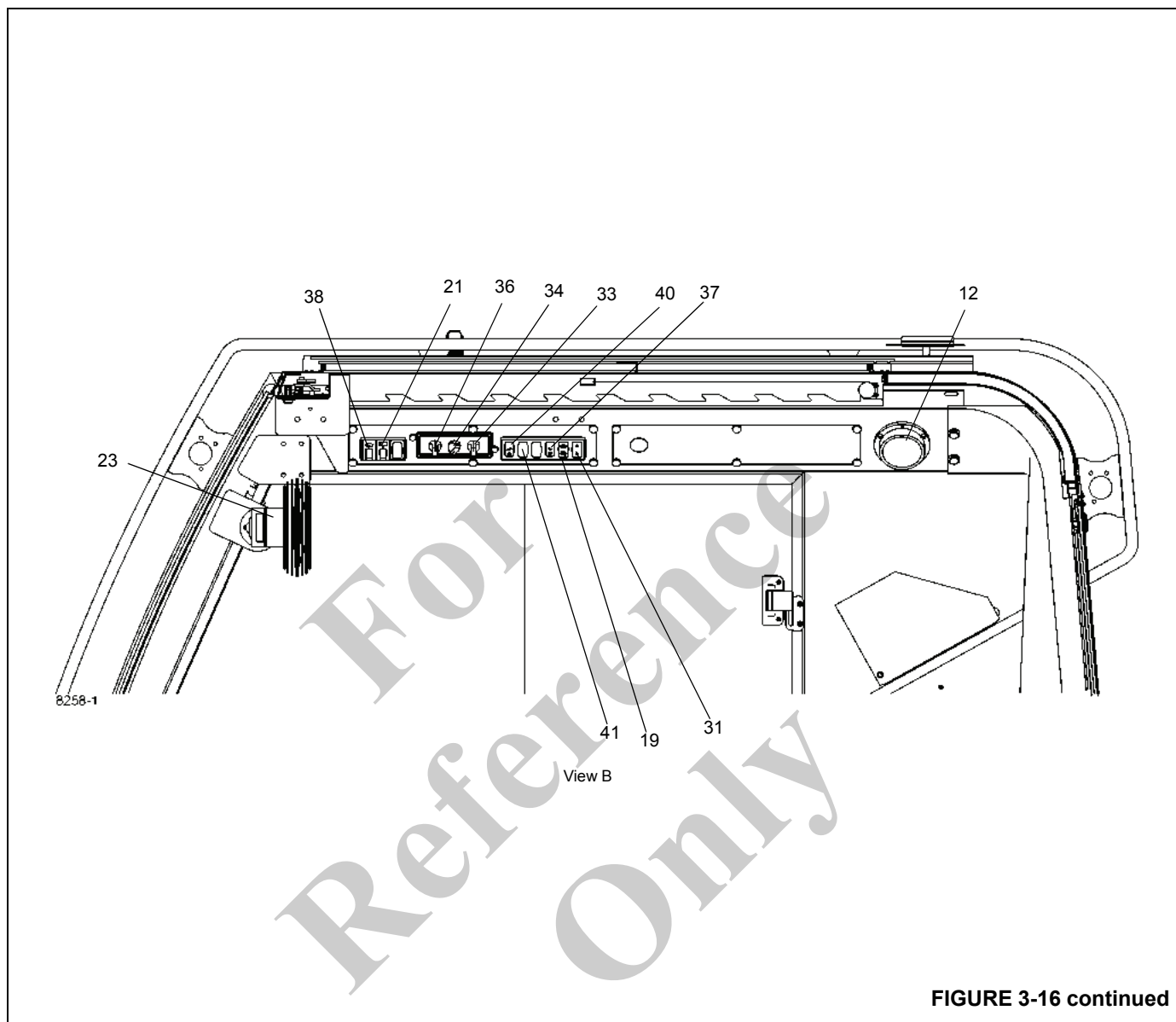


FIGURE 3-16 continued

Item	Description
1	Work Lights
2	Windshield Wiper/Washer
3	Telescope Control Pedal
4	Foot Throttle Pedal
5	Bubble Level Indicator
6	Swing Lock Control (Pin Type)
7	Seat Adjustment Lever (Not Shown)
8	Main Hoist Joystick
9	Boom Lift Joystick

Item	Description
10	Main Hoist Speed Selector Switch
11	Cab Tilt Switch
12	Cab Dome Light
13	Fuse and Relay Panel
14	Beacon Light (Not Shown)
15	Fire Extinguisher
16	Auxiliary Hoist Speed Selector Switch (optional)
17	Swing Brake Selector Switch
18	Telescope /Auxiliary Hoist Joystick

Item	Description
19	Engine Regen Initiate/Inhibit Switch (ISX only)
20	Swing Horn Button
21	Skylight Wiper Switch; Skylight Wiper
22	Swing Brake Pedal
23	Cab Circulating Fan
24	Operator Display
25	360° Swing Lock Control (Positive Lock Type)
26	12V Accessory Outlet
27	RCL Override Switch
28	Emergency Stop Switch
29	Jib Stowage Controller
30	RCL Panel
31	Engine Increment/Decrement Switch
32	Ignition Switch
33	Air Conditioner Switch (Optional)
34	Heater/Air Conditioner Control Switch
35	Hoist Rotation Indicator (Main and Aux Hoist)
36	Heater/Air Conditioner Fan Switch
37	Crane Function Power Switch
38	Windshield Wiper/Washer Switch
39	Swing Joystick
40	Work Lights Switch
41	Boom Lights Switch (Optional)
42	Swing Speed Switch
43	Crane System Diagnostic Connector (Not Shown)

Swing Speed Switch

The swing speed switch (42) is a two-position switch located on the left armrest. Push the top of the switch for high swing speed or the bottom of the switch for low swing speed.

Cab Tilt Switch

The cab tilt switch (11) is located on the right armrest. It is a three position, momentary spring centered to off rocker switch. The switch allows the cab to be tilted either up or down.

Jib Stowage Controller

The remote jib stowage controller (29) is stored behind the seat in the superstructure cab. The IN and OUT switch on the controller is used to pivot the jib during erecting and

stowing procedure. Refer to “Set-up and Installation” on page 4-1.

Accessory Controls and Indicators

Work Lights Switch

The work lights switch (40) is a two position ON/OFF switch located on the overhead console, it controls the crane's work lights (1) mounted on the bottom front of the superstructure cab. Press the top of the switch to the on position to illuminate the work lights. Press the bottom of the switch to turn the work lights off.

Boom Lights Switch (Optional)

The boom lights switch (41) is a two position ON/OFF switch located on the overhead console. The switch controls the flood lights located on the boom base section. Press the top of the switch to the ON position to illuminate the flood lights. Press the bottom of the switch to turn the flood lights off.

Cab Circulating Fan

The cab circulating fan (23) is located on the right side of the cab. A swivel allows the fan to be positioned in any direction and a HIGH-OFF-LOW switch on the base controls the fan.

Cab Dome Light

The cab dome light (12) is located on the right rear corner of the cab roof and provides illumination of the cab. The light is controlled by an ON/OFF switch on the light.

Fire Extinguisher

The fire extinguisher (15) is located at the left rear side of the cab. The fire extinguisher is a BC rated dry type fire extinguisher for emergency use.

Windshield Wiper/Washer Switch and Motor

The windshield wiper/washer toggle switch (38) is located on the right side of the overhead panel. The switch is used for removing moisture from the windshield. The switch has an OFF and HIGH position with six intermittent positions between HIGH and OFF. Pushing the switch up from the OFF position energizes the wiper motor (2). Continue to push switch up for each intermittent position and the HIGH position. Push the switch down to OFF to stop the motor and return the wiper blade to the parked position.

Push the very top of the switch to activate the washer switch to spray washer fluid on the windshield.

Skylight Wiper Switch

The skylight wiper switch (21) is installed on the overhead console. The wiper is used to remove moisture from the skylight. The switch has an OFF and HIGH position with six intermittent positions between HIGH and OFF. Pushing the switch up from the OFF position energizes the wiper motor.

Continue to push switch up for each intermittent position and the HIGH position. Push the switch down to OFF to stop the motor and return the wiper blade to the parked position.

Heater/Air Conditioner Control

The heater/air conditioner control (34) is located on the overhead right side console. Rotate the knob to the left for heat and to the right for air conditioned air.

Heater/Air Conditioner Fan Switch

The heater/air conditioner fan switch (36) is located on the overhead right side console. The switch controls the speed which in turn regulates the volume of air output of the heater and air conditioner fan by positioning switch to: LOW, MEDIUM, and HIGH.

Air Conditioner Switch (Optional)

The air conditioning switch (33) is located on the overhead right side console. The switch controls the operation of the optional air conditioning system in conjunction with the fan switch. Rotate the switch to turn air conditioner ON.

Beacon Light

The beacon light is located on a bracket on the left rear side of the crane beside the hoists. It is operational anytime the ignition switch is in the ACC or RUN position.

Fuse and Relay Panel (Not shown)

The fuse and relay panel (13) is located in the rear of the cab. It contains 20 fuses, six relays, a cab warning buzzer and a crane system diagnostic connector (43).

The 20 fuses may be accessed by removing the plastic cover on the front of the fuse and relay panel. These fuses are used to protect superstructure cab and turntable wiring.

The 6 relays are used to control key switch ignition and accessory power, wipers, and the heater control motor.

Crane System Diagnostic Connector

The crane system diagnostic connector (43) is an USB connector located on the Fuse and Relay Panel (13). This connector is use to troubleshoot or monitor inputs/outputs/settings.

NOTE: Never use this connector for downloading software which shall only be done using the carrier cab crane system diagnostic connector.

Contact CraneCare for necessary tools including diagnostic cable and software.

Throttle pedal

The throttle pedal (4) is the right most pedal on the cab floor and is angled for increased operator comfort. It is used to control engine speed. The throttle pedal sends a PWM (pulse width modulated) signal, based on the pressure applied, to the crane's electronic operating system which in turn sends a J1939 percent accelerator position message to the engine ECM.

Engine Regen Initiate/Inhibit Switch (ISX Engine Only)

(see carrier)

12V Accessory Outlet

The 12V Accessory Outlet is located on the cab's front console panel. It may be used for 12V accessories that do not exceed a 3A load.

Emergency Stop Switch

The emergency stop switch (28) is located on the left center side of the outrigger panel. Push the switch to stop the engine.

Pull switch out to restart the crane and resume operation.

If the emergency stop switch on either outrigger control panel or in the superstructure cab is not pulled out for normal operation, the emergency stop indicator in the carrier cab will illuminate red and engine will not start.

RCL Override Switch

The RCL Override Switch is used to override the RCL in the event of an emergency that requires placing the crane in a safer position because of a malfunction or when rigging the crane to defeat the anti-two-block switch.

RCL Panel

The RCL Panel is the graphical interface to the RCL system. This panel is used to setup a lift and monitors all craning functions.

Outrigger Extend/Retract Switch

NOTE: The park brake in the carrier cab must be set before the outrigger controls will operate.

Be sure the outriggers plus the center front stabilizer are properly extended and set, and the crane is level for operation on outriggers. The center front stabilizer outrigger is a vital factor in the stability of the crane.

All four outrigger beams must be equally extended to the mid position vertical stripe or fully extended position before beginning operation.

While in craning mode (operating from the superstructure), carrier outrigger controls are ignored while superstructure cab outrigger controls are being activated and superstructure cab outrigger controls will be ignored while carrier outrigger controls are being activated. All outrigger functions are disabled while performing a craning function such as swing, lift, tele or hoisting. Crane functions such as swing, lift, tele or hoist are disabled while outrigger controls are being activated.

The center front stabilizer will retract automatically when the extend/retract switch is activated in the retract position for any stabilizer; therefore the center front stabilizer **MUST** be reset if any craning functions are to be continued.

The outrigger extend/retract momentary switch (1) (Figure 3-17) is located on the side of the controller. It must be used in conjunction with the outrigger selector switches to control the operation of the stabilizer and extension cylinders.

Push the top of the switch to select the extend function or push the bottom of the switch to select the retract function. In addition, when the switch is positioned to either EXTEND or RETRACT position, a signal is sent to the engine ECM to increase engine speed above idle for operation of the outriggers.

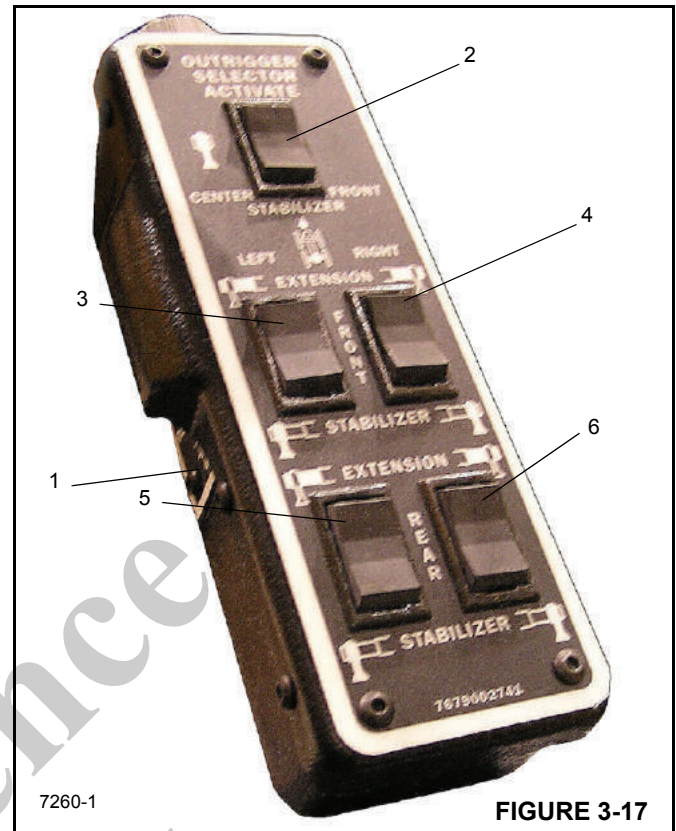


FIGURE 3-17

Center Front Stabilizer Switch

A center front stabilizer switch (2) is located on the top of the controller. To extend the center front stabilizer, push the top of the outrigger extend/retract switch, then push the top of the center front stabilizer switch.

To retract the center front stabilizer, push the bottom of the outrigger extend/retract switch, then push the bottom of the center front stabilizer switch.

NOTE: The center front stabilizer will retract anytime the extend/retract switch is positioned to the retract position.

Left Front Outrigger Switch

The left front outrigger switch (3) is located on the left side of the controller. It is a three-position switch used to extend or retract the left front stabilizer and extension cylinders. It must be used in conjunction with the outrigger extend/retract switch.

To extend the left front outrigger beam, push the top of the outrigger extend/retract switch (1) and the top of the left front outrigger switch.

To retract the left front outrigger beam, push the bottom of the outrigger extend/retract switch and the top of the left front outrigger switch.

To extend the left front stabilizer, push the top of the outrigger extend/retract switch and the bottom of the left front outrigger switch.

To retract the left front stabilizer, push the bottom of the outrigger extend/retract switch and the bottom of the left front outrigger switch.

Right Front Outrigger Switch

The right front outrigger switch (4) is located on the right side of the controller. It is a three-position switch used to extend or retract the right front stabilizer and extension cylinders. It must be used in conjunction with the outrigger extend/retract switch.

To extend the right front outrigger beam, push the top of the outrigger extend/retract switch (1) and the top of the right front outrigger switch.

To retract the right front outrigger beam, push the bottom of the outrigger extend/retract switch and the top of the right front outrigger switch.

To extend the right front stabilizer, push the top of the outrigger extend/retract switch and the bottom of the right front outrigger switch.

To retract the right front stabilizer, push the bottom of the outrigger extend/retract switch and the bottom of the right front outrigger switch.

Left Rear Outrigger Switch

The left rear outrigger switch (5) is located on the left side of the controller. It is a three-position switch used to extend or retract the left rear stabilizer and extension cylinders. It must be used in conjunction with the outrigger extend/retract switch.

To extend the left rear outrigger beam, push the top of the outrigger extend/retract switch and the top of the left rear outrigger switch.

To retract the left rear outrigger beam, push the bottom of the outrigger extend/retract switch and the top of the left rear outrigger switch.

To extend the left rear stabilizer, push the top of the outrigger extend/retract switch and the bottom of the left rear outrigger switch.

To retract the left rear stabilizer, push the bottom of the outrigger extend/retract switch and the bottom of the left rear outrigger switch.

Right Rear Outrigger Switch

The right rear outrigger switch (6) is located on the right side of the controller. It is a three-position switch used to extend or retract the right rear stabilizer and extension cylinders. It must be used in conjunction with the outrigger extend/retract switch.

To extend the right rear outrigger beam, push the top of the outrigger extend/retract switch and the top of the right rear outrigger switch.

To retract the right rear outrigger beam, push the bottom of the outrigger extend/retract switch and the top of the right rear outrigger switch.

To extend the right rear stabilizer, push the top of the outrigger extend/retract switch and the bottom of the right rear outrigger switch.

To retract the right rear stabilizer, push the bottom of the outrigger extend/retract switch and the bottom of the right rear outrigger switch.

OPERATING PROCEDURES

Breaking in a New Carrier

Your new Grove carrier has been thoroughly tested, adjusted, lubricated, and inspected prior to delivery. For detailed engine break-in, refer to the applicable engine manual.

The guidelines below will aid in getting a long service life out of the crane.

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

These guidelines should not be considered limitations but rather as a guide for familiarization of the crane and development of good operating habits.

Pre-Starting Checks

A complete walk-around visual inspection of the crane should always be made with special attention to structural damage, loose equipment, leaks, or other conditions that would require immediate correction for safe operation. Refer to "Maintenance Checklist" on page 6-1. The following checklist items are suggested to ensure the crane is prepared for starting the day's work.

Fuel Supply

Fill the fuel tank and ensure the cap is on tight. For ISX engines **ONLY USE ULTRA LOW SULFUR DIESEL (ULSD) FUEL.**

DEF Fluid Level (ISX Engines)

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

Engine Oil

CAUTION

Do not overfill.

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

Engine Coolant

Check the coolant level in the radiator and fill to the proper level. Do not overfill and ensure the radiator cap is secure.



WARNING

Do not loosen radiator cap on a hot engine. Steam or hot coolant will cause severe burns.

Batteries

Check the state-of-charge indicator if applicable with maintenance free batteries or check each cell for the correct fluid level if equipped with standard or low maintenance batteries. Use only clean distilled water and do not overfill. On all types of batteries, make sure the cables and clamps are tight and not corroded.

Hydraulic Reservoir and Filter

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

Check breather for cleanliness and security.

Wire Rope

Inspect the wire rope in accordance with applicable Federal Regulations. Sheaves, guards, guides, drums, flanges, and any other surfaces that come in contact with the rope should be inspected for any condition that could cause possible damage to the rope.

Hook Block and Headache Ball

Inspect for nicks, gouges, cracks, and evidence of any other damage. Replace a hook that has cracks or shows evidence of excessive deformation of the hook opening (including twist). Be sure the safety latch is free and aligned.

Seats and Mirrors

Adjust seat and mirrors for clear vision and safe driving.

Seat Belts

Seat Belt Maintenance

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

Cleaning Seat Belt Webbing

Wash the seat belt webbing with any mild soap or detergent. Do not use commercial solvents. Also, bleaching or re-

dyeing the webbing is not recommended because of possible loss of webbing strength.

Signal and Running Lights

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

Service and Parking Brakes

Check for proper operation.

Tires

Check the pressure and condition of all tires before traveling.

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

Wheels

Maintain proper torque on wheel lugs and check for proper wheel mounting. If equipped with steel or aluminum wheels, the wheels should be retorqued 80 to 160 km (50 to 100 miles) after initial installation or after any time the tires and wheels are removed. Doing this will reseal the lug nuts. Recheck the lug nuts for proper torque every 800 km (500 miles) thereafter.

Safety Equipment

Check all lights, windshield wipers, washers, washer liquid supply, horn, instruments, signaling devices, etc.

Daily Lubrication

Ensure all components requiring daily lubrication have been serviced. (Refer to "Lubrication" on page 5-1).

Cold Weather Operation

The following recommendations are for operating Manitowoc/Grove cranes in very low (that is, freezing) temperatures.

Use particular care to ensure that cranes being operated in very cold temperatures are operated and maintained in accordance with the procedures as provided by Manitowoc Crane Group. Cranes should have appropriate hydraulic oil, lubricants, and other auxiliary items required for operation in sub-zero temperatures. Individual crane functions should be operated to ensure they are sufficiently warmed prior to performing a lift.

Operation of cranes at full rated capacities in temperatures between 0°C and -40°C (+32°F and -40°F) or lower shall be accomplished only by competent operators who possess the skill, experience, and dexterity to ensure smooth operation. Shock loading shall be avoided.

Operation Below -40°C

For crane operation below -40°C, capacities shall be derated 3.67% of the capacities shown on the load chart for each degree (1°C) below -40°C.

Operation Below -40°F

For crane operation below -40°F, capacities shall be derated 2.0% of the capacities shown on the load chart for each degree (1°F) below -40°F.

Engine Operation

Start-up and shutdown procedures for most diesel engines are generally the same. Therefore, the following procedures can be applied, except where specific differences are noted. (Refer to the applicable engine manufacturer's manual for detailed procedures).

Start-Up Procedure

Make an under-the-hood inspection for fuel, DEF, oil, and coolant leaks, worn drive belts, and trash build-up.



CAUTION

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

CAUTION

Never crank engine for more than 30 seconds during an attempted start. If engine does not start after 30 seconds, allow starter motor to cool for about two minutes before attempting another start.

If engine does not start after four attempts, correct malfunction before attempting another start.

Use the correct grade of oil for the prevailing temperature in the crankcase to prevent hard cranking. Diesel fuel should have a pour point of 5°C (10°F) less than the lowest expected temperature. In case of an emergency, white kerosene can be added to the fuel to bring the pour point down to the required temperature. This will prevent clogging of filters and small passages by wax crystals. The addition of kerosene is NOT recommended for general use.

Warm Engine

The engine warning and engine stop indicators will illuminate and go off after about two seconds (as a check) when the key is first turned on. If an indicator comes on and continues to blink after initial start-up, there is a problem that needs to be corrected. Check the engine manufacturer's service manual for further information.

1. Set the parking brake to ON, position the transmission to neutral, and depress the service brake foot pedal.

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

2. Turn the ignition switch to START (far right position) and release immediately when the engine starts. Do not push or hold the throttle down. The ECM will automatically provide the proper amount of fuel to start the engine.
3. Immediately check the engine instruments for proper indication after starting. Shut down the engine if the oil pressure gauge does not reach the proper reading within 15 seconds.



WARNING

Both air system pressures must be in the normal operating range prior to disengaging the park brake.

CAUTION

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

4. Allow the engine to warm up for about five minutes before applying a load. Do not race the engine for a faster warm up.

Cold Engine



WARNING

Wear proper eye protection when replacing starting fluid containers. Starting fluid can cause blindness or severe eye damage and breathing problems.

CAUTION

Always start a cold engine from the carrier cab.

The engine warning and engine stop indicators will illuminate and go off after about two seconds (as a check) when the key is first turned on. If an indicator comes on and continues to blink after initial start-up, there is a problem that needs to be corrected. Check the engine manufacture's service manual for further information.

The engine is equipped with an automatic cold starting system that provides a metered flow of starting fluid to the engine when the engine temperature is 13°C (55°F) or

below. A thermostatically-controlled valve automatically opens to allow starting fluid to the engine. It is recommended that no other type of cold starting aid be used with this engine. An engine block heater is also provided, the plug connector is located in the right front step well.

If starting fluid runs out, replace the empty starting fluid container with a full container.

CAUTION

The optional engine cold start system operates automatically when the engine temperature is 13°C (55°F) or below. If the engine does not start immediately, avoid overloading the air box with highly volatile fluid which could result in a minor explosion.

1. Ensure the parking brake is set and position the transmission in neutral.

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

2. Turn the ignition switch to START (far right position) and release immediately when the engine starts. Do not push or hold the throttle down. The ECM will automatically provide the proper amount of fuel to start the engine.
3. Immediately check the engine instruments for proper indication after starting. Shut down the engine if the oil pressure gauge does not reach the proper reading within 15 seconds.



WARNING

Both air system pressures must be in the normal operating range prior to disengaging the park brake.

CAUTION

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

4. Allow the engine to warm up for about five minutes before applying a load. Do not race the engine for a faster warm up.

Idling the Engine

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

NOTE: When prolonged engine idling is necessary, maintain at least 800 rpm.

After prolonged idle, you may notice momentary white vapor and an odor. This is normal.

Racing the Engine

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

Shutdown Procedure

1. Allow the engine to run at fast idle speed for about five minutes to avoid high internal heat rise and allow for heat dissipation.
2. Position the ignition switch to OFF (vertical position).
3. Drain the fuel filter-water separator.

Exhaust Regeneration (ISX Engines)

The engine utilizes a particulate filter in the exhaust system for the reduction of emissions. Under normal operation, the engine runs hot enough to turn soot into carbon dioxide and the particulates do not clog the filter. If the exhaust is not hot enough, the filter begins to clog and the exhaust filter light illuminates. If possible, the crane can be run on a road duty at normal highway speeds to increase engine temperature and engage the automatic regeneration process. If regeneration does not occur, the exhaust regeneration light will begin to flash. Eventually, if regeneration does not occur, the Engine Warning light will also illuminate and regeneration will have to take place.



WARNING

During regeneration, exhaust temperatures may reach 800°C (1500°F) which is hot enough to ignite or melt common materials. Do not park the vehicle over combustible materials and keep all materials at least 0.6 m (2 ft) away from the exhaust outlet.

Exhaust regeneration is automatic and can occur while parked or driving. Engine speed will increase and possibly reach between 1000 and 1500 rpm. Also, a reduction in power might be noticed.

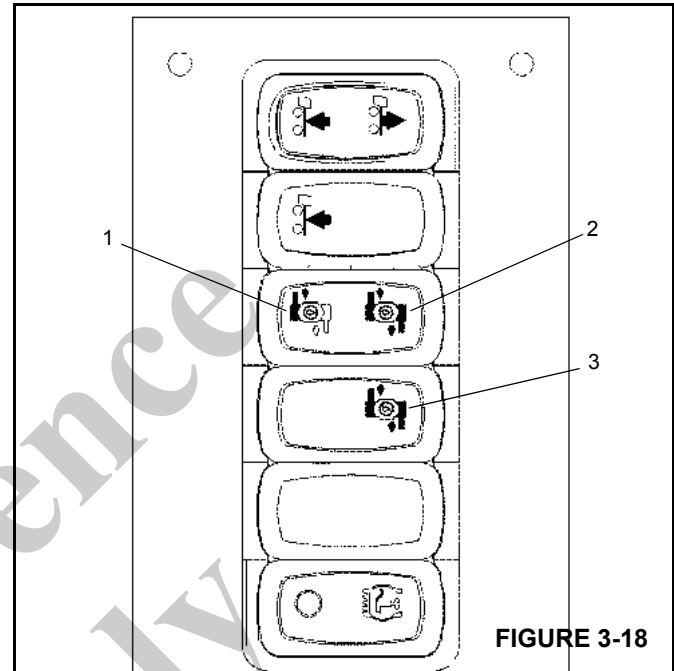
General Crane Operation

Pump Drive

The No. 1 hydraulic pump is driven by an engine PTO (ISX engines). The No. 2 and No. 3 pumps are direct engine driven.

Pump Disconnect (ISX Engines)

The electric pump disconnect system is used to disconnect Pump 1, making it easier to crank the engine and preventing unnecessary operation of the pump when traveling the crane. The disconnect is an air operated electrically controlled clutch that disconnects the engine PTO drive line from the pump. The switch is located on the right hand control panel in the carrier cab, see Figure 3-18.



To Disconnect the Pumps

1. Turn the ignition key on, but do not start the engine.
2. Press the switch to the left (1), to the disengaged position.
3. Start engine.

The engaged lamp (3) will go off when the pumps are disconnected.

To Connect the Pumps

1. Turn the ignition key on, but do not start the engine.
2. Press the switch to the right (2), to the engaged position.
3. Start engine.

The engaged lamp (3) will light when the connection is fully engaged.

Control Lever Operation

The control lever operation for crane functions is proportional, that is, the closer the lever is to neutral (center), the slower the system responds. Return the control lever to neutral to hold the load. Do not feather the hoist control to hold the load.

NOTE: Always operate the control levers with slow, even pressure.

Preload Check

After the crane has been readied for service, an operational check of all crane functions (with no load applied) should be performed. Preload check is as follows:

- Extend and set the outriggers and level the crane.
- Raise, lower, and swing the boom right and left at least 45 degrees.
- Telescope the boom out and back in, ensuring all sections extend and retract properly.
- Raise and lower the cable a few times at various boom lengths. Make sure there are no kinks and that the cable is spooling on the hoist properly.

CAUTION

Run the engine at or near the governed RPM during operation of all crane functions.

NOTE: Carefully read and become familiar with all crane operating instructions before operating the crane.

Using Your Load Chart

NOTE: One of the most important tools of every Grove Manitowoc crane is the *Load Chart* found in the crane operator's cab.

Refer to Figure 3-19 for terms to know in determining lifting capacities.

The *Load Chart* contains the lifting capacities of the crane in all allowable lifting configurations, and must be thoroughly understood by the operator.

The *Load Chart* is divided into capabilities limited by crane structural strength and stability which is shown by a bold line

across the chart. Structural strength limits are above the line and stability limits are below the line.

The left column is the load radius, which is the distance from the axis of the crane rotation to the load center of gravity. The top row lists various boom lengths from fully retracted to fully extended (with swingaway 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 the required boom angle (in degrees) for that load. Boom lengths between increments should always be treated as if it were the next longer length. For example, if the actual boom length is 15.2 m (50 ft) and the chart shows boom lengths of 14.6 - 16.4 m (48 - 54 ft), use the load capacity shown in the 16.4 m (54 ft) column.

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

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

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 Manitowoc/Grove load handling devices such as hookblocks, overhaul balls, jib sections, etc, which must be considered as part of the load. The weight of any other load handling devices such as chains, slings, or spreader bars must also be added to the weight of the load.

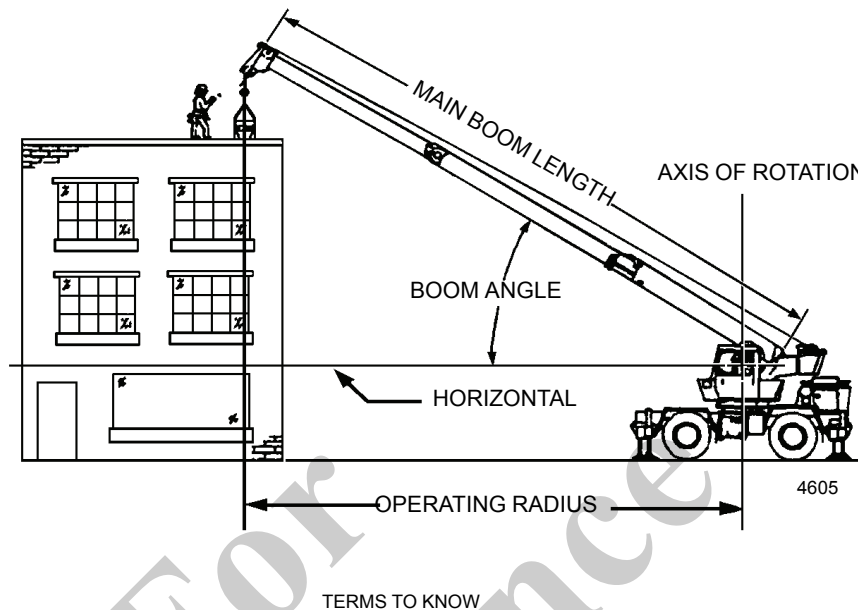


FIGURE 3-19

NOTE: The information in the following paragraph is an example of how to compute a lift. The numbers used in the example may not coincide with the *Load Chart* in the crane cab.

Problem: A concrete beam weighing 2268 kg (5000 lbs) 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) in order to reach a height of 9.1 m (30 ft) at a radius of 15.2 m (50 ft).

First we need to check the crane for load handling devices. In our example, the crane is equipped with an 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. We subtract the load handling weight of 632 lbs from the 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 constricted in making the lift over-front only and the boom angle will be about 29 degrees.

Crane Functions



DANGER

Death or serious injury could result from improper crane setup on outriggers.



WARNING

The outriggers and the center front stabilizer must be properly extended and set and the crane level before any other operation of the crane on outriggers is attempted.

The center front stabilizer will retract automatically when the extend/retract switch is activated in the retract position for any stabilizer; therefore the center front stabilizer **MUST** be reset if any craning functions are to be continued.

Setting the Outriggers

NOTE: The park brake must be set before the outriggers will operate.

The air suspension system must be deflated when on outriggers.

The outrigger control switches are located on the outrigger control box located in a pocket at the front of the superstructure cab. In addition, the outriggers may be operated from optional control boxes mounted on both sides of the carrier just forward of the front outriggers. When using the optional control boxes, the engine speed is increased due to a signal to the engine ECM when the Extend/Retract Switch is placed in either position.

CAUTION

Depress outrigger selector switch before the outrigger extension/retraction switch. Failure to do so may cause a hydraulic lock against the individual solenoid valves, and keep them from opening.

1. If outrigger floats are not already installed, remove them from float stowage locations on left, right, and rear of carrier frame. Secure the floats to the rods of the outrigger jack cylinders (aka outrigger stabilizer cylinders) using the levers on each float.
2. Depress the appropriate Outrigger Selector switch to EXTENSION and then position the Outrigger Extension/Retraction switch to EXTEND. The outrigger beam should begin to extend. Refer to *Engaging the Mid Extend Lock Pin*, page 3-48 if the crane is to be operated at the mid-extend position.



DANGER

All four outrigger beams must be equally extended to the mid position vertical stripe or fully extended position before beginning operation.

NOTE: More than one outrigger may be extended at one time. However, each Outrigger Selector switch should be depressed individually and the outrigger extension/retraction switch momentarily positioned to EXTEND to ensure that each outrigger is fully extended.

For cranes equipped with an Outrigger Monitoring System, outrigger positions are automatically monitored through the RCL. Refer to *Outrigger Monitoring System (OMS) (Optional—Standard in North America)*, page 3-48.

3. After all four outrigger beams have been extended, depress the appropriate Outrigger Selector switch to STABILIZER and position the Outrigger Extension/Retraction switch to EXTEND.
4. Extend each stabilizer, until the floats touch the ground.

NOTE: More than one stabilizer may be extended at one time.

5. After all floats are on the ground, extend the front stabilizers about 8 to 10 cm (3 to 4 inches) and then extend the back stabilizers the same distance. Repeat until all tires are off the ground.



DANGER

All four outrigger beam lock pins must be engaged before operating from the mid-extend position.

For cranes not equipped with an Outrigger Monitoring System, the operator must select the proper load chart and RCL program for the outrigger position selected.

6. Repeat step 5 until all wheels are clear of the ground and the crane is level as indicated by the sight level bubble located on the right side of the cab or in each carrier outrigger control panel. If it is suspected that the bubble level indicator is out of adjustment, verify and adjust the bubble level as described in *Bubble Level Adjustment*, page 3-47:

Proper Leveling of the Crane

ASME B30.5 specifies that if a crane is not level within 1% of grade, the allowable capacities must be reduced. Therefore, whether lifting on rubber or outriggers, it is essential that the crane is level to within 1% of grade. The bubble level that is provided on the crane is calibrated to be accurate within 1% of grade.

To properly level the crane, the boom must be positioned over the front of the crane, fully lowered to horizontal and fully retracted (for cranes fitted with a boom rest, the boom shall be stowed onto the rest). Raise and level the crane using the outriggers; refer to *Setting the Outriggers*, page 3-46.

A working crane may settle during lifting operations. Frequently check the crane for level. When rechecking the crane for level, the boom must be positioned over the front of the crane, fully lowered to horizontal and fully retracted (for cranes fitted with a boom rest, the boom shall be stowed onto the rest). If necessary, relevel the crane using the procedures under *Setting the Outriggers*, page 3-46.

Bubble Level Adjustment

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

1. Position the crane on a firm, level surface.
2. Extend and set the outriggers. Level the crane, as indicated by the bubble level indicator, using the outriggers.

3. Place a miracle pointer level, carpenter level, or similar type device on a machined surface such as the turntable bearing or bearing mounting surfaces.
4. Using the outriggers, level the crane as indicated on the leveling device used in step 3.
5. Using the bubble level indicator mounting screws, adjust the bubble level indicator to show level.

Outrigger Monitoring System (OMS) (Optional—Standard in North America)

The Outrigger Monitoring System (OMS) aids the operator in accurately programming the Rated Capacity Limiter (RCL) by automatically identifying the horizontal position of each outrigger beam. The OMS uses four sensors, one per outrigger beam, to identify when an outrigger beam is positioned to one of three pre-defined locations, including fully retracted, mid-extend, and fully extended.

Set up of the outriggers is the same for cranes equipped with OMS; refer to "Setting the Outriggers" on page 3-46. The RCL only indicates the horizontal position of the outrigger beam and should not be used to deploy the beam.

If the crane is setup on outriggers and "On Outriggers" is chosen when programming the RCL, then the OMS indicates to the RCL the horizontal position of each of the four outrigger beams. Based on this information, the RCL will choose the most conservative outrigger beam configuration (that is, if three outriggers are fully extended and one is retracted, the RCL will select retracted as the outrigger configuration). A confirmation of this outrigger configuration is all that is needed. Refer to the Rated Capacity Limiter *Operator's Handbook* for detailed instructions.

Engaging the Mid Extend Lock Pin

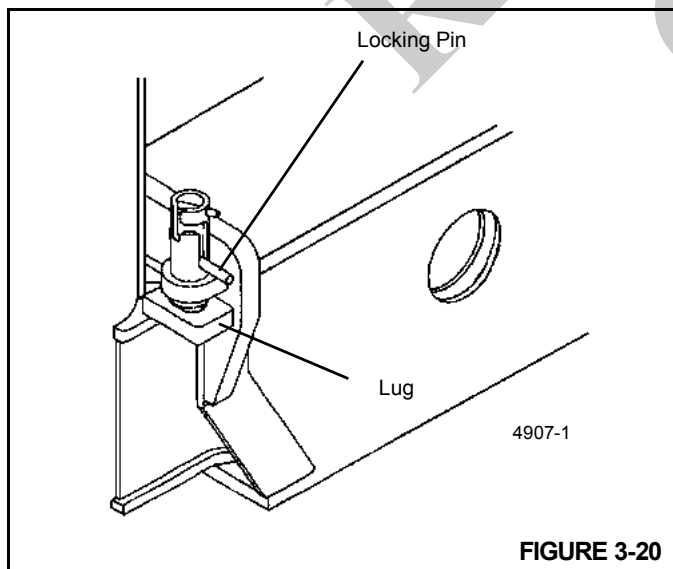


FIGURE 3-20

1. Turn the locking pin (Figure 3-20) 90° from its stowed position and allow the pin to rest on top of the outrigger beam.

NOTE: It may be necessary to jog the outrigger extension/retraction switch slightly to ensure proper pin engagement.

2. Slowly extend or retract the outrigger beam, allowing the locking pin to drop into the hole in the top of the outrigger beam, engaging the outrigger beam at the desired length.

Stowing the Outriggers

1. Position the rear Outrigger Selector switches to STABILIZER and position the Outrigger Extension/Retraction switch to RETRACT until the rear stabilizers have retracted several inches.
2. Position the front outrigger selector switches to STABILIZER and position the Outrigger Extension/Retraction switch to RETRACT until the front stabilizers have retracted several inches.
3. Repeat steps 1 and 2 until the crane is resting on all four wheels and the stabilizer floats are several inches off the ground.



CAUTION

Keep feet and hands clear of floats when unlocking the floats from the stabilizers.

4. Release the locking levers and allow the floats to drop to the ground.

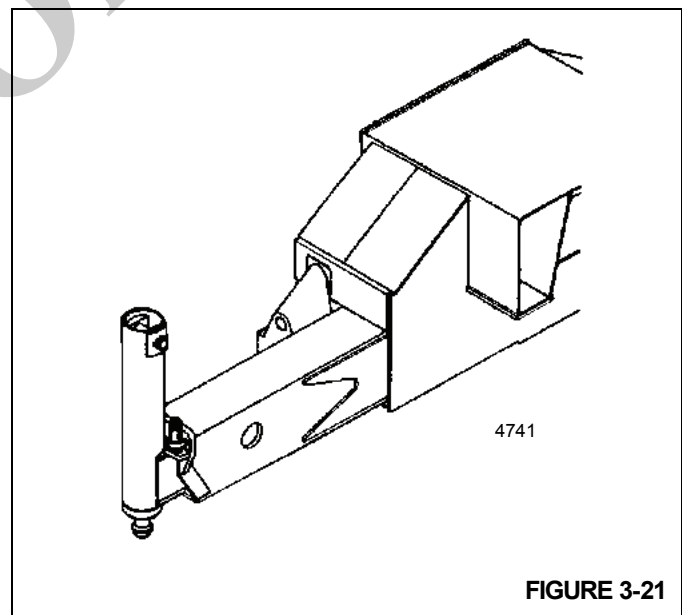


FIGURE 3-21

5. Continue to retract the stabilizers until they are fully retracted.

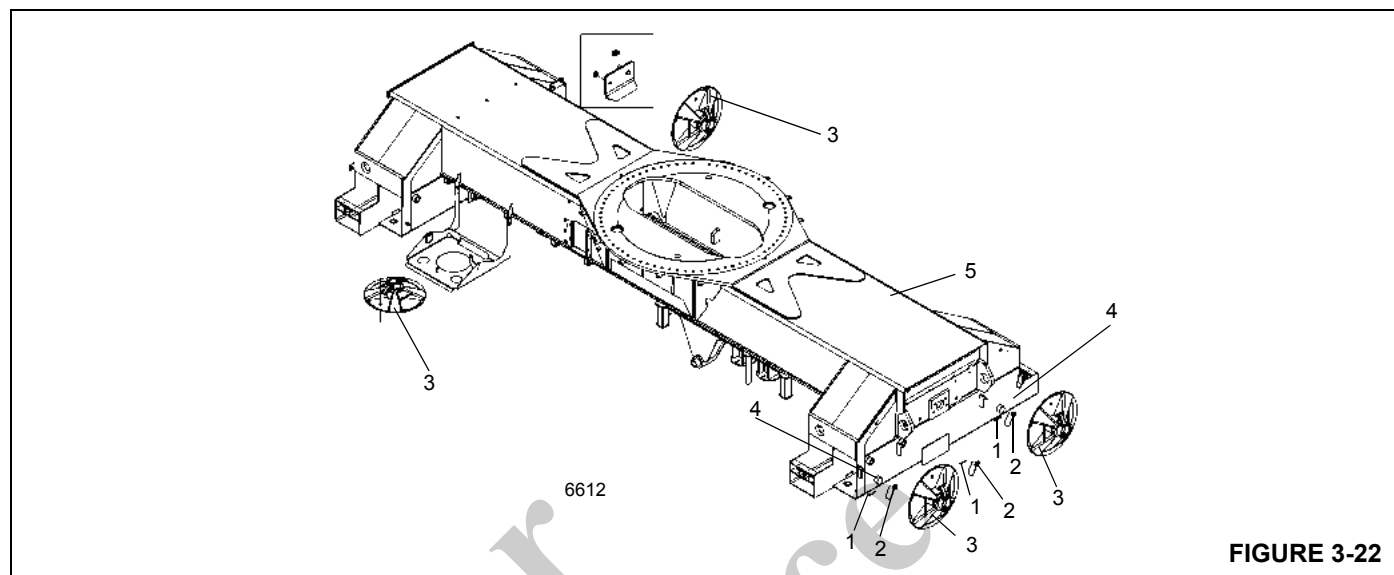


FIGURE 3-22

Stowing the Mid-Extend Lock Pin

Item	Description
1	Cotter Pin
2	Quick Pin
3	Outrigger Float
4	Rubber Bumper
5	Frame

6. Position the desired Outrigger Selector switch to EXTENSION and hold the Outrigger Extension/Retraction switch to RETRACT. The appropriate outrigger beam should begin to retract.

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

7. After all outriggers have been fully retracted, stow the outrigger floats. (Figure 3-22) Secure the floats with quick pins and cotter pins.

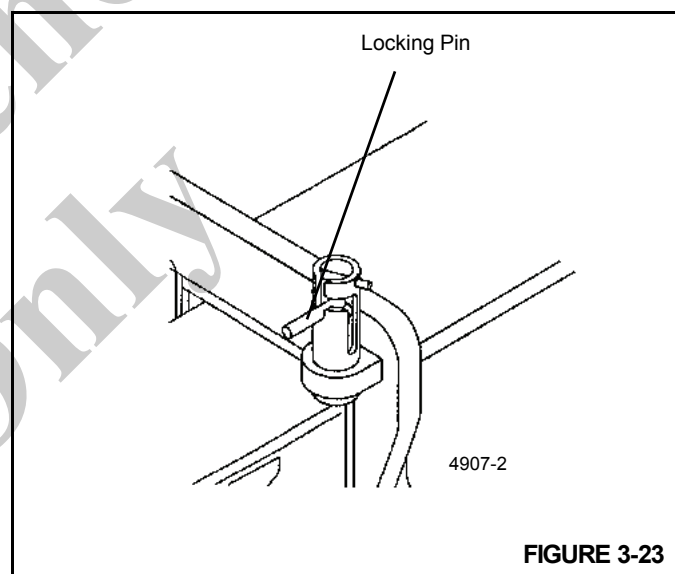


FIGURE 3-23

1. Retract the outrigger extension/retraction cylinder.

NOTE: If the lock pin (Figure 3-8) is wedged in the hole in the outrigger beam, it may be necessary to jog the outrigger extension/retraction switch slightly while pulling upward on the pin.

2. Lift the lock pin and turn it 90° to its stowed position.

Setting the Center Front Stabilizer**CAUTION**

Never operate center front stabilizer unless boom is retracted and in boom rest, and outriggers and stabilizers are extended and set. Retract center front stabilizer before stabilizers and outriggers.

1. Position the Center Front Stabilizer control switch to **ACTIVATE** and position the outrigger extension/retraction switch to **EXTEND**.

CAUTION

Do not try to lift or level the crane with the center front stabilizer.

2. Continue to extend the stabilizer until the float is firmly set on the ground.

Stowing the Center Front Stabilizer**CAUTION**

The center front stabilizer will retract automatically when the extend/retract switch is activated in the retract position; therefore the center front stabilizer **MUST** be reset if any craning functions are to be continued.

CAUTION

Only operate center front stabilizer when outriggers are extended and set, and boom is retracted and in boom rest.

1. Position the Center Front Stabilizer control switch to **ACTIVATE** and position the outrigger extension/retraction switch to **RETRACT**.
2. Fully retract the center front stabilizer.

Swinging the Boom**DANGER**

Death or serious injury could result from being crushed by moving machinery. Sound swing horn and clear all personnel from moving parts.

Do not elevate or swing boom over side unless outriggers are properly extended and crane is level.

Clear boom and tail swing path of all obstructions and personnel.

When swinging from over-the-front to over-the-side, refer to over-the-side *Load Chart* and make certain the capacity is not exceeded. Traveling with any load over-the-side is prohibited.

CAUTION

Disengage 360° swing lock, pin swing lock, and swing brake before swinging.

Never push or pull swing joystick through neutral to the opposite direction to stop swing motion.

To swing the boom, push the joystick on the left hand armrest to the right for clockwise swing or to the left for counterclockwise swing. Always operate the joystick with a slow, even pressure. Rotation is stopped utilizing the swing brake foot pedal. When rotation is stopped, press the top of the swing brake switch to the on position to prevent further rotation.

Elevating and Lowering the Boom**DANGER**

Clear area above and beneath boom of obstructions and personnel before elevating or lowering boom.

Boom Lift Joystick (Single Axis)

The Boom Lift Joystick is located on the right armrest. The joystick, when pushed forward, lowers the boom; when pulled back, it raises the boom.

Elevating the Boom (Dual Axis Option—Not Shown)

To elevate the boom, push the joystick on the right hand armrest to the left, and hold until the boom reaches the desired elevation.

Lowering the Boom (Dual Axis Option—Not Shown)

To lower the boom, push the joystick on the right hand armrest to the right and hold until the boom is lowered to the desired position.

**WARNING**

Long cantilever booms can create a tipping condition even when unloaded and in an extended and lowered position.

**WARNING**

Lower boom and let out cable simultaneously to prevent two-blocking.

CAUTION

The closer the load is to the boom nose, the more important it becomes to let out cable as the boom is lowered.

Telescoping the Boom**WARNING**

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

**DANGER**

Check the load chart for maximum load at given radius, boom angle, and length before extending boom with a load.

NOTE: When the crane is equipped with an auxiliary hoist the telescope function is controlled by a foot pedal.

Telescope or Auxiliary Hoist Joystick (Single Axis)

The Telescope or Auxiliary Hoist (TELE or AUX) Joystick is located on the left armrest. The joystick controls the telescope functions when the crane is not equipped with an auxiliary hoist. Push the joystick forward to telescope the boom out, or pull the joystick back to telescope boom in.

When equipped with an auxiliary hoist, the joystick controls the auxiliary hoist functions and the telescope functions are controlled through a foot pedal. Push the joystick forward to let out the hoist cable or pull the joystick back to reel the cable in.

Extending the Boom (Dual Axis Option with Single Hoist)

Push the joystick on the left hand armrest to the left, and hold until the boom reaches the desired length.

Retracting the Boom (Dual Axis Option with Single Hoist)**WARNING**

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

To retract the boom, push the joystick on the left hand armrest to the right and hold until the boom retracts to the desired position.

Telescope Control Pedal

The telescope control pedal is used on cranes equipped with an auxiliary hoist. Push on the top of the pedal to extend the boom and push on the bottom of the pedal to retract the boom.

Lowering and Raising the Hoist Cable**WARNING**

Keep the area beneath the load clear of all obstructions and personnel when lowering or raising the cable (load).

**WARNING**

Do not jerk joystick when starting or stopping hoist. Jerking causes load to bounce, which could result in possible damage to the crane.

NOTE: When the load is stopped at the desired height, the automatic brake will engage and hold the load as long as the joystick remains in neutral.

Lowering the Cable

Push the main hoist (right hand armrest) or auxiliary hoist (left hand armrest) joystick forward, away from the operator, and hold until the hook or load is lowered to the desired height.

Raising the Cable

Pull the main hoist (right hand armrest) or auxiliary hoist (left hand armrest) joystick, toward the operator, and hold until the hook or load is raised to the desired height.

Hoist Speed Range Selection



WARNING

Do not change the hoist speed range with the hoist rotating.

To change the speed range of the hoist(s), press the top (high speed) or bottom (low speed) of the main hoist speed switch located on the right hand armrest or auxiliary hoist speed switch located on the left hand armrest.

Operational Aids



DANGER

Electronic equipment on this crane is intended as an aid to the operator. Under no condition should it be relied upon to replace the use of capacity charts and operating instructions. Sole reliance upon these electronic aids in place of good operating practices can cause an accident.

Rated Capacity Limiter (RCL) System

The RCL is an electro-mechanical sensing system designed to alert the crane operator of impending capacity when the system has been properly preset by the operator. The control panel is mounted in the front console of the operator's cab. When an overload condition is sensed, the system provides the operator with a visual and audible warning, and locks out the control levers to prevent lowering the boom, extending the boom, or raising the main or auxiliary hoist cables.

Three additional features are included within the RCL system:

- Swing Angle Set Limitation
- Work Area Definition
- Anti-Two-Block Device

Swing Angle Set Limitation allows left and right swing angle to be preset. When the preset angle is reached, the system will provide an audible warning.

Work Area Definition allows the crane operator to describe the crane's working area by setting up "virtual walls". They are referred to as virtual walls because they exist in the system and are not real walls. The virtual walls represent obstacles (i.e. buildings, towers, poles, etc.) in the crane's working range. They are set by defining points along the outer limits of the working area with the tip of the boom. Once the working area has been defined, the system will provide a visual and an audible warning if the boom approaches a virtual wall.

CAUTION

When defining virtual walls always allow a safe working distance to any obstacles. Never work outside a safe working area as defined by common practice, standards, and manuals.



WARNING

There are no cut-outs associated with the swing angle set limitation or the work area definition features.

An Anti-Two-Block Device is also incorporated into the system to prevent the hook block or headache ball from coming into contact with the boom nose or jib. This condition will also cause a lockout of hoist up, boom down, and telescope out, and also provide a visual and an audible alarm.

Refer to the RCL Operator's Handbook for more detailed information on the function of the RCL system.

Control Lever Lockout System

The control lever lockout system consists of hydraulic solenoid valves located in the directional control valves. The valves are activated in such a manner as to prevent worsening the condition, that is, boom down, telescope out, or hoist up. The control lever lockout system is used with the anti-two-block system or the rated capacity limiter (RCL) system. The RCL sends a signal to the CAN bus system which turns off the solenoids on the directional valves.

Crane Travel Operation

Active Restraints

Seat Belts

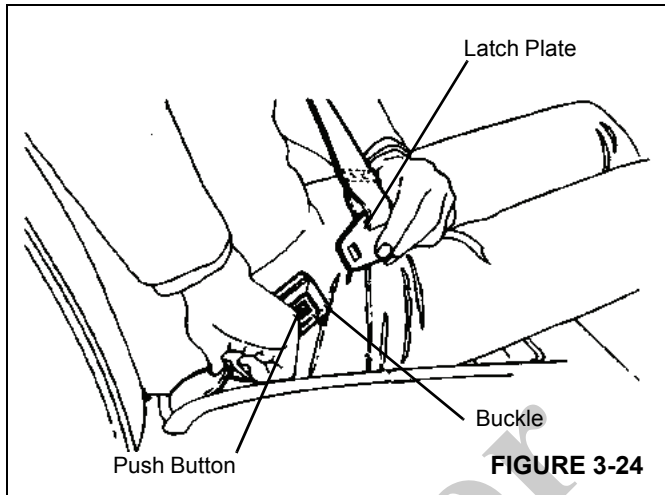


FIGURE 3-24

1. Before fastening a seat belt, always adjust the driver's seat to the position in which you will drive.
2. Pull the belt across your lap and push the latch plate into the buckle until it clicks (Figure 3-24).
3. To reduce the risk of sliding under the belt during a collision, position the belt across your lap as low on your hips as possible and pull it toward the door to a snug fit so the retractor can take up the slack.

NOTE: The lap/shoulder belt is designed to lock only during a sudden stop or impact. At other times it should move freely.

4. If the shoulder belt is too snug, do the following:
 - a. Pull the shoulder belt out (A) at least 130 mm (5 in) so that when it is let go, it returns to your chest (Figure 3-25).
 - b. Then pull down on the shoulder belt (B) the least amount needed to ease pressure but no more than 25 mm (1 inch) and let go.

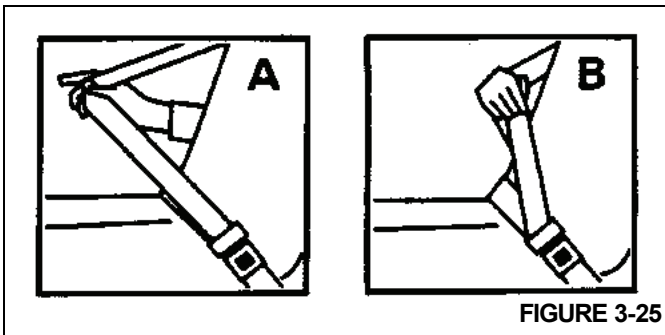


FIGURE 3-25

5. To reduce slack in the belt, pull the belt out as you did in step 4.a.



DANGER

Keep any shoulder belt slack to a minimum, no more than 25 mm (1 inch). Belt slack beyond the specified amount could significantly reduce the amount of protection in an accident because the belt is too loose to restrain you as intended.

6. To unfasten the belt, push in on the button in the center of the buckle. To store the belt, pull out about 180 mm (7.1 in) and let go. The belt should retract when the buckle is unlatched. To help prevent damage to the seat belt and interior, before closing the door be sure the belt is fully retracted and the latch plate is out of the way.

Traveling - General

CAUTION

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

Job site travel with deflated suspension must be limited to 8 km/h (5 mph). Attempting to travel at higher speeds may cause drive train component failure.

If traveling with 10,900 kg (24,000 lb) counterweight installed, maximum travel speed is 4 km/h (2.5 mph). Suspension air bags should be inflated.

Do not move the crane until the superstructure has been secured as outlined below.

1. To ensure the axles and/or suspension are not overloaded, adhere to the following.
 - a. For highway travel with 8170 kg (18,000 lb) of counterweight, install 3630 kg (8000 lb) of counterweight on the carrier. Check that front axle load does not exceed 22,300 kg (49,200 lb) and rear axle load does not exceed 27,200 kg (60,000 lb).
 - b. For highway travel with 6350 kg (14,000 lb) or 3630 kg (8000 lb) of counterweight, install 1810 kg (4000 lb) of counterweight on the carrier. Check that front axle load does not exceed 22,300 kg (49,200 lb) and rear axle load does not exceed 27,200 kg (60,000 lb).
 - c. GVW should never exceed 49,530 kg (109,200 lb). Also refer to certification label on inside of cab door for Gross Axle Weight Ratio (GAWR).

NOTE: For 10,900 kg (24,000 lb) counterweight job site travel without extension and/or inserts erected, the boom must be extended to a length of 15 m (50 ft).

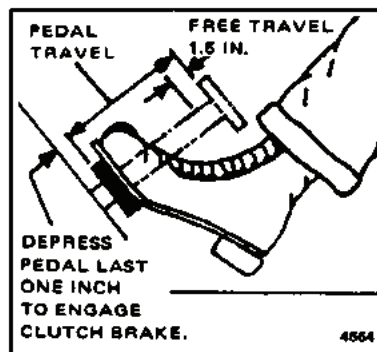
2. Ensure all boom sections are fully retracted or set to whatever extension is necessary for balance load on the axles.
3. Ensure the boom is fully lowered into the boom rest.
4. Engage the swing brake.
5. Engage the swing lock.
6. Ensure the swingaway, if so equipped, is properly stowed and secured or removed from crane.
7. Remove the hookblock and/or headache ball from the hoist cable(s) and stow securely before traveling or ensure headache ball is properly secured to the tie down provided for that purpose.
8. Ensure the outrigger stabilizers and outrigger beams are fully retracted and the floats are removed.
9. Ensure the center front stabilizer is fully retracted.
10. Ensure the stabilizer floats are properly stowed in their holding racks.
11. Ensure the cover doors on the outrigger control panels, battery box, and sling box are closed.
12. Close and/or install all superstructure cab windows and door.

NOTE: The electric-actuated variable geometry turbocharger causes the engine sound to vary at different times. This is normal. You may also hear a slight turbo whistle during idling.

13. If traveling on job site or off-highway, select LOW range to prevent clutch damage.
14. If traveling with 10,900 kg (24,000 lb) of counterweight installed, maximum travel speed is 4 km/h (2.5 mph). Suspension air bags should be inflated.

Clutch Operation

Clutch pedal adjustment (Figure 3-26) provides for approximately 38.1 mm (1.5 in) for free travel movement of the pedal after the first free travel of 12.7 mm (0.5 in) is passed before engaging the release bearing fully. It is important that this free travel be maintained to avoid possible excessive wear on the bearing and/or clutch slippage. Approximately the last 25 mm (one inch) of downward clutch pedal travel engages the



Clutch Travel
FIGURE 3-26

clutch brake which overcomes the tendency of the clutch to rotate at high speed when the clutch is disengaged. A slight but definite resistance to clutch pedal downward movement will be felt at the last 25 mm (one inch) of travel.

The clutch brake is particularly useful for initial gear engagement in the lower gears when going uphill, when the road speed drops off more quickly than the engine speed, requiring rapid shifts. The clutch brake **MUST NOT BE USED** when making a downshift.

CAUTION

Never fully depress the clutch pedal before the transmission is put in neutral. If the clutch brake is applied with the transmission still in gear, a reverse load will be put on the gears making it difficult to get the transmission out of gear. At the same time, it will have the effect of trying to stop or decelerate the crane with the clutch brake, with resultant rapid wear and generation of excessive heat, necessitating frequent replacement of the brake friction discs.

Clutch engagement should always be made smoothly while synchronizing accelerator movement necessary to move the crane.

Double clutching is a means of bringing the speed of the transmission gears into synchronization so the shift can be made without clash. The engine is used to speed up the countershaft for a downshift and to slow it down for an upshift. Double clutching operation is accomplished as follows.

1. Depress the clutch (do not engage clutch brake) and shift into neutral.
2. Release clutch pedal and accelerate the engine (when making downshift) or allow the engine to slow down (when upshifting) until engine speed approximately corresponds to road speed of the gear ratio selected.
3. Depress the clutch pedal (do not engage clutch brake) and shift into gear.
4. Release the clutch pedal. Always use the double clutching technique.

NOTE: Never allow your foot to ride the clutch pedal when the clutch is engaged. This causes premature release bearing failure and short clutch disc life.

Shifting Gears

Next to concern for safety, good shifting habits are probably the most important capability a driver can have. Knowing how and when to shift can return savings in trip time and operating expense.

In the early stage of moving the crane, keep the engine speed down to the actual power requirement but anticipate

the next shift demand and do not cause the engine to labor with the next shift. Start the crane in the lowest gear necessary and with the first few shifts, develop only the engine speed (RPM) needed to get rolling. Then as you upshift, increase crane speed in each gear with a progressive increase in engine speed. It should seldom be necessary to go to governed engine speed in the lower gears except in a peak load situation, such as starting up a grade.

The biggest task when climbing a grade generally will be maintaining a reasonable rate of speed. When possible, preplan the climb and probable shift requirements according to traffic conditions and grade to be climbed.

When approaching a hill, gradually move the throttle all the way down, if necessary, to maintain governed engine speed (RPM) and remain at full throttle as the crane starts up the grade. If there is sufficient power to maintain satisfactory road speed without the engine laboring, remain in that gear for the entire grade. Whenever a grade proves too great for the gear that you are in and the engine begins to labor, ease off the throttle as necessary and allow speed to drop off to the next lower shift point before downshifting to the next gear. Speed usually drops off quickly while shifting so the shift should be made rapidly. Additional downshifting should be performed in the same way, as necessary. By riding each gear down to the next shift point, you will get over your grades in the best possible time with minimum shifts.

On downhill operation, the engine provides most efficient braking when run at or near top engine speed in the operating range, BUT REMEMBER, the governor has no control over the engine speed when it is being pushed by a heavy crane. When the engine exceeds the rated governed engine speed while descending a grade or downshifting at the high end of the operating range, engine overspeed can result in serious damage. On downhill operation, use the vehicle brakes and gears in combination to keep crane speed under control and the engine below rated governed engine speed.

The transmission has 11 forward speeds and three reverse, consisting of a five speed front section and a three speed auxiliary section. The auxiliary section contains low and high range ratios, plus three deep reduction gears. The three lowest (LL1, LO, LL2) gear sets are used for road speed control and are not intended to be used as progressive shifts. The other four ratios are used twice, once in low (LO) range and once in high (HI) range.

As with any transmission gearing, shifting depends on proper synchronization. Never try to force the gear lever. During regular shifts, when moving the gear lever into the next gear position for engagement, the lever should be held lightly against the gear to be engaged. If gears are

synchronized, engagement will be made immediately. If not synchronized, the flat gear teeth will rotate against each other until synchronization is reached. Do not jerk the shift lever into the next gear position or try to force gear engagement. If gears are out of synchronization, no amount of force is going to make the engagement before synchronization.

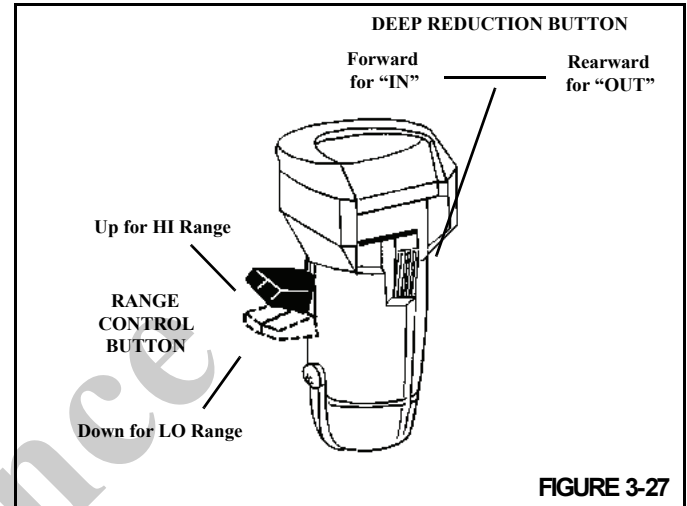


FIGURE 3-27

All shifts are made with one lever and a Range Control Button Figure 3-27 which is used only once during an upshift sequence, and only once during a downshift sequence. Always preselect the range shift. After preselection, the transmission will automatically make the synchronizer range shift as the shift lever passes through neutral.

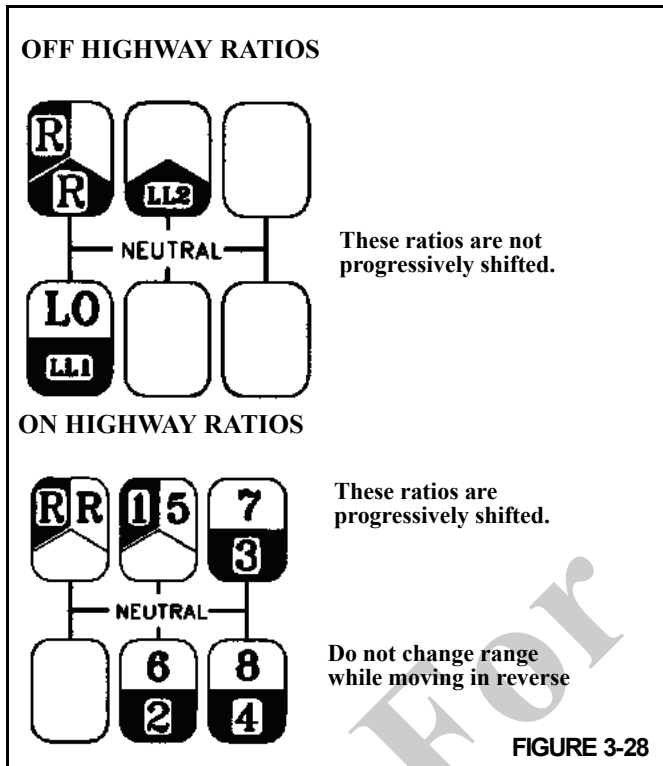
In the following instructions, it is assumed that the driver is familiar with motor trucks and tractors, and that he can coordinate the necessary movements of the shift lever and clutch pedal to make progressive and selective gear engagements in either direction, up or down.

Initial Start-up

CAUTION

Before moving the crane, make sure you understand the shift pattern configuration Figure 3-28.

1. Ensure the shift lever is in neutral and the parking brake is set.
2. Start the engine.
3. Allow air pressure to build up.
4. Apply the service brakes.



5. Ensure the range button is down in the LO position.
6. If the crane is to be started in deep reduction (LL2 or LL1), move the deep reduction button forward to IN.
7. Depress the clutch pedal to the floor.
8. Move the shift lever to the desired initial gear.
9. Release the parking brakes.
10. Slowly release the clutch pedal and depress the foot throttle pedal.

Upshifting

CAUTION

Never move the deep reduction button or the range button with the shift lever in neutral while the crane is moving.

To make a deep reduction button shift from LL2 to 1st, proceed as follows.

- a. Just before making the upshift, move the deep reduction button rearward to OUT while maintaining foot throttle position.
- b. Immediately release the foot throttle pedal, depress the clutch pedal once to brake torque, release the pedal to engage the clutch, allow the engine to decelerate until the shift is complete. Continue

driving or upshifting. The transmission shifts from LL2 to 1st when synchronous is reached.

11. To shift in LO range, proceed as follows.

Move the shift lever, double clutching, to the next desired gear position (1st to 2nd to 3rd to 4th).

12. To shift from LO (4th) to HI (5th) range, proceed as follows.

When in the last gear position for LO range and ready for the next upshift, pull the range button up to HI and move the shift lever, double clutching, to the next higher gear position. As the shift lever passes through neutral, the transmission will automatically shift from LO to HI range.

CAUTION

Never move the shift lever to the lower speed gear position after HI range preselection, or anytime the transmission is in HI range.

13. To shift in HI range, proceed as follows.

Move the shift lever, double clutching, to the next desired gear position (5th to 6th to 7th to 8th).

Downshifting

1. To shift in HI range, proceed as follows.

Move the shift lever, double clutching, to the next desired gear position (8th to 7th to 6th to 5th).

2. To shift from HI (5th) to LO (4th) range, proceed as follows.

When in the 5th gear position for HI range and ready for the next downshift, push the range button down to LO and move the shift lever, double clutching, to the next lower gear position. As the shift lever passes through neutral, the transmission will automatically shift from HI to LO range.

3. To shift in LO range, proceed as follows.

Move the shift lever, double clutching, to the next desired gear position (4th to 3rd to 2nd to 1st).

4. To make a deep reduction button shift from 1st to LL2, proceed as follows.

- a. Just before making the downshift, move the deep reduction button forward to IN while maintaining foot throttle position.
- b. Immediately release the foot throttle pedal, depress the clutch pedal once to brake torque, release the pedal to engage the clutch, and depress the foot throttle pedal. The transmission shifts from 1st to LL2 when synchronous is reached.

Shifting to Reverse**CAUTION**

Never make a range shift or deep reduction shift while moving in reverse.

1. With the transmission in neutral, determine which reverse range is to be used. Move the range control button up for HI reverse or down for LO reverse.
2. Move the shift lever to the reverse position.
3. To engage deep low reverse, position the range control button in the down (LO) position. Move the deep reduction button to the forward (IN) position.
4. Carefully release the clutch, making sure deep reverse is fully engaged.

Driving Tips

- For a smooth start, always select an initial starting gear that will provide sufficient reduction for the load and terrain.
- On later model cranes, do not progressively shift the road control ratios.
- Always use normal double clutching procedures when making lever shifts.
- Never slam or jerk the shift lever to complete gear engagement.
- Never coast with the gear shift lever in the neutral position.
- Never move the Deep Reduction Button or the Range Control Button with the gear shift lever in the neutral position while the vehicle is moving.
- Never make a range shift while operating in reverse.
- Never downshift at too high of a road speed.
- When slowing down, the proficient operator can downshift through all the individual gear speeds to prolong the life of the brakes.
- In most cases, depending on the engine and axle ratios, fuel can be saved by operating the crane at less than governed RPM while cruising in 8th gear.

Differential Control Switches

There are two differential switches for controlling the tandem axle differentials, the Inter-Axle Control Switch and the Cross-Axle Control Switch.

The Inter-Axle Control Switch is used to control the locking capability between the front and rear axles in the tandem set. The switch has two positions, LOCK and UNLOCK.

The Cross-Axle Control Switch is used to control the locking capability between the right and left wheels in the tandem set. The switch has two positions, LOCK and UNLOCK.

CAUTION

Do not actuate the selector switch while the wheels are actually slipping or spinning. This will result in damage to the drive train components.

Operation of the vehicle with differentials locked increases wear on tires, axles, drive shafts, and the transmission. These features should only be utilized as required for mobility.

Traveling with Jib and/or Inserts Erected**10 m (33 ft)/17 m (56 ft) Extension**

Travel is permissible under the following conditions.

1. The 10 m (33 ft) or 17 m (56 ft) jib shall be erected at minimum offset. If traveling with just the 10 m (33 ft) extension, the stinger section must be stowed on the boom base section, not on the extension base section.
2. Jobsite travel only on firm, level surface.
3. Main boom shall be fully retracted.
4. Main boom angle: 3 degrees minimum, 30 degrees maximum.
5. Maximum travel speed: 4 km/h (2.5 mph).
6. Counterweight:
 - a. With the boom over the front, the counterweight used can be from 0 kg to 8170 kg (18,000 lb) or 10,900 kg (24,000 pounds).
 - b. With the boom over the rear, the counterweight used must be from 5440 kg (12,000 lb) to 8170 kg (18,000 lb).
7. Swing lock and pin shall be engaged.
8. Hookblock must be removed from main boom nose.
9. Headache ball may be reeved over jib, hanging 0.9 m (3 feet) below sheave.
10. Suspension air bags shall be inflated.
11. The tires shall be properly inflated.

10 m (33 ft)/17 m (56 ft) Extension Plus One or Two 6 m (20 ft) Insert(s)

Travel is permissible under the following conditions.

1. The 10 m (33 ft) or 17 m (56 ft) jib shall be erected at minimum offset. If traveling with just the 10 m (33 ft)

extension, the stinger section must be stowed on the boom base section, not on the extension base section.

2. Jobsite travel only on firm, level surface.
3. Main boom shall be fully retracted.
4. Main boom angle: 3 degrees minimum, 30 degrees maximum.
5. Maximum travel speed: 4 km/h (2.5 mph).
6. With the boom over the front, the counterweight used can be from 0 kg to 8170 kg (18,000 lb) or 10,900 kg (24,000 pounds). Travel with the boom over the rear is not permitted with insert(s) erected.
7. Swing lock and pin shall be engaged.
8. Auxiliary hoist or IPO counterweight must be installed.
9. Hookblock must be removed from main boom nose.
10. Headache ball may be reeved over jib, hanging 0.9 m (3 feet) below sheave.
11. Suspension air bags shall be inflated.
12. The tires shall be properly inflated.

Rear Tandem Inter-Axle/Cross-Axle Locks

CAUTION

Do not operate differential locks on dry roads.

To engage the inter-axle or cross axle differential locks for maximum pulling power when approaching slippery or poor road conditions, do the following:

CAUTION

Do not engage or disengage differential locks while wheels are spinning or at speeds over approximately 16 km/h (10 mph).

1. Stop the crane and position the switch to the lock position.
2. Proceed over the poor road conditions cautiously.

When adverse conditions have passed, do the following:

1. Stop the crane and position the switch to the unlock position.
2. Resume driving at a safe speed.

Service/Parking Brakes

For the most effective braking and maximum life from the brake system components, the following suggestions are made.

- Air brakes have light pedal operation and the driver is cautioned to use extreme care in application until a good feel is achieved.
- Use the engine as a brake when approaching a stop or going down a long grade. On a downgrade, use the same transmission gear as would be needed to go up the same grade.
- When necessary to use brakes to reduce crane speed on downgrades, use an on-and-off application to minimize heat and wear. Do not hold a continuous brake application or slide the wheels.
- When driving on slippery pavement or under icy conditions, alternately and smoothly apply and release the brakes to prevent skidding.
- Keep the tires properly inflated. Improperly inflated tires can reduce the efficiency of the brakes.
- After driving through water, dry the brakes by applying them lightly while maintaining a slow forward speed with an assured clear distance ahead until brake performance returns to normal.



DANGER

Stop immediately if low air pressure warning sounds and determine cause of air loss. Stop by downshifting and use engine as a brake. Make final stop using a single brake pedal movement to avoid excessive loss of air and sudden engagement of parking brakes.

NOTE: If the pressure drops below 14 kPa (2 psi) per minute with the engine stopped, have the air system checked for leaks.

- Regularly check the air pressure gauge. System air pressure should never drop below 310 kPa (45 psi). If both systems drop below 310 kPa (45 psi), the automatic spring brakes will actuate. Normal operating pressure is 725 to 825 kPa (105 to 120 psi).



DANGER

Do not use parking brake for stopping crane except in case of an emergency, as a severe sudden stop will occur.

CAUTION

Release brakes before moving crane, or drive train damage will result.

NOTE: Park brake must be set before outrigger controls can be operated.

- The parking brakes are controlled by a push-pull knob on the front console. Pull the knob out to apply and push the knob in to release the parking brake.

Engine Braking

NOTE: Do not keep a foot lightly on the clutch pedal or the throttle pedal. This will cause the engine brake not to come on.

Compression brakes are quieter on engines with the exhaust aftertreatment feature.

By energizing the engine brake, the power producing diesel engine, in effect, becomes a power absorbing air compressor. To retard a crane on a downgrade using the Engine Brake, the operator selects a gear which will provide a balance between engine speed and road speed, then engages the engine brake. If the engine speed exceeds maximum rated RPM for a desired speed, a lower gear can be selected or intermittent use of the service brakes can be made. This selection of a lower gear will generally allow complete control of the crane by the engine brake leaving the service brakes in reserve to be used for emergency stops. With the engine brake turned on, the engine brake will not be energized until the momentum is driving the engine.

- Position the engine brake On/Off switch to ON (push top of switch).
- Position the engine brake switch to either HIGH (press top of switch) or LOW (press bottom of switch) position, depending on the amount of braking desired.
- Let off the throttle to activate the engine braking system and slow the crane.

NOTE: The engine braking system will automatically deactivate when the throttle is depressed.

CAUTION

Before engaging engine brake on slippery roads, be sure crane is maintaining traction.

TRAILING BOOM (OPTIONAL)

The trailing boom option allows the crane to be driven on roads or surfaces that normally cannot support the axle loads by allowing a portion of the boom weight to be carried on the boom trailer.

In order to use the trailer the boom lift circuit and swing brake circuit must be opened to allow the boom to freely move. After transporting and before using the crane the lift circuit and swing circuit valves (Figure 3-32) must be fully closed by turning clockwise.

Travel Configuration

- Swing the boom to over the rear of the crane.



For Reference Only
Actual Trailer May be Different

FIGURE 3-29

- Align the trailer to the boom supports on the bottom of the boom (Figure 3-29).
- Lower the boom onto the trailer supports.
- Align the support pins with the boom attachment lugs.
- Connect the control connector (blue) (1, Figure 3-30) to the rear of the crane.
- Connect the brake supply (red) connector (2) to the rear of the crane.
- Connect the electrical cable (3) to the crane.

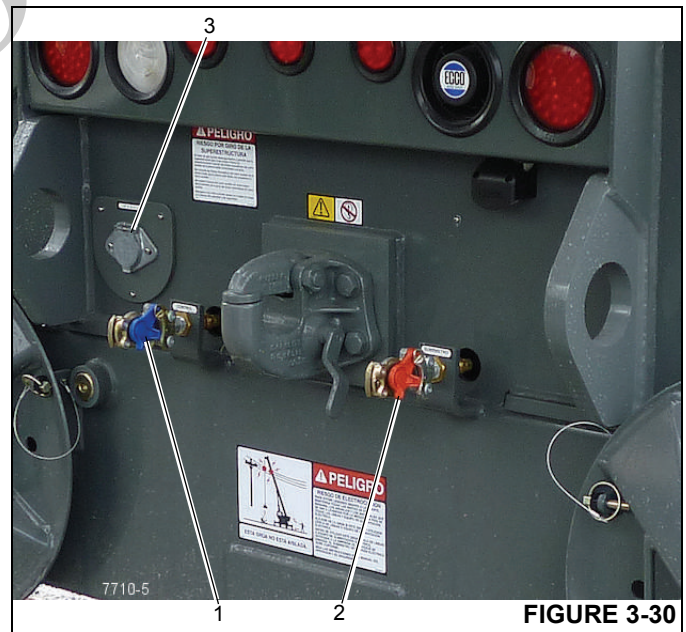
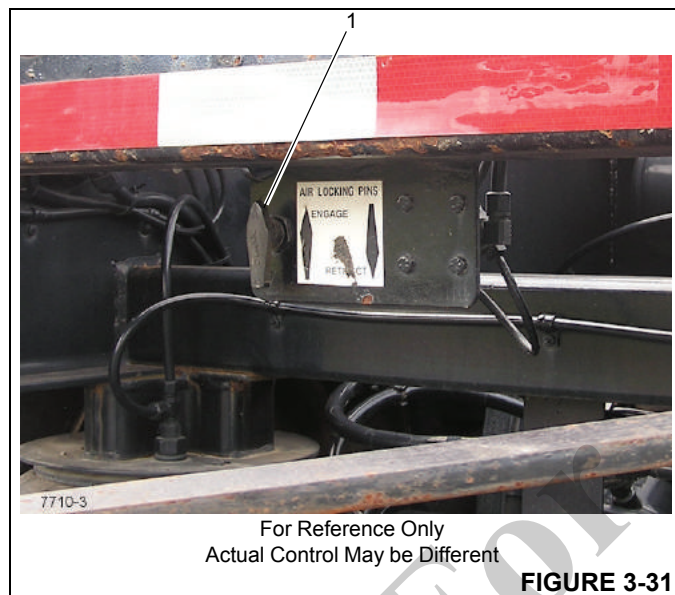
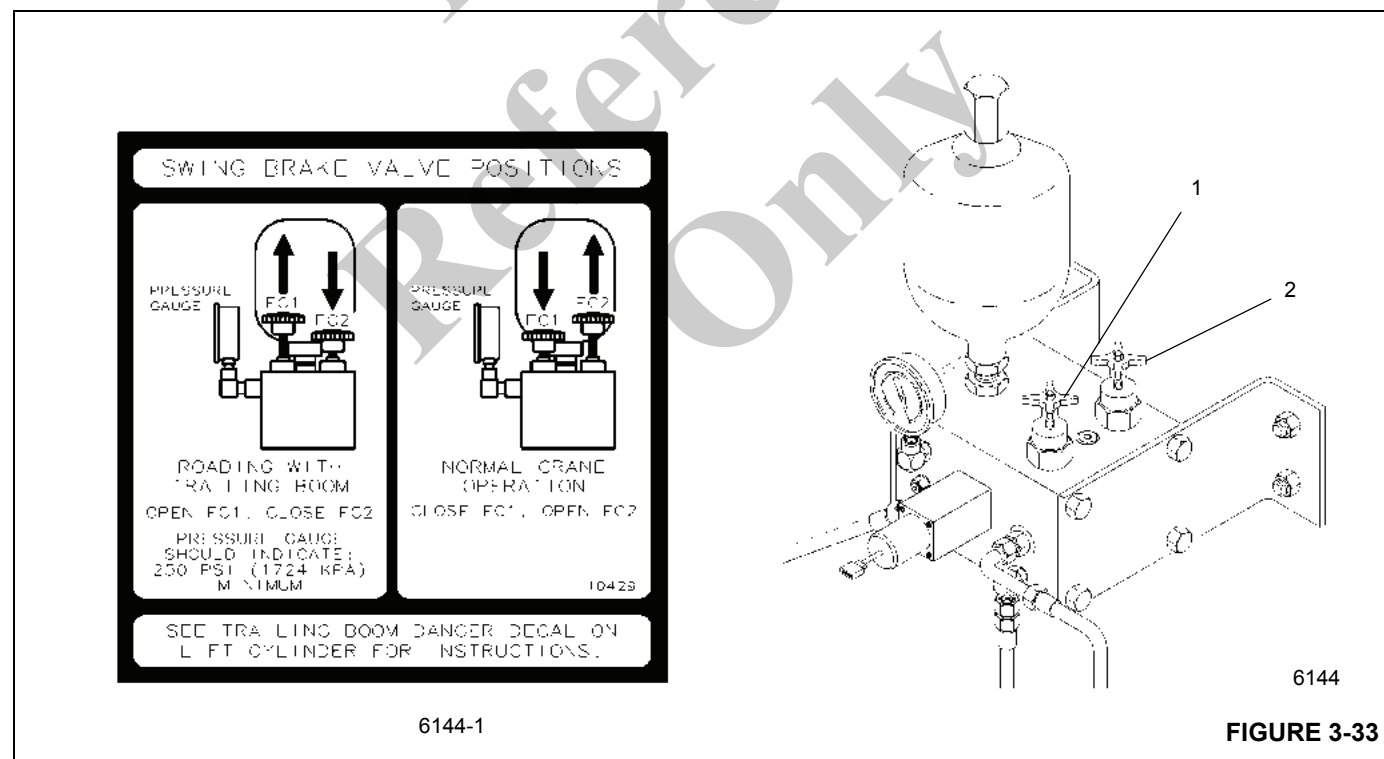


FIGURE 3-30

8. Turn the handle of the support pin control (1, Figure 3-31) to ENGAGE and verify the support pins fully engage the boom support lugs.



9. Open the lift cylinder pressure release valve by turning counterclockwise (1, Figure 3-32).
10. Open the swing brake release valve (2) by turning counterclockwise.
11. Open and close valves FC1 and FC2 as shown in Figure 3-33,



Item	Description
1	Needle Valve FC1
2	Needle Valve FC2

PILE DRIVING AND EXTRACTION

By operating within the guidelines detailed below, pile driving is an approved application for Grove brand mobile hydraulic cranes. Because pile driving and extracting with the use of a mobile hydraulic crane presents many variables and unknowns, Grove crane owners must exercise discretion when considering the use of a crane for this application.

It is not our intention to recommend specific types or makes of pile driving and extracting equipment but rather to advise crane owners of our operational requirements to help avoid pile driving and extracting from having any detrimental effect on the crane and invalidating the new machine warranty. The following are the operating requirements that shall be used during pile driving and extracting with a Grove mobile hydraulic crane. These notes are in addition to the "notes to lifting capacities" contained in the crane's in-cab load chart.

Operation of Pile Driving and Extracting Equipment

- All pile driving and extracting operations shall be restricted to fully extended outriggers with all tires clear of the ground.
- The combined weight of the driver or extractor, piling, leads, attachments, etc., shall not exceed 80% of the published load chart values for on-outriggers operation.
- The pile driver or pile extractor and attachments shall be kept clear of the boom nose at all times.
- The pile driver and piling shall be suspended from a hoist cable with sufficient line speed to meet or exceed the rate of descent of the driver and piling to preclude impact loading or vibration from being induced into the boom and crane structure.
- Pile driving or extracting shall be restricted to over the main boom only and shall not be permitted over a boom extension or jib.
- Pile extraction using only the crane's hoist line is unsafe and not permitted since load values cannot be accurately determined. Only pile extraction devices that do not transmit vibration or shock loading into the crane are permitted. All possible precautionary measures shall be taken to prevent shock loads or vibration from being imposed on crane components, either directly through the hoist cable or indirectly from ground borne vibration.
- The operator and other personnel associated with the pile driving and pile extraction operation shall have read and understood all safety standards applicable to crane operations as well as being thoroughly trained in the safe operation of pile driving and extracting equipment.
- The load lines shall be kept vertical at all times during pile driving and pile extraction operations.

Crane Equipment

- Hoists shall be equipped with a cable follower to aid in proper spooling of cable.
- All cable retainer pins and cable guides/retainers shall be in place.
- All boom extensions or jibs must be removed from the machine before pile driving or extraction begins.
- All hoist hooks shall be equipped with a positive locking latch.

Crane Inspection

- In addition to the crane's frequent and periodic inspections, dated daily records shall be maintained showing inspections were performed on the crane during the time it was used for pile driving or extraction.
- All anti-two block warning devices and RCL systems shall be inspected daily and verified to be functional.
- All areas of the crane subject to fatigue shall be inspected monthly, and before the crane is to return to lifting service.
- The boom shall be inspected daily to ensure all wear pads remain in place. Cranes which utilize pinned boom sections shall be inspected daily to ensure the pinning mechanism operates properly and to check for undue wear at the pins and pinning plates. The hoist cable shall be inspected daily to ensure no chafing or wear is occurring.

STOWING AND PARKING



DANGER

Never park crane near holes, on rocky surfaces, or on soft spots. This may cause crane to overturn, resulting in injury or death to personnel.

When parking the crane, do the following.

1. Remove the load from the hook.
2. Remove or stow jibs if so equipped.
3. Fully retract all boom sections.
4. Lower the boom to normal travel position.
5. Engage the swing brake, swing lock pin, and 360 degree swing lock.
6. Retract all stabilizer cylinders and outrigger beams.
7. Turn the crane function power switch to the off position (press bottom of switch).

8. Park the crane on a stable surface.
9. Apply the parking brakes and if necessary, chock wheels.
10. Ensure all operating controls are in neutral position.
11. Shut down engine following proper procedures specified in this manual and the applicable engine manual.
12. Remove the keys.
13. Close and lock, if applicable, all windows, covers, and doors.

Unattended Crane



WARNING

Tipping Hazard!

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

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

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

Crane Shutdown Procedures

The following procedures will extend serviceable life of various crane components, reduce vandalism, and accidents during crane shutdown periods or anytime the crane is left unattended.

1. Perform the procedures found under *Shutdown Procedure*, page 3-44.



DANGER

Never park crane near holes, on rocky surfaces, or on soft spots. This may cause crane to overturn, resulting in injury or death to personnel.

2. Park the crane on a proper surface with the outrigger stabilizers and beams fully retracted. Do not park in a location where it may become frozen to the ground or settle unevenly and overturn.
3. Apply parking brakes and if necessary, chock the wheels.
4. Position all controls to neutral or off.
5. Shut down the engine using the proper procedures as specified by this manual and the engine manual.
6. Perform any other specified procedures required at the end of the workday, that is, drain water from the fuel filter - water separator, refueling, etc.
7. Close all windows.
8. Remove the keys from the crane.
9. Lock the crane. Install vandal guards, if used.

CAUTION

Step 10 does not take the place of the prestarting checks which must be performed just prior to using the crane at the next working day.

10. Make a thorough walk around inspection to ensure that all cylinders that can be retracted are retracted. The only exceptions are those cylinders which cannot be fully retracted, that is, steer cylinders. Also, look for anything that could hinder or prevent starting the next day's work.

SECTION 4

SET-UP AND INSTALLATION

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GENERAL

This section provides procedures for installing the hoist cable on the hoist drum, cable reeving, and erecting and stowing the jib.

INSTALLING CABLE ON THE HOIST

CAUTION

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

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

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

1. Position the cable over the boom nose sheave and route to the hoist drum.
2. Position the hoist drum with the cable anchor slot on top.
3. Insert the cable through the slot and position around the anchor wedge Figure 4-1.

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

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

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

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

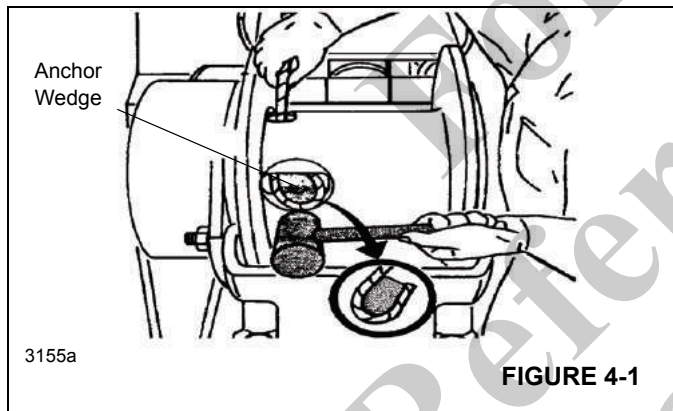


FIGURE 4-1

CABLE REEVING

NOTE: There are two types of cable (wire rope) available on this crane; 6 x 36 WS and 35 x 7 (non-rotating).

Within the limits of the load and range charts and permissible line pull, multi-part lines allow the operator to raise a greater load than can be raised with a single part line. Various cable reeving (part line) is possible with the boom nose and hook block Figure 4-6 and Figure 4-7. This reeving should be accomplished by a qualified rigger using standard rigging procedures.

CAUTION

Do not reeve Auxiliary Hoist rope through the rope grab. Do reeve the Main Hoist rope through the rope grab. If both Main & Auxiliary Hoists are being reeved, neither one may be reeved through the rope grab. Keep it in the down position. Figure 4-2

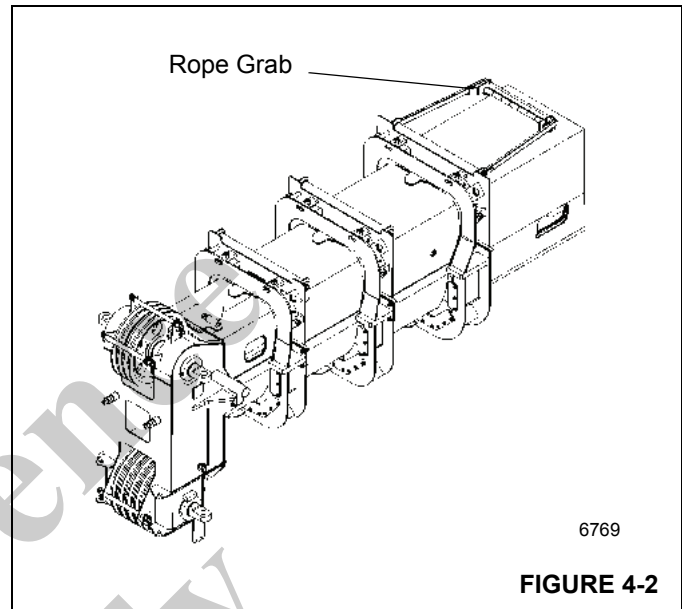


FIGURE 4-2

NOTE: Also use the rope grab when using the Main Hoist with lattice extensions.

To quick reeve the hook block without removing the wedge socket on the end of the cable refer to Figure 4-3.

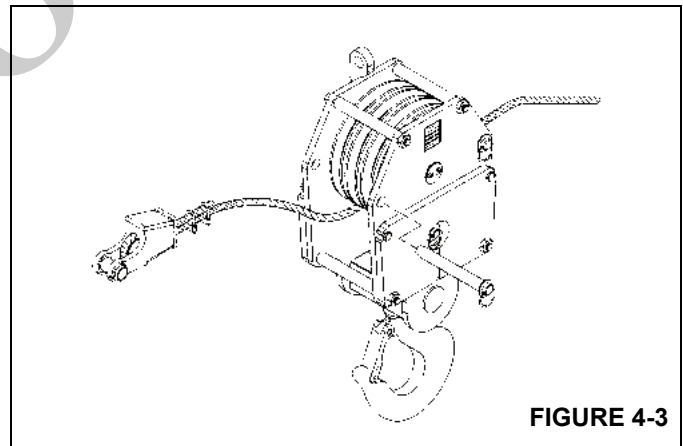


FIGURE 4-3

DEAD-END RIGGING/WEDGE SOCKETS

Wedge socket assemblies are popular rigging accessories and have been successfully used for decades to terminate wire ropes on mobile cranes. A wedge socket assembly is easily installed and dismantled but it must be installed and used correctly. It is essential to use only a wedge and socket of the correct size for the rope fitted. Failure to do so may result in the rope pulling through the fitting.

Since state and local laws may vary, alternate attachment methods may be necessary depending upon work conditions. If alternate methods are selected, the user is responsible and should proceed in compliance with the regulations in force. If there are any questions, contact your local Grove Distributor or Manitowoc Crane Care.

Do not mix components from different manufacturers. The selection, installation and use of a wedge socket assembly must be in accordance with the requirements of the wedge socket manufacturer and the wire rope manufacturer upon whose wire rope the wedge socket assembly will be used.

Manitowoc/Grove Crane specifies the size, type, class and line pulls for wire rope, predominately rotation resistant wire rope, and rigging accessories such as overhaul balls and hook blocks for use with each new crane that it manufactures. Other wire ropes and rigging accessories are available from various vendors. Different wire rope manufacturers have differing requirements for the construction, handling, cutting, seizing, installation, termination, inspection and replacement of the wire ropes they produce. Their advice should be sought for each specific type of wire rope a crane user intends to install on a mobile crane.

When assembly is complete, raise the boom to a working position with a load suspended to firmly seat the wedge and rope into the socket before the crane is used operationally.

CAUTION

If the socket is not positioned with the flat face away from the boom sections, structural damage will occur.

When anchoring the socket to the boom, ensure the flat face of the socket is in position, as shown, away from the boom sections Figure 4-4.

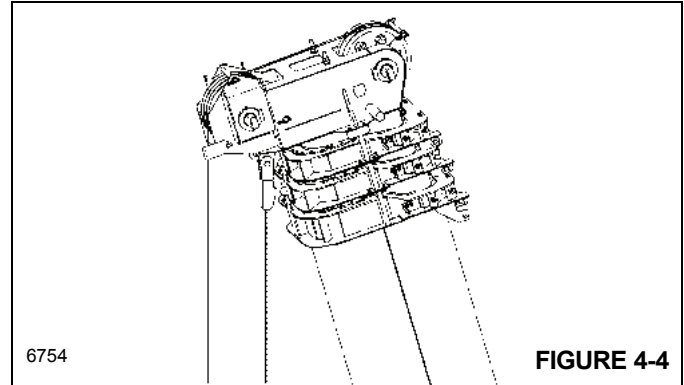


FIGURE 4-4

Installing Wedge and Socket

1. Inspect the wedge and socket. Remove any rough edges and burrs.
2. The end of the wire rope should be seized using soft, or annealed wire or strand. If the end of the rope is welded, the welded end should be cut off. 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.

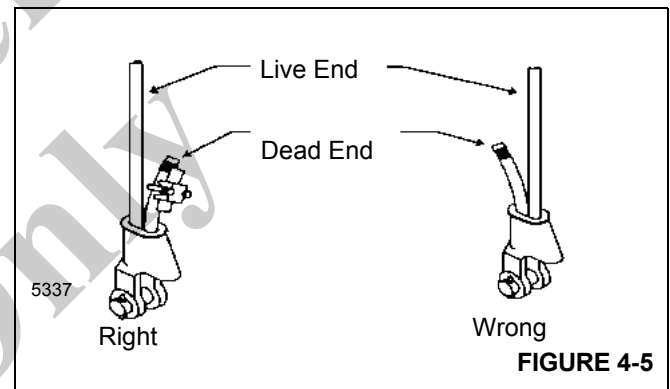


FIGURE 4-5

3. Make sure the live-loaded side Figure 4-5 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.
4. Insert the end of a wire rope into the socket, form a loop in the rope, and route the rope back through the socket allowing the "dead" end Figure 4-5 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 crane's hoist to first apply a light load to the live line.

6. After final pin connections are made, increase the loads gradually until the wedge is properly seated.
7. The wire rope and wedge must be properly secured inside the socket before placing the crane into lifting service. It is the wedge that secures the wire rope inside the socket whereas the dead-end treatment is used to restrain the wedge from becoming dislodged from the socket should the rope suddenly become unloaded from the headache ball or hook block striking the ground, etc.

Sketches A through F (Figure 4-6) illustrate various methods for treating the dead-ends of wire ropes which exit a wedge socket assembly. While use of the loop-back method is acceptable, care must be exercised to avoid the loop becoming entangled with tree branches and other components during crane transport and with the anti-two block system and other components during use of the crane.

Of the methods shown below, Grove prefers that method A or F be used on Grove cranes, that is, clipping a short piece of wire rope to the dead-end or using a commercially available specialty wedge. Typically, it is recommended that the tail length of the dead-end should be a minimum of 6 rope diameters but not less than 15.2 cm (6 in) for standard 6 to 8 strand ropes and 20 rope diameters but not less than 15.2 cm (6 in) for rotation resistant wire ropes.

When using method A, place a wire rope clip around the dead end by clamping a short extra piece of rope to the rope dead end. **DO NOT CLAMP THE LIVE END.** The U-bolt should bear against the dead end. The saddle of the clip should bear against the short extra piece. Torque the U-bolts according to the figures listed in the chart titled Wire Rope Clip Torque Values (Table 4-1).

Other sources for information with which crane users should be familiar and follow is provided by the American Society of Mechanical Engineers, American National Standard, ASME B30.5, latest revised. ASME (formerly ANSI) B30.5 applies to cableways, cranes, derricks, hoists, hooks, jacks, and slings. It states, in section 5-1.7.3, "(c) Swagged, compressed, or wedge socket fittings shall be applied as recommended by the rope, crane or fitting manufacturer." Wire ropes are addressed in ASME B30.5, section 5-1.7.2, ROPES. It states, in pertinent part, "(a) The ropes shall be of a construction recommended by the rope or crane manufacturer, or person qualified for that service." Additional information is published by the Wire Rope Technical Board in the Wire Rope Users Manual, latest revised.

Table 4-1

WIRE ROPE CLIP TORQUE VALUES			
Clip Sizes		*Torque	
mm	Inches	Nm	Ft-Lbs
3.18	1/8	6	4.5
4.76	3/16	10	7.5
6.35	1/4	20	15
7.94	5/16	40	30
13.28	3/8	60	45
11.11	7/16	90	65
12.70	1/2	90	65
14.29	9/16	130	95
15.88	5/8	130	95
19.05	3/4	175	130
22.23	7/8	300	225
25.40	1	300	225
28.58	1-1/8	300	225
31.75	1-1/4	490	360
38.68	1-3/8	490	360
38.10	1-1/2	490	360

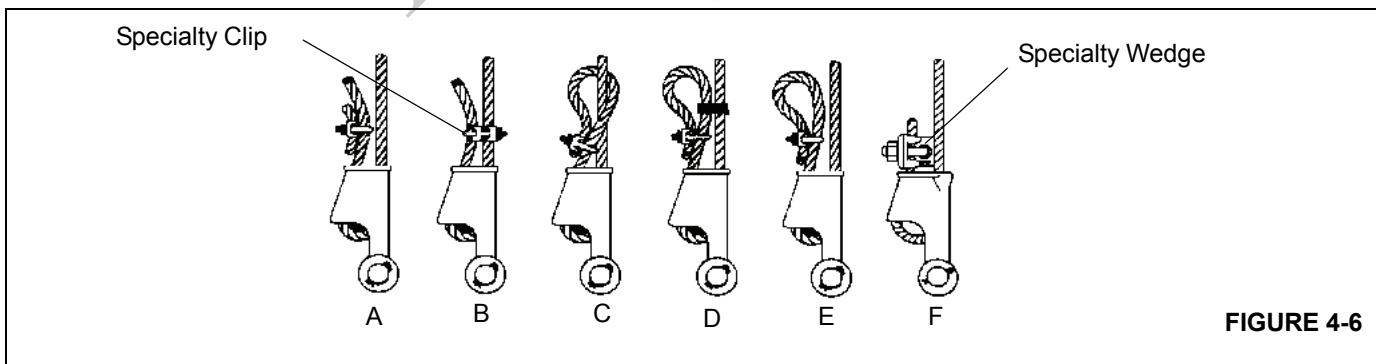
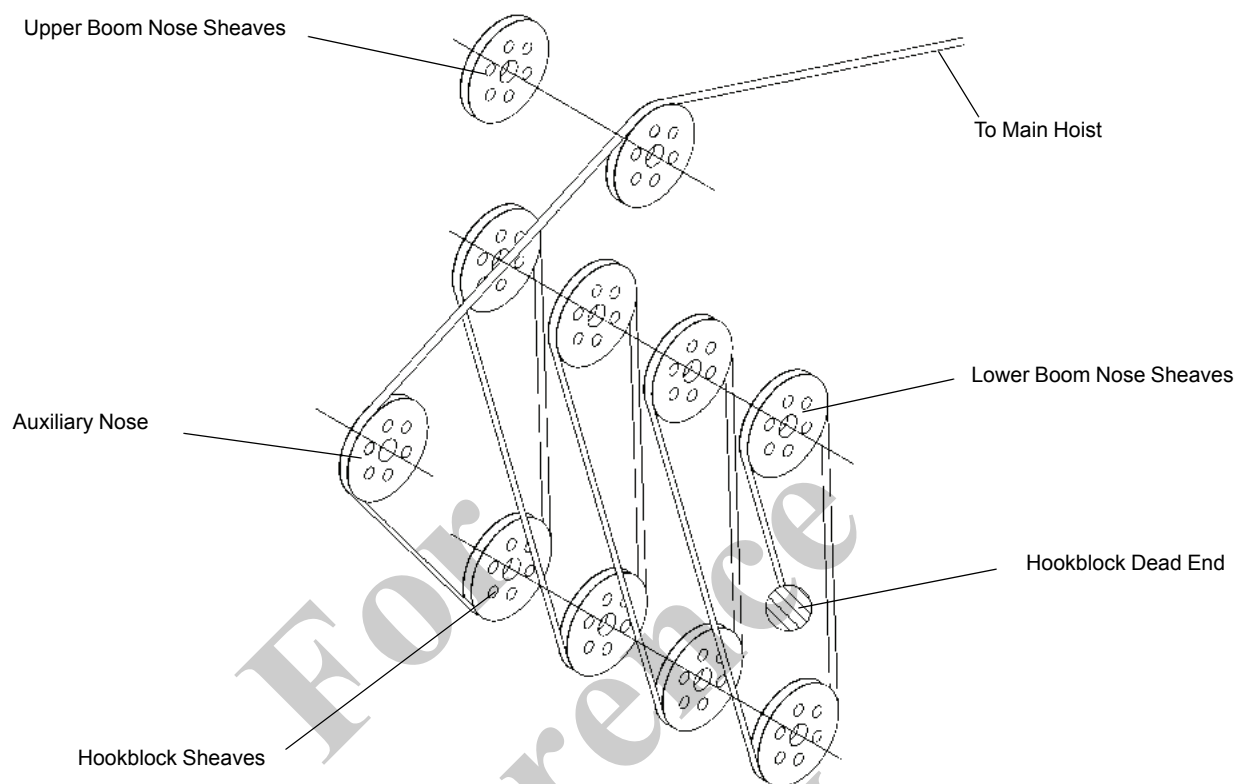
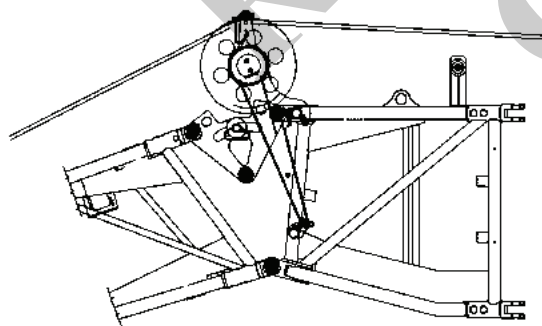


FIGURE 4-6



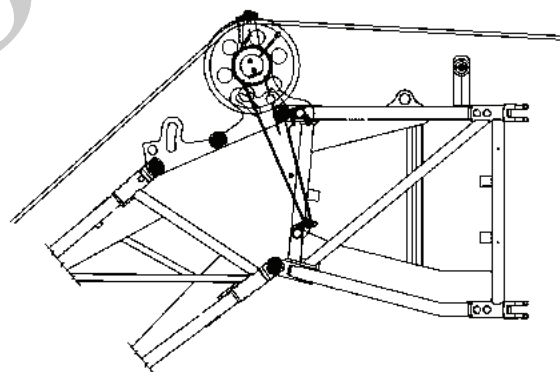
9 PARTS LINE

6453



6453-3

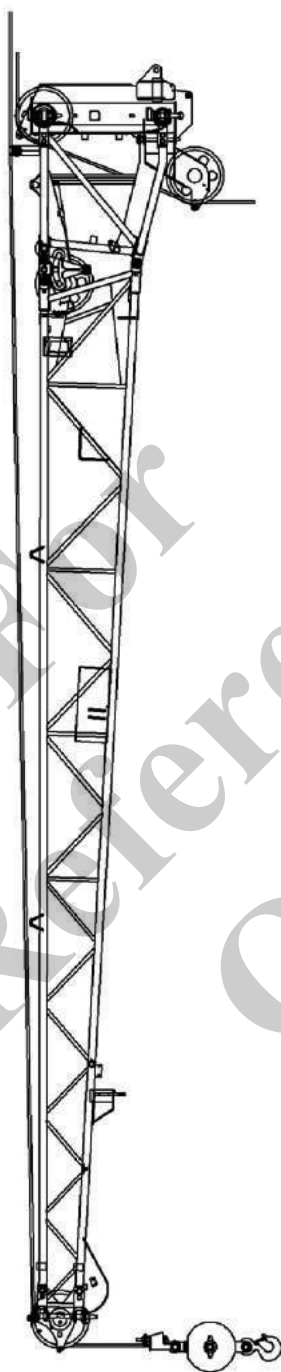
One Part Line Using Jib Shown at
20° Offset



One Part Line Using Jib Shown at
40° Offset

FIGURE 4-7

33 Ft (10 m) FIXED JIB SHOWN AT 0°
OFFSET



6453-1

56 Ft (17 m) BI-FOLD JIB SHOWN AT 0° OFFSET

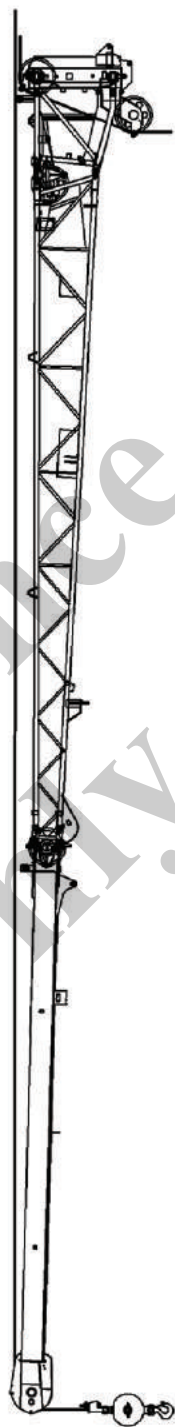
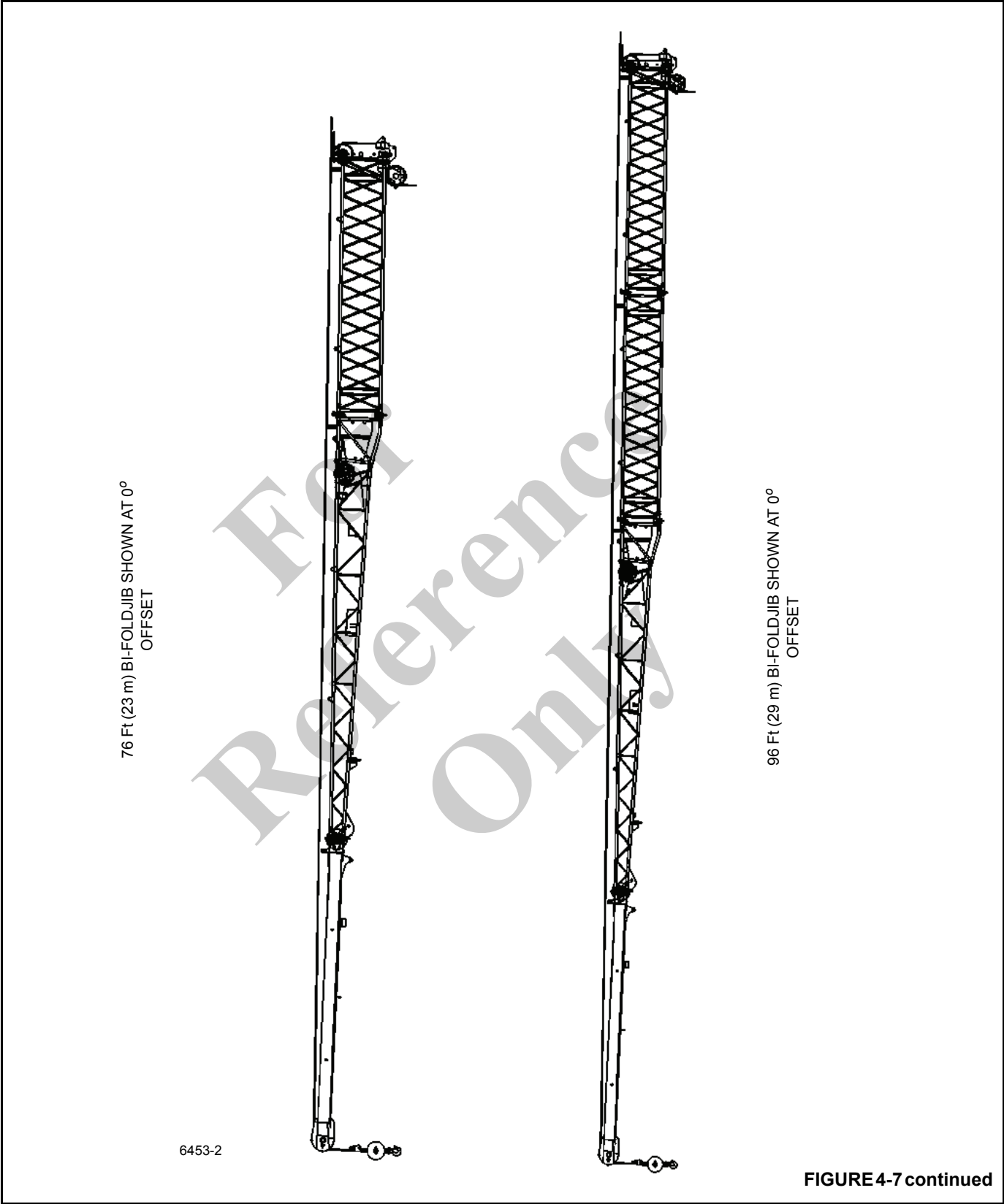


FIGURE4-7continued



REMOVABLE COUNTERWEIGHT



DANGER

Ensure that all mounting pins are properly installed and locked, during, and after operating the counterweight removal system.

- The 5443 kg (12,000 lb) removable counterweight consists of three slabs, each weighing 1814 kg (4000 lb).
- The 8165 kg (18,000 lb) removable counterweight consists of three slabs each weighing 1814 kg (4000 lb) and one slab weighing 2721 (6000 lb).
- An optional 10,885 kg (24,000 lb) removable counterweight consists of two 1,360 kg (3000 lb) "wing weights" that hang on the existing 8,165 kg (18,000 lb) counterweight stack.

NOTE: This extra counterweight is not roadable due to the overall width of the machine when installed, but you can move around the jobsite with the full counterweight installed.

The following procedures are applicable for removal and installation of any or all pieces Figure 4-9.

The counterweight contains lugs for attachment to the removal cylinders and lugs to pin it under the hoist mounting. The additional slabs pin the structure to each other. The counterweights can be pinned to the carrier deck and are transferred between the turntable and the carrier deck by two hydraulic removal cylinders. The cylinders are controlled from a valve assembly located under the hoist mounting. The valve contains an inlet section, an outlet section with relief valve, and a working section for each cylinder. The valve is electrically controlled by the switch panel on the right side of the turntable.

Mounting the Counterweight

1. Position the crane on a firm level surface. Fully extend and set the outriggers.
2. Rotate and align the rear of the superstructure above the removable counterweight stowed on the carrier deck. Engaging the pin type turntable lock will aid alignment.

NOTE: The crane function switch must be OFF before using the counterweight switch panel.

3. Using the counterweight switch panel (Figure 4-8), lower the counterweight cylinders by pushing on a power/enable button while pushing the appropriate cylinder lower button. Pin the cylinders to the counterweight

using the attach pins in the cylinders. Insert the retaining pins in the attach pins.

4. Push in, turn, and remove the long attach pins from the counterweight and carrier frame lugs.

5. Using the switch panel, raise the counterweight up under the superstructure frame.

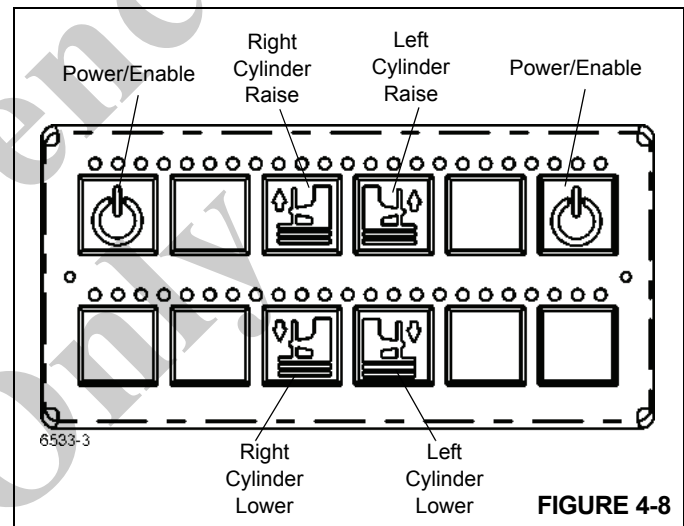
NOTE: It may be necessary to jog the counterweight switch(es) (Figure 4-9) to install the upper attach pins.

6. Remove the upper attach pins from the stowage bushings and install them into the upper counterweight and superstructure frame lugs.

7. Push in on the pins and turn to lock pin in the notch.

8. Insert the long pins into the bottom of the counterweight. Push in on the pins and turn to lock pin in the notch.

9. The crane is now ready for operation with the counterweight installed.



Stowing the Counterweight

1. Position the crane on a firm level surface. Fully extend and set the outriggers.
2. Rotate the superstructure to align the counterweight with the stowage area. Engaging the pin type turntable lock will aid alignment.

NOTE: It may be necessary to jog the counterweight using the switch(es) to remove the weight of the counterweight from the upper attach pins.

3. Using the counterweight switch panel, raise the counterweight cylinders to relieve weight on the upper attach pins. Push in, turn, and remove the upper attach pins from the superstructure frame lugs and the counterweight

4. Stow the upper attach pins in the bushings on the side of the superstructure.
5. Push in, turn, and remove the long pins from the bottom of the counterweight.
6. Using the switch panel, slowly lower the counterweight onto the carrier stowage area.
7. Insert the long pins through the carrier lugs and counterweight. Push in and turn to lock pin in the notch.
8. Remove the attach pins from the counterweight lugs and cylinder ends. Raise the cylinders and stow the attach pins in cylinder and insert retainer clip pins.
9. The carrier is now ready for highway travel with the counterweight stowed.

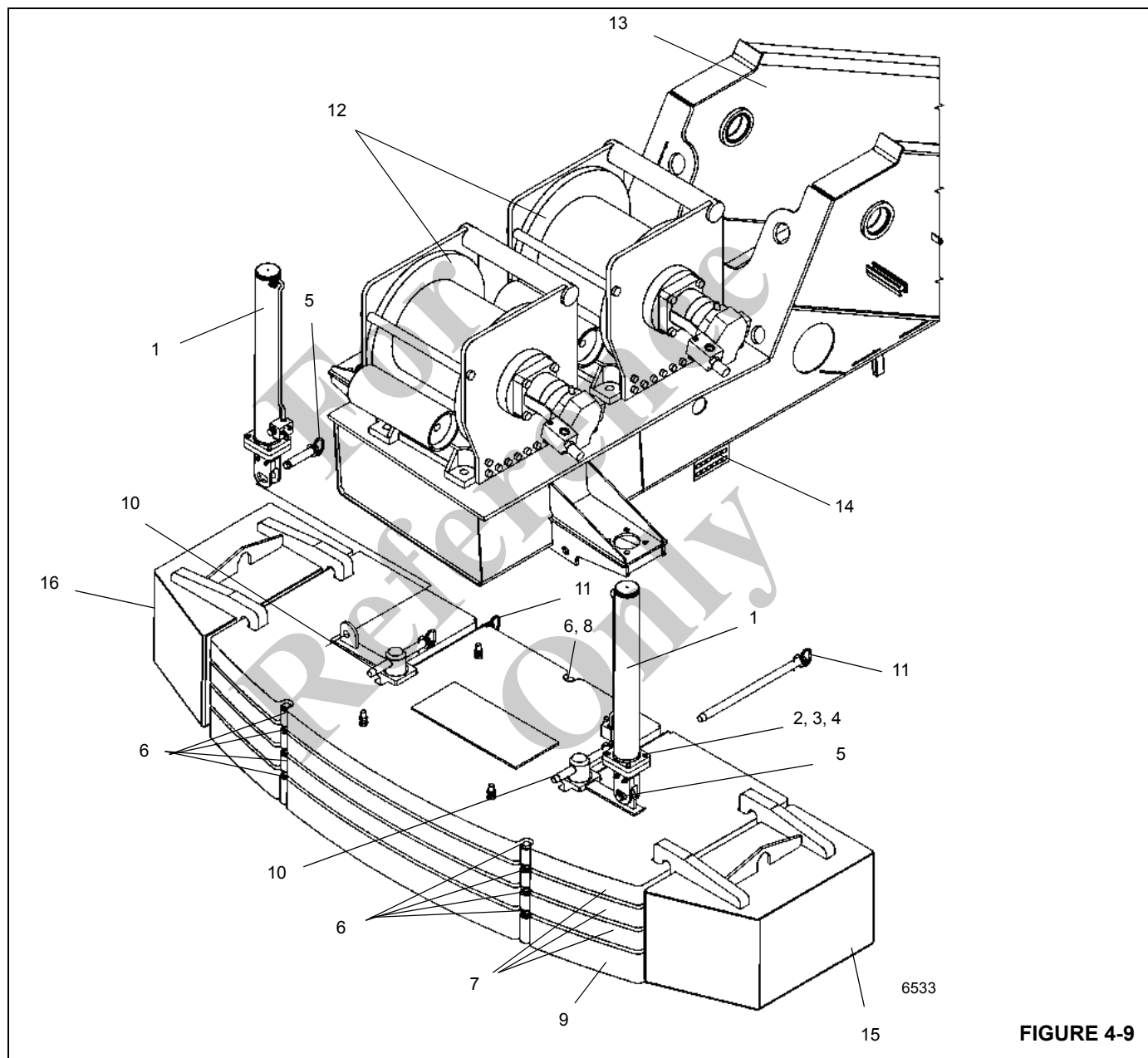


FIGURE 4-9

Item	Description
1	Counterweight Removal Cylinder
2	Spacer
3	Bolt
4	Washer
5	Cylinder Attach Pin Assembly
6	Capscrew
7	Counterweight Weldment
8	Nut
9	Counterweight Weldment (18,000# Only)
10	Box Attach Pin
11	Counterweight Weldment Attach Pin
12	Hoist
13	Turntable
14	Counterweight Switch Panel
15	Counterweight Weldment - LH (Optional)
16	Counterweight Weldment - RH (Optional)

INSTALLING THE BI-FOLD MANUAL JIB



WARNING

To prevent serious injury or death, always wear personal protective equipment; i.e., a hard hat, eye protection, gloves and metatarsal boots.

1. Before installing the jib make sure the crane is set up on outriggers using normal setup procedures. Refer to *Operating Controls and Procedures*, page 3-1.

NOTE: An auxiliary crane with sling is required to install the bi-fold jib.

2. Check the transport condition of the bi-fold extension.
3. Using an auxiliary crane, attach sling to the bi-fold extension.
4. Lift the bi-fold extension in front of the main boom with the auxiliary crane and lock the 10.1 m (33 ft) section to the right of the main boom head (Figure 4-10).

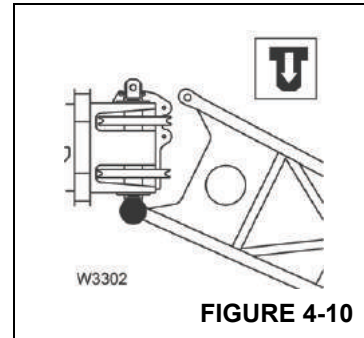


FIGURE 4-10

5. Pin the left side to the boom nose.
6. Establish electrical connection between the extension and the main boom.
7. For units equipped with hydraulic luffing jib, establish hydraulic connections between the extension and the main boom.

NOTE: You can also install the bi-fold swingaway jib in front of a 4.9 m (16 ft) section.

Checking the Transport Condition

For transportation you must establish certain connections between both parts of the lattice extension. The connections which need to be established depend on whether the lattice extension:

- is folded up at the side of the main boom for transportation or
- is completely removed for transportation.



WARNING

Be careful not to damage the lattice extension and the main boom. Always put the lattice extension into transport condition when folded at the side or working with the main boom. Only then is the lattice extension secured against slipping. This way you prevent the partly fastened lattice extension hitting the main boom or the individual components of the lattice extension hitting each other and becoming damaged.

You must check transport condition:

- After stowing the lattice extension, before you drive the crane with the lattice extension folded at the side or work with the main boom.
- Before installation and before erecting the lattice extension.

Transport Condition with Lattice Extension Folded at the Side

The transport condition with the lattice extension folded at the side is created when all of the following connections are established.

- Check the connections and establish them if necessary (Figure 4-11).

If 7 m (23 ft) Section and 10.1 m (33 ft) Section are Folded at the Side:

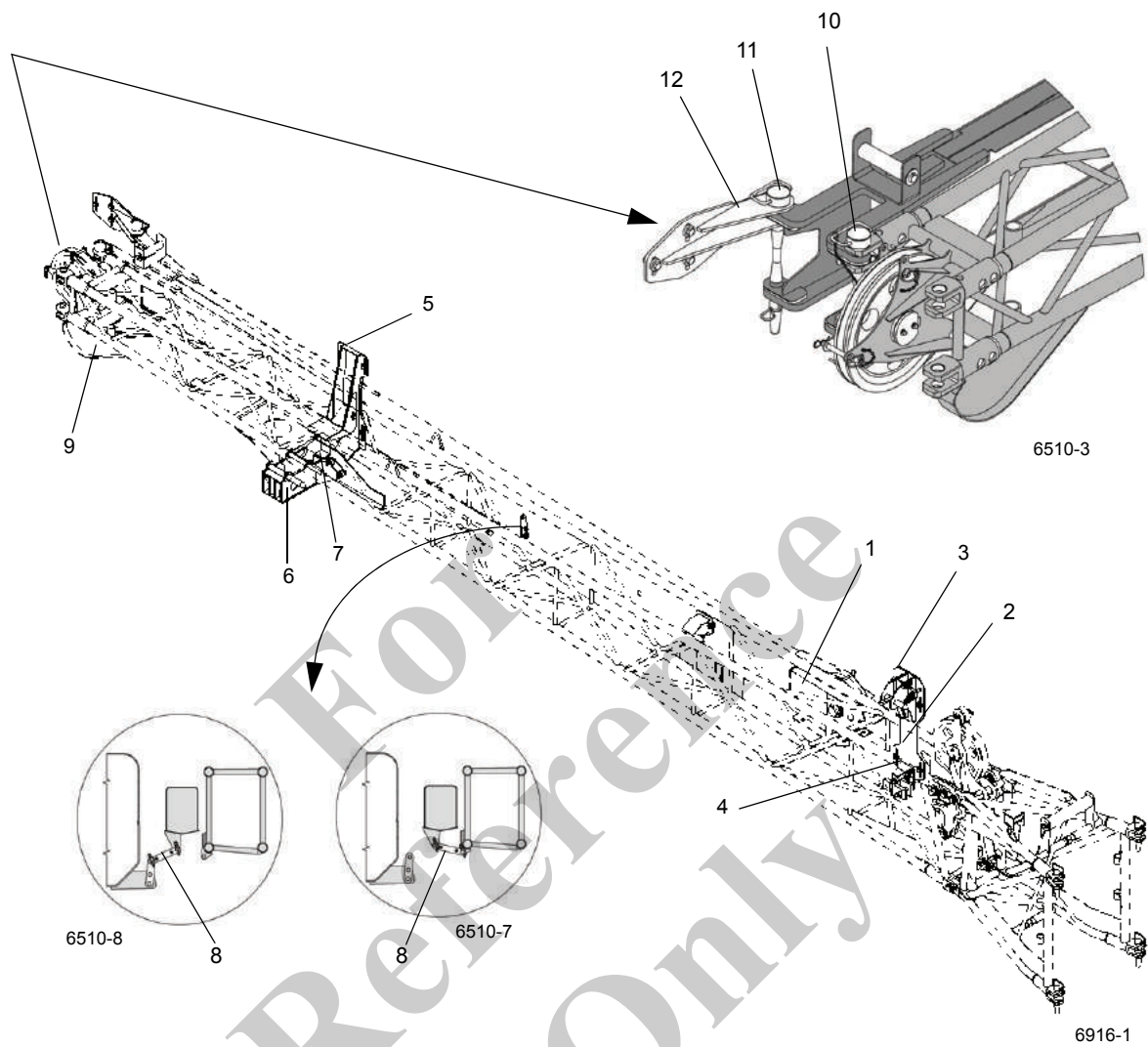
- The 10.1 m (33 ft) section is locked at the front mount (2) on the main boom (Figure 4-11).
- The pins (4) are inserted on the pivot point between the 7 m (23 ft) section and the 10.1 m (33 ft) section (Figure 4-11).

- The connection (8) in the middle area is between the 7 m (23 ft) section/10.1 m (33 ft) section (Figure 4-11).
- The connection (8) between 7 m (23 ft) section and main boom in the rear area is established (Figure 4-11).

If the 7 m (23 ft) Section Only is Folded at the Side:

- The connection (8) in the middle area is between the 7 m (23 ft) section and the main boom (Figure 4-11).
- The connection (5) between the 7 m (23 ft) section and the main boom in the rear area is established.

For
Reference
Only



Item	Description
1	Stinger
2	Front Mount
3	Upper Hangar
4	Lower Support
5	Rear Hangar
6	Carrier

Item	Description
7	Bumper Pad
8	Holding Plate
9	Jib
10	Pin
11	Pin
12	Bracket

FIGURE 4-11

JIB ERECTING AND STOWING PROCEDURE

General Warnings



WARNING

To prevent serious injury or death, always wear personal protective equipment; that is, a hard hat, eye protection, gloves and metatarsal boots.

Boom angles are used to control speed at which extensions swing during erecting and stowage. Improper boom angles will cause uncontrollable swing speeds of the extension.

NOTE: Tag line used in these procedures is to control the movement of the jib.

Preparing the Crane for Jib Erection Procedure

Requirements for Jib Erection

Before you erect a lattice extension or the jib, the following requirements must be met:

- The swingaway lattice extension is mounted on the side of the main boom and is in transport condition.
- The crane is supported by the outriggers according to the *lifting capacity chart* for the planned operation with the lattice extension and is aligned horizontally.
- The main boom is completely retracted and has been lowered into horizontal position.
- If the crane is equipped with two hoists with additional equipment, the hook block is unreeved on the hoist which is not used for working with the lattice extension.

Requirements for Stowing the Jib

Before you lower a lattice extension or the jib into a horizontal position, the following requirements must be met:

- No other load is raised apart from the hook block.
- The counterweight required according to the *lifting capacity chart* for the planned operation with the lattice extension is rigged.

- The crane is supported with the outriggers prescribed for operation with the erected lattice extension according to the *lifting capacity chart*.
- The main boom is fully retracted.

Securing Lattice Extension with Tag Line (Rope)



WARNING

Always secure the lattice extension with a tag line (rope) on the main boom before removing any connections. This will prevent the lattice extension from slipping off the run-up rail, swinging around and knocking you off the carrier or injuring other persons in the swing range.

The lattice extension may swing out on its own accord when the jib is removed from its stowage brackets.

You must therefore secure the lattice extension before you begin with the erection procedure.

Secure the lattice extension as follows:

- Attach a tag line (rope) at the front of the lattice extension.
- Guide the tag line (rope) underneath the lattice extension, via the holding rod on the main boom and back again.
- Secure the other end of the tag line (rope) on the crane (for example, on the steps of the access ladder to the carrier or to the hole in the superstructure). Leave enough play in the tag line (rope) that it is tight only when you swing the lattice extension towards the main boom head later on. Refer to ERECTION AND STOWING PROCEDURE.

Erecting Procedure

10.1 m (33 ft) Jib



DANGER

To prevent serious injury or death, do not stand on decking until extensions are secure.

1. Visually check to ensure all pins are installed.

2. Crane should be set up on outriggers using normal setup procedures (Figure 4-12). Refer to *Operating Controls and Procedures*, page 3-1.



FIGURE 4-12

- a. Fully retract boom.
- b. Lower boom to horizontal for erecting over the front of the crane.

NOTE: Tag line is used to control movement of the jib during erecting procedure.

3. Attach tag line (1, Figure 4-13) to tip of extension and to the superstructure.

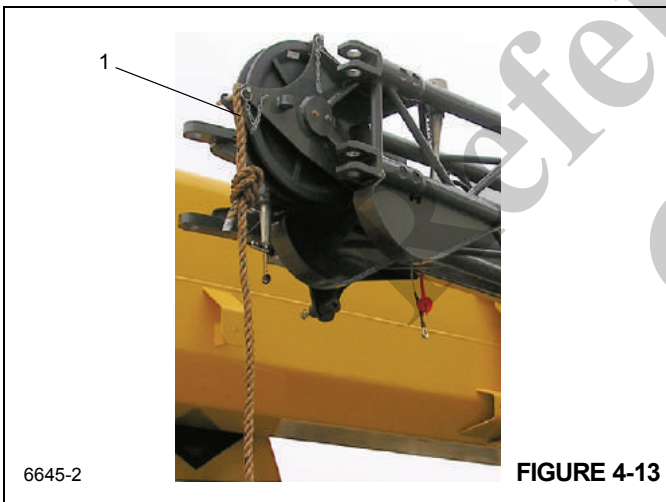


FIGURE 4-13

NOTE: If erecting the 10.1 m (33 ft) section without the 7 m (23 ft) section, perform steps 4 and 5, otherwise proceed to step 6.

4. If not using the bi-fold 7m (23 ft) section, remove pin (1, Figure 4-14, photo 6642-8) from the locking bar (2). Move locking bar (2, photo 6642-9) to the base section attachment bar (1) and install pin (3). Secure with retaining pin.

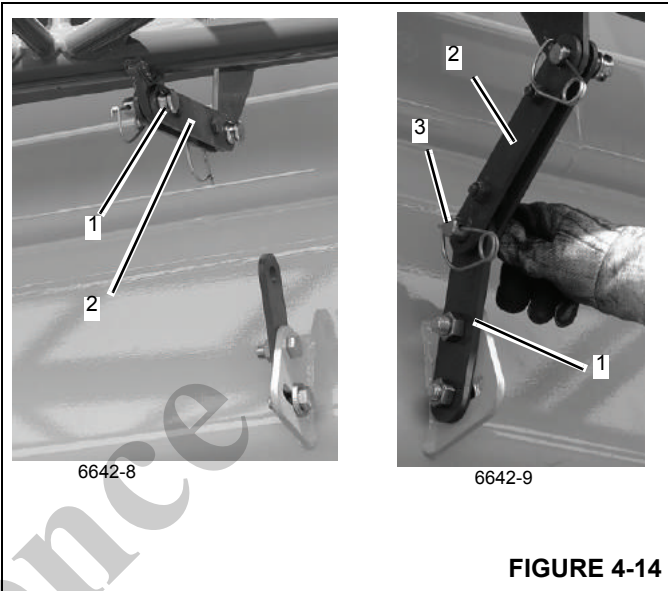


FIGURE 4-14

5. If not using the bi-fold 7m (23 ft) section, remove the retainer clip and bi-fold stowage pin (1, Figure 4-15) at the base section connection. Stow pin on bi-fold. Leave the pin (2) attaching the 7m (23 ft) section to the base section to retain the 7m (23 ft) section.

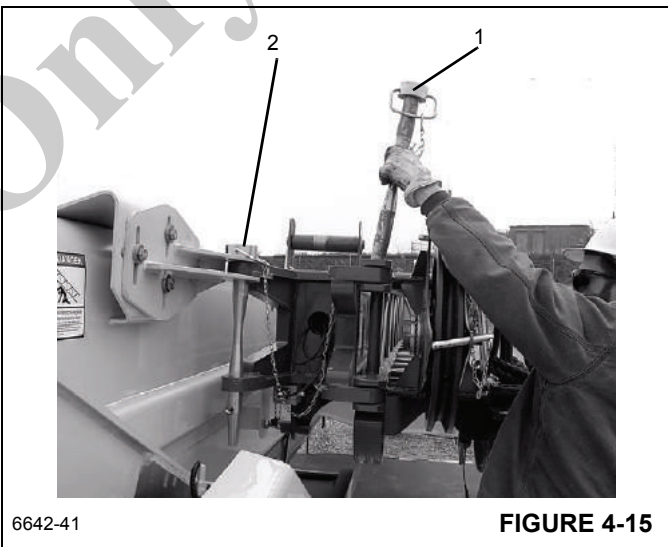
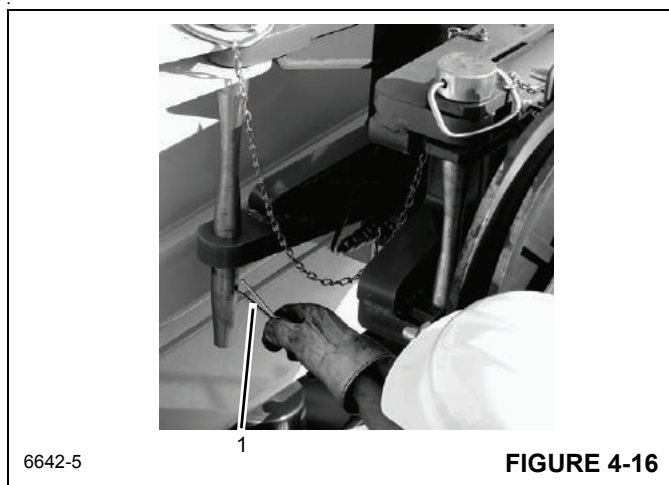


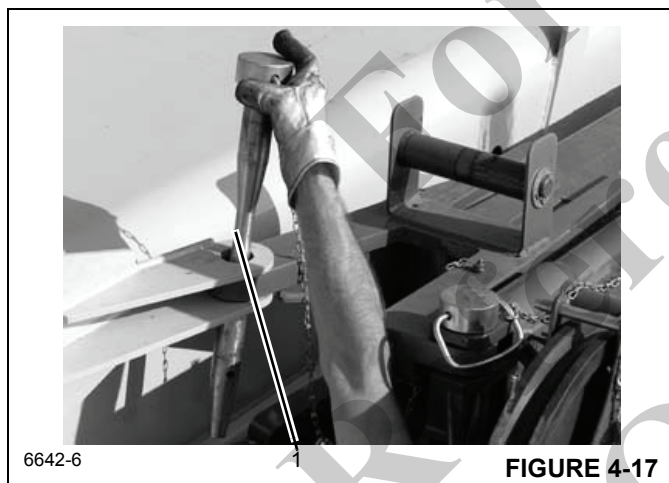
FIGURE 4-15

NOTE: Steps 6, 7 and 8 apply when erecting the 7m (23 ft) section together with the 10.1 m (33 ft) section. If not using the bi-fold 7m (23 ft) section, proceed to step 11.

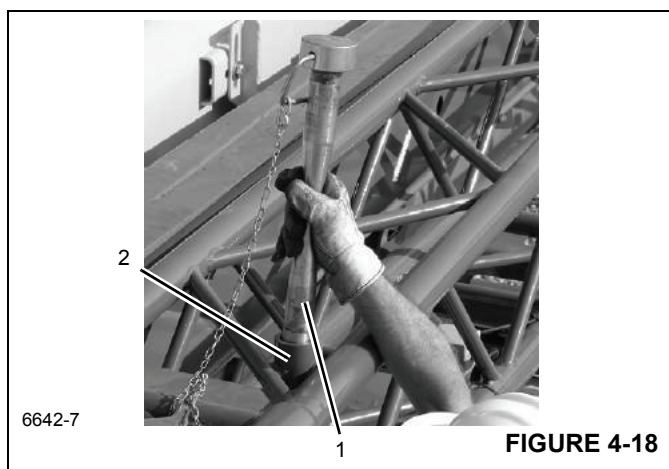
6. Remove retainer clip (1, Figure 4-16) from the pin attaching the 7m (23 ft) section to the base section.



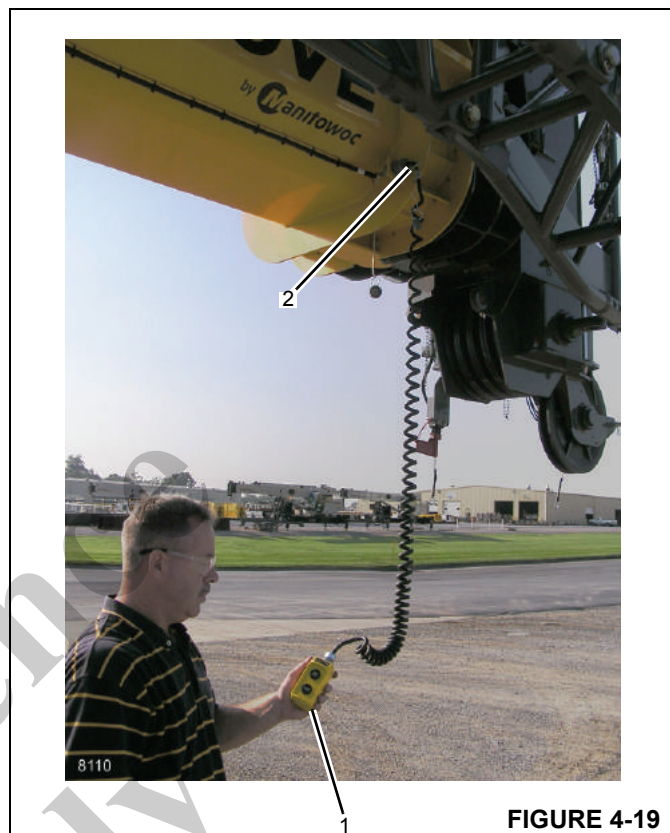
7. Remove the stowage pin (1, Figure 4-17).



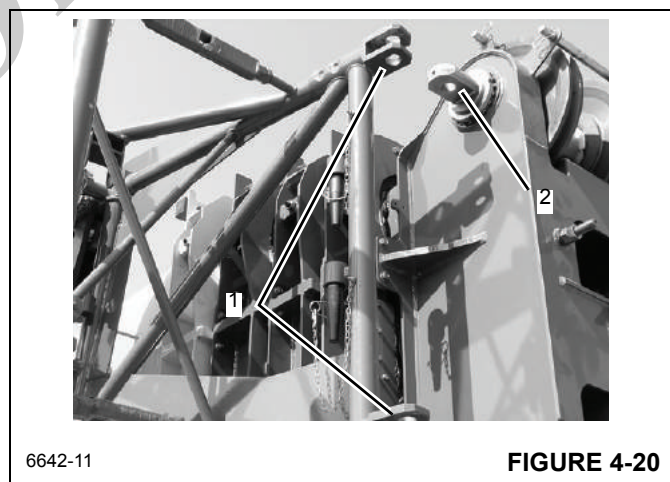
8. Stow the pin (1, Figure 4-18) in pin holder (2) provided on the swingaway extension.



9. Remove the jib stowage controller (1, Figure 4-19) from behind the seat in the superstructure cab and connect it to the electrical plug (2) near the boom nose.



10. Use the controller to pivot the jib so that lugs (1, Figure 4-20) on jib align with the holes in the lugs (2) on the boom nose.



11. Remove pins (1, Figure 4-21) stowed in extension and install in holes (right side of boom nose) and secure with retainer clips (2).

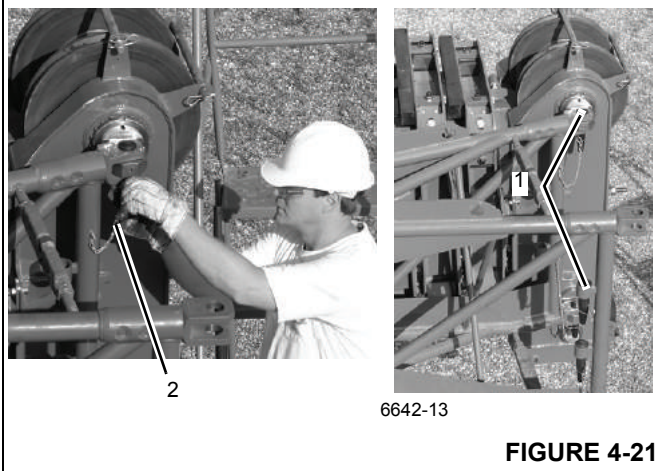


FIGURE 4-21

12. Remove the clip pin (1, Figure 4-22) from the stowage pin (2) at the front mount. Unpin the stowage pin (2) and store in holder (3).

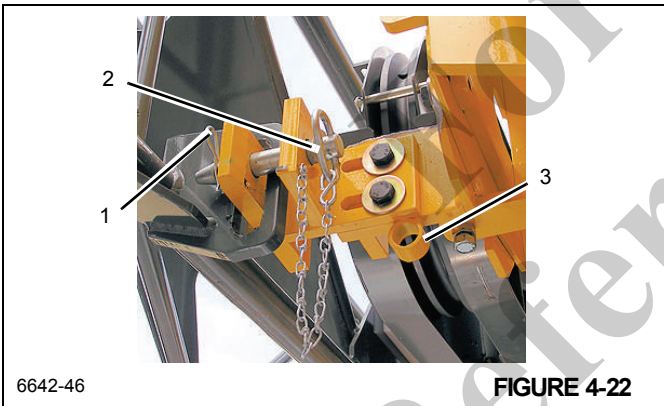


FIGURE 4-22

13. Extend the boom approximately 60.9 cm (2 feet) to move extension (1, Figure 4-23) off of the ramp (2).

NOTE: If the boom is not extended or extended more than approximately 60.9 cm (2 ft) the stinger will hit the jib hanger.

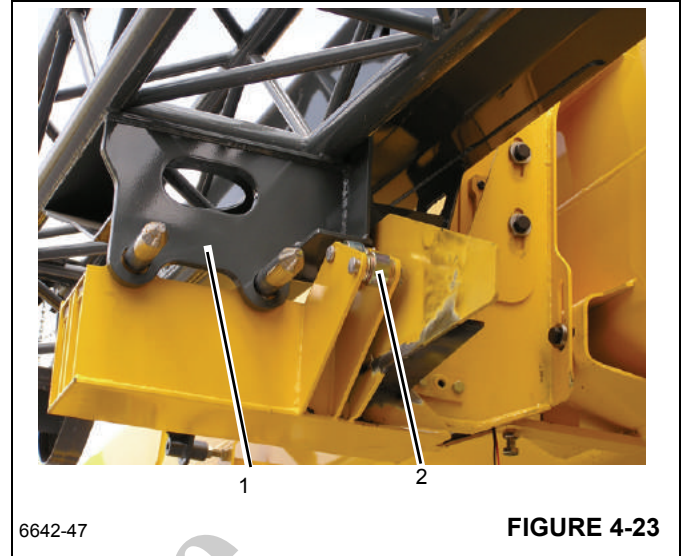


FIGURE 4-23

14. Remove tag line from superstructure.

NOTE: Tag line is used to control movement of the jib during erecting procedure.

**WARNING**

To prevent serious injury or death, do not stand on the crane deck to pull extension off ramp.

NOTE: If erecting the 7 m (23 ft) section with the 10.1 m (33 ft) section, perform steps 18 and 19. If erecting the 10.1 m (33 ft) section without the 7 m (23 ft) section, proceed to step 17.

15. Using the tag line (rope), pull the extension away from the boom (Figure 4-24).

16. While maintaining control of the extension with the tag line, swing extension into position on boom nose (Figure 4-24).

7m (23 ft) section with the
10.1 m (33 ft) section

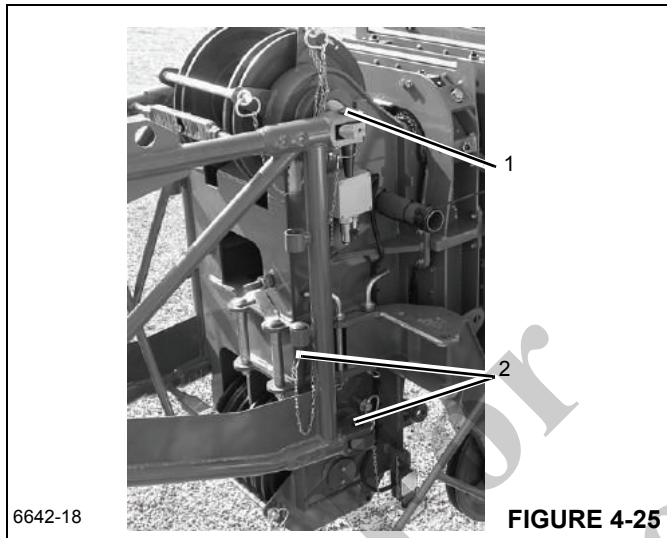


6645-3

FIGURE 4-24

NOTE: Step 17 is with the 7m (23 ft) section stowed on boom.

17. While maintaining control with the tag line, swing extension into position on boom nose. The 7m (23 ft) section will remain on the boom.
18. Remove pins from holders and install pins (1, Figure 4-25) on left side of boom nose and secure with retainer clips. Lower pin (2) is shown in pin holder, remove from holder and install on boom nose.

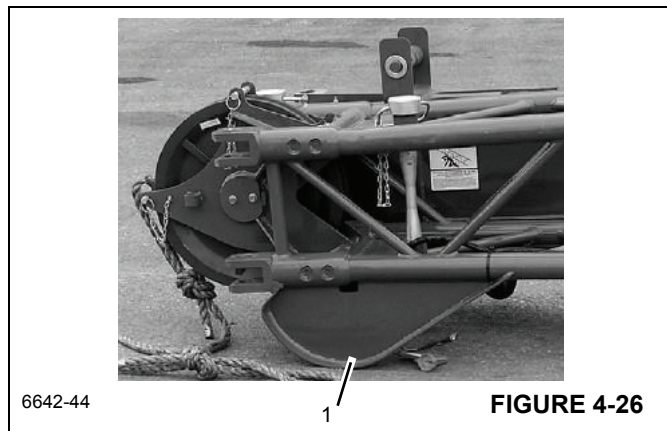


Relieving the Load on Bearing Points

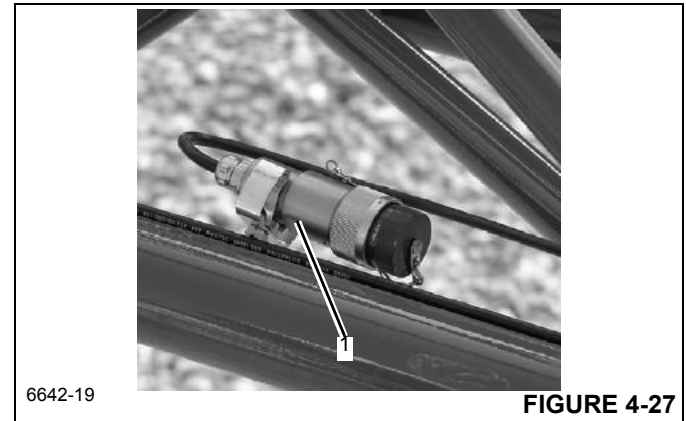
NOTE: The weight of the lattice extension can cause the bearing points on the left side to be misaligned or the pins to bind which makes it impossible to knock them out.

When establishing or disconnecting the connections, proceed as follows:

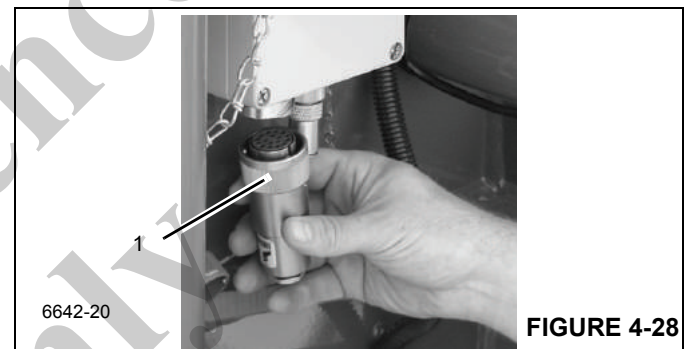
- Lower the lattice extension until it is on the ground (Figure 4-26, 1). If necessary, override the lifting limit switch.
- Continue to lower carefully until the connecting points align or until the load has been removed from the pins.



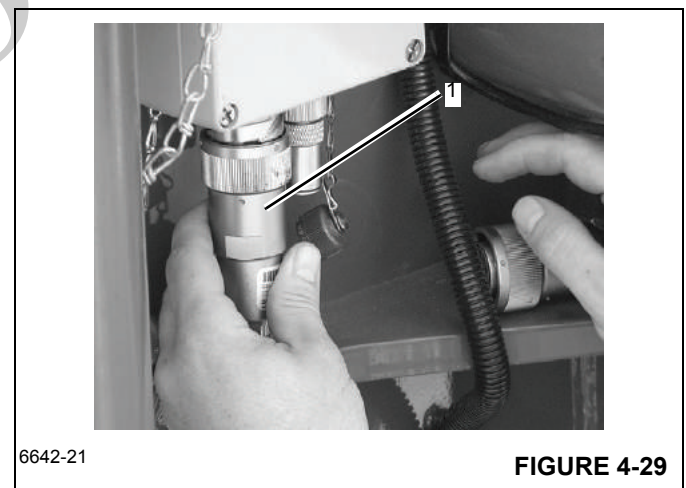
1. Connect RCL cables:
 - a. Remove RCL cable end connector (1, Figure 4-27) from extension and route through jib.



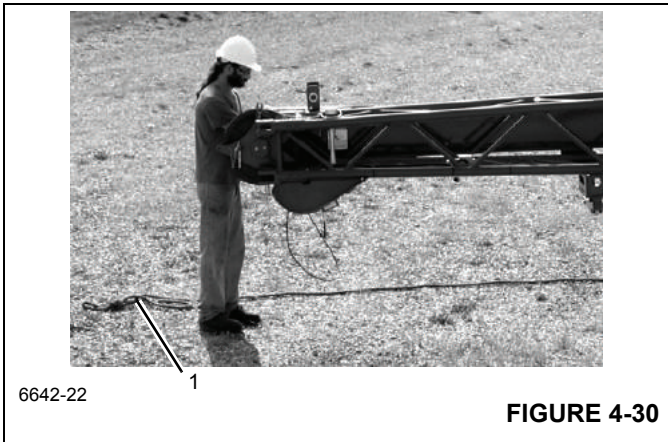
- b. Remove dummy plug (1, Figure 4-28) from junction box on boom nose.



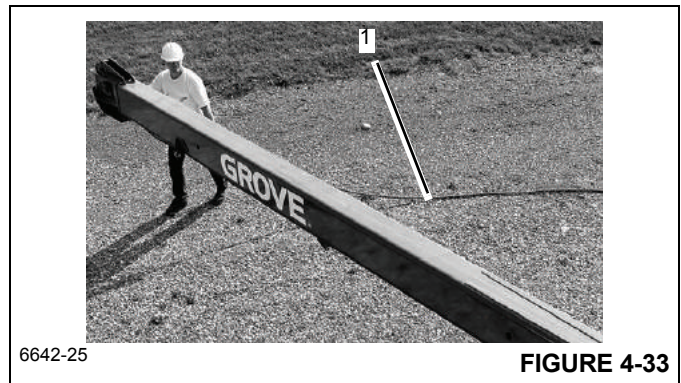
- c. Install cable end connector (1, Figure 4-29) from jib where dummy plug was removed.



2. Lower boom and remove tag line (1, Figure 4-30) from the tip of the extension. Figure 4-30 shows the 7 m (23 ft) and 10.1 m (33 ft) section together.

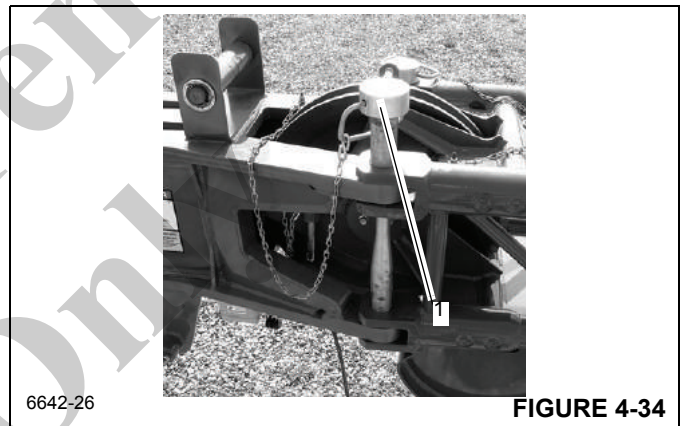
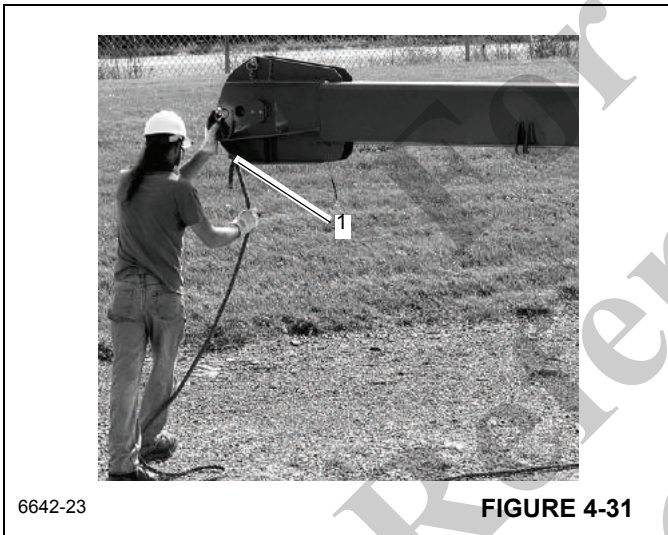


4. Using the tag line (1, Figure 4-33) to maintain control of the bi-fold (stinger), swing stinger into erected position.

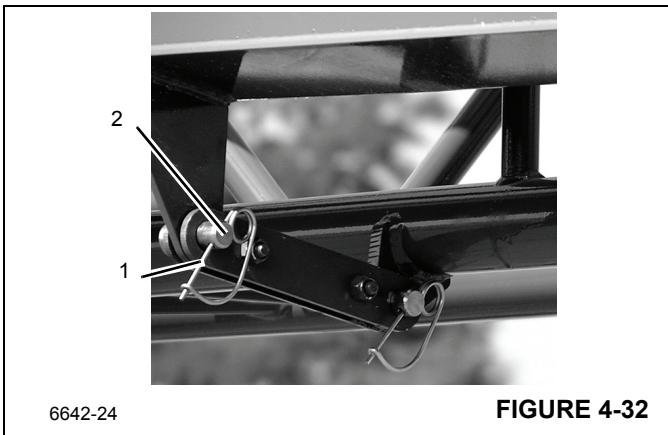


NOTE: Do not lower boom until stinger has been completely swung in front of the 10.1 m (33 ft) section.

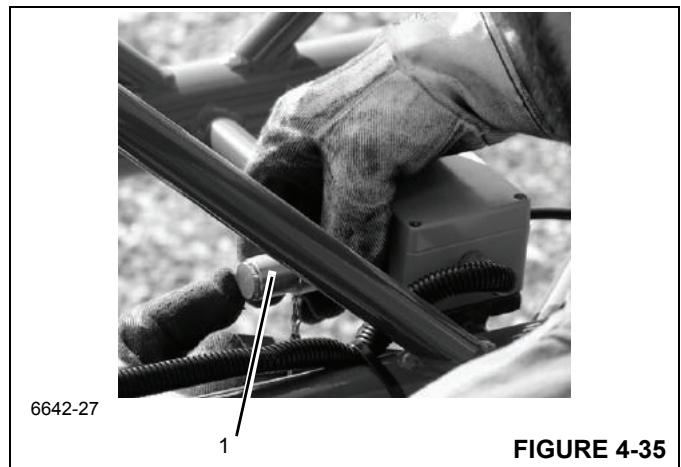
5. Lower the boom.
6. Remove pin (1, Figure 4-34) from swingaway. Install pin in stinger and retain with clip pin.



2. Raise boom slightly above horizontal.
3. Remove retainer clip (1, Figure 4-32) and remove bi-fold stowage pin (2).



7. Connect RCL connector (1, Figure 4-35) to RCL connection box. The cable is stowed in the 7m (23 ft) section.



8. Remove tag line before operating crane.

NOTE: Reeve the hoist cable as described under rigging and unrigging procedure in this section.

Stowing Procedure

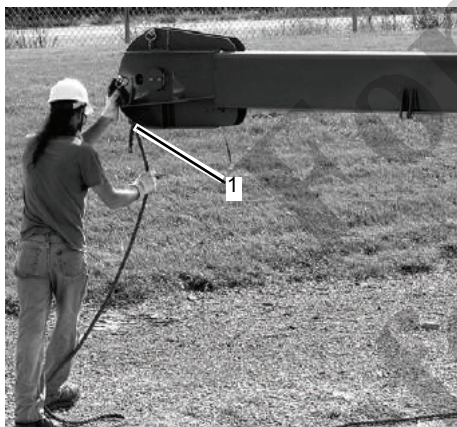
17.1 m (56 ft) Jib



WARNING

To prevent serious injury or death, do not stand on decking until extensions are secure.

1. Lower boom below horizontal.
2. Attach tag line to stinger nose Figure 4-36.



6642-23

FIGURE 4-36

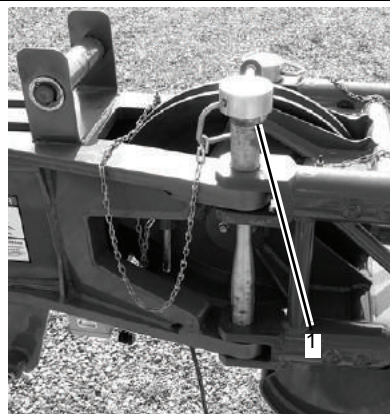
3. Disconnect RCL connection (1, Figure 4-37). Stow the cable in the 23 ft (7 m) section.



6642-28

FIGURE 4-37

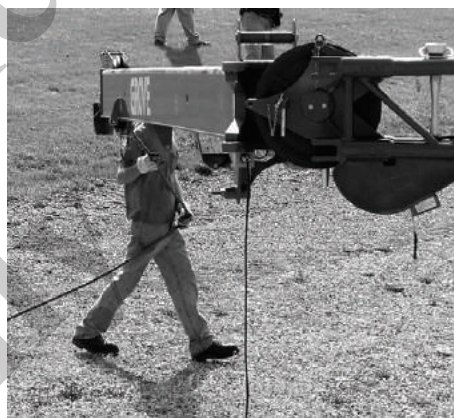
4. Remove retainer clip and remove the left side stinger retaining pin (1, Figure 4-38). Place pin in holder.



6642-26

FIGURE 4-38

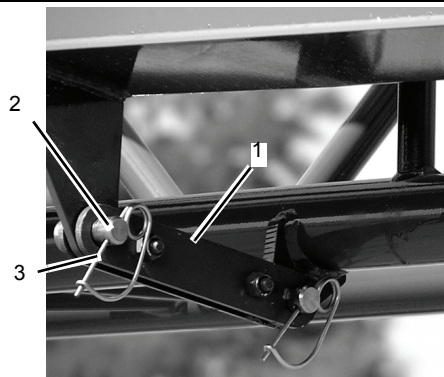
5. Raise boom to slightly above horizontal.
6. Using tag line to control movement of stinger, swing stinger into stowed position Figure 4-39.



6642-29

FIGURE 4-39

7. Raise boom slightly above horizontal.
8. Connect stowage link (1, Figure 4-40) to stinger using pin (2) and retainer clip (3).



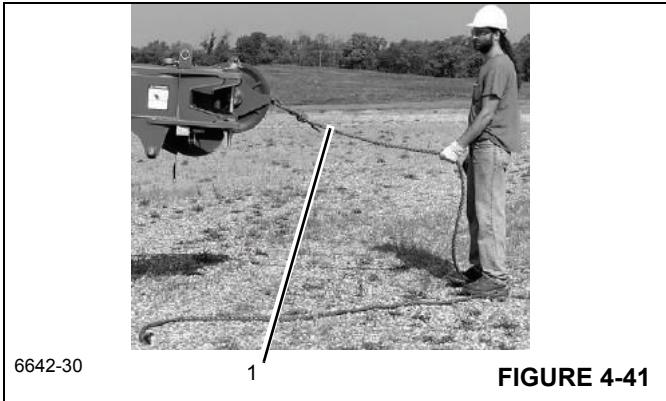
6642-24

FIGURE 4-40

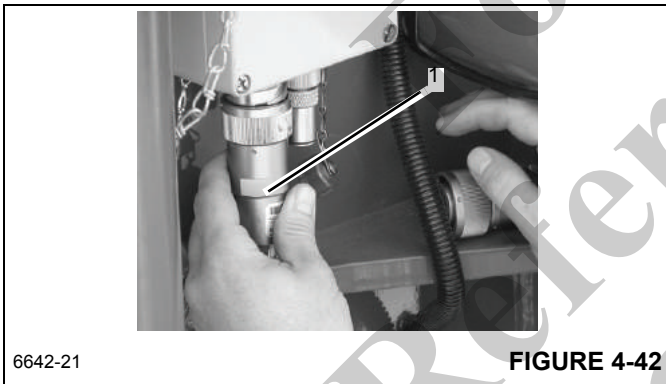
9. Remove tag line from stinger.

10.1 m (33 ft) Jib

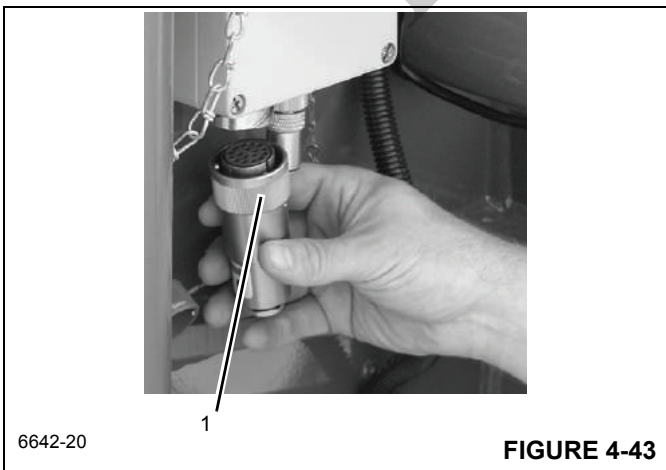
1. Lower boom and secure tag line (1, Figure 4-41) to tip of jib. Figure 4-41 shows the 7 m (23 ft) and 10.1 m (33 ft) extension together.



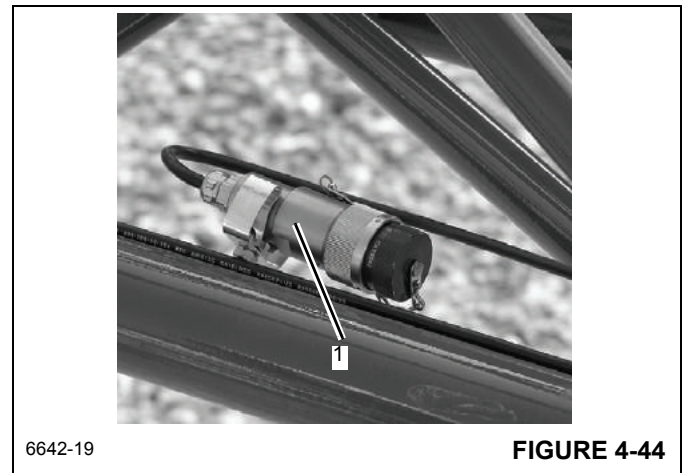
2. Disconnect RCL Cable.
 - a. Remove connector (1, Figure 4-42) from junction box on boom nose.



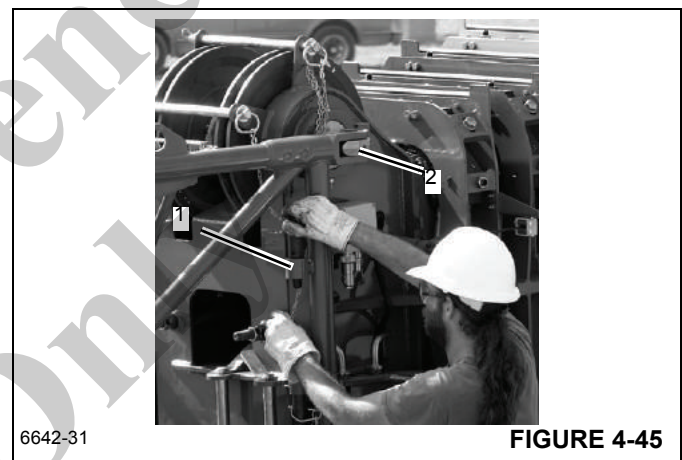
- b. Install dummy plug (1, Figure 4-43) on junction box.



- c. Route cable through jib and stow connector (1, Figure 4-44).



3. Remove two pins attaching the jib to the left side of boom nose (2, Figure 4-45). Stow the pins in the jib pin holders (1) and install the retainer clips.



4. Completely retract boom.
5. Extend boom approximately 60.9 cm (2 feet).
6. Raise boom above horizontal.

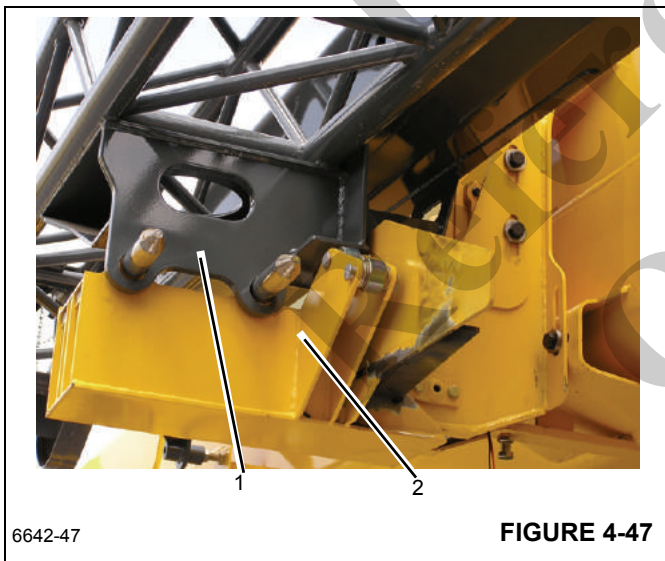
NOTE: Step 7 is stowing with the 7 m (23 ft) section and 10.1 m (33 ft) section together. If the 7 m (23 ft) section remained on the boom, proceed to step 9.

7. Use the tag line to maintain control of the jib, and swing the extension into the stowed position Figure 4-46.



NOTE: Step 8 is with the 7 m (23 ft) section stowed on boom. If stowing the 7 m (23 ft) section and 10.1 m (33 ft) section together, proceed to step 10.

8. Use the tag line to maintain control of the jib (Figure 4-46), and swing the extension into stowed position until tag line can be attached to superstructure.
9. Raise the boom to ensure wear pad rests against bumper plate on ramp (Figure 4-47).
10. Completely retract boom so that the jib (1, Figure 4-47) stows on the ramp (2) and front stowage brackets.



11. Lower the boom.

DANGER

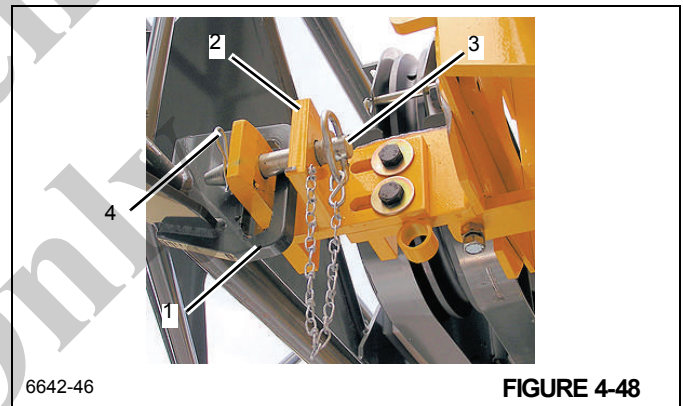
If the 10.1 m (33 ft) lattice extension (1, Figure 4-47) does not engage the ramp (2, Figure 4-47) correctly or does not align with the front stowage bracket (2, Figure 4-48) correctly, **STOP**. DO NOT continue to stow the jibs until they are properly secured at these two points.

DO NOT climb onto decking or walk under jibs.

Severe injury or death may occur if the front stowage bracket and ramp are not properly attached to the jibs; the jibs may fall or swing away from the main boom stowage brackets.

Contact Manitowoc Crane Care for correct adjustments if unable to align the lattice extension with the stowage brackets.

12. Remove the stowage pin from the holder at the front mount. Secure the lattice extension (1, Figure 4-48) to boom front stowage bracket (2) using stowage pin (3) and clip pin (4).



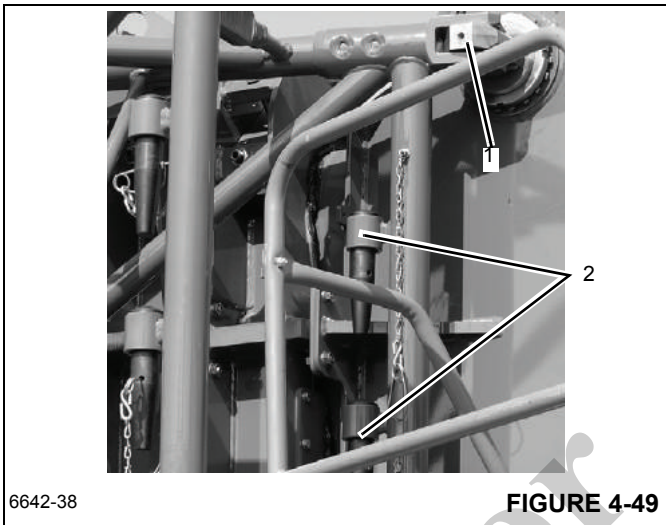
DANGER

Never remove the stowage pins from the right side boom nose lugs (1, Figure 4-49) until the 10.1 m (33 ft) lattice extension has been properly secured to the stowage ramp (2, Figure 4-47) and front stowage bracket (2, Figure 4-48).

Severe injury or death may occur, jibs will fall from the main boom if not secured properly.

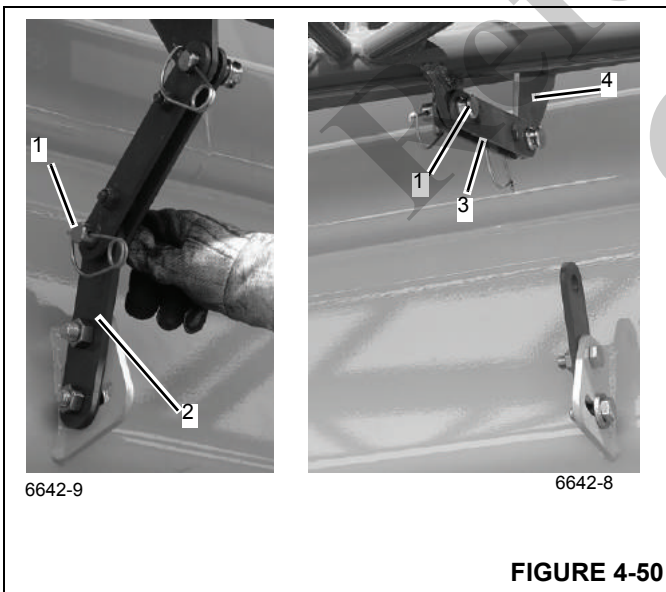
13. Remove pins from right side boom nose lugs (1, Figure 4-49). Stow the pins in pin holders (2) on jib and install retainer clips.
 - a. If the 7 m (23 ft) section was left stowed, use controller to pivot jib in towards boom so that the lugs on 10.1 m (33 ft) section align with 7 m (23 ft) section.

- b. If using both the 10.1 m (33 feet) and 7 m (23 ft) sections, use the controller to pivot jib towards boom such that the lugs on the 7 m (23 ft) section align with rear stowage bracket.

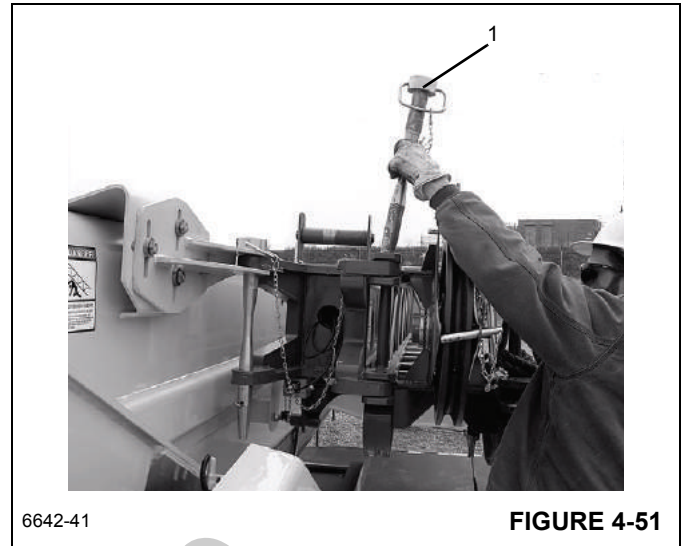


NOTE: Perform steps 14 and 15 if stowing the 10.1 m (33 ft) section when the 7 m (23 ft) section remained on the boom, otherwise proceed to step 19.

14. If the bi-fold 7m (23 ft) section was not used, remove pin (1, Figure 4-50, photo 6642-9) from the base section locking bar (2). Move locking bar (3, Figure 4-50, photo 6642-8) to the 7 m (23 ft) section (4) and install pin (1). Secure with retaining pin.

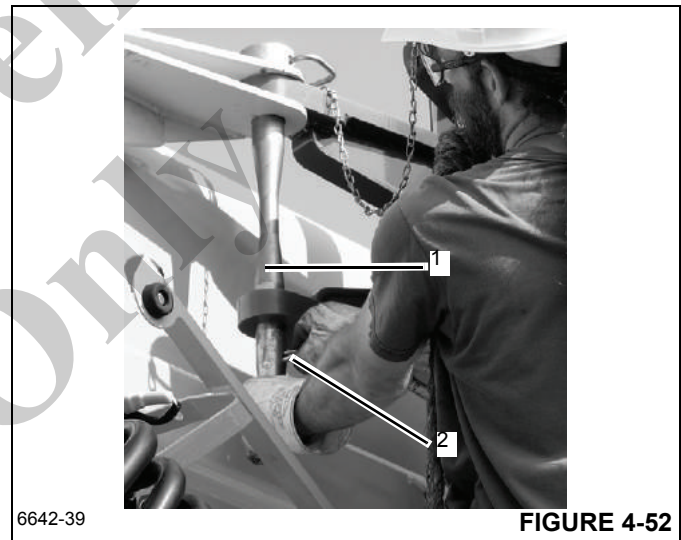


15. If the bi-fold 7m (23 ft) section was not used, remove bi-fold stowage pin (1, Figure 4-51) from bi-fold and install at the lattice/bi-fold connection. Install retainer clip to pin.



NOTE: Step 16 applies when the 7m (23 ft) section was erected with the 10.1 m (33 ft) section.

16. Install rear stowage pin (1, Figure 4-52) and retainer clip (2).



17. Lower boom.

18. Remove tag line.

Reeve the hoist cable as described in this section

Raising and Lowering the Hydraulic Jib

NOTE: For more information on operation of the jib switches, refer to *Operating Controls and Procedures*, page 3-1.

When Erecting

To remotely raise or lower the lattice extension when erecting there are two control units each with two push buttons on the 10.1 m (33 ft) section.

- Press the top push-button to raise the lattice extension (1).
- Press the bottom push-button to lower the lattice extension (2).

During Operation

During operation the lattice extension is raised or lowered from the crane cab. The lattice extension can be raised or lowered, only when the power for the lattice extension is switched on.

When the power is switched on:

- The indicator lamp in the on/off rocker switch on the lattice extension lights up brightly.
- Activation of the power is shown on the RCL display.
- If necessary, switch on the power of the lattice extension, by pressing the lattice extension on/off rocker switch.

To **raise**, press the switch to the rear.

To **lower**, press the switch to the front.

Transportation on a Separate Vehicle



DANGER

Risk of accidents from a falling lattice extension.

Only attach the lattice extension in such a way that it is positioned in the center of gravity and always use lifting gear with sufficient lifting capacity. This prevents the lattice extension from falling and injuring people while loading.

- Check if all the required connections for transport condition are established.
- For transportation, place the lattice extension on the skid at the front and onto the lower cross strut at the rear of the 10.1 m (33 ft) section.
- Always secure the lattice extension on the separate vehicle with belts to prevent slipping and overturning.

CAUTION

Risk of damaging the lattice extension.

Always secure the lattice extension by tying it down with suitable belts when it is transported on the separate vehicle. This prevents the two-stage swingaway lattice extension tipping and becoming damaged during transportation.

Lifting Limit Switch on the Lattice Extension

The functions raise hoist, extend main boom and lower main boom are monitored during operation with the lattice extension by the lifting switch on the lattice extension and are switched off when the lifting limit switch is actuated.

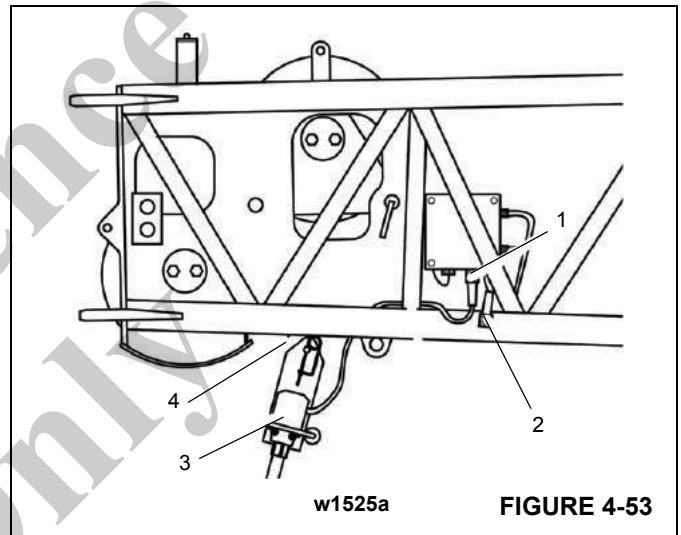
NOTE: The same lifting limit switch is used for lattice extension and main boom.

Overriding Connection on Main Boom

For operation with the lattice extension you must remove the lifting limit switch on the main boom and override the connection.

- Insert the short-circuit plug (2) in the socket (1) for the connection of the lifting limit switch Figure 4-53.

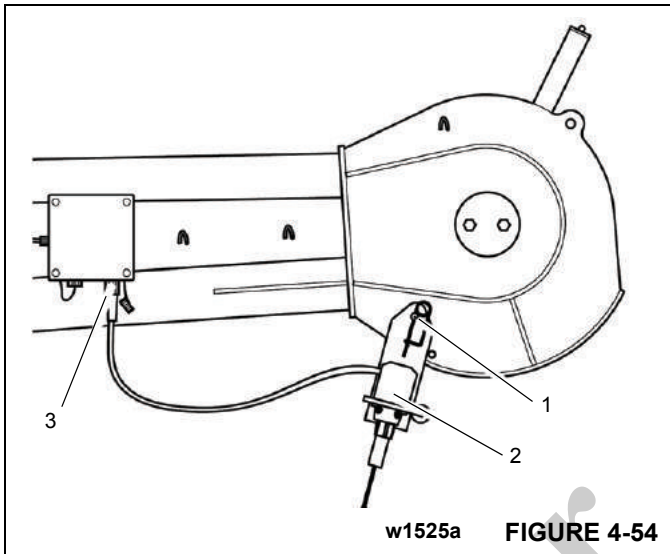
The connection is now overridden.



On 10.1 m (33 ft) swingaway lattice extension

- Attach the lifting limit switch (3) in the holder (4) and secure it with a retaining pin. Figure 4-53
- Remove the short-circuit plug (2) from the socket (1).
- Connect the lifting limit switch on the socket (1).
- When unrigging you must insert the short-circuit plug (2) back in the socket (1).

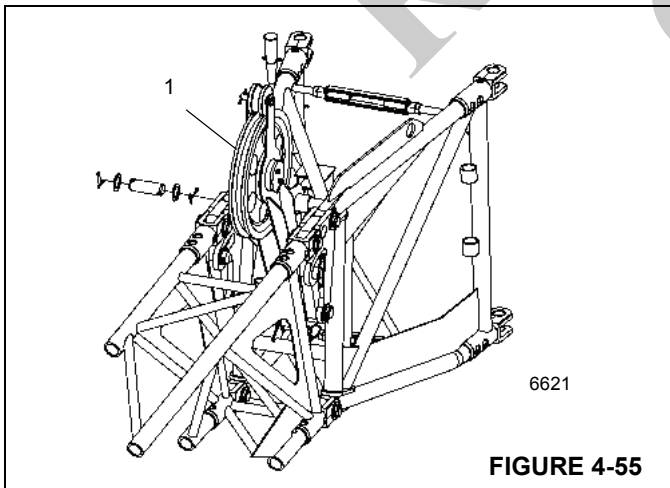
On the 17.1 m (56 ft) Two-Stage Swingaway Lattice Extension



NOTE: For operation with the 17.1 m (56 ft) two-stage swingaway lattice extension the connection for the lifting limit switch on the 10.1 m (33 ft) section must be overridden with a short-circuit plug.

- Attach the lifting limit switch (2) on the shackle (1) and secure it with a retaining pin (Figure 4-54).
- Connect the lifting limit switch on the socket (3).
- When stowing, close the socket (3) with the protective cap.

Folding Out/In the Deflection Sheaves on the 10.1 m (33 ft) Section



To prevent the hoist rope dragging on the main boom or lattice extension during operation with the lattice extension or jib, the hoist rope is guided via deflection sheaves.

On the 10.1 m (33 ft) section, there is a deflection sheave at the rear (1, Figure 4-55). Fold out the deflection sheave if the jib offset angle is 20° or 40°.

NOTE: For zero (0) degree offset, leave the mast assembly in the stowed position.

The sheave must be folded out:

- for operation with the swingaway lattice extension,
- for operation with the 17.1 m (56 ft) two-stage swingaway lattice extension.

For transportation the mast sheave must be folded in.

Folding Rear Deflection Sheave

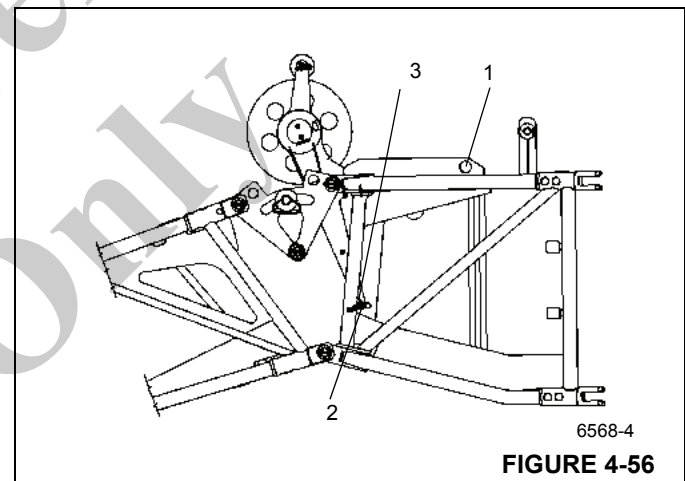


CAUTION

Risk of crushing.

Always hold the deflection sheave by the handle, when removing the pin. You might get your fingers crushed if you hold the sheave by the side plates.

Folding Out Deflection Sheave



- Remove the pin (2) from the bore (1). Figure 4-56
- Fold the deflection sheave up and secure it with the pin in the bore (3).
- Secure the pin with a retaining pin.

Folding In Deflection Sheave

- Remove the pin (2) from the bore (3).
- Fold the deflection sheave down and insert the pin in the bore (1).
- Secure the pin with a retaining pin.

Positioning/Removing the Hoist Cable



CAUTION

Risk of accidents due to falling parts.

Always secure the hoist cable holding rollers and rods with retaining pins. This prevents elements from coming loose, falling down and injuring people.

Positioning Hoist Cable

- Remove the hoist cable holding rollers and rod (1) Figure 4-57.
- Guide the hoist rope via the deflection sheaves (3) and via the head sheave (2) on the 10.1 m (33 ft) section or on the 7 m (23 ft) section. Put all hoist cable holding rollers and rods back in place and secure these with retaining pins.
- Attach the overhaul ball.
- Install the A2B weight assembly.

Removing Hoist Cable

- Unpin the overhaul ball.
- Remove the hoist cable holding rollers and rods (1).

- Take the hoist cable off the head sheave (2) and the deflection sheaves (3) and place it onto the ground on the left side.

Setting the Folding Swingaway Extension Offset



WARNING

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

1. Extend and set the outriggers and swing the boom to over the front. Position the boom to above horizontal (Figure 4-58).
2. Block up under the tip of the extension assembly section.
3. To set the offset from a lesser degree to higher degree, perform the following procedures.

CAUTION

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

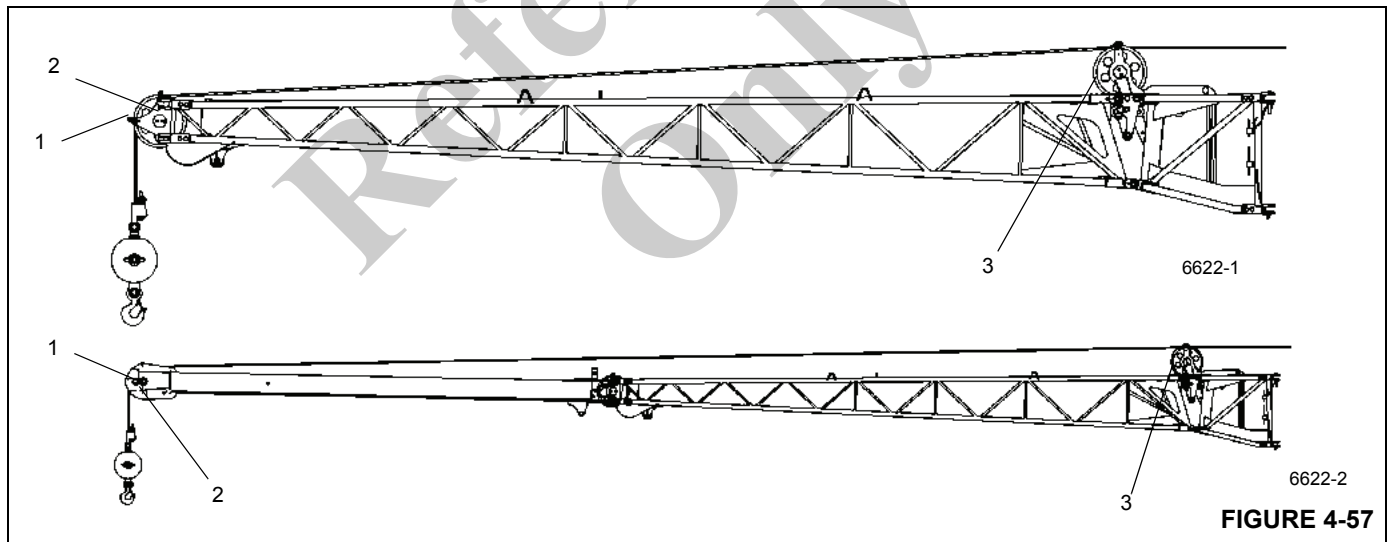
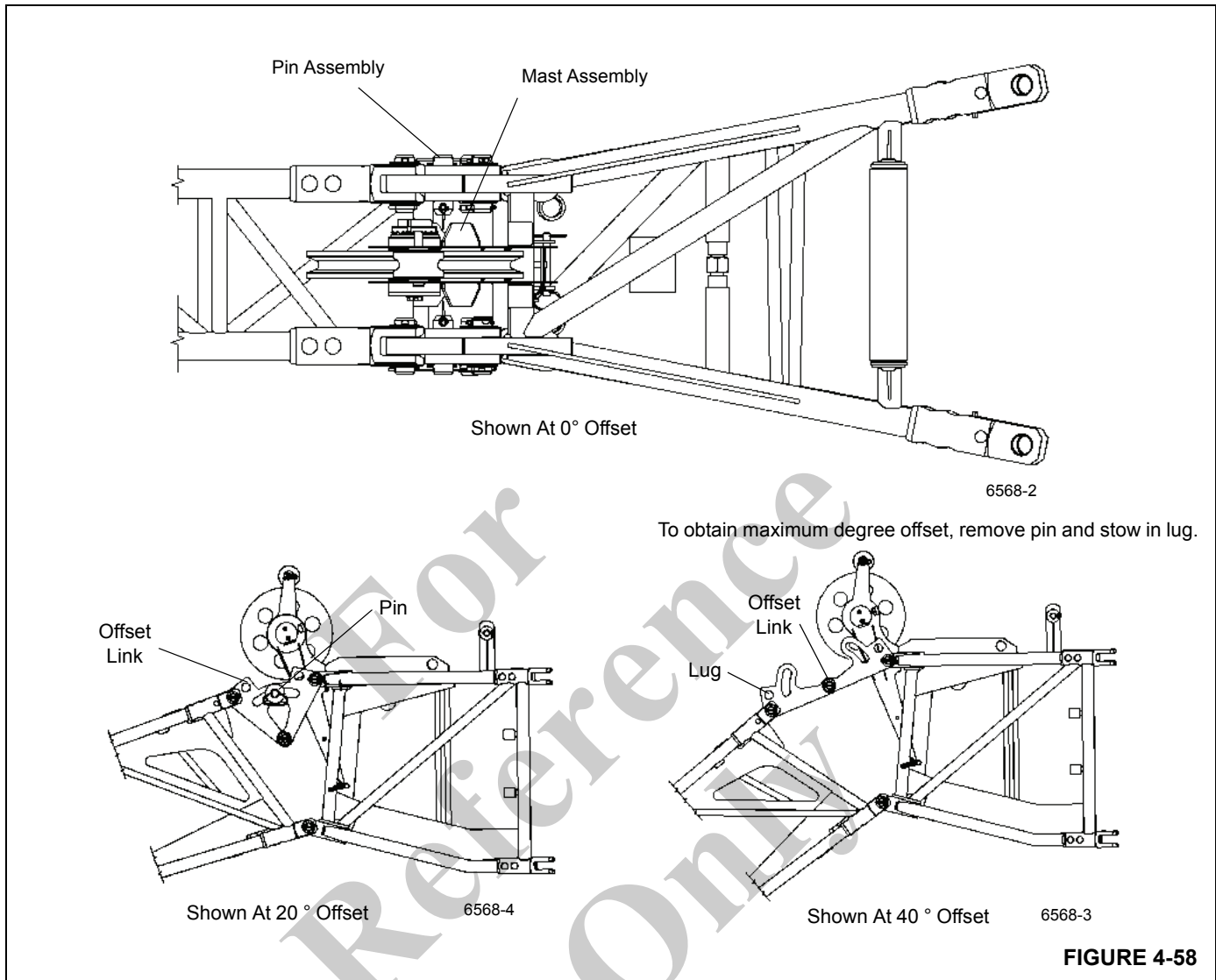


FIGURE 4-57



- a. Slowly lower the boom until the pressure is relieved on the offset link pins.

NOTE: For 20 or 40 degree offset, make sure the mast is in the raised position.

- b. Remove the offset link clip pins and attach pins securing the offset links in the lesser degree offset position. If going to maximum offset, stow them in the stowage lugs. If going to the intermediate (20 degree) offset, install them in the offset links for that degree of offset.
- c. Slowly elevate and telescope the boom at the same time so that the extension does not move off of the blocking until the offset links take the full weight of the extension.
- d. Reeve the hoist cable as described under normal erecting procedures.

REMOVING THE BI-FOLD MANUAL JIB



WARNING

To prevent serious injury or death, always wear personal protective equipment; that is, a hard hat, eye protection, gloves and metatarsal boots.

1. Before removing the jib make sure the crane is set up on outriggers using normal setup procedures. Refer to *Operating Controls and Procedures*, page 3-1.

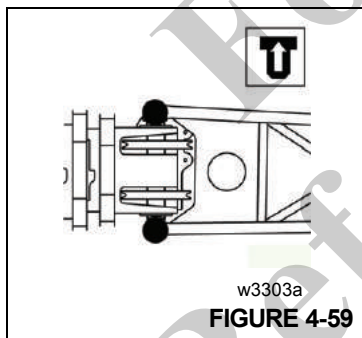
NOTE: An auxiliary crane with sling is required to remove the bi-fold jib.

1. Retract the main boom completely and lower it into the horizontal position.
2. Unreeve the hoist cable from the hook block and remove it from the jib.
3. Fold in the deflection sheave on the 10.1 m (33 ft) section.
4. Disconnect electrical connection between the lattice extension and the main boom.
5. Attach auxiliary crane sling to bi-fold swingaway extension.

**WARNING**

Lattice extension must be supported by an auxiliary crane before removing pins.

6. Remove locking pins Figure 4-59 on both sides between 10.1 m (33 ft) section and main boom head and remove the bi-fold swingaway extension.

**FIGURE 4-59**

7. Check the transport condition of the bifold swingaway extension.

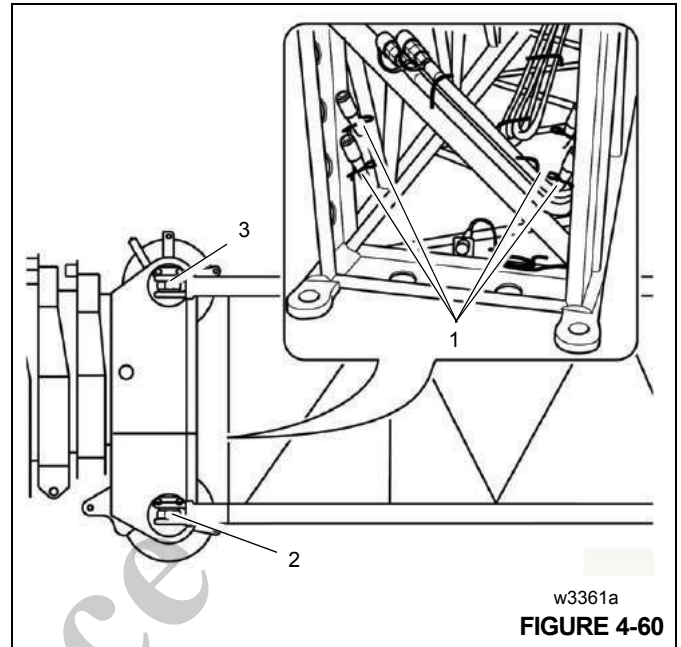
INSTALLING/REMOVING 4.9 M (16 FT) SECTIONS

- In order to rig the 22 m (72 ft) jib, you must install the 4.9 m (16 ft) section with support roller in front of the main boom head.
- In order to rig the 27.1 m (89 ft) jib, you must additionally install the 4.9 m (16 ft) section without support roller in front of the 4.9 m (16 ft) section with support roller.

NOTE: An auxiliary crane must be used to install and remove the 4.9 m (16 ft) sections.

Installing the 4.9 m (16 ft) Sections

The securing pins (1) for the connection are secured with retaining pins in the holders at the foot of the 4.9 m (16 ft) sections (Figure 4-60).

**FIGURE 4-60**

- Using an auxiliary crane with sling, lift the 4.9 m (16 ft) section with support roller in front of the main boom head so that the bearing points (2) and (3) align on both sides.
- Insert the securing pins into the bearing points (2) and (3) on both sides.
- Secure all pins with retaining pins.
- Install the second 4.9 m (16 ft) section in front of the first 4.9 m (16 ft) section for the 27.1 m (89 ft) jib in the same way.
- Install 17.1 m (56 ft) section in front of the respective 4.9 m (16 ft) section per previous instructions in this section.

Removing the 4.9 m (16 ft) Sections

- Using an auxiliary crane with sling, lift the 4.9 m (16 ft) section until the bearing points (2) and (3) are relieved.
- Release the pins and knock them out of the bearing points (2) and (3) on both sides.
- Insert the pins into the holders at the foot of the 4.9 m (16 ft) sections and secure them with retaining pins.

JIB (ADDITIONAL EQUIPMENT)

Identification and Slinging Points

Identification

The jib consists of the 17.1 m (56 ft) bi-fold swingaway lattice extension and two jib sections. The jib is designed for the crane it was delivered with. The parts which belong to the crane have the same serial number as the crane.

The following sections are identified by the serial number:

- All parts of the 17.1 m (56 ft) bi-fold swingaway lattice extension.
- Both sections of the 4.9 m (16 ft) sections.

CAUTION

Operate the crane only with those sections of the jib which have the same serial number as the crane. This prevents malfunctions and damage.

NOTE: For technical reasons a crane may only be set with one jib.

If you wish to use the jib on several Manitowoc/Grove cranes, the parts of the jib must be adjusted for these cranes and labeled with all of the respective serial numbers.

CAUTION

Have the adjustment of the jib only carried out on site by Manitowoc Crane Care.

Serial numbers on the 4.9 m (16 ft) sections

The serial number is on a plate at the front of the 4.9 m (16 ft) sections.

Slinging Points

CAUTION

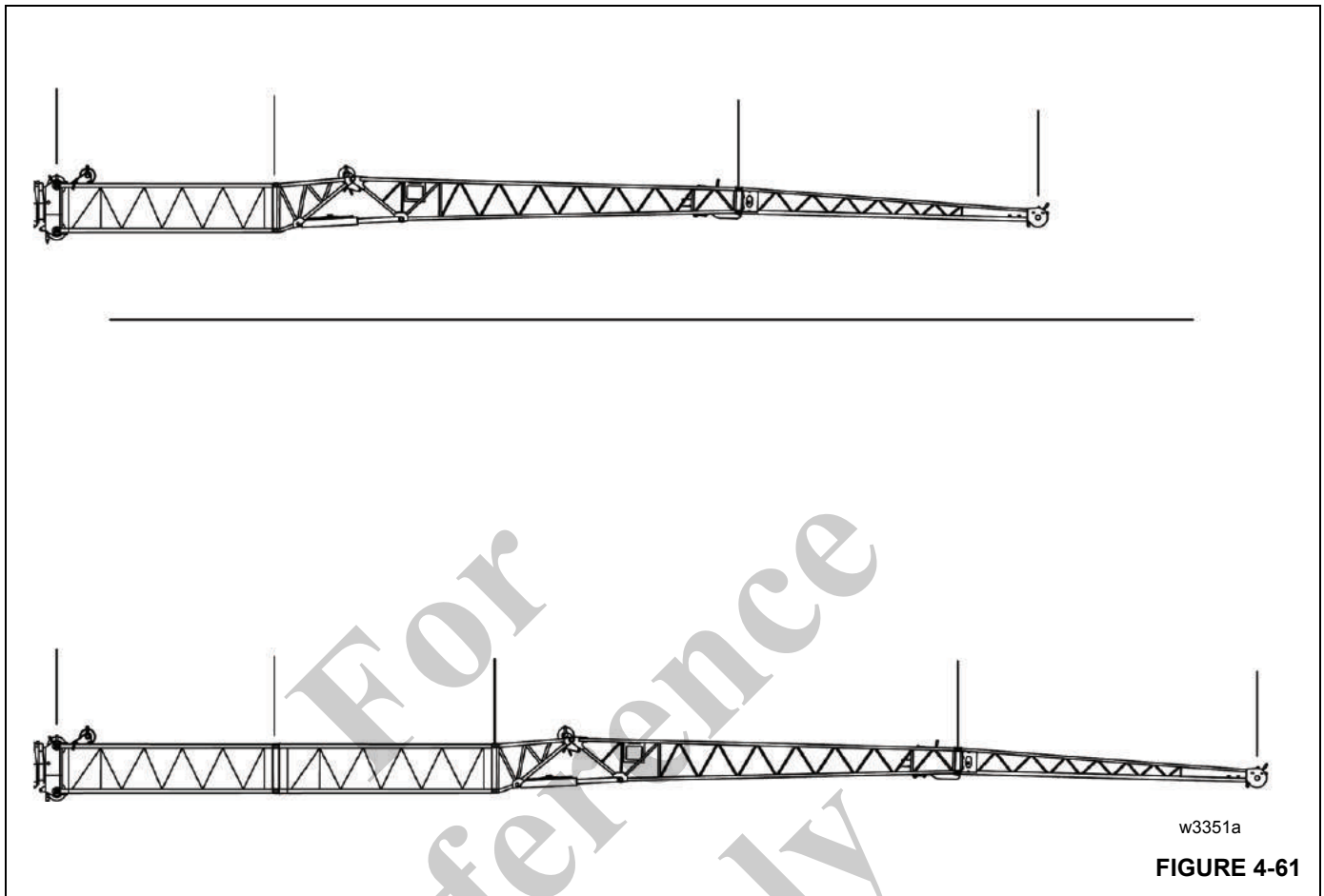
This section shows the slinging points of the 4.9 m (16 ft) sections. Attach the sections only to these slinging points because they will then automatically have the correct center of gravity. Use only lifting gear with sufficient load bearing capacity.

The 4.9 m (16 ft) sections have two slinging points (one slightly offset on each side) (Figure 4-61).

NOTE: For electrical connections at the 4.9 m (16 ft) sections, refer to Electrical Connections at the Jib, in this section.

ASSEMBLY OF JIBS

NOTE: The lengths of 22.0 m (72 ft) and 27.1 m (89 ft) respectively equal the distance between the center of the locking pin (on the main boom head) and the front edge of the head sheave.



The designation 10.1 m (33 ft) section, 7 m (23 ft) section, and 4.9 m (16 ft) section have been adjusted to these lengths. The total length of the individual sections is greater or smaller.

Electrical Connection at the Jib

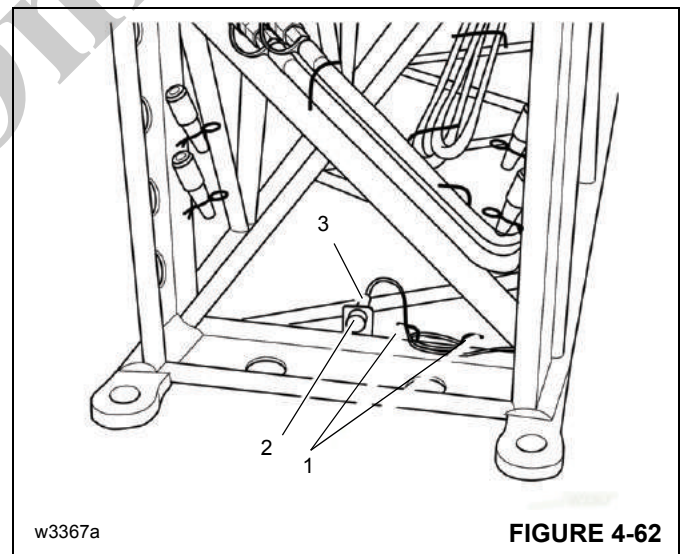
The following describes the electrical connections at the 4.9 m (16 ft) sections. Establish the electrical connection at the bi-fold swingaway lattice extension per the following procedures

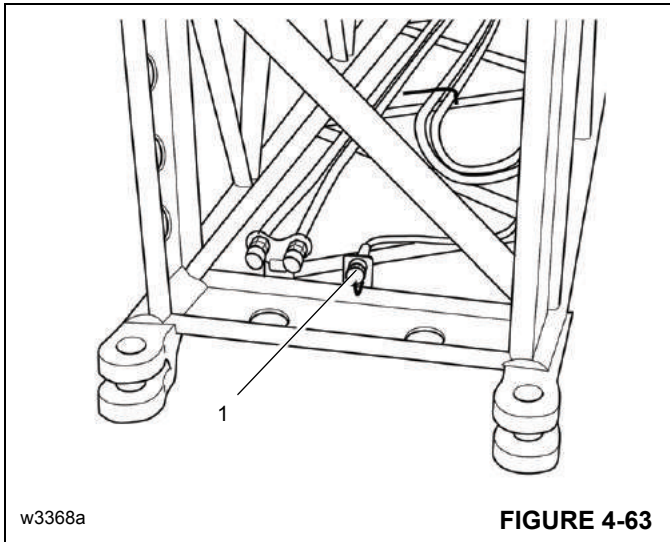
Transport Condition of the Connection

For transport, bring the electrical connections into the following condition.

There is a cable with a plug (3) at the rear of the 4.9 m (16 ft) sections Figure 4-62.

For transport, the cable is wound around the holders (1) and the plug is inserted in the dummy socket (2).





There is a plug socket (1) at the front of each 4.9 m (16 ft) section Figure 4-63.

For transport, the sockets are covered with protective caps.

At the 22.0 m (72 ft) Jib

Establishing a Connection

- Connect the cable of the 10.1 m (33 ft) section to the socket of the second 4.9 m (16 ft) section at the front.
- Connect the cable of the 4.9 m (16 ft) section to the socket at the main boom.

Disconnecting

- Detach the electrical connection between 10.1 m (33 ft) and 4.9 m (16 ft) section.
- Detach the electrical connection between 4.9 m (16 ft) section and main boom head.
- Prepare the electrical connections at the 10.1 m (33 ft) section for transport.

At the 27.1 m (89 ft) Jib

Establishing a Connection

- Connect the cable of the 10.1 m (33 ft) section to the socket of the second 4.9 m (16 ft) section at the front.
- Connect the cable of the second 4.9 m (16 ft) section to the socket of the first 4.9 m (16 ft) section at the front.

- Connect the cable of the first 4.9 m (16 ft) section to the socket at the main boom head.

Disconnecting

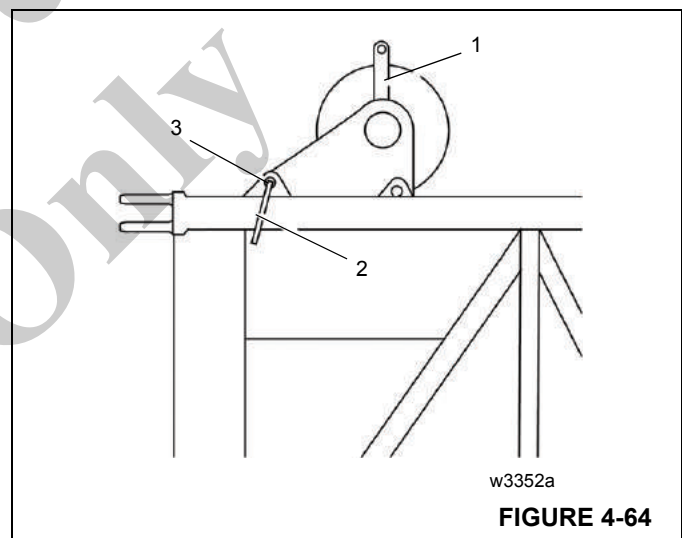
- Detach the electrical connection between the 10.1 m (33 ft) and front 4.9 m (16 ft) section.
- Detach the electrical connection between the two 4.9 m (16 ft) sections.
- Detach the electrical connection between the rear 4.9 m (16 ft) section and the main boom head.
- Prepare the electrical connections at the 4.9 m (16 ft) section for transport.
- Prepare the electrical connections at the 10.1 m (33 ft) section for transport.

Unfolding/Folding the Deflection Sheave on the 4.9 m (16 ft) Section

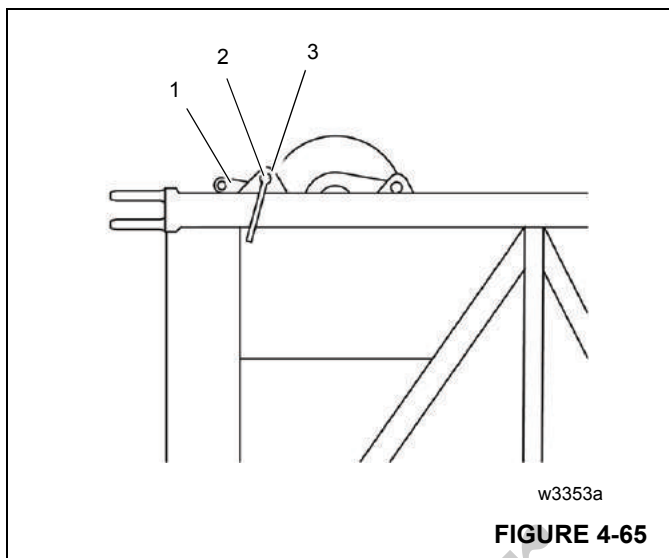
This section describes only the unfolding and folding of the deflection sheave on the 4.9 m (16 ft) section.

For work with the jib, you must fold out the deflection sheave on the rear 4.9 m (16 ft) section.

Folding Out Deflection Sheave



1. Pull the pin (2) out of the bore (3) (Figure 4-64).
2. Fold the deflection sheave on the strut (1) upwards until the locking positions are aligned with the bore hole (3).

Folding In Deflection Sheave

1. Hold the deflection sheave by the strut (1) and remove the pin (3) from the bore (2) (Figure 4-65).
2. Fold the deflection sheave down as far as possible.
3. Insert the pin in the bore hole (3) and secure it with a retaining clip.

Positioning/Removing the Hoist Cable**CAUTION**

Risk of accidents due to falling parts.

Always secure the hoist cable holding rollers and rods with retaining pins. This prevents elements from becoming loose, falling down and injuring people.

Positioning Hoist Cable

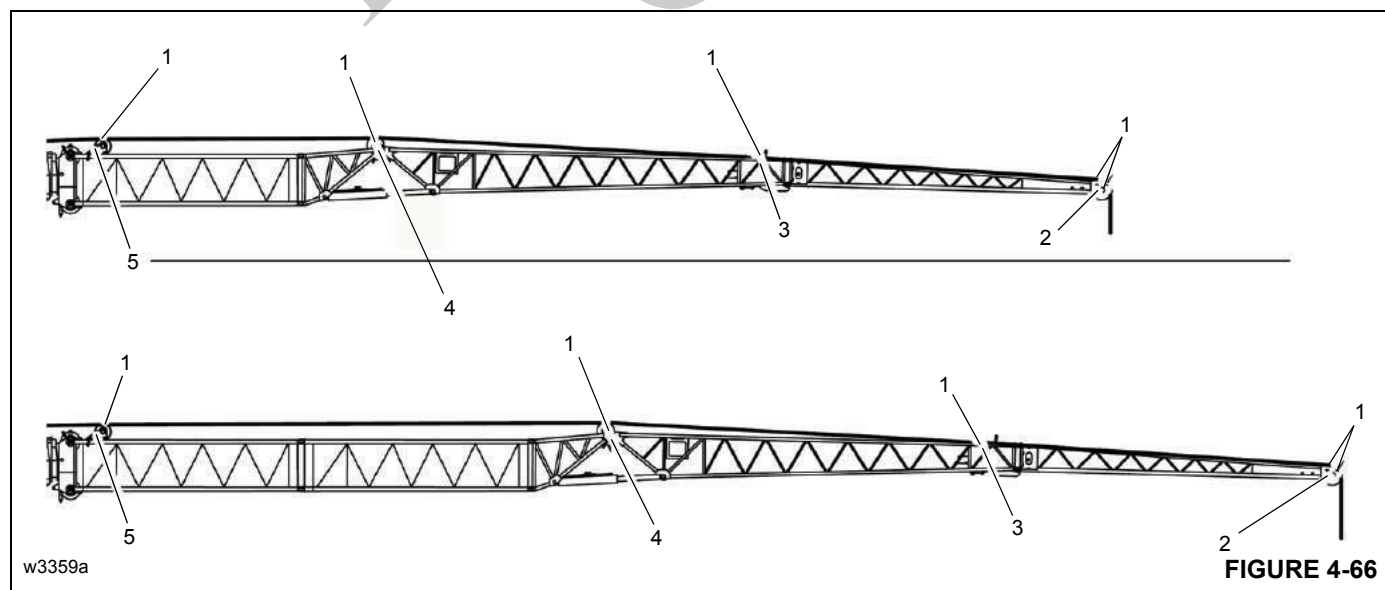
- Remove the hoist rope holding rollers and rods (1) (Figure 4-66).
- Guide the hoist rope via the deflection sheaves (3) and via the head sheave (2) on the 10.1 m (33 ft) section or on the 7 m (23 ft) section. Put all hoist cable holding rollers and rods back in place and secure these with retaining pins.
- Attach the overhaul ball.
- Install the A2B weight assembly.

Removing Hoist Cable**CAUTION**

Risk of accidents due to falling parts.

Always secure the hoist cable holding rollers and rods with retaining pins. This prevents elements from becoming loose, falling down and injuring people.

- Unpin the overhaul ball.
- Remove the hoist rope holding rollers and rods (1) (Figure 4-66).
- Take the hoist cable off the head sheave (2) and the deflection sheaves (3) and place it onto the ground on the left side.
- Put all hoist cable holding rollers and rods back in place and secure them with retaining pins.



Traveling with Manually Offsettable Jib and/or Inserts Erected

10.1 m (33 ft)/17.1 m (56 ft) Extension Plus 4.9 m (16 ft) or 10 m (32 ft) Inserts

Travel is permissible under the following conditions:

1. The 10.1 m (33 ft) or 17.1 m (56 ft) jib shall be erected at minimum offset.
2. Jobsite travel only on firm, level surface.
3. Main boom shall be fully retracted.
4. Main boom angle: 0 degrees minimum, 40 degrees maximum.
5. Maximum travel speed: 4 km/h (2.5 mph).
6. Counterweight shall be installed.
7. The boom shall be over the front.
8. Swing lock and pin shall be engaged.
9. Hookblock must be removed from main boom nose.
10. Headache ball may be reeved over jib, hanging 0.9 m (3 ft) below sheave.
11. The tires shall be properly inflated.
12. The suspension air bags shall be properly inflated.

AUXILIARY SINGLE-SHEAVE BOOM NOSE (ADDITIONAL EQUIPMENT)

Identification

The auxiliary single-sheave boom nose is designed for the crane it was delivered with.

CAUTION

Operate the crane only with the auxiliary single-sheave boom nose that has the identical serial number.

If you wish to use the auxiliary single-sheave boom nose on several Manitowoc/Grove cranes, it needs to be adapted to the corresponding crane and marked with all the serial numbers.

CAUTION

The auxiliary single-sheave boom nose should only be adjusted by Manitowoc Crane Care at the particular location.

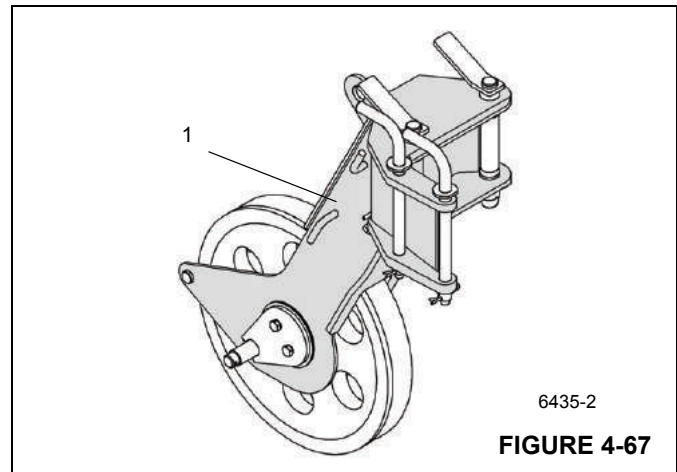


FIGURE 4-67

The serial number (1) is on a plate, in the front on the auxiliary single-sheave boom nose (Figure 4-67).

Installing/Removing Auxiliary Single-Sheave Boom Nose



WARNING

Risk of accidents if boom nose should fall off! During installation and removal, always use the proper equipment with sufficient load bearing capacities.

Installing Auxiliary Single-Sheave Boom Nose

1. Loosen the retaining pin (4) and remove the pins (1) from the bearing point (2) (Figure 4-68).

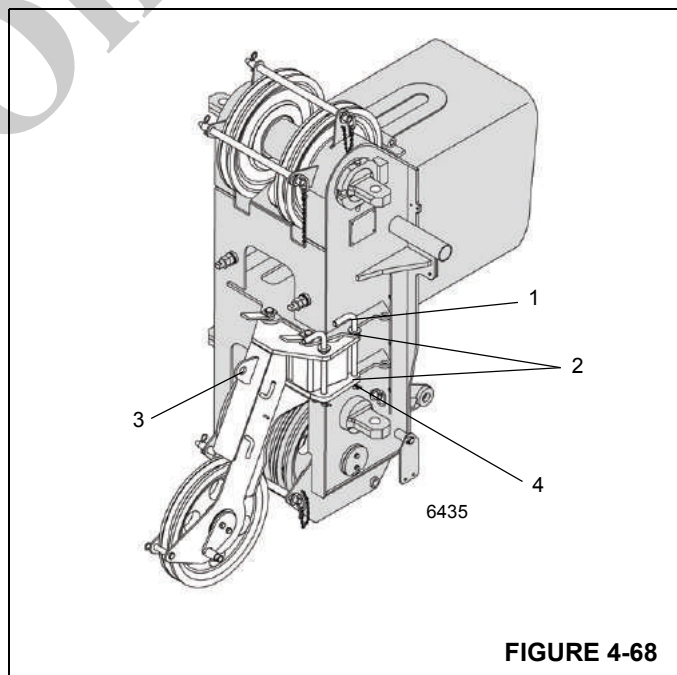


FIGURE 4-68

2. Use an auxiliary crane to couple the holding device to the connection eyes (3) on the auxiliary boom nose and lift it to the left onto the main boom head.
3. Align the auxiliary single-sheave boom nose so that the bearing point (2) lines up to the front bore holes in the holding device.
4. Secure the auxiliary single-sheave boom nose to the holding device using a pin (1).
5. Secure the pin (1) with a retaining pin (4).
6. Depending on the application, bring the auxiliary single-sheave boom nose into transport position or working position.

Removing the Auxiliary Single-Sheave Boom Nose

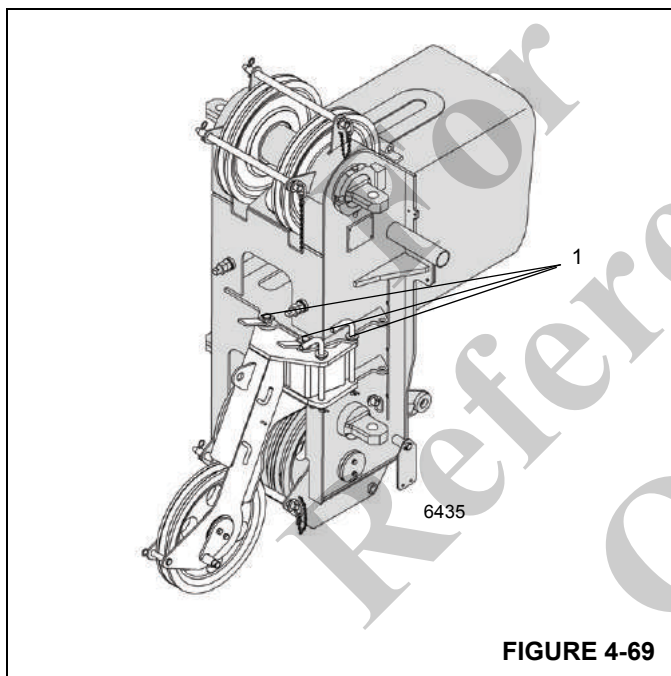


FIGURE 4-69

In the working position, the auxiliary single-sheave boom nose is positioned in front of the main boom head and is fastened with three pins (1) Figure 4-69.

In the transport position, the auxiliary single-sheave boom nose is positioned to the side of the main boom head and is fastened with two pins.

1. Attach an auxiliary crane to the connection eyes of the boom nose.
2. Remove the retaining pins and remove all the pins out of the bores and bearing points.

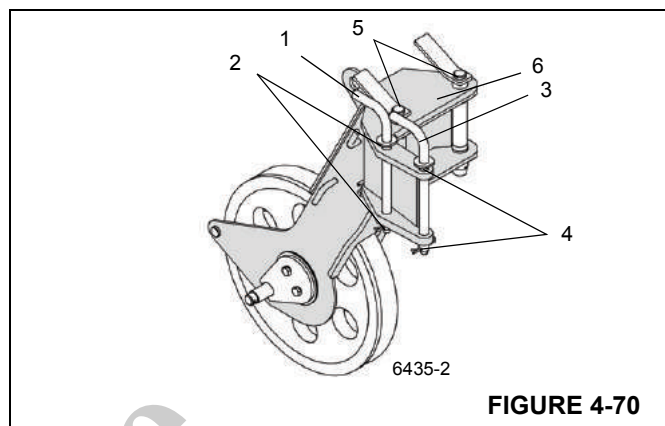


FIGURE 4-70

3. Lift the auxiliary single-sheave boom nose from the head of the main boom.
4. Insert the two thin pins (1) and (3) into the bearing points (2) and (4) on the auxiliary single-sheave boom nose (Figure 4-70).
5. Insert the two pins (5) into the mounting brackets (6) in front on the auxiliary single-sheave boom nose.
6. Secure all pins using retainer pins.

RIGGING THE AUXILIARY SINGLE-SHEAVE BOOM NOSE

Rigging in Transport Position

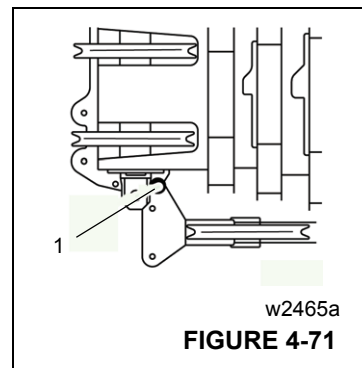
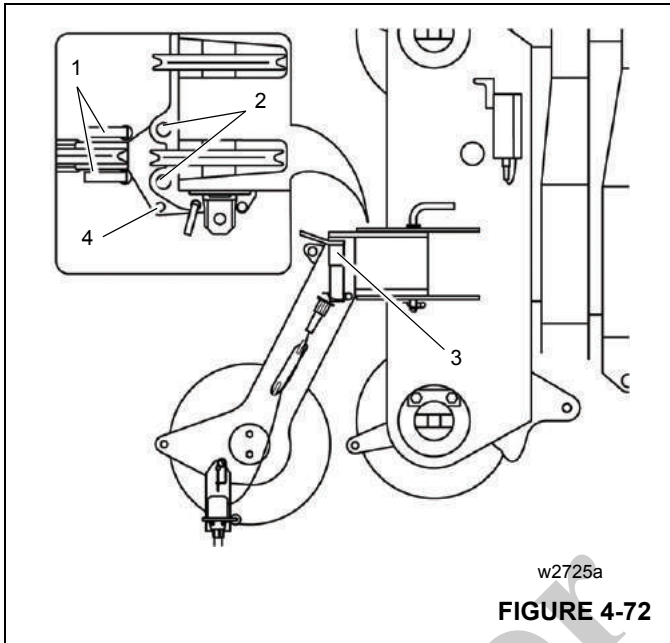
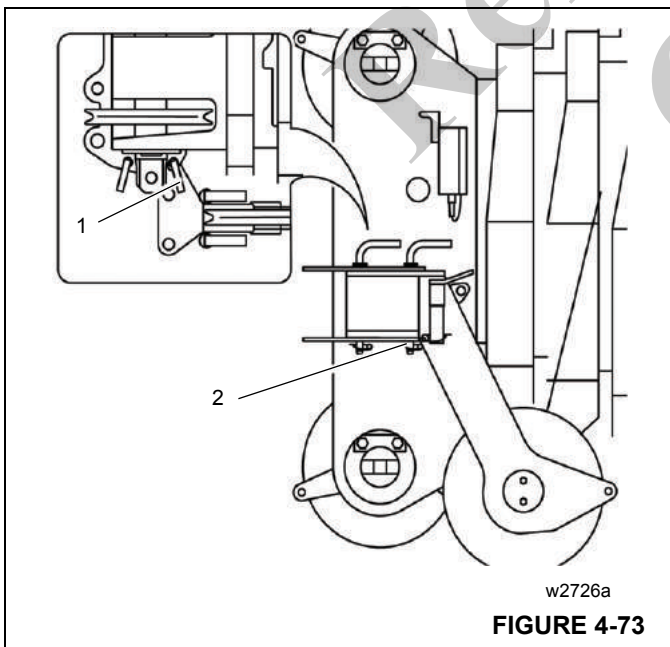


FIGURE 4-71

On the left side of the main boom head there is a holding device. In transport position, the boom nose is connected to the rear bore holes on the holding device (Figure 4-71).

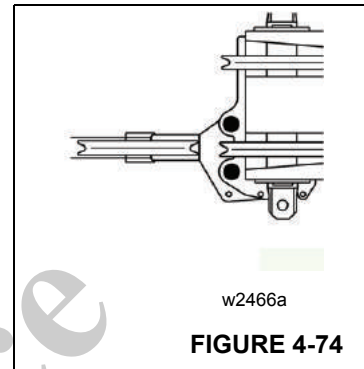


1. Remove the retaining pins and take both pins (1) out of the bearing points (2) at the front of the main boom head (Figure 4-72).
2. Insert both pins into the holders (3) and secure them with retaining pins.
3. Release the retaining pin and remove the thin pin from the bearing point (4).
4. Rotate the auxiliary boom nose to the side of the main boom head.

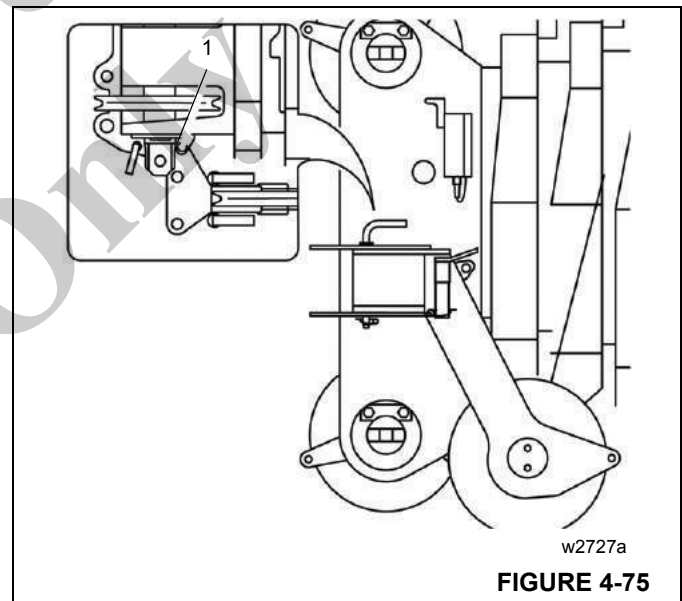


5. Using the thin pin (1), fasten the auxiliary single-sheave boom nose to the bearing point (2) (Figure 4-73).
6. Secure the pin with a retaining pin.
7. The auxiliary single-sheave boom nose is now in transport position.

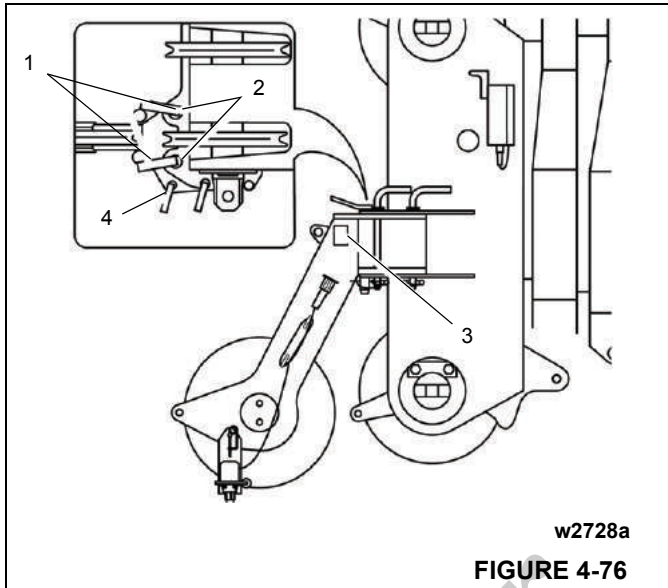
Rigging in Working Position



On the left side of the main boom head, there is a holding device. In working position, the auxiliary single-sheave boom nose is attached to the main boom head at both bore holes (Figure 4-74).



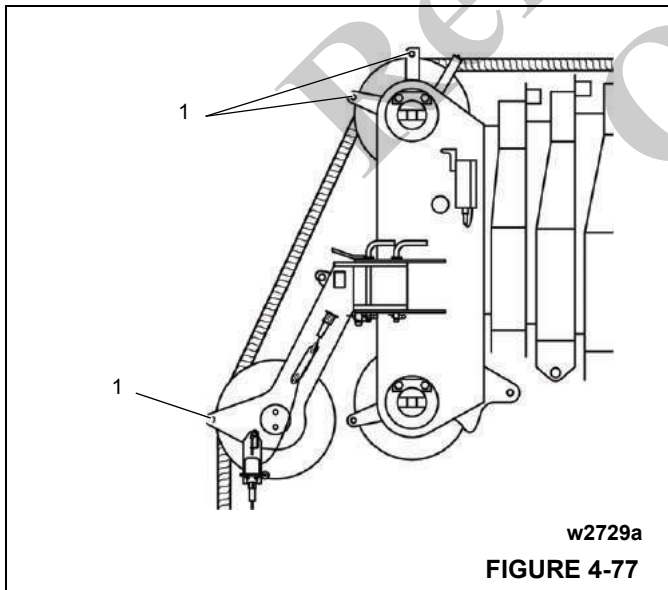
1. Release the retaining pin and remove the thin pin from the bearing point (Figure 4-75).
2. Swing the auxiliary single-sheave boom nose in front of the main boom head.



3. Remove the retaining pin and take out both thick pins from the holders (Figure 4-76).
4. Insert both pins into the pivot points at the front of the main boom head and secure them with retaining pins.
5. Insert the thin pin into the bearing point and secure it with a retaining pin.

The auxiliary single-sheave boom nose is now in working position.

Attaching and Removing Hoist Cable



1. Remove the cable holding rods from the head of the main boom and from the auxiliary single-sheave boom nose (1, Figure 4-77).
2. When reeving, guide the hoist cable over the left hand upper sheave of the main boom.

3. Insert the rope holding rods into the appropriate bore holes and secure them with the corresponding retaining pins.
4. Fasten the cable end clamp on the headache ball or the hook block.

Reverse the sequence of operations to remove the hoist cable before rotating the auxiliary boom nose into transport position.

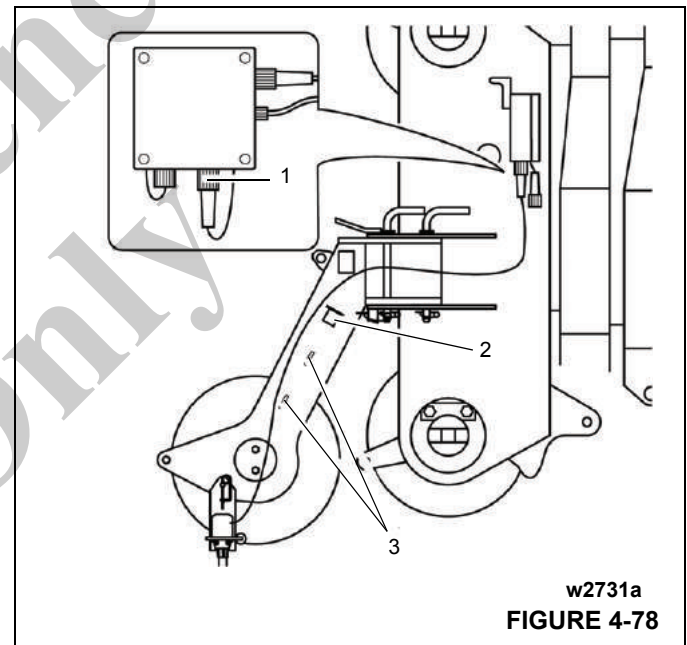
Possible Reeving Methods on the Auxiliary Single-Sheave Boom Nose

NOTE: The hoist cable may only be simply reeved (single drop).

Maximum load bearing capacity for single-reeving, 7.3 t (16,000 lb)

Lifting Limit Switch

In Operation

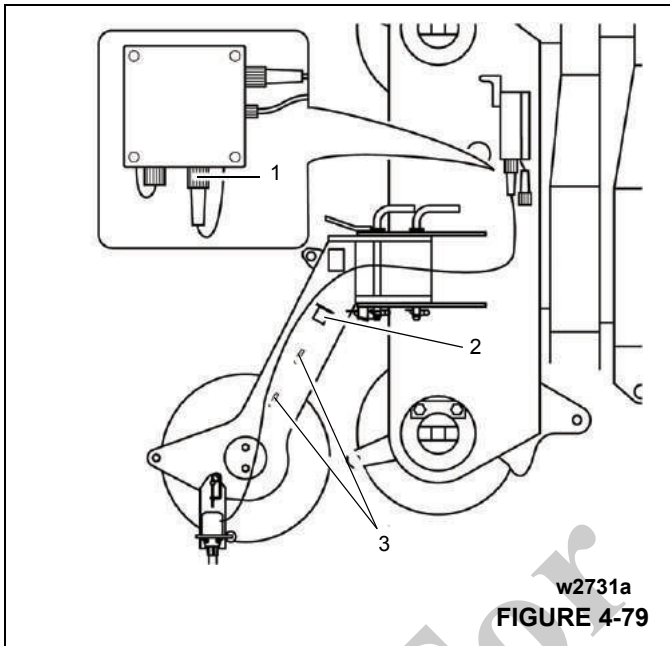


1. Pull the plug of the connecting cable from the storage socket (2) (Figure 4-78).
2. Unwind the connecting cable from the holders (3).
3. Insert the plug of the connecting cable into the socket (1) on the main boom head.
4. Guide the hoist cable through the lifting limit switch weight.

During Transport

1. Insert the plug of the connecting cable into the storage socket (2) (Figure 4-79).
2. Wind the connecting cable onto the holders (3).

3. Plug the short-circuit plug into the socket (1).



RAISING AND SETTING DOWN THE MAIN BOOM WITH RIGGED LATTICE EXTENSION

NOTE: The information in this section also applies for raising and setting down the main boom with a rigged jib.

To raise and lower the main boom with a rigged lattice extension, the main boom must be fully retracted.

For raising and lowering, the following prerequisites must be fulfilled:

- Apart from the hook block there is no load on the lattice extension.

TELESCOPING WITH RIGGED LATTICE EXTENSION

CAUTION

The main boom may become overloaded!

If you telescope the main boom with a rigged lattice extension or jib, you must not rotate the superstructure at the same time. This prevents the main boom being subjected to additional side forces and increased vibration and becoming overloaded.

NOTE: Do not actuate the swing gear when telescoping.

OPERATING WITH THE LATTICE EXTENSION

NOTE: The information in this section also applies to operation with the jib. Observe the following safety instruction before working with the jib.

CAUTION

Risk of overturning when working with the jib!

When lifting over the swingaway and/or jib combinations, deduct the total weight of all load handling devices reeved over the main boom nose directly from the swingaway or jib capacity.

NOTE: The hoisting, lowering, swinging, lifting and telescoping movements are done in the same way as when operating with the main boom. Telescoping is permitted only at main boom angles of approximately 75° - 80°, depending on the length of the lattice extension.

Procedure if the Permissible Wind Speed is Exceeded

Strong winds can overstrain the crane. Therefore, closely observe the instructions in Table 4-2.

If the maximum permissible wind speed according to the lifting capacity table is exceeded during the main boom operation, proceed per the following table:

Table 4-2

with wind speed up to 72 km/h (45 mph)	with wind speed over 72 km/h (45 mph)
<ul style="list-style-type: none"> • Set down the load. • Swing the superstructure so that the main boom creates as little wind resistance as possible. 	<ul style="list-style-type: none"> • Set down the load. • Fully retract the main boom. • Set down the lattice extension.

NOTE: The information in Table 4-3 applies to malfunctions during operation with the 10.1/17.1 m (33/56 ft) lattice extension.

Table 4-3

Malfunction	Cause	Remedy
No function of the lifting limit switch	Lifting limit switch not connected	Connect the lifting limit switch.
	Electrical connection between the boom head and lattice extension and between 10.1 m (33 ft) section and 7 m (23 ft) section is not established.	Establish electrical connection.
	Lifting limit switch on the main boom head not overridden.	Override the lifting limit switch on the main boom head.
	When operating with a 17.1 m (56 ft) lattice extension or jib, the short-circuit plug is not inserted on the head of the 12.5 m (33 ft) section.	Insert short-circuit plug.
The main boom cannot be telescoped with the rigged lattice extension or jib.	The main boom is derricked to such an angle at which telescoping is not permissible	Derrick the main boom to the required angle.
The lattice extension can not be derricked.	Derricking gear of the lattice extension is switched off.	Switch ON the derricking gear of the lattice extension.

MONTHLY MAINTENANCE WORK

Pins

Lubricate the following:

- the pins for the pin connection on the lattice extension,
- the retaining pins on the return pulleys,

- the retaining pins used for fastening the lattice extension sections for transport,
- the spring latch on the run-up rail.

NOTE: The maintenance interval applies to average operation. Also, lubricate the pins after high-pressure cleaning and generally at an interval that will prevent them getting dry.

For
Reference
Only

SECTION 5
LUBRICATION

SECTION CONTENTS

General	5-1	Lubrication Points	5-4
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GENERAL

Following the designated lubrication procedures is important in ensuring maximum crane lifetime and utilization. The procedures and lubrication charts in this section include information on the types of lubricants used, the location of the lubrication points, the frequency of lubrication, and other information.

The service intervals specified are for normal operation where moderate temperature, humidity, and atmospheric conditions prevail. In areas of extreme conditions, the service periods and lubrication specifications should be altered to meet existing conditions. For information on extreme condition lubrication, contact your local Grove distributor or Manitowoc Crane Care.

CAUTION

Chassis grease lubricants must not be applied with air pressure devices as this lubricant is used on sealed fittings.

CAUTION

The multipurpose grease installed during manufacture is of a lithium base. Use of a noncompatible grease could result in damage to equipment.

ENVIRONMENTAL PROTECTION

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

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

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

When filling and draining crane components, observe the following:

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

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 of Grove cranes that inspections be performed on the basis of how and where each crane 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, filters and breathers be inspected and oils sampled at least every 3 to 6 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, oil appears “milky” or no longer has a transparent clear to amber color). The return filter by-pass indicator should be observed daily to determine if the contaminants content may be 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 hydraulic oil, fill a

small glass container with a sample of reservoir oil and another glass container with fresh oil. Let the samples stand, undisturbed, for one to two hours and 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 was due to air foaming, it will dissipate and the oil should closely match the fresh oil. Should you have any questions, please contact your local Grove distributor or Manitowoc Crane Care.

Arctic Conditions Below -18°C (0°F)

In general, petroleum based fluids developed especially for low temperature service may be used with satisfactory results. However, certain fluids, such as halogenated hydrocarbons, nitro hydrocarbons, and phosphate ester hydraulic fluids, might not be compatible with hydraulic system seals and wear bands. If you are in doubt about the suitability of a specific fluid, check with your authorized Grove 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 start-up procedures to ensure adequate lubrication during system warm-up.

ALL WEATHER PACKAGE & LUBRICANTS

Arctic Conditions Down to -40°C (-40°F)

Engineering recommends the following lubricants for components that will be operated in ambient temperatures to -40°C (-40°F). Special lubricants alone are not sufficient to operate at extreme low temperatures. We also recommend the use of appropriately sized heaters for the hydraulic tank, engine oil pan, engine jacket water and batteries. The operator needs to follow the guide lines as stated in the operator's manual. We assume that the customer has taken steps for use of an appropriate engine antifreeze coolant, taken care of the fuel, fuel system and starting system, and has done whatever they feel necessary to add insulation for under hood temperatures and meet the engine manufacture's intake air temperature requirements. Other lubricants may be used if they meet the specifications of the lubricant that is requested. Please consult the factory.

Axles and Swing Box - Spec 6829014058:

- Petro- Canada Traxon E Synthetic 75W-90
- CITGO, Syntetic Gear Lube 75W-90
- Eaton, Roadranger EP75W-90
- Mobil, Mobilube SCH 75W-90
- Shell, Spirax S 75W-90
- Sunoco Duragear EP75W-90

Engine - 2013 ISX engine - Spec 80056036:

- Shell Rotella® T6 0W-40
- Mobil Delvac 1 ESP 0W-40
- Caterpillar Cat DEO-ULS Cold Weather

2013 QSM engine - Spec 6829104412:

- Citgo Citgard Syndurance Synthetic Engine Oil CJ-4 5W-40
- Maxtron DEO Synthetic Engine Oil CJ-4 5W-40

Transmission:

- Use Standard Lubricants Package

Hydraulic tank - Spec 6829101559:

- Petro-Canada Duratran Synthetic THF
- Chevron All Weather THF
- Texaco TDH Oil SS

Hoist - Spec 6829103636:

- Petro-Canada ENDURATEX Synthetic EP 150
- Mobil SHC 629

Grease - Spec 6829104275:

- Petro-Canada Precision Synthetic EP1
- Mobil: Mobilith SHC 220

Open Gear Lube (bearing/swing drive teeth) - No Spec:

- Vultrex OGL Synthetic All Season

Antifreeze Coolant - Spec 6829104212:

- Petro-Canada AFC 60/40
- Old World Industries, Inc. Fleet Charge SCA Pre-charged Antifreeze/ Coolant-60/40
- Fleetguard Compleat EG Antifreeze/Coolant Premix 60/40

STANDARD LUBRICANTS PACKAGE

Axles and Swing Box - Spec 6829012964:

- Century Unigear Semi-synthetic SAE 80W-90
- Texaco Multigear SS 80W-90
- Chevron DELO 80W-90

Engine - 2013 ISX engine - Spec 6829104182:

- Mobil delvac 1300 Super CJ-4 15W-40
- Conoco Fleet Supreme EC CJ-4 15W-40

2013 QSM engine - Spec 6829003483:

- Conoco Fleet Supreme CI-4 15W-40

- Exxon XD-3 CI-4 15W-40

Transmission - Fuller Manual & Automatic - Spec 6829013433:

- Citgo Synthetic Gear Lubricant CD50
- Eaton Roadranger SAE 50
- Mobil Delvac Synthetic Transmission Fluid 50
- Shell Spirax GSX SAE 50
- Texaco Syn-Star TL SAE 50
- Petro-Canada Traxon E Synthetic CD50
- Chevron Delo Transmission Fluid SAE 50
- Conoco/Phillips/Union 76 Triton Synthetic Transoil 50

Hydraulic Tank - Spec 6829006444:

- Hyden 052-10W-20
- Exxon Torque Fluid 56- 10W-20
- Esso Torque Fluid 56- 10W-20
- BP-Eldoran UTH & Trak-Tran 9 - 10W20
- BP- Blend- 7367 -10W20
- Exxon Mobil 424- 10W-30

Hoist - Spec 6829100213:

- AGMA No. 4 EP Extreme Pressure Gear Lube

- Mobil: Mobilfluid 629

- Texaco: Meropa 150

Grease - Spec 6829003477:

- Citgo Lithoplex MP # 2
- Texaco Starplex Moly # 2
- Phillips 66 Philube M Grease
- Mobil Mobilgrese XHP 222 Special, # 53055-0
- Chemtool Inc, Lube-A-Boom-Grease

Open Gear Lube (bearing / swingdrive teeth) - Spec 6829102971:

- FUCHS: CEPLATTYN 300 SPRAY

Antifreeze Coolant - Spec 6829101130:

- AFC - 50/50 Old World Industries, Inc.
- Fleet Charge SCA Pre-charged Antifreeze/Coolant
- Caterpillar DEAC Antifreeze/Coolant
- Fleetguard Complete EG Antifreeze/Coolant

Supplemental Coolant Additive (SCA) - Spec 6829012858

- Fleetguard DCA4
- Fleetguard DCA2
- Penray Pencool 3000

For Reference Only

LUBRICATION POINTS

A regular frequency of lubrication must be established for all lubrication points. Normally, this is based on component operating time. The most efficient method of keeping track of lube requirements is to maintain a job log indicating crane usage. The log must use the engine hourmeter to ensure coverage of lube points that will receive attention based on their readings. Other lubrication requirements must be made on a time basis, that is, weekly, monthly, etc.

All oil levels are to be checked with the crane parked on a level surface in transport position, and while the oil is cold, unless otherwise specified.

On plug type check points, the oil levels are to be at the bottom edge of the check port.

On all hoists with a check plug in the drum, the check/fill plug shall be at the 3 o'clock position with the oil level at the bottom edge of the check port.

All grease fittings are SAE STANDARD unless otherwise indicated. Grease non-sealed fittings until grease is seen extruding from the fitting. 0.28 kg (1 oz) of EP-MPG equals one pump on a standard 0.45 kg (1 lb) grease gun.

Over lubrication on non-sealed fittings will not harm the fittings or components, but under lubrication will definitely lead to a shorter lifetime.

On sealed U-joints, care must be exercised to prevent rupturing seals. Fill only until expansion of the seals first becomes visible.

Unless otherwise indicated, items not equipped with grease fittings, such as linkages, pins, levers, etc., should be lubricated with oil once a week. Motor oil, applied sparingly, will provide the necessary lubrication and help prevent the formation of rust. An anti-seize compound may be used if rust has not formed, otherwise the component must be cleaned first.

Grease fittings that are worn and will not hold the grease gun, or those that have a stuck check ball, must be replaced.

Where wear pads are used, cycle the components and relubricate to ensure complete lubrication of the entire wear area.

Surface Protection for Cylinder Rods

Steel cylinder rods include a thin layer of chrome plating on their surfaces to protect them from corroding. However, chrome plating inherently has cracks in its structure which can allow moisture to corrode the underlying steel. At typical ambient temperatures, hydraulic oil is too thick to penetrate these cracks. Normal machine operating temperatures will allow hydraulic oil to warm sufficiently to penetrate these cracks and if machines are operated daily, protect the rods. Machines that are stored, transported, or used in a corrosive environment (high moisture, rain, snow, or coastline conditions) need to have the exposed rods protected more frequently by applying a protectant. Unless the machine is operated daily, exposed rod surfaces will corrode. Some cylinders will have rods exposed even when completely retracted. Assume all cylinders have exposed rods, as corrosion on the end of the rod can ruin the cylinder.

It is recommended that all exposed cylinder rods be protected using Boeshield® T-9 Premium Metal Protectant. Manitowoc Crane Care has Boeshield® T-9 Premium Metal Protectant available in 12 oz. cans that can be ordered through the Parts Department.

NOTE: Cylinder operation and inclement weather will remove the Boeshield® protectant; therefore, inspect machines once a week and reapply Boeshield® to unprotected rods.

Table 5-1
Lube Symbol Chart

Symbol	Description
AFC	Antifreeze/Coolant - 50/50 Blended, Fully Formulated - SAE Grade J1941
EO	Engine Oil - SAE 15W-40, API Service Classification CJ-4.
EP-MPG	Extreme Pressure Multipurpose Grease - Lithium Soap Base, NLGI Grade 2.
SGL-5	Synthetic Gear Lubricant - SAE Grade 50, API Gravity 23.
HYDO	Hydraulic Oil - Must meet John Deere Standard JDM-J20C, Allison C4, and ISO 4406 level.
SSGL-5	Semi-Synthetic Gear Lubricant - SAE Grade 80W-90, API Service Designation GL-5.
ASC	Anti-Seize Compound - Military Specifications MIL-A-907E.
EP-OGL	Open Gear Lubricant - Fuchs Ceplattyn 300 Spray, NLGI Class 1-2
AGMA No. 4 EP	Extreme Pressure Gear Lube

Table 5-2
Lube Description

Lubrication Description	Lube Specification
50/50 Fully Formulated Anti-Freeze Coolant	6829101130
Engine Oil SAE 15W40	6829104182
Extreme Pressure Multi-Purpose Grease	6829003477
Synthetic Gear Lube	6829013433
Hydraulic Oil	6829006444
Semi-Synthetic Gear Lube	6829012964
Anti-Seize Compound	6829003689
Open Gear Lube	6829102971
Extreme Pressure Gear Lube	6829100213
Supplemental Coolant Additive	6829012858
Wire Rope	See Service Manual

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 (refer to Figure 5-1 through 5-3, Table 5-1 and Table 5-2).

CAUTION

The following lube intervals are to be used as a guideline only. Actual lube intervals should be formulated by the operator to correspond accordingly to conditions such as continuous duty cycles and/or hazardous environments.

CARRIER LUBRICATION

1. Engine Crankcase

Lube Type - EO - 15W40

Lube Interval - Check fluid level every 10 hours or daily, whichever interval occurs first. Drain, fill and replace filter every 400 hours.

Lube Amount - Capacity - ISX - 42.8 l (11.3 gal)
- QSM - 37 l (9.7 gal)

Application - Fill to full mark on dipstick.

2. Engine Cooling System

Lube Type - AFC

Lube Interval - Check coolant level every 10 hours or daily, whichever interval occurs first. Drain and refill cooling system every 2000 hours or 12 months.

Lube Amount - Capacity - ISX - 74.6 l (19.7 gal)
- QSM - 64.4 l (17 gal)

CAUTION

Improper filling of the engine coolant system can result in engine damage.

Application -

- a. Open petcock in upper radiator tube to vent air during initial fill.

Fill slowly. Flows exceeding 12 l/min (3 gpm) can give a false level. When coolant squirts out, close petcock, then fill radiator to bottom of filler neck with mixture of 50% AFC and 50% water.

Run engine through two (2) thermal cycles.

Wait 1 minute and recheck coolant level and refill as required.

Supplemental Coolant Additive SCA - Spec 682912858:

Lube Interval - Change filter and check coolant SCA level every 500 hours or 6 months.

Check coolant for contamination every 1000 hours or 1 year.

Lube Amount - See Service Manual

3. Transmission

Lube Type - SGL-5

Lube Interval - Check fluid level every 500 hours, 6 months, or 9,000 miles, whichever interval occurs first.

Drain, fill, and replace filter every 80,000 km (50,000 mi) or 2 years, whichever interval occurs first.

Lube Amount - Capacity - 18.9 l (20 qt)

Application - Fill to check plug on the left-hand side of the transmission.

4. Pump Drive Shaft

a. U-Joints

Lube Type - EP-MPG

Lube Interval - 250 hours

Lube Amount - Until grease extrudes

Application - 2 grease fittings

b. Spline

Lube Type - EP-MPG

Lube Interval - 500 hours

Lube Amount - Until grease extrudes

Application - 1 grease fitting

5. PTO Clutch

Lube Type - HYDO

Lube Interval - 500 hours or 3 months

Lube Amount - Capacity - 650 ml (22 fl.oz.)

Application - Fill until oil weeps from side port.

6. Driveline

Lube Type - EP-MPG

Lube Interval - 500 Hours or 10,000 miles whichever interval occurs first

Lube Amount - Until grease extrudes

Application - 3 grease fittings

7. Power Steering Gearbox

Lube Type - EP-MPG

Lube Interval - 1000 hours

Lube Amount - Until grease extrudes

Application - 1 grease fitting

8. Steering Relay Arms

Lube Type - EP-MPG

Lube Interval - 250 hours

Lube Amount - Until grease extrudes

Application - 2 grease fittings

9. Front Aluminum Wheel Pilots

Lube Type - ASC

Lube Interval - When wheels are removed for service.

Lube Amount - Generously coat the wheel pilot or hub pads with anti-seize (ASC) compound. Do not apply anti-seize compound to the face of the wheel of the hub.

Application - Brush on

CAUTION

Axle fluid levels shall be adjusted to bottom of fill plug threads. Check with crane on level ground, at its normal ride height, cold or room temperature oil only.

10. Front Axle Hubs

Lube Type - SSGL-5

Lube Interval - Check fluid level every 250 hours and refill as necessary.

Lube Amount - 0.95 liter (1.0 quart)

Application - Fill to the oil level mark on the housing with the fill plug and the oil level mark horizontal.

11. Front Axle Tie Rod Ends

Lube Type - EP-MPG

Lube Interval - 1000 hours

Lube Amount - Until grease extrudes

Application - 4 grease fittings

12. Front Axle King Pins

Lube Type - EP-MPG

Lube Interval - 1000 hours

Lube Amount - Until grease extrudes

Application - 8 grease fittings

13. Front Axle Brake Slack Adjusters

Lube Type - EP-MPG

Lube Interval - 1000 hours

Lube Amount - Until grease extrudes

Application - 4 grease fittings

14. Front Axle Brake Camshafts

Lube Type - EP-MPG

Lube Interval - 1000 hours

Lube Amount - Until grease extrudes

Application - 4 grease fittings

15. Rear Aluminum Wheel Pilots

Lube Type - ASC

Lube Interval - When wheels are removed for service.

Lube Amount - Generously coat the wheel pilot or hub pads with anti-seize (ASC) compound. Do not apply anti-seize compound to the face of the wheel or the hub.

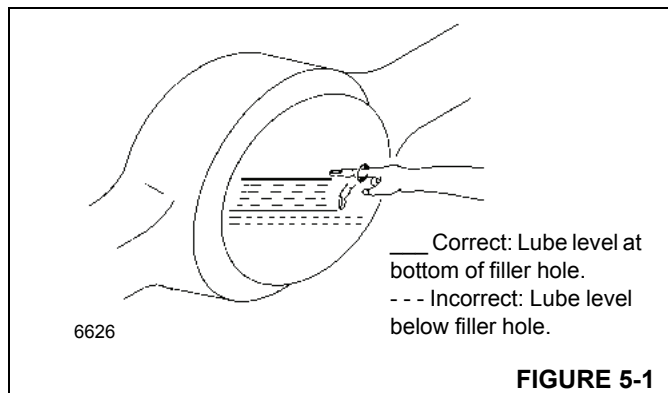
Application - Brush on; 8 places

16. Front Rear Axle Differential

Lube Type - SSGL-5

Lube Interval - Check lubricant level every 250 hours and refill as necessary. Drain, fill, and clean magnetic drain plug every 80,000 km (50,000 mi) or 2 years, whichever interval occurs first.

drain plug every 80,000 km (50,000 mi) or 2 years, whichever interval occurs first

**CAUTION**

Axle fluid levels shall be adjusted to bottom of fill plug threads. Check with crane on level ground, at its normal ride height, cold or room temperature oil only.

If the makeup amount is substantially more than 0.23 liter (0.5 pint) check for leaks.

CAUTION

Axle fluid levels shall be adjusted to bottom of fill plug threads. Check with crane on level ground, at its normal ride height, cold or room temperature oil only.

If the makeup amount is substantially more than 0.23 liter (0.5 pint) check for leaks.

Lube Amount - Capacity - 27 l (57 pt) Normal makeup - less than 0.23 l (0.5 pt)

Application - Fill to bottom of fill plug threads.

Lube Amount - Capacity - 17.5 l (37 pt) Normal makeup - less than 0.23 l (0.5 pt)

Application - Fill to bottom of fill plug threads.

NOTE: Lube level (Figure 5-1) close enough to the hole to be seen or touched is not sufficient. It must be level with the hole.

When checking lube level, also check and clean housing breathers.

NOTE: Figure 5-1 pertains to the differentials and the planetary hubs and wheel bearings.

17. Rear Rear Axle Differential

Lube Type - SSGL-5

Lube Interval - Check lubricant level every 250 hours and refill as necessary. Drain, refill, and clean magnetic

18. Rear Axle Brake Slack Adjusters

Lube Type - EP-MPG

Lube Interval - 1000 hours

Lube Amount - Until grease extrudes

Application - 4 grease fittings

19. Rear Axle Brake Camshafts

Lube Type - EP-MPG

Lube Interval - 1000 hours

Lube Amount - Until grease extrudes

Application - 4 grease fittings

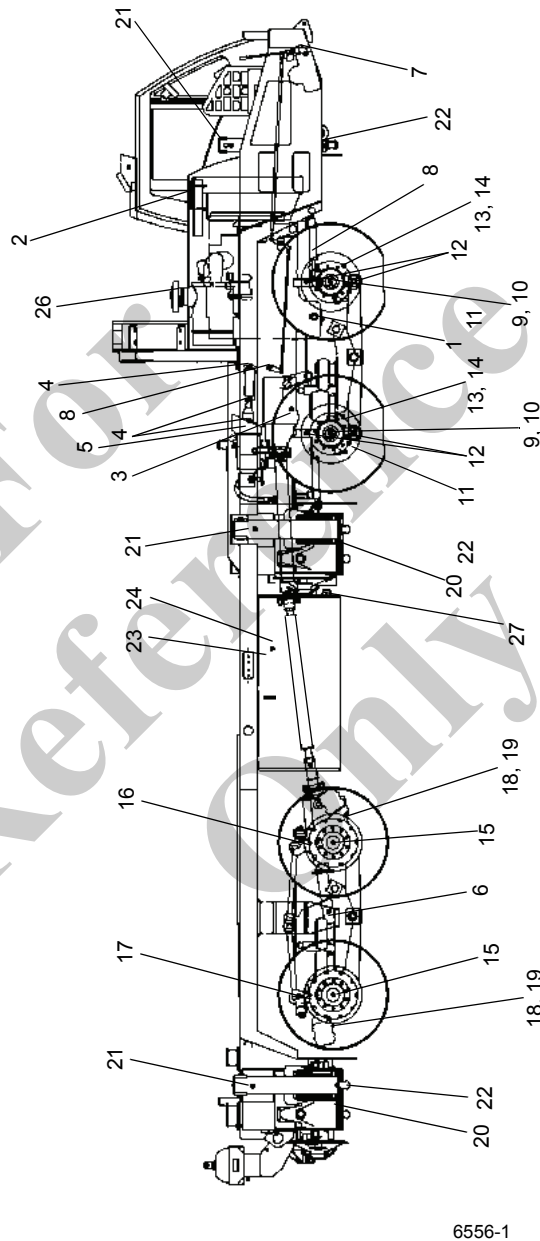


FIGURE 5-2

Item	Description
1	Engine Crankcase
2	Engine Cooling System
3	Transmission
4	Pump Drive Shaft U-Joints and Spline
5	PTO Clutch
6	Driveline
7	Power Steering Gearbox
8	Steering Relay Arms
9	Front Aluminum Wheel Pilots
10	Front Axle Hubs
11	Front Axle Tie Rod Ends
12	Front Axle King Pins
13	Front Axle Brake Slack Adjusters
14	Front Axle Brake Camshafts
15	Rear Aluminum Wheel Pilot
16	Front Rear Axle Differential
17	Rear Rear Axle Differential
18	Rear Axle Brake Slack Adjusters
19	Rear Axle Brake Camshafts
20	Outrigger Beams
21	Jack Cylinder Support Tubes
22	Jack Cylinder Barrels
23	Hydraulic Reservoir
24	Hydraulic Filter
25	Fuel Filter
26	Air Cleaner
27	Coolant Strainer (Superstructure Cab Heater)
28	N/A

20. Outrigger Beams

Lube Type - EP-MPG

Lube Interval - 50 hours or 1 week, whichever interval occurs first

Lube Amount - Brush on bottom of outrigger beams.

Application - Brush on; 8 places

21. Jack Cylinder Support Tubes

Lube Type - EP-MPG

Lube Interval - 500 hours

Lube Amount - Brush on ID of jack cylinder support tubes and wear bands before installing jack cylinders.

Application - Brush on; 5 places

22. Jack Cylinder Barrels

Lube Type - EP-MPG

Lube Interval - 50 hours or 1 week, whichever interval occurs first

Lube Amount - Fully extend outriggers and brush lubricant onto cylinder barrels.

Application - Brush on; 5 places

23. Hydraulic Reservoir

Lube Type - HYDO

Lube Interval - Check fluid level every 10 hours or daily, using sight gauge on side of tank, with boom down and retracted and all outrigger cylinders retracted; drain and refill as necessary. Replace oil every 2000 hours or 2 years, whichever interval occurs first.

NOTE: After 2000 hours or 2 years of service, an oil sample should be taken and laboratory analyzed. If it continues to meet a minimum cleanliness level of ISO 16/13, the service interval can be increased to 3000 hours or 3 years.

Lube Amount - 656.6 l (173.5 gal) (tank only), to the FULL mark on sight gauge.

Application - Fill through filler cap on top of tank. When tank is drained, clean the magnetic pipe plug.

Replace breather every 500 hours or 6 months, whichever interval occurs first.

24. Hydraulic Filter

Check filter every 500 hours or 6 months, whichever interval occurs first.

Change the filter when the indicator is red.

25. Fuel Filter

Drain water trap every 10 hours or daily and change filter every 500 hours or 6 months.

26. Air Cleaner Filter

Replace air cleaner filter element when indicator shows red (25" H₂O).

27. Coolant Strainer (Superstructure Cab Heater)

Close the shutoff valves. Unscrew the hex plug and clean the strainer screen after first 100 hours and every 2000 hours or 12 months thereafter.

28. N/A**SUPERSTRUCTURE LUBRICATION****29. Turntable Gear Box**

Lube Type - SSGL-5

Lube Interval - Check and fill every 50 hours. Drain and fill after first 250 hours and every 500 hours or 12 months thereafter, whichever interval occurs first.

Lube Amount -5.4 l (1.4 gal)

Application - Fill until oil level is at top of sight gauge

30. Turntable Gear and Drive Pinion

Lube Type - OGL

Lube Interval - 500 hours or 6 months, whichever interval occurs first

Lube Amount - Coat all teeth

Application - Spray on; 2 places

Swivel Lock Pin

Lube Type - EP-OGL

Lube Interval - 500 hours or 6 months, whichever interval occurs first

Lube Amount - Coat pin

Application - Spray on

31. Turntable Bearing

Lube Type - EP-MPG

Lube Interval - 500 hours or 6 months, whichever interval occurs first

Lube Amount - Until grease extrudes the whole circumference of the bearing.

Application - 2 grease fittings. Rotate the turntable 90° and apply grease to fittings. Continue rotating 90° and grease the fittings until the whole bearing is greased.

32. Main Hoist

Lube Type - AGMA EP-4

Lube Interval - Check and fill every 1000 hours or 12 months, whichever interval occurs first. Drain and fill annually.

Lube Amount - Capacity - 14.7 l (15.5 qt)

Application - Fill until level with the check plug opening.

33. Auxiliary Hoist

Lube Type - AGMA EP-4

Lube Interval - Check and fill every 1000 hours or 12 months, whichever interval occurs first. Drain and fill annually.

Lube Amount - Capacity - 14.7 l (15.5 qt)

Application - Fill until level with the check plug opening.

BOOM, JIB, AND BOOM ACCESSORIES LUBRICATION

NOTE: To service the boom at boom lengths longer than 120 ft (to access grease fittings, grease the sections, or to change the holding valve), a minimum of 12,000 pounds of counterweight must be installed on the turntable and the outriggers must be fully extended. Boom must be positioned over the right-hand side of the machine. No rigging, no hook block, or overhaul ball may be installed on the nose of the boom.

Extend boom to desired length at a boom angle of 20 degrees. Lower boom until RCL limits the boom lower function. Override RCL per RCL Operator's Manual and lower boom to desired angle.

34. Boom Pivot Shaft

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months, whichever interval occurs first

Lube Amount - Until grease extrudes

Application - 2 grease fittings, one on each side

35. Extend Cable Sheaves

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months, whichever interval occurs first

Lube Amount - Until grease extrudes

Application - 1 grease fitting; extend boom for entry through access holes in fly and outer mid sections.

36. Retract Cable Sheaves

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months, whichever interval occurs first

Lube Amount - Until grease extrudes

Application - 2 grease fittings; extend boom for entry through access holes in front of inner mid section at boom length of 39 m (128 feet)

37. Telescope Cylinder Wear Pads

Lube Type - EP-MPG

Lube Interval - Every boom teardown.

Lube Amount - Thoroughly coat all areas the wear pads move on.

Application - By brush; 5 places.

NOTE: Should boom chatter or rubbing noises in the boom occur, it will be necessary to lubricate the telescope cylinder wear pads. By adding an extension adapter to a grease gun the wear pads and wear areas can be reached through the lubrication access holes in the side of the boom and through the access hole in the boom nose between the sheaves.

38. Internal Side and Bottom Wear Pads (Inner Sections)

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months, whichever interval occurs first. Lubricate more frequently if environmental conditions and/or operating conditions necessitate.

Lube Amount - Thoroughly coat all areas the wear pads move on.

Application - By brush: 14 places; with boom in extended position through access holes in inner and outer mid section.

39. Boom Section Upper Wear Pads

Lube Type - EP-MPG

Lube Interval - 50 hours or 1 week, whichever interval occurs first. Lubricate more frequently if environmental conditions and/or operating conditions necessitate.

Lube Amount - Until grease extrudes

Application - 8 places; with boom in extended position through access holes.

40. Boom Section Upper and Lower Wear Pads

Lube Type - EP-MPG

Lube Interval - 50 hours or 1 week, whichever occurs first. Lubricate more frequently if environmental conditions and/or operating conditions necessitate.

Lube Amount - Thoroughly coat all areas the wear pad moves on.

Application - By brush; 12 places; with boom in extended position.

41. Upper Boom Nose Sheaves

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months, whichever occurs first

Lube Amount - Until grease extrudes

Application - 2 grease fittings per sheave

42. Lower Boom Nose Sheaves

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months, whichever occurs first

Lube Amount - Until grease extrudes

Application - 4 grease fittings per sheave

43. Boom Extension Sheaves

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months, whichever occurs first

Lube Amount - Until grease extrudes

Application - 2 grease fittings

44. Boom Extension Mast Sheave

Lube Type - EP-MPG

Lube Interval - 500 hours or 12 months, whichever occurs first

Lube Amount - Until grease extrudes

Application - 1 grease fitting

45. Auxiliary Boom Nose Sheave

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months, whichever interval occurs first

Lube Amount - Until grease extrudes

Application - 1 grease fitting

46. Hook Block Swivel Bearing

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months, whichever interval occurs first

Lube Amount - Until grease extrudes

Application - 1 grease fitting

47. Hook Block Sheaves

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months, whichever interval occurs first

Lube Amount - Until grease extrudes

Application - 1 grease fitting per sheave

(4 fittings total - 75 ton)

48. Overhaul Ball Swivel Top

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months, whichever interval occurs first

Lube Amount - Until grease extrudes

Application - 1 grease fitting

Item	Description
29	Turntable Gearbox
30	Turntable Gear and Drive Pinion
31	Turntable Bearing
32	Main Hoist
33	Auxiliary Hoist
34	Boom Pivot Shaft
35	Extend Cable Sheaves
36	Retract Cable Sheaves
37	Telescope Cylinder Wear Pads
38	Internal Side and Bottom Wear Pads (Internal Sections)
39	Boom Section Upper Wear Pads
40	Boom Section Upper and Lower Wear Pads
41	Upper Boom Nose Sheaves
42	Lower Boom Nose Sheaves
43	Boom Extension Sheaves
44	Boom Extension Mast Sheave
45	Auxiliary Boom Nose Sheave
46	Hook Block Swivel Bearing
47	Hook Block Sheaves
48	Overall Ball Swivel Top

WIRE ROPE LUBRICATION

Wire rope is lubricated during manufacturing so that the strands, and individual wires in strands, may move as the rope moves and bends. A wire rope cannot be lubricated sufficiently during manufacture to last its entire life. Therefore, new lubricant must be added periodically throughout the life of a rope to replace factory lubricant which is used or lost.

NOTE: Wire rope may be purchased by contacting the Manitowoc Crane Care Parts Department.

For more detailed information concerning the lubrication and inspection of wire rope, refer to WIRE ROPE in Section 1-INTRODUCTION in the *Service Manual*.

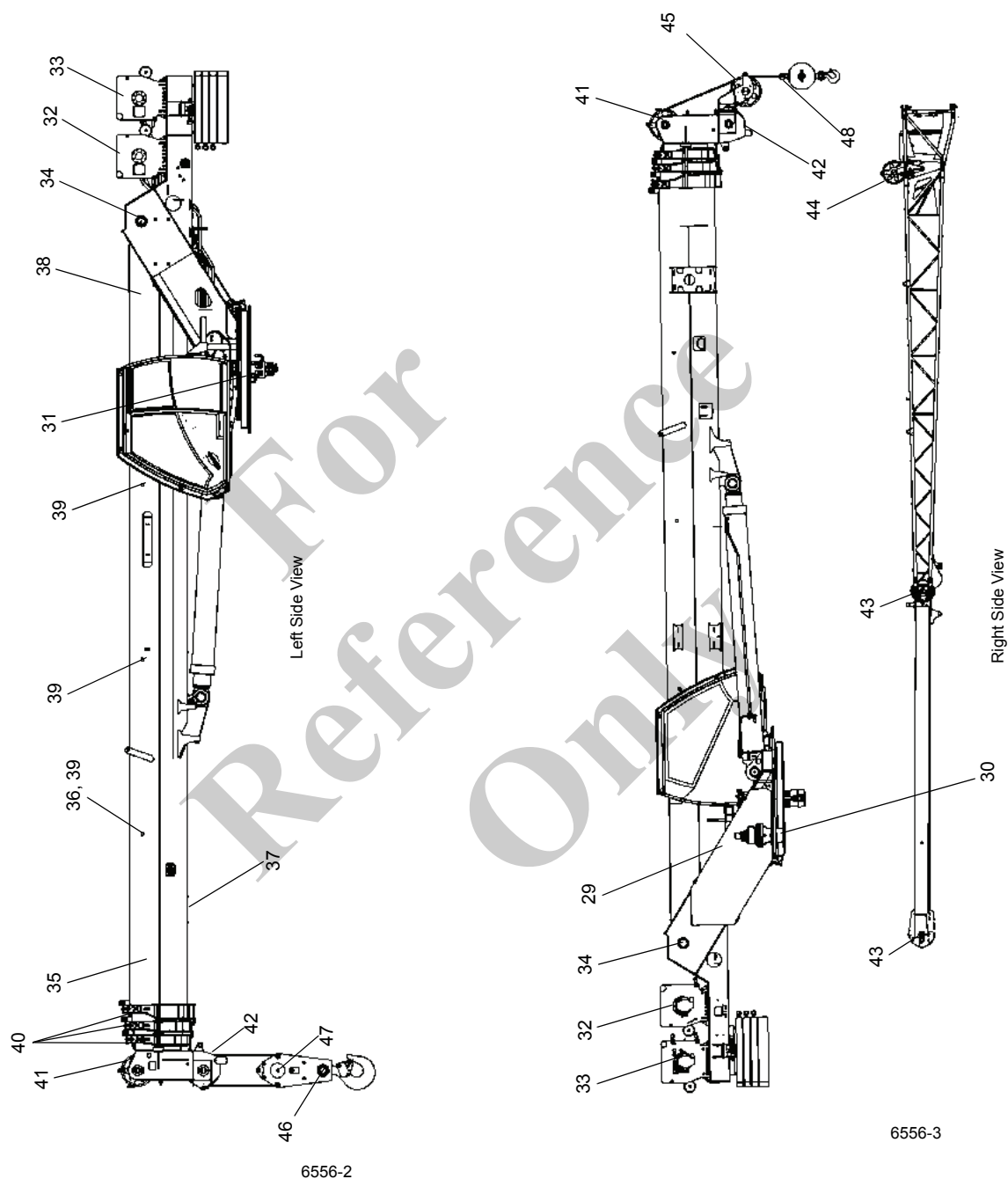


FIGURE 5-3

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SECTION 6

MAINTENANCE CHECKLIST

SECTION CONTENTS

General	6-1	Instructions	6-1
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GENERAL

This section contains a list of daily inspection and maintenance checks. Performing the checks will help maintain the safety, dependability, and productivity designed into your crane.

INSTRUCTIONS

See Service Manual for specific maintenance and adjustment procedures.

See Section 5 (in this handbook) for lubrication intervals, types of fluids, and lube point locations.

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INSPECTION SERVICE LOG

Reference	Items to be Inspected Daily	Interval	DAY OF INSPECTION																														
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
	December	D																															
1	Verify Outrigger Float Pads are properly installed & show no signs of structural damage	D																															
2	Verify Tire Condition has no excessive wear and Pressure is at the proper level	D																															
3	Visually check machine for any Hydraulic Components (including Hoses) with excessive wear, loose fittings, or leaks	D																															
4	Visually check for any loose or damaged Wiring	D																															
5	Verify Engine Coolant is at the proper level	D																															
6	Verify Crankcase and Transmission have the proper fluid levels	D																															
7	Verify Hoists are installed properly with no signs of damage, or leaks	D																															
8	Operator's Manual installed properly on machine.	D																															
9	Verify that the "Operator Aids" are working properly - Boom Angle Indicator, Load Moment Indicator (LMI), Antitwo-Block.	D																															
10	Gauges and Instruments are functional	D																															
11	Back-up Alarm operates properly when operating machine	D																															
12	Swing Brake operates properly	D																															
13	Verify Brakes and Air System (if equipped) are working properly	D																															
14	Lights and Horn are in good working order and not damaged	D																															
15	Verify Hydraulic Reservoir has the proper fluid level	D																															
16	Hydraulic Oil Filter (check back pressure)	D																															
17	Verify Boom and Attachments are properly installed with no signs of damage, or leaks	D																															
18	Verify Wire Rope has no damaged, frayed, or broken strands	D																															
19		D																															
20		D																															
Inspector's Initials																																	
22	0	D																															
23	0	D																															
24	0	D																															
25	0	D																															
Inspector's Initials																																	

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