

Grove TMS700E

Operator Manual





WARNING

California Proposition 65

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

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

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

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

California Spark Arrestor

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

The original language of this publication is English.

OPERATOR MANUAL

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

TMS700E13

Crane Model Number

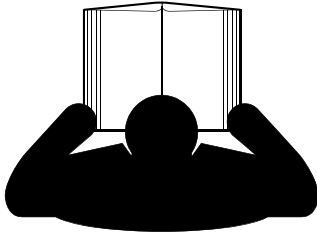
This Manual is divided into the following sections:

- SECTION 1 INTRODUCTION
- SECTION 2 SAFETY INFORMATION
- SECTION 3 OPERATING CONTROLS AND PROCEDURES
- SECTION 4 SET-UP AND INSTALLATION PROCEDURES
- 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.

	<p style="text-align: center;">! DANGER</p> <p>An untrained operator subjects himself and others to death or serious injury. Do not operate this crane unless:</p> <ul 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 Manual and Load Chart are in the holder provided on crane.
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*For
Reference
Only*

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*For
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GENERAL

NOTE: Throughout this handbook, 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.

This manual provides important information for the operator of the TMS700E13 Series Grove Manitowoc Crane.

The mobile crane carrier incorporates an all welded steel frame. The 8x4x4 carrier utilizes two drive axles and two steer axles. Axle 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 an 11 speed forward and 3 speed reverse manual transmission.

Hydraulic, single stage double box telescopic beams with inverted 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 jack that has a permanently mounted 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 swingaway boom extension. Lifting is provided by a main hoist and an optional auxiliary hoist. For basic crane component locations, see Figure 1-1.

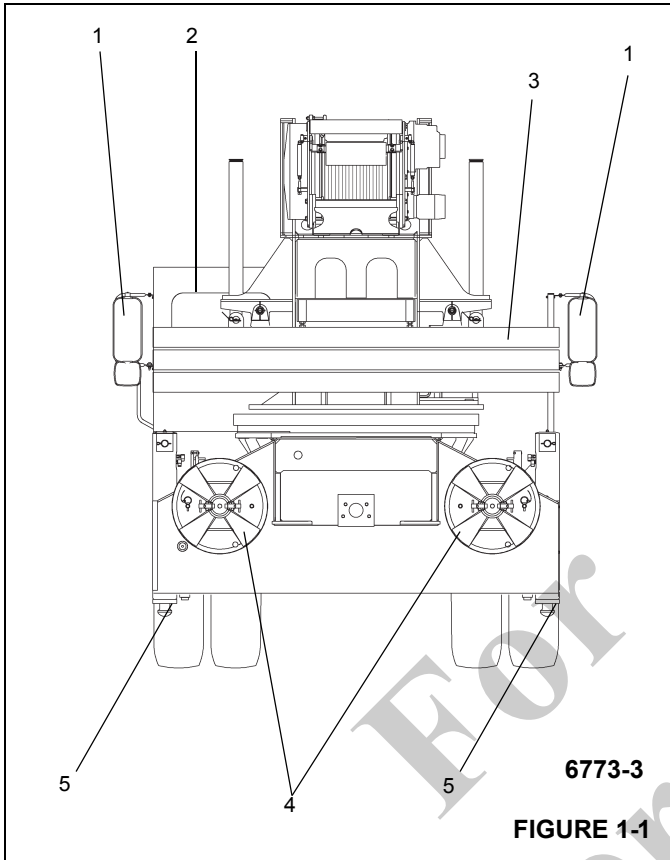
New Owner

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.

NOISE/VIBRATION TEST RESULTS

Noise Level Test Results

- When equipped with the CE certification package, the guaranteed sound power level at the operator’s station with closed cab operation, is L_{wa} 105 dB(A) as measured by Directive 2000/14/EC and 80 db(A) at the crane operator position as measured by Annex G.1 of EN 13000:2010+A1:2014.



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

Reference Only

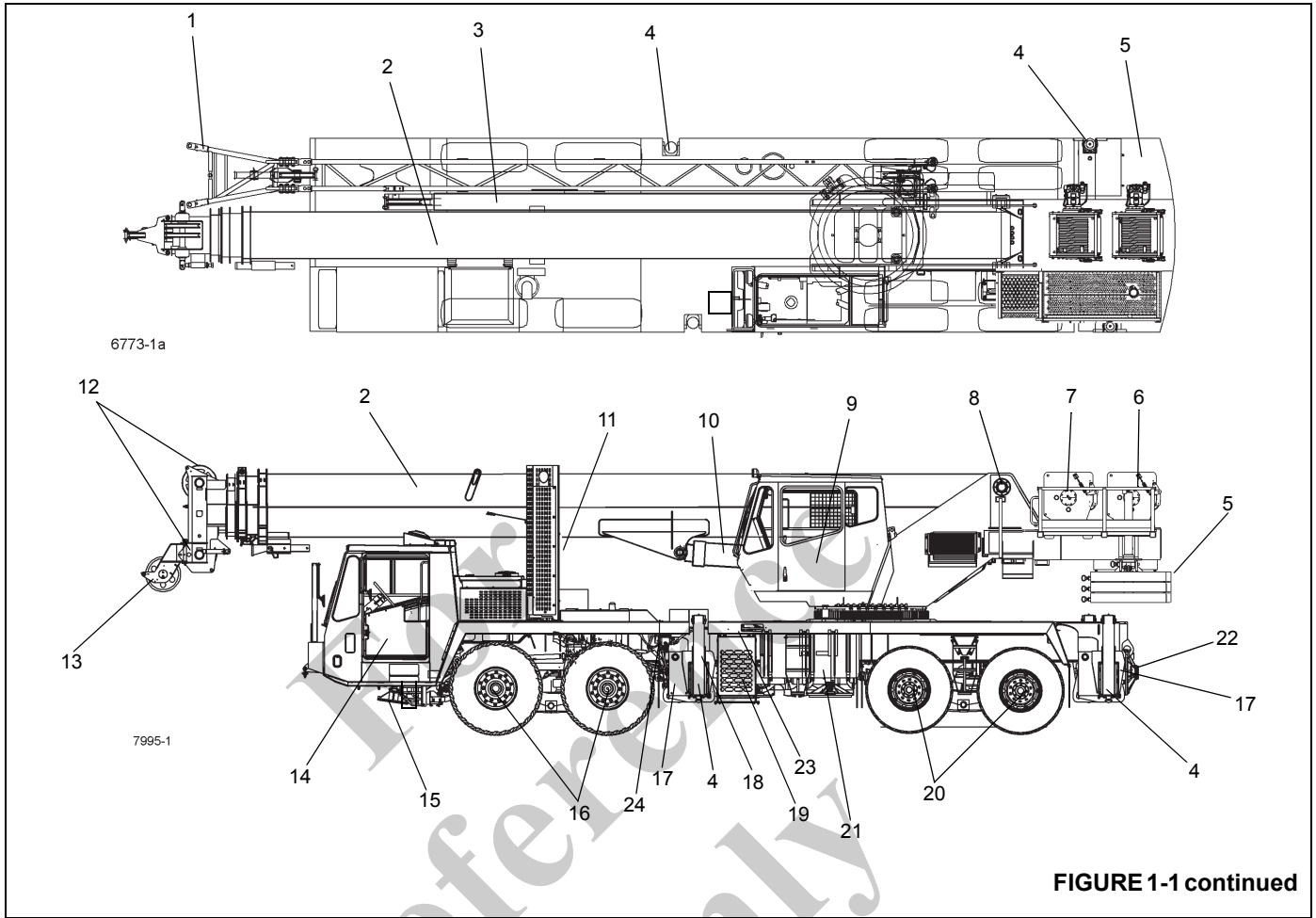


FIGURE 1-1 continued

Item	Description	Item	Description
1	Folding Swingaway	13	Auxiliary Boom Nose
2	Boom	14	Carrier Cab
3	Section 4	15	Center Front Jack
4	Outrigger Jack	16	Front Axles
5	Removable Counterweight	17	Outrigger Beam
6	Auxiliary Hoist	18	Outrigger
7	Main Hoist	19	Hydraulic Oil Cooler
8	Boom Pivot	20	Rear Tandem Axles
9	Superstructure Cab	21	Fuel Tank
10	Lift Cylinder	22	Outrigger Float
11	Boom Rest	23	Diesel Exhaust Fluid (DEF) Tank
12	Boom Nose Sheaves	24	Fuel Filter, Primary

LIST OF SPECIFICATIONS

General

Model	TMS700E13 Series
Rated Capacity	See Load Chart in cab
Drive	8 x 4 x 4
Gross Weight	43,956 kg (96,906 lb)

Dimensions

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

Wheelbase	5639 mm (222 in)
Overall Crane Length	13,538 mm (533 in)
Overall Crane Width	2591 mm (102 in)
Overall Crane Height	3586 mm (141 in)
Tail-Swing	4102 mm (162 in)
Outrigger Spread	
Retracted	2429 mm (96 in)
Mid Extend	4262 mm (168 in)
Fully Extended	6096 mm (240 in)

Capacities

Fuel Tank	367 l (97 gal)
Coolant System	See Engine Specifications
Engine Lubrication System	See Engine Specifications
Hydraulic Tank (Reservoir Capacity)	
Total	564 l (149 gal)
at Full Level	507 l (134 gal)
at Add Level	477 l (126 gal)
Expansion Space	57 l (15 gal)
Hoists	14.7 l (15.5 qt)
Swing Gearbox	1.30 l (2.75 pt)
Front Axle Hubs	0.95 l (1 qt)
Front Rear Axle Differentials	.27 l (57 pt)
Rear Rear Axle Differentials	17.5 l (37 pt)
Transmission	.19 l (20 qt)
Pump Drive	2.4 l (2.5 qt)

Transmission

Speeds	11 forward - 3 reverse
Gear Ratios	
LL2	11.85
Low	16.30
LL1	26.08
Low	
First	7.41
Second	5.23
Third	3.79
Fourth	2.77
High	
Fifth	1.95
Sixth	1.38
Seventh	1.00
Eighth	0.73
Reverse	
Low	13.03
High	3.43

Clutch

Type	2 plate pull type dry disc
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Engine

Cummins ISX12-2013 or QSMT3 in-line 6 cyl. Turbo-Charged

Displacement	11.9 l (729 cu in)(ISX)
	10.9 l (665 cu in)(QSM)
Firing Order	1-5-3-6-2-4
Lube Amount	41.6 l (11 gal)(ISX)
	34 l (36 qt)(QSM)
Coolant System	.54 l (57 qt)

Axles

Front

Type	Non-drive steer
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Rear

Type	Single reduction tandem
Ratio	5.38:1

Brakes

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

Wheel and Tires

Lugs	10
Torque	610 to 678 Nm (450 to 500 lb-ft)
Tire Size	
Front	445/65R22.5
Rear	315/80R22.5
For roading and lifting pressures, refer to the Tire Inflation Decal.	

Swing Gearbox

Reduction Ratio	36:2
Output Torque	5.54 Nm (49,825 lb-in)

Boom

Length	10.84 to 33.5 m (35 to 110 ft)
Power	4 Section, Full Power
Elevation	-3 to +78 degrees
Extensions	
Fixed*	9.75 m (32 ft)
Folding*	9.75 or 17.07 m (32 or 56 ft)
Lattice Extension	20 and 6.1 and 12.2 m (40 ft)
*Extensions are offsettable at 0 or 45 degrees	

Swivel Assembly

Electrical	49 Slip Rings
Hydraulic	5 ports
Water	2 ports

Hydraulic Pumps

NOTE: Pump output figures are theoretical.

Pump #1

Type	Gear
Sections	3

Output - @ engine speed 1800 rpm
 Section 1 184.3 lpm (48.7 gpm)
 Section 2 70.4 lpm (18.6 gpm)
 Section 3 88.9 lpm (23.5 gpm)

Section 1 78.7 lpm (20.8 gpm)

Pump #2

Type Gear
 Sections 1
 Output - @ 1800 rpm
 Section 1 88.2 lpm (23.3 gpm)
 Priority flow of 37.9 lpm (10 gpm) at 2175 psi

Pump #3

Type Gear
 Sections 1
 Output - @ 1800 rpm

Hoists

Drum Dimensions
 Diameter 381 mm (15 in)
 Length 467 mm (18-3/8 in)
 Cable
 Diameter 19 mm (3/4 in)
 Length-Main 153 m (500 ft)
 Length-Aux. 153 m (500 ft)
 Max. Permissible Line Pull (6x36)
 90.1 kN (20,250 lb)
 Hoist Motor Displacement
 110 cm³ (6.7 in³) per revolution (low)
 61 cm³ (3.7 in³) per revolution (high)

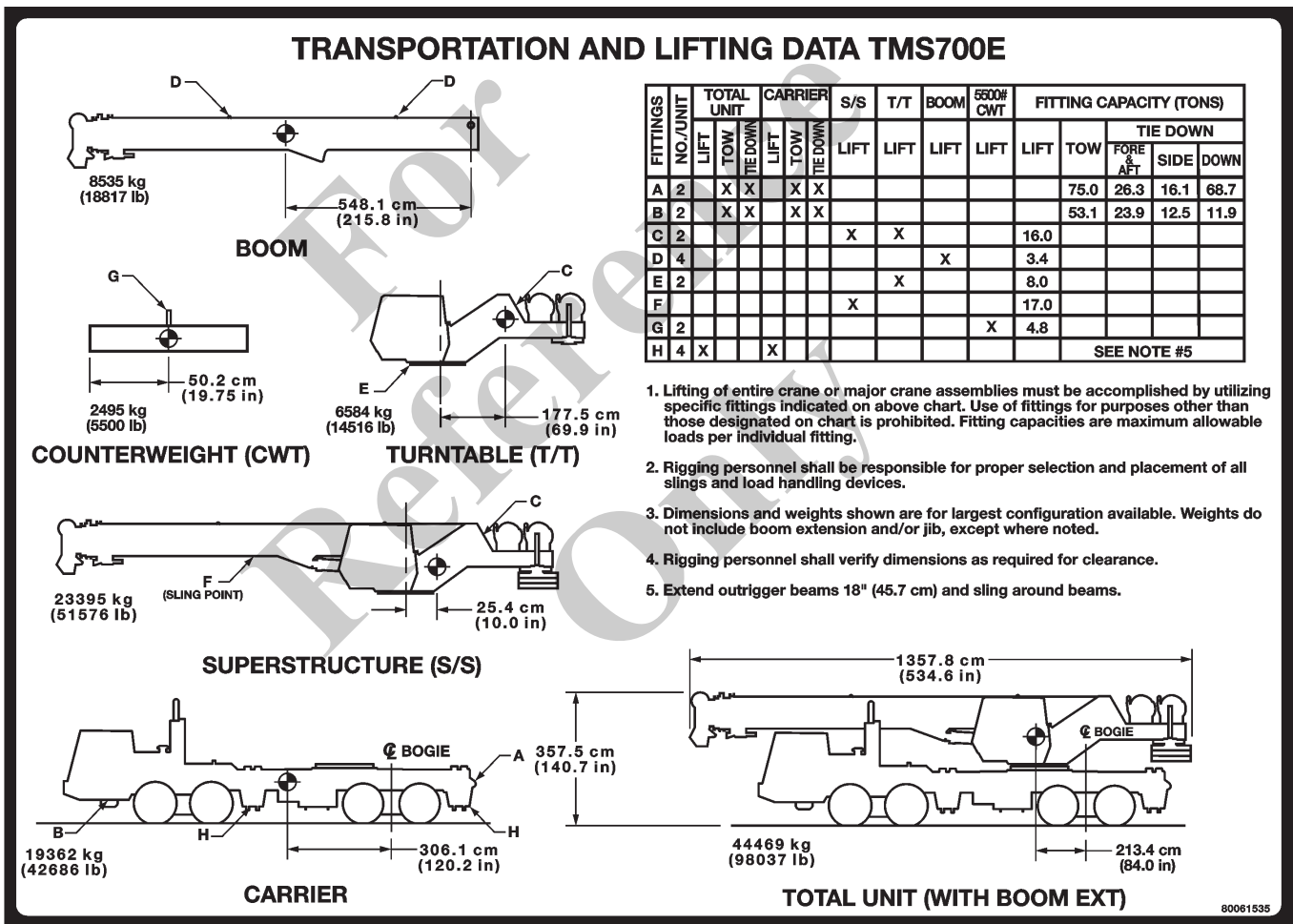


FIGURE 1-2

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SECTION 2

SAFETY INFORMATION

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SAFETY MESSAGES

General

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

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

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

Safety Alert Symbol



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

Signal Words



DANGER

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



WARNING

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



CAUTION

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

CAUTION

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

NOTE: Emphasizes operation or maintenance procedures.

GENERAL

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

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

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

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

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

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

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 INFORMATION

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

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

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

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



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

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

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

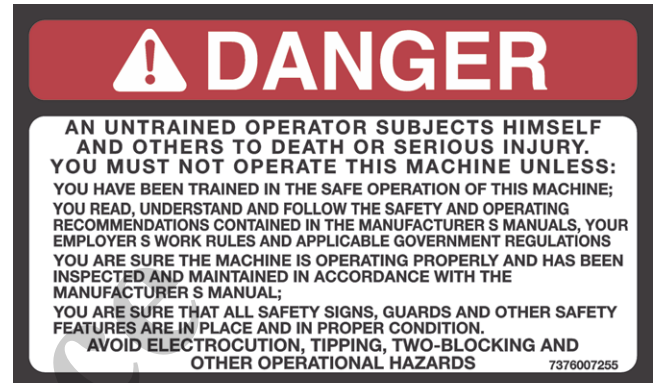
OPERATOR QUALIFICATIONS

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

Ensure that all personnel working around the crane are thoroughly familiar with safe operating practices. You must be thoroughly familiar with the location and content of all 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* and *Service Manuals*.

Anti-Two-Blocking Device

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

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

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

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

Two-blocking can be prevented. Operator awareness of the hazards of two-blocking is the most important factor in preventing this condition. An Anti-Two-Block System is

intended to assist the operator in preventing dangerous two-block conditions. It is not a replacement for operator awareness and competence.

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

Working Area Limiter (If Equipped)

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

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



! DANGER

	<p>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>POSITION CRANE ON FIRM SURFACE. EXTEND OUTRIGGERS AND LEVEL CRANE.</p>	<p>TO AVOID DEATH OR SERIOUS INJURY:</p> <p>NEVER handle personnel with this machine unless the requirements of the applicable national, state and local regulations and safety codes are met.</p> <p>NEVER use this crane for bungee jumping or any form of amusement or sport.</p> <p>NEVER permit anyone to ride loads, hooks, slings or other rigging for any reason.</p> <p>NEVER get on or off a moving crane.</p> <p>NEVER allow anyone other than the operator to be on this crane while it is operating or traveling.</p>
	<p>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>DO NOT PASS LOADS OR BOOM OVER GROUND PERSONNEL.</p>	<p>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.</p> <p>Do not remove any decal, the load chart, or the Operator's and Safety Handbook from this crane.</p>

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FOLLOW INSTRUCTIONS IN OPERATOR'S AND SAFETY HANDBOOK.

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CRANE STABILITY/STRUCTURAL STRENGTH

To avoid death or serious injury, ensure that the crane is on a firm surface with load and crane's configuration within

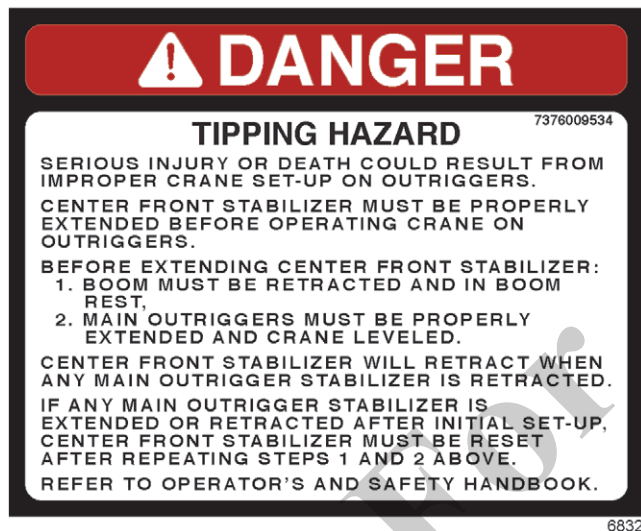
capacity as shown on the crane's *Load Chart* and notes.

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

outriggers must also be pinned when operating from the mid-extend position.

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

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



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

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

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

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

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

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



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

Load Charts

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

Load Chart capacities are based on freely suspended loads.

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

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

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

Work Site

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

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

Wind Forces

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

upon the direction from which the wind is blowing (e.g., wind on the rear of the boom can result in decreased forward stability, wind on the underside of the boom can result in decreased backward stability, wind on the side of the boom can result in structural damages, etc.). 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 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 hoist 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 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.

PILE DRIVING AND EXTRACTING

Pile driving and extracting are applications approved by Manitowoc, provided all equipment is operated within factory guidelines. The following operating requirements must be used during pile driving and extracting with a Manitowoc mobile hydraulic crane:

Pile driving and pile extraction using a mobile crane introduces many variable and unknown factors that must be considered when using a crane for this application. Because of these factors, discretion must be exercised when pile driving or pile extraction is being considered.

It is not the intention of Manitowoc to recommend specific types or makes of pile driving and pile extraction equipment, but rather to advise of the operational requirements to help avoid the detrimental effects that pile driving and pile extraction can have on the crane.

In addition to the operating requirements that are detailed in the operating manuals and on the load capacity chart, pile driving and extracting operations are approved by Manitowoc, provided all guidelines outlined below are followed:

- All pile driving and extracting operations shall be restricted to fully extended outriggers with all tires clear of the ground.
- The combined weight of the driver or extractor, piling, leads, attachments, etc., shall not exceed 80% of the published load chart values for on-outriggers operation.
- The pile driver or pile extractor and attachments shall be kept clear of the boom nose at all times.
- The pile driver and piling shall be suspended from a hoist cable with sufficient line speed to meet or exceed the rate of descent of the driver and piling to preclude impact loading or vibration from being induced into the boom and crane structure.
- Pile driving or extracting shall be restricted to over the main boom only and shall not be permitted over a boom extension 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 load lines shall be kept vertical at all times during pile driving and pile extraction operations.
- The operator and other personnel associated with the pile driving and pile extraction operation shall have read and understood all safety standards applicable to crane operations as well as being thoroughly trained in the safe operation of pile driving and extracting equipment.

Crane Equipment

- Hoists shall be equipped with a cable follower to aid in proper spooling of cable.
- All cable retainer pins and cable guides/retainers shall be in place.
- All boom extensions 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.

ELECTROCUTION HAZARD

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

United States federal law prohibits the use of cranes closer than 6 m (20 ft) to power sources up to 350 kV and greater distances for higher voltages unless the line's voltage is known [29CFR1910.180 and 29CFR1926, subpart CC].

To avoid death or serious injury, Manitowoc recommends that all parts of crane, boom, and load be kept at least 6 m (20 ft) away from all electrical power lines and equipment less than 350 kV.

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.



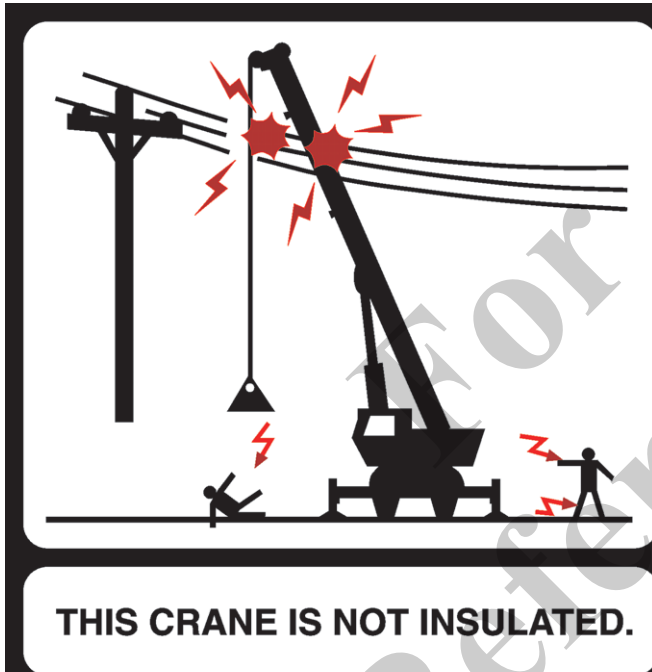
DANGER **Electrocution Hazard!**

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

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

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

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

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

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

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

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

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

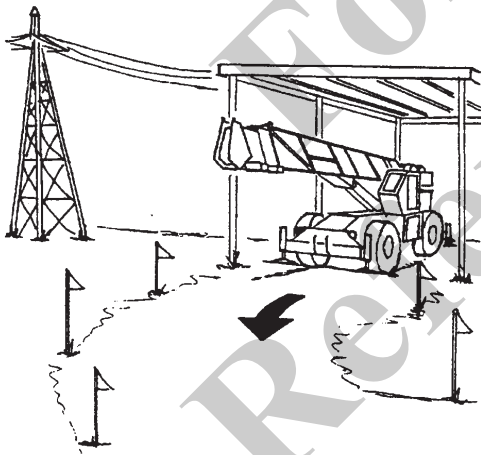
Set-Up and Operation

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

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

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

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



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

Appoint a reliable and qualified signal person, equipped with a loud signal whistle or horn and voice communication equipment, to warn the operator when any part of the crane or load moves near a power source. This person 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 hoist 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 Manual* and other operating manuals are at the operator's station and readily accessible to the operator.
- The platform meets the requirements as prescribed by applicable standards and regulations.
- For hoist rope suspended platforms:
 - The crane is equipped with a hook that can be closed and locked, eliminating the throat opening.
 - The crane is equipped with a functional anti-two-block device.
 - The platform is properly attached and secured to the load hook.
- For boom mounted platforms:
 - The platform is properly attached and secure.

To avoid death or serious injury:

- NEVER use this crane for bungee jumping or any form of amusement or sport.
- NEVER handle personnel on the loadline unless the requirements of applicable national, state and local regulations and safety codes are met.
- NEVER permit anyone to ride loads, hooks, slings or other rigging for any reason.

- NEVER get on or off a moving crane.
- NEVER allow anyone other than the operator to be on this crane while the machine is operating or traveling.
- NEVER allow anyone on the hoist access platform while traveling.

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

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

Service and Repairs



WARNING

Fall Hazard!

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

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

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

HOIST ROPE

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

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

Wire Rope

Always make daily inspections of the wire rope, keeping in mind that all wire rope will eventually deteriorate to a point where it is no longer usable. Refuse to work with worn or damaged wire rope. 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 ropes and attachments, keep all parts of your body and clothing away from rotating hoist drums and all rotating sheaves. Never handle the rope with bare hands.

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

- Sheaves that are too small, worn or corrugated cause damage to a wire rope.
- Broken wires mean a loss in strength.
- Kinks permanently damage a 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.

Synthetic Hoist Rope

For detailed information concerning synthetic hoist rope, refer to KZ100 Synthetic Crane Hoist Line Manual P/N 9828100734 available by contacting Manitowoc Crane Care.

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

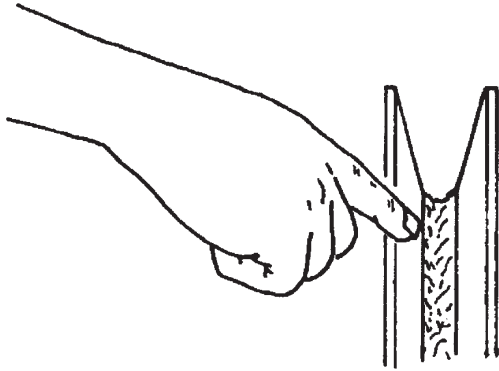
Always make daily inspections of the hoist rope, keeping in mind that all hoist rope will eventually deteriorate to a point where it is no longer usable. Refuse to work with worn or damaged hoist rope.

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

NOTE: Example; if usage of a wire rope has cut grooves with sharp edges in a wear pad, they need to be

addressed before the synthetic hoist rope is used in that same position.

Sheaves



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

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

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

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

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

Batteries

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

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

- Wear safety glasses when servicing batteries.

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

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.

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

TRANSPORTING THE CRANE

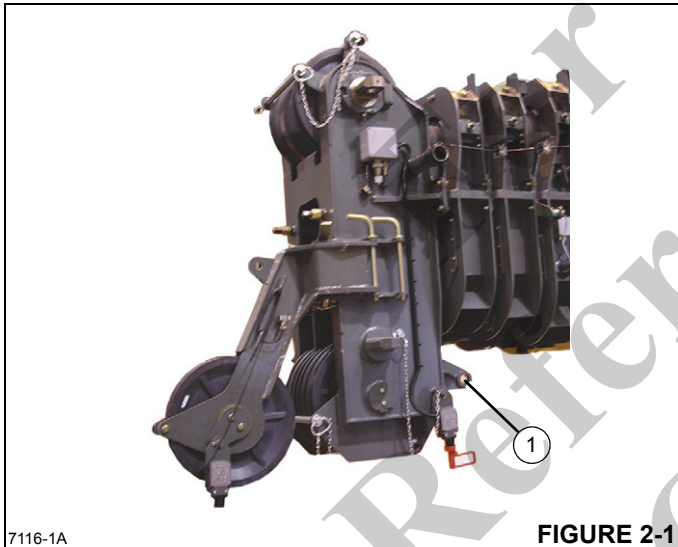
Before transporting the crane, check the suitability of the proposed route with regard to the crane height, width, length, and weight.

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

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

Ensure the crane is adequately secured to the transporting vehicle.

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



7116-1A **FIGURE 2-1**

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 effect 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 down, if equipped with a tilting cab.

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

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

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

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

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

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

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

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

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

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

Stay alert at the wheel.

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

Slopes:

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

WORK PRACTICES

Personal Considerations

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

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

Crane Access



WARNING

Fall Hazard!

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

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

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

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

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

Do not make modifications or additions to the crane's access system that have not been evaluated and approved by 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 jack cylinders are properly extended and set before performing any lifting operations. On models equipped with outriggers that can be pinned at the mid-extend position, the outriggers must also be pinned when operating from the mid-extend position.

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

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

Working

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

Know the location and function of all crane controls.

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

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

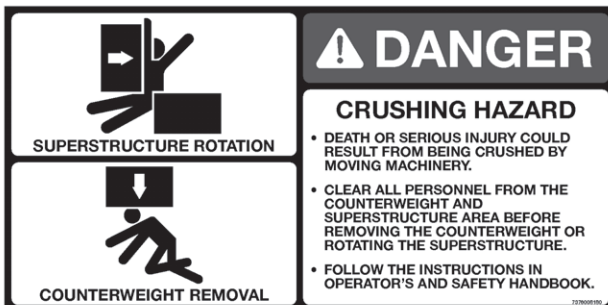
Carbon monoxide fumes from the engine exhaust can cause suffocation in an enclosed area. Good ventilation is very important when operating the crane.

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

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

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

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



Keep unauthorized personnel clear of the working area during operation.

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

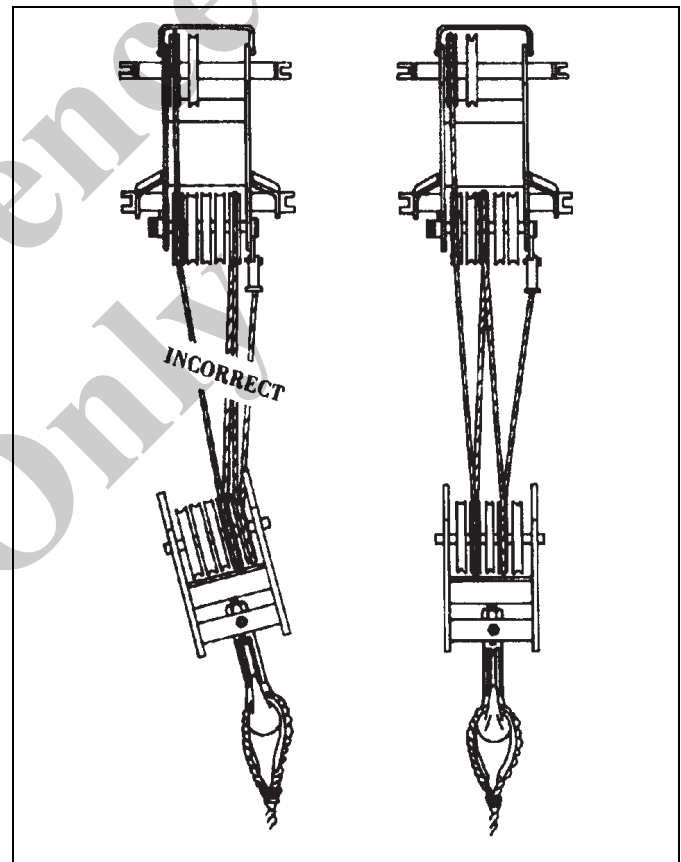
You must always be aware of everything around the crane while lifting or traveling. If you are unable to clearly see in the direction of motion, you must post a look out or signal person before moving the crane or making a lift. Sound the horn to warn personnel

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



Lifting

Use enough parts of line for all lifts and check all lines, slings, and chains for correct attachment. To obtain maximum lifting capacities, the hook block must be set up with enough parts of line. Too few parts of line can result in failure of the hoist rope or hoist. **No less than three wraps of wire rope** should remain on the hoist drum. **No less than eight wraps of synthetic 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:

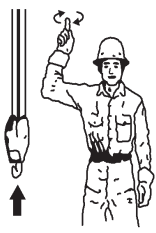
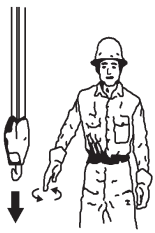
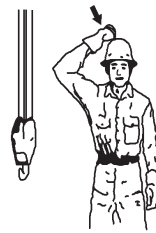
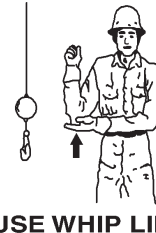
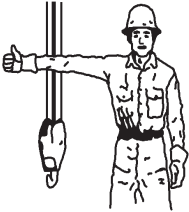
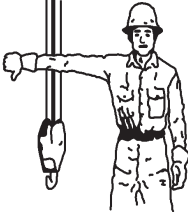
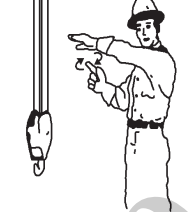
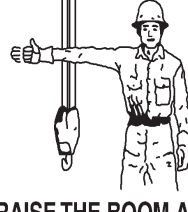
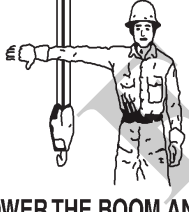

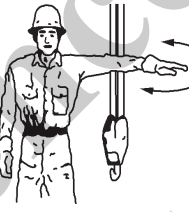
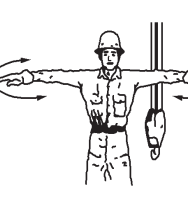
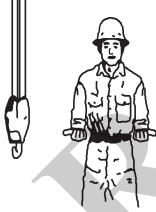

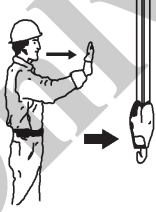
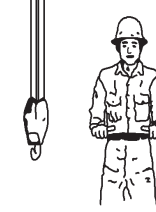


- Working in the vicinity of power lines.
- The crane operator cannot clearly see the load at all times.
- Moving the crane in an area or direction in which the operator cannot clearly see the path of travel.

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.

			
HOIST	LOWER	USE MAIN HOIST	USE WHIP LINE (Auxiliary Hoist)
			
RAISE BOOM	LOWER BOOM	MOVE SLOWLY	RAISE THE BOOM AND LOWER THE LOAD
			
LOWER THE BOOM AND RAISE THE LOAD	SWING	STOP	EMERGENCY STOP
			
EXTEND BOOM	DOG EVERYTHING	TRAVEL	RETRACT BOOM
	HAND SIGNALS		
EXTEND BOOM (ONE HAND)	Reprinted by permission of The American Society of Mechanical Engineers		RETRACT BOOM (ONE HAND)

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



DANGER

Tipping Hazard!

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

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

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

Section 3 of this manual provides instructions for parking and securing a crane when it is to be left unattended. These instructions are intended to allow the crane to be placed in the most stable and secure position. However, 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 0.00077 cubic centimeters per cubic centimeter of volume for 1°C of temperature change (0.00043 cubic inches per cubic inch of volume for 1°F of temperature change). **Thermal contraction will allow a cylinder to retract as the hydraulic fluid which is trapped in the cylinder cools.**

The change in the length of a cylinder is proportional to the extended length of the cylinder and to the change in temperature of the oil in the cylinder. For example, a cylinder

extended 7.6 m (25 ft) in which the oil cools 15.5°C (60°F) would retract approximately 196 mm (7 3/4 in) [see Table 2-2]. A cylinder extended 1.5 m (5 ft) in which the oil cools 15.5°C (60°F) would only retract approximately 38 mm (1 1/2 in). The rate at which the oil cools depends on many factors and will be more noticeable with a larger difference in oil temperature verses the ambient temperature.

Thermal contraction coupled with improper lubrication or improper wear pad adjustments may, under certain conditions, cause a “stick-slip” condition in the boom. This “stick-slip” condition could result in the load not moving smoothly. Proper boom lubrication and wear pad adjustment is important to permit the boom sections to slide freely. Slow movement of the boom may be undetected by the operator unless a load is suspended for a long period of time. To minimize the effects of thermal contraction or “Stick-slip” it is recommended that the telescope control lever is activated periodically in the extend position to mitigate the effects of cooling oil.

If a load and the boom is allowed to remain stationary for a period of time and the ambient temperature is cooler than the trapped oil temperature, the trapped oil in the cylinders will cool. The load will lower as the telescope cylinder(s) retracts allowing the boom to come in. Also, the boom angle will decrease as the lift cylinder(s) retracts causing an increase in radius and a decrease in load height.

This situation will also occur in reverse. If 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. (in³/in³/ °F) X 12 in/ft



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

Coeff. = 0.000774 (1/ °C)		<i>Metric</i>									
STROKE	Temperature Change (°C)										
(m)	5	10	15	20	25	30	35	40	45	50	55
1.5	6	12	17	23	29	35	41	46	52	58	64
3	12	23	35	46	58	70	81	93	104	116	128
4.5	17	35	52	70	87	104	122	139	157	174	192
6	23	46	70	93	116	139	163	186	209	232	255
7.5	29	58	87	116	145	174	203	232	261	290	319
9	35	70	104	139	174	209	244	279	313	348	383
10.5	41	81	122	163	203	244	284	325	366	406	447
12	46	93	139	186	232	279	325	372	418	464	511
13.5	52	104	157	209	261	313	366	418	470	522	575
15	58	116	174	232	290	348	406	464	522	581	639
16.5	64	128	192	255	319	383	447	511	575	639	702
18	70	139	209	279	348	418	488	557	627	697	766

Length change in mm = Stroke (m) X Temperature Change (°C) X Coeff. (1/ °C) X 1000 mm/m

OVERLOAD INSPECTION

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

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

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

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

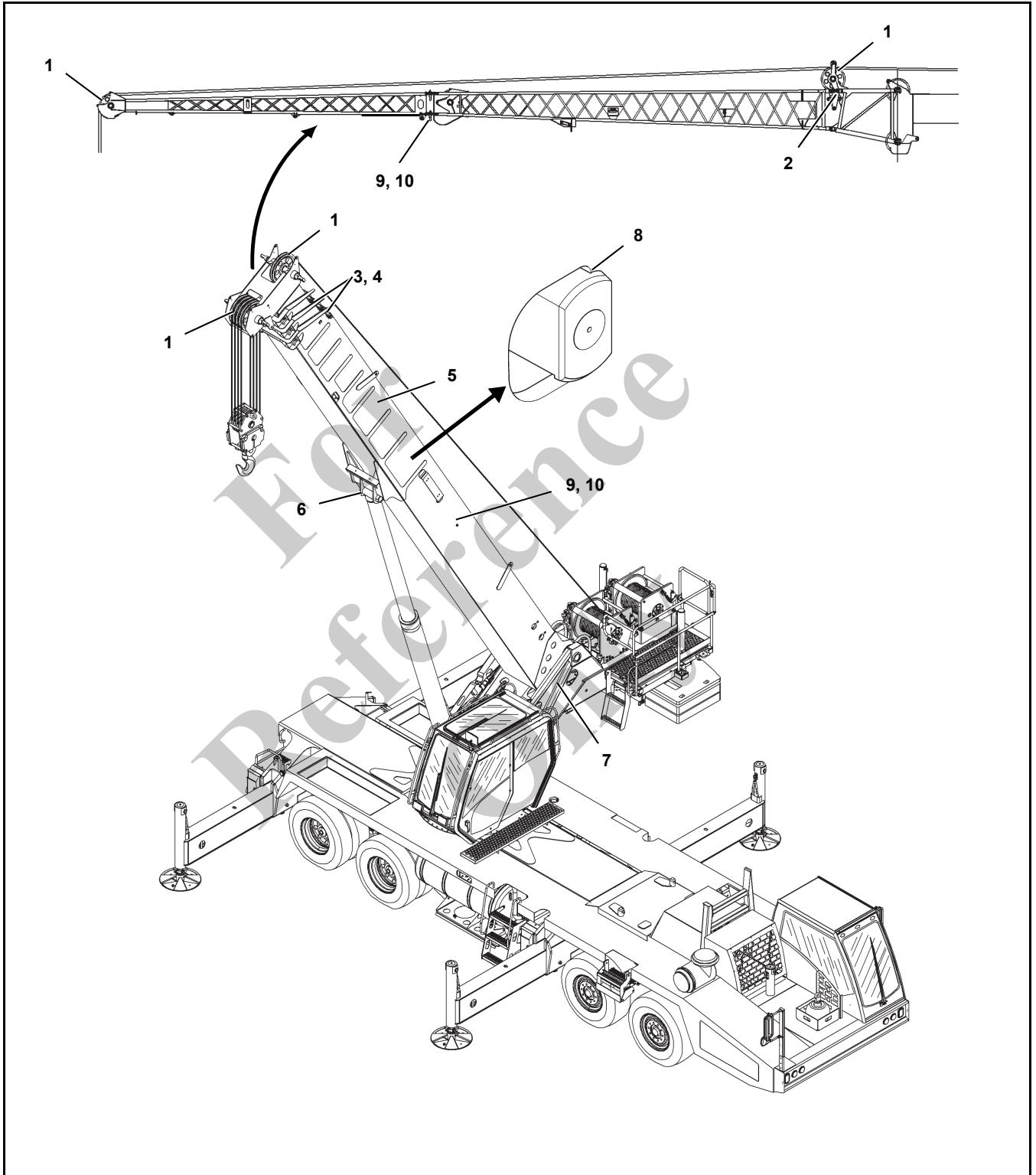
- Perform the inspections outlined in this publication for overloads up to 50%.
 - Stop operating the crane and contact Manitowoc Crane Care immediately for overloads of 50% and higher.
-

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.

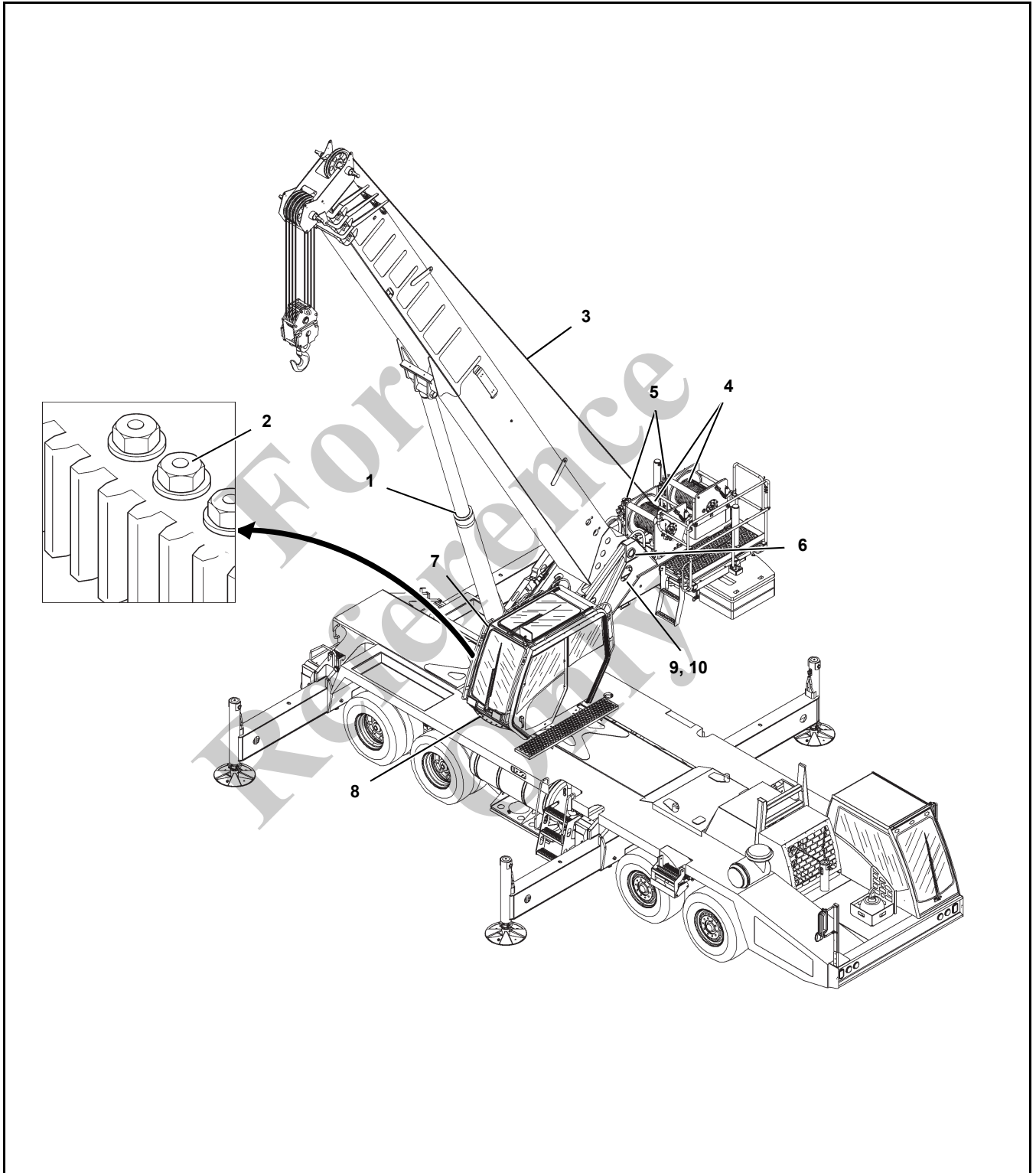
For
Reference
Only

Boom Inspection



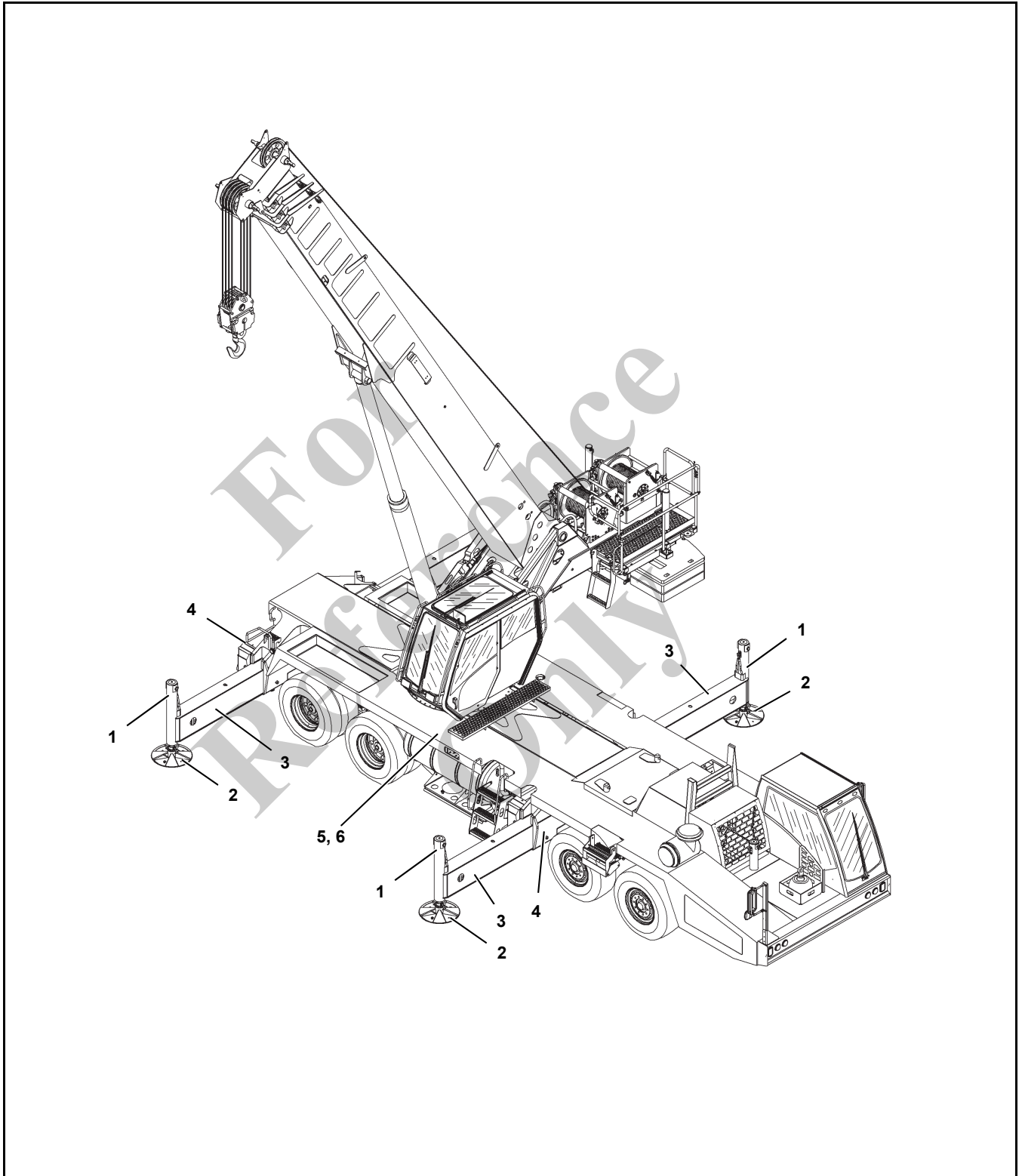
Overload less than 25%			
1	Sheaves	Inspect all for damage.	
2	Luffing Mechanism/ Cylinder	Inspect for damage/leaks.	
3	Collar-wear pads	Inspect all for damage.	
Overload from 25% to 49%			
1	Sheaves	Inspect all for damage.	
2	Luffing Mechanism/ Cylinder	Inspect for damage/leaks.	
3	Collar-wear pads	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.	

For Reference Only

SECTION 3 OPERATING CONTROLS AND PROCEDURES

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The crane is equipped with two cabs, a carrier cab and a superstructure cab. The carrier cab (Figure 3-1) contains all controls and indicators necessary for crane traveling and parking. The superstructure cab (Figure 3-3) 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 or SUPERSTRUCTURE CAB in this Section.

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

All rocker switches, except the engine diagnostics switches, contain one or two LED lighted slots in the switch for illumination. In addition, all but the hydraulic pump disconnect switch contains a LED lighted square to indicate when the switch/function is activated.

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 (1) 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 10 to 16 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 100 psi. It receives a signal from an oil pressure sending unit on the engine.

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 240°F. The gauge receives a signal from a temperature sending unit in the engine cooling system.

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 quantity gauge receives a signal from a sending unit in the fuel tank.

Engine Stop Indicator

The engine stop indicator (23) is located at the top middle left of the front console. It lights red when energized by a signal from the engine ECM that signifies a serious engine problem that requires the vehicle and the engine to be stopped as soon as safely possible. Also a warning buzzer will sound.

Besides alerting the operator of system faults, the engine stop light, along with the engine warning light, is used in the diagnostic work of the engine control system.

The diagnostic mode begins when the ignition switch and engine diagnostics test switch are on and the engine is not running. The amber light flashes at the beginning of a fault code sequence, the red light flashes the three-digit or four-digit code for the active fault and the amber light flashes again to separate the previous red light sequence from the next one. Each code will be flashed twice before moving to the next code. When all codes have been flashed, the sequence will begin again. If no codes are present, both the engine warning and engine stop lights will remain on.

Engine Warning Indicator

The engine warning indicator (24) is located at the top middle left of the front console. It lights amber when energized by a signal from the engine ECM that gives the operator a signal that there is an engine problem which must be corrected.

Besides alerting the operator of system faults, the engine warning light, along with the engine stop light, is used in diagnostic work of the engine control system.

The diagnostic mode begins when the ignition switch and engine diagnostics test switch are on and the engine is not running. The amber light flashes at the beginning of a fault code sequence, the red light flashes the three-digit or four-digit code for the active fault and the amber light flashes again to separate the previous red light sequence from the next one. Each code will be flashed twice before moving to the next code. When all codes have been flashed, the sequence will begin again. If no codes are present, both the engine warning and engine stop lights will remain on.

Tachometer

The tachometer (2) is located on the left side of the front console. The tachometer is calibrated in RPM x 100 with a range of zero (0) to 35 and receives a signal from the sender unit on the engine.

Engine Brake Switches

The engine brake switches are located at the top of the right hand console. The two position (ON/OFF) switch (22) energizes the engine brake. When the switch is in the ON position, the amber LED in the switch will be lit. The two position (HIGH/LOW) switch (20) controls the amount of engine braking. When the switch is in the HIGH position, the amber LED in the switch will be lit.

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 (ACC) (3), OFF (0), RUN (1), and START (2). With ignition switches in both cabs in the OFF position, all electrical power is off except for the headlights, marker lights, gauge lights, turn and stop light, backup lights and alarm, carrier and superstructure cab dome lights, carrier and superstructure cab 12v accessory outlets, boom work lights, superstructure cab work lights, and superstructure horn. The ACC position energizes all electrical components except the engine ECM and starter circuit components. The RUN position is the same as ACC except the engine ECM is energized. The START position energizes the starter relay which in turn energizes the cranking motor solenoid and cranks the engine for starting. The switch will return to RUN when the switch is released after the engine is started. Turn the switch to OFF to shut down the engine.

Throttle Pedal

The throttle pedal (38) is the right most pedal on the cab floor. It is used to control engine RPM. The foot pedal is electronically connected to the engine and modulates engine speed proportionately to the foot pressure applied. The pedal is angled for increased operator comfort.

Engine Diagnostics Switches

Two engine diagnostics (35, 36) switches are located on the right side panel.

Engine Diagnostics/ Idle +/- Switch

This switch (35) is a three position (+/-) momentary rocker switch that provides idle-control inputs that increase and decrease the engine idle speed (when test mode switch is in the OFF position) or diagnostic mode fault codes (when the test mode switch is in the ON position and engine is not running).

Engine Diagnostics Test Switch

This switch (36) is located on the right side console in the carrier cab. It enables the operator to turn on or off the engine diagnostic testing mode.

High Exhaust Temp Indicator

The high exhaust temp indicator (16) lights when an active exhaust regeneration has been initiated and the exhaust temperatures will be elevated above normal levels for the vehicle operating conditions. This can occur while driving or during a manually initiated "stationary regeneration".



WARNING

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

Diesel Exhaust Fluid (DEF) Level Gauge

This gauge (10), 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.

Regen Needed/Inhibit Indicator

This dual lamp indicator (42) is located on the right side of the front console in the carrier cab. The upper lamp is used to indicate when the first level of exhaust regeneration is needed. The inhibit indicator is illuminated when regen inhibit switch has been activated.

Regen Initiate/Inhibit Switch

This switch (41), located on the right side of the front console in the carrier cab, is used to initiate or inhibit a stationary exhaust regeneration. The switch must be cycled on and off to initiate regeneration. The regen inhibit switch is a maintained ON switch, when selected to manually override the regen process.

The clutch and brake pedals must also be released. The engine will automatically change speed as needed. The cycle will take approximately 20 minutes.

If regeneration (active or stationary) is not desired, press the inhibit side (bottom) of the switch. The regeneration inhibit indicator should illuminate. When the switch is in the center position, the engine will perform an active regeneration as it requires and is able.

Travel Controls and Indicators

Dual Air Pressure Gauge

The dual air pressure gauge (1) is located on the left 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 Indicator

The low air pressure (AIR PRESSURE LOW) indicator (27) is located on the upper center of the front console above the steering wheel. The indicator is a red light that lights when the pressure in either or both air systems is below 72-84 psi (5-5.8 bar). 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 air pressure low indicator, the pressure switches also energize a warning buzzer.

Speedometer

The speedometer (4) is located on the upper left side of the front console above the steering wheel. The speedometer indicates road speed in both km/h (kilometers per hour) and mph (miles per hour). There is an odometer located at the bottom of the speedometer that 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 On Indicator

The park brake on indicator (29) is located at the top of the front console on the right side above the steering wheel. The indicator is a red light that lights when the crane parking brakes are applied. It is energized by a pressure switch on the parking brake valve. The pressure switch also controls the outrigger enable relay that permits operation of the outriggers.

Cross-Axle Differential Locked Indicators

The cross-axle differential locked (CROSS AXLE LOCKED AXLE #3 & CROSS AXLE LOCKED AXLE #4) indicators (26, 62) are located at the top of the front console above the

steering column. The amber indicators light to show that the cross axle differentials are locked.

CAUTION

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

Cross-Axle Differential Lock Control

The cross-axle differential lock control (17) is located on the lower left 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 lever actuated air valve.

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 Control

The inter-axle differential control (15) is located on the lower right side of the front console. In the LOCK position, both rear axles are locked together and turning at the same speed. In the UNLOCKED position, the axles operate independently of each other. The control is a lever actuated air valve.

CAUTION

Do not operate inter-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 Control Indicator

The inter-axle differential locked control indicator (inter-axle locked) (32) is located on the right side of the front console panel at the top. The amber indicator lights 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.

Clutch Pedal

The clutch pedal (52) is located on the left side of the cab floor. It is used to engage or disengage the clutch for starting and stopping the vehicle.

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.

Transmission Range Control Switch

The transmission range control switch (39) is located on the shift lever knob. It provides for high and low range shifting.

Transmission Deep Reduction Switch

The transmission deep reduction switch (59) is an air solenoid valve which can position the transmission for deep reduction. Pushing switch forward engages deep reduction, pulling switch backward disengages deep reduction. Operate only when machine is standing still.

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.

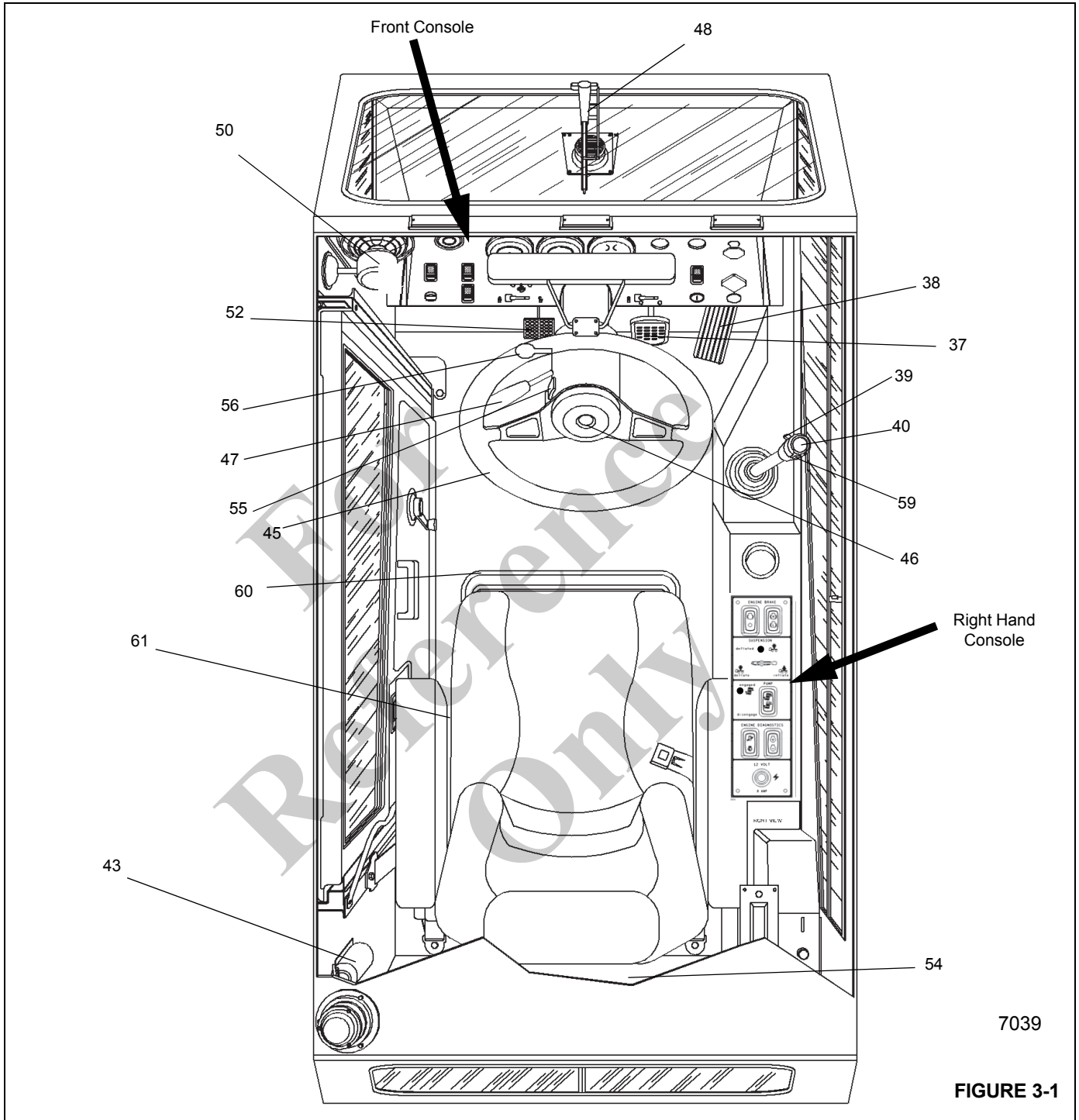
Suspension Control

The suspension control (34) is a lever operated air valve located on the right side console. When positioned to INFLATE, the suspension air bags are inflated. When positioned 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 Deflated Indicator

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



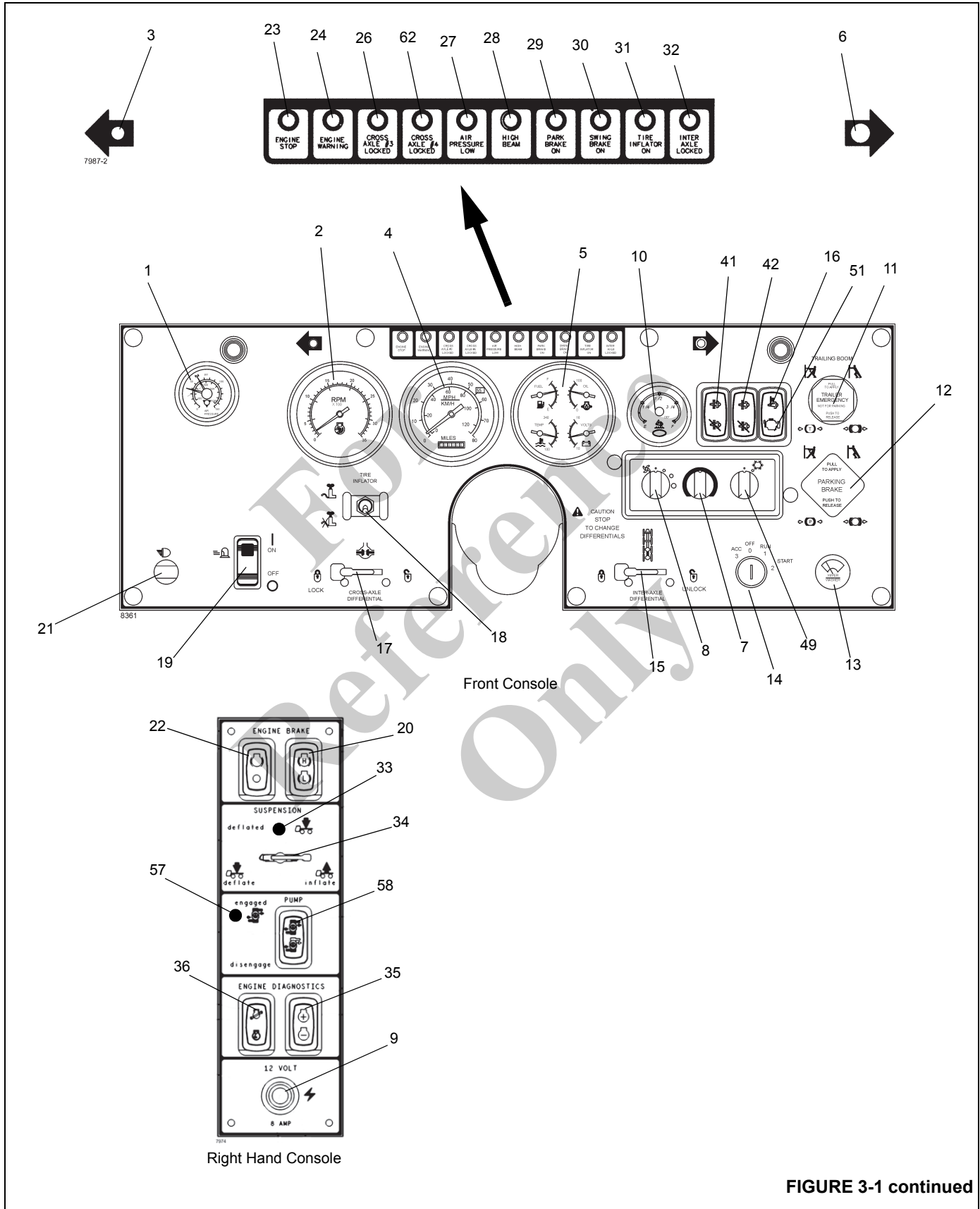


FIGURE 3-1 continued

Item	Description
1	Dual Air Pressure Gauge
2	Tachometer
3	Left Turn Signal Indicator
4	Speedometer
5	Gauge Cluster (Fuel, Temperature, Oil, Volts)
6	Right Turn Signal Indicator
7	Heater Air Temperature Control
8	Heater Fan Switch
9	12 Volt Accessory Outlet
10	DEF Fluid Level Gauge
11	Trailing Boom Trailer Emergency Brake Control
12	Parking Brake Control
13	Windshield Wiper/Washer Switch
14	Ignition Switch
15	Inter-Axle Differential Lock Control
16	High Exhaust Temperature Indicator
17	Cross-Axle Differential Lock Control
18	Tire Inflator Control Switch
19	Beacon Light Switch
20	Engine Brake High/Low Switch
21	Headlights Switch
22	Engine Brake On/Off Switch
23	Engine Stop Indicator
24	Engine Warning Indicator
25	Not Used
26	Cross-Axle Differential Locked Indicator, Axle #3
27	Air Pressure Low Indicator
28	High Beam Indicator
29	Park Brake On Indicator
30	Swing Brake On Indicator
31	Tire Inflator On Indicator
32	Inter-Axle Differential Locked Indicator
33	Suspension Deflated Indicator
34	Suspension Control
35	Engine Diagnostics/Idle Switch
36	Engine Diagnostics Test
37	Brake Pedal

Item	Description
38	Throttle Pedal
39	Transmission Range Control Switch
40	Transmission Shift Lever
41	Regen Initiate/Inhibit Switch
42	Regen Needed/Inhibit Indicator
43	Fire Extinguisher
44	Cab Dome Light
45	Steering Wheel
46	Horn Button
47	Headlight Dimmer/Turn Signal Lever
48	Windshield Wiper
49	Air Conditioner Switch
50	Cab Circulating Fan
51	Malfunction Indicator Lamp
52	Clutch Pedal
53	Not Used
54	Circuit Breaker and Relay Panel
55	Hazard Light Switch
56	Steering Column Tilt/Telescope Lever
57	Hydraulic Pump Engaged Indicator
58	Hydraulic Pump Switch
59	Transmission Deep Reduction Switch
60	Seat Adjustment Lever
61	Seat Tilt Lever
62	Cross-Axle Differential Locked Indicator, Axle #4

Swing Brake On Indicator (Optional)

The Swing Brake On Indicator (30) is located at the top of the front console. The red indicator lights 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 swing brake on indicator, the pressure switch also energizes a warning buzzer.

Hydraulic Pump Engaged Indicator

The Pump Engaged Indicator (57) is located on the right side console. The amber indicator lights when the hydraulic pumps are engaged.

Hydraulic Pump Switch

The Hydraulic Pump Switch (58) is located on the right side console. Putting the switch at ENGAGE energizes the PTO clutch solenoid to engage the transmission PTO that drives

the main hydraulic pumps. In some cases, the PTO may not fully engage or disengage on the first attempt. When this occurs, place the hydraulic pump switch in the engaged position and jog the crane's engine starter to assist with pump engagement. For disengagement, the hydraulic pump switch can be cycled and the engine momentary shut down to fully disengage the pump. A pressure switch senses when the pump is engaged and sends a signal to the engine ECM to limit engine speed to 1800 rpm on QSM machines and 1600 rpm on ISX machines. When the hydraulic pump is engaged, function of the foot throttle in the Carrier Cab is disabled.

Malfunction Indicator Lamp

The Malfunction Indicator Lamp (MIL) (51) illuminates amber when there is an emission related system error. When this indicator illuminates have the crane serviced as soon as possible.

Accessory Controls and Indicators

High Beam Indicator

The headlight High Beam Indicator (28) is located at the top of the center front console. The indicator is a blue light that lights when the headlights are on high beam.

Heater Air Temperature Control

The Heater Air Temperature Control (7) is located on the right side of the front console. The control is a rotary thermostat that opens and closes the valve in the hot water supply line to the heater.

Fan Switch

The Fan Switch (8) is located on the right side of the front console. This rotary switch controls the speed of the fan (LOW, MED, and HI) which in turn regulates the volume of air output. The far left position is OFF. The next two positions at 90° increments are LOW and medium (MED). The far right position is high (HI).

Air Conditioner Switch

The Air Conditioner Switch (49) turns on the air conditioner when the fan switch is in an on position.

Windshield Wiper/Washer Switch

The Windshield Wiper/Washer Switch (13) is located on the right side of the front console. The switch has three positions; off, low, and high range. Rotating the switch energizes the wiper motor on the windshield washer pump assembly. Rotating the switch to the first detent energizes the wiper motor at low speed and rotating it to the second detent energizes the motor at high speed. Rotating the

switch counterclockwise to off stops the motor and returns the wiper blade to the parked position. Push in on the switch to spray washing fluid on the windshield.

Headlights Switch

The Headlights Switch (21) is located on the left side of the front console. The switch is a push-pull type switch with a rheostat control. Pull the switch to the first detent to light the marker and gauge lights. Pull the switch to the second detent to light the headlights, marker lights and the gauge lights. Rotating the switch knob controls the brightness of the gauge lights.

Beacon Light Switch (Optional)

The Beacon Light Switch (BEACON) (19) is a two position, ON-OFF rocker switch located on the left side of the front console that controls the beacon light on the top of the carrier cab. When the switch is in the ON position, the amber LED in the switch will be lit.

Headlights Dimmer Switch

The Headlight 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(s) 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 column and the left front and left rear signals to flash. Positioning the lever up causes the indicator light on the column and the right front and right rear signals to flash.

Hazard Light Switch

The Hazard Light Switch (55) is located on the steering column. Pushing forward on the switch (in the direction of the arrow) causes all the turn signals and the turn signal indicator lights on the column 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 light switch is on.

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 light switch is on.

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 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 switch on the base of the fan.

Seat Adjustment Lever

The Seat Adjustment Lever (60) works by lifting on the bar at the front center of the seat.

Seat Tilt Lever

The Seat Tilt Lever (61) operates by lifting the handle to tilt the backrest forward or backward.

Tire Inflator Switch

The Tire Inflation Switch (TIRE INFLATOR) (18) is located on the left side of the front console. It is a guarded two position toggle air valve that activates the tire inflation system.

Tire Inflator On Indicator

The Tire Inflator On Indicator (31) is located at the top of the front console. It is an amber light that is lit when the pressure switch in the tire inflation system is activated. In addition to illuminating the Tire Inflator On Indicator, the pressure switch also energizes a warning buzzer.

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. It is protected by a 10 amp fuse.

Cab Dome Light

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

The fuse and relay panel (54) is located on the rear of the cab under a removable cover. It contains fuses and relays that protect and control the various electrical components of the carrier.

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

There is an outrigger control box located on each side of the crane carrier. Each box contains an outrigger control panel with switches for extending and retracting the outrigger beams and for raising and lowering the outrigger jack cylinders on that side of the crane. Each control panel also contains a control switch for raising and lowering the center front jack cylinder. A level is installed at the bottom of the outrigger box. The following paragraphs explain these controls.

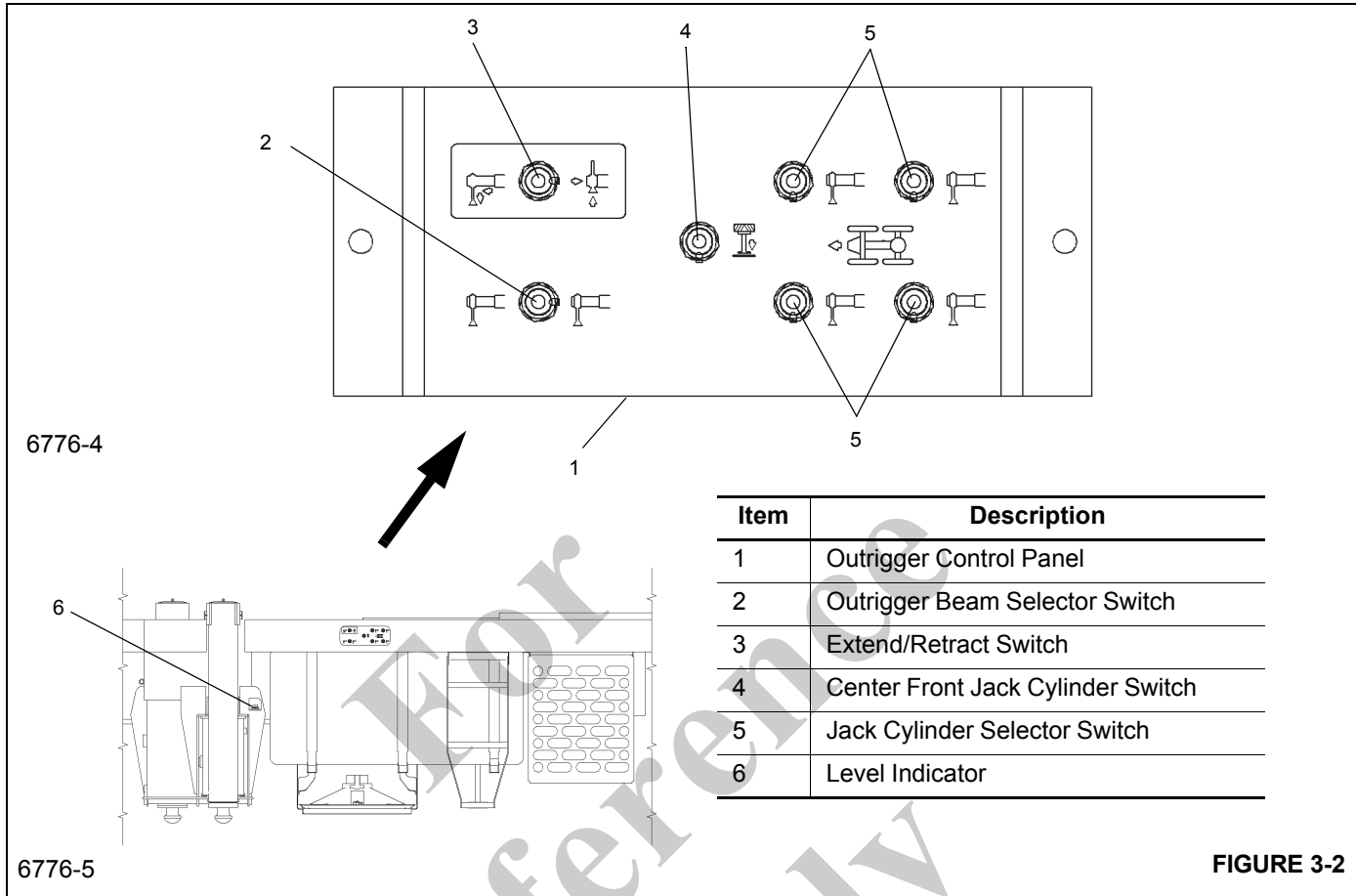


FIGURE 3-2

Outrigger Control Panel

There is one Outrigger Control Panel (1) on each side of the unit's frame. The panel on the right side operates the outrigger beams for that side only. The panel on the left side operates the outrigger beams for that side only. The jack cylinders 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 jack cylinders. 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 Jack Cylinder Switch

The Center Front Jack Cylinder 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 jack cylinder. The center front jack cylinder will retract automatically when any of the other four jack cylinders are retracted, therefore it must be reset if lifting is to be continued.

Jack Cylinder Selector Switch

The Jack Cylinder Selector Switch (5) is used to choose which jack cylinder to operate.

Level Indicator

The Level Indicator (6) is used to indicate when the crane is level during the positioning of the jack cylinders.

Daytime Running Lights

The Daytime Running Lights are powered by the carrier ignition switch (14) accessory circuit (Figure 3-1). When the park brake control (29) is pulled to apply the park brake, the daytime running lights lose power and turn off. This feature allows the low beam of the headlights to automatically be on any time the crane is roading.

SUPERSTRUCTURE CAB

The front console is laid out vertically and is located in the right front of the superstructure cab. This location provides the operator with a clear view out of the front of the cab. Additional indicators and switches are on the overhead console above the right side cab window. The outrigger controls are located on a hand held control box that is stored in a pocket on the left front of the superstructure cab.

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

All rocker switches contain one or two LED lighted slots in the switch for illumination. In addition, all but the throttle mode switch contains a LED lighted square to indicate when the switch/function is activated.

Engine Controls and Indicators

Hand Throttle Switch (Engine Increment/Decrement Switch)

This switch (31), located on the front 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 (ISX engine only). 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.

Gauge Cluster

The Gauge Cluster (29) is located in the center of the front console above the RCL panel and contains a Voltmeter, Oil Pressure Gauge, Water Temperature Gauge, and a Fuel Quantity Gauge.

Voltsmeter

The Voltmeter (VOLTS) is located on the lower right of the gauge cluster. With the ignition switch in the RUN (1) 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 10 to 16 volts.

Engine Oil Pressure Gauge

The Engine Oil Pressure Gauge (OIL) 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 100 psi. It receives a signal from an oil pressure sending unit on the engine.

Water Temperature Gauge

The Engine Coolant Temperature Gauge (TEMP) is located on the lower left of the gauge cluster. The gauge indicates the engine coolant temperature on a scale calibrated from 100 to 240°F. The gauge receives a signal from a temperature sending unit in the engine cooling system.

Fuel Quantity Gauge

The Fuel Quantity Gauge (FUEL) 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 Quantity Gauge receives a signal from a sending unit in the fuel tank.

Ignition Switch

The Ignition Switch (32) is located on the front console. It is a key operated switch with four positions; 3 (accessory), 0 (off), 1 (run), and 2 (start). The switch is spring returned from the 2 position to the 1 position. In the 0 position, all electrical power in the superstructure is off except for the boom work lights, cab work lights, panel lights, dome light, swing horn, and accessory outlet. In the 3 position, all electrical components are energized except the starter circuit components. Placing the switch in the 2 position energizes the starter motor relay and solenoid for starting the engine. Releasing the switch will allow it to spring return to the 1 position. To shut down the engine, turn the switch to the 0 position.

Tachometer

The Tachometer (TACH) (27) is located at the top of the front console and registers engine RPM. The Tachometer is calibrated in RPM x 100 with a range of zero (0) to 35. The Tachometer receives an electrical signal from a sending unit on the engine that does not use the machine's electrical system.

Hourmeter

The Hourmeter (28) is located at the bottom of the Tachometer and registers the total hours that the engine has run. The Hourmeter receives an electrical signal from the Tachometer.

Engine Stop Indicator

The Engine Stop Indicator (25) is located on the alert panel at the top of the right hand console. It is a red light that lights when energized by a signal from the engine ECM. When the light lights a buzzer also sounds.

Foot Throttle Pedal

The Foot Throttle Pedal (4) is located on the right side of the cab floor. The pedal sends an electronic signal to control engine speed.

Engine Warning Indicator

The Engine Warning Indicator (48) will light to alert the operator of a temperature high, a pressure low, or a coolant level low condition.

For
Reference
Only

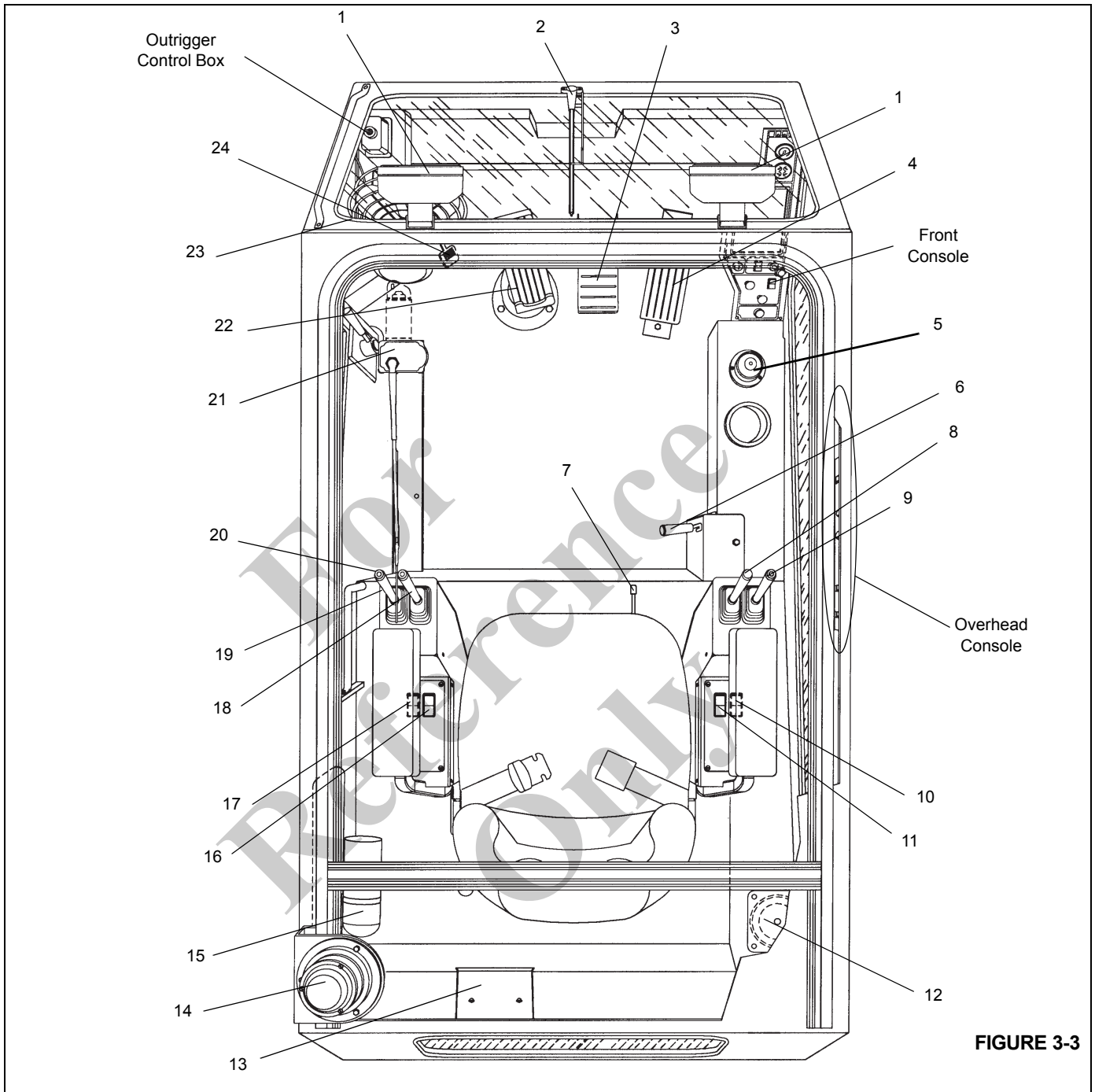


FIGURE 3-3

Item	Description
1	Work Lights
2	Windshield Wiper/Washer
3	Boom Telescope Control Pedal (Optional)
4	Throttle Pedal
5	Bubble Level Indicator
6	Swing Pin Lock Control Lever
7	Seat Adjustment Lever
8	Boom Lift Control Lever
9	Main Hoist Control Lever
10	Main Hoist Speed Selector Switch
11	Hydraulic Boost Switch
12	Cab Dome Light
13	Fuse Panel
14	Beacon Light (Optional)
15	Fire Extinguisher
16	Auxiliary Hoist Speed Selector Switch (Optional)
17	Swing Brake Control Switch
18	Telescope or Auxiliary Hoist Control Lever
19	Swing Control Lever
20	Swing Horn Button
21	Skylight Wiper
22	Swing Brake Pedal
23	Cab Circulating Fan
24	Positive Swing Lock Control Pedal

Regeneration Exhaust/Inhibit Indicator

The Regeneration Exhaust/Inhibit Indicator (49) lights 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: A) On solid: Regeneration should be done within two to six hours of operation. B) Flashing: Regeneration needs to be done in the next one to two hours. C) Flashing w/Engine Warning Light illuminated: Regenerate immediately.

If regeneration (active or stationary) is not desired, press the inhibit side (bottom) of the switch. The regeneration inhibit indicator should illuminate. When the switch is in the center position, the engine will perform an active regeneration as it requires and is able.

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. (Use the Engine Regen Initiate/Inhibit Switch for regeneration.)

If successful regeneration still does not occur, the engine stop light will replace the previous lamps and the filter unit will need to be removed and serviced by an authorized facility.

Crane Controls and Indicators

Telescope or Auxiliary Hoist Control Lever

The Telescope or Auxiliary Hoist Control Lever (18) is located on the left armrest. The lever controls the telescope functions when the crane is not equipped with an auxiliary hoist. Positioning the lever forward actuates the control valve to telescope the boom out and pulling the lever back actuates the boom to telescope in.

When equipped with an auxiliary hoist, the lever controls auxiliary hoist functions and telescope functions are controlled through a foot pedal (3). Positioning the lever forward actuates the control valve to let out the hoist cable and pulling the lever back reels the cable in.

Swing Control Lever

The Swing Control Lever (19), located on the left armrest, controls the swing function. The lever, when positioned forward (rotates the turntable clockwise) or back (rotates the turntable counterclockwise), actuates a control valve through hydraulic pilot pressure to provide 360 degree continuous rotation in the desired direction.

Boom Lift Control Lever

The Boom Lift Control Lever (8) is located on the right armrest. The lever, when positioned forward (lowers the boom) or back (raises the boom), actuates the control valve through hydraulic pilot pressure to raise or lower the boom.

Main Hoist Control Lever

The Main Hoist Control Lever (9) is located on the right armrest. The lever, when positioned forward (lowers the cable) or back (raises the cable), actuates the control valve through hydraulic pilot pressure to raise or lower the main hoist cable.

Swing Horn Switch

The Swing Horn Switch (20) is located on top of the swing controller and is used by the operator to provide a warning that the superstructure is rotating. Press down on the switch to sound the swing horn.

Telescope Control Pedal (Optional)

The Telescope Control Foot Pedal (3), supplied when the crane is equipped with an auxiliary hoist, is located at the center of the cab floor. Pushing forward on the top of the pedal will extend the boom and pushing down on the bottom of the pedal will retract the boom.

Main Hoist Speed Selector Switch

The Main Hoist Speed Selector Switch (10) is located on the right armrest. It is a two position switch placarded HIGH and LOW. Positioning the switch to HIGH energizes a solenoid controlled valve on the main hoist to direct the flow of hydraulic oil to the hoist motors. When the switch is in the HIGH position, the amber LED square in the switch will light.

Auxiliary Hoist Speed Selector On/Off Switch (Optional)

The Auxiliary Hoist Speed Selector Switch (16) is located on the left armrest. It is a three position switch placarded HIGH-OFF-LOW. Positioning the switch to HIGH energizes a solenoid controlled valve on the auxiliary hoist to direct the flow of hydraulic oil to the hoist motors. When the switch is in either the HIGH or LOW position, the amber LED square in the switch will light. The switch must be in the HIGH or LOW position before the auxiliary hoist can be operated. Positioning the switch to OFF prevents the operator from accidentally activating the auxiliary hoist.

Regen Initiate/Inhibit Switch

This switch (50), located on the right side of the console in the superstructure cab, is used to initiate or inhibit a stationary exhaust regeneration. The switch must be cycled on and off to initiate regeneration. The Regen Inhibit Switch is a maintained ON switch, when selected to manually override the regen process.

The clutch and brake pedals must also be released. The engine will automatically change speed as needed. The cycle will take approximately 20 minutes.

If regeneration (active or stationary) is not desired, press the inhibit side (bottom) of the switch. The regeneration inhibit

indicator should illuminate. When the switch is in the center position, the engine will perform an active regeneration as it requires and is able.

High Exhaust Temp Indicator

The High Exhaust Temp Indicator (51) lights when an active exhaust regeneration has been initiated and the exhaust temperatures will be elevated above normal levels for the vehicle operating conditions. This can occur while driving or during a manually initiated "stationary regeneration".

**WARNING**

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

Diesel Exhaust Fluid (DEF) Level Gauge

This gauge (52), 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:

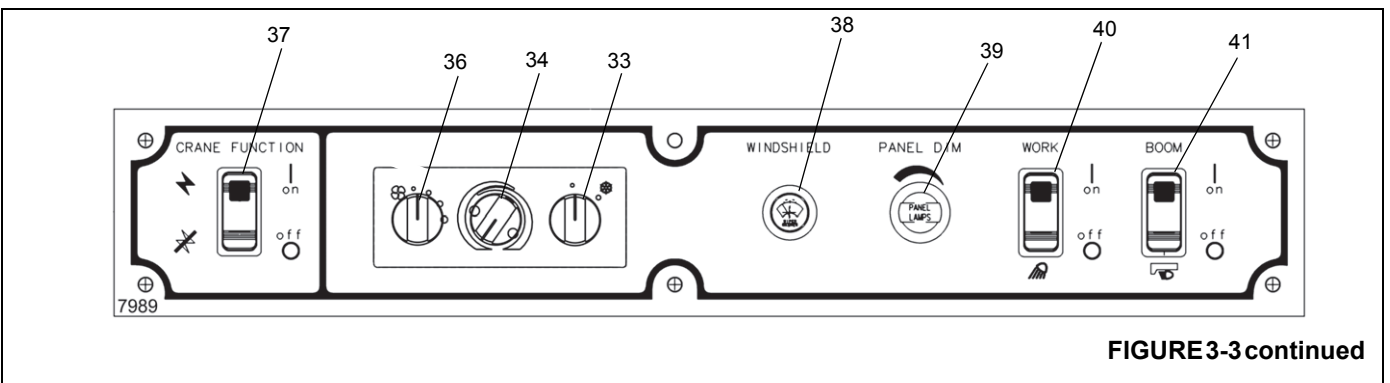
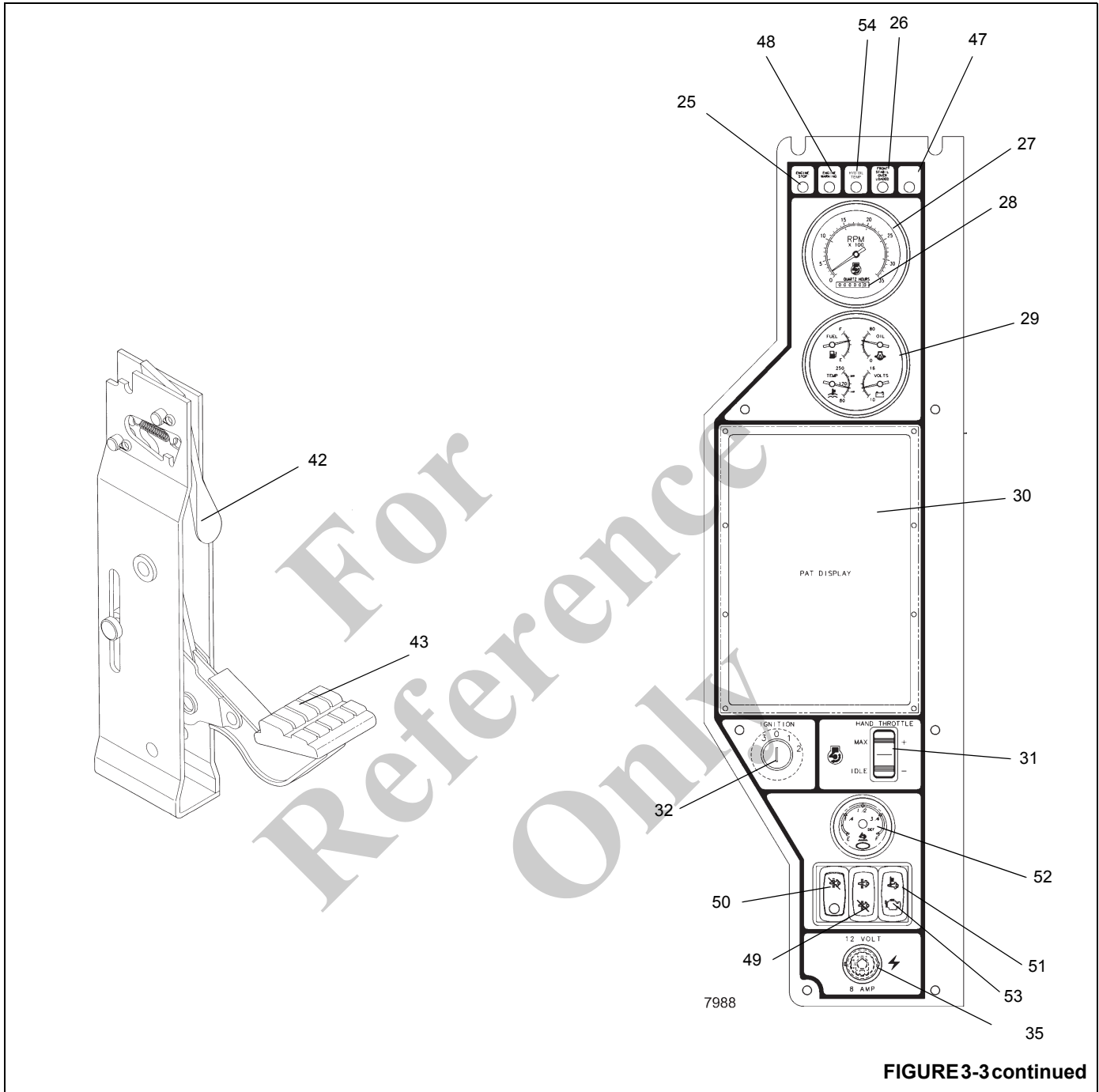
- 3% derated during inducement
- 5% derated during the warning level of the fluid
- 10% derated when the fluid level is low.

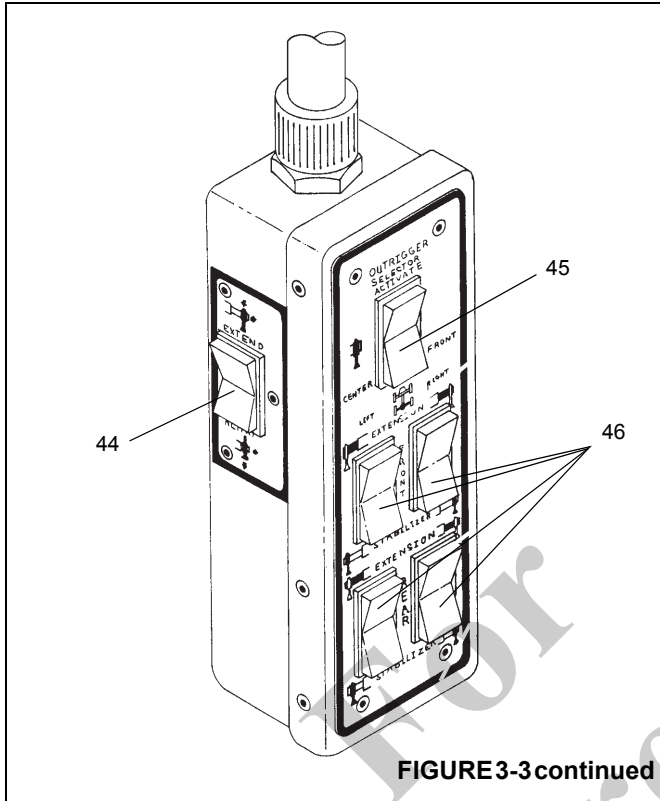
Malfunction Indicator Lamp

The Malfunction Indicator Lamp (MIL) (53) illuminates amber when there is an emission related system error. When this indicator illuminates have the crane serviced as soon as possible.

Hydraulic Oil Temperature Lamp

The Hydraulic Oil Temperature Lamp (54) illuminates red when the hydraulic oil temperature reaches 210 degrees. is an emission related system error. When this indicator illuminates, discontinue operations and have the crane serviced as soon as possible.





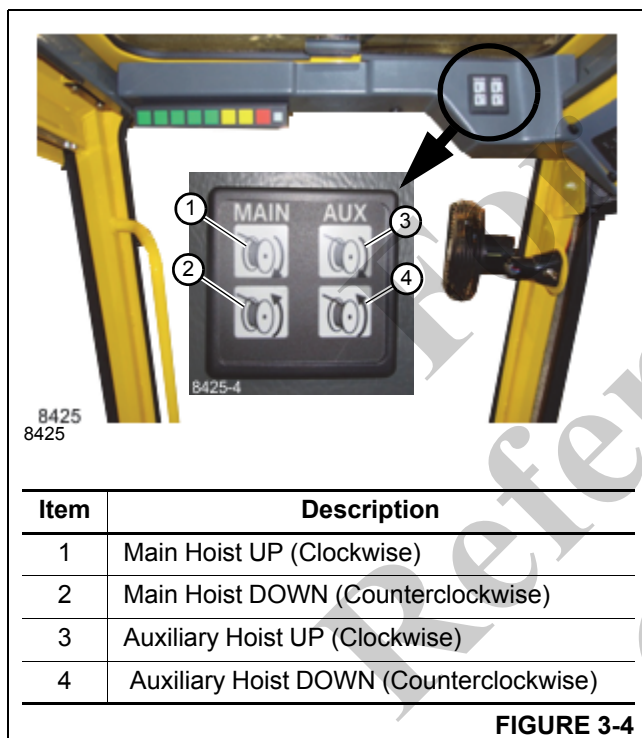
Item	Description
25	Engine Stop Indicator
26	Front Jack Cylinder Overloaded Indicator
27	Tachometer
28	Hourmeter
29	Gauge Cluster (Fuel, Temperature, Oil, Volts)
30	RCL Panel
31	Hand Throttle Switch
32	Ignition Switch
33	Air Conditioning Control Switch (Optional)
34	Heat Control Knob
35	12 VDC Accessory Outlet
36	Fan Switch
37	Crane Function Power Switch
38	Windshield Wiper/Washer Switch
39	Panel Light Control Dimmer
40	Work Lights Switch
41	Boom Lights Switch (Optional)
42	Positive Swing Lock Release Lever
43	Positive Swing Lock Foot Pedal
44	Outrigger Extension/Retraction Switch
45	Center Front Jack Cylinder Control Switch
46	Outrigger Selector Switches
47	Wait to Start Indicator
48	Engine Warning Indicator
49	Regen Exhaust/Inhibit Indicator
50	Initiate/Inhibit Exhaust Switch
51	High Engine Temperature Indicator
52	Diesel Exhaust Fluid (DEF) Level Gauge
53	Malfunction Indicator Lamp
54	Hydraulic Oil Temperature Lamp

Hoist Rotation Indicators (HRI)

The Hoist Rotation Indicators (“thumb thumpers”) are located on top of each hoist control lever. The HRI indicators are electronically driven by a signal from an electronic transmitter and sensor attached to each hoist. A pulsating signal is sensed by the operator’s thumb during hoist operation.

HRI Display

The HRI display is located in the front overhead panel (Figure 3-4). The LED display illuminates to indicate the current hoist in operation and which direction the hoist is rotating.



Crane Function Power Switch

The Crane Function Power Switch (37) is located on the right overhead console. This two-position (ON/OFF) rocker switch permits the operator to disconnect power from the crane functions controlled by the hydraulic remote controllers on the armrests. Positioning the switch to OFF prevents inadvertent operation of functions due to bumping the controllers while roading or any other operation. With the switch in the OFF position, operation of hydraulic boost and high speed hoist is also prevented. When the switch is in the ON position, the red LED square in the switch will light.

Hydraulic Boost Switch

NOTE: The Hydraulic Boost Switch must be positioned to LOW to function the outrigger circuits

The Hydraulic Boost Switch (11) is located on the right arm rest. This two position switch is used to control the high speed boost selector valve. With the switch in the HI position, the solenoid valve is energized. The solenoid valve stops flow of oil from Pump No. 1 (Section 2) to the integrated outrigger selector valve. The poppet check valve opens to combine this flow of oil with the output from Pump No. 1 (Section 1). Hydraulic boost will not function unless the crane function switch is in the ON position. With the switch in the HI position, the amber LED square in the switch will light.

Outrigger Control Box

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

The Outrigger Control Box contains the switches that are used to control the outrigger beams, jack cylinders, and center front jack cylinder. The box is a hand held unit that is stored in a pocket at the left front of the superstructure cab. The parking brake must be set before the outrigger controls can be operated.

There are four outrigger selector switches on the top of the control box and one extend/retract switch on the side of the control box. To extend or retract an outrigger component, first select the component with the outrigger selector switch, then select EXTEND or RETRACT with the appropriate outrigger extend/retract switch.

A center front jack cylinder switch is also located on the top of the outrigger control box. To extend or retract the center front jack cylinder, press the center front jack cylinder switch and then energize the related extend/retract switch.

NOTE: The center front jack cylinder will retract any time any one of the main jack cylinders are retracted.

Front Jack Cylinder Overloaded Indicator

The Front Jack Cylinder Overloaded Indicator (26) (FRONT STABIL OVER LOAD) is located on the LED alert panel at the top of the front console. The indicator is a red light that will light when the pressure switch in the front jack cylinder circuit senses over-pressurization indicating an overload condition. In addition to the indicator light, a buzzer will sound.

Bubble Level Indicator

The Bubble Level Indicator (5) is located at the bottom of the front console. The indicator provides the operator with a visual indication for determining the levelness of the machine. Refer to *Bubble Level Adjustment*, page 3-28 for more information.

Swing Brake Control Switch

The Swing Brake Control Switch (17) is located on the left armrest. This two-position rocker switch (ON/OFF) is used to

control a hydraulic valve that directs a regulated flow of pressure to and from the swing brake. Positioning the switch to ON will apply the swing brake and positioning the switch to OFF will release the swing brake. When the switch is in the ON position, the square amber LED in the switch is lit.

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 release circuit, 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.

Pin 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 down 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 up, the pin is pulled out of the socket, unlocking the superstructure.

Swing Lock Control (Positive Lock Type)

The Swing Lock Control Pedal (24) is located on the left side of the cab floor. The purpose of the swing lock is to secure the superstructure in any position. When the control pedal is up, the swing lock is disengaged and swing can be accomplished. Pushing down on the control pedal engages the swing lock. Pulling up on the lever releases the swing lock.

Accessory Controls and Indicators

Panel Light Control

The panel light (PANEL DIM) control (39) is located on the right overhead console. Rotate the control knob to turn the lights on and control the brightness of the gauge lights.

Work Lights Switch

The Work Lights Switch (40) is a two position ON/OFF rocker switch which is located on the right overhead console and controls the crane's work lights mounted on the top front of the superstructure cab. When the switch is in the ON position, the square amber LED in the switch is lit.

Boom Lights Switch (Optional)

The Boom Lights Switch (41) is a two position ON/OFF rocker switch located on the overhead panel. The switch controls the flood lights located on the boom base section. When the switch is in the ON position, the square amber LED in the switch is lit.

Cab Circulating Fan

The Cab Circulating Fan (23) is located on a mounting bracket above the left window frame. 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

The Windshield Wiper/Washer Switch (38) is located on the overhead console. The switch is a three position rotary switch (off-low-high) that controls the windshield wiper. The low and high positions run the wiper at low and high speeds and the off positions turns off the wiper and parks the wiper blade. Pushing the switch sprays washer fluid on the windshield.

Skylight Wiper

The electrically-operated Skylight Wiper (21) is installed to remove moisture from the skylight. The wiper is located on the left side of the skylight frame. The skylight wiper is controlled by an on/off switch on the wiper motor.

Heat Control Knob

The Heat Control Knob (34) is located on the front console. The knob is a push-pull control that positions a flow diverter valve in the hot water heater supply line. Pull out on the knob (PULL ON) to allow hot water to flow through the heater coil and push in on the knob (PUSH OFF) to shut off the flow of hot water to the coil.

Fan Switch

The Fan Switch (36) is located on the left side of the front console. The switch is a four-position rotary switch (OFF, LOW, MED, HI) that controls operation of the blower to circulate heated or cool air throughout the cab.

Air Conditioner Control Switch (Optional)

The Air Conditioner (AIR COND) Control Switch (33) is located on the right side of the front console. The switch is a two-position rocker switch (OFF, ON) that controls the operation of the optional air conditioning system in conjunction with the FAN switch. When the switch is in the ON position, the square amber LED on the switch is lit.

Beacon Light (Optional)

The Beacon Light (14) is located on the left rear corner of the cab roof. It is operational anytime the ignition switch is in the ACC or RUN position.

12 V_{DC} Accessory Outlet

The 12 VOLT Accessory Outlet (35) is located at the bottom of the front console. It provides an outlet for the operator to plug in a 12 V_{DC} accessory. It is protected by a 10 amp fuse.

Fuse Panel

The Fuse Panel (13) is located under the cover panel on the back wall of the cab behind the seat. It contains fuses that protect the various electrical components of the superstructure.

For
Reference
Only

OPERATING PROCEDURES

Breaking in a New Carrier

Your new Grove Manitowoc 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 a guide for familiarization of the machine 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*, 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.

Diesel Exhaust Fluid (DEF) Supply

Check the level of the fluid; engine derates occur when tank is below 10% capacity.

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.

Swingaway Extension



DANGER

Engage boom extension stop block to keep swingaway and boom nose attach fittings from hitting each other when boom is retracted. Failure to do so can result in damage to the boom and possible injury or death to personnel.

The boom extension stop block must be engaged to keep the swingaway and boom nose attach fittings from hitting each

other, when the boom is fully retracted and the swingaway is properly stowed.

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*, page 5-1).

Cold Weather Operation

The following recommendations are for operating Grove cranes in very low (i.e. 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 Grove 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.

Crane Warm-up Procedures

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

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

Before starting the crane, ensure the appropriate lubricants are used to provide lubrication for the prevailing ambient temperatures in which the crane will operate in (a list of lubricants and their temperature ranges can be found in the Lubrication section of your crane's *Operator Manual*, by contacting your local 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**Warm-up Procedures for All Temperature Ranges:**

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

Transmission

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

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

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

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

Hoist

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

Warm-up Procedures:

1. Without operating the hoist function, warm the hydraulic oil (see *Hydraulic Oil System*, page 3-23).
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**Warm-up Procedures for Temperatures Below -35°C (-30°F):**

1. Setup the crane on outriggers.
2. Engage the transmission (see *Crane Transmission*, page 3-35) with 4-wheel drive selected (if equipped) and allow crane to run at idle until the temperature of the transmission sump reaches normal operating temperature.

NOTE: Warm-up operation of 4-wheel drive transmission engaged in 2-wheel drive only could cause transmission damage.

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.

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, 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.

NOTE: The engine control system will allow only 30 seconds of cranking every two minutes, this system will automatically reset.

This crane is equipped with an over-crank protected starter that will automatically cut out when the starter gets too hot.

CAUTION

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 light and go off in sequence after about two seconds (as a check) when the key is first turned on. If an indicator comes on after initial start-up, there is a problem that needs to be corrected. With the ignition key on, but engine not running, place the engine diagnostics test switch at ON for code retrieval and check the engine manufacturer's service manual for code identification.

1. Place the hydraulic pump switch at DISENGAGE.
2. Ensure the parking brake is set and position the transmission in neutral. Depress the brake pedal.

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

3. Turn the ignition switch to start (2) 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.
 4. 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.
-



CAUTION

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.

5. 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**CAUTION**

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 (with pump disconnected).

The ENGINE WARNING and ENGINE STOP indicators will light and go off in sequence after about two seconds (as a check) when the key is first turned on. If an indicator comes on after initial start-up, there is a problem that needs to be corrected. With the ignition key on, but engine not running, place the engine diagnostics test switch at ON for code retrieval and check the engine manufacturer's service manual for code identification.

The engine is equipped with an automatic cold starting system that provides a metered flow of starting fluid to the engine when the engine ECM determines this is necessary. An engine block heater is also provided. It is recommended that no other type of cold starting aid be used with this engine.

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

CAUTION

The engine cold start system operates automatically when the engine temperature is at or below a preset temperature. If the engine does not start immediately, avoid overloading the air box with highly volatile fluid which could result in a minor explosion.

1. Place the hydraulic pump switch at DISENGAGE.
2. Ensure the parking brake is set and position the transmission in neutral. Depress the brake pedal.

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

3. Turn the ignition switch to start (2) 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.
4. 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.

**CAUTION**

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.

5. 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.

Particulate Filter Maintenance at Idle — Unexpected Idle Speed Increase

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

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

Racing the Engine

DO NOT race 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.
3. Drain the fuel filter-water separator.

General Crane Operation

Pump Drive

The main three section hydraulic pump is driven by an engine driven pump drive with disconnect. The two single section hydraulic pumps are direct engine driven.

Control Lever Operation

The control lever operation for crane functions is standard, i.e., 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 crane is the *Load Chart* found in the crane operator's cab.

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.

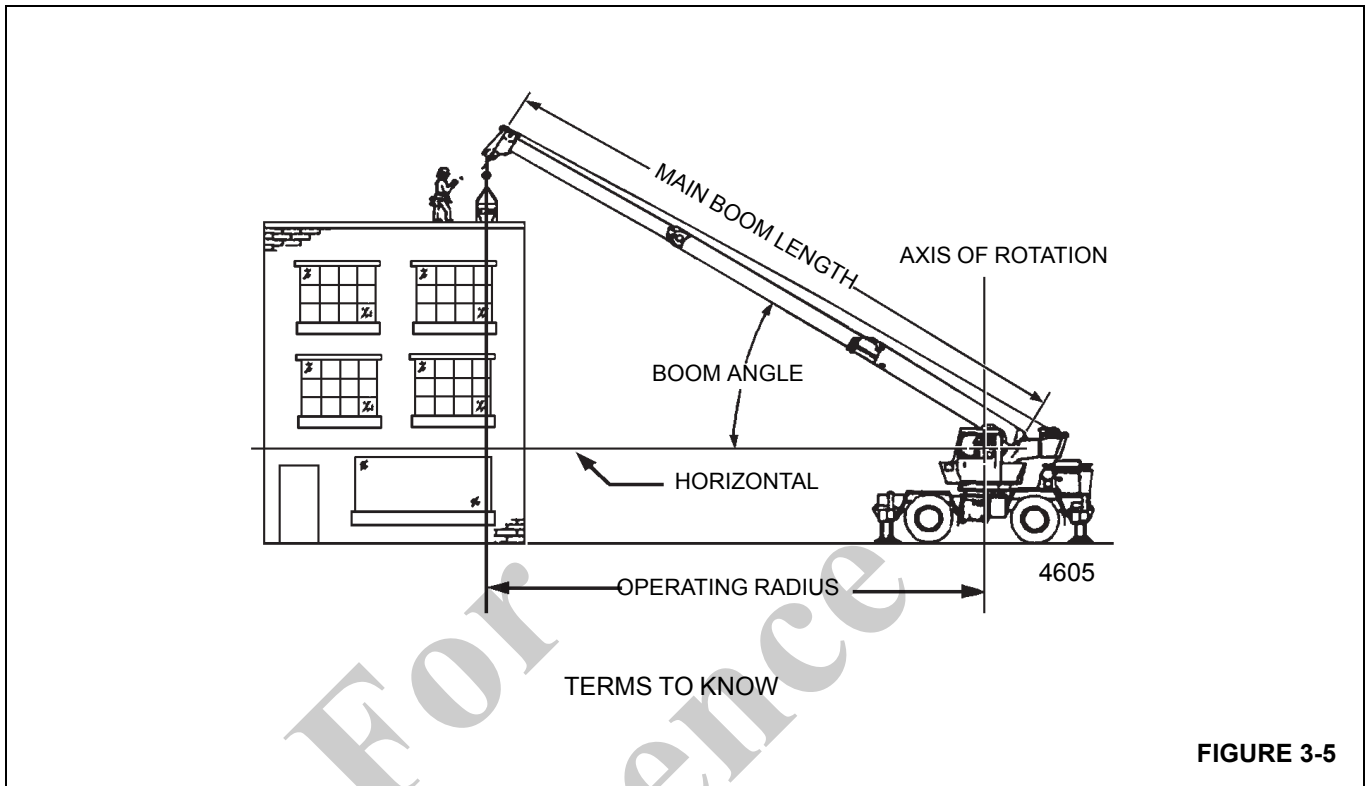


FIGURE 3-5

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 jack 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 Grove load handling devices such as hookblocks, headache balls, boom extension 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.

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

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 headache ball. The rooster sheave is 110 lb (50 kg), and the headache ball is

172 lb (78 kg) for a total of 282 lb (128 kg). The lift requires slings and spreader bars weighing 350 lb (159 kg) which makes the total weight for the load handling devices 632 lb (286 kg).

A check of the load chart for a 50 ft (15.2 m) radius and 64 ft (19.5 m) of boom length shows a capacity of 7940 lb (3601 kg) on outriggers over-front and 4970 lbs on outriggers 360 degrees. We subtract the load handling weight of 632 lbs from the load capacity of 7940 lb (3601 kg) and 4970 lb (2254 kg). The result is a weight capacity of 7308 lb (3315 kg) over-the-front and 4338 lb (1968 kg) for 360 degrees. We are constricted in making the lift over-front only and the boom angle will be about 29 degrees.

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 3-28.

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 3-28.

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.

Crane Functions



DANGER

Death or serious injury could result from improper crane setup on outriggers.



WARNING

The outriggers and the center front jack cylinder must be properly extended and set and the crane level before any other operation of the crane on outriggers is attempted.

When operating the crane on outriggers, the outriggers should always be fully extended or locked in the mid-extend position, depending on the *Load Chart* being used.

The center front jack cylinder will retract when any main outrigger jack cylinder is retracted. Reset center front jack cylinder if any main outrigger jack cylinder is retracted or extended after initial set-up.

Setting the Outriggers

NOTE: The park brake must be set and the hydraulic boost switch must be in the LOW position 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 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 Extension Lock Pin*, page 3-29 if the crane is to be operated at the mid-extend position.



WARNING

All four outrigger beams must be equally extended to the mid position vertical stripe or fully extended position before beginning operation. Failure to properly deploy the outriggers may cause death or serious injury.

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.

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 jack cylinder, until the floats touch the ground.

NOTE: More than one jack cylinder may be extended at one time.

5. After all floats are on the ground, extend the front jack cylinders about 3 to 4 in (8 to 10 cm) and then extend the

back jack cylinders 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.

Operator must select proper *Load Chart* and RCL program for the outrigger position selected.

Improper setup on outriggers may cause death or serious injury.

- Repeat step 5 until all wheels are clear of the ground and the crane is level as indicated by the sight bubble level located on the right side of the cab. 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 3-28.

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*, page 3-28. The RCL only indicates the horizontal position of the outrigger beam and should not be used to deploy the beam.

Engaging the Mid Extension Lock Pin

- Turn the locking pin 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.

- 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

- Position the rear outrigger selector switches to STABILIZER and position the outrigger extension/retraction switch to RETRACT until the rear jack cylinders have retracted several inches.
- Position the front outrigger selector switches to STABILIZER and position the outrigger extension/

retraction switch to RETRACT until the front jack cylinders have retracted several inches.

- Repeat steps 1 and 2 until the crane is resting on all four wheels and the jack cylinder floats are several inches off the ground.



DANGER

Keep feet and hands clear of floats when unlocking the floats from the jack cylinders.

- Release the locking levers and allow the floats to drop to the ground.
- Continue to retract the jack cylinders until they are fully retracted.
- 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.

- After all outriggers have been fully retracted, stow the outrigger floats. Secure the floats with quick pins and spring clips.

Stowing the Mid-Extend Lock Pin

- Retract the outrigger extension/retraction cylinder.

NOTE: If the lock pin 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.

- Lift the lock pin and turn it 90° to its stowed position.

Setting the Center Front Jack Cylinder

CAUTION

Never operate center front jack cylinder unless boom is retracted and in boom rest, and outriggers and jack cylinders are extended and set. Retract center front jack cylinder before jack cylinders and outriggers.

- Position the CENTER FRONT jack cylinder 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 jack cylinder.

- Continue to extend the jack cylinder until the float is firmly set on the ground.

Stowing the Center Front Jack Cylinder



WARNING

Center front jack cylinder will retract when any main outrigger jack cylinder is retracted. Reset center front jack cylinder if any main outrigger jack cylinder is retracted or extended after initial set-up.

CAUTION

Only operate center front jack cylinder when outriggers are extended and set, and boom is retracted and in boom rest.

- Position the CENTER FRONT jack cylinder control switch to ACTIVATE and the extension/retraction switch to RETRACT.
- Fully retract the center front jack cylinder.

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 control lever through neutral to the opposite direction to stop swing motion.

To swing the boom, push the SWING control lever to forward for right swing and pull back for left swing. Always operate

the control lever with a slow, even pressure. Rotation is stopped utilizing the swing brake foot pedal. When rotation is stopped, put the SWING BRAKE switch in 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.

Elevating the Boom

To elevate the boom, pull the BOOM control lever back, and hold until the boom rises to the desired elevation.

Lowering the Boom

To lower the boom, push the BOOM control lever forward 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. Death or serious injury may result from the crane overturning.

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

NOTE: When the crane is equipped with an auxiliary hoist the telescope function is controlled by a foot pedal.

Extending the Boom



DANGER

Check the *Load Chart* for maximum load at given radius, boom angle, and length before extending boom with a load. Death or serious injury may result from the load falling.

**WARNING**

When extending the boom, simultaneously let out the cable to prevent two-blocking the boom nose and hook block. Death or serious injury may result from the load falling.

CAUTION

Before extending the boom, ensure the large access covers on each side of the boom base section are installed.

Push the TELESCOPE control lever forward away from the operator and hold until the boom extends to the desired length.

Retracting the Boom**CAUTION**

When retracting the boom, the load will lower unless the cable is taken in at the same time.

To retract the boom, pull the TELESCOPE control lever back, toward the operator, and hold until the boom retracts to the desired length.

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). Death or serious injury may result from the load falling.

Do not jerk control lever 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 control lever remains in neutral.

Lowering the Cable

Push the MAIN or AUX hoist control lever forward, away from the operator, and hold until the hook or load is lowered to the desired height.

Raising the Cable

Pull the MAIN or AUX hoist control lever back, 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), position the applicable switch (MAIN HOIST SPEED or AUX HOIST SPEED) to HIGH or LOW as applicable.

Operational Aids**WARNING**

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 Rated Capacity Limiter (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 (s), 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 boom extension. 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) which are in series between the hydraulic remote control valves in the cab and the pilot-operated directional control valves. When the valves are actuated, they prevent pilot flow between the hydraulic remote control valve in the cab and the appropriate directional control valve. The valves are activated in such a manner as to prevent worsening the condition, i.e. 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.

Crane Travel Operation

Active Restraints

Seat Belts

Before fastening a seat belt, always adjust the driver’s seat to the position in which you will drive.

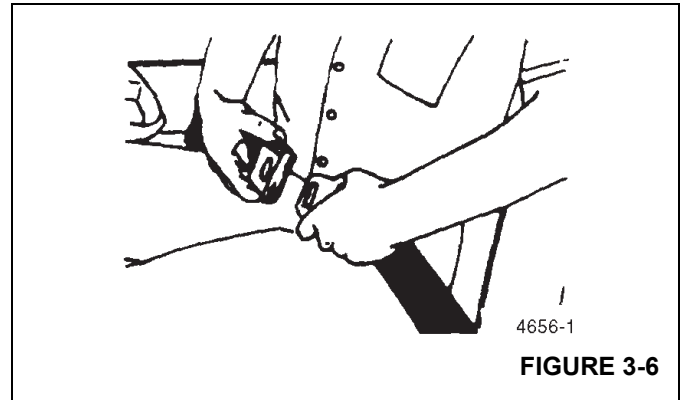


FIGURE 3-6

For greater restraint and comfort:

1. Be sure the belt is snugly fitted around the hips - not the waist - and not twisted. Failure to properly fit belts may result in unnecessary injury in the event of a collision.

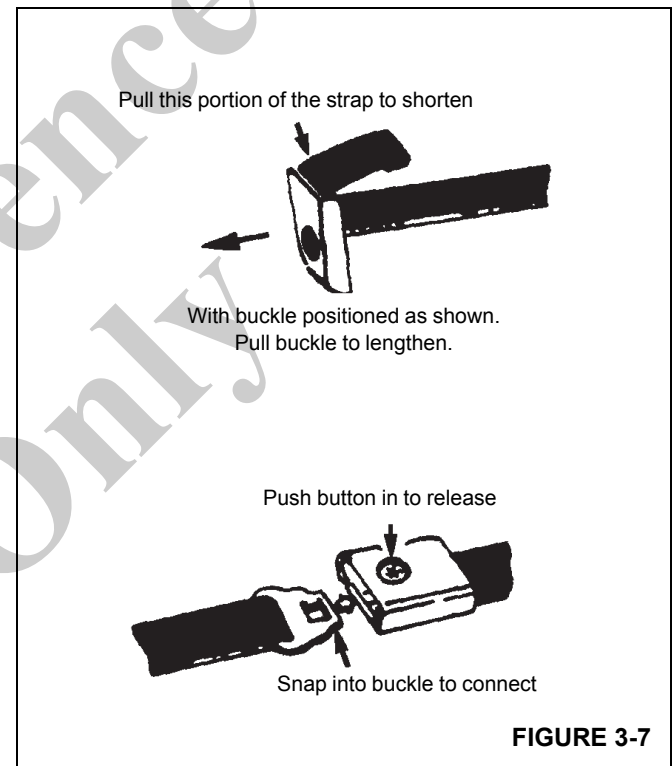


FIGURE 3-7

2. Only one person should be strapped in each seat belt.

To lengthen the belt, tip the buckle end downward, as shown, and pull the buckle until the belt ends can be joined. Insert the belt into the open end of the buckle until a snap is heard and check for latch engagement. The belt can be shortened, after connection, by pulling on the loose end until the belt is snug. Press the buckle release to remove the belt.

*Traveling - General***CAUTION**

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

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

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 16,500 lb (7484 kg) of counterweight, install 5500 lb (2495 kg) of counterweight on the carrier. Check that front axle load does not exceed 49,200 lb (22,318 kg) and rear axle load does not exceed 60,000 lb (27,216 kg).
 - b. GVW should never exceed 109,200 lb (49,532 kg). Also refer to certification label on inside of cab door for Gross Axle Weight Ratio (GAWR).
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.
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 jack cylinders and outrigger beams are fully retracted and the floats are removed.
9. Ensure the center front jack cylinder is fully retracted. Float remains installed.
10. Ensure the jack cylinder floats are properly stowed in their holding racks.
11. Ensure the cover doors on the battery box and sling box are closed.
12. Close and/or install all superstructure cab windows and door.

*Traveling with Boom Extension and/or Inserts Erected***10.1 m (33 ft)/17.1 m (56 ft) Extension**

Travel is permissible under the following conditions.

1. The 33 ft (10.1 m) or 56 ft (17.1 m) boom extension shall be erected at minimum offset. If traveling with just the 10.1 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: 0 degrees minimum, 20 degrees maximum.
5. Maximum travel speed: 2.5 mph (4 km/h).
6. Main counterweight (as applicable) shall be installed.
 - a. With the 33 ft (10.1 m) extension and any counterweight, the boom shall be over the front or rear.
 - b. With the 56 ft (17.1 m) extension and 16,500 lb (7484 kg) counterweight only, the boom shall be over the front or rear.
 - c. With the 56 ft (17.1 m) extension and less than 16,500 lb (7484 kg) counterweight, the boom shall be over the front only.
7. Swing lock and pin shall be engaged.
8. Hookblock must be removed from main boom nose.
9. Headache ball may be reeved over boom extension, hanging 3 ft (0.9 m) below sheave.
10. Suspension air bags shall be inflated.
11. The tires shall be properly inflated.

33 ft (10.1 m)/56 ft (17.1 m) Extension Plus 20 ft (6.1 m) Insert

Travel is permissible under the following conditions.

1. The 33 ft (10.1 m) or 56 ft (17.1 m) boom extension plus 20 ft (6.1 m) insert shall be erected at minimum offset. If traveling with just the 33 ft (10.1 m) extension and insert, 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: 0 degrees minimum, 20 degrees maximum.
5. Maximum travel speed: 2.5 mph (4 km/h).
6. Main counterweight (as applicable) shall be installed.

- a. With the 33 ft (10.1 m) or 56 ft (17.1 m) extension plus insert and 16,500 lb (7484 kg) counterweight only, the boom shall be over the front or rear.
 - b. With the 33 ft (10.1 m) or 56 ft (17.1 m) extension plus insert and less than 16,500 lb (7484 kg) counterweight, the boom shall be over the front only.
7. Swing lock and pin shall be engaged.
 8. Hookblock must be removed from main boom nose.
 9. Headache ball may be reeved over boom extension, hanging 3 ft (0.9 m) below sheave.
 10. Suspension air bags shall be inflated.
 11. The tires shall be properly inflated.

33 ft (10.1 m) Extension Plus 40 ft (12.2 m) Insert

NOTE: Travel with the 56 ft (17.1 m) extension plus 40 ft (12.2 m) insert is not permissible.

Travel is permissible under the following conditions.

1. The 33 ft (10.1 m) boom extension plus 40 ft (12.2 m) insert shall be erected at minimum offset. 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: 0 degrees minimum, 20 degrees maximum.
5. Maximum travel speed: 2.5 mph (4 km/h).
6. Main counterweight (as applicable) shall be installed.
 - a. With the 33 ft (10.1 m) extension plus insert and 16,500 lb (7484 kg) counterweight only, the boom shall be over the front or rear.
 - b. With the 33 ft (10.1 m) extension plus insert and less than 16,500 lb (7484 kg) counterweight, the boom shall be over the front only.
7. Swing lock and pin shall be engaged.
8. Hookblock must be removed from main boom nose.
9. Headache ball may be reeved over boom extension, hanging 3 ft (0.9 m) below sheave.
10. Suspension air bags shall be inflated.
11. The tires shall be properly inflated.

Clutch Operation

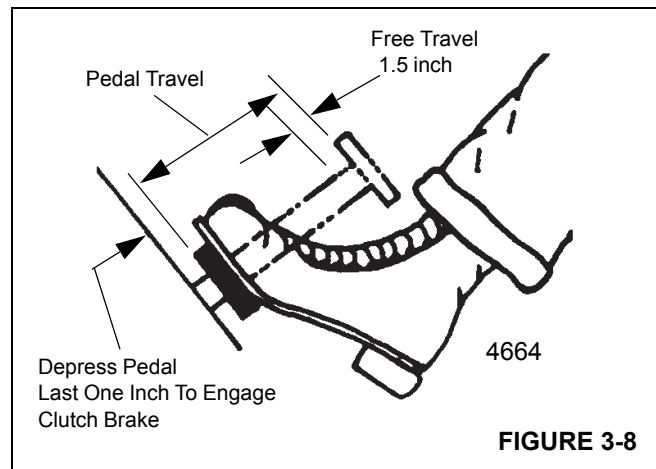


FIGURE 3-8

Clutch pedal adjustment provides for approximately 1.5 in (3.8 cm) for free travel movement of the pedal after the first free travel of 0.5 in (1.27 cm) 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 one inch of downward clutch pedal travel engages the clutch brake which overcomes the tendency of the clutch to rotate at high speed when the clutch is disengaged. A slight but definite resistance to clutch pedal downward movement will be felt at the last 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 RPM requiring rapid shifts. The clutch brake **MUST NOT BE USED** when making a downshift.

Clutch engagement should always be made smoothly while synchronizing accelerator movement necessary to move the crane.

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.

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 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 facing 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 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 RPM and remain at full throttle as the crane starts up the grade. If there is sufficient power to maintain satisfactory road speed without 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 RPM 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 RPM 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 RPM.

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. Adhere to the following:

- 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.

All shifts are made with one lever and a range control switch which is used only once during an upshift sequence, and only once during a downshift sequence.

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.

Crane Transmission

Initial Start-Up

CAUTION

Before moving the crane, make sure you understand the shift pattern configuration (see Figure 3-9), or see the decal in the cab.

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 control switch is down in the low position.
6. If the crane is to be started in deep reduction (LL2 or LL1), move the deep reduction switch 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 switch or the range control switch with the shift lever in neutral while the crane is moving.

1. To make a deep reduction switch shift from LL2 to 1st, proceed as follows.
 - a. Just before making the upshift, move the deep reduction switch rearward to OUT while maintaining foot throttle position.
 - b. Immediately release the foot throttle pedal, depress the clutch pedal once to break 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.
2. To shift in low range, proceed as follows.
 - a. Move the shift lever, double clutching, to the next desired gear position in low range (1st to 2nd to 3rd to 4th).
3. To shift from low (4th) to high (5th) range, proceed as follows.

- a. When in the last gear position for low range and ready for the next upshift, pull the range control switch up to high 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 low to high range.

CAUTION

Never move the shift lever to the low speed gear position after high range preselection, or anytime the transmission is in high range.

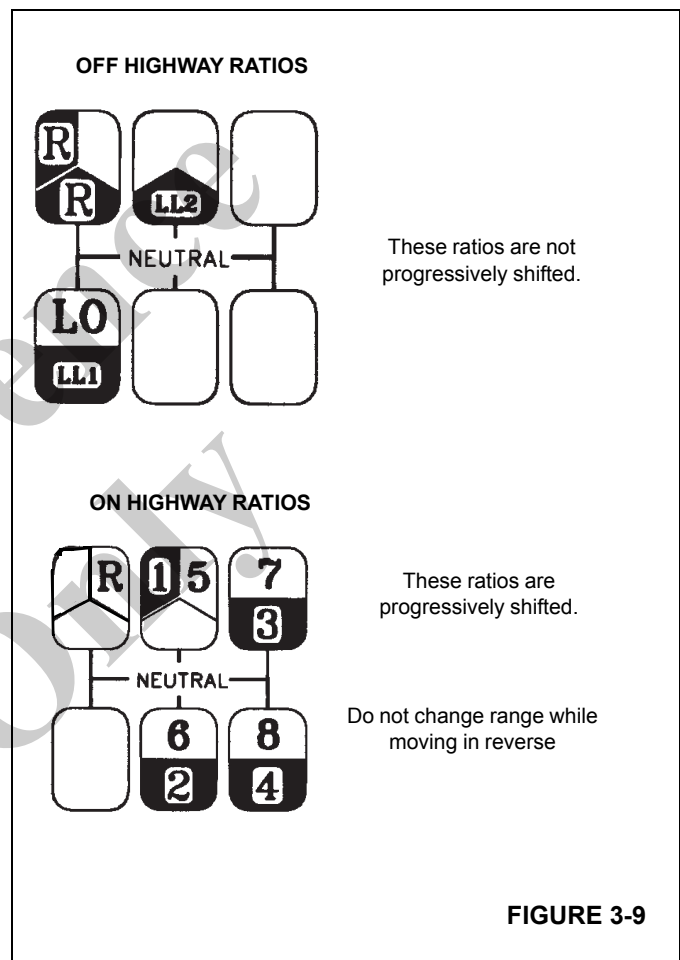


FIGURE 3-9

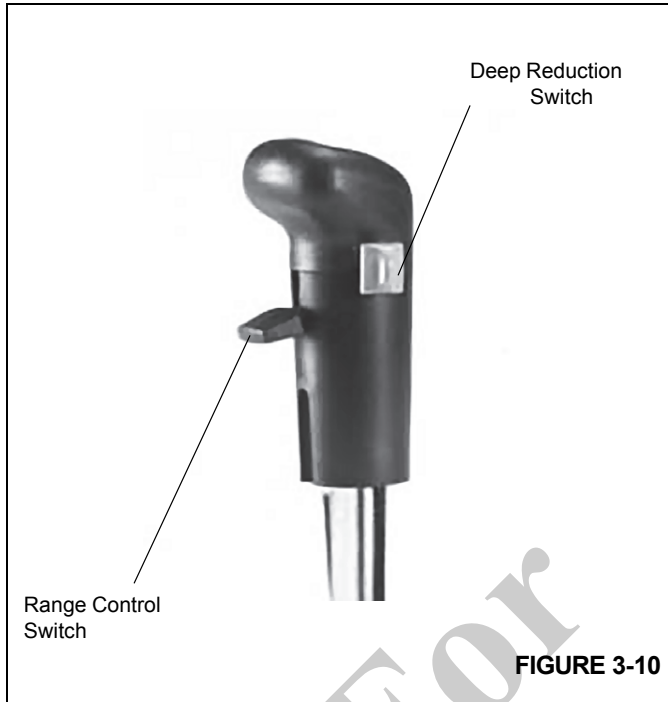


FIGURE 3-10

4. To shift in high range, proceed as follows.
 - a. Move the shift lever, double clutching, to the next desired gear position in high range (5th to 6th to 7th to 8th).

Downshifting

CAUTION

Never move the deep reduction switch or range control switch with the shift lever in neutral while crane is moving.

1. To shift in high range, proceed as follows.
 - a. Move the shift lever, double clutching, to the next desired gear position in high range (8th to 7th to 6th to 5th).
2. To shift from high (5th) to low (4th) range, proceed as follows.
 - a. When in the 5th gear position for high range and ready for the next downshift, push the range control switch down to low range 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 high range to low range.
3. To shift in low range, proceed as follows.
 - a. 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 switch shift from low range (1st) to low-low range (LL2), proceed as follows.
 - a. Just before making the downshift, move the deep reduction switch 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 speed 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 switch up for high reverse or down for low reverse.
2. Move the shift lever to the reverse position.
3. To engage deep low reverse, put the range control switch in the down (low) position. Move the deep reduction switch 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, 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 switch or the range control switch 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 in 8th gear.

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 10 mph (16 km/h).

1. Stop the crane and position the control lever 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 control lever 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 2 psi (14 kPa) 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 45 psi (310 kPa). If both systems drop below 45 psi (310 kPa), the automatic spring brakes will actuate. Normal operating pressure is 105 to 120 psi (725 to 825 kPa).



WARNING

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.

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.

1. Position the Engine Brake On/Off switch to ON.
2. Position the Engine Brake High/Low switch to either position, depending on the amount of braking desired.
3. 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 3-14)) must be fully closed by turning clockwise.

Travel Configuration

1. Swing the boom to over the rear of the crane.



For Reference Only
Actual Trailer May be Different

FIGURE 3-11

2. Align the trailer to the boom supports on the bottom of the boom ((Figure 3-11)).
3. Lower the boom onto the trailer supports.

4. Align the support pins with the boom attachment lugs.
5. Connect the control connector (blue) (1, (Figure 3-12)) to the rear of the crane.
6. Connect the brake supply (red) connector (2) to the rear of the crane.
7. Connect the electrical cable (3) to the crane.

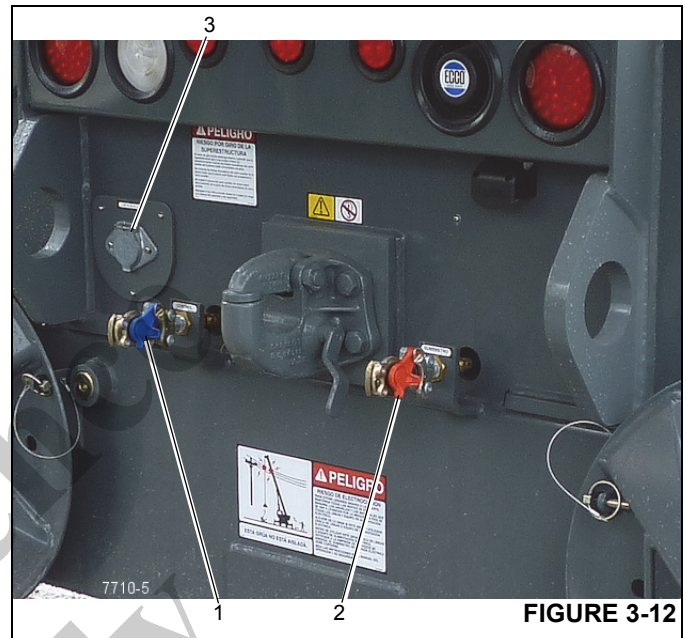


FIGURE 3-12

8. Turn the handle of the support pin control (1, (Figure 3-13)) to ENGAGE and verify the support pins fully engage the boom support lugs.



For Reference Only
Actual Control May be Different

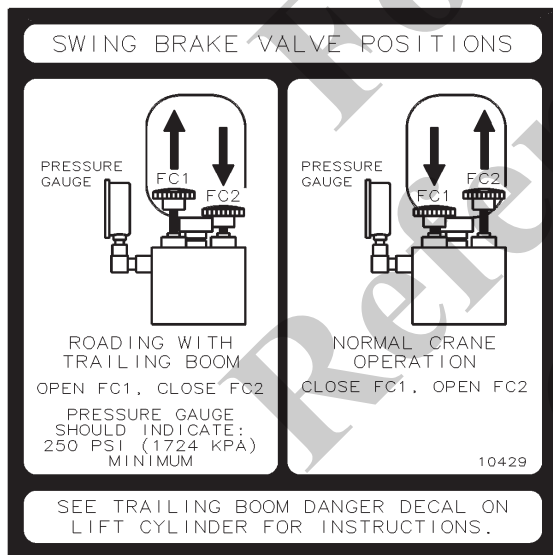
FIGURE 3-13

9. Open the lift cylinder pressure release valve by turning counterclockwise (1, (Figure 3-14)).

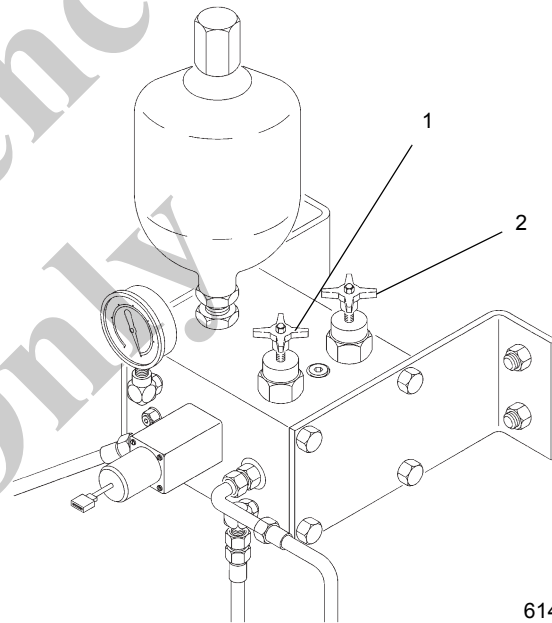
- 10. Open the swing brake release valve (2) by turning counterclockwise.
- 11. Open and close valves FC1 and FC2 as shown in (Figure 3-15),



FIGURE 3-14



6144-1



6144

FIGURE 3-15

Stowing and Parking

Item	Description
1	Needle Valve FC1
2	Needle Valve FC2



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 boom extensions 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 house lock.
6. Retract all jack cylinders and outrigger beams.
7. Turn off CRANE FUNCTION power 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.

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 in this manual.



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 jack cylinders 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, i.e., drain water from the fuel filter - water separator, refueling, etc.
7. Close all windows.
8. Remove the keys from the crane.
9. Lock up the crane. Install vandal guards, if used.



CAUTION

Step 10 does not take the place of the pre-starting checks which must be performed just prior to using the crane at the next working day.

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, i.e., steer cylinders. Also, look for anything that could hinder or prevent starting the next day's work.

Unattended Crane



DANGER

Tipping Hazard!

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

For
Reference
Only

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SECTION 4 SET-UP AND INSTALLATION PROCEDURES

SECTION CONTENTS

General	4-1	Stowing	4-17
Installing Cable on the Hoist	4-1	Setting the Folding Swingaway Offset	4-18
Cable Reeving	4-2	Erecting and Stowing the Bi-Fold Boom	
Dead-End Rigging/Wedge Sockets	4-7	Extension Using the 20 ft (6.1 m) Insert	4-19
Installing Wedge and Socket	4-7	Erecting	4-19
Erecting and Stowing the Bi-Fold Boom		Stowing	4-19
Extension	4-10	Removable Counterweight	4-21
Erecting	4-10	Mounting the Counterweight	4-21
		Stowing the Counterweight	4-21

GENERAL

This section provides procedures for installing the hoist cable on the hoist drum, cable reeving, and erecting and stowing the boom extension, and removal and installation of the counterweight.

INSTALLING CABLE ON THE HOIST

CAUTION

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

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

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

1. Position the cable over the boom nose sheave and route to the hoist drum.
2. Position the hoist drum with the cable anchor slot on top.
3. Insert the cable through the slot and position around the anchor wedge (1) (Figure 4-1).

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

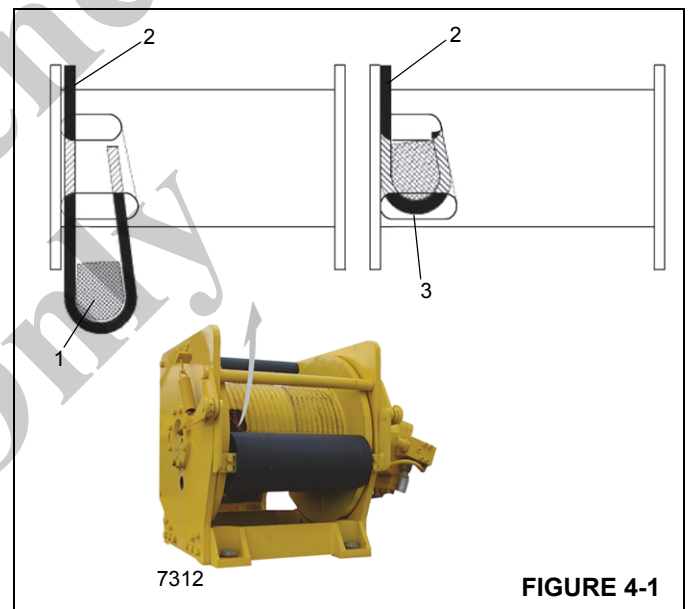


FIGURE 4-1

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

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



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

CABLE REEVING

NOTE: There are two types of cable (wire rope) available on this crane; 6 x 37 and 35 x 7 (non-rotating).

The use of swivels is not allowed in conjunction with non-rotation resistant wire ropes.

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. This reeving should be accomplished by a qualified rigger using standard rigging procedures (Figure 4-3)

In order to quick reeve the hook block without removing the wedge socket on the end of the cable, refer to Figure 4-2.

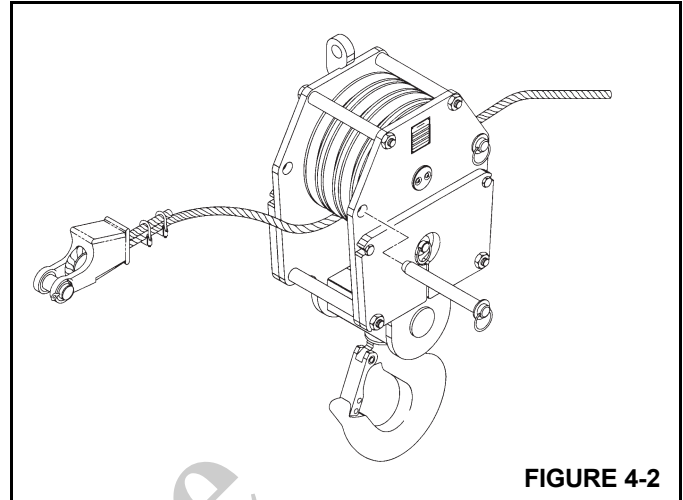


FIGURE 4-2

For
Reference
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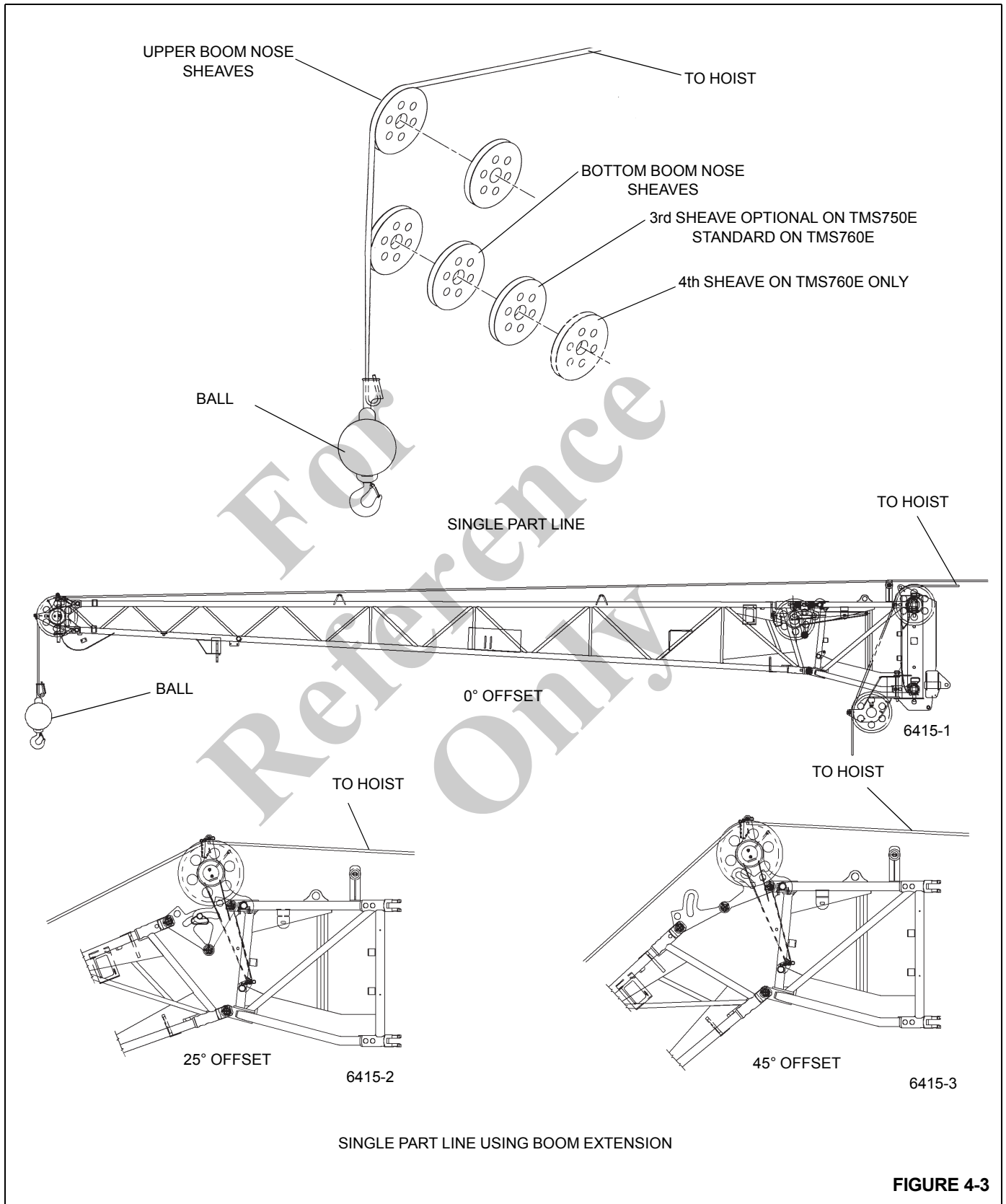


FIGURE 4-3

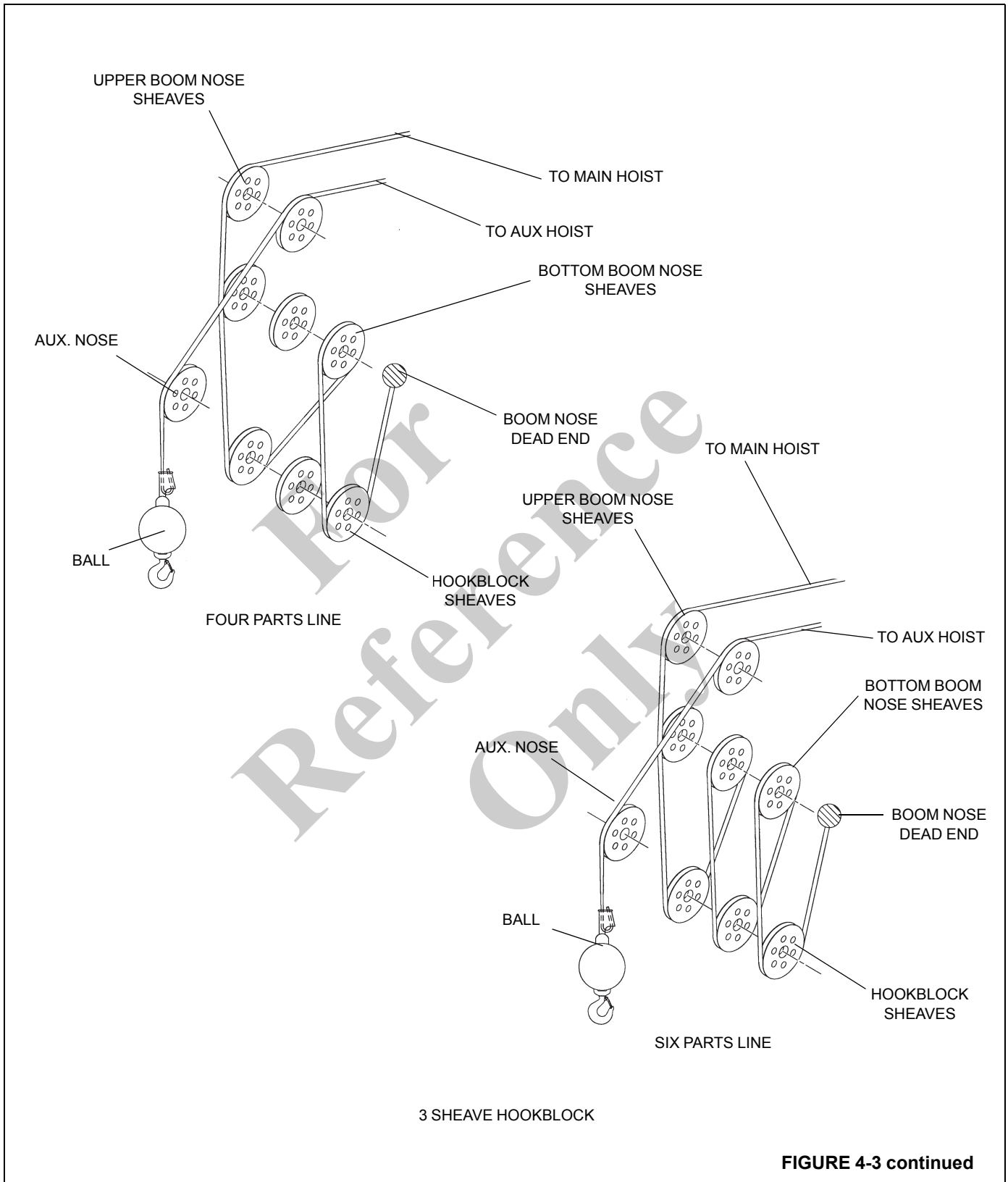


FIGURE 4-3 continued

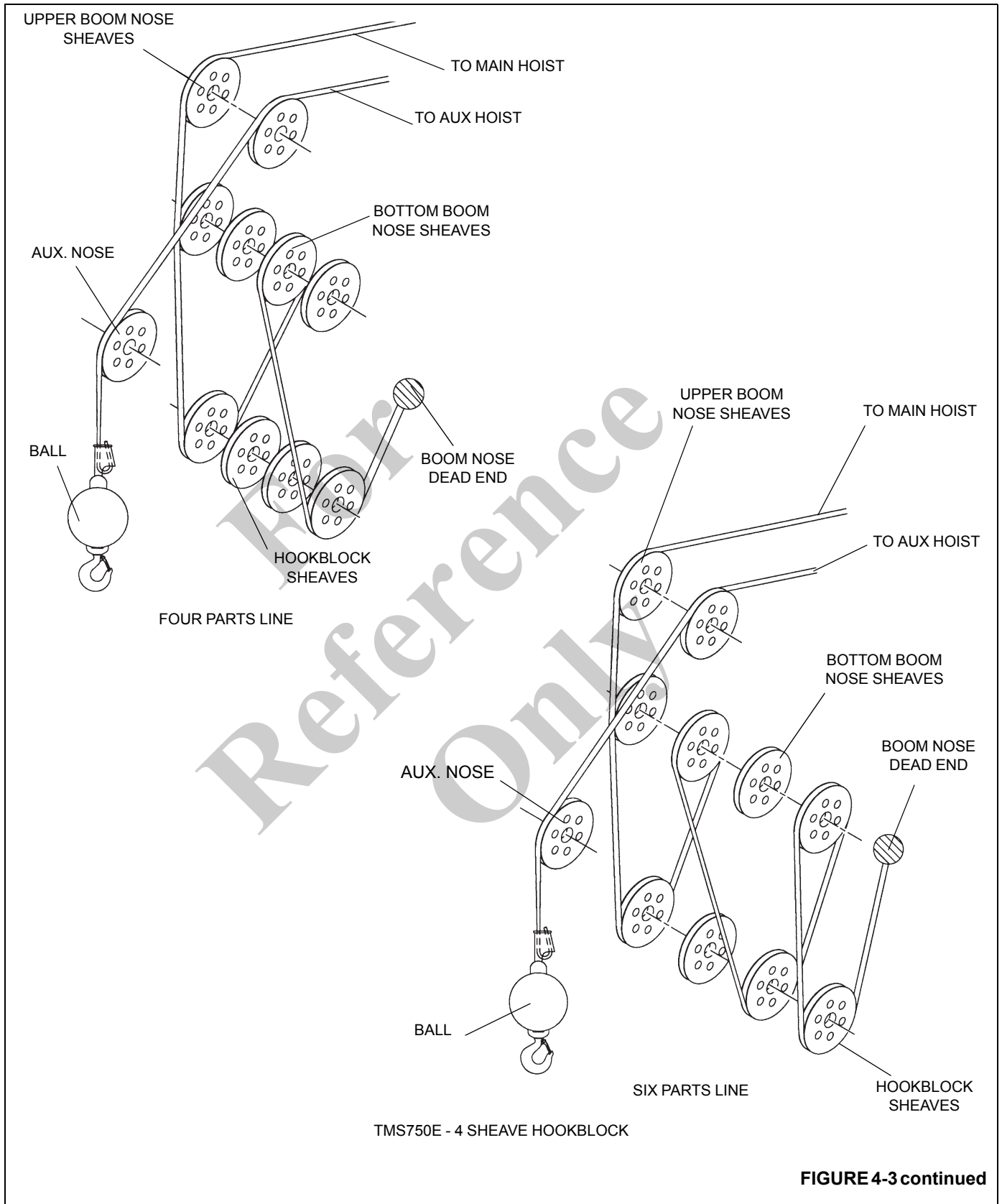


FIGURE 4-3 continued

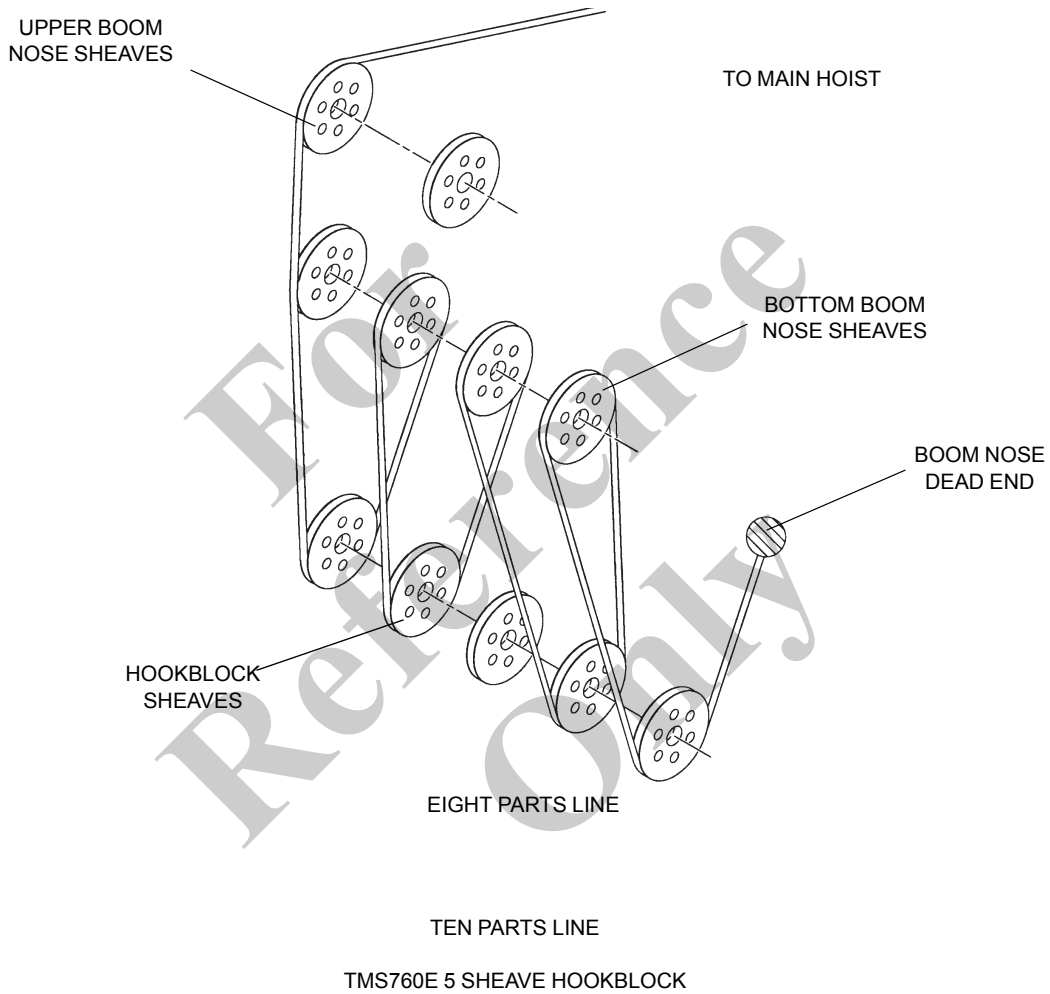


FIGURE 4-3 continued

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 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 Cranes specifies the size, type, class and line pulls for wire rope, predominately rotation resistant wire rope, and rigging accessories such as overhaul balls and hook blocks for use with each new crane that it manufactures. Other wire ropes and rigging accessories are available from various vendors. Different wire rope manufacturers have differing requirements for the construction, handling, cutting, seizing, installation, termination, inspection and replacement of the wire ropes they produce. Their advice should be sought for each specific type of wire rope a crane user intends to install on a mobile crane.

When assembly is complete, raise the boom to a working position with a load suspended to firmly seat the wedge and rope into the socket before the crane is used operationally.

CAUTION

If the socket is not positioned with the flat face toward the boom sections, structural damage will occur.

When anchoring the socket to the boom (Figure 4-4), ensure the flat face of the socket is in position, as shown, toward the boom sections.

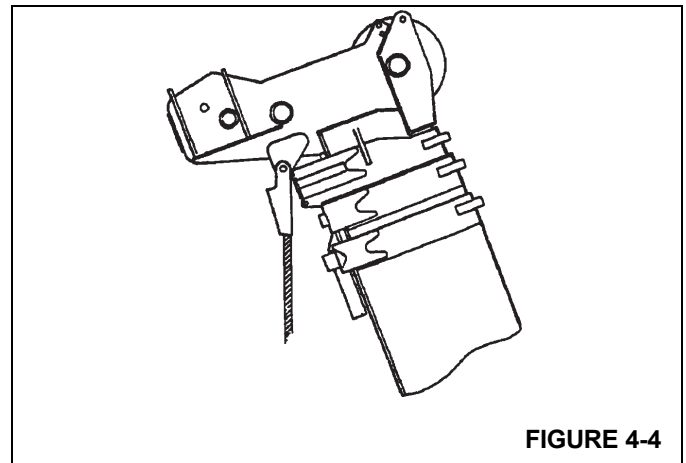


FIGURE 4-4

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. Do not weld on size 6X37 rope. This will allow the distortion of the rope strands, caused by the bend around the wedge, to adjust themselves at the end of the line. Refer to *Section 1 - Introduction* in the *Service Manual* for wire rope procedures.
3. Make sure the live-end (Figure 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.

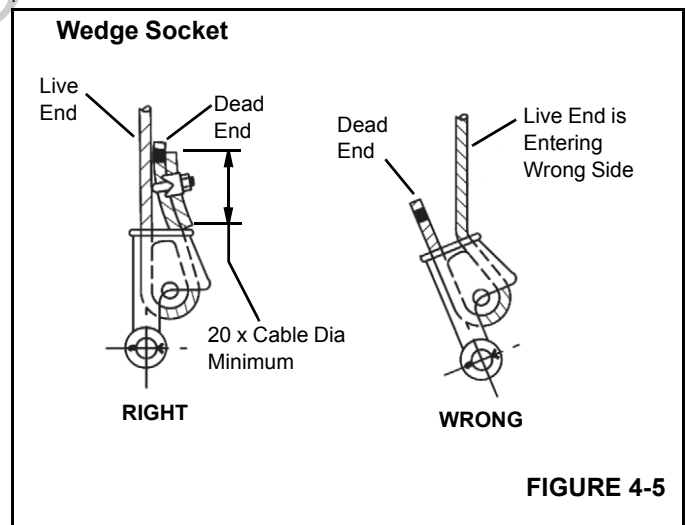


FIGURE 4-5

4. Insert the end of the wire rope into the socket, form a loop in the rope, and route the rope back through the

socket allowing the dead-end (Figure 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-end.
6. After final pin connections are made, increase the loads gradually until the wedge is properly seated.
7. The wire rope and wedge must be properly secured inside the socket before placing the crane into lifting service. It is the wedge that secures the wire rope inside the socket. The dead-end treatment is used to restrain the wedge from becoming dislodged from the socket should the rope suddenly become unloaded due to the headache ball or hook block striking the ground, etc.

Sketches A through F (Figure 4-6) illustrate various ANSI approved methods for treating the dead-ends of wire ropes which exit a wedge socket assembly. While use of the loop-back method is acceptable, care must be exercised to avoid the loop becoming entangled with tree branches and other components during crane transport and with the anti-two block system and other components during use of the crane.

Of the methods shown below, Manitowoc prefers that method A or F be used, i.e., clipping a short piece of wire rope to the dead-end or using a commercially available specialty wedge. Typically, it is recommended that the tail length of the dead-end should be a minimum of 6 rope diameters but not less than 6 in (15.2 cm) for standard 6 to 8 strand ropes and 20 rope diameters but not less than 6 in (15.2 cm) for rotation resistant wire ropes.

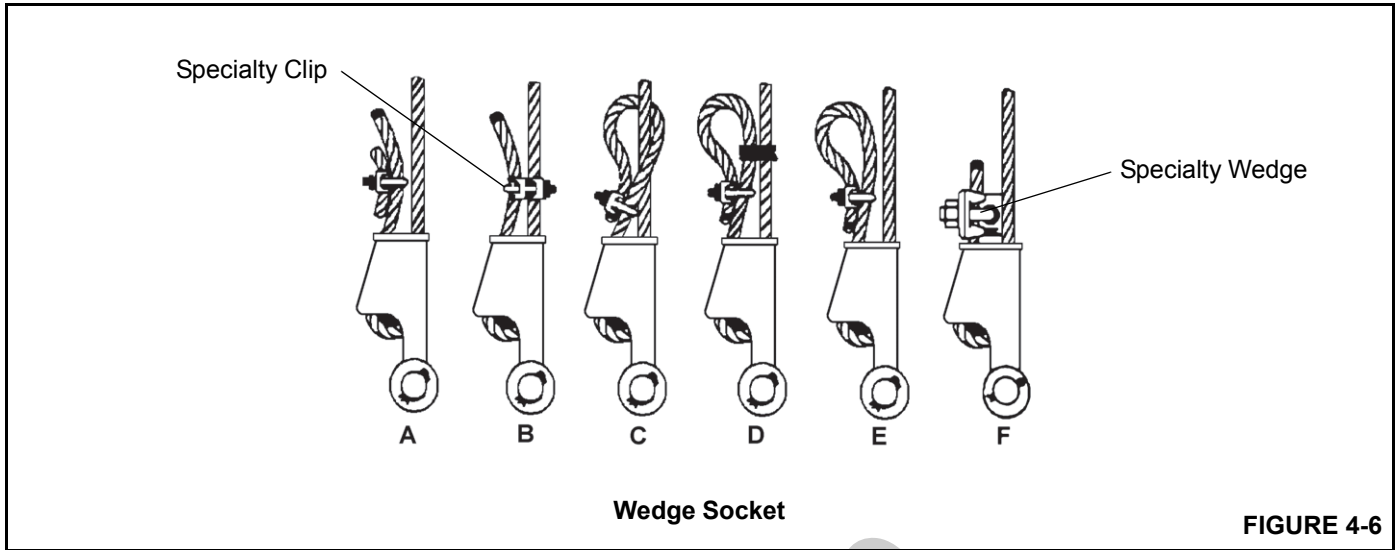
When using method A, place a wire rope clip around the dead end by clamping a short extra piece of rope to the rope dead end. **DO NOT CLAMP THE LIVE END.** The U-bolt should bear against the dead end. The saddle of the clip

should bear against the short extra piece. Torque the U-bolts according to the table titled Wire Rope Clip Torque Values (Table 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 edition.

Table 4-1

Wire Rope Clip Torque Values			
Clip Sizes		Torque	
Inches	mm	lb-ft	Nm
1/8	3.18	4.5	6
3/16	4.76	7.5	10
1/4	6.35	15	20
5/16	7.94	30	40
3/8	13.28	45	60
7/16	11.11	65	90
1/2	12.70	65	90
9/16	14.29	95	130
5/8	15.88	95	130
3/4	19.05	130	175
7/8	22.23	225	300
1	25.40	225	300
1-1/8	28.58	225	300
1-1/4	31.75	360	490
1-3/8	38.68	360	490
1-1/2	38.10	360	490



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ERECTING AND STOWING THE BI-FOLD BOOM EXTENSION



DANGER

Before attempting to erect or stow the boom extension (Figure 4-8), read and strictly adhere to all danger decals installed on the boom/boom nose, boom extension, and stowage brackets.

Lifting over the bi-fold extension base section is strictly prohibited, when the fly extension is either erected or folded along side of extension base section.

Erecting

1. Fully extend and set the outriggers.
2. Position the boom over the rear.
3. If extended, fully retract all the boom sections and lower the boom to minimum elevation to permit ease of installation of pins and access to the boom nose.

NOTE: The auxiliary boom nose (rooster sheave) does not have to be removed. However, if reeved, the hoist cable must be removed from the sheave.

4. Rig either the main hoist or optional auxiliary hoist cable for single part line with nothing but the wedge socket on the end of the cable.
5. Extend the boom enough to disengage the spring loaded boom stop block (Figure 4-7).

6. Pull down on the handle to disengage the spring loaded boom stop block. Place the end of the handle in the retainer plate. Fully retract the boom.

NOTE: When the boom retracts, the handle will be released allowing the stop block to engage when the boom is extended.

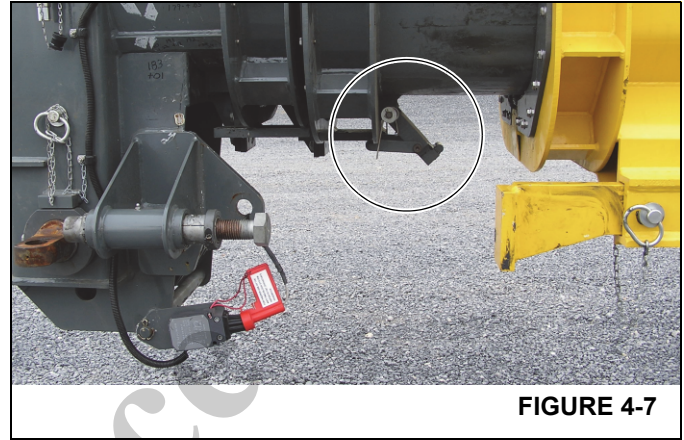


FIGURE 4-7

7. Remove the retainer clips from the attachment pins stowed in the base of the boom extension and insert the attachment pins through the attachment and anchor fittings on the right side of the boom nose. Install the retainer clips in the attachment pins.

CAUTION

If the boom extension fly section (stinger) is not to be erected, it should remain on the stowage brackets on the side of the boom.

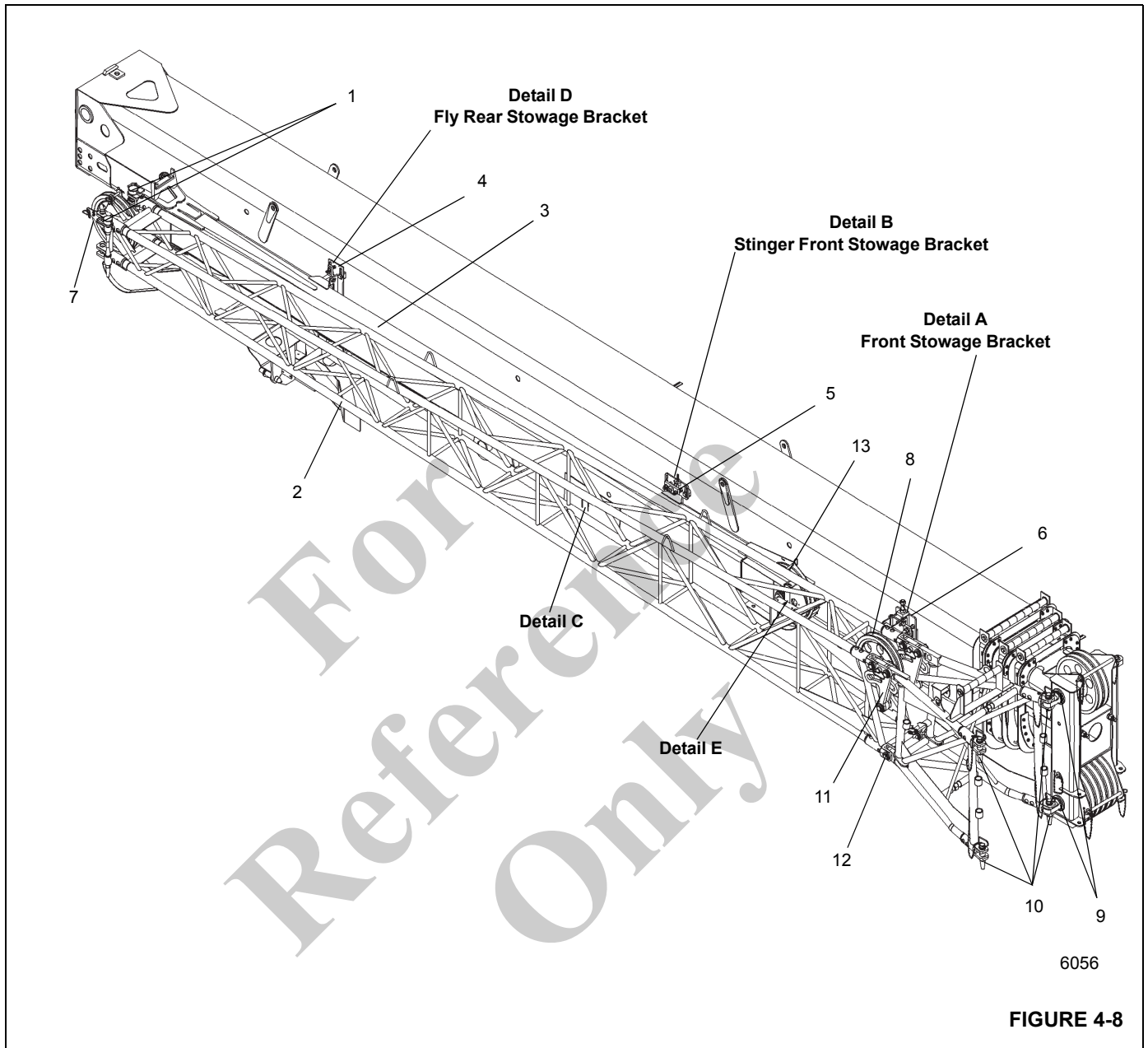


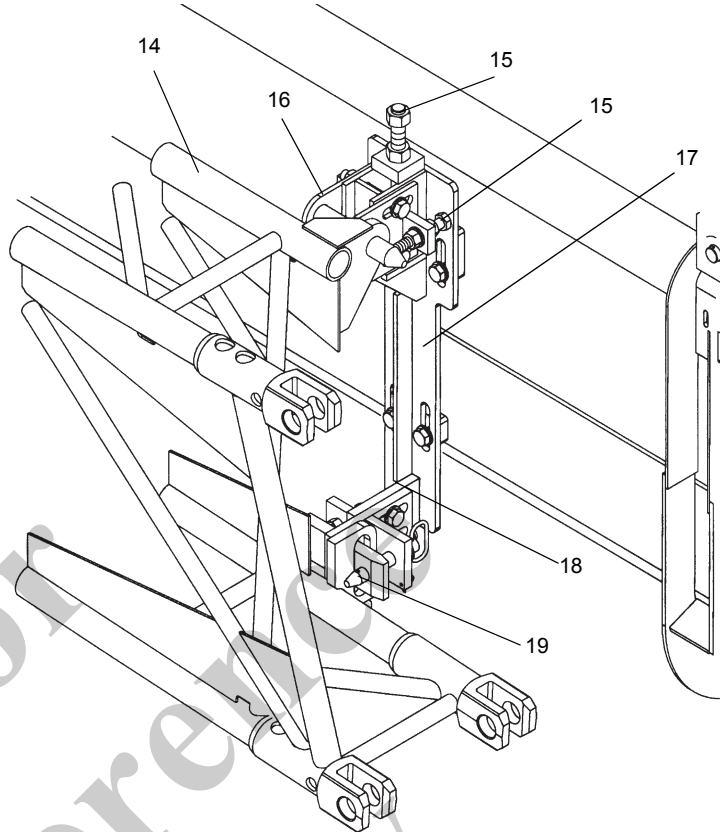
FIGURE 4-8

Item	Description
1	Base to Fly Attachment Pins
2	Boom Extension Base Section
3	Boom Extension Section
4	Fly Rear Stowage Bracket
5	Stinger Section Front Stowage Bracket
6	Front Stowage Bracket
7	Swingaway Base Sheave

Item	Description
8	Mast Assembly
9	Boom Nose to Boom Extension Attachment Anchor Fittings
10	Boom Nose to Boom Extension Attachment Pins
11	Offset Links
12	Offset Pivot Point
13	Stinger Sheave

Item	Description
14	Boom Extension Base Section
15	Adjusting Bolt
16	Upper Hanger
17	Main Hanger
18	Lower Support
19	Lock Hitch Pin

DETAIL A



Item	Description
20	Boom Extension Fly Section
21	Adjusting Bolt
22	Adjusting Bolts
23	Front Mount
24	Hangar

DETAIL B

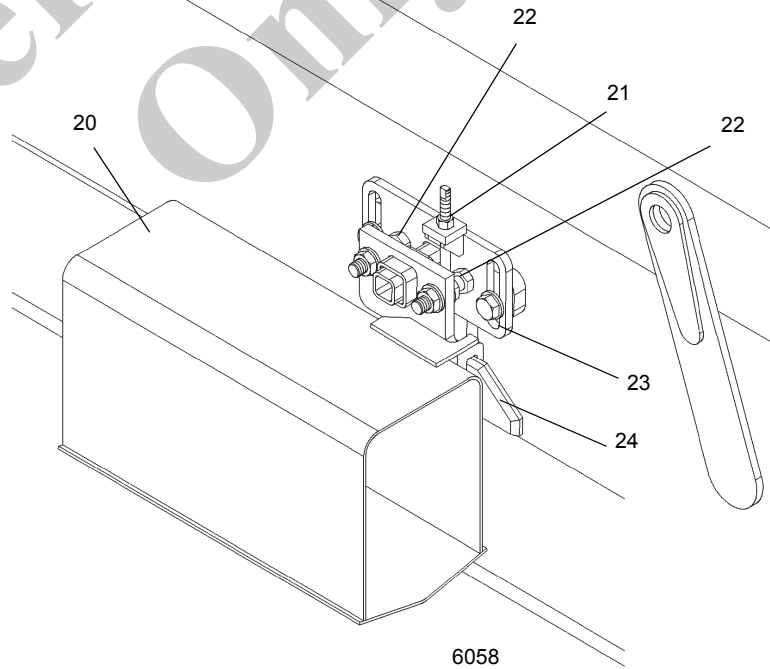
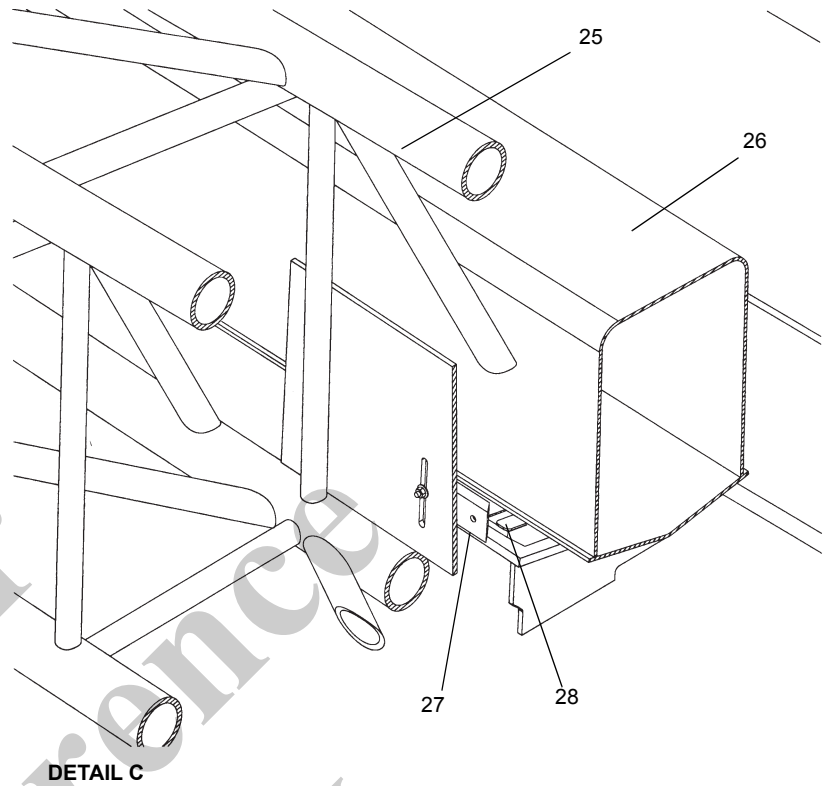


FIGURE 4-8 continued

Item	Description
25	Boom Extension Base Section
26	Boom Extension Fly Section
27	Shock Wear Pad and Shim
28	Ramp Wear Pad and Shim



Item	Description
29	Boom Extension Base Section
30	Boom Extension Fly Section
31	Fly Attachment Pin and Hitch Pin
32	Adjusting Bolts
33	Pin Stowage Lug
34	Upper Support
35	Lower Mount Ramp
36	Wear Pad

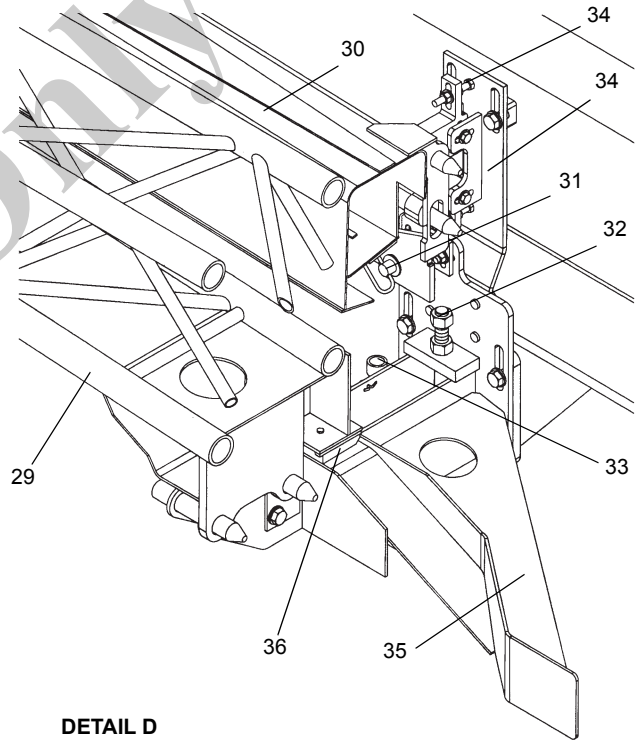
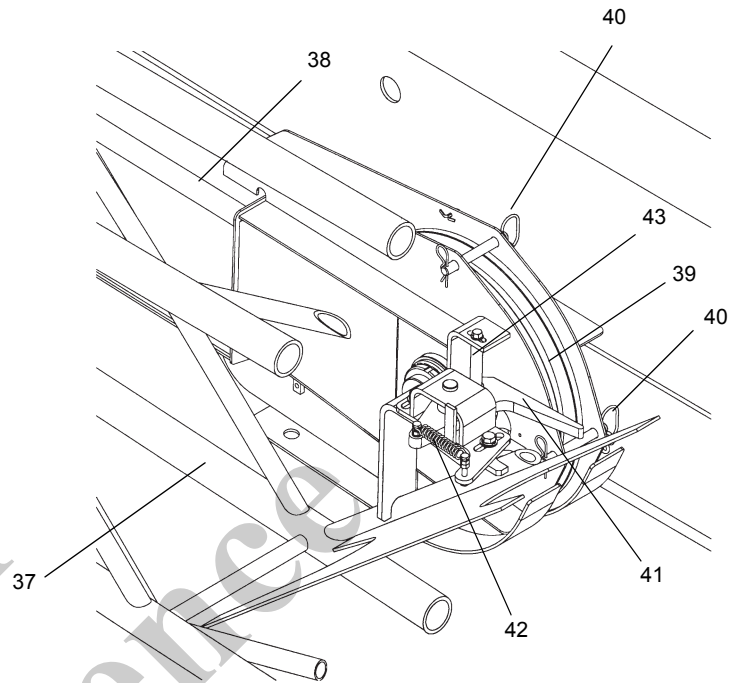


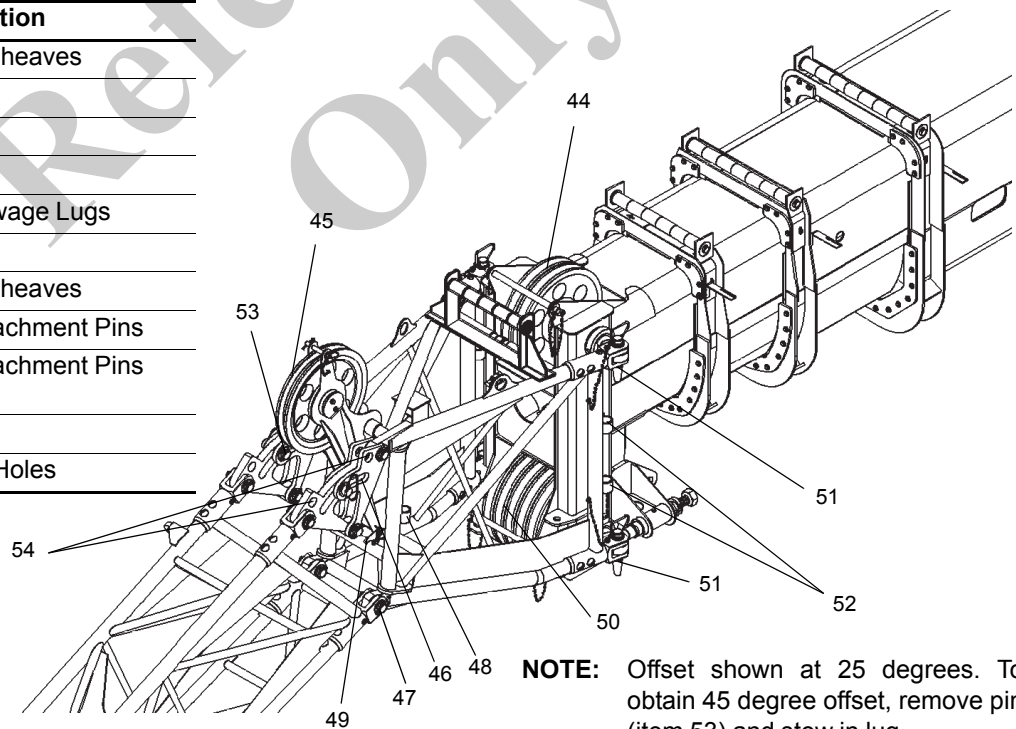
FIGURE4-8continued

Item	Description
37	Boom Extension Base Section
38	Boom Extension Fly Section
39	Fly Sheave
40	Cable Retainer Pins
41	Latch Hook
42	Spring
43	Latch Bar



DETAIL E

Item	Description
44	Boom Nose Upper Sheaves
45	Mast Assembly
46	Offset Links
47	Offset Pivot Points
48	Offset Link Pins Stowage Lugs
49	Mast Assembly Pin
50	Boom Nose Lower Sheaves
51	Boom Extension Attachment Pins
52	Boom Extension Attachment Pins Stowage Lugs
53	Offset Link Pins
54	Zero Degree Offset Holes



NOTE: Offset shown at 25 degrees. To obtain 45 degree offset, remove pin (item 53) and stow in lug.

FIGURE 4-8 continued

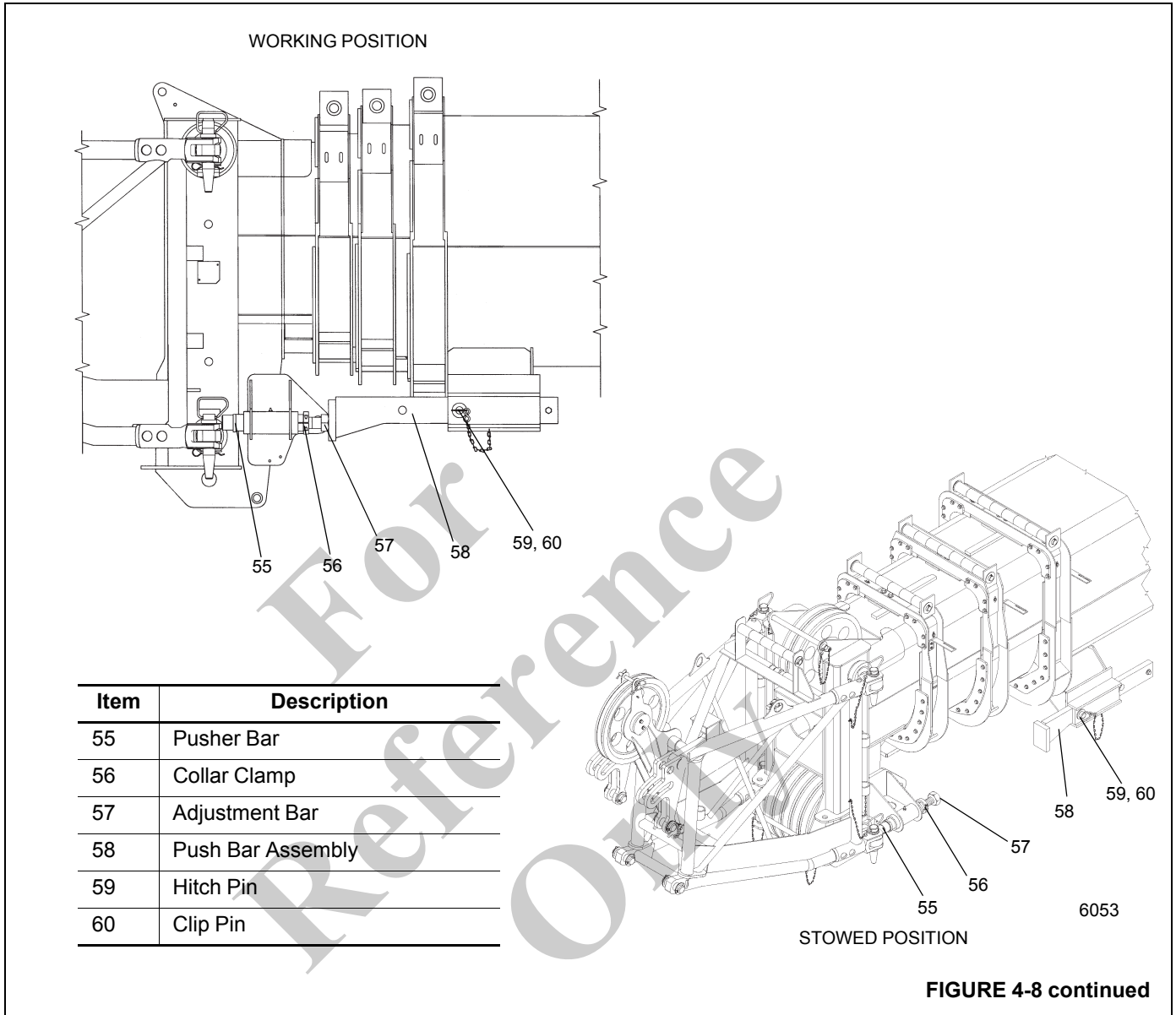


FIGURE 4-8 continued

- NOTE:** If erecting the boom extension fly section with the boom extension base section, skip to step 12. If not erecting the boom extension fly section, perform steps 8 to 11 and skip step 12.
8. Remove retainer clip from base to fly attachment pin and remove attachment pin from base section to fly section attachment fittings.
 9. Stow the pin in the opposite attach fitting or the stowage lug.
 10. Ensure the pin attaching the fly section to the boom base section rear stowage bracket (see detail D) is in place.

11. At fly section sheave end (see detail E) push in on the spring loaded latch hook to release latch, allowing the base to separate from the fly.
12. Remove the pin attaching the fly extension section to the boom base section rear storage bracket (see detail D). Ensure that the latch hook at the fly section sheave end (see detail E) is latched.
13. Remove the lock hitch pin securing the extension base to the front stowage bracket (see detail A). Stow lock hitch pin in lug provided.
14. Attach a length of rope to the extension base section tip to aid in the extension of the swingaway into place ahead of the boom nose.

CAUTION

If the fly section remains on the extension base, do not extend the extension assembly too far as the nose of the extension fly section could contact the front stowage bracket and cause damage.

15. Raise the boom to horizontal and extend the boom just enough to clear the extension stowage lugs from the guide ramps and stowage pins on the front and rear stowage brackets.
16. Remove the hitch pin and clip pin securing the boom extension alignment device in the stowed position. Pull the push bar assembly out to the working position and secure it in place with the hitch pin and clip pin.

**DANGER**

When erecting the boom extension, ensure that all personnel and equipment are kept clear of the swing path. The boom extension may swing around causing death or serious injury.

17. Slightly raise and/or lower the boom to help control the extension. Using the rope attached to the tip of the extension, swing the extension into place ahead of the boom nose, engaging the anchor fittings with the attachment fittings on the left side of the boom nose.

**DANGER**

Do not modify the attach points to permit the installation of the attach pins. Modified equipment may not assemble properly and allow the extension to fall, causing death or serious injury.

18. Install the attachment pin into the upper anchor and attachment fitting on the left side of the boom nose. Install retainer clip in attachment pin.

NOTE: If the boom extension alignment device does not properly align the anchor and attachment fittings to allow installation of the last attachment pin, refer to the *Service Manual* and adjust the boom extension alignment device.

19. Fully retract the boom until the bottom extension anchor fitting is against the boom extension alignment device and install the attachment pin in the lower anchor and attachment fittings on the left side of the boom nose. Install the retainer clip in the attachment pin.

20. Lower the boom and remove the rope from the tip of the extension base section.

21. Remove the hitch pin and clip pin securing the boom extension alignment device in the working position. Push the push bar assembly back to the stowed position and secure it in place with the hitch pin and clip pin.

**DANGER**

Do not attempt to erect the fly section unless it was attached to the boom extension base section during the initial erection procedure.

22. Erect the boom extension fly section as follows:

- a. Attach a length of rope to the tip of the extension fly section to aid in swinging the fly into place ahead of the base section. Ensure that the right base to fly extension attachment pin is in place.
- b. Position the boom to horizontal.
- c. At the fly section sheave end (see detail E), push in on the spring loaded latch hook to release the latch allowing fly to separate from the base.

**DANGER**

When erecting the extension fly section, ensure that all personnel and equipment are kept clear of the swing path.

- d. Slightly raise and/or lower the boom to help control the extension fly. Using the rope attached to the tip of the fly section, swing the fly into place ahead of the extension base, engaging the anchor fittings with the attachment fittings on the left side of the base section.
- e. Install the attachment pin into the anchor and attachment fittings on the left side of the base section.
- f. Lower the boom and remove the rope from the tip of the extension.

NOTE: Refer to *Setting the Folding Swingaway Offset*, page 4-18 to obtain a 25 or 45 degree offset with the swingaway.

23. Remove the cable retainer pins and clip pins from the tip of the extension base section or extension fly section.

NOTE: For zero (0) degree offset, leave the mast assembly in the stowed position.

24. Remove the mast assembly clip pin and pin from the stowed position on the extension and raise the mast assembly to an upright position. Install the pin and clip pin. Remove the cable retainer pin and clip pin from the mast.

NOTE: The hoist cable is not routed over the base extension sheave when using the fly extension.

25. Route the hoist cable over the mast sheave, the rollers on the adapter, the roller on the fly extension, and the sheave on the extension tip. Install the cable retainer pins and clip pins.

NOTE: Do not reeve hoist cable through sheaves on the main boom nose.

26. Rig the hoist cable.

Stowing

NOTE: The boom extension must be set at the zero (0) degree offset. Refer to *Setting the Folding Swingaway Offset*, page 4-18.

If so equipped, the folding fly section must be stowed on the side of the base section.

1. Fully retract the boom and swing it over the rear.
2. Lower the boom to minimum elevation.
3. Remove the cable retainer pins and clip pins from the swingaway tip and mast assembly. Remove the hoist cable from the extension sheave and/or mast. Install the cable retainer pins and clip pins.
4. Remove the mast assembly pin and clip pin securing the mast in the upright position. Lay the mast over to the stowed position and install the mast assembly pin and clip pin.
5. If erected, stow the extension fly section as follows:
 - a. Attach a length of rope to the fly extension tip.
 - b. Raise the boom to horizontal.
 - c. Remove the retainer clip and attachment pin from the anchor and attach fittings on the left side of the base section and stow in the base section.



DANGER

When stowing the extension fly, ensure that all personnel and equipment are kept clear of the swing path.

- d. Slightly raise and/or lower the boom to help control the extension fly. Using the rope attached to the tip of the fly section, swing the fly to the side of the base section.
- e. Elevate the boom and push in on the fly section to engage the spring loaded latch hook (see detail E)

on the base section. Ensure the latch hook is properly engaged.

- f. Lower the boom and remove the rope from the fly section.
6. Remove the pin and clip pin securing the boom extension alignment device in the stowed position. Pull the alignment device out to the working position and secure it in place with the pin and clip pin.
7. Lower the boom to minimum elevation.
8. Attach a length of rope to the base extension tip.
9. Raise the boom to horizontal.
10. Remove the retainer clips and attach pins from the anchor and attachment fittings on the left side of the boom nose and stow them in the base of the base extension.
11. Extend the boom enough so that the extension base and fly stowage lugs will line up in front of the guide ramps and pins on the stowage brackets when the swingaway is positioned to the side of the boom.



DANGER

When stowing the extension, ensure that all personnel and equipment are kept clear of the swing path.

12. Raise and/or lower the boom to help control the swingaway and using the rope attached to the tip of the base extension, swing the base extension to the side of the boom.
13. Elevate the boom to approximately 30° and push in on the extension to align the stowage lugs on the extension with the guide ramps and pins on the stowage brackets and fully retract the boom. (An increased boom angle will help the extension to slide into place for storage.)



DANGER

During disengagement of the stop block, extend the boom only enough to free the block. Extending the boom too far will cause the base extension to slide off the guide ramps and allow the extension to swing.

14. Lower the boom and extend the boom only enough to disengage the spring loaded boom stop block.
15. Pull down on the handle to disengage the spring loaded boom extension stop block (Figure 4-9). Place the end of the handle in the retainer plate. Fully retract the boom.



FIGURE 4-9

NOTE: When the boom retracts, the handle will be released allowing the stop block to engage when the boom is extended.

16. Ensure that all the stowage lugs on the base and fly are fully engaged with the pins on the stowage brackets.
 17. Insert lock hitch pin. Install the pin securing the extension base to the front stowage bracket (see detail A). Ensure the lock hitch pin is pushed all the way in.
 18. Install the pin attaching the fly section to the boom base section stowage bracket (see detail D).
- NOTE:** If the extension fly section remained on the boom stowage brackets, perform steps 19 thru 22.
19. Remove retainer clip and attachment pin from the bushing on base section.
 20. Insert the attachment pin into the base section to fly section attachment fittings and install the retainer pin.
 21. Ensure the spring loaded latch hook is engaged on fly section sheave end (see detail E).
 22. Ensure the pin attaching the fly section to the boom base section stowage bracket (see detail D) is in place.
 23. Remove the retainer clips and attachment pins from the anchor and attach fittings on the right side of the boom nose and stow them in the base of the swingaway.
 24. Remove the clip pin and pin securing the boom extension alignment device. Place the boom extension push bar assembly in the stowed position and secure it in place with the pin and clip pin.

**DANGER**

Failure to maintain the proper clearance between the base extension anchor fittings and the boom nose attach fittings could cause these fittings to contact each other during operation of the boom.

25. Extend the boom enough to engage the boom stop block.
26. Rig the boom nose and hoist cable as desired and operate the crane using normal operating procedures.

Setting the Folding Swingaway Offset**DANGER**

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 rear. Position the boom to above horizontal.
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.

- a. Slowly lower the boom until the pressure is relieved on the offset link pins.
 - 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 (25 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.
4. To set the offset from higher degree to lesser degree, perform the following procedures.

CAUTION

Do not overload the extension anchor fittings or the extension base section when lowering the boom.

- a. Slowly lower the boom until the pressure is relieved from the offset links.
- b. Remove the offset link clip pins and attachment pins and lower the boom until the holes for the lesser

degree offset position align in the offset links. Install the offset pins and clip pins.

- 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.

ERECTING AND STOWING THE BI-FOLD BOOM EXTENSION USING THE 20 FT (6.1 M) INSERT



DANGER

Before attempting to erect or stow the bi-fold extension with insert (see Figure 4-10), read and strictly adhere to all danger decals installed on the boom/boom nose, boom extension, insert, and stowage brackets.

Erecting

1. Fully extend and set the outriggers.
2. Position the boom over the rear.
3. If extended, fully retract all the boom sections and lower the boom to minimum elevation to permit ease of installation of pins and access to the boom nose.

NOTE: The auxiliary boom nose (rooster sheave) does not have to be removed. However, if reeved, the hoist cable must be removed from the sheave.

4. Attach the swingaway to the boom nose using steps 5 thru 21 of *Erecting and Stowing the Bi-Fold Boom Extension*, page 4-10.
5. Extend the boom as necessary to permit sufficient clearance for installation of the 20 ft (6.1 m) extension insert; then lower it until the tip of the bi-fold extension assembly is laying on the ground. Block up under the bi-fold extension, approximately 8 to 10 ft (2.4 to 3.0 m) ahead of the boom nose.
6. Remove the four retainer clips and attachment pins that secure the bi-fold extension to the boom nose.
7. Retract the boom leaving the bi-fold extension on the blocking.
8. Using the main or auxiliary hoist cable, lift the Insert by the lifting lugs and position it at the base end of the bi-fold extension.
9. Mate the Insert to the bi-fold extension and install the four attaching pins and retainer clips removed in step 6.

10. With the hoist cable still attached to the Insert, lift the assembled unit and move the blocking, erected in step 5, to approximately 8 to 10 ft (2.4 to 3.0 m) ahead of the boom nose attach end of the Insert.

NOTE: Repeat steps 6 through 16 in a similar manner to install the second insert if applicable.

11. Lower the bi-fold and insert assembly onto the blocks and detach the hoist cable.
12. Retract the boom and lower to minimum elevation.
13. Rig the hoist cable for single part line with nothing but the wedge socket on the end of the cable.
14. Extend the boom and mate the attachment lugs on the Insert with the anchor fittings on the boom nose. It may be necessary to raise or lower the boom slightly to mate the attach lugs.

NOTE: If the insert attach lug holes are not in lateral alignment with the holes in the boom nose anchor fittings to install the pins, adjust the upper and lower cross strut adjustment screws on the insert to align the holes.

15. Remove the retainer clips from the four attachment pins stowed on the insert and install them in the attachment and anchor fittings on both sides of the boom nose. Install the retainer clips.

CAUTION

Do not attempt to swing the boom extension around to the right side of the insert. This could result in damage to the insert.

16. Slowly elevate the boom and remove the blocking from under the insert and bi-fold extension.
17. Refer to steps 22 thru 26 of *Erecting*, page 4-10 to erect the fly section, to set the offset, and rig the hoist cable.

Stowing

NOTE: If so equipped, the folding fly section must be stowed on the side of the base section.

1. If the fly section is erected, refer to steps 1 thru 5 of *Stowing the Bi-Fold Boom Extension*.
2. Extend the boom approximately 4 to 5 ft (1.22 to 1.52 m). Lower the boom until the sheave is on the ground.
3. Block up under the insert approximately 8 to 10 ft (2.4 to 3 m) forward of the boom nose.
4. Remove the retainer clips from the four pins in the attachment and anchor fittings and remove the attachment pins. Stow the pins in the holders on the insert.

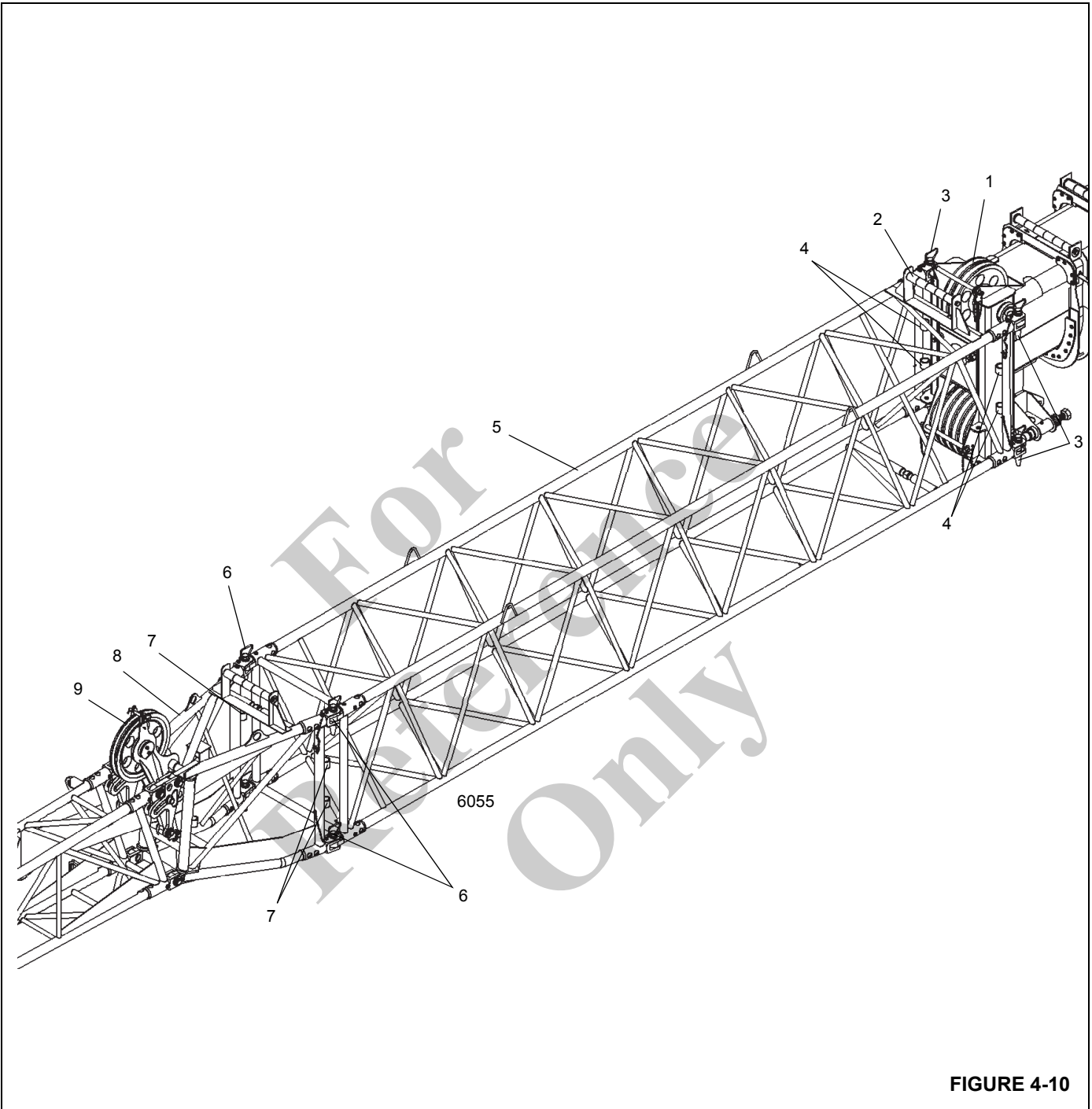


FIGURE 4-10

Item	Description
1	Boom Nose Upper Sheaves
2	Cable Roller
3	Insert Attachment Pins
4	Insert Attachment Pins Stowage Lugs
5	6.2 m (20 foot) Insert

Item	Description
6	Bi-Fold Extension Attachment Pins
7	Bi-Fold Extension Attachment Pins Stowage Lugs
8	Bi-Fold Extension Assembly
9	Mast Assembly

5. Retract the boom disengaging the anchor fittings on the boom nose from the attaching lugs on the insert.
6. Attach a hook to the hoist cable.
7. Attach the hoist cable hook to the lifting lugs on the insert. Lift the assembly and reposition the blocking approximately 8 to 10 ft (2.4 to 3 m) forward of the insert to swingaway attachment points.
8. While supporting the insert with the hoist cable, remove the retainer clips from the four pins attaching the insert to the swingaway. Remove the four pins.
9. Remove the insert and position it to one side of the crane.
10. Position the boom and extend it to engage the boom nose with the swingaway. Install the four attachment pins and retainer clips removed in step 8.
11. Stow the swingaway on the side of the main boom using steps 6 thru 26 of Stowing the Swingaway Boom Extension.

REMOVABLE COUNTERWEIGHT



DANGER

Ensure that all mounting pins are properly installed and locked, during, and after operating the counterweight removal system.

NOTE: The removable counterweight consists of one standard box and a maximum of two slabs, each weighing 5500 lb (2495 kg). The following procedures are applicable for removal and installation of any or all pieces (Figure 4-12).

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.
3. On the counterweight cylinders control panel (Figure 4-11), open the power switch cover (1) and toggle the switch to the on position.
4. Using the counterweight cylinders control panel, lower the counterweight cylinders by pushing down on the left side cylinder switch (2) and right side cylinder switch (3). Pin the cylinders to the counterweight using the attach pins in the cylinders. Insert the retaining pins in the attach pins.

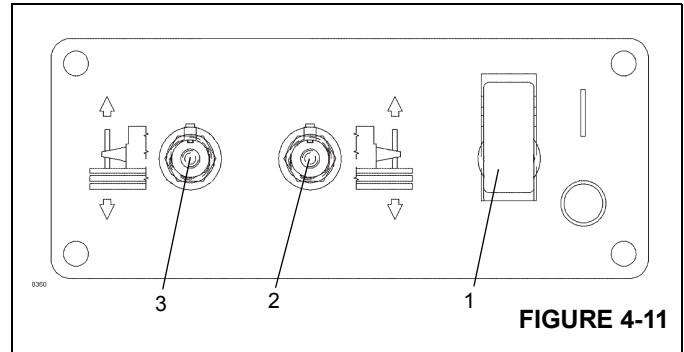


FIGURE 4-11

5. Push in, turn, and remove the long attach pins from the counterweight and carrier frame lugs.
 6. Using the control panel switches, raise the counterweight up under the superstructure frame.
- NOTE:** It may be necessary to jog the counterweight control switches to install the upper attach pins.
7. Remove the upper attach pins from the stowage bushings and install them into the upper counterweight and superstructure frame lugs.
 8. Push in on the pins and turn to lock each pin in the notch.
 9. Insert the long pins into the bottom of the counterweight. Push in on the pins and turn to lock each pin in the notch.
 10. The crane is now ready for operation with the counterweight installed.

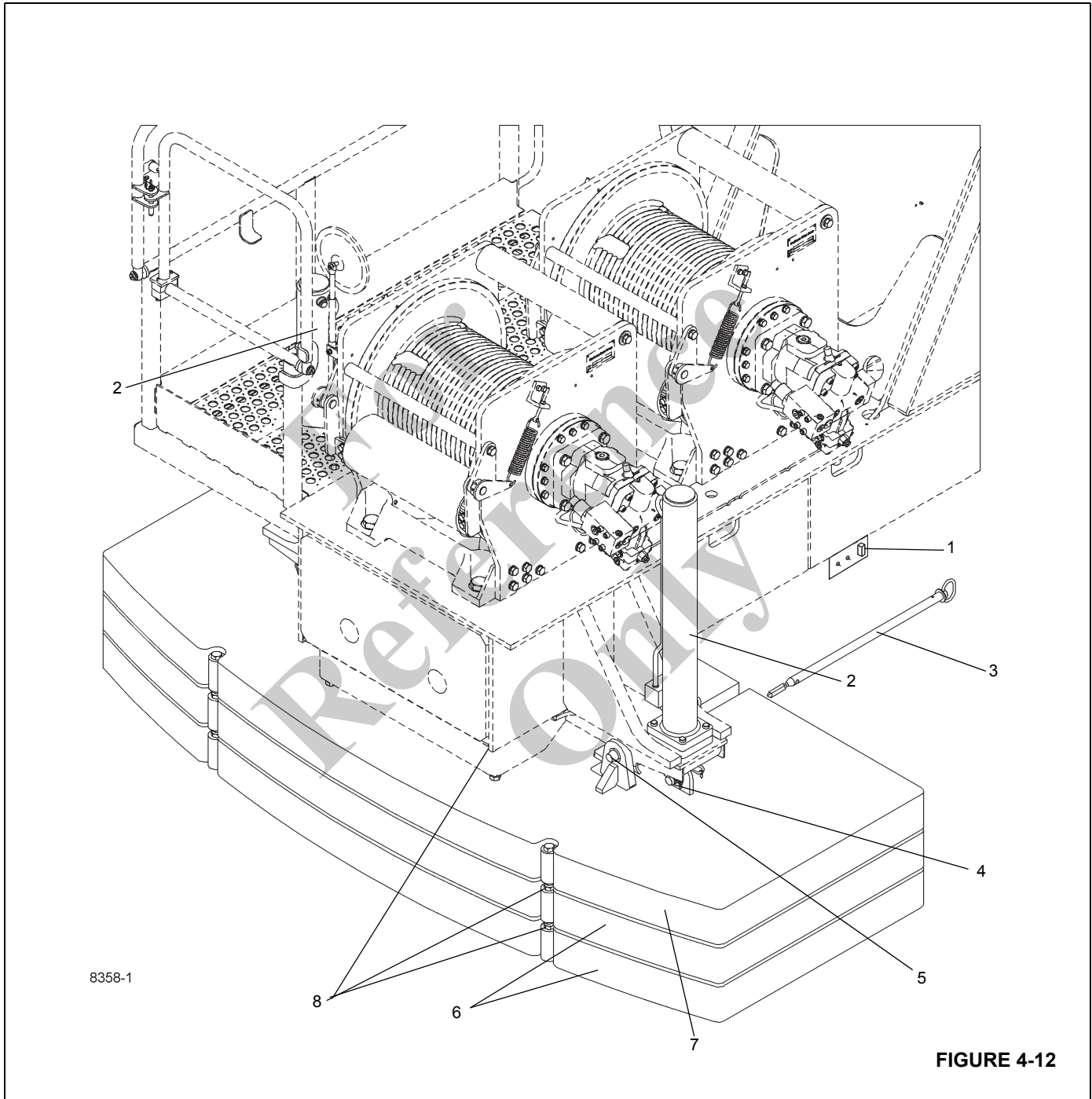
Stowing the Counterweight

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 control switches to remove the weight of the counterweight from the upper attach pins.

3. Using the counterweight cylinders control panel switches, 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 counterweight cylinders control panel switches, 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.



Item	Description
1	Counterweight Cylinders Control Panel
2	Removal Cylinder
3	Slab Attach Pin
4	Cylinder Attach Pin

Item	Description
5	Box Attach Pin
6	5500 lb (2495 kg) Slabs
7	5500 lb (2495 kg) Standard Box
8	Jack Screws

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Only

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SECTION 5 LUBRICATION

SECTION CONTENTS

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GENERAL

Following the designated lubrication procedures is important in ensuring maximum crane lifetime and utilization. The procedures and lubrication charts in this section include information on the types of lubricants used, the location of the lubrication points, the frequency of lubrication, and other information.

The service intervals specified are for normal operation where moderate temperature, humidity, and atmospheric conditions prevail. In areas of extreme conditions, the service periods and lubrication specifications should be altered to meet existing conditions. For information on extreme condition lubrication, contact your local 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.

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.

ARCTIC CONDITIONS BELOW -9°C (15°F)

In general, petroleum based fluids developed especially for low temperature service may be used with satisfactory results. However, certain fluids, such as halogenated hydrocarbons, nitro hydrocarbons, and phosphate ester hydraulic fluids, might not be compatible with hydraulic system seals and wear bands. If you are in doubt about the suitability of a specific fluid, check with your authorized distributor or Manitowoc Crane Care.

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°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 water jacket and batteries. The operator needs to follow the guide lines as stated in this *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, Synthetic Gear Lube 75W-90
- Eaton, Roadranger EP75W-90
- Mobil, Mobilube SCH 75W-90
- Shell, Spirax S 75W-90
- Sunoco Duragear EP75W-90

Engine - Pre-2007 ISM and QSM engine burning non-ULSD fuel- Spec 6829101560:

- Petro-Canada Duron Synthetic CI-4 5W-40
- Mobil Delvac 1 5W-40

2007 ISM engine, 2010 ISX and QSM engines burning ULSD- 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 SHC629

Grease - Spec 6829104275:

- Petro-Canada Precision Synthetic EP1
- Mobil: Mobilith SHC 220

Open Gear Lube (bearing/swingdrive 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

Supplemental Coolant Additive (SCA) - Spec 6829012858:

- Fleetguard DCA4
- Fleetguard DCA2
- Penray Pencool 3000

Diesel Exhaust Fluid (DEF)– Spec 80019225:

- Fleetguard StableGuard™ Urea 32 Premix
- AdBlue®
- TerraCair Ultrapure® DEF

STANDARD LUBRICANTS PACKAGE

Axle and Swing Box - Spec 6829012964:

- Century Unigear Semi-synthetic SAE 80W-90
- Texaco Multigear SS 80W-90
- Chevron DELO 80W-90

Engine - Pre-2007 ISM and QSM engine burning non-ULSD fuel - Spec 6829003483:

- Engine Oil Exxon XD-3 CI-4 15W-40
- Conoco Fleet Supreme CI-4 15W-40

2007 ISM, 2010 ISX and QSM engines burning ULSD- Spec 6829104182:

- Conoco Fleet Supreme EC CJ-4 15W-40
- Mobil Delvac 1300 Super CJ-4 15W-40

Transmission - Fuller Manual - Spec 6829013433:

- Citgo Synthetic Gear Lubricant CD50
- Eaton Roadranger SAE50
- 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 Pencoool 3000

Diesel Exhaust Fluid (DEF)– Spec 80019225:

- Fleetguard StableGuard™ Urea 32 Premix
- AdBlue®
- TerraCair Ultrapure® DEF

LUBRICATION POINTS

A regular frequency of lubrication must be established for all lubrication points. Normally, this is based on component operating time. The most efficient method of keeping track of lube requirements is to maintain a job log indicating crane usage. The log must use the engine hourmeter to ensure coverage of lube points that will receive attention based on their readings. Other lubrication requirements must be made on a time basis, i.e. weekly, monthly, etc.

All oil levels are to be checked with the crane parked on a level surface in transport position, and while the oil is cold, unless otherwise specified.

On plug type check points, the oil levels are to be at the bottom edge of the check port.

On all hoists with a check plug in the drum, the fill plug shall be directly on top of the hoist, and the check plug level.

All grease fittings are SAE STANDARD unless otherwise indicated. Grease non-sealed fittings until grease is seen extruding from the fitting. A measure of 1 oz (0.28 kg) of EP-MPG equals one pump on a standard 1 lb (0.45 kg) grease gun.

Over lubrication on non-sealed fittings will not harm the fittings or components, but under lubrication will definitely lead to a shorter lifetime.

On sealed U-joints, care must be exercised to prevent rupturing seals. Fill only until expansion of the seals first becomes visible.

Unless otherwise indicated, items not equipped with grease fittings, such as linkages, pins, levers, etc., should be lubricated with oil once a week. Motor oil, applied sparingly, will provide the necessary lubrication and help prevent the formation of rust. An Anti-Seize compound may be used if rust has not formed, otherwise the component must be cleaned first.

Grease fittings that are worn and will not hold the grease gun, or those that have a stuck check ball, must be replaced.

Where wear pads are used, cycle the components and relubricate to ensure complete lubrication of the entire wear area.

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. (CI-4 for pre-2007 ISM engines)
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
EPGL-5H	Extreme Pressure Gear Lubricant - SAE Grade 80W-140
DEF	Diesel Exhaust Fluid
SCA	Supplemental Coolant Additive

Table 5-2
Lube Description

Lubrication Description	Lube Specification
50/50 Fully Formulated Anti-Freeze Coolant	6829101130
Engine Oil SAE 15W40, CJ4	6829104182
Engine Oil SAE 15W40, CI4	6829003483
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
EPGL Gear Lube	6829006240
Supplemental Coolant Additive	6829012858
Diesel Exhaust Fluid	80019225
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 according to conditions such as continuous duty cycles and/or hazardous environments.

CARRIER LUBRICATION**1. Engine Crankcase**

Lube Type - EO - 15W40

T3 Engine - CI-4, Grove spec. 6829003483

T4 Engine - CJ-4, Grove spec. 6829104182

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

QSM Engine - 38 qt (36 l)

ISX Engine - 47 qt (44 l)

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. Test and refresh per instructions in *Service Manual*.

Lube Amount - Capacity

QSM Engine - 57 qt (54 l)

ISX Engine - 79 qt (75 l)

CAUTION

Improper filling of the engine coolant system can result in engine damage.

Lube Type - SCA

Lube Interval - Change filter and check SCA levels every 500 hours. Check coolant for contamination every 1000 hours. Test and refresh per instructions in *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 - 19 liters (20 quarts)

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.

Application - Final fluid levels shall be adjusted to indicating arrows, dipstick markings, or to bottom of fill plug threads.

4. Pump Drive

Lube Type - SSGL-5

Lube Interval - Check fluid level every 100 hours or monthly, whichever interval occurs first. Drain and fill every 500 hours.

Lube Amount - Capacity - 2.4 liters (2.5 quarts)

Application - Through fill pipe (dipstick pipe) to oil level mark on dipstick.

5. 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

DANGER

Ensure crane is on jacks and wheels are off ground, parking brakes are set, transmission is in neutral gear, and an assistant is depressing the clutch pedal before trying to grease the clutch throw-out bearing. Doing so allows the transmission input shaft -- shielded by the transmission's clutch housing -- to turn and distribute grease without the other drive shafts turning and posing further hazards to workers. Allowing crane to move could cause workers death or serious injuries.

6. Clutch Throw-Out Bearing

Lube Type - EP-MPG

Lube Interval - 250 hours

Lube Amount - Until grease extrudes

Application - 1 grease fitting, apply with engine running for equal distribution of grease

7. Clutch Linkage

Lube Type - EP-MPG

Lube Interval - 500 hours

Lube Amount - Until grease extrudes

Application - 5 grease fittings

8. Transmission**a. Shift U-Joints/Control Unit**

Lube Type - EP-MPG

Lube Interval - 500 hours

Lube Amount - Until grease extrudes

Application - 3 grease fittings

b. Driveline Slip

Lube Type - EP-MPG

Lube Interval - 500 hours or 10,000 miles, whichever interval occurs first

Lube Amount - Until grease extrudes

Application - 2 grease fittings

9. Power Steering Gearbox

Lube Type - EP-MPG

Lube Interval - 1000 hours

Lube Amount - Until grease extrudes

Application - 1 grease fitting

10. Steering Relay Arms

Lube Type - EP-MPG

Lube Interval - 250 hours

Lube Amount - Until grease extrudes

Application - 2 grease fittings

11. 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 antiseize compound. Do not apply antiseize compound to the face of the wheel of the hub.

Application - Brush on. 4 places

12. Front Axle Hubs**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.

Lube Type - SSGL-5

Lube Interval - Check fluid level every 250 hours and refill as necessary.

Lube Amount - 0.95 liters (1.0 quart)

Application - Fill to the oil level mark on the housing with the fill plug and the oil level mark horizontal. 4 places

13. Front Axle Tie Rod Ends

Lube Type - EP-MPG

Lube Interval - 1000 hours

Lube Amount - Until grease extrudes

Application - 4 grease fittings

14. Front Axle King Pins

Lube Type - EP-MPG

Lube Interval - 1000 hours

Lube Amount - Until grease extrudes

Application - 8 grease fittings

15. Front Axle Brake Slack Adjusters

Lube Type - EP-MPG

Lube Interval - 1000 hours

Lube Amount - Until grease extrudes

Application - 4 grease fittings

16. Front Axle Brake Camshafts

Lube Type - EP-MPG

Lube Interval - 1000 hours

Lube Amount - Until grease extrudes

Application - 4 grease fittings

17. Rear Aluminum Wheel Pilots

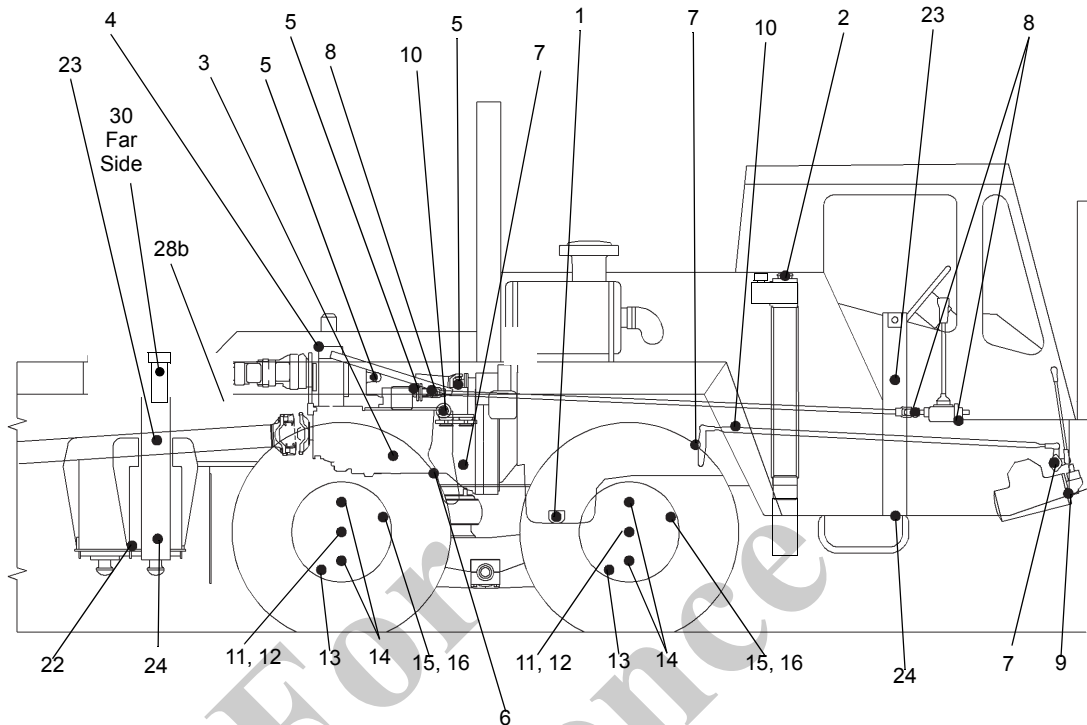
Lube Type - ASC

Lube Interval - When wheels are removed for service.

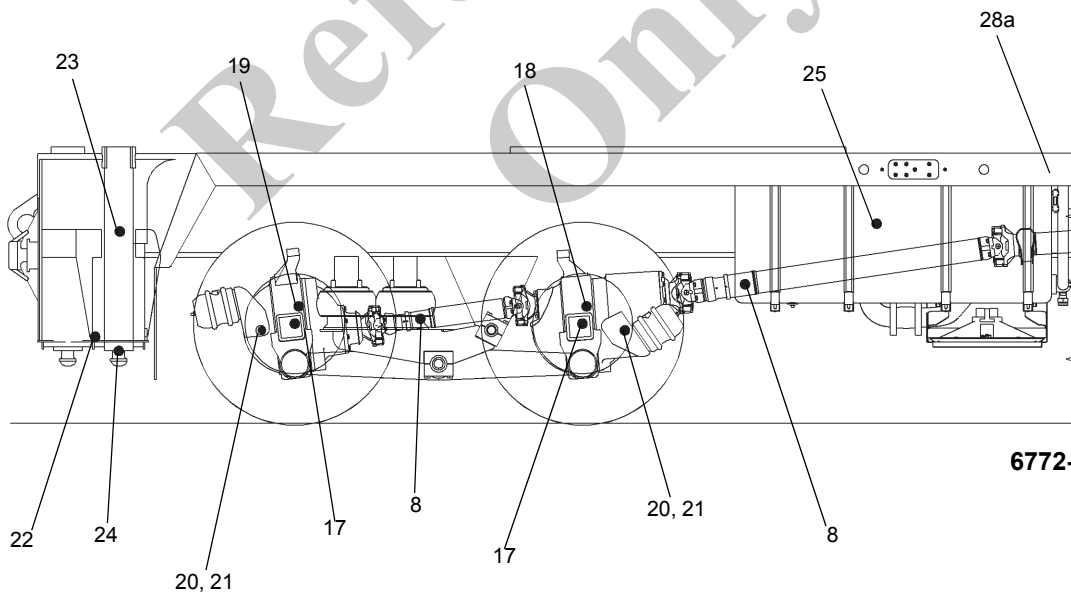
Lube Amount - Generously coat the wheel pilot or hub pads with antiseize compound. Do not apply antiseize compound to the face of the wheel of the hub.

Application - Brush on. 8 places

For
Reference
Only



6772-1



6772-2

FIGURE 5-1

Item	Description
1	Engine Crankcase
2	Engine Cooling System
3	Transmission
4	Pump Drive
5	Pump Drive Shaft U-Joints and Spline
6	Clutch Throw Out Bearing
7	Clutch Linkage
8	Transmission Shift U-Joints and Control Unit
9	Power Steering Gearbox
10	Steering Relay Arms
11	Front Aluminum Wheel Pilots
12	Front Axle Hubs
13	Front Axle Tie Rod Ends
14	Front Axle King Pins
15	Front Axle Brake Slack Adjusters
16	Front Axle Brake Camshafts
17	Rear Aluminum Wheel Pilot
18	Front Rear Axle Differential
19	Rear Rear Axle Differential
20	Rear Axle Brake Slack Adjusters
21	Rear Axle Brake Camshafts
22	Outrigger Beams
23	Jack Cylinder Support Tubes
24	Jack Cylinder Barrels
25	Hydraulic Reservoir
26	Hydraulic Filter
27	Fuel Filter
28	Air Cleaner
28a	DEF Tank
28b	DEF Filter
29	Coolant Strainer (Superstructure Cab Heater)
30	Fuel Filter

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.

18. Front Rear Axle Differential

Lube Type - SSGL-5

Lube Interval - Check lubricant level every 250 hours and refill as necessary. Drain, fill, change filter, and clean magnetic drain plug every 80,000 km (50,000 mi) or 2 years, whichever interval occurs first.

Lube Amount - Capacity - 27 liters (57 pints) Normal makeup - less than 0.23 liter (0.5 pint)

Application - Fill to bottom of fill plug threads.

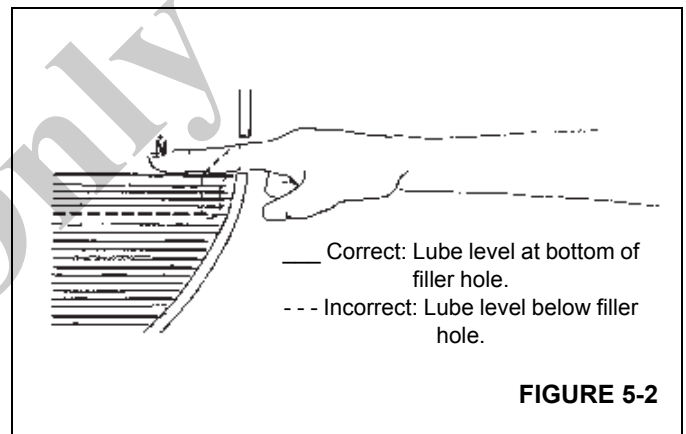
CAUTION

Use of non-semi-synthetic lubricant may damage components and/or invalidate published lubrication intervals.

If the makeup amount is substantially more than 0.23 liter (0.5 pint) check for leaks.

NOTE: Lube level (Figure 5-2) 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 5-2 pertains to the differentials and the planetary hubs and wheel bearings.

19. 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 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.

Lube Amount - Capacity - 17.5 liters (37 pints) Normal makeup - less than 0.23 liter (0.5 pint)

Application - Fill to bottom of fill plug threads.

20. Rear Axle Brake Slack Adjusters

Lube Type - EP-MPG

Lube Interval - 1000 hours

Lube Amount - Until grease extrudes

Application - 4 grease fittings

21. Rear Axle Brake Camshafts

Lube Type - EP-MPG

Lube Interval - 1000 hours

Lube Amount - Until grease extrudes

Application - 4 grease fittings

22. Outrigger Beams

Lube Type - EP-MPG

Lube Interval - 50 hours or 1 week, whichever interval occurs first

Lube Amount - Brush on outrigger beams.

Application - Brush on; 8 places

23. Jack Cylinder Support Tubes

Lube Type - EP-MPG

Lube Interval - 500 hours

Lube Amount - Brush lubrication on ID of jack cylinder support tubes and wear bands before installing jack cylinders.

Application - Brush on; 5 places

24. 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

HYDRAULIC LUBRICATION

NOTE: 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 (e.g., 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 distributor or Manitowoc Crane Care.

25. Hydraulic Reservoir

Lube Type - Standard Hydraulic Oil - Above -9°C (15°F).

The factory fill standard hydraulic oil is Exxon Mobil 424 10W-30. This fluid is acceptable for operating temperatures above Above -9°C (15°F). For alternate hydraulic oil products, refer to Manitowoc lube specifications in the *Service Manual*.

Lube Interval - Check fluid level every 10 hours or daily, using sight gauge on side of tank, with boom retracted and in boom rest 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 (SAE J1165), the service interval can be increased to 3000 hours or 3 years.

Lube Amount - 507 liters (134 gal.) (tank only), to the FULL mark on sight gauge.

Application - Remove the breather; fill through the breather hole on top of tank; reinstall breather. When tank is drained, clean the magnetic pipe plug.

Replace breather every 500 hours or 6 months, whichever interval occurs first.

Check filter every 500 hours or 6 months, whichever interval occurs first.

26. Fuel Filter

Drain water trap every 10 hours or daily and change filter when clear cover is full of fuel.

27. Air Cleaner Filter

Replace air cleaner filter element when indicator shows red (25" H₂O).

28. 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.

28a. Diesel Exhaust Fluid Reservoir

Lube Type - DEF.

Lube Interval - As Required.

Lube Amount - 10 gal (38 l).

Application - Fill through cap on top of tank.

28b. Diesel Exhaust Fluid Filter

Replace filter every 200,000 miles or 4500 hours of crane operation.

SUPERSTRUCTURE LUBRICATION

29. Turntable Gear Box

Lube Type - SSGL-5

NOTE: Remove one valve to equalize the pressure before checking the swing gearbox oil level. This will keep the oil from pushing out.

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 -

Gearbox - 1.30 liters (2.75 pints)

Application - Fill until oil level is at top of sight gauge

30. Turntable Gear and Drive Pinion

Lube Type - EP-OGL

Lube Interval - 500 hours or 6 months, whichever interval occurs first

Lube Amount - Coat all teeth

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 at the front of the turntable. Rotate the turntable 90° and apply grease to fittings. Continue rotating 90° and grease the fittings until the whole bearing is greased.

31a. 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

32. Upper Lift Cylinder Pivot Pin

Lube Type - EP-MPG

Lube Interval - 500 hours or every 3 months, whichever interval occurs first

Lube Amount - Until grease extrudes

Application - 1 grease fitting

33. Lower Lift Cylinder Pivot Pin

Lube Type - EP-MPG

Lube Interval - 500 hours or 3 months, whichever interval occurs first

Lube Amount - Until grease extrudes

Application - 2 grease fittings

34. Main Hoist

Lube Type - EPGL-5H

Lube Interval - Check and fill every 1000 hours or 12 months, whichever interval occurs first. Drain and fill annually.

Lube Amount - Capacity - 14.7 liters (15.5 quarts)

Application - Fill until level with the check plug opening or in middle of sight glass. Hoist must be at 21°C ±7 (70°F ±20), level and idle for 20 minutes.

35. Auxiliary Hoist (Optional)

Lube Type - EPGL-5H

Lube Interval - Check and fill every 1000 hours or 12 months, whichever interval occurs first. Drain and fill annually.

Lube Amount - Capacity - 14.7 liters (15.5 quarts)

Application - Fill until level with the check plug opening or in middle of sight glass. Hoist must be at 21°C ±7 (70°F ±20), level and idle for 20 minutes.

36. Cable Guard Roller and Guide Roller

Lube Type - EP-MPG

NOTE: Rollers may or may not have bearings that need lubrication. Those that do will have grease fittings. Lubricate more frequently than interval indicated, if

environmental conditions and/or operating conditions necessitate.

Lube Interval - 250 hours or 3 months, whichever interval occurs first.

Lube Amount - Until grease extrudes

Application - To each grease fitting.

BOOM, BOOM EXTENSION, AND BOOM ACCESSORIES LUBRICATION

37. 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

38. 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.

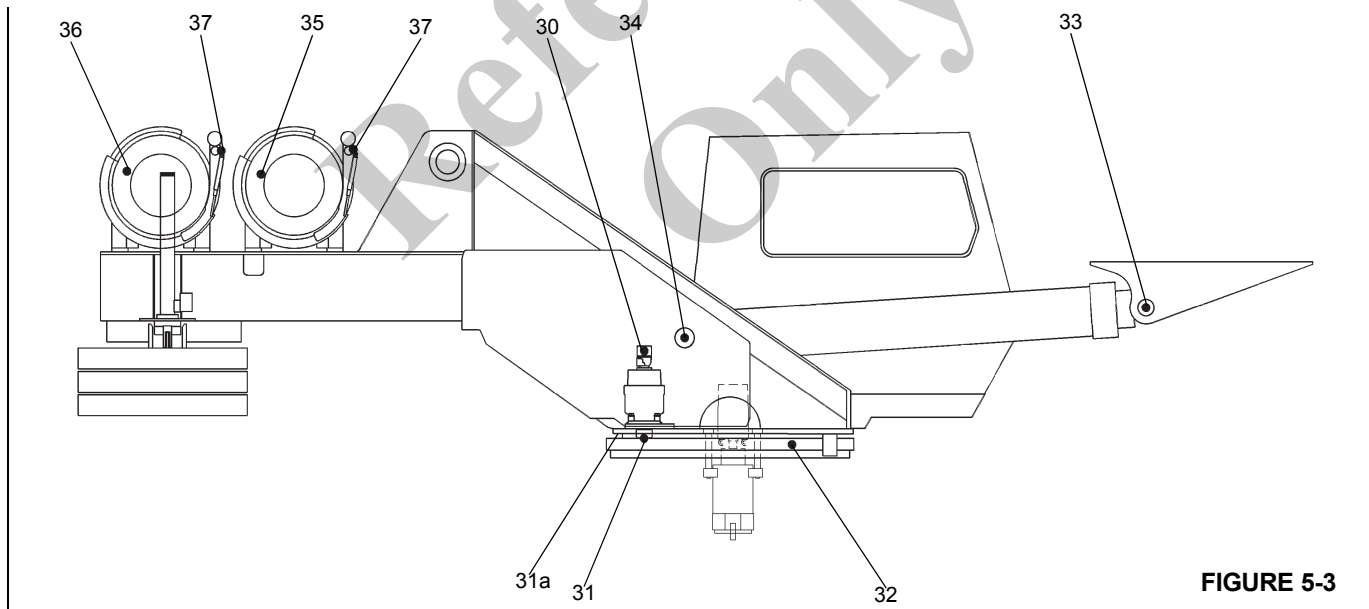


FIGURE 5-3

Item	Description
30	Turntable Gear Box
31	Turntable Gear and Drive Pinion
31a	Swivel Lock Pin
32	Turntable Bearing
33	Upper Lift Cylinder Pivot Pin
34	Lower Lift Cylinder Pivot Pin
35	Main Hoist
36	Auxiliary Hoist (Optional)
37	Cable Guard Roller and Guide Roller (possible)

39. 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.

40. 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: 2 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. Extend boom for access to holes as needed.

41. Inner Mid Side Wear Pads

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months, whichever interval occurs first

Lube Amount - Thoroughly coat all areas the wear pads move on.

Application - By brush: 2 places; with boom in extended position through access holes in base section.

42. Boom Section Upper Wear Pads

Lube Type - EP-MPG

Lube Interval - 50 hours or 1 week, whichever interval occurs first

Lube Amount - Until grease extrudes

Application - 6 grease fittings; with boom in extended position through access holes.

43. Boom Section Upper and Lower Wear Pads

Lube Type - EP-MPG

Lube Interval - 50 hours or 1 week, whichever occurs first.

Lube Amount - Thoroughly coat all areas the wear pad moves on.

Application - By brush; 6 places; with boom in extended position.

44. Upper Boom Nose Sheave

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months, whichever occurs first

Lube Amount - Until grease extrudes

Application - 1 grease fitting per sheave (2 total)

45. Lower Boom Nose Sheave

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months, whichever occurs first

Lube Amount - Until grease extrudes

Application - 1 grease fitting per sheave (5 total)

46. Boom Extension Sheaves

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months, whichever occurs first

Lube Amount - Until grease extrudes

Application - 1 grease fitting

47. Boom Extension Mast Sheave

Lube Type - EP-MPG

Lube Interval - 500 hours or 6 months, whichever occurs first

Lube Amount - Until grease extrudes

Application - 1 grease fitting

48. 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

49. 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

50. 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

(5 fittings total - 60 ton)

(4 fittings total - 50 ton)

(3 fittings total - 40 ton)

51. Headache Ball Swivel Top

Lube Type - EP-MPG

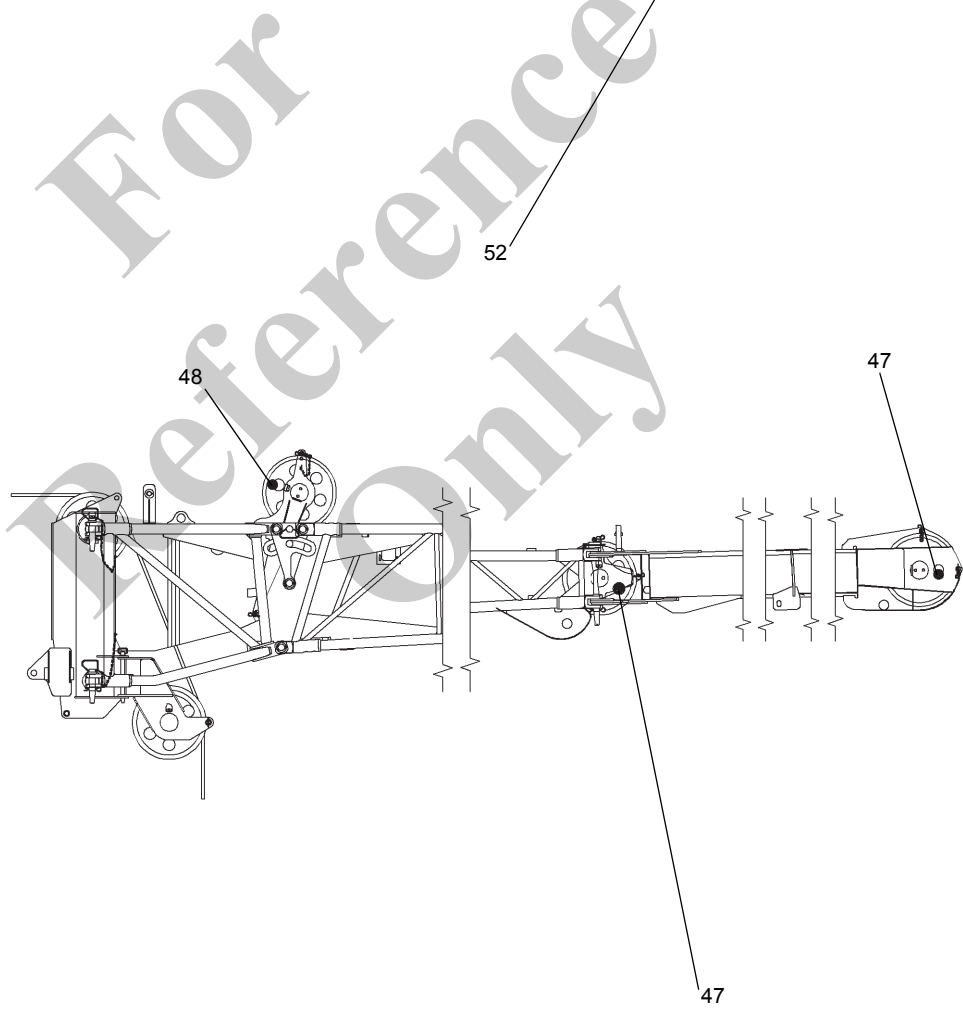
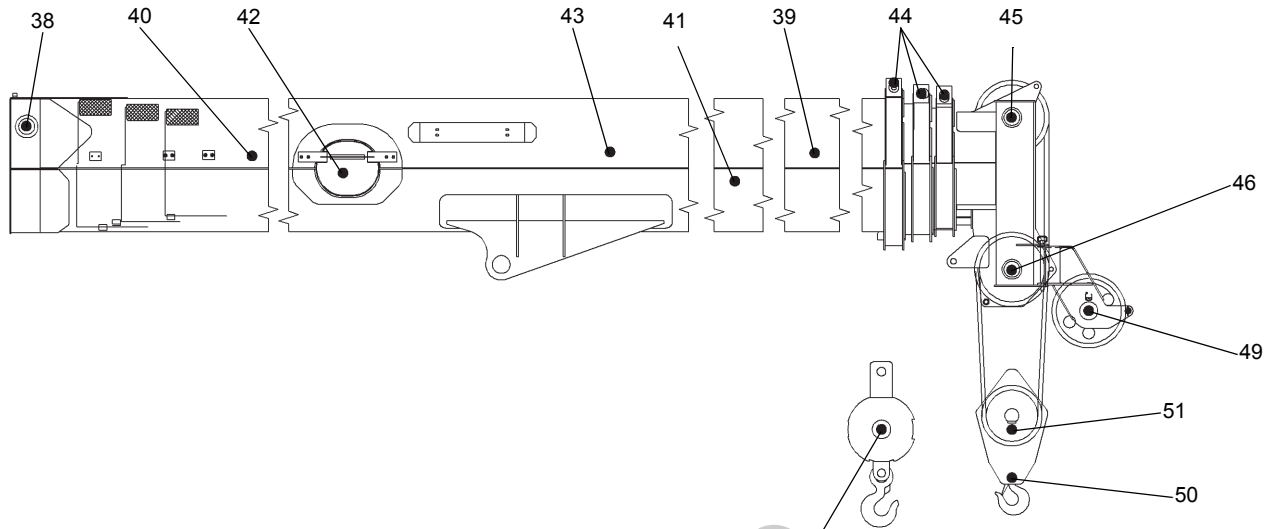
Lube Interval - 250 hours or 3 months, whichever interval occurs first

Lube Amount - Until grease extrudes

Application - 1 grease fitting

WIRE ROPE LUBRICATION

Wire rope is lubricated during manufacturing so that the strands, and individual wires in strands, may move as the rope moves and bends. A wire rope cannot be lubricated sufficiently during manufacture to last its entire life. Therefore, new lubricant must be added periodically throughout the life of a rope to replace factory lubricant which is used or lost. For more detailed information concerning the lubrication and inspection of wire rope, refer to WIRE ROPE in *Section 1- Introduction of the Service Manual*.



For Reference Only

FIGURE 5-3 continued

Item	Description
38	Boom Pivot Shaft
39	Extend Cable Sheaves
40	Retract Cable Sheave
41	Telescope Cylinder Wear pads
42	Inner Mid Side Wear Pads
43	Boom Section Upper Rear Wear Pads
44	Boom Section Upper and Lower Wear Pads
45	Upper Boom Nose Sheave
46	Lower Boom Nose Sheave
47	Boom Extension Sheaves
48	Boom Extension Mast Sheave
49	Auxiliary Boom Nose Sheave
50	Hook Block Swivel Bearing
51	Hook Block Sheaves
52	Headache Ball Swivel Top

For
Reference
Only

**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.

For Reference Only

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		D																																
23		D																																
24		D																																
25		D																																
Inspector's Initials																																		

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For
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