GROVE

OPERATOR'S MANUAL

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

RT600E

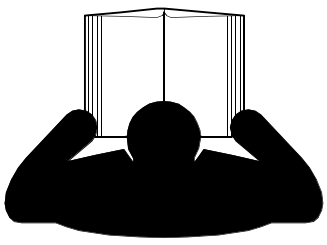
Crane Model Number

This Manual is divided into the following sections:

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.



⚠ WARNING

To prevent death or serious injury:

- Avoid unsafe operation and maintenance.
- This crane must be operated and maintained by trained and experienced personnel. Manitowoc is not responsible for qualifying these personnel.
- Do not operate or work on this crane without first reading and understanding Operator's Manual and Rating Plate supplied with crane.
- Store Operator's Manual in holder provided on crane.
- Attach laminated Capacity Charts supplied with crane to chain in operator's cab.
- If Operator's Manual or Capacity Charts are missing from cab, contact your distributor for new ones.

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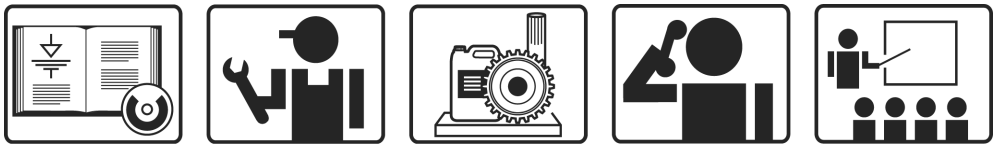

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SECTION 1
INTRODUCTION

This handbook has been compiled to assist you in properly operating and maintaining your Grove Crane.

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

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

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

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

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

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

GENERAL

NOTE: Throughout this handbook, reference is made to left, 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.

NOTE: Basic crane nomenclature is shown in (Figure 1-1).

This Operator's Manual provides important information for the operator of the Model RT600E Series Grove Crane.

The rough terrain crane incorporates an all welded steel frame, using planetary drive axles to provide four-wheel drive. Axle steering is accomplished utilizing hydraulic steer cylinders. The engine is mounted at the rear of the crane and provides motive power through a six speed forward and reverse transmission. Hydraulic, double box, sliding beam outriggers are integral with the frame.

The carrier frame incorporates an integral fifth wheel, to which the rear axle is mounted, to provide axle oscillation. Axle oscillation lockout is automatic when the superstructure rotates from the travel position.

The superstructure is capable of 360° rotation in either direction. All crane functions are controlled from the fully-enclosed cab mounted on the superstructure. The crane is equipped with a four-section, cable-synchronized boom. Additional reach is obtained by utilizing an optional swingaway boom extension. Lifting is provided by a main hoist and an optional auxiliary hoist.

NOISE/VIBRATION TEST RESULTS

Noise Level Test Results Are As Follows:

- At the operator's station with closed cab operation, the value is 80.7 dba maximum when measured according to the directives 79/113/EEC and Kebomatief 27.

Vibration Level Test Results Are As Follows:

- At the operator's station with closed cab operation, vibration levels are less than 0.5 m/s/s for Whole Body Vibration exposure and are less than 2.5 m/s/s for Hand Arm Vibration exposure when measured according to 89/392/EEC Community Legislation on Machinery per standard ISO 2631/1 - Evaluation of Human Exposure to Work Body Vibration, ISO 5349 - Guidelines for the Measurement and Assessment of Human Exposure to Hand Transmitted Vibrations, and ISO/DIS 8041 - Human Response Vibration Measuring Instrumentation.

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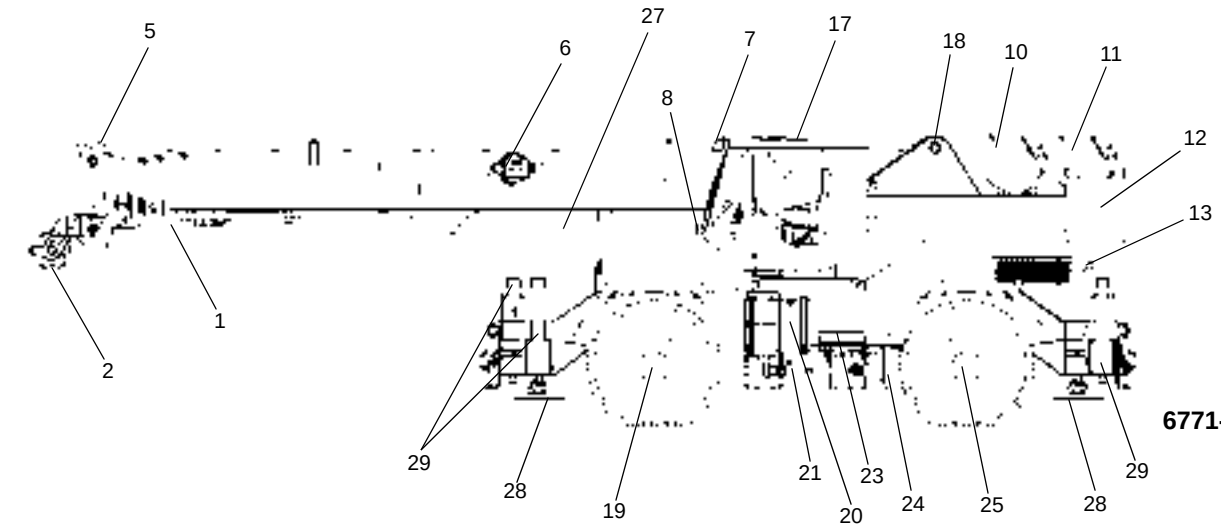

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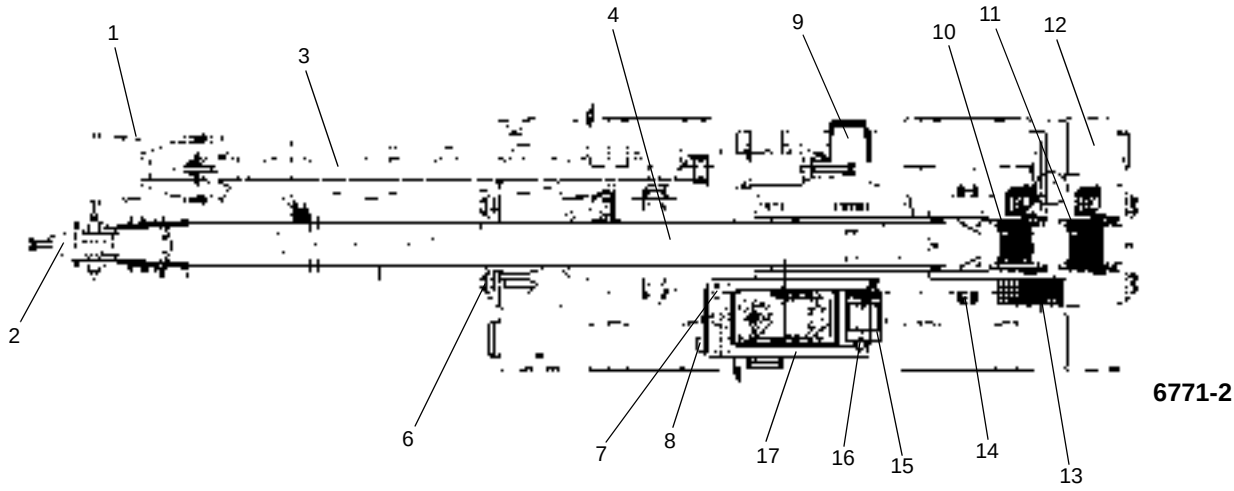

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FIGURE 1-1

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Item	Description
1	Swingaway
2	Auxiliary Boom Nose
3	Swingaway Extension
4	Boom
5	Boom Nose Sheaves
6	LMI Cable Reel
7	Spotlight
8	Work Light
9	Hydraulic Tank
10	Main Hoist
11	Auxiliary Hoist
12	Counterweight
13	Muffler
14	Air Intake Cleaner
15	Windshield Washer Fluid Container

Item	Description
16	Beacon Light
17	Cab
18	Boom Pivot
19	Front Axle
20	Fuel Tank
21	Driveline
22	Hookblock Tie Down
23	Battery
24	Transmission
25	Rear Axle
26	Oil Cooler
27	Lift Cylinder
28	Outrigger Float
29	Outrigger Jack Cylinder
30	Steps

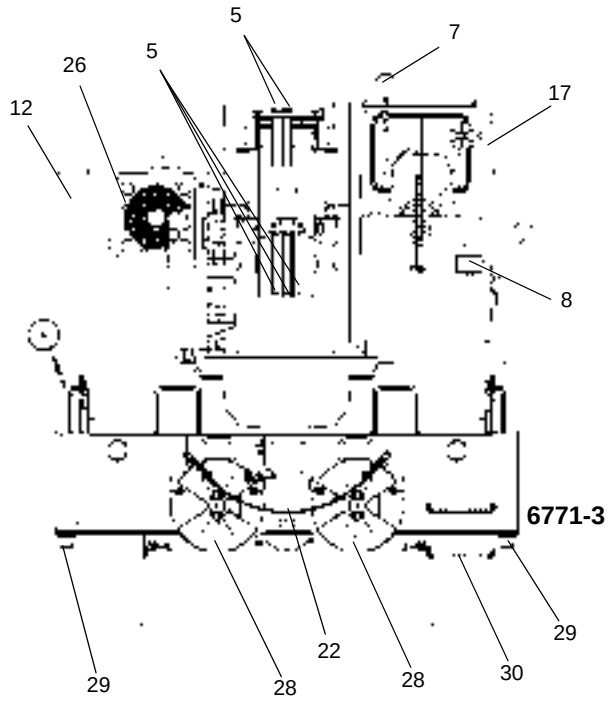

FIGURE 1-1 continued

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SAFETY INFORMATION

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SECTION 2
SAFETY PRECAUTIONS

DIESEL ENGINE EXHAUST

CALIFORNIA PROPOSITION 65 WARNING

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

BATTERY POSTS, TERMINALS, AND RELATED ACCESSORIES

CALIFORNIA PROPOSITION 65 WARNING

The battery posts, terminals, and related accessories contains chemical lead and lead compounds, chemicals known to the State of California to cause cancer, birth defects or other reproductive harm. Wash hands after handling.

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

WARNING

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

CAUTION

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

CAUTION

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

NOTE: Highlights operation or maintenance procedures.

GENERAL

Illustrations have been included in this section to emphasize certain proper and improper points; READ AND FOLLOW PRINTED INSTRUCTIONS.

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.

With this thought in mind, this information has been provided to assist you, the operator, 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, the operator, are the only part of the crane that can think and reason, your responsibility is not lessened by

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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, the operator, 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.

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

OPERATOR'S INFORMATION

You must READ and UNDERSTAND the Operator's and Safety Handbook and the Load Chart before operating the crane. You must also VIEW and UNDERSTAND the safety video titled "The Real Key to Crane Safety" supplied with your new Grove product. The handbook and Load Chart must be readily available to the operator at all times and must remain in the cab while the crane is in use.

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.

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.

DO NOT REMOVE the Load Chart, this Operator's Manual, or any decal from this crane.

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

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

OPERATIONAL AIDS

Grove remains committed to providing reliable products that enable users and operators to safely lift and position loads. Grove has been an industry leader in the incorporation of operational aids into the design of its cranes. Federal law requires that cranes be properly maintained and kept in good working condition. The manuals that Grove provides that are specific for each crane and the manufacturer's manuals for the operational aids shall be followed. If an operational aid should fail to work properly, the crane user or owner must assure that repair or recalibration is accomplished as soon as is reasonably possible.

An operational aid is an accessory that provides information to facilitate operation of a crane or that takes control of particular crane functions without action of the operator when a limiting condition is sensed.

Operational Aids include, but are not limited to the following:

- Hydraulic Capacity Alert System (HCAS)
- Load Moment Indicator (LMI)
- Anti-Two Block Prevention/Warning Device
- Load Indicator
- Rated Capacity Limiter
- Rated Capacity Indicator
- Boom Angle Indicator
- Crane Level Indicator
- Boom Length Indicator
- Radius Indicator

If any operational aid is malfunctioning follow the guidance provided in ASME B30.5-2004 Section 5-3.2.1.2 (b), which is reprinted below:

(b) When operational aids are inoperative or malfunctioning, the crane and/or device manufacturer's recommendations for continued operation or shutdown of the crane shall be followed until the problems are corrected. Without such recommendations and any prohibitions from the manufacturer against further operation, the following requirements shall apply:

(1) Recalibration or repair of the operational aid shall be accomplished as soon as is reasonably possible, as determined by a qualified person.

(2) When a load indicator, rated capacity indicator, or rated capacity limiter is inoperative or malfunctioning, the

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designated person responsible for supervising the lifting operations shall establish procedures for determining load weights and for conducting the lifts in accordance with paras. 5-3.2.1.1(a) through (c). (Note: Paras. 5-3.2.1.1(a)-(c) relate to using the crane within the limits of the load capacity chart.)

(3) When a boom angle or radius indicator is inoperative or malfunctioning, radii or boom angle shall be determined by measurement.

(4) When an anti-two-block device, two-block 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. Personnel shall not be lifted when two-block devices are not functioning properly.

(5) When a boom length indicator is inoperative or malfunctioning, the designated person responsible for supervising the lifting operations shall establish procedures for conducting the lifts in accordance with paras. 5-3.2.2.1(a) through (c).

(6) When a level indicator is inoperative or malfunctioning, other means shall be used to level the crane within the level requirements specified by the manufacturer.

OPERATOR'S QUALIFICATIONS

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

YOU MUST NOT OPERATE THIS MACHINE UNLESS:

- You have been trained in the safe operation of this machine.
- 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 machine is operating properly and has been inspected and maintained in accordance with the manufacturer's manuals.
- 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.

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.

Do not lift loads unless the outriggers are properly extended and the crane leveled. 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.

This crane should have a functional load moment indicator and control lock-out system. Test daily for proper operation. Never interfere with the proper functioning of operational aids or warning devices.

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.

Ensure all pins and floats are properly installed and outrigger beams are properly extended before lifting on outriggers.

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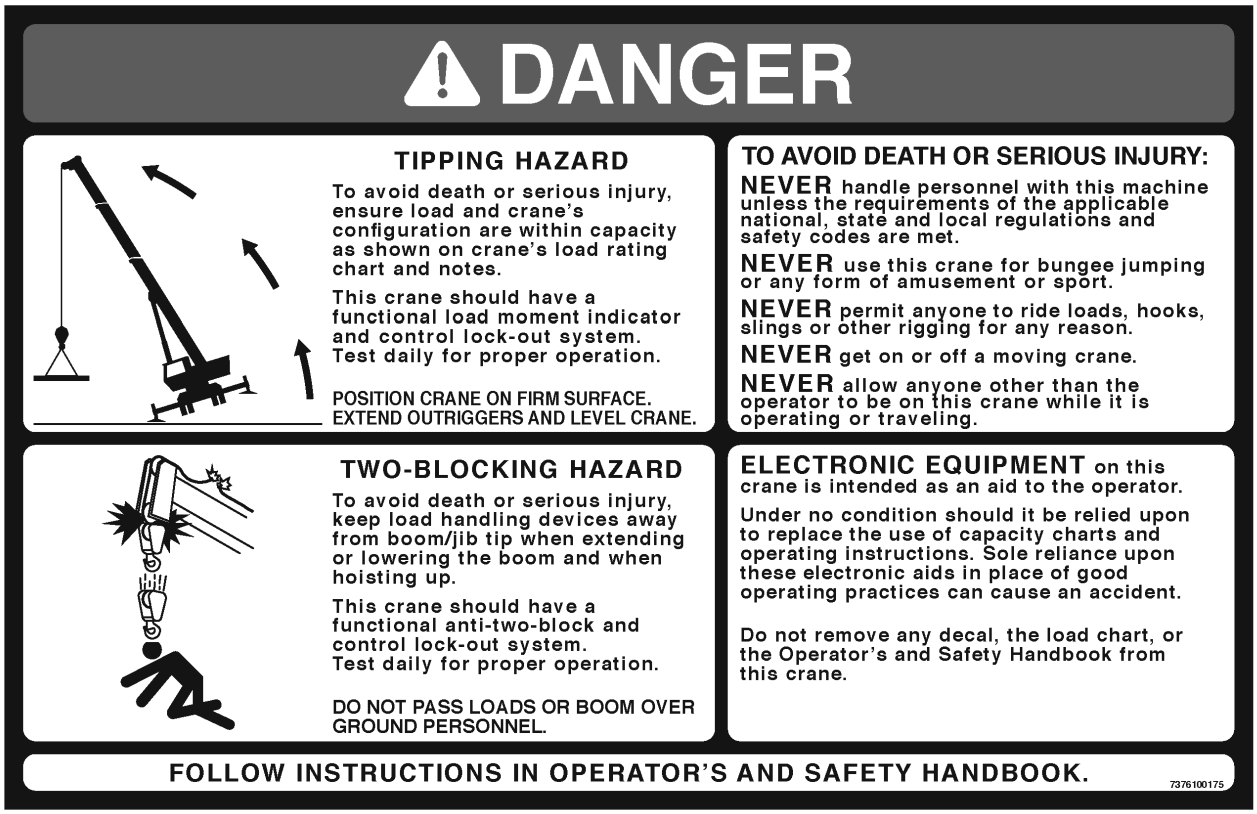

Unless lifting within On Rubber capacities, outrigger beams must be properly extended and jack cylinders extended and set to provide maximum leveling of the crane. On models equipped with outriggers that can be pinned at the mid-extend position, the outriggers must also be pinned when operating from the mid-extend position. Tires must be clear of the ground before lifting on outriggers. Remove all weight from tires before lifting on outriggers.

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

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

Be sure the outriggers are properly extended and set, and the crane is level for operation on outriggers.

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

All four outrigger beam lock pins must be engaged before operating from the mid-extend position.

The operator must select the proper Load Chart and Load Moment Indicating (LMI) System program for the outrigger position selected.

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Table 2-1

Wind Force		Wind Velocity km/h (mph)	Visible Indicator Effects of wind as observed on land
Beauford Scale	Designation		
Zero (0)	Calm	<2 (<1)	No wind: smoke rises vertically
1	Light Air	2-5 (1-3)	Wind direction seen by smoke but not by wind vanes
2	Light Breeze	6-11 (4-7)	Wind felt on face: leaves rustle: wind vane moves slightly
3	Gentle Breeze	13-19 (8-12)	Leaves/small twigs in constant motion: wind extends flag
4	Moderate Breeze	21-29 (13-18)	Raises dust & loose paper: moves small branches
Reduce crane load ratings and operating parameters at 32 km/h (20 mph)			
5	Fresh Breeze	31-39 (19-24)	Small trees in leaf begin to sway: on ponds, crested wavelets form
6	Strong Breeze	40-50 (25-31)	Large branches in motion: telegraph wires whistle: umbrellas used with difficulty
Cease all craning operations at 48 km/h (30 mph); lower & retract boom			
7	Moderate Gale	52-61 (32-38)	Whole trees in motion: walking against wind is inconvenient

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.

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.

Barricade the area where the crane is working and keep all unnecessary personnel out of that area.

Use caution when operating in the vicinity of overhanging banks and edges.

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

Wind can have a significant affect on loads that may be lifted by a crane. Wind forces act differently on a crane depending upon the direction from which the wind is blowing (e.g., wind on the rear of the boom can result in decreased forward stability, wind on the underside of the boom can result in decreased backward stability, wind on the side of the boom can result in structural damages, etc.). To assist you in determining prevailing wind conditions, refer to (Table 2-1).

Lifting Operations

If the boom extension, jib, 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 LMI is programmed for the crane configuration. Refer to the LMI handbook supplied with the crane.

Before lifting, position the crane on a firm surface, properly extend and set the outriggers, and level the crane.

If the boom extension or auxiliary boom nose is to be used, you must ensure that the cable for the LMI system is properly connected at the junction box located on the boom nose.

Depending on the nature of the supporting surface, adequate cribbing may be required to obtain a larger bearing surface.

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.

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

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.

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, jib, etc.) must be considered part of the load.

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

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.

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

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 rating 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.

Wind forces can exert extreme dynamic loads. **Grove recommends that a lift not be made if the wind can cause a loss of control in handling the load.** Grove recommends if the wind speed (velocity) is between 20 mph (32 km/h) to 30 mph (48 km/h), that 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, boom extension, and jib lengths. Further, operation of the crane in wind velocities over 30 mph (48 km/h) is not recommended. To assist you in determining prevailing wind conditions, refer to (Table 2-1).

The crane cab is equipped with a sight level bubble 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.

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 load capacity chart is not exceeded when this occurs.

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.

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.

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.

Use only one hoist at a time when lifting loads

Always use enough parts-of-line to accommodate the load to be lifted. Lifting with too few parts-of-line can result in failure of the wire rope.

Never operate the crane with less than two wraps of wire rope on the hoist drum.

Counterweight

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

To reduce the crushing hazard and to prevent death or serious injury, always clear all personnel from the counterweight and superstructure area before moving the counterweight or rotating the superstructure.

Do not add material to the counterweight to increase capacity.

Federal law prohibits modification or additions which affect the capacity or safe operation of the equipment without the manufacturer's written approval. [29CFR 1926.550]

Multiple Crane Lifts

Multiple crane lifts are not recommended.

Any lift that requires more that one crane must be precisely planned and coordinated by a qualified engineer.

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.

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1. Secure the services of a qualified engineer to direct the operation.
2. Use one qualified signal person.
3. Coordinate lifting plans with the operator, engineer, and signal person prior to beginning the lift.
4. Communication between all parties must be maintained throughout the entire operation. If possible, provide approved radio equipment for voice communication between all parties engaged in the lift.
5. Use cranes and rigging of equal capabilities and use the same boom length.
6. Use outriggers on cranes so equipped.
7. Be certain cranes are of adequate lifting capacity.
8. Calculate the amount of weight to be lifted by each crane and attach slings at the correct points for proper weight distribution.
9. Ensure the load lines are directly over the attach points to avoid side loading and transfer of loading from one crane to the other.
10. DO NOT TRAVEL. Lift only from a stationary position.

LOAD MOMENT INDICATING (LMI) SYSTEMS

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.

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.

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

For detailed information concerning the operation and maintenance of the load moment indicating system installed on the crane see the manufacturer's manual supplied with the crane.

Two-Blocking

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

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

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

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

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

This crane should have a functional ANTI-TWO-BLOCK and CONTROL LOCK-OUT system. Test daily for proper operation.

Do not pass loads or boom over ground personnel.

Barricade the area where the crane is working and keep all unnecessary personnel out of that area. DO NOT allow personnel to be under the load or boom.

Never pass loads, load handling devices, or the crane boom over people on the ground.

Never operate the crane with less than two wraps of wire rope on the hoist drum.

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

Work Area Definition System

You must read and understand the manufacturer's Operator's Manual before operating the system. Become familiar with all proper operating procedures and with the identification of symbol usage.

Barricade the area where the crane is working and keep all personnel out of the selected work area definition.

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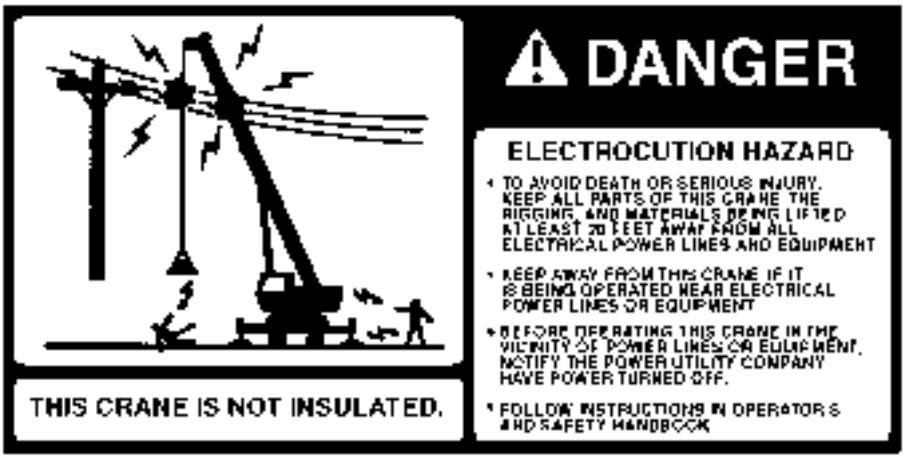

The work area definition system is intended as an aid to the operator. It is not a substitute for safe crane operating practices, experience and good operator judgements.

For detailed information concerning the operation and maintenance of the Work Area Definition system installed on this crane, refer to the manufacturer's manual supplied with the crane.

ELECTROCUTION HAZARD

To avoid death or serious injury, keep all parts of this machine, the rigging, and materials being lifted at least 6 m (20 ft) away from all electrical power lines and equipment.

Keep all personnel away from this machine if it is being operated near electrical power lines or equipment.

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 machine is NOT INSULATED. Always consider all parts of the load and the crane, including the wire rope, hoist cable, pendant cables, and tag lines, as conductors.

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.

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.

If the load, wire rope, crane 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.

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

You, the operator, are responsible for alerting all personnel of dangers associated with electrical power lines and equipment. The crane is not insulated. 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.

Even if the crane operator is not affected by an electrical contact, others in the area may become seriously injured or killed.

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.

Thoroughly read, understand, and abide by all applicable federal, state, and local regulations.

Federal law prohibits the use of cranes closer than 3 m (10 ft) to power sources up to 50,000 volts and greater distances for higher voltages [29CFR1910.180 and 29CFR1926.550]. Grove recommends keeping cranes twice the minimum distance [e.g., 6 m (20 ft)] as specified by US Department of Labor - Occupational Safety and Health Administration (OSHA) standards.

Set Up And Operation

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

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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 (jibs, 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

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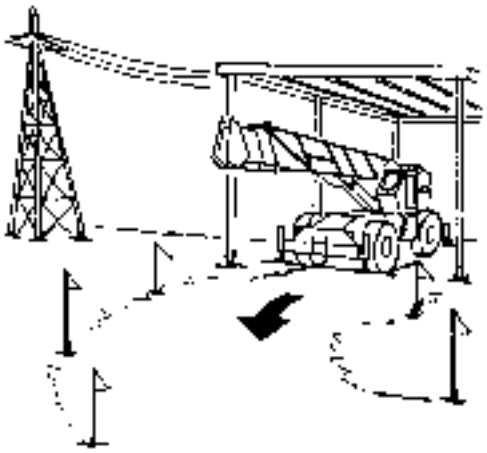

Plan ahead and always plan a safe route before traveling under power lines. Rider poles should be erected on each side of a crossing to assure sufficient clearance is maintained.

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 handbook 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 supposed to detect the existence of electricity and not its quantity or magnitude.
- Some proximity devices will 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 and 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 (wire) conductor used, the condition of the ground, the magnitude of the voltage and current present, and numerous other factors.

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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 are likely to remain 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 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 local, authorized, Grove distributor must be immediately advised of the incident and consulted on necessary inspections and repairs. Thoroughly inspect the wire rope and all points of contact on the crane. Should the distributor not be immediately available, contact Manitowoc CraneCARE. 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 Grove or your local Grove distributor.

Special Operating Conditions And Equipment

Never operate the crane during an electrical thunderstorm.

Working in the vicinity of radio frequency transmission towers and other transmission sources may cause a crane to become "electrically charged."

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.

CRUSHING HAZARDS

Death or serious injury could result from being crushed by moving machinery.

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

Barricade the entire area where the crane is working and keep all unnecessary personnel out of the work area.

Never allow anyone to stand or work on or near the superstructure while the crane is in operation. Always barricade the tail-swing of the rotating superstructure.

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

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.

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

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.

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.

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Be sure the outriggers are properly extended, set and the crane is level for operation on outriggers.

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

All four outrigger beam lock pins must be engaged before operating from the mid-extend position.

The operator must select the proper Load Chart and LMI program for the outrigger position selected.

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

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

PERSONNEL HANDLING

The American Society of Mechanical Engineers issued a new American National Standard entitled, Personnel Lifting Systems, ASME B30.23-1998. This standard provides, "lifting and lowering of personnel using ASME B30 Standard hoisting equipment shall be undertaken only in circumstances when it is not possible to accomplish the task by less hazardous means. Unless all of the applicable requirements of this volume are met, the lifting or lowering of personnel using ASME B30 Standard equipment is prohibited." This new standard is consistent with the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) regulations for Construction that state, in 29CFRI926.550(g)(2): "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, and in OSHA regulations 29CFRI910.180 for General Industry and 29CFRI926.550 for Construction.

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

- The requirements of the applicable national, state and local regulations and safety codes are met.
- A determination has been made that use of a crane to handle personnel is the least hazardous means to perform the work.
- The crane operator shall be qualified to operate the specific type of hoisting equipment used in the personnel lift.
- The crane operator and occupants have been instructed in the recognized hazards of personnel platform lifts.
- The crane is in proper working order.
- The crane is equipped with a functional anti-two block device.
- The crane's load capacity chart is affixed inside the crane's cab, 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 uniformly level within one percent of level grade and located on a firm footing. Cranes with outriggers shall have them all fully deployed following manufacturer's specifications.
- The crane's Operator's Manual and other operating manuals are inside the crane's cab, readily accessible to the Operator.
- The platform meets the requirements as prescribed by applicable standards and regulations.
- For wire rope suspended platforms, the crane is equipped with a hook that can be closed and locked, eliminating the throat opening.

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- 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 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.

Grove continues to recommend that cranes be properly maintained, regularly inspected and repaired as necessary. Grove reminds crane owners to ensure that all safety decals are in place and legible. Grove continues to urge Grove crane owners to upgrade their cranes with load moment indicator (LMI) and control lever lockout systems for all lifting operations.

The following standards and regulations 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.

TRAVEL OPERATION

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

When traveling, the boom should be completely retracted and lowered to the travel position and the turntable pin swing lock should be engaged.

When driving machine, ensure the cab is level.

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.

Drive carefully and avoid speeding.

Stay alert at the wheel.

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

ACCIDENTS

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

Manitowoc Crane Group
1565 East Buchanan Trail
Shady Grove, PA 17256-0021

Phone: 888-777-3378 (888-PSR-DEPT)
Fax: 717-593-5102
E-mail: psafety@groveworldwide.com

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.

Keep the crane properly maintained and adjusted at all times. 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 handbook when performing crane maintenance as well as crane operations.

Before crane use:

- Conduct a visual inspection for cracked welds, damaged components, loose pin/bolt, 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.
- Check for proper functioning of all controls and operator aids (e.g. LMI).

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- Check all braking (e.g. wheel, hoist, and swing brakes) and holding devices before operation.

Keep the crane clean at all times, free of mud, dirt, and grease. 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 Grove Crane Maintenance and Inspection Manual. Any questions regarding procedures and specifications should be directed to the your local, authorized Grove Distributor.

Service And Repairs

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 handbook, and the service manual for this machine. All replacement parts must be Grove approved.

Any modification, alteration, or change to a crane which affects its original design and is not authorized and approved by Grove is STRICTLY PROHIBITED. Such action invalidates all warranties and makes the owner/user liable for any resultant accidents.

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.
- 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.

Recognize and avoid pinch-points while performing maintenance. Stay clear of sheave wheels and holes in crane booms.

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.
- Perform load tests when a structural or lifting member is involved in a repair.

Lubrication

The crane must be lubricated according to the factory 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:

1. Follow the manufacturer's recommendations when adding oil to the system. Mixing the wrong fluids could destroy seals, causing machine failure.
2. Be certain all lines, components, and fittings are tight before resuming operation.
3. When checking for suspected leaks, use a piece of wood or cardboard and wear appropriate personal protective equipment.
4. Never exceed the manufacturer's recommended relief valve settings.

Tires

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

Wire Rope

Use ONLY the wire rope specified by Grove as indicated on the crane's load capacity chart. Substitution of an alternate wire rope may require the use of a different permissible line pull and, therefore, require different reeving.

NOTE: Wire rope may be purchased by contacting the Manitowoc CraneCARE Parts Department.

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

1. 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.
2. For running ropes other than rotation resistant-six (6) broken wires in one rope lay or three (3) broken wires in one strand.
3. One valley break where the wire fractures between strands in a running rope is cause for removal.
4. Abrasion of the rope resulting in wear of the individual outside wires of 1/3 of the original wire diameter.

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5. Any kinking, bird caging, crushing, corrosion, or other damage resulting in distortion of the rope structure.
6. 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.
7. 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.
8. Core deterioration is usually observed as a rapid reduction in rope diameter and is cause for immediate removal of the rope.

Refuse to work with worn or damaged wire rope.

When installing and inspecting wire ropes and attachments, keep all parts of your body and clothing away from rotating hoist drums and all rotating sheaves.

Never handle the wire rope with bare hands.

Periodic rope inspection records are required by law. Make sure these records have been reviewed and are up to date.

When installing a new rope:

- 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:

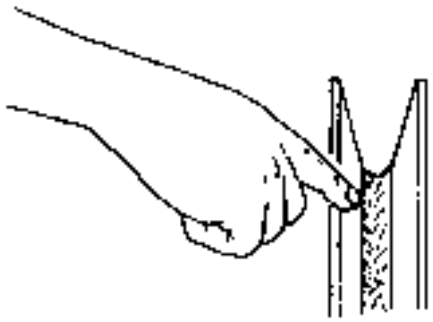
- Always inspect socket, wedge, and pin for correct size and condition.
- Do not use parts that are damaged, cracked, or modified.
- Assemble the wedge socket with live end of rope aligned with the centerline of pin and assure proper length of tail (dead end) protrudes beyond the socket.

Never overload or shock load a wire rope.

Lubricate the wire rope periodically as the lubricant becomes depleted.

Inspect the boom nose and hook block sheaves for wear. Damaged sheaves cause rapid deterioration of wire rope.

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



If applicable to your crane, the use of nylon (nylatron) sheaves, as compared with metallic sheaves, may change the replacement criteria of rotation-resistant wire rope.

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

BATTERIES

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

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

- Disconnect the batteries.
- Wear safety glasses when servicing batteries.
- Do not short across the battery posts to check charge. Short circuit, spark, or flame could cause battery explosion.
- Maintain battery electrolyte at the proper level. Check the electrolyte with a flashlight.
- If applicable to your crane, check battery test indicator on maintenance-free batteries.
- 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.
- 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.

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ENGINE

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.

WORK PRACTICES

Crane Access

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).

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

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.

Wear shoes with a highly slip-resistant sole material. Clean any mud or debris from shoes before entering the crane cab 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 make modifications or additions to the crane's access system that have not been evaluated and approved by Manitowoc CraneCARE.

Job Preparation

You must inspect the crane prior to your work shift - checking for cracked welds, damaged components, and evidence of improper maintenance (consult Manitowoc CraneCARE Maintenance-Inspection and Service Manual).

You must ensure that the crane is properly equipped including access steps, covers, doors, guards, and controls.

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

Wear appropriate clothing and personal protective equipment whether or not required by local or job regulations. Be prepared for the work day.

Before moving the crane, you must be THOROUGHLY familiar with the planned route of travel and area of operation, including surface conditions and the presence of overhead obstructions and power lines.

Always keep the crane clean, free of dirt, debris, and grease.

Fuel the crane ONLY with the engine turned off. Do not smoke while fueling the crane. Do not store flammable materials on the crane or in the operator's cab.

Follow standard safety precautions when refueling. FUEL IT SAFELY.

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

Cold weather requires special starting procedures, use of built-in starting aids, if provided, and ample time for hydraulic oil to warm-up. Keep the crane free of ice and snow.

Working

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

Keep unauthorized personnel clear of the working area during operation.

Operate the crane only from the operator's seat.

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.

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

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

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

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. NO LESS THAN TWO WRAPS of wire rope should remain on the hoist drum. When slings, ties, hooks, etc., are

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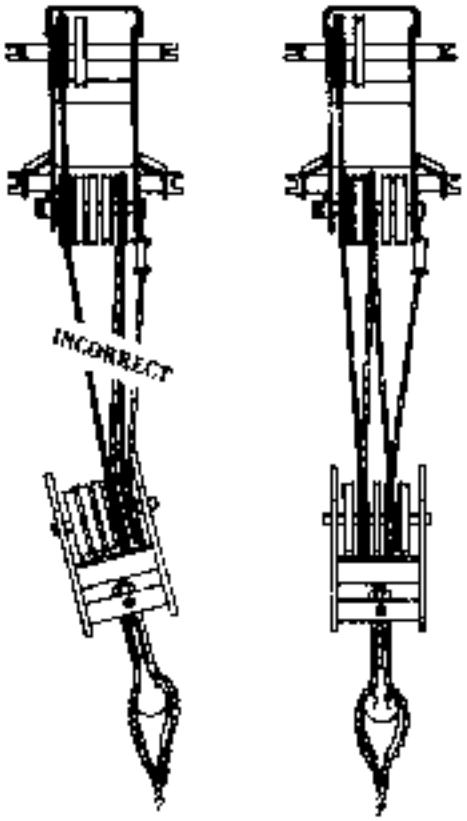
used, make certain they are correctly positioned and secured before raising or lowering the loads.



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.

Lifting

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.

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 cab.

Remember - all rigging equipment must be considered as part of the load. Lifting capacities vary with working areas. Permissible working areas are posted in the crane cab. When swinging from one working area to another, ensure load chart capacities are not exceeded. Know your crane!

Never swing or lower the boom into the carrier cab.

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.

Keep everyone away from suspended loads. Allow no one to walk under a load. Ensure that all slings, ties, and hooks are correctly placed and secured before raising or lowering the load.

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.

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

Use only slings or other rigging devices rated for the job and use them properly. Never wrap the hoist cable around a load.

Check all tackle, hardware, and slings before use. Refuse to use faulty equipment.

Never work the crane when darkness, fog, or other visibility restrictions make such operations unsafe.

Hand Signals

A 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.

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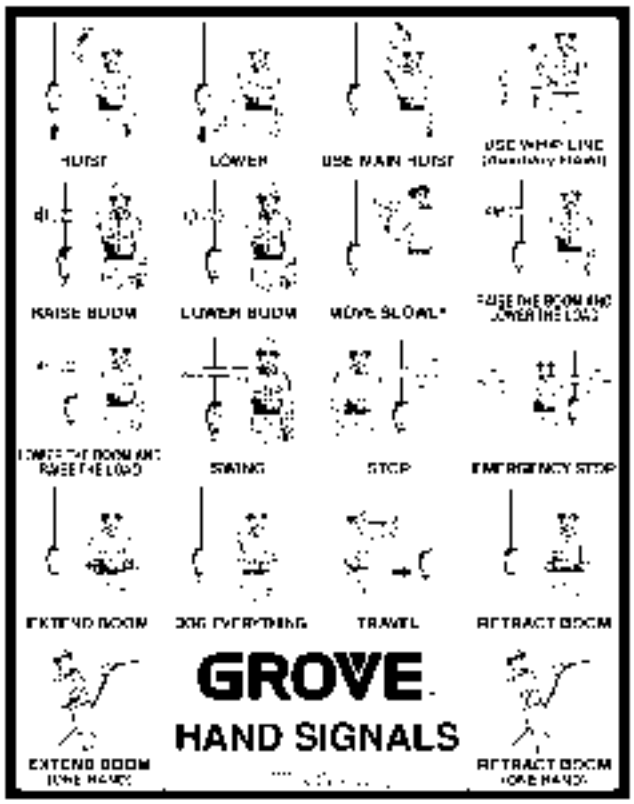

At all times use standardized hand signals - previously agreed upon and completely understood by the operator and signal person.

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.

When vision is obscured, use and follow the directions of a single qualified signal person.

Obey a signal to stop from anyone.

TRANSPORTING THE CRANE

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.

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

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

Always drive the crane carefully, obeying speed limits and highway regulations. Keep lights on and use traffic warning flags and signs and front and rear flag vehicles as applicable.

SHUT-DOWN

Never leave the crane with a load suspended. Lower the load to the ground before shutting down the crane.

Use the following steps when shutting down the crane:

- Engage the parking brake.
- Fully retract and lower the boom.
- Engage the pin swing lock or 360 degree swing lock.
- Place controls in neutral position.
- Shut down the engine and remove the ignition key.
- Chock the wheels.
- Lock the operator's cab and install vandal guards, if used.

In cold weather, never park the crane where the tires can become frozen to the ground.

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BOOM EXTENSION/JIB

To avoid death or serious injury, follow proper procedures during erection, stowage, and use of the boom extension/jib.

Install and secure all pins properly.

Control movement of boom extension/jib at all times.

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

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.

See the appropriate section of this handbook for the proper boom extension/jib erection and stowage procedure.

Properly inspect, maintain, and adjust boom extension/jib and mounting.

Sling jib sections from the main chords or the end fittings.

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

Stay outside of jib sections and lattice work.

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

COLD WEATHER OPERATION

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

Check operating procedures 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 HYDRAULIC CYLINDERS

Hydraulic oil expands when heated and contracts when cooled. This is a natural phenomena that happens to all liquids. The coefficient of expansion for API Group 1 hydraulic oil is approximately 0.00043 cubic inches per cubic inch of volume for 1°F of temperature change. **Thermal contraction will allow a cylinder to retract as the hydraulic fluid which is trapped in the cylinder cools.** The change in the length of a cylinder is proportional to the extended length of the cylinder and to the change in temperature of the oil in the cylinder. For example, a cylinder extended 25 feet in which the oil cools 60°F would retract approximately 7 3/4 inches (see chart below). A cylinder extended 5 feet in which the oil cools 60°F would only retract approximately 1 1/2 inches. 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.

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.

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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) has 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 98-036 dealing with testing telescope cylinders.

Table 2-2: BOOM DRIFT CHART (Cylinder length change in inches)

Coeff. = 0.00043 (in^3/in^3/ °F)

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

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

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SECTION 3
OPERATING CONTROLS AND PROCEDURES

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SECTION 3
OPERATING CONTROLS AND PROCEDURES

NOTE: The following paragraphs describe all the available (standard and optional) controls and indicators located in the cab. Some machines may not be equipped with the optional controls shown. The numbers in parenthesis ( ) represent the index number from (Figure 3-1), (Figure 3-2) or (Figure 3-3).

NOTE: All rocker switches except for engine diagnostics and throttle, contain one or two LED lighted slots in the switch for illumination. In addition, all but the outrigger and rear steer switches contain a LED lighted square to indicate when the switch/function is activated. The numbers in parenthesis ( ) represent the index number from (Figure 3-3).

CONTROLS AND INDICATORS

Hand Throttle Control

The HAND THROTTLE control (1) is located to the right of the ignition switch. It controls engine RPM which increases or decreases proportionately with the direction it is turned. The engine rpm increases when the hand throttle is turned clockwise (fast). When the hand throttle is turned counterclockwise (slow), the engine rpm decreases. The hand throttle control is electrically connected to the superstructure control module which sends the signal to the engine ECM via the J1939 data link.

Transmission Oil Temperature Gauge

The transmission oil temperature (TRANS TEMP) gauge (2) is located in the center of the front console to the left of the steering column. The gauge indicates the transmission oil temperature on a dual scale calibrated from 60 to 160°C and 140 to 320°F. The gauge receives a signal from a temperature sending unit in the oil line at the torque converter.

Fuel Gauge

The fuel (FUEL) gauge (3) is located in the center of the front console. The gauge indicates the quantity of fuel in the fuel tank and has a scale calibrated from zero [0] to 4/4. The fuel gauge receives a signal from a sending unit in the fuel tank.

Voltmeter

The voltmeter (BATTERY) gauge (4) is located in the center of the front console to the right of the steering column. The voltmeter indicates the voltage being supplied to or from the battery and has a scale of 10 to 16 volts.

Ignition Switch

The (IGNITION) switch (5) is located at the bottom of the front console, to the right of the steering column. The switch is key-operated and has four positions: ACC [3], OFF [0], RUN [1], and START [2]. In the OFF position, all electrical power is off except for the lights controlled by the HEADLIGHTS switch, boom flood lights, spotlights, turn/hazard/stop lights, backup lights and alarm, and work lights. Positioning the switch to ACC energizes all electrical components except for the start solenoid. Positioning the switch to RUN is the same as ACC. Positioning the switch to START energizes the start relay, which in turn energizes the cranking motor solenoid and cranks the engine for starting. The switch is spring returned from START to RUN. To shut down the engine, position the switch to OFF.

Tachometer

The tachometer (6) is located on the top right side of the console. The tachometer registers engine rpm and is calibrated in rpm x 100 with a range of zero [0] to 35. The tachometer receives a signal from the engine ECM.

Engine Coolant Temperature Gauge

The engine coolant temperature (WATER TEMP) gauge (7) is located in the center of the front console. The gauge indicates the engine coolant temperature on a dual scale calibrated from 38 to 138°C and 100 to 280°F. The gauge receives a signal from a temperature sending unit in the engine cooling system.

Foot Throttle Pedal

The foot throttle pedal (8) is located directly under the LMI display module, on the floor. It is used to control engine RPM which increases or decreases proportionately with the amount of foot pressure applied to the pedal. The pedal is electrically connected to the superstructure control module which sends the signal to the engine ECM via the J1939 data link.

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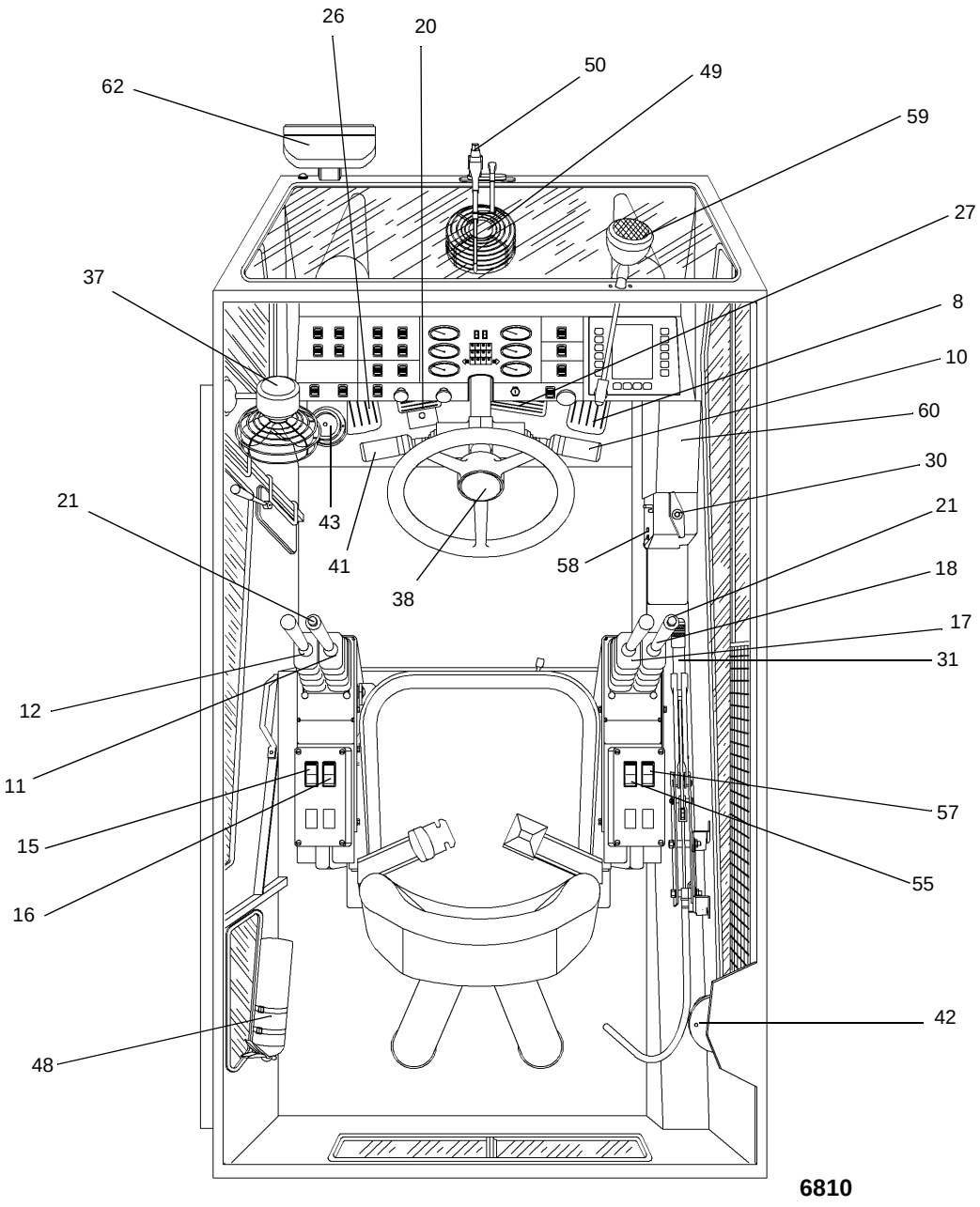

Single Axis Controller Option

FIGURE 3-1

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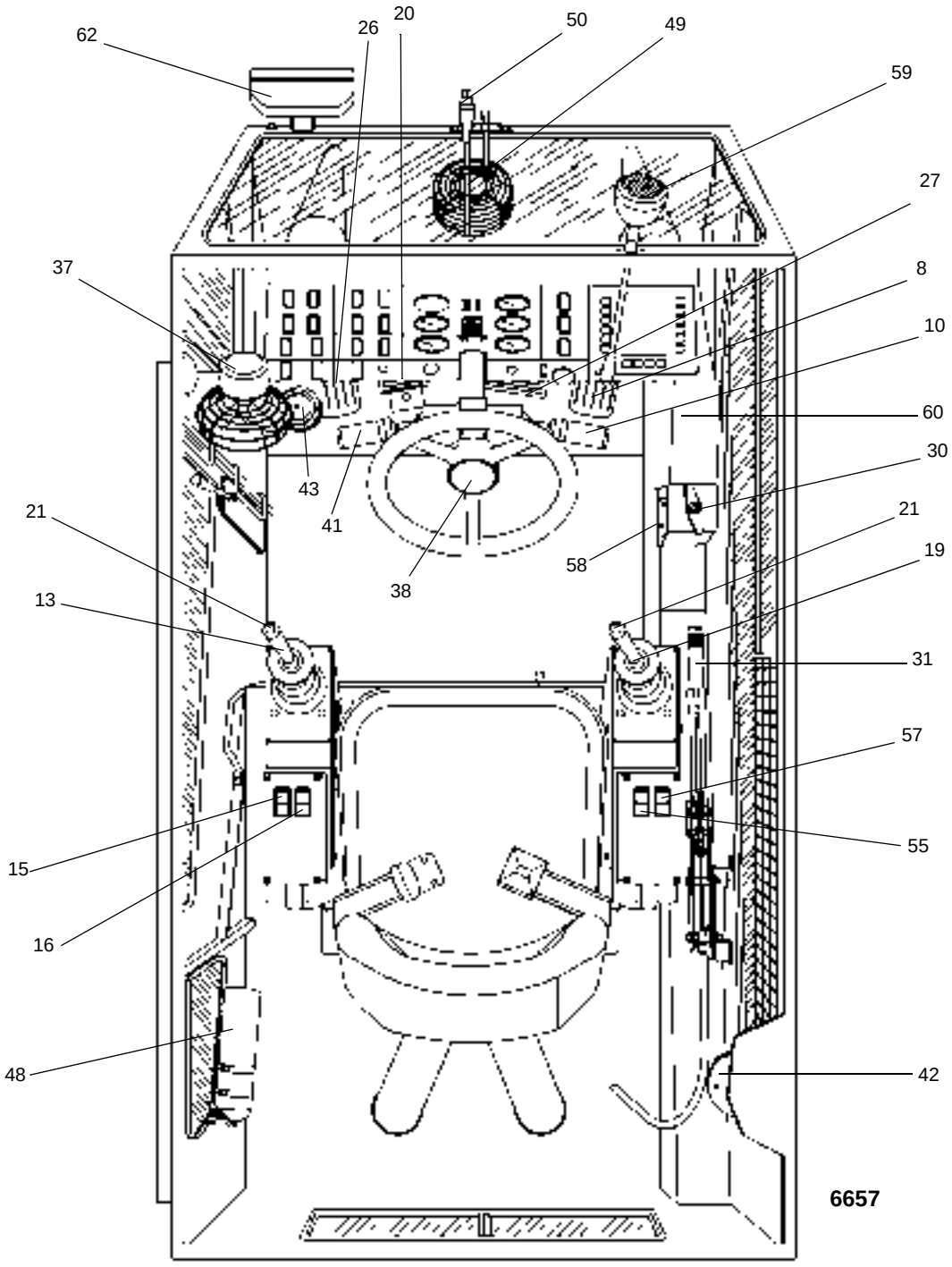

Dual Axis Controller Option

FIGURE 3-2

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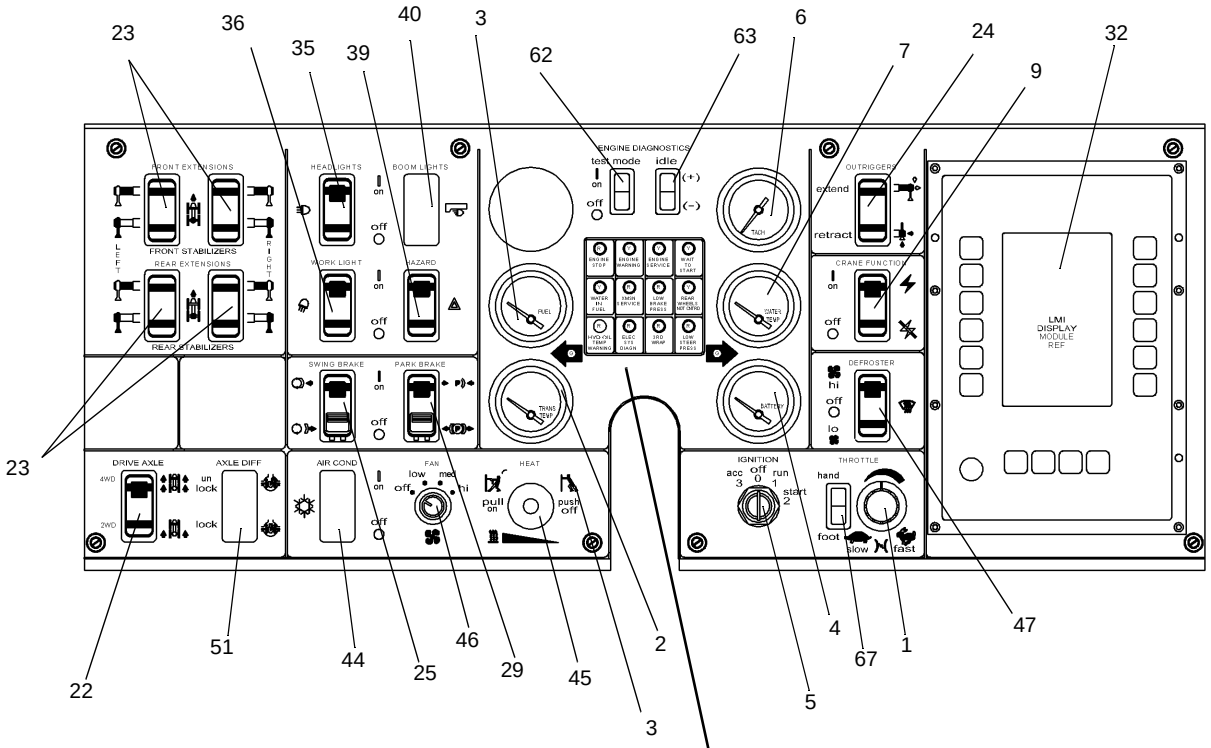

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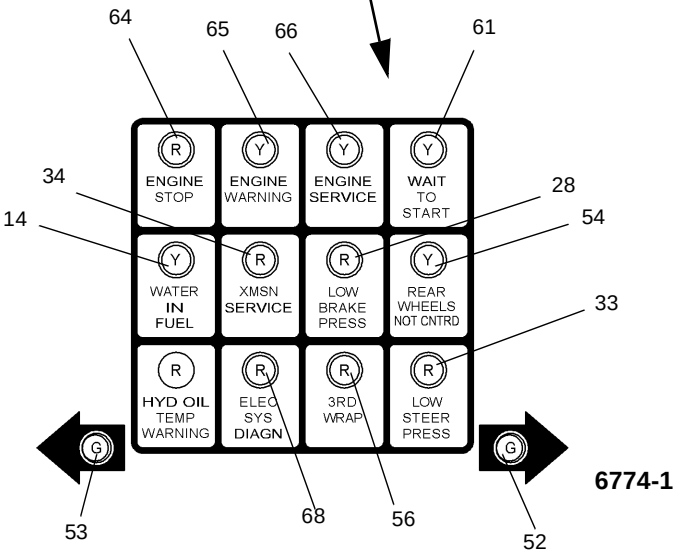

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FIGURE 3-3

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Item	Description
1	Hand Throttle Control
2	Transmission Oil Temperature Gauge
3	Fuel Gauge
4	Voltmeter
5	Ignition Switch
6	Tachometer
7	Engine Coolant Temperature Gauge
8	Foot Throttle Pedal
9	Crane Function Power Switch
10	Transmission Shift Lever
11	Telescope or Auxiliary Hoist Control Lever (Single Axis Controller Option)
12	Swing Control Lever (Single Axis Controller Option)
13	Swing and Telescope or Auxiliary Hoist Control Lever (Dual Axis Controller Option)
14	Water-In- Fuel Indicator
15	Rear Steer Control Switch
16	Auxiliary Hoist Speed Selector Switch (Optional)
17	Boom Lift Control Lever (Single Axis Controller Option)
18	Main Hoist Control Lever (Single Axis Controller Option)
19	Boom Lift and Main Hoist Control Lever (Dual Axis Controller Option)
20	Telescope Control Foot Pedal (Optional)
21	Hoist Rotation Indicators
22	Drive Axle Selector Switch
23	Outrigger Control Switches
24	Outrigger Extend/Retract Switch
25	Swing Brake Control Switch
26	Swing Brake Pedal
27	Service Brake Foot Pedal
28	Low Brake Pressure Indicator
29	Park Brake Control Switch
30	Turntable Lock Control (Pin Type)
31	360 Degree Swing Lock Control (Positive Lock Type) (Optional)
32	Load Moment Indicating (LMI) and Work Area Definition System

Item	Description
33	Low Steer Pressure Indicator (CE Units)
34	Transmission Service Indicator (XMSN)
35	Headlights Switch
36	Work Lights Switch
37	Cab Circulating fan
38	Horn
39	Hazard Lights Switch
40	Boom Light Switch (Optional)
41	Turn Signal Lever and Windshield Wiper/Washer Controls
42	Cab Dome Light
43	Bubble Level Indicator
44	Air Conditioner Control Switch (Optional)
45	Heat Control Knob
46	Fan Switch
47	Defroster Switch
48	Fire Extinguisher
49	Defroster Fan
50	Windshield Wiper
51	Differential Lock Control Switch (Optional)
52	Right Turn Signal Indicator
53	Left Turn Signal Indicator
54	Rear Wheels Not Centered Indicator
55	Hydraulic Boost Switches
56	Hoist 3rd Wrap Indicator (Optional w/CE)
57	Main Hoist Speed Selector Switch
58	12 VDC Accessory Outlet
59	Spotlight (Optional)
60	Circuit Breaker Panel
61	Wait-To-Start Indicator
62	Test Mode Switch
63	Idle Switch
64	Engine Stop Indicator
65	Engine Warning Indicator
66	Engine Service indicator
67	Throttle Mode Switch
68	System Diagnostic (DIAGN) Indicator
69	Work Light

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Hourmeter (Not Shown)

The hourmeter is located on the left side of the engine hood, in front of the muffler. The hourmeter is used to register hours of engine operation.

Crane Function Power Switch

The CRANE FUNCTION power switch (9) is located on the right side of the front 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 be illuminated, and the crane function solenoid will be energized allowing crane functions controlled by the hydraulic remote controllers to be performed.

Transmission Shift Lever

The transmission shift lever (10) is located on the right side of the steering column. The control lever operates the transmission selector valve electrically. Positioning the lever up actuates forward and positioning the lever down actuates reverse. When the lever is in neutral, it rests in a detent. To move the lever up or down, pull back on the lever first. To shift the transmission to forward first through sixth gear, rotate the knob to the small 1 through 6. To shift the transmission to reverse first through third, rotate the knob to the large 1 through 3.

Telescope or Auxiliary Hoist Control Lever (Single Axis Controller Option)

The telescope or auxiliary hoist (TELE or AUX HOIST) control lever (11) is located on the left armrest. The lever controls the telescope functions when the crane is not equipped with an auxiliary hoist. Push the lever forward to telescope the boom out, or pull the lever back to telescope boom in.

When equipped with an auxiliary hoist, the lever controls auxiliary hoist functions and telescope functions are controlled through a foot pedal (). Push the lever forward to let out the hoist cable or pull the lever back to reel the cable in.

Swing Control Lever (Single Axis Controller Option)

The SWING control lever (12), 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.

Swing And Telescope Or Auxiliary Hoist Control Lever (Dual Axis Controller Option)

The SWING and TELESCOPE or AXILIARY HOIST (SWING/TELE or SWING/AUX) control lever (13) is located on the end of the left armrest. The lever controls the swing and telescope functions when the crane is not equipped with an auxiliary hoist. When equipped with an auxiliary hoist, the lever controls swing and auxiliary hoist functions and telescope functions are controlled through a foot pedal.

If not equipped with an auxiliary hoist, positioning the lever to the left or right actuates a control valve through hydraulic pilot pressure to provide 360 degree continuous rotation in the desired direction. Positioning the lever forward actuates the control valve to telescope the boom out and pulling the lever back actuates the boom to telescope in.

If equipped with an auxiliary hoist, positioning the lever forward actuates the control valve to let out hoist cable and pulling the lever back reels the cable in. Moving the lever in a diagonal direction actuates the two functions simultaneously.

Water-In-Fuel Indicator

The WATER-IN-FUEL indicator (14) is located at the center of the console on the indicator light display. It illuminates amber when the engine fuel water separator needs maintenance. Maintenance should be performed as soon as possible whenever this lamp is illuminated. This light is controlled by the engine ECM. The ENGINE WARNING indicator will also illuminate.

Rear Steer Control Switch

The REAR STEER control switch (15) is a three-position, spring centered to off, rocker switch, located on the left side of the front console. Positioning the switch to the right (R) actuates a control valve to turn the rear wheels to the left, causing the crane to turn to the right. Positioning the switch to the left (L) actuates a control valve to turn the rear wheels to the right, causing the crane to turn to the left. Releasing the switch allows it to spring return to the center off position.

Auxiliary Hoist Speed Selector Switch (Optional)

The auxiliary hoist (AUX HOIST) rocker switch (16) is located on the left armrest. The auxiliary hoist switch must be in the ON position before the auxiliary hoist can be operated. Positioning this switch to OFF prevents the operator from accidentally activating the auxiliary hoist. With the switch in the ON position, the amber LED square in the switch will be illuminated.

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Boom Lift Control Lever (Single Axis Controller Option)

The boom LIFT control lever (17) is located on the right armrest. Pull lever back to raise the boom. Push lever forward to lower the boom.

Main Hoist Control Lever (Single Axis Controller Option)

The MAIN HOIST control lever (18) is located on the right armrest. Push lever forward to lower the cable. Pull lever back to raise the cable.

Boom Lift And Main Hoist Control Lever (Dual Axis Controller Option)

The boom lift/main hoist control lever (19) is located on the right armrest. Push the control lever to the right to lower the boom, or to the left to raise the boom.

When used for main hoist, push the control lever forward to lower the cable or pull back to raise the cable.

Telescope Control Foot Pedal (Optional)

The telescope control foot pedal (20), supplied when the crane is equipped with an auxiliary hoist, is located on the left side of the cab floor. Push forward on the top of the pedal to extend the boom. Push down on the bottom of the pedal to retract the boom.

Hoist Rotation Indicators

The hoist rotation indicators (21) are located on top of each hoist control lever. The 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.

Drive Axle Selector Switch

The DRIVE AXLE selector switch (22) is located on the left side of the front console. This two-position rocker switch is placarded 2WD (high range) and 4WD (low range). The switch controls a solenoid valve energized for 2WD that operates the speed range and axle disconnect cylinders on the transmission. When the switch is in the 4WD position, the square amber LED on the switch is illuminated.

Outrigger Control Switches

NOTE: The hydraulic boost switch must be positioned to LOW to function the outriggers.

The outrigger selector panel (23) is located on the left side of the front console. There are four three-position, spring centered to off rocker switches on the panel. The switches, in conjunction with the OUTRIGGER Extension/Retraction switch, provide control of all four outrigger extension and stabilizer cylinders. Positioning any one of the EXTENSIONS or STABILIZERS switches so that the desired component is selected, energizes the solenoid valve for the selected component. When the OUTRIGGER Extension/ Retraction switch is positioned to EXTEND or RETRACT, the selected component moves in the selected direction.

Outriggers Extend/Retract Switch

The OUTRIGGERS EXTEND/RETRACT switch (24) is located on the top right of the front console. The switch is a three-position, spring centered to off rocker switch. It has two placarded positions, EXTEND and RETRACT, and is used in conjunction with the switches on the outrigger selector panel to control the operation of the stabilizer and extension cylinders. After positioning the switch on the outrigger selector panel, positioning the OUTRIGGER Extend/Retract switch to EXTEND or RETRACT energizes the control solenoid to allow hydraulic fluid to flow through the control solenoid valve and the individual solenoid valve to move the selected component in the selected direction.

Swing Brake Control Switch

The SWING BRAKE control switch (25) is located on the left side of the front console. 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 red LED in the switch is illuminated. The switch is guarded to prevent accidental activation.

Swing Brake Pedal

The swing brake pedal (26) is located on the left side of the cab floor. The swing brake pedal is used to actuate the swing brake to slow or stop swing motion. Braking is proportional to pedal depression. With the pedal not depressed and the swing brake control valve disengaged, hydraulic pressure is applied to the brake, overcoming spring pressure and releasing the brake. Depressing the pedal actuates a swing power brake valve to apply pressure to the brake assembly. This pressure aids the spring pressure to overcome the hydraulic pressure being applied to the brake release circuit and applies the spring brake according to the pressure from the swing power brake valve.

Service Brake Foot Pedal

The brake foot pedal (27) is the second pedal from the right on the cab floor. Depressing the pedal controls the application of the service brakes.

Low Brake Pressure Indicator

The LOW BRAKE PRESSURE indicator (28) is located on the center of the console on the indicator light alert display. It

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illuminates red and a warning buzzer is activated when the pressure in the dual accumulator charge valve falls below normal operating requirements.

Park Brake Control Switch

The PARK BRAKE control switch (29) is located on the left side of the front console. This two-position rocker switch (ON/OFF) is used to apply and release the parking brake on the transmission. The red square LED on the switch is illuminated when the pressure switch in the brake release system is activated. The switch is guarded to prevent accidental activation.

Turntable Lock Control (Pin Type)

The pin swing lock control handle (30) is located beside the front console 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 for pick and carry loads. When the control handle is pushed down and the superstructure is directly over the front, the swing lock pin drops into the 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.

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

The 360 degree swing lock control lever (optional) (31) is located on the right side of the operator's seat next to the control armrest. The purpose of the swing lock is to secure the superstructure in position at any point in its 360 degree of rotation.

The lock is engaged when the control lever is pushed down and disengaged when the control lever is pulled up. The control lever is adjusted to require approximately 20.4 kg (45 pounds) of force to move the lever into the engaged position.

Load Moment Indicating (LMI) and Work Area Definition System Control Panel

The LMI and Work Area Definition System control panel (32) is located on the right side of the front console. It maintains the controls and indicators for the crane's Load Moment Indicating (LMI) System and Work Area Definition System. Refer to the LMI Manual for detailed information.

Low Steer Pressure Indicator (CE Units)

The LOW STEER PRESSURE indicator (33) is located on the center of the front console on the indicator light display. It illuminates red when the hydraulic pressure is low.

Transmission Service Indicator (XMSN)

The TRANSMISSION SERVICE indicator (34) is located on the center of the console on the indicator light display. It illuminates red and a warning buzzer is activated during low transmission oil pressure or high transmission oil temperature conditions.

Headlights Switch

The HEADLIGHTS switch (35) is located on the left side of the front console. This two-position ON/OFF rocker switch controls operation of the instrument lights, switch LED's, and the marker lights on the front, rear, and side of the crane. When the switch is in the ON position, the square amber LED on the switch is illuminated.

Work Light Switch

The WORK light switch (36) is a two-position ON/OFF rocker switch, located on the left side of the front console. The switch controls the operation of the crane's work light (69). When the switch is in the ON position, the square amber LED on the switch is illuminated.

Cab Circulating Fan

The cab circulating fan (37) is located on a mounting bracket on the left front side of the cab, above the window frame. A swivel allows the fan to be rotated and a switch on the fan base controls the fan.

Horn

The horn button (38) is a push-button type switch located in the center of the steering wheel. Depressing the horn button energizes a relay that sounds the horn on the cab exterior.

Backup Alarm (Not Shown)

The backup alarm is an audio system used to warn personnel outside the crane when the crane is backing up. The alarm system is electrical and consists of the backup alarm and its associated wiring. The alarm is connected to the electrical wiring for the backup light, and is activated when the backup light is activated. The backup alarm is installed on the radiator shroud at the rear of the engine hood.

Hazard Lights Switch

The HAZARD lights switch (39) is located on the left side of the front console. The switch is a two-position ON/OFF rocker switch that causes the four turn signal lights to flash at the same time when the switch is positioned to ON. When the switch is positioned to ON, the square amber LED on the switch is also illuminated.

Boom Light Switch (Optional)

The BOOM LIGHT switch (optional) (40) is located on the left side of the front console. This two-position ON/OFF rocker switch controls operation of the boom flood lights. When the switch is in the ON position, the square amber LED on the switch is illuminated.

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Turn Signal Lever and Windshield Wiper/ Washer Controls

The turn signal lever and windshield wiper/washer controls (41) are located on the left side of the steering column. Pushing the turn signal lever down causes the left front and left rear turn signals to flash. Pushing the turn signal lever up causes the right front and right rear turn signals to flash.

The windshield wiper switch is incorporated in the turn signal lever. The knob of the lever has three positions: O, I, and II. Pushing the button in the end of the knob energizes the windshield washer pump to spray washer fluid on the windshield. Positioning the knob to I operates the wiper at low speed and positioning the knob to II operates the wiper at high speed. Positioning the knob to O turns the wiper motor off and automatically returns the wiper to the parked position.

Cab Dome Light

The cab dome light (42) is located on the right rear corner of the cab roof and provides illumination in the cab. The dome light is controlled by a switch on the light.

Skylight Wiper (Not Shown)

The electrically-operated skylight wiper 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 a switch on the wiper motor.

Bubble Level Indicator

The bubble level indicator (43) is located on the left side of the cab by the door latch plate. The indicator provides the operator with a visual aid in determining the levelness of the crane.

Air Conditioner Control Switch (Optional)

The air conditioner (AIR COND) control switch (44) is located on the left 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 illuminated.

Heat Control Knob

The HEAT control knob (45) is located on the left side of front console. The knob is a push-pull cable 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 control switch (46) is located on the left side of the front console. The switch is a four-position rotary switch (OFF, LOW, MED, HIGH) that controls operation of the heater or air conditioning blower to circulate heated or cool air throughout the cab.

Defroster Switch

The DEFROSTER switch (47) is located on the right side of the front console above the throttle controls. The switch is a three-position rocker switch (HIGH, OFF, LO) that controls operation of the defroster fan, which is located on top of the front console.When the switch is in the HIGH or LO position, the square amber LED on the switch is illuminated.

Beacon Light (Optional) (Not Shown)

The beacon light 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.

Fire Extinguisher

The fire extinguisher (48) is located on the left side of the cab behind the operator's seat. The fire extinguisher is a BC rated dry type fire extinguisher for emergency use.

Defroster Fan

A defroster fan (49) is located at the front of the dashboard. The fan is controlled by a switch (44) on the front console, and is used to circulate air to remove moisture and fog from the inside of the windshield.

Windshield Wiper

A windshield wiper (50) is installed on the front of the cab. The wiper is controlled by the knob on the turn signal lever, and is used to remove moisture from the windshield.

Differential Lock Control Switch (Optional)

NOTE: The differential lock will only work when the crane is in the 4WD LO mode.

The differential lock (AXLE DIFF) control switch (51) is located on the left side of the front console. It is a two position, momentary rocker switch placarded LOCK and UNLOCK.

When positioned to LOCK, the splines on the shift collar are engaged with the splines on the differential case and the axle shafts and the differential assembly are locked together and there is no differential action between the wheels. When positioned to UNLOCK, there is normal differential action between the wheels all the time. The square amber LED on the switch is illuminated when the switch in each axle is activated.

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Right Turn Signal Indicator

The right turn signal indicator (52) is located on the center of the front console on the indicator light alert display. It is a green arrow light that flashes when the turn signal lever is pushed up or the HAZARD light switch is positioned to ON.

Left Turn Signal Indicator

The left turn signal indicator (53) is located on the center of the front console on the indicator light alert display. It is a green arrow light that flashes when the turn signal lever is pushed down or the HAZARD light switch is positioned to ON.

Rear Wheels Not Centered Indicator

The REAR WHEELS NOT CENTERED indicator (54) is located in the center of the front console on the indictor light alert display. The indicator is an amber light that will illuminate any time the rear wheels are not centered.

Hydraulic Boost Switch

NOTE

NOTE: The hydraulic boost switch must be positioned to LOW to function the rear steer or the outrigger circuits

The hydraulic boost control switch (55) 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 #1 section #2 to the rear steer/ outrigger valve. The poppet check valve opens to combine this flow of oil with the output from pump #1 section #1. Hydraulic boost will not function unless the transmission is in neutral and the CRANE FUNCTION switch is in the ON position. With the switch in the HI position, the amber LED square in the switch will be illuminated.

Hoist 3rd Wrap Indicator (CE Option)

The hoist 3RD WRAP indicator (56) is located in the center of the front console on the indicator light alert display. The indicator is a amber light that will illuminate when three wraps or less of cable remains on either hoist.

Main Hoist Speed Selector Switch

The MAIN HOIST SPEED selector rocker switch (57) is located on the right armrest. It is a two position (HI/LOW) switch. Position the switch to HI to energize 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 HI position, the amber LED square in the switch will be illuminated.

12 VDC Accessory Outlet

The 12 vdc accessory outlet (58) is located in the side of the pin swing lock control mounting bracket. It provides an outlet for the operator to plug in a 12 vdc accessory. It is protected by a 10 amp fuse.

Spotlight (Optional)

The spotlight (59) is mounted on the outside of the cab roof in the right front corner. The light can be tilted 180 degrees and rotated 360 degrees from inside the cab. The switch that activates the spotlight is located on the end of the spotlight arm.

Circuit Breaker Panel

The circuit breaker panel (60) is located on the right side of the cab in front of the pin house lock control. It contains 19 fuses that protect the various electrical components of the crane.

Anemometer (CE Units)

A hand held anemometer is provided in the cab. It is a wind speed indicator with a compass located on the top. It measures wind speed on a scale from 15 to 70 mph.

Emergency Exit (CE Units)

The windshield is considered the Emergency Exit. In an emergency, push out on the windshield and escape through the opening.

Wait-To-Start Indicator

The WAIT-TO-START indicator (61) is located at the center of the console on the indicator light display. It illuminates amber for a period of time when the IGNITION switch is in the ON position. The engine should not be cranked until the Wait-To-Start lamp turns off. This indicator is controlled by the engine ECM.

Engine Diagnostics Switches

Two ENGINE DIAGNOSTICS switches (Test Mode and Idle Mode) are located in the center of the front console.

Test Mode Switch

The TEST MODE switch (62) is used when servicing the engines electronic control system. It is a two position on/off rocker switch used to activate the testing mode (fault codes). When the test mode switch is on, and is used in conjunction with the idle (+/-) switch, access will be gained to toggle up and down through the fault codes.

Idle Switch

The IDLE switch (63) is a two position (+/-) momentary rocker switch that provides idle-control inputs that increases

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and decreases the engine idle (when the test mode switch is in the OFF position) or diagnostic mode fault codes (when the test mode switch is in the ON position).

Engine Stop Indicator

The ENGINE STOP indicator (64) is located at the center of the console on the indicator light alert display. It illuminates red when energized by a signal from the engine ECM. In addition, a warning buzzer will also sound.

NOTE: If this indicator light illuminates, see Engine Operator's Manual.

Engine Warning Indicator

The ENGINE WARNING indicator (65) is located at the center of the console on the indicator light alert display. It illuminates amber when energized by a signal from the engine ECM.

NOTE: If this indicator light illuminates, see Engine Operator's Manual.

Engine Service Indicator

The ENGINE SERVICE indicator (66) is located in the center of the console on the indicator light alert display. It illuminates amber when energized by a signal from the engine ECM.

NOTE: If this indicator light illuminates, see Engine Operator's Manual.

Throttle Mode Switch

The THROTTLE MODE switch (67) is located on the front console next to the hand throttle control. The switch is a two position switch labeled HAND, FOOT and is used to specify which throttle controls the engine. The HAND position is for selecting the hand throttle control on the front console. The FOOT position is for selecting the foot throttle pedal on the cab floor.

System Diagnostic (DIAGN) Indicator

The SYSTEM DIAGNOSTIC indicator (68) is located in the center of the front console on the indicator light alert display. The indicator is a red light that is used for troubleshooting the can buss system.

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

Work Light

The work light (69) is installed on the front of the cab. It is controlled by the work light switch (36).

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OPERATING PROCEDURES

New Crane Conditioning

Your new Grove carrier has been thoroughly tested, adjusted, lubricated, and inspected prior to delivery. However, during the initial hours of operation, an occasional oil, air, or coolant leak may develop. Immediate corrective action should be taken concerning each of these leaks to avoid major repairs later. For detailed engine conditioning, refer to the applicable engine manual.

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

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

These guidelines should not be considered limitations but rather as 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 safety of operation. The following checklist items are suggested specifically for the operator's benefit to make certain his crane is prepared for starting the day's work.

Fuel Supply

Check the fuel level and make sure the cap is on tight.

Engine Oil

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 check to make sure the cap is secure.

Batteries

Check that the battery cables and clamps are tight and not corroded.

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.

Foot And Parking Brakes

Check the foot and parking brakes for proper operation.

Daily Lubrication

Make certain that all components requiring daily lubrication have been serviced. (Refer to Section 5 - LUBRICATION.)

Hydraulic Reservoir And Filter

Check hydraulic fluid quantity level and filter condition indicator. Check breather for cleanliness and security.

Tires

Check for severe cuts, foreign objects embedded in treads, and for correct inflation pressures. A tire inflation chart, providing the correct air pressures, is located in the Load Chart Book in the crane cab.

Wire Rope

Inspect wire rope in accordance with applicable Federal Regulations.

Inspect sheaves, guards, guides, drums, flanges, and any other surfaces that may come in contact with the rope for any condition that could cause possible damage to the rope.

Hook Block

Visually inspect for nicks, gouges, cracks, and evidence of any other damage. Replace any hook that contains cracks or shows evidence of excessive deformation of the hook opening, including twist. Be sure the safety latch is free and aligned.

Air Cleaner

Check the filter condition indicator. Check filter and tubing for security.

Access Hole Covers (CE Units)

Ensure the covers are installed in all access holes in the boom and the outrigger beams.

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Cold Weather Operation

The following recommendations are for operating Grove cranes in very low (i.e., sub-zero) 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 Worldwide. 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 -18°C (0°F) and -40°C (-40°F) or lower should be accomplished only by competent operators who possess the skill, experience, and dexterity to ensure smooth operation. Shock loading shall be avoided.

Operation Below -40°C

For crane operation below -40°C, capacities shall be de-rated 3.67 percent of the rated load shown on the capacity charts for each degree below -40°C.

Operation Below -40°F

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

Battery Disconnect

The battery disconnect switch is located in the battery box on the left side of the crane. To disconnect the batteries, turn the battery disconnect switch to OFF. Turn the switch to ON to connect the batteries.

Engine Operation

Starting and shutdown procedures for most diesel engines generally follow the same pattern. Therefore, the following procedures can be applied except where specific differences are noted. (Refer to the applicable engine manufacturers manual for detailed procedures.)

Starting Procedure

WARNING

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

DANGER

Before starting the engine, apply the parking brake and engage the swing lock.

CAUTION

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

CAUTION

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

Warm Engine

WARNING

Do not spray starting fluid into the air inlet. The spray will contact the heater elements and could explode causing personal injury.

NOTE: The engine ECM monitors the engine and, under certain conditions, cycles the air heater on and off at start-up and during operation.

The engine is equipped with an electric air heater grid at the air inlet elbow to aid in cold starting and reduce white smoke at start-up. In the preheat mode, the engine should not be cranked until the WAIT-TO-START lamp turns off.

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

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

2. 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.
3. The WAIT-TO-START lamp is illuminated during the preheat time that takes place when the IGNITION switch is in the ON position during cold weather starting. To minimize cranking time during cold weather starting, the engine should not be cranked until the WAIT-TO-START lamp turns off.

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

Cold Engine

WARNING

Do not spray starting fluid into the air inlet. The spray will contact the heater elements and could explode causing personal injury.

NOTE: The engine ECM monitors the engine and, under certain conditions, cycles the air heater on and off at start-up and during operation.

The engine is equipped with an electric air heater grid at the air inlet elbow to aid in cold starting and reduce white smoke at start-up. In the preheat mode, the engine should not be cranked until the WAIT TO START lamp turns off.

1. Prior to starting a cold engine, ensure the CRANE FUNCTION switch is positioned to OFF and the hydraulic pump disconnected if the optional disconnect is provided.
2. Ensure the parking brake is set and position the transmission in neutral.

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

3. The WAIT-TO-START lamp is illuminated during the preheat time that takes place when the IGNITION switch is in the ON position during cold weather starting. To minimize cranking time during cold weather starting, the engine should not be cranked until the WAIT-TO-START lamp turns off.
4. Turn the IGNITION switch to START 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.
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.

Detailed cold weather starting and operating procedures are covered in the engine manual.

Cold Weather Starting

The correct grade of oil for the prevailing temperature should be used in the crankcase to prevent hard cranking. Diesel fuel should have a pour point of 6°C (10°F) less than the lowest expected temperature. In case of emergency, white kerosene may be added to the fuel to bring the pour point down to the required temperature to prevent clogging of filters and small passages by wax crystals. The addition of kerosene is NOT recommended for general use.

The engine is equipped with an electric air heater grid. An optional engine block heater is also provided.

Prior to starting a cold engine, ensure the CRANE FUNCTION switch is positioned to OFF and the hydraulic pump disconnected if the optional disconnect is provided.

To start the engine, position the ignition switch to START (2). If the engine does not start within 30 seconds, allow the starter to cool a minute or two and repeat the procedure.

Detailed cold weather starting and operating procedures are covered in the engine manual.

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 idling is necessary, maintain at least 800 rpm.

Racing The Engine

NEVER race the engine during the warm-up period. NEVER 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 operate at fast idle for about five minutes to avoid high internal heat rise and allow for heat dissipation.
2. Turn the ignition switch to OFF (0).

Crane Travel Operation

Traveling - General

DANGER

Before traveling, ensure the crane function switch is in the off position. This will prevent inadvertent operation of craning functions due to bumping of the controllers while roading.

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CAUTION

On cranes equipped with the optional pump disconnect feature, disengage the pumps for extended traveling, cold weather starting, or engine checks.

RT machines are subject to the same road regulations as any truck, regarding gross weight, width, and length limitations.

Although RT machines are specifically designed for rough terrain, the operator should be extremely cautious and aware of the terrain in which he is operating.

DANGER

Do not travel with an empty hook in a position where it can swing freely.

DANGER

Do not drive the crane with the boom off center because automatic oscillation lockout will occur, making the crane subject to tipping on uneven surfaces.

DANGER

Avoid holes, rocks, extremely soft surfaces, and any other obstacles which might subject the crane to undue stresses or possible overturn.

CAUTION

Do not drive the crane with the lift cylinder bottomed. position the boom slightly above horizontal.

Use four-wheel drive only when greater traction is necessary. (Refer to FOUR-WHEEL DRIVE OPERATION, this section, for operating instructions.)

DANGER

On open ground, tow or pull only on the tow/tie-down lugs or with the optional pintle hook.

CAUTION

Should the crane become mired down, use a tow truck or tractor to free the vehicle. Severe damage to the transmission or axles may occur if the operator attempts to free the crane unassisted.

CAUTION

If the crane is mired down, use the tow/tie-down lugs to pull or tow.

There are two tow/tie-down lugs installed on each end of the crane. Use both lugs to tow or pull the crane.

Traveling With Boom Extension Erected

Travel with boom extension erected is permissible under the following conditions.

1. Boom extension shall be erected at minimum offset with stinger section (if applicable) pinned in fully retracted position.
2. Job site 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: 4 km/h (2.5 mph).
6. Boom over the front, lock pin (in cab) in down position.
7. Hookblock may be reeved over main boom nose, hanging 0.9 m (3 feet) below nose sheaves.
8. Headache ball may be reeved over boom extension, hanging 0.9 m (3 feet) below sheave.

Extended Travel

CAUTION

For extended travel, check the cold tire pressure prior to start. (refer to tire inflation chart in load chart book.) After every one hour of travel time, regardless of ambient temperature, stop and allow the tires to cool off for at least 30 minutes. At the destination, the tires must be allowed to cool to ambient temperature before crane lifting on rubber.

Depending upon the tire manufacturer, the higher inflation pressures normally specified for lifting on rubber are not recommended for site to site transfer over extended distances. The higher static/creep 8 km/h (5 mph) inflation pressures may remain in the tire while operating the crane on site within a distance of less than 6.4 km (4 miles).

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Moving The Crane

The following superstructure conditions should be strictly adhered to before moving the crane. Procedures for accomplishing the following can be found in the various sections of this manual.

1. Fully retract the boom.
2. Ensure the swingaway jib is properly stowed and secured.
3. Swing the boom to over-the-front and lower it to slightly above horizontal.
4. Turn the SWING BRAKE switch on the front console to ON and engage the swing lock pin by pushing down on the handle.
5. Remove the hook block and/or headache ball from the hoist cable(s) and stow securely before traveling or make sure the hook block or headache ball is properly secured to the tie down provided for that purpose.
6. Fully retract the outrigger stabilizers and remove the floats.
7. Properly store the floats.

Steering

Steering is accomplished by the steering wheel and the rear steer control. These controls, used singly or together, provide front wheel steering, rear wheel steering, four-wheel steering, and crabbing capabilities (Figure 3-4).

Front Wheel Steering

Conventional front wheel steering is accomplished with the steering wheel. This method of steering should always be used when traveling at higher speeds.

DANGER

Operate the rear steer only for added job site maneuverability.

Rear Wheel Steering

Rear wheel steering is controlled by the REAR STEER control switch located on the left hand armrest in the cab. Moving the control switch to the desired position activates the rear steer cylinders, thereby steering the crane in the selected direction.

Four Wheel Steering

Four wheel steering is accomplished with the steering wheel and the REAR STEER control. Depending upon which direction the operator wishes to travel, the steering wheel is turned opposite direction of the REAR STEER control position. This allows the crane to turn or maneuver in close, restricted areas.

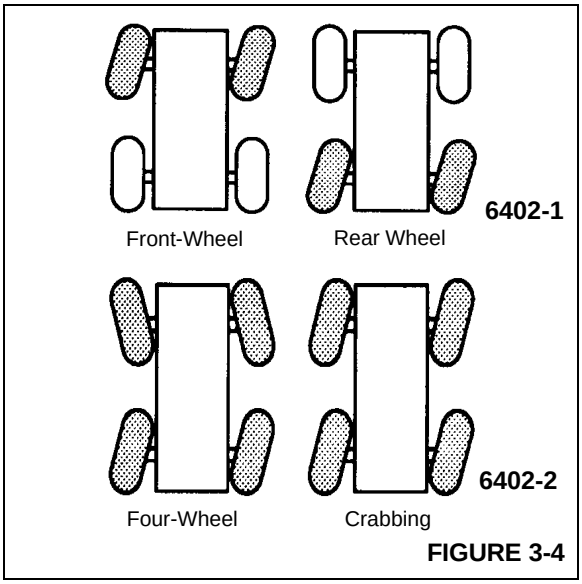

FIGURE 3-4

Crabbing

Crabbing is accomplished with the steering wheel and the REAR STEER control switch. Depending upon which direction the operator wishes to travel (crab), the steering wheel is turned in the same direction as the REAR STEER control switch. This permits driving the crane forward or backward in a crabbing manner.

Secondary Steering

A secondary steering system is provided to backup the normal front steering system if loss of hydraulic flow occurs. This happens automatically when normal steering load sense flow is lost. The pilot operated, two position, 3-way valve will shift and supply flow from the accumulator to the steer control valve to allow the operator to safely steer the crane to a safe stop.

Traveling - Forward

DANGER

Engage the swing lock pin for extended travel.

1. After the engine has warmed up, position the transmission shift lever from neutral (N) to forward (F) position.
2. Position the DRIVE AXLE switch to either 2WD or 4WD.

CAUTION

Use four wheel drive only when more traction is required.

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NOTE: Rotate the shift lever knob to the smaller numbers for forward travel and the larger numbers for reverse travel.

3. Put the transmission shift lever knob to the first (1) gear position and release the parking brake. Depress the foot throttle until maximum first gear speed is attained and shift into the second (2) gear position.
4. Repeat the above procedure for the remaining gear positions until the desired travel speed is attained.

CAUTION

Do not downshift to a lower gear if the road speed is greater then the maximum speed of the lower gear.

Traveling - Reverse

Traveling in reverse is accomplished the same way as traveling forward, except for shifting the transmission shift lever to reverse (R) position and rotating the knob to the larger 1, 2, and 3 positions. (Refer to TRAVELING - FORWARD.)

CAUTION

Apply service brakes and bring crane to a complete stop before shifting transmission into reverse.

Four-wheel Drive Operation

If more traction is required due to slipping or spinning wheels, engage the front axle drive as follows:

CAUTION

Before shifting from two-wheel drive to four wheel drive (or from four back to two), crane travel must be stopped, otherwise equipment damage could occur.

1. Position the DRIVE AXLE selector switch to 4WD.
2. Select gear speed and direction of travel.
3. Return the DRIVE AXLE selector switch to the 2WD position as soon as two-wheel traction will suffice.

Proper Operation Of Differential Lock (Optional)

DANGER

When using the differential lock steering characteristics may be affected.

CAUTION

Try to use four wheel drive to gain adequate traction before using the differential lock.

CAUTION

Do not operate the differential lock while the crane is moving; when traveling downhill; at speeds above 10mph; on hard, dry surfaces; during axle spin-out.

NOTE: The differential lock will not operate unless the DRIVE selector switch is in the 4WD-LO position.

General

The purpose of the differential lock is to provide maximum traction and control on poor road or highway surfaces. When the differential locks are actuated, the clutch collar completely locks the differential case, gearing, and axle shafts together, thus maximizing traction to both wheels of each axle. The lock position will also protect against spinout. When normal driving conditions exist (during periods of good traction), the differential locks should not be actuated. The axles should be allowed to operate with differential action between both wheels.

When using the differential locks, the operator must remember the following:

1. The AXLE DIFF control switch is a momentary rocker switch and must be held in the LOCK position.
2. The differentials can be locked or unlocked when the vehicle is standing still or at a constant low speed when the wheels are not slipping.
3. Lock the differentials and operate the vehicle only at low speeds.
4. When the differentials are locked, the crane's turning radius will increase, creating an understeer condition. The operator must use caution, good judgement and drive at low speeds when operating the vehicle with a locked differentials.
5. Lock the differentials only when maximum traction is needed on poor road or highway surfaces.
6. Always unlock the differentials when the need for maximum traction has passed or when traveling on good road or highway surfaces.
7. Do not lock the differentials when the wheels are slipping. Damage to the differentials can result.
8. Do not lock the differentials when the vehicle is traveling down steep grades and traction is minimal. Potential loss of vehicle stability can result.

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Operation

The differential lock (AXLE DIFF) should preferably be engaged when the crane is STATIONARY but may be engaged when moving if the following conditions are met.

1. The crane is moving very slowly (creep speed).
2. The wheels are not spinning freely at the time of engagement.

When traveling with the lock engaged do not deviate from a straight path more than is absolutely necessary.

1. When operating the differential lock, position the switch to the locked position with the crane stationary or at slow speed.
2. If moving at slow speed, let up momentarily on the accelerator to relieve torque on the differential gearing. This will fully engage the differential locks. When activated the square amber LED on the switch should be illuminated.
3. Proceed over the poor road condition cautiously.

When the adverse condition has passed, adhere to the following:

1. Position the differential lock (AXLE DIFF) switch to the UNLOCK position while maintaining slow speed.
2. Let up momentarily on the accelerator to relieve torque on the differential gearing, allowing the differential to fully unlock. The square amber LED on the switch should go out.
3. Resume driving at a normal speed using good driving judgement.

Proper Operation Of Axle Oscillation Lockouts

NOTE: The following procedure should be used to periodically check the axle oscillation system and ensure that it is in proper working condition.

1. Ensure the tires are inflated to the recommended pressure. Refer to the Load Chart Book in the crane cab for proper inflation pressures.
2. With the hook unloaded, the boom fully retracted and centered over the front at no more than a 10 to 15 degree boom angle, position the crane on a block or curb so that one rear tire is approximately 15 to 30 cm (6 to 12 inches) above the level of the opposite tire.
3. Slowly swing the superstructure to the right or left until the axle oscillation lockout valve is activated. This will lock the rear axle out of level. Do not swing beyond the tire track.
4. After engaging the swing brake, slowly drive off of the block or curb and stop. The rear tires should both be touching the road surface and the opposite front tire should be light or slightly off the road surface.
5. Release the swing brake and swing the superstructure until it is centered over the front.

CAUTION

Do not operate the crane if the axle oscillation lockout system is not functioning properly.

6. If the axle oscillation lockout valve is not functioning properly, the crane will not re-level itself. If the rear axle does not lock or unlock properly, evaluate the lockout system and repair as necessary.

General Crane Operation

Pump Drive

Hydraulic pump number 1 is a two section gear pump and is mounted on the torque converter drive pad. Pump number 2 is a single section pump mounted on the right side of the engine. Pump number 3 is a single section pump mounted on the torque converter drive pad. The pumps operate any time the engine is running.

Setting The Park Brake When Crane Is On Outriggers

When operating certain crane functions with the crane on outriggers at high engine speeds, it may be necessary to set the parking brake in order to keep the rear drive axle from rotating. This rotating is caused by a small amount of drag in the hydraulic clutch, resulting in rotation of the rear wheels.

When operating the crane on outriggers, the transmission should be shifted into 4WD (four-wheel-drive) and the parking brake set. When this procedure is correctly followed, the wheels will not rotate with the crane on outriggers during any crane function.

Control Lever Operation

The control lever operation for all crane functions is standard, i.e. the closer the lever is to neutral (center), the slower the system responds. The control lever should be returned to neutral to hold the load. Never feather the hoist control lever 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. The Preload Check is as follows:

CAUTION

Operate engine at or near governed rpm during preload check of crane functions.

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NOTE: Carefully read and become familiar with all crane operating instructions before attempting a preload check or operating the crane under load.

1. Extend and set outriggers.
2. Raise, lower, and swing the boom a minimum of 45° right and left.
3. Telescope the boom in and out.
4. Raise and lower the cable a few times at various boom lengths. Ensure there is no kinking.

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.

NOTE: Refer to (Figure 3-5) for terms to know in determining lifting capacities.

The load chart contains a large amount of information, which must be thoroughly understood by the operator.

The load chart contains four outrigger capacity charts: fully, mid, and retracted outriggers main boom and boom extension with full outriggers. In addition, the load chart contains three on-rubber capacity charts: over front stationary, 360° stationary, and pick and carry over front.

The capacity charts are divided into structural strength and stability limits. This is shown by the bold line across the chart. Capacities above the line are structural strength limits and capacities below the line are stability limits.

The left column is the load radius, which is the distance from the center of crane rotation to the load center of gravity. The top row lists various boom lengths ranging from fully retracted to fully extended with the swingaway jib. The number at the intersection of the left column and top row is the total load capacity for that load radius and boom length. The number in parentheses below the total load capacity 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 50 ft and the chart shows boom lengths of 48 and 54 ft, use the load capacity shown in the 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 be quickly determined from the range diagram. Or, if the boom length and angle are known, the tip height and operating radius can be quickly determined.

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

A boom extension capacity chart and notes are included to list the capacities for the extension length, load radius, and boom angle.

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

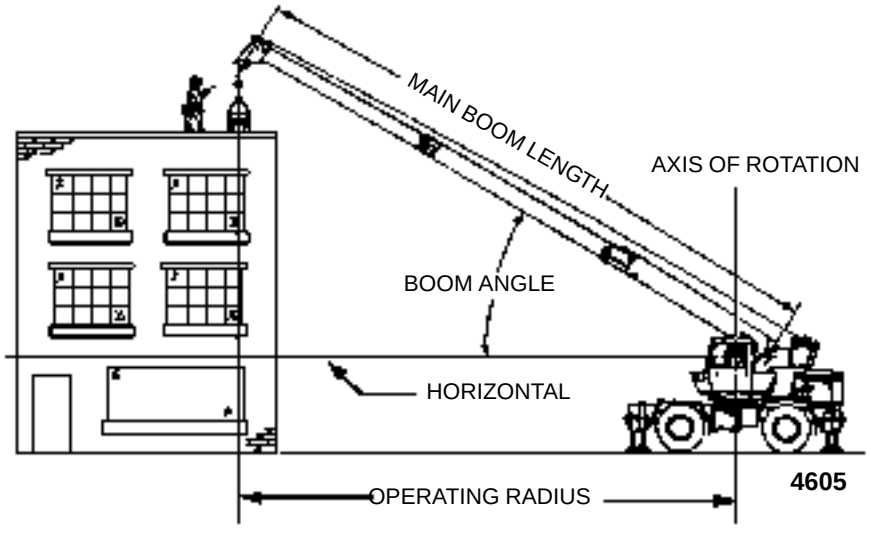

FIGURE 3-5

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The load chart also gives weight reductions for Grove load handling devices such as hook blocks, headache balls, boom extensions, etc., which must be taken into consideration as part of the load. Remember, the weight of any other load handling devices such as chains, slings, or spreader bars must be added to the weight of the load.

Crane Functions

DANGER

Death or serious injury could result from improper crane set-up on outriggers.

DANGER

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

DANGER

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.

Setting The Outriggers

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

CAUTION

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

2. Depress the desired EXTENSION rocker switch on the OUTRIGGER SELECTOR panel and hold the outrigger EXTENSION/RETRACTION rocker switch to EXTEND. The appropriate outrigger beam should begin to extend. Refer to Engaging the Mid-Extend Lock Pin if the crane is to be operated with the outriggers at the at the mid-extend position.

DANGER

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

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

3. After all four outrigger beams have been fully extended, position the appropriate STABILIZER rocker switch on the OUTRIGGER SELECTOR panel and hold the outrigger EXTENSION/RETRACTION rocker switch to EXTEND.

4. Extend each stabilizer, positioning the float as necessary, until the locking levers of the float engage the stabilizer cylinder rod.

NOTE: More than one stabilizer may be extended at one time.

5. With each stabilizer float firmly touching the ground, extend the front stabilizers approximately 8 to 10 cm (3 to 4 inches).

6. Extend the rear stabilizers approximately 8 to 10 cm (3 to 4 inches).

DANGER

All four outrigger beam lock pins must be engaged before operating from the mid-extend position.

DANGER

The operator must select the proper load chart and LMI program for the outrigger position selected.

7. Repeat steps 5 and 6 until all wheels are clear of the ground and the crane is level as indicated by the sight level bubble located on the right side of the cab. If it is suspected that the bubble level indicator is out of adjustment, verify and adjust the bubble level as follows:

a. Locate the crane on a firm, level surface.

b. Extend and set the outriggers. Level the crane, as indicated by the bubble level indicator, using the outriggers.

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c. Place a miracle pointer level, carpenter level, or similar type device on a machined surface such as the turntable bearing or bearing mounting surfaces.

d. Using the outriggers, level the crane as indicated on the leveling device used in step c.

e. Using the bubble level indicator mounting screws, adjust the bubble level indicator to show level.

Engaging The Mid-Extend Lock Pin

1. 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.

2. Slowly extend or retract the outrigger beam, allowing the locking pin to drop into the hole in the top of the outrigger beam, engaging the outrigger beam at the desired length.

Setting The Outriggers (CE Units)

The outrigger circuits are electrically interlocked to prevent extending or retracting more than one beam at a time. However, more than one stabilizer may be extended or retracted at a time.

Stowing The Outriggers

1. Select the rear stabilizers with the STABILIZER SELECTOR switches and hold the EXTENSION/RETRACTION switch to RETRACT until the rear stabilizers have retracted several inches.

2. Select the front stabilizer with the STABILIZER SELECTOR switches and hold the EXTENSION/RETRACTION switch to RETRACT until the front stabilizers have retracted several inches.

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

DANGER

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

4. Release the locking levers and allow the floats to drop to the ground.

5. Continue to retract the stabilizers until they are fully retracted.

6. Depress the desired EXTENSION rocker switch on the OUTRIGGER SELECTOR panel and hold the outrigger EXTENSION/RETRACTION rocker switch to RETRACT. The appropriate outrigger beam should begin to retract.

NOTE: More than one outrigger may be retracted at one time.

7. After all outriggers have been fully retracted, stow the outrigger floats.

Stowing the Mid-Extend Lock Pin

1. 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.

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

Stowing The Outriggers (CE Units)

The outrigger circuits are electrically interlocked to prevent extending or retracting more than one beam at a time. However, more than one stabilizer may be extended or retracted at a time.

Swinging The Boom (Single Axis Controller Option)

DANGER

Death or serious injury could result from being crushed by moving machinery. Before activating swing, sound the steering wheel horn and verify that all personnel are clear of rotating and moving parts.

WARNING

Keep the areas in the swing path of the hook, load and tail clear of all obstructions and personnel.

CAUTION

Disengage the swing brake and the swing lock pin or 360° swing lock before attempting to swing.

CAUTION

The operator must select the proper load chart and LMI program for the outrigger position selected.

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CAUTION

Never push or pull the swing control lever through neutral to the opposite direction to stop swing motion. Use the swing brake foot pedal to stop swing rotation.

NOTE: Automatic rear axle oscillation lockout will activate when the boom swings right or left of the crane centerline.

To swing the turntable clockwise, push SWING control lever forward away from the operator. To swing turntable counterclockwise, pull control lever back, toward the operator. Always operate the control level with a slow, even pressure. Use the swing brake foot pedal to stop rotation, then position the swing brake switch to ON to prevent further rotation.

Elevating And Lowering The Boom (Single Axis Controller Option)

Elevating the Boom

WARNING

Keep the area above and below the boom clear of all obstructions and personnel when elevating the boom.

To elevate the boom, pull the BOOM (lift) control lever back, toward the operator, and hold until the boom reaches the desired elevation level.

Lowering the Boom

WARNING

Keep the area beneath the boom clear of all obstructions and personnel when lowering the boom.

WARNING

Long cantilever booms can create a tipping condition, even when unloaded and in an extended, lowered position.

CAUTION

When lowering the boom, simultaneously let out the hoist cable to prevent two-blocking the boom nose and hook block.

CAUTION

The closer the load is carried to the boom nose, the more important it becomes to simultaneously let out the hoist cable as the boom is lowered.

To lower the boom, push the BOOM control lever forward, away from the operator, and hold until the boom is lowered to the desired position.

Telescoping The Boom (Single Axis Controller Option)

Extending the Boom

WARNING

When extending the boom, simultaneously let out the hoist cable to prevent two-blocking the boom nose and hook block.

DANGER

Check the load chart for the maximum load at a given radius, boom angle, and length before extending the boom with a load.

CAUTION

Before extending the boom, ensure the large access cover on top of the boom base section is installed.

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

To extend the boom, push the TELESCOPE control lever forward, away from the operator, and hold until the boom extends to the desired length.

Retracting the Boom

WARNING

When retracting the boom, the load will lower unless the hoist 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.

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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 (Single Axis Controller Option)

WARNING

Keep the area beneath the load clear of all obstructions and personnel when lowering or raising the cable (load).

WARNING

Do not jerk the control lever when starting or stopping the hoist. Jerking the lever causes the 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.

Swinging the Boom (Dual Axis Controller Option)

DANGER

Death or serious injury could result from being crushed by moving machinery. Before activating swing, sound the steering wheel horn and verify that all personnel are clear of rotating and moving parts.

WARNING

Keep the area beneath the boom clear of all obstructions and personnel when lowering the boom.

CAUTION

The operator must select the proper load chart and LMI program for the outrigger position selected.

CAUTION

Never push or pull the swing control lever through neutral to the opposite direction to stop swing motion. Use the swing brake foot pedal to stop swing rotation.

NOTE: Automatic rear axle oscillation lockout will activate when the boom swings right or left of the crane centerline.

To swing the boom, push the controller on the left hand armrest to the right for right swing (rotates turntable clockwise), or to the left for left swing (rotates turntable counterclockwise. Always operate the control lever with a slow, even pressure. Use the swing brake foot pedal to stop rotation, then position the swing brake switch to ON to prevent further rotation.

Swinging The Boom (Single Axis Controller Option)

DANGER

Death or serious injury could result from being crushed by moving machinery. Before activating swing, sound the steering wheel horn and verify that all personnel are clear of rotating and moving parts.

WARNING

Keep the areas in the swing path of the hook, load and tail clear of all obstructions and personnel.

CAUTION

Disengage the swing brake and the swing lock pin or 360° swing lock before attempting to swing.

CAUTION

The operator must select the proper load chart and LMI program for the outrigger position selected.

CAUTION

Never push or pull the swing control lever through neutral to the opposite direction to stop swing motion. Use the swing brake foot pedal to stop swing rotation.

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NOTE: Automatic rear axle oscillation lockout will activate when the boom swings right or left of the crane centerline.

To swing the turntable clockwise, push SWING control lever forward away from the operator. To swing turntable counterclockwise, pull control lever back, toward the operator. Always operate the control level with a slow, even pressure. Use the swing brake foot pedal to stop rotation, then position the swing brake switch to ON to prevent further rotation.

Elevating and Lowering the Boom (Dual Axis Controller Option)

Elevating the Boom

WARNING

Keep the area above and below the boom clear of all obstructions and personnel when elevating the boom.

To elevate the boom, push the controller on the right hand armrest to the left (raises the boom), and hold until the boom reaches the desired elevation.

Lowering the Boom

WARNING

Keep the area beneath the boom clear of all obstructions and personnel when lowering the boom.

WARNING

Long cantilever booms can create a tipping condition, even when unloaded and in an extended, lowered position.

CAUTION

When lowering the boom, simultaneously let out the hoist cable to prevent two-blocking the boom nose and hook block.

CAUTION

The closer the load is carried to the boom nose, the more important it becomes to simultaneously let out the hoist cable as the boom is lowered.

To lower the boom, push the controller on the right hand armrest to the right (lowers the boom) and hold until the boom is lowered to the desired position.

Telescoping the Boom (Dual Axis Controller Option)

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

Extending the Boom

WARNING

When extending the boom, simultaneously let out the hoist cable to prevent two-blocking the boom nose and hook block.

DANGER

Check the load chart for the maximum load at a given radius, boom angle, and length before extending the boom with a load.

CAUTION

Before extending the boom, ensure the large access cover on top of the boom base section is installed.

To extend the boom push the controller on the left hand armrest forward and hold until the boom reaches the desired length.

Retracting the Boom

WARNING

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

To retract the boom, pull the controller on the left armrest back and hold until the boom retracts to the desired position.

Hoist Speed Range Selection

DANGER

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 optional AUX HOIST SPEED) to HIGH or LOW as applicable.

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Operational Aids

DANGER

Electronic equipment on this crane is intended as an aid to the operator. Under no condition should it be relied upon to replace the use of capacity charts and operating instructions. sole reliance upon these electronic aids in place of good operating practices can cause an accident.

Load Moment Indicator (LMI) System

The Load Moment Indicator (LMI) 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 dashboard 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.

CE Units

In addition to the audible warning in the cab, an audible warning alarm is also mounted in the vicinity of the boom flood lights to warn all personnel that a lockout has occurred.

Three additional features are included within the LMI 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 wall(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 cutouts 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 LMI Operator's Handbook for more detailed information on the function of the LMI system.

Control Lever Lockout System

The control lever lockout system consists of hydraulic solenoid valves placed in-line 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 load moment indicator (LMI) system.

Stowing And Parking

DANGER

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

When parking the crane, do the following:

1. Park the crane on a stable surface.
2. Remove the load from the hook.
3. Stow the swingaway boom extension, if erected.
4. Fully retract the boom and position it in the normal travel position.
5. Engage the swing brake and/or swing lock pin.
6. Retract all stabilizer cylinders and outrigger beams.
7. Apply the parking brake.
8. Put all operating controls in the neutral position.
9. Position the CRANE FUNCTION switch to OFF.

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10. Shut down the engine following the proper procedures specified in this Handbook and the applicable Engine manual.

11. Remove the keys.

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

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SECTION 4
SET-UP AND INSTALLATION

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SECTION 4
SET-UP AND INSTALLATION PROCEDURES

GENERAL

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

INSTALLING CABLE ON THE HOIST

CAUTION

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

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

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

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

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

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

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

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

CABLE REEVING

NOTE: There are two types of cable (wire rope) available on this crane; 6 x 36 WS and 35 x 7 (rotation resistant).

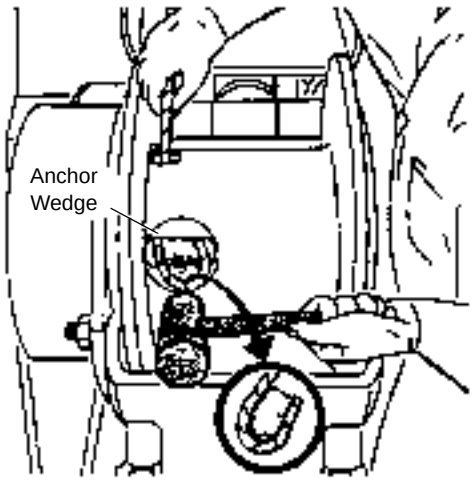

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FIGURE 4-1

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, see (Figure 4-2).

FIGURE 4-2

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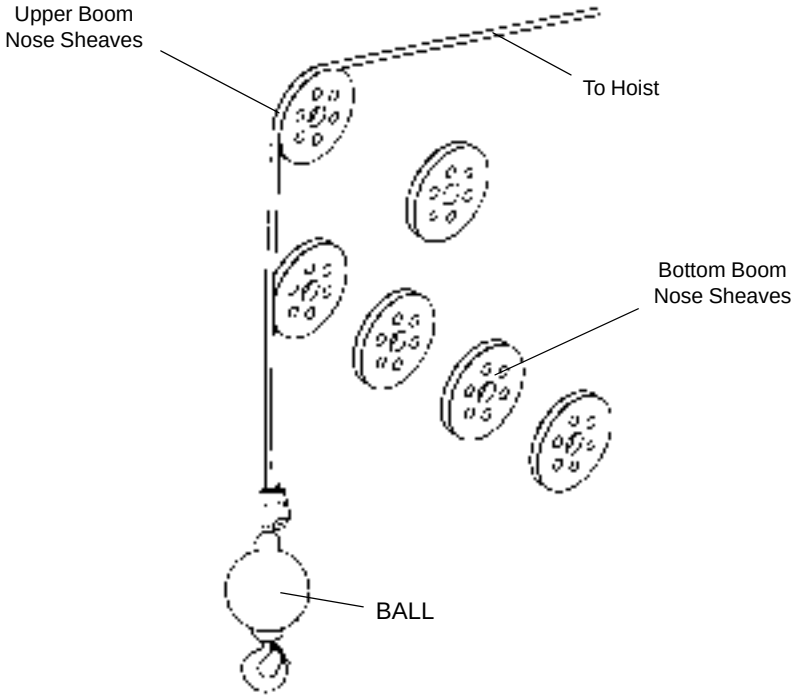
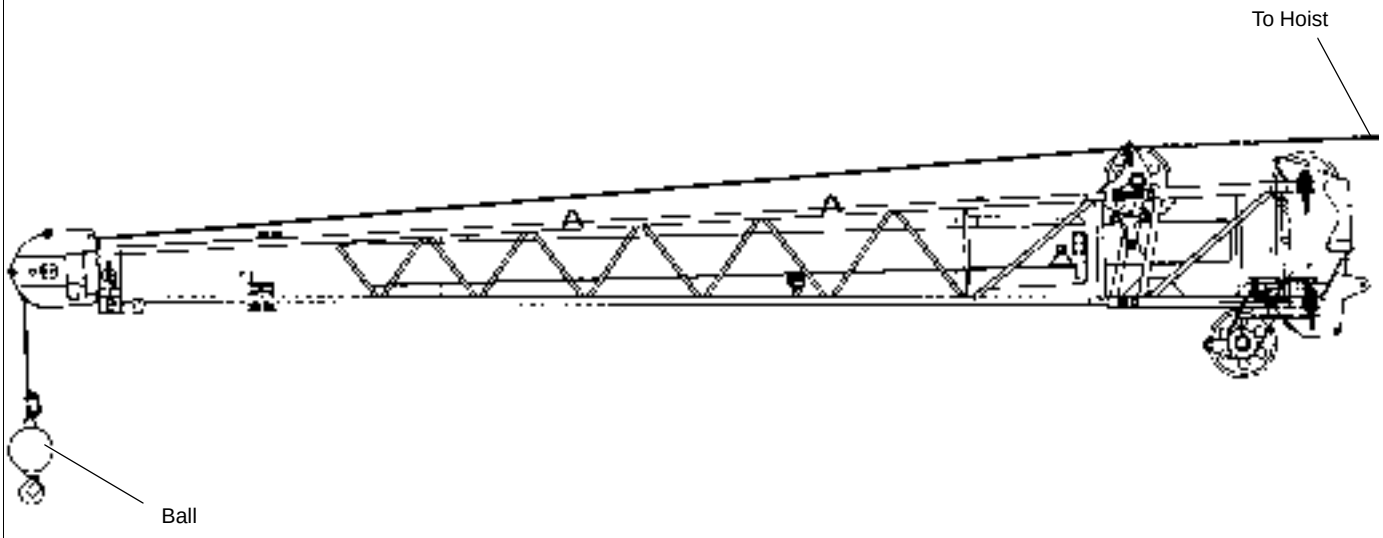


SINGLE PART LINE



**SINGLE PART LINE
USING BOOM EXTENSION**

FIGURE 4-3

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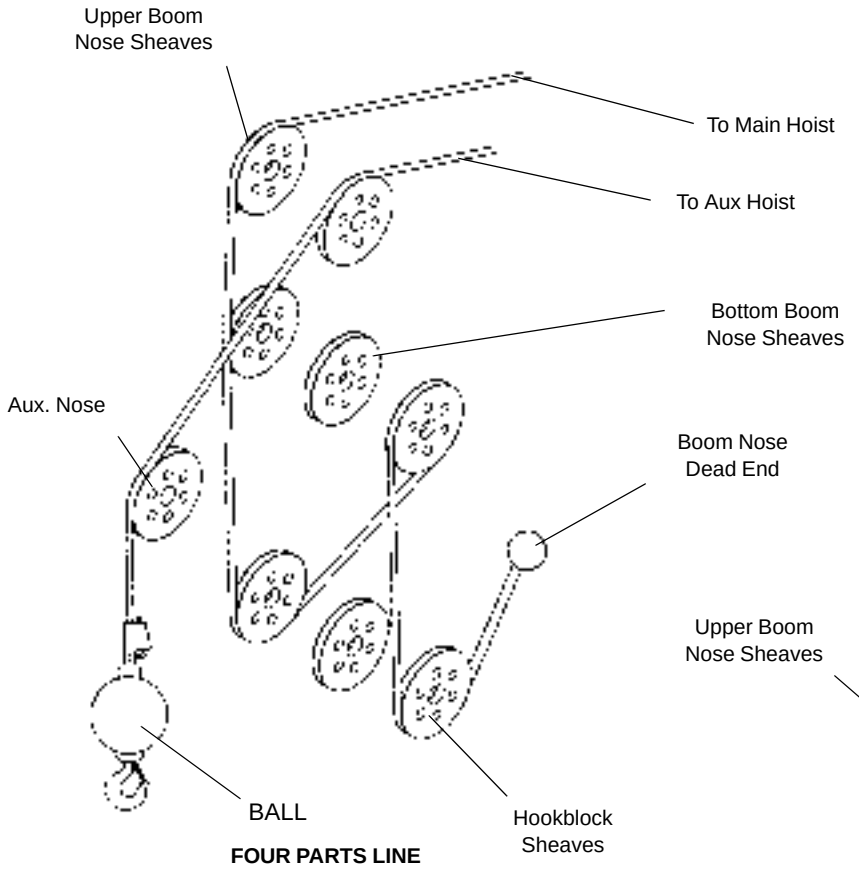
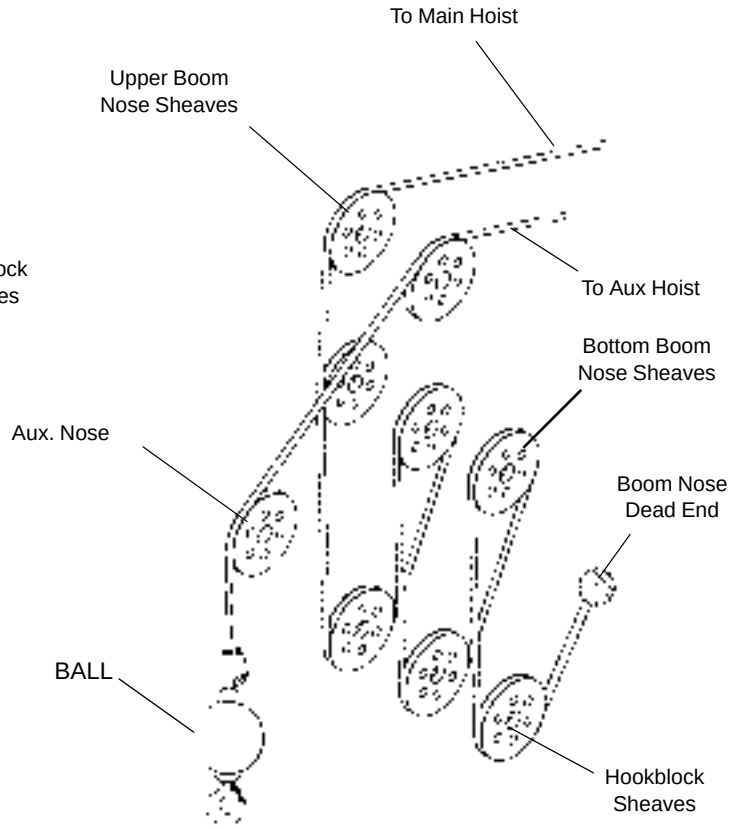


FOUR PARTS LINE



SIX PARTS LINE

RT600E Series - 3 SHEAVE HOOKBLOCK

FIGURE 4-3 continued

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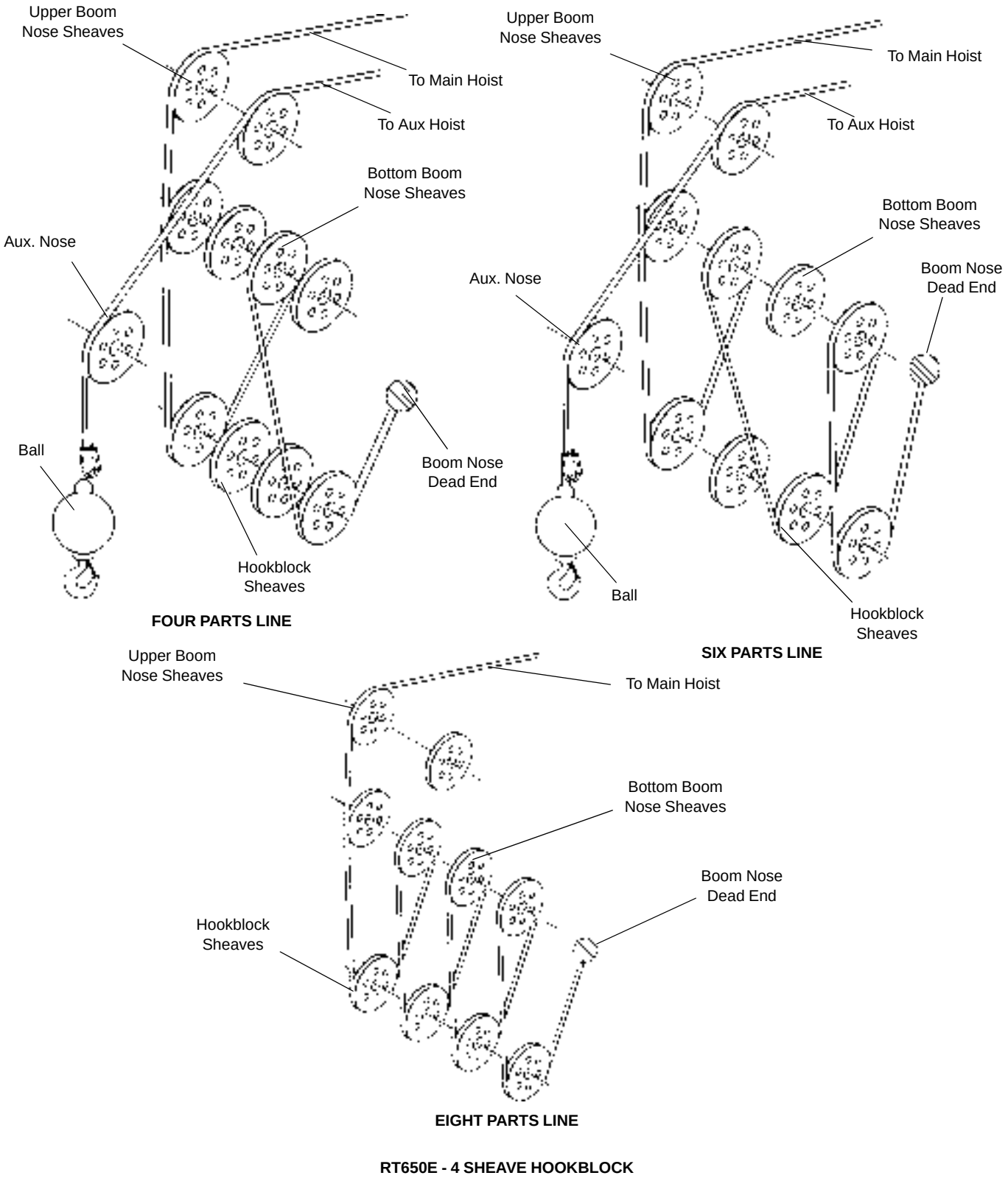

RT650E - 4 SHEAVE HOOKBLOCK

FIGURE 4-3 continued

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DEAD-END RIGGING/WEDGE SOCKETS

Wedge socket assemblies are popular rigging accessories and have been successfully used for decades to terminate wire ropes on mobile cranes. A wedge socket assembly is easily installed and dismantled but it must be installed and used correctly. It is essential to use only a wedge and socket of the correct size for the rope fitted. Failure to do so may result in the rope pulling through the fitting.

Since state and local laws may vary, alternate attachment methods may be necessary depending upon work conditions. If alternate methods are selected, the user is responsible and should proceed in compliance with the regulations in force. If there are any questions, contact your local Grove Distributor or Manitowoc CraneCARE.

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 Crane Group 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.

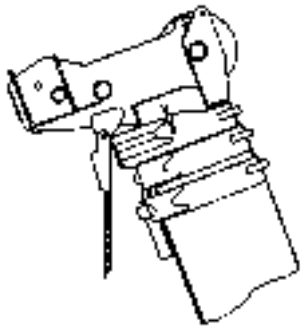
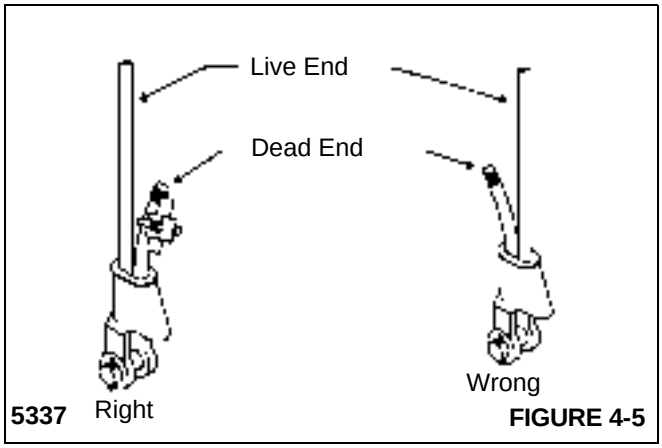


FIGURE 4-4

When anchoring the socket to the boom, 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. 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.



5337 **FIGURE 4-5**

3. Make sure the live-loaded side (Figure 4-5) of the rope is directly in line with the ears of the socket and the direction of pull to which the rope will be subjected. If the rope is loaded into the socket incorrectly, under a load the rope will bend as it leaves the socket, and the edge of the socket will wear into the rope causing damage to the rope and eventual failure.
4. Insert the end of a wire rope into the socket, form a loop in the rope, and route the rope back through the socket allowing the "dead" end to protrude from the socket. Ensure the dead end of the rope is of sufficient length to apply end treatment to the dead end after the wedge has been seated.
5. Insert the wedge into the loop and pull the live end of the rope until the wedge and rope are snug inside the socket. It is recommended that the wedge be seated inside the socket to properly secure the wire rope by using the crane's hoist to first apply a light load to the live line.
6. After final pin connections are made, increase the loads gradually until the wedge is properly seated.
7. The wire rope and wedge must be properly secured inside the socket before placing the crane into lifting service. It is the wedge that secures the wire rope inside the socket whereas the dead-end treatment is used to

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restrain the wedge from becoming dislodged from the socket should the rope suddenly become unloaded from the headache ball or hook block striking the ground, etc.

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

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

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

Table 4-1

WIRE ROPE CLIP TORQUE VALUES			
Clip Sizes		***Torque**	
mm	**Inches**	**Nm**	**Ft-Lbs**
3.18	1/8	6	4.5
4.76	3/16	10	7.5
6.35	1/4	20	15
7.94	5/16	40	30
13.28	3/8	60	45
11.11	7/16	90	65
12.70	1/2	90	65
14.29	9/16	130	95
15.88	5/8	130	95
19.05	3/4	175	130
22.23	7/8	300	225
25.40	1	300	225
28.58	1-1/8	300	225
31.75	1-1/4	490	360
38.68	1-3/8	490	360
38.10	1-1/2	490	360
*The tightening torque values shown are based upon the threads being clean, dry, and free of lubrication.			

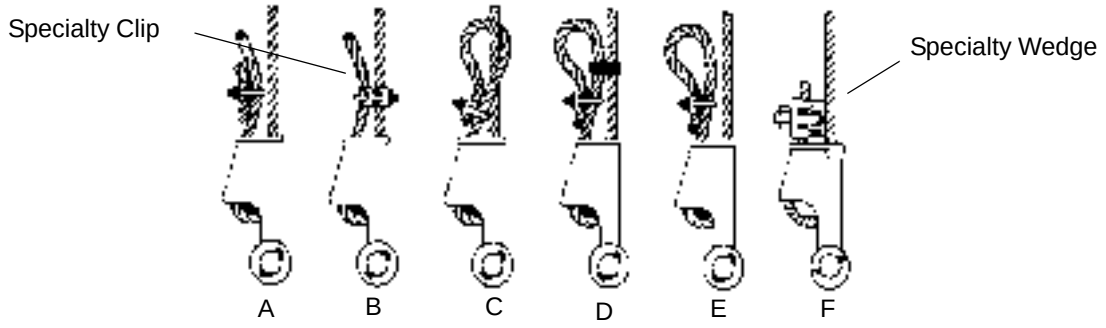

FIGURE 4-6

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ERECTING AND STOWING THE SWINGAWAY BOOM EXTENSION

General Warnings

DANGER

To prevent serious injury or death, always wear personal protective equipment; i.e., a hard hat, eye protection, gloves and metatarsal boots.

DANGER

Before attempting to erect or stow the boom extension; read and strictly adhere to all danger decals installed on the boom/boom nose, boom extension, and stowage brackets to prevent serious injury or death.

DANGER

Controlling the boom extension during erecting and stowing procedures is accomplished by raising or lowering the boom. Failure to control the swingaway could cause serious injury or death.

Securing the Boom Extension with Tag Line (Rope)

NOTE: A tag line attached t the tip of the extension is used to control the movement of the boom extension.

DANGER

Always secure the boom extension with a tag line (rope) on the main boom before removing any connections. This will prevent the extension from swinging around and knocking you off the carrier or injuring other persons in the swing range.

The extension may swing our on its own accord when you remove the last connection that held the extension at the side of the main boom.

You must therefore secure the extension before you begin the erection procedure.

Secure the boom extension as follows:

- Attached a tag line (rope) at the front of the extension.
- Have a helper hold the tag line (rope) tight while you are removing the last connection.

NOTE: If you are alone, secure the other end of the tag line (rope) on the crane (e.g., on the steps of the access ladder or to the superstructure. Leave enough play in the tag line that it is tight only when you swing the extension towards the main boom head later in the procedure.

Erecting

DANGER

To prevent serious injury or death, do not stand on crane decking until boom extension is secure.

1. Fully extend and set the outriggers using normal setup procedures. Refer to Section 3 - OPERATING CONTROLS and PROCEDURES.
2. Position the boom over the front.
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. On the rear stowage bracket (Figure 4-7) (Detail B), remove the pin securing the sliding support in the "IN" position. Push in on the handle to push the swingaway away from the rear of the boom and engage the swingaway anchor fitting with the boom nose attachment lugs. Install the pin securing the sliding support in the "OUT" position (Figure 4-7) (Detail B).
6. Remove the retainer clips from the right side attachment pins stowed in the adapter of the swingaway and remove the attachment pins from the swingaway. Insert the right side attachment pins through the boom attachment lugs and swingaway adapter anchor fittings. Install the retainer clips in the attachment pins.
7. Attach a length of rope to the swingaway tip to aid in swinging it into place ahead of the boom nose.
8. Remove the hitch pin from the pin that secures the swingaway to the rear stowage bracket. Remove the pin, unlocking the swingaway from the rear stowage bracket.

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9. Raise the boom to horizontal and extend the boom approximately 51 to 64 cm (20 to 25 in). Make certain that the swingaway stowage lugs clear the guide pins and ramp on the front and rear stowage brackets.

DANGER

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

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

DANGER

Do not modify the attachment points to permit the installation of the attachment pins.

DANGER

To prevent possible damage to the sheave wheel, do not place blocking under the swingaway sheave wheel.

11. Install the top left side attachment pin and retainer clip into the upper anchor and attachment fittings of the boom nose.

12. Extend the swingaway alignment jack until the lower left side boom nose and swingaway lugs are aligned.

13. Install the bottom left side attachment pin and retainer clip into the lower anchor and attachment fittings of the boom nose.

14. Release pressure on the boom extension alignment jack.

15. Lower the boom and remove the rope from the tip of the swingaway.

NOTE: Refer to SETTING THE OFFSET in this Section to obtain a 25 or 45 degrees offset with the swingaway.

NOTE: Refer to SETTING THE TELESCOPING EXTENSION LENGTH in this Section for extending or retracting the telescoping section.

16. Lower the boom to minimum elevation and remove the cable retainer pins from the tip of the swingaway.

17. Remove the upper boom nose cable retainer pin. This pin must be removed to prevent the hoist cable from rubbing on the pin.

NOTE: The hoist cable must be routed over the mast assembly and under the roller on the mast for all configurations.

18. Route the hoist cable over the mast assembly sheave, and over the sheave on the swingaway tip. Install the swingaway tip cable retainer pin.

19. Rig the hoist cable.

Stowing

NOTE: The swingaway boom extension must be set at the minimum offset, and if used, the telescoping section must be fully retracted or replaced with the standard nose section in order to be stowed. Refer to SETTING THE OFFSET and/or SETTING THE TELESCOPING EXTENSION LENGTH in this Section.

1. Fully retract the boom and swing to over-the-front.

2. Lower the boom to minimum elevation.

3. Remove the cable retainer pin from the swingaway tip . Remove the hoist cable from the sheaves. Install the swingaway cable retainer pins

4. Attach a length of rope to the swingaway tip.

5. Raise the boom to horizontal.

6. Extend the boom approximately 51 to 64 cm (20 to 25 inch). Make certain that the swingaway stowage lugs will line up in front of the guide pins and ramp on the stowage brackets when the swingaway is positioned to the side of the boom.

7. Ensure the hitch pin and retaining pin are removed from the rear stowage bracket and that the sliding support is pinned in the "OUT" position (Figure 4-7) (Detail B).

8. Extend the swingaway alignment jack until the bottom left side attachment pin is free. Remove the bottom left side retainer clip and attachment pin.

9. Release pressure on the swingaway alignment jack.

10. Remove the top left side attachment pin and retainer clip from the upper anchor and attachment fittings of the boom nose.

DANGER

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

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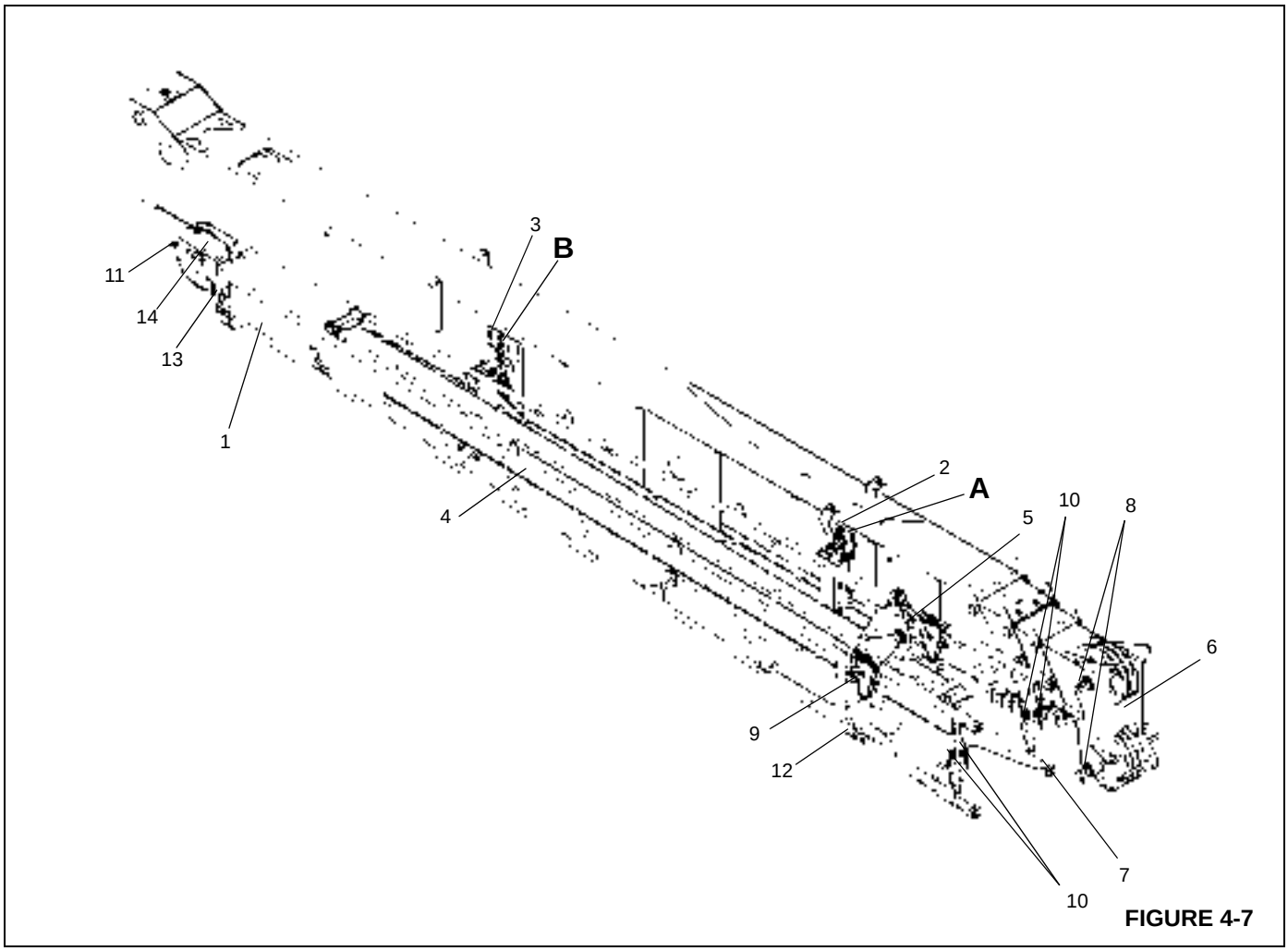

FIGURE 4-7

Item	Description
1	Swingaway
2	Front Stowage Bracket
3	Rear Stowage Bracket
4	Telescoping Section
5	Mast Assembly
6	Boom Nose
7	Swingaway Anchor Fitting

Item	Description
8	Boom Nose Attach Fitting
9	Offset Links
10	Attach Pins and Retainer Clips
11	Swingaway Nose
12	Offset Pivot Point
13	Telescope Section Retainer Pin
14	Hoist Cable Attach Fitting For Retracting Telescope Section

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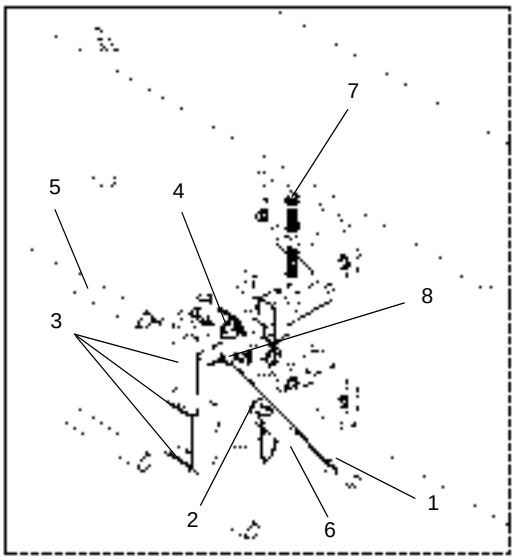
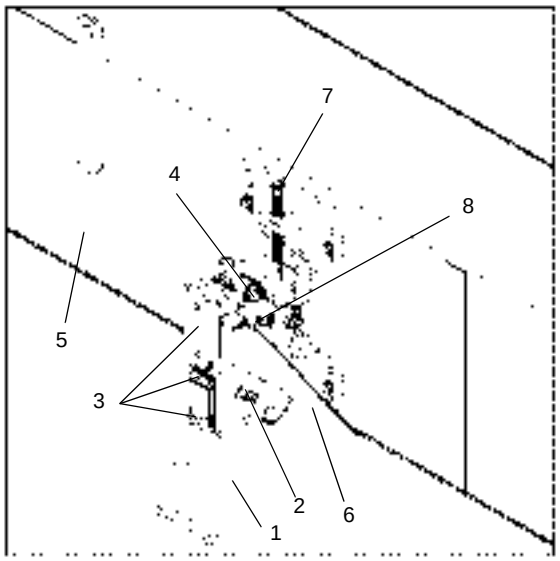


Out Position 6778-3



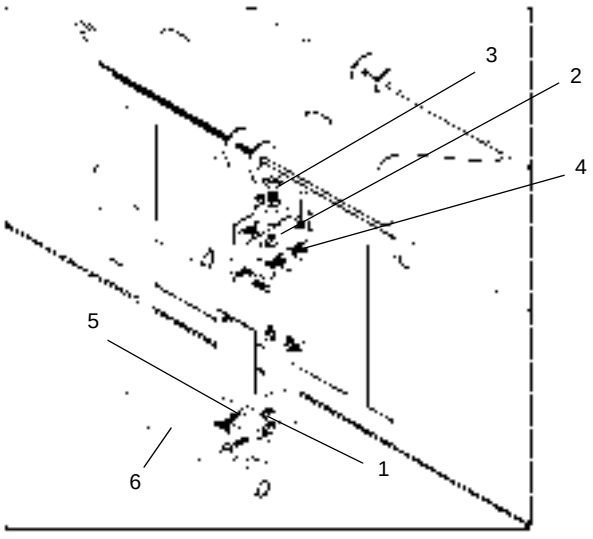
In Position 6778-2

Item	Description
1	Handle
2	Hitch Pin
3	Wear Pads
4	Hitch Pin

Item	Description
5	Swingaway
6	Sliding Support
7	Vertical Adjustment Screw
8	Hitch Pin Clip

DETAIL B
Rear Stowage Bracket

Item	Description
1	Lower Hangar
2	Upper Hangar
3	Vertical Adjustment Screw
4	Upper Hangar Horizontal Adjustment Bolt
5	Lower Hangar Horizontal Adjustment Bolt
6	Swingaway



DETAIL A 6778-1
Front Stowage Bracket

FIGURE 4-7 continued

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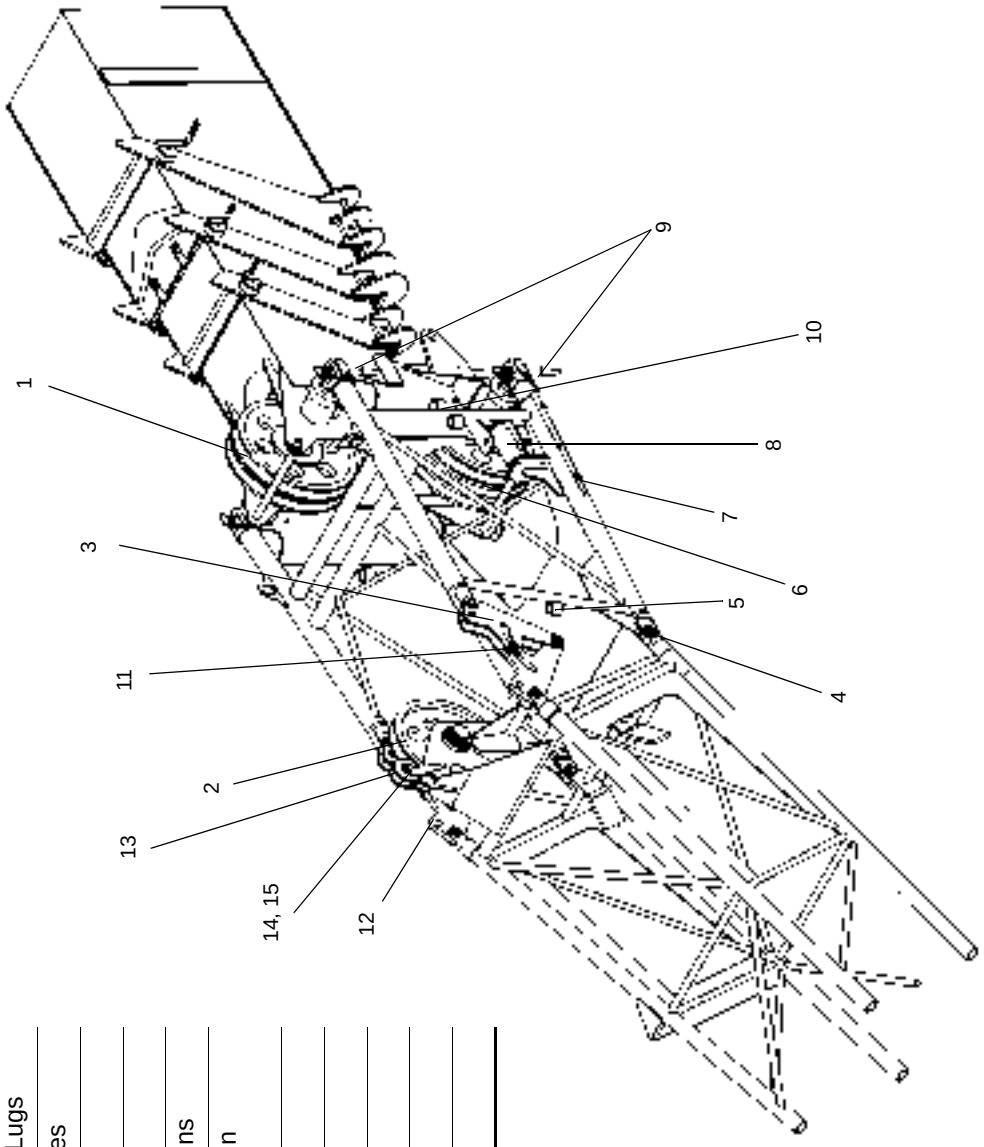
NOTE: Offset shown at 25 degrees. To obtain 45 degree offset, remove pin (item 12) and stow in lug. Cranes with s/n 220720, 220721& 220722 can only be offset to a maximum of 25 degrees. The offset links for these cranes are of different design.



Item	Description
1	Boom Nose Upper Sheaves
2	Mast Assembly
3	Offset Links
4	Offset Pivot Points
5	Offset Link Pins Stowage Lugs
6	Boom Nose Lower Sheaves
7	Jack Handle
8	Alignment Jack
9	Swingaway Attachment Pins
10	Swingaway Attachment Pin Stowage Lugs
11	Offset Link Pins
12	Zero Degree Offset Hole
13	Roller
14	Clevis Pin
15	Hitch Pin Clip

FIGURE 4-7 continued

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CAUTION

Do not allow the swingaway to slam into the stowage bracket when swinging into the stowed position.

11. Using the rope attached to the tip of the swingaway, manually swing the extension to the side of the boom.

12. Align the stowage lugs on the swingaway with the guide pins and ramp on the stowage brackets and fully retract the boom.

13. Install the hitch pin and pin securing the swingaway to the rear stowage bracket.

14. Remove the attachment pins and retainer clips from the anchor and attachment fittings on the right side of the boom nose and stow them in the adapter of the swingaway.

15. On the rear stowage bracket, remove the pin securing the sliding support in the "OUT" position. Pull out on the handle to push the swingaway against the rear of the boom and disengage the swingaway anchor fitting with the boom nose attachment lugs. Install the pin securing the sliding support in the "IN" position (Figure 4-7) (Detail B).

16. Rig the boom nose and hoist cable as desired and operate the crane using normal operating procedures.

Setting The Offset

NOTE: Cranes S/N 220720, 220721, and 220722 can only be offset to 25 degrees maximum.

1. Extend and set the outriggers. Swing the boom over to the front of the crane.

2. To set the offset from a lesser degree to higher degree perform the following procedures.

CAUTION

Do not overload the swingaway anchor fittings or the swingaway 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 until the offset links take the full weight of the swingaway.
- **d.** Reeve the hoist cable as described under normal erecting procedures.

3. To set the offset from higher degree to lesser degree, perform the following procedures.

CAUTION

To prevent component damage, do not overload the swingaway anchor fittings or the swingaway 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 attach 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 until the offset links take the full weight of the swingaway.
- **d.** Reeve the hoist cable as described under normal erecting procedures.

Changing Swingaway Boom Extension From Telescoping Type To Fixed Type

1. Erect the swingaway.

2. Position the boom to horizontal.

3. Disconnect the anti-two block cable connector from the junction box.

4. Remove the telescoping section hitch pin and retaining pin.

NOTE: The telescoping section weighs approximately 336 kg (741 pounds).

5. Extend the telescoping section and attach an adequate lifting device to support the telescoping section. Remove the stop block from the telescoping section and remove the telescoping section from the base.

NOTE: The pin-on swingaway nose weighs approximately 74 kg (163 pounds).

6. Using an adequate lifting device, position the pin-on swingaway nose in the base section and secure with the two pins and hitch pins.

7. Connect the anti-two block cable connector to the junction box.

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Setting The Telescoping Swingaway Length

Extending

1. Extend and set the outriggers and swing the boom to over the front.

NOTE: Depending upon how well the swingaway is lubricated, it might be possible to pull the telescoping section to the desired length without setting the offset. If so, skip step 2 and continue with step 4. It is not desirable to change the offset, perform step 3.

2. Set the swingaway to maximum offset according to the procedures in SETTING THE OFFSET in this section.

3. Loosen the side wear pads on the swingaway until the telescoping section is free.

4. Pin the hoist cable becket to the back of the swingaway nose.

5. Within the limits of the load chart, extend the boom to at least the length of telescoping swingaway, and lower the boom until the swingaway sheave touches the ground or is as low as it will go.

DANGER

Before removing the hitch pin and pin securing the telescoping section inside the base section. ensure the telescoping section cannot slide completely out of the base section. Personal injury or death could occur.

NOTE: Use the hoist cable to control the extension of the telescoping swingaway.

6. Remove the pin and hitch pin securing the telescoping section to the base section.

7. While controlling the extension of the telescoping swingaway section with the hoist cable, raise and/or retract the boom allowing the section to slide out of the base until the holes line up.

8. Install the pin and hitch pin.

9. If the wear pads were loosened, retighten the wear pads as necessary to ensure the telescoping section is straight with the base section.

10. Unpin the hoist cable becket from the nose and rig the hoist cable as desired.

Retracting

1. Attach the hoist cable becket at the rear of the swingaway nose.

2. Remove the pin and hitch pin securing the telescoping section to the base section.

DANGER

When using the hoist cable to pull the telescoping section into the swingaway base, do not damage the hoist cable or swingaway by pulling the section past its fully stowed position.

CAUTION

If a binding condition occurs during retraction stop immediately. Resolve the problem before continuing the retraction of the telescoping section.

3. Slowly reel in the hoist cable pulling the section into the swingaway base until the pin and hitch pin can be installed.

4. Unpin the hoist cable becket from the nose and rig the hoist cable as desired.

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COUNTERWEIGHT

The counterweight is pinned to the rear of the turntable and weighs 5553 kg (12132 pounds). For cranes without an auxiliary hoist, an additional 862 kg (1900 pounds) counterweight is bolted to the hoist mounting area in lieu of the auxiliary hoist.

DANGER

Death or serious injury could result from being crushed by a falling counterweight.

DANGER

Ensure the retainer pin is properly installed to secure the counterweight mounting pin.

Removal

1. Fully extend and set the outriggers.
2. Rotate the superstructure so the counterweight is over the front of the carrier to gain additional clearance.

CAUTION

When lifting/handling the counterweight, keep the chains/ straps vertical to minimize side pull on the lifting lugs.

NOTE: The counterweight weighs approximately 5553 kg (12132 pounds).

NOTE: The use of a forklift to install/remove the counterweight is not recommended.

3. Attach an adequate lifting device to the counterweight.
4. Ensure the four counterweight leveling bolts are set for maximum clearance with the turntable.
5. Take up any slack on the lifting chains and raise the counterweight just enough to remove any pressure on the counterweight mounting pins.
6. Remove the hitch pins and washers that secure the counterweight mounting pins and remove the counterweight mounting pins.
7. Lower the counterweight enough to clear the superstructure and remove the counterweight from the crane.

Installation

1. Fully extend and set the outriggers.
2. Rotate the superstructure so the counterweight will be over the front of the carrier to gain additional clearance.

CAUTION

When lifting/handling the counterweight, keep the chains/ straps vertical to minimize side pull on the lifting lugs.

NOTE: The counterweight weighs approximately 5553 kg (12132 pounds).

NOTE: The use of a forklift to install/remove the counterweight is not recommended.

3. Attach an adequate lifting device to the counterweight and lift the counterweight into place on the superstructure, aligning the mounting holes on the counterweight to the holes in the superstructure.
4. Install the counterweight mounting pins and secure them in place with the washers and hitch pins.
5. Remove the lifting device from the counterweight.
6. Using the four counterweight leveling bolts, level the counterweight and eliminate any relative movement between the counterweight and turntable. Maximum height of counterweight shall not exceed 6.35 mm (0.25 inch) out of level with the turntable bearing when measured from either counterweight outer edge.

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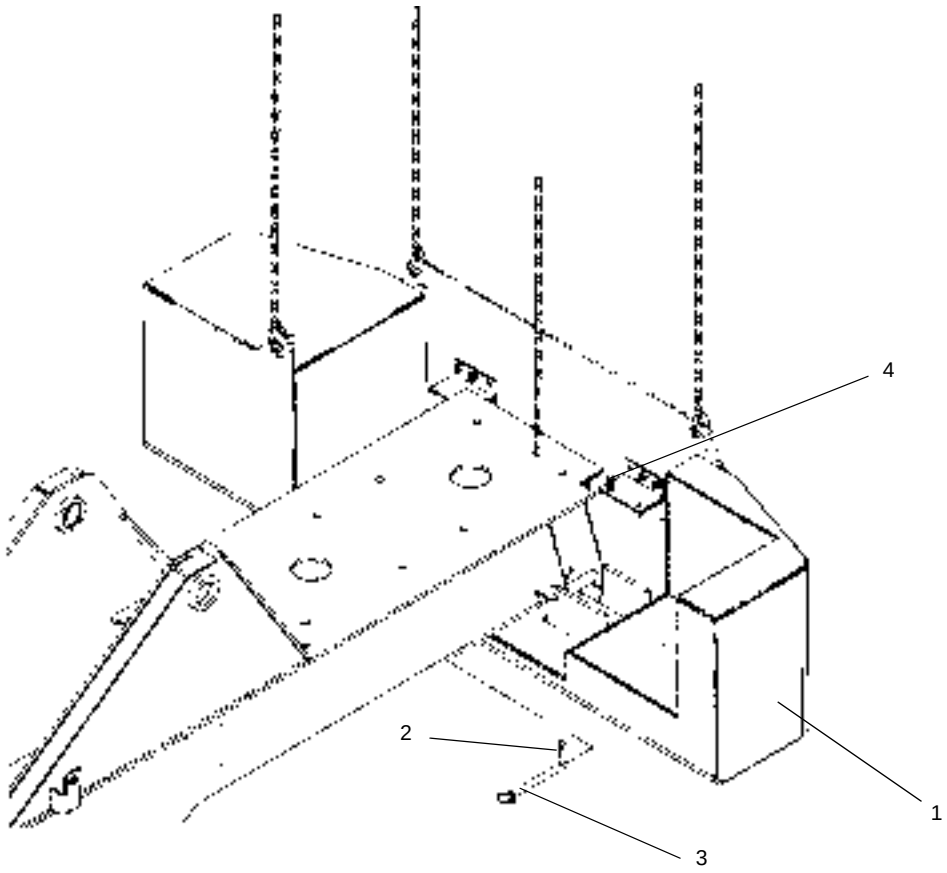

FIGURE 4-8

Item	Description
1	Counterweight
2	Clip Pin

Item	Description
3	Mounting Pin
4	Counterweight

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SECTION 5
LUBRICATION

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SECTION 5
LUBRICATION

GENERAL

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

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

CAUTION

Chassis grease lubricants must not be applied with air pressure devices as this lubricant is used on sealed fittings.

CAUTION

The multipurpose grease installed during manufacture is of a lithium base. Use of a noncompatible grease could result in damage to equipment.

Arctic Conditions Below -18°C (0°F).

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

NOTE: All fluids and lubricants may be purchased by contacting the Manitowoc CraneCARE Parts Department.

Regardless of temperature and oil viscosity, always use suitable start-up procedures to ensure adequate lubrication during system warm-up.

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. One ounce(28 grams) of EP-MPG equals one pump on a standard one pound (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.

Surface Protection for Cylinder Rods

Steel cylinder rods include a thin layer of chrome plating on their surfaces to protect them from corroding. However, chrome plating inherently has cracks in its structure which can allow moisture to corrode the underlying steel. At typical ambient temperatures, hydraulic oil is too thick to penetrate these cracks. Normal machine operating temperatures will allow hydraulic oil to warm sufficiently to penetrate these cracks and if machines are operated daily, protect the rods. Machines that are stored, transported, or used in a corrosive environment (high moisture, rain, snow, or coastline

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conditions) need to have the exposed rods protected more frequently by applying a protectant. Unless the machine is operated daily, exposed rod surfaces will corrode. Some cylinders will have rods exposed even when completely retracted. Assume all cylinders have exposed rods, as corrosion on the end of the rod can ruin the cylinder.

It is recommended that all exposed cylinder rods be protected using Boeshield® T-9 Premium Metal Protectant. Manitowoc CraneCARE has Boeshield® T-9 Premium Metal Protectant available in 12 oz. cans that can be ordered through the Parts Department.

Cylinder operation and inclement weather will remove the Boeshield® protectant; therefore, inspect machines once a week and reapply Boeshield® to unprotected rod

The following describe the lubrication points and gives the lube type, lube interval, lube amount, and application of each. Each lubrication point is numbered, and this number corresponds to the index number shown on the Lubrication Chart (Figure 5-1). Lube description and symbols are found in (Table 5-1) and (Table 5-2).

Table 5-1

Symbol	Description
EP-MPG	Extreme Pressure Multipurpose Grease - Lithium Soap Base, NLGI Grade 2.
GL-5	Extended Service Interval Gear Lubricant
AFC - 50/50	50/50 Blended Fully Formulated Antifreeze/Coolant, SAE J1941, ASTM D6210
HYDO	Hydraulic Oil - Must meet John Deere Standard JDM-J20C (Anti-brake chatter) and ISO 4406 cleanliness level 17/14
EO-15W/40	Engine Oil - SAE 15W-40, API Service Classification CI-4 or better
EPGL-5H	Extreme Pressure Gear Lubricant - SAE Grade 80W-90, API Service Designation GL-5
EP-OGL	Open Gear Lubricant, CEPLATTYN 300 Spray, NLGI Class 1-2
AGMA EP-4	Extreme Pressure Gear Lubricant.

Table 5-2
Lube Description

Lubrication Description	Lube Specification
Extreme Pressure Multipurpose Grease	A6-829-003477
Extended Service Interval Gear Lube	A6-829-012964
Fully Formulated Anti-Freeze Coolant	A6-829-101130
Hydraulic Oil	A6-829-006444
Engine Oil SAE 15W40	A6-829-003483
EPGL-5H	A6-829-006240
Open Gear Lube	A6-829-102971
Extreme Pressure Gear Lube	A6-829-100213
See Service Manual	***

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CAUTION

The following lube intervals are to be used as a guideline only. Actual lube intervals should be formulated by the operator to correspond accordingly to conditions such as continuous duty cycles and/or hazardous environments.

1. Hook Block Swivel Bearing

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

Lube Amount - Until grease extrudes

Application - 1 grease fitting

2. Hook Block Sheaves

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

Lube Amount - Until grease extrudes

Application - 1 grease fitting per sheave
(4 fittings total - 50 ton)
(3 fittings total - 40 ton)
(2 fittings total - 22 ton)

3. Telescope Cylinder Wear Pads

Lube Type - EP-MPG

Lube Interval -125 hours or 3 months

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

Application - By brush: 2 places; extend boom for entry through access holes.

4. Side Wear Pads

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

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

NOTE: For side wear pads and boom section upper and lower wear pads, lubricate more frequently than interval indicates if environmental conditions and/or operating conditions necessitate.

Application - By brush: 12 places; with boom in extended position through access holes.

5. Boom Section Upper Wear Pads

Lube Type - EP-MPG

Lube Interval - 50 hours or 1 week

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

Application - By brush: 6 places; with boom in extended position through access holes.

6. Boom Section Lower Wear Pads

Lube Type - EP-MPG

Lube Interval - 50 hours or 1 week

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

Application - By brush; 3 places; with boom in extended position.

7. Extend Cable Sheaves

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

Lube Amount - Until grease extrudes

Application - 3 grease fitting; extend boom for entry through access holes at front top of inner mid section.

8. Retract Cable Sheaves

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

Lube Amount - Until grease extrudes

Application - 4 grease fittings; extend boom for entry through access holes

9. Boom Pivot Shaft

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

Lube Amount - Until grease extrudes

Application - 2 grease fittings, one on each side

10. Boom Extension Sheave

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

Lube Amount - Until grease extrudes

Application - 1 grease fitting

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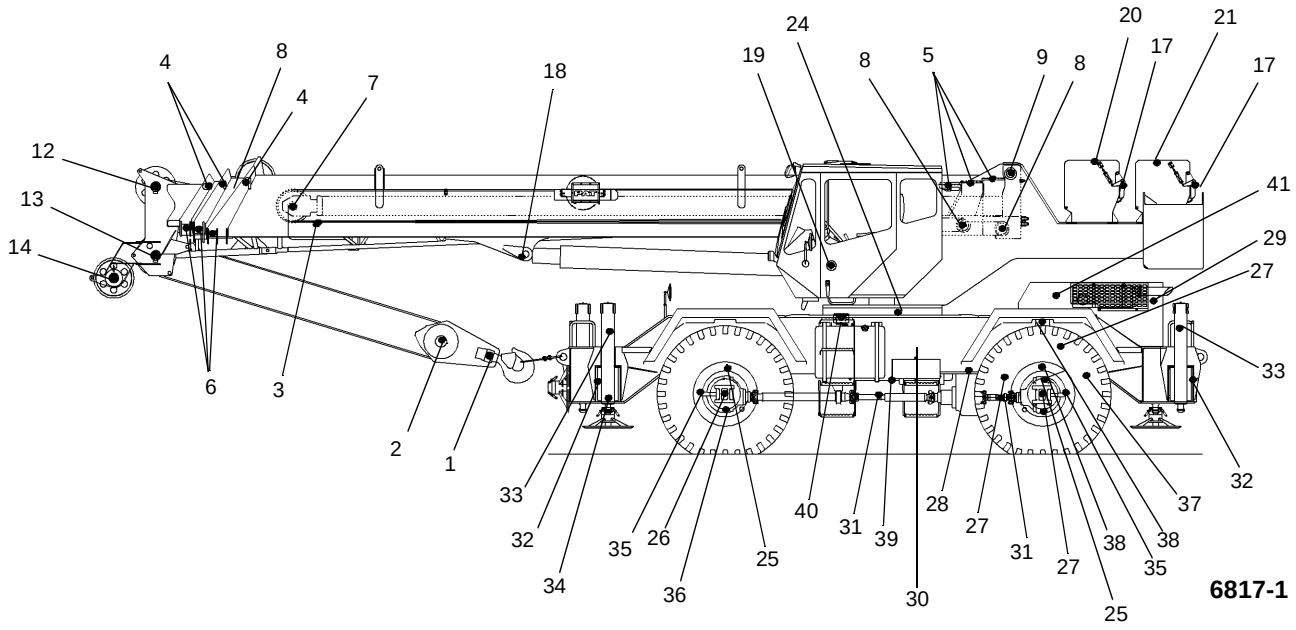

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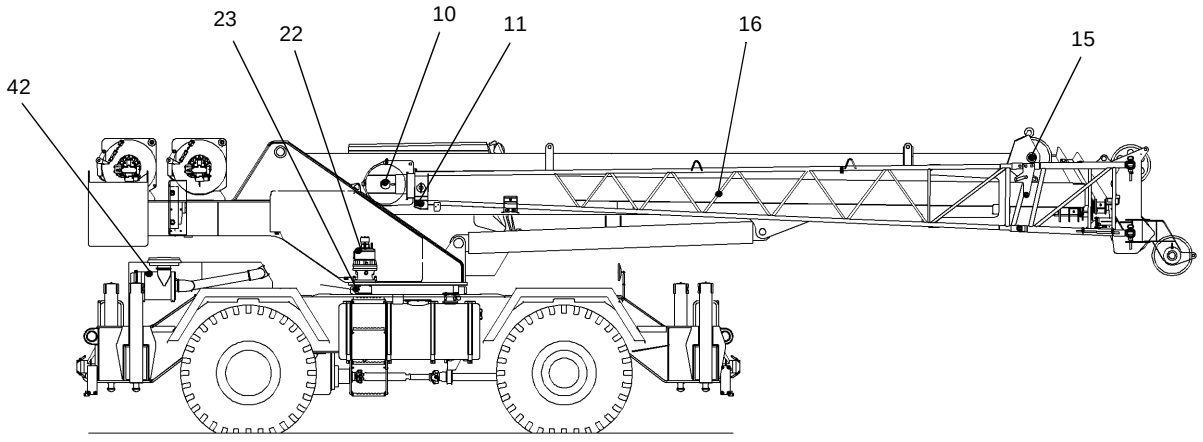

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FIGURE 5-1

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Item	Description
1	Hook Block Swivel Bearing
2	Hook Block Sheaves
3	Telescope Cylinder Wear Pads
4	Side Wear Pads
5	Boom Section Upper Wear Pads
6	Boom Section Lower Wear pads
7	Extend Cable Sheaves
8	Retract Cable Sheaves
9	Boom Pivot Shaft
10	Boom Extension Sheave
11	Boom Extension Roller
12	Upper Boom Nose Sheave
13	Lower Boom Nose Sheave
14	Auxiliary Boom Nose Sheave
15	Boom Extension Mast Sheave
16	Swingaway Hangar Wear Pads
17	Cable Follower Arms
18	Upper Lift Cylinder Pivot Pins
19	Lower Lift Cylinder Pivot Pins
20	Main Hoist
21	Auxiliary Hoist (Optional)

Item	Description
22	Turntable Gear Box
23	Turntable Gear and Drive Pinion
24	Turntable Bearing
25	Differentials
26	Planetary Hubs and Wheel Bearings
27	Engine Crankcase
28	Transmission and Torque Converter
29	Engine Cooling System
30	Coolant Strainer (Cab Heater)
31	Drive Line - Slip Joints
32	Outrigger Beams
33	Jack Cylinder Support Tubes
34	Jack Cylinder Barrels
35	Steering Cylinder Pivot Pins
36	Upper and Lower King Pins
37	Fifth Wheel Pivots
38	Lockout Cylinder Pivot Pins
39	Hydraulic Reservoir
40	Hydraulic Filter
41	Fuel Filter
42	Air Cleaner Filter

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11. Boom Extension Roller

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

Lube Amount - Until grease extrudes

Application - 1 grease fitting

12. Upper Boom Nose Sheave

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

Lube Amount - Until grease extrudes

Application - 1 grease fitting per sheave

13. Lower Boom Nose Sheave

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

Lube Amount - Until grease extrudes

Application - 1 grease fitting per sheave

14. Auxiliary Boom Nose Sheave

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

Lube Amount - Until grease extrudes

Application - 1 grease fitting

15. Boom Extension Mast Sheave

Lube Type - EP-MPG

Lube Interval - 500 hours or 12 months

Lube Amount - As Necessary

Application - Disassemble sheave and repack bearing.

16. Swingaway Hangar Wear Pads

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

Lube Amount - Thoroughly coat wear pad

Application - Brush on

17. Cable Follower Arms

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

NOTE: Lubricate more frequently if environmental conditions and/or operating conditions necessitate

Lube Amount - Until grease extrudes

Application - 2 grease fittings on each idler assembly.

18. Upper Lift Cylinder Pivot Pins

Lube Type - EP-MPG

Lube Interval - 500 hours or every 3 months

Lube Amount - Until grease extrudes

Application - 1 grease fitting

19. Lower Lift Cylinder Pivot Pins

Lube Type - EP-MPG

Lube Interval - 500 hours or 3 months

Lube Amount - Until grease extrudes

Application - 2 grease fittings

20. Main Hoist

Lube Type - AGMA EP-4

Lube Interval - Every 1000 hours or 12 months

Lube Amount - Capacity - 14.7 liters (15.5 quarts)

Application - Fill until level with the check plug opening.

21. Auxiliary Hoist (Optional)

Lube Type - AGMA EP-4

Lube Interval - Every 1000 hours or 12 months

Lube Amount - Capacity - 14.7 liters (15.5 quarts)

Application - Fill until level with the check plug opening.

22. 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.

CAUTION

Use of non-extended service interval lubricant may damage components and/or invalidate published lubricant intervals.

Lube Amount - Capacity - 4.9 liters (5.25 quarts)

Application - Fill mark on dipstick

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23. Turntable Gear and Drive Pinion

Lube Type - OGL

Lube Interval - 500 hours or 6 months

Lube Amount - Coat all teeth

Application - Spray on

24. Turntable Bearing

Lube Type - EP-MPG

Lube Interval - 500 hours or 6 months

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.

25. Differentials

Lube Type - SSGL-5

Lube Interval - Check lubricant level every 500 hours or 3 months and refill as necessary. Drain and refill every 4000 hours or 2 years.

CAUTION

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

CAUTION

Use of non-extended service interval lubricant may damage components and/or invalidate published lubricant intervals.

NOTE: Any lubricant used in the field for either top-off or refill of the axles must be an "Extended Drain Lubricant" as approved by Arvinmeritor. These lubricants are listed in Arvinmeritor Technical Bulletin TP-9539 available at www.arvinmeritor.com or by contacting Grove Customer Support.

Lube Amount - Capacity - 9.5 liters (20 pints) Normal makeup - less than 0.23 liter (0.5 pint)

Application - Fill to bottom of hole in the housing on the steer cylinder side.

26. Planetary Hubs and Wheel Bearings

Lube Type - SSGL-5

Lube Interval - Check fluid level every 500 hours or 3 months and refill as necessary. Drain and refill every 4000 hours or 2 years.

CAUTION

Use of semi-synthetic lubricant is required to avoid damage to components during published service intervals.

Lube Amount - Capacity - 1.6 liters (3.5 pints).

Application - Fill to the bottom of the level hole in the housing with the fill plug and the oil level mark horizontal

27. Engine Crankcase

Lube Type - EO - 15W-40

Lube Interval - Check fluid level every 10 hours or daily; drain, fill and replace filter every 500 hours.

Lube Amount - Capacity - 14.2 liters (15 quarts)

Application - Fill to full mark on dipstick.

28. Transmission and Torque Converter

Lube Type - HYDO

Lube Interval - Check fluid level every 10 hours or daily with the engine running at 800 rpm and the oil at 82 to 93 °C (180 to 200 °F); Drain and refill every 1000 hours or 6 months with the oil at 65 to 93 °C (150 to 200 °F); Change transmission filter after the first 50 and 100 hours of service, then every 500 hours thereafter. To add fluid:

a. Fill to FULL mark on dipstick.

b. Run engine at 800 rpm to prime torque converter and lines.

c. Check oil level with engine running at 800 rpm and oil at 82 to 93 °C (180 to 200 °F). Add oil to bring oil level to FULL mark on dipstick.

NOTE: When checking the oil level, the oil temperature must be stabilized at 82 to 93 °C (180 to 200 °F) to properly check the oil level. Do not attempt an oil level check with cold oil. To bring the oil temperature to this range, it is necessary to either work the crane or stall the converter. Converter stall should be accomplished by engaging the shift lever in forward high range with the brakes applied and then accelerating the engine to half or three-quarter throttle. Hold the stall until the desired converter temperature is reached and stabilized.

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CAUTION

Full throttle stall speeds for an excessive length of time will overheat the converter and cause serious damage.

Lube Amount - Capacity - Torque converter, lines, and transmission as a system - Approximately 25.6 liters (27 quarts).

Application - Through fill pipe to FULL mark on dipstick.

29. Engine Cooling System

Lube Type - AFC

Lube Interval - Check coolant level every 10 hours or daily; drain and refill cooling system every 2000 hours or 12 months.

Lube Amount - Capacity - 34 liters (36 quarts)

Application - Fill surge tank to bottom of filler neck with mixture of 50% AFC and 50% water. Run engine through two (2) thermal cycles. Check coolant level and refill as required.

30. Coolant Strainer (Cab Heater)

Close shutoff valves. Unscrew the hex plug and clean the strainer screen after the first 100 hours and every 2000 hours or 12 months thereafter.

31. Drive Line - Slip Joints

Lube Type - EP-MPG

Lube Interval - 500 hours or every 3 months

Lube Amount - Until grease extrudes

Application - 2 grease fittings

32. Outrigger Beams

Lube Type - EP-MPG

Lube Interval - 50 hours or 1 week

Lube Amount - Thoroughly coat the area the beam moves on.

Application - By brush; 8 places; extend beams fully and coat the bottom plate.

33. Jack Cylinder Support Tubes

Lube Type - EP-MPG

Lube Interval - 50 hours or 1 week

Lube Amount - Brush on ID of jack cylinder support tubes before installing jack cylinders.

Application - By brush; 4 places

34. Jack Cylinder Barrels

Lube Type - EP-MPG

Lube Interval - 50 hours or 1 week

Lube Amount - Thoroughly coat barrels.

Application - By brush; 4 places

35. Steering Cylinder Pivot Pins

Lube Type - EP-MPG

Lube Interval - 500 hours or 3 months

Lube Amount - Until grease extrudes

Application - 8 grease fittings

36. Upper and Lower King Pins

Lube Type - EP-MPG

Lube Interval - 500 hours or 3 months

Lube Amount - Until grease extrudes

Application - 8 grease fittings

37. Fifth Wheel Pivots

Lube Type - EP-MPG

Lube Interval - 500 hours or 3 months

Lube Amount - Until grease extrudes

Application - 2 grease fittings

38. Lockout Cylinder Pivot Pins

Lube Type - EP-MPG

Lube Interval - 500 hours or 3 months

Lube Amount - Until grease extrudes

Application - 4 fittings

39. Hydraulic Reservoir

Lube Type - HYDO

Lube Interval - Check fluid level every 10 hours or daily, using sight gauge on side of tank, with boom down and all outrigger cylinders retracted; drain and refill as necessary.

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

Application - Fill through breather/fill cap on top of tank. When tank is drained, clean the magnetic pipe plug.

40. Hydraulic Filter

Change the filter when the restriction indicator gauge on the filter head is in the red.

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41. Fuel Filter

Drain water trap every 10 hours or daily and change filter every 500 hours or 6 months.

42. Air Cleaner Filter

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

WIRE ROPE LUBRICATION

Wire rope is lubricated during manufacturing so that the strands, and individual wires in strands, may move as the rope moves and bends. A wire rope cannot be lubricated sufficiently during manufacture to last its entire life. Therefore, new lubricant must be added periodically throughout the life of a rope to replace factory lubricant which is used or lost.

NOTE: Wire rope may be purchased by contacting the Manitowoc CraneCARE Parts Department.

For more detailed information concerning the lubrication and inspection of wire rope, refer to WIRE ROPE in Section 1-INTRODUCTION in the Service Manual.

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SECTION 6
MAINTENANCE CHECKLIST

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SECTION 6
MAINTENANCE CHECKLIST

GENERAL

This section contains a list of daily inspection and maintenance checks. Performing the checks will help maintain the safety, dependability, and productivity designed into your crane.

INSTRUCTIONS

See Service Manual for specific maintenance and adjustment procedures.

See Section 5 (in this handbook) for lubrication intervals, types of fluids, and lube point locations.

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INSPECTION SERVICE LOG

Reference	Items to be Inspected Daily	Interval	DAY OF INSPECTION																												
	December	D	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
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																															
14	Lights and Horn are in good working order and not damaged	D																														
15	Verify Hydraulic Reservoir has the proper fluid level	D																														
16	Hydraulic Oil Filter (check back pressure)	D																														
17	Verify Boom and Attachments are properly installed with no signs of damage, or leaks	D																														
18	Verify Wire Rope has no damaged, frayed, or broken strands	D																														
19		D																														
20		D																														
	Inspector's Initials																															
22	0	D																														
23	0	D																														
24	0	D																														
25	0	D																														
	Inspector's Initials																															

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