

# GROVE

***OPERATOR'S  
AND  
SAFETY  
HANDBOOK***

***RT 9000E SERIES  
CRANE***

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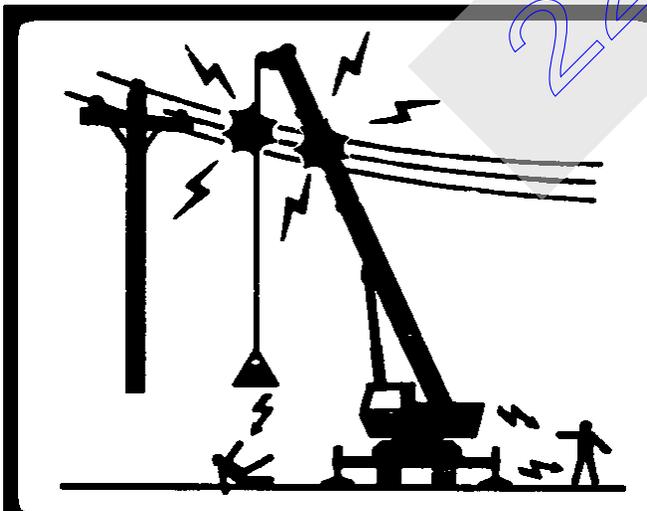
# DANGER

**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 MANUAL;
- YOU ARE SURE THAT ALL SAFETY SIGNS, GUARDS AND OTHER SAFETY FEATURES ARE IN PLACE AND IN PROPER CONDITION.

**AVOID ELECTROCUTION, TIPPING, TWO-BLOCKING AND OTHER OPERATIONAL HAZARDS**

7376007255



**THIS CRANE IS NOT INSULATED.**

# DANGER

## **ELECTROCUTION HAZARD**

- TO AVOID DEATH OR SERIOUS INJURY, KEEP ALL PARTS OF THIS CRANE, THE RIGGING, AND MATERIALS BEING LIFTED AT LEAST 20 FEET AWAY FROM ALL ELECTRICAL POWER LINES AND EQUIPMENT.
- KEEP AWAY FROM THIS CRANE IF IT IS BEING OPERATED NEAR ELECTRICAL POWER LINES OR EQUIPMENT.
- BEFORE OPERATING THIS CRANE IN THE VICINITY OF POWER LINES OR EQUIPMENT, NOTIFY THE POWER UTILITY COMPANY. HAVE POWER TURNED OFF.
- FOLLOW INSTRUCTIONS IN OPERATOR'S AND SAFETY HANDBOOK.

## NOTICE TO OWNER/USER

Should this crane become involved in an accident, please contact your local Grove distributor immediately and relate details of the incident so he can notify Grove Worldwide. If the distributor is unknown and/or cannot be reached, please contact:

Grove Worldwide Product Safety & Reliability  
1565 East Buchanan Trail  
Shady Grove, PA 17256-0021  
Telephone: 888-777-3378 (888-PSR-DEPT)  
Facsimile: 717-593-5074  
Email: [psafety@groveworldwide.com](mailto:psafety@groveworldwide.com)

## FOREWORD

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 Worldwide 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.

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. If immediate repair or recalibration of an operational aid is not possible and there are exceptional circumstances which justify continued short-term use of the crane when operational aids are inoperative or malfunctioning, the following requirements shall apply for continued use or shutdown of the crane:

1. Steps shall be taken to schedule repairs and recalibration immediately. The operational aids shall be put back into service as soon as replacement parts, if required, are available and the repairs and recalibration can be carried out. Every reasonable effort must be made to expedite repairs and recalibration.
2. When a **load indicator**, **rated capacity indicator**, or **rated capacity limiter** is inoperative or malfunctioning, the designated person responsible for supervising the lifting operations shall establish procedures for determining load weights and shall ascertain that the weight of the load does not exceed the crane ratings at the radius where the load is to be handled.
3. When a **boom angle** or **radius indicator** is inoperative or malfunctioning, the radius or boom angle shall be determined by measurement.
4. When an **anti-block device**, **two-blocking damage prevention** or **two-block warning device** is inoperative or malfunctioning, the designated person responsible for supervising the lifting operations shall establish procedures, such as assigning an additional signal person to furnish equivalent protection. This does not apply when lifting personnel in load-line supported personnel platforms. Personnel shall not be lifted when anti-two block devices are not functioning properly.
5. When a **boom length indicator** is inoperative or malfunctioning, the designated person responsible for supervising the lifting operations shall establish the boom lengths at which the lift will be made by actual measurements or marking on the boom.

6. When a **level indicator** is inoperative or malfunctioning, other means shall be used to level the crane.  
The definitions of DANGER, CAUTION, and NOTE as used in this manual apply as follows.

**DANGER**

**A DANGER IS USED TO EMPHASIZE THAT IF AN OPERATION, PROCEDURE, OR PRACTICE IS NOT FOLLOWED EXACTLY, DEATH OR INJURY TO PERSONNEL MAY RESULT.**

**CAUTION**

**A CAUTION IS USED TO EMPHASIZE THAT IF AN OPERATION, PROCEDURE, OR PRACTICE IS NOT FOLLOWED EXACTLY, EQUIPMENT DAMAGE MAY RESULT.**

**NOTE**

**A note is used to emphasize an important procedure or condition.**

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**NOTES**

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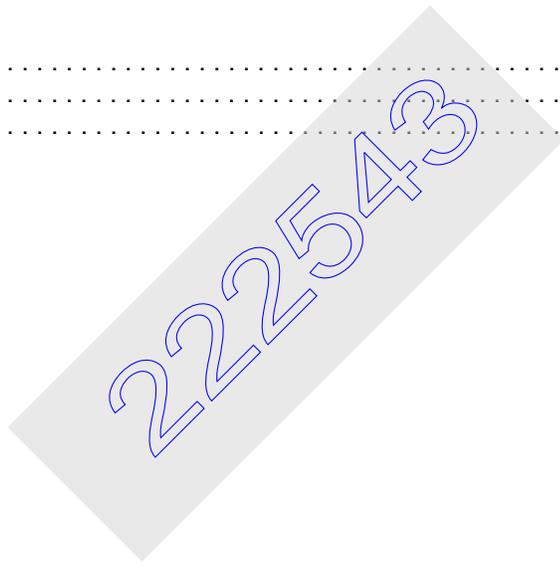
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# SECTION 1

## INTRODUCTION

### GENERAL

#### NOTE

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

This Handbook provides important information for the operator of the Model RT9000E 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 removable.

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 five-section, full power, sequenced and synchronized boom. Additional reach is obtained by utilizing an optional swingaway boom extension. Lifting is provided by a main and auxiliary hoist.

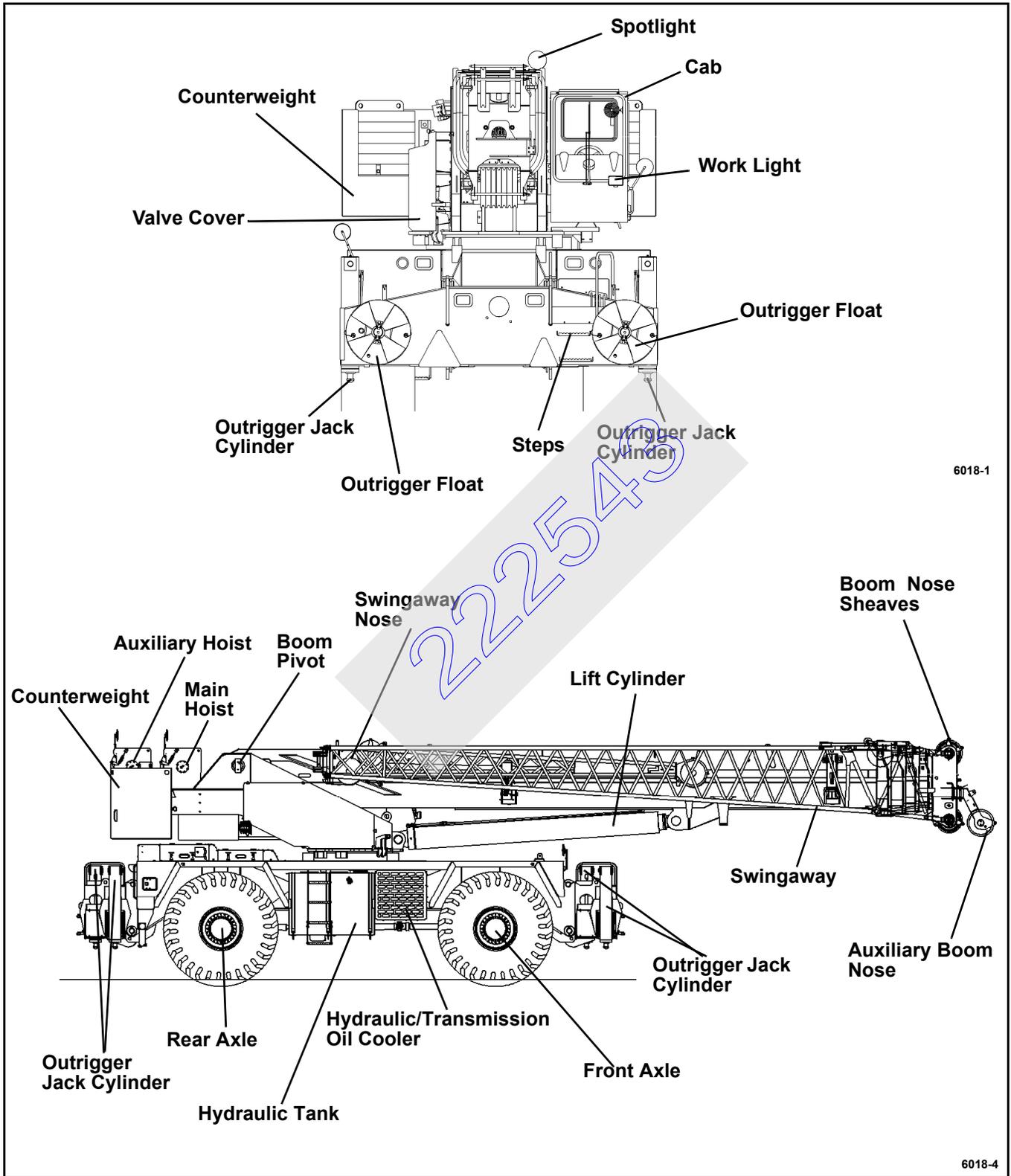
### NOISE/VIBRATION TEST RESULTS

#### NOISE LEVEL TEST RESULTS ARE AS FOLLOWS:

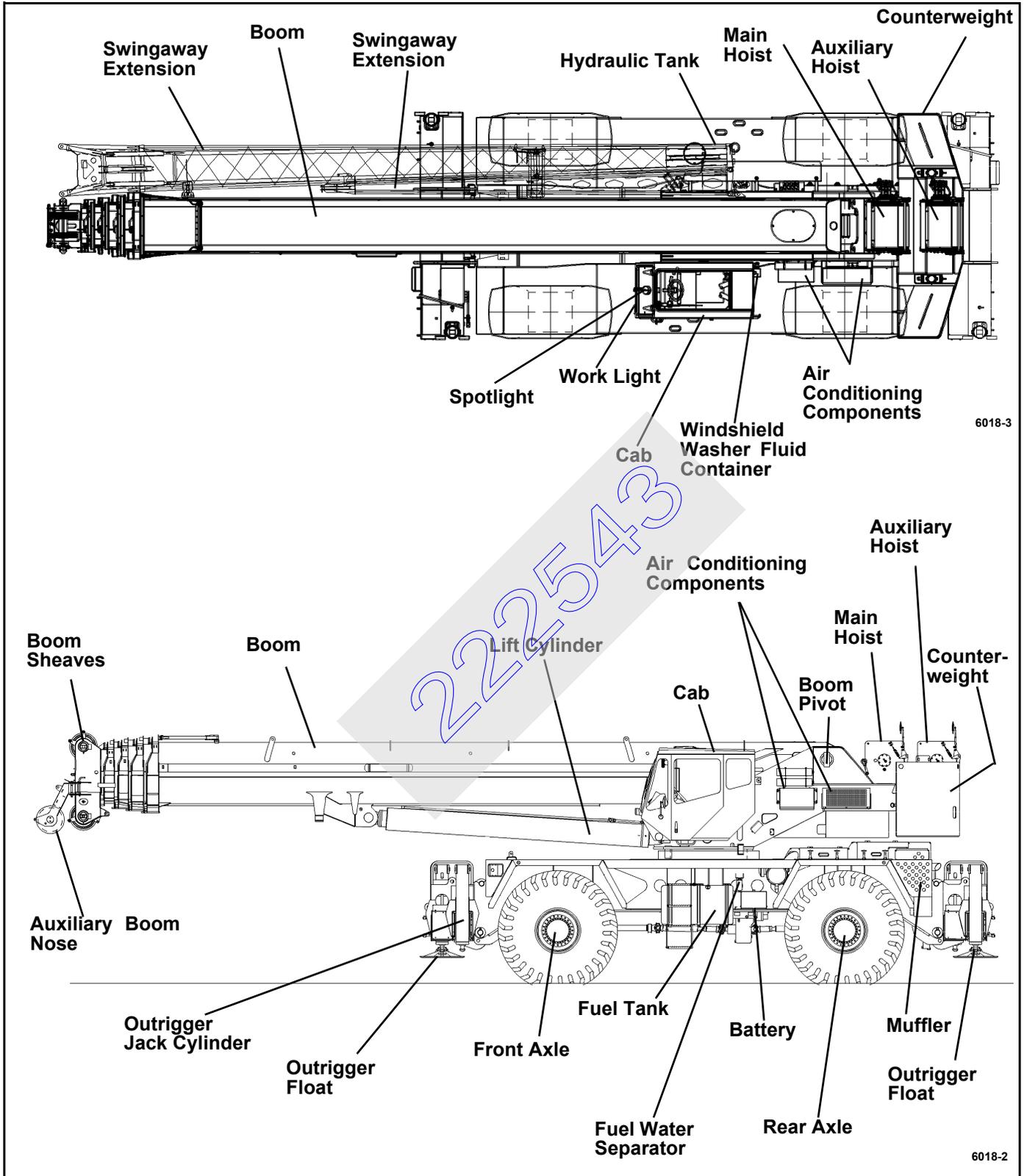
- At the operator's station with closed cab operation, the value is 82.5 dBA maximum when measured at 114.4dBa(A) according to the directives 79/113/EEC and Kebomatief 27 and 93.0 dBA with open cab operation.

#### 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.



Basic Nomenclature (Sheet 1 of 2)



Basic Nomenclature (Sheet 2 of 2)

NOTES

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## SECTION 2

# SAFETY PRECAUTIONS

### GENERAL

#### NOTE

**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 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 Grove Worldwide Customer Support. 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 Worldwide distributor and/or Grove Worldwide.

### 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 and Safety Handbook, 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.

**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.

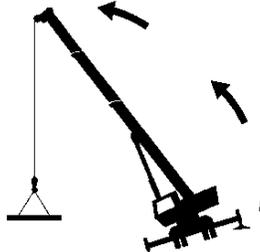
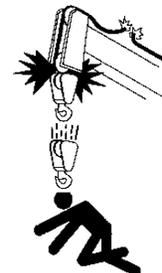
Before swinging the superstructure over the side when the outriggers are retracted, check the load chart for backwards stability.

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.

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.

<b>⚠ DANGER</b>	
	<p><b>TIPPING HAZARD</b></p> <p>To avoid death or serious injury, ensure load and crane's configuration are within capacity as shown on crane's load rating chart and notes. This crane should have a functional load moment indicator and control lock-out system. Test daily for proper operation.</p> <p><b>Position Crane On Firm Surface.</b> Extend outriggers and level crane.</p>
	<p><b>TWO-BLOCKING HAZARD</b></p> <p>To avoid death or serious injury, keep load handling devices away from boom/jib tip when extending or lowering the boom and when hoisting up. This crane should have a functional anti-two-block and control lock-out system. Test daily for proper operation.</p> <p><b>Do not pass loads or boom over ground personnel.</b></p>
<p><b>TO AVOID DEATH OR SERIOUS INJURY:</b></p> <p>Never handle personnel with this machine unless the requirements of the applicable national, state and local regulations and safety codes are met.</p> <p>Never use this crane for bungee jumping or any form of amusement or sport.</p> <p>Never permit anyone to ride loads, hooks, slings or other rigging for any reason.</p> <p>Never get on or off a moving crane.</p> <p>Never allow anyone other than the operator to be on this crane while it is operating or traveling.</p>	
<p><b>ELECTRONIC EQUIPMENT</b> on this crane is intended as an aid to the operator.</p> <p>Under no condition should it be relied upon to replace the use of capacity charts and operating instructions. Sale reliance upon these electronic aids in place of good operating practices can cause an accident. Do not remove any decal, the load chart, or the Operator's and Safety Handbook from this crane.</p>	
<p><b>FOLLOW INSTRUCTIONS IN OPERATOR'S AND SAFETY HANDBOOK.</b></p>	

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

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.

**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

<b>⚠ DANGER</b>
<p><b>DEATH OR SERIOUS INJURY COULD RESULT FROM IMPROPER CRANE SET-UP ON OUTRIGGERS</b></p> <p><b>FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN THE CRANE OVERTURNING</b></p>
<ul style="list-style-type: none"> <li>- BE SURE OUTRIGGERS ARE PROPERLY EXTENDED AND SET AND CRANE IS LEVEL FOR OPERATION ON OUTRIGGERS.</li> <li>- ALL FOUR OUTRIGGER BEAMS MUST BE EQUALLY EXTENDED TO THE APPROPRIATE VERTICAL STRIPE BEFORE BEGINNING OPERATION.</li> <li>- ALL FOUR OUTRIGGER BEAM LOCK PINS MUST BE ENGAGED BEFORE OPERATING FROM THE MID-EXTEND POSITION.</li> <li>- OPERATOR MUST SELECT PROPER LOAD CHART AND LMI PROGRAM FOR THE OUTRIGGER POSITION SELECTED.</li> </ul>

Carefully follow the procedures in this handbook when extending or retracting the outriggers. Death or serious

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 the "WIND VELOCITY CHART" on page 2-5.

## 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.

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 32 km/h (20 mph) to 48 km/h (30 mph), 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 48 km/h (30 mph) is not recommended. To assist you in determining prevailing wind conditions, refer to the “WIND VELOCITY CHART” on page 2-5.

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.

### WIND VELOCITY CHART

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

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 than 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.

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 opera-

tor, 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

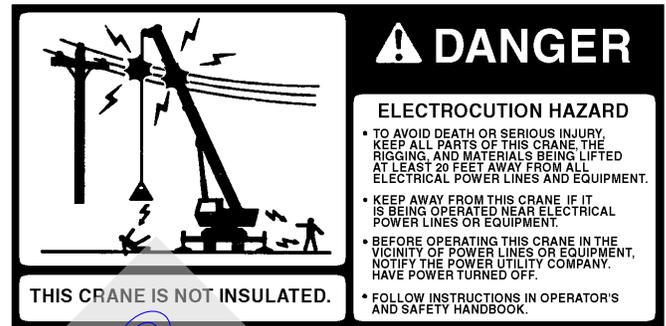
You must read and understand the manufacturer's Operator's Handbook before operating the system. Become familiar with all proper operating procedures and with the identification of symbol usage.

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

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 handbook 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.

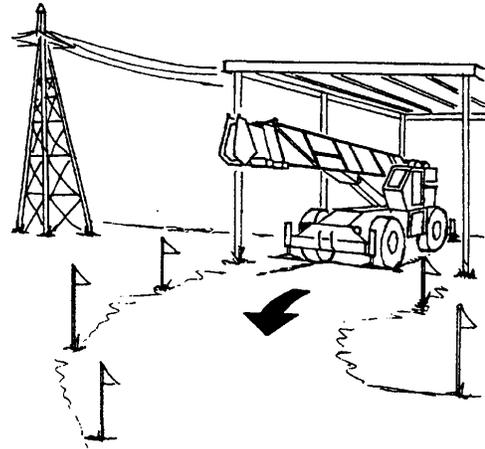
Federal law prohibits the use of cranes closer than 3 m (10 ft) to power sources up to 50,000 volts and greater distances for higher voltages [29CFR1910.180 and 29CFR1926.550]. Grove recommends keeping cranes twice the minimum distance [e.g., 6 m (20 ft)] as specified by US Department of Labor - Occupational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

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.



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.

## 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 Worldwide 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 Grove Worldwide Customer Support. The crane must not be returned to service until it is thoroughly inspected for any evidence of damage and all damaged parts are repaired or replaced as authorized by Grove Worldwide or your local Grove Worldwide distributor.

## SPECIAL OPERATING CONDITIONS AND EQUIPMENT

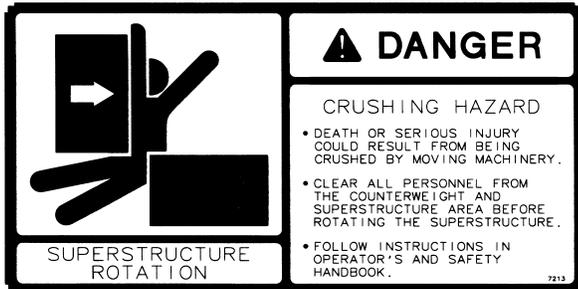
Never operate the crane during an electrical thunderstorm.

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.

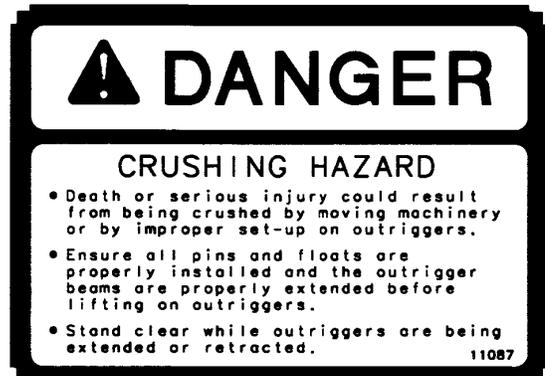
Never allow anyone to stand or work on or near the superstructure while the crane is in operation. Always barricade the tail-swing of the rotating superstructure.

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 handbook when extending or retracting the outriggers. Death or serious injury could result from improper crane set up on outriggers.

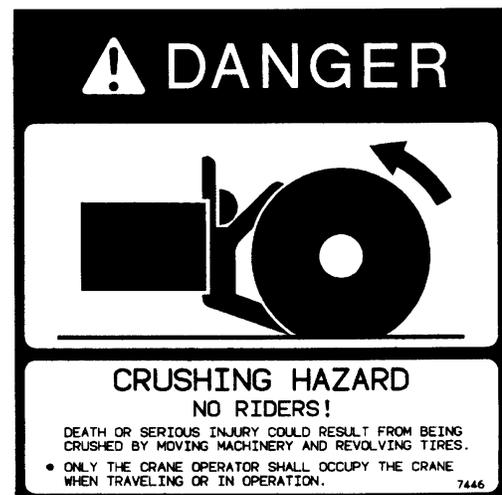
Be sure the outriggers are properly extended, set and the crane is level for operation on outriggers.

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 29CFR1926.550(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 29CFR1910.180 for General Industry and 29CFR1926.550 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 And Safety Handbook 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.
- 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 Worldwide 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.

## **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).
- 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 Worldwide Crane Maintenance and Inspection Manual. Any questions regarding procedures and specifications should be directed to the your local, authorized Grove Worldwide 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 Worldwide 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 Worldwide 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.

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.
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.

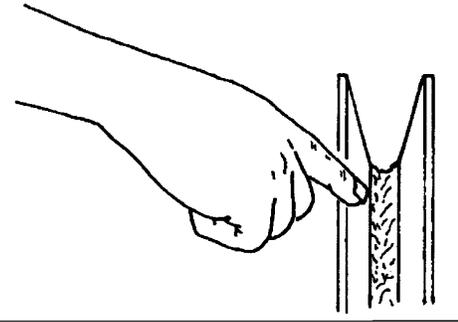
When installing a new rope:

- 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.

## **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.



On cranes with intake manifold grid heaters, do not use ether to start a cold 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 Grove Worldwide.

### **JOB PREPARATION**

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

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

You must ensure that the outriggers 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 entering the cab, 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. Do not reach in a window or door to operate any controls.

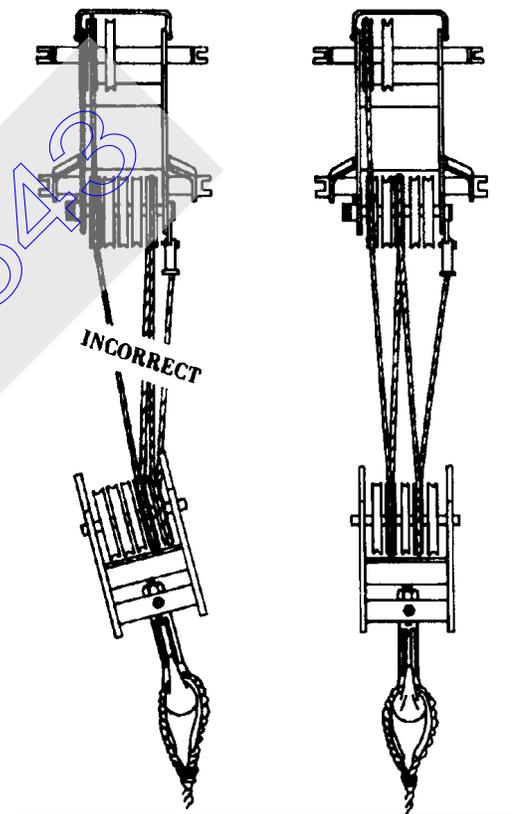
Operate the crane slowly and cautiously, looking carefully in the direction of movement.

"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 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.

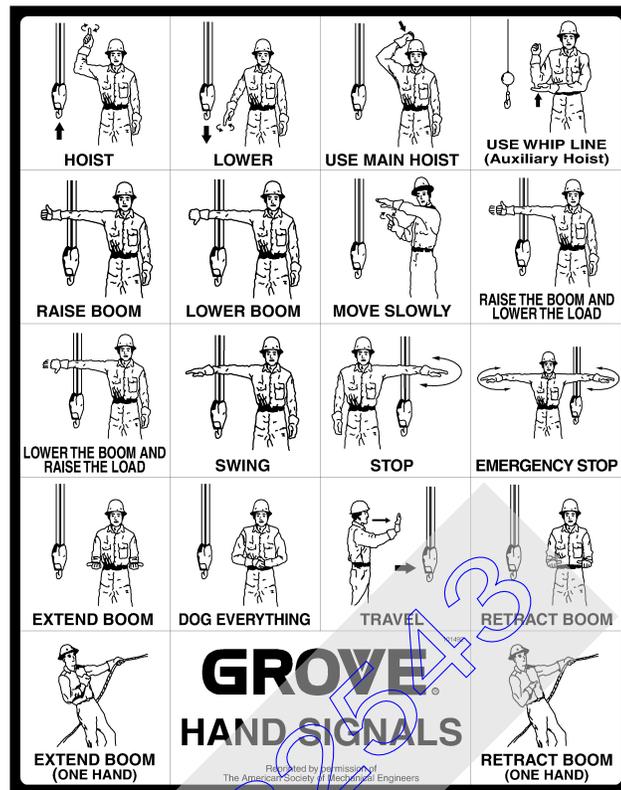
Be sure the load is well secured and attached to the hook with rigging of proper size and in good condition.

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.

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 rail-road 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.

## **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.

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.

The chart below 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.**

**BOOM DRIFT CHART (Cylinder length change in inches)**

Coeff. = 0.00043 (in<sup>3</sup>/in<sup>3</sup>/ °F)

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

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

## SECTION 3

# CAB CONTROLS AND INDICATORS

### NOTE

The following paragraphs describe all the available (standard and optional; some machines may not be equipped with the optional controls shown) controls and indicators located in the cab. The numbers in ( ) represent the index number from the figure titled Cab Controls and Indicators.

### 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.

## CAB CONTROLS AND INDICATORS

### DEFROSTER SWITCH

The DEFROSTER switch (1) is located on the right side of the front console, above the THROTTLE controls. The switch is a three-position rocker switch (HIGH, OFF, LOW) that controls operation of the defroster fan, which is located on top of the front console. When the switch is in the HIGH or LOW position, the square amber LED on the switch is illuminated.

### HAND THROTTLE CONTROL

The (THROTTLE) control (2) is located on 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 knob is electrically connected to the superstructure control module which sends the signal to the engine ECM via the J1939 data link.

### NOTE

Throttle mode switch must be in the hand mode for the hand throttle to be activated.

### IGNITION SWITCH

The (IGNITION) switch (3) 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 floodlights, spotlights, turn/hazard/stop lights, dome light, horn, work light, superstructure control module. Positioning the switch to ACC allows you to start all electrical components except for the engine ECM wake up and start solenoid. Positioning the switch to RUN is the same as ACC, except the engine ECM is now in wake state. With the transmission shifter in neutral position, 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.

### VOLTMETER

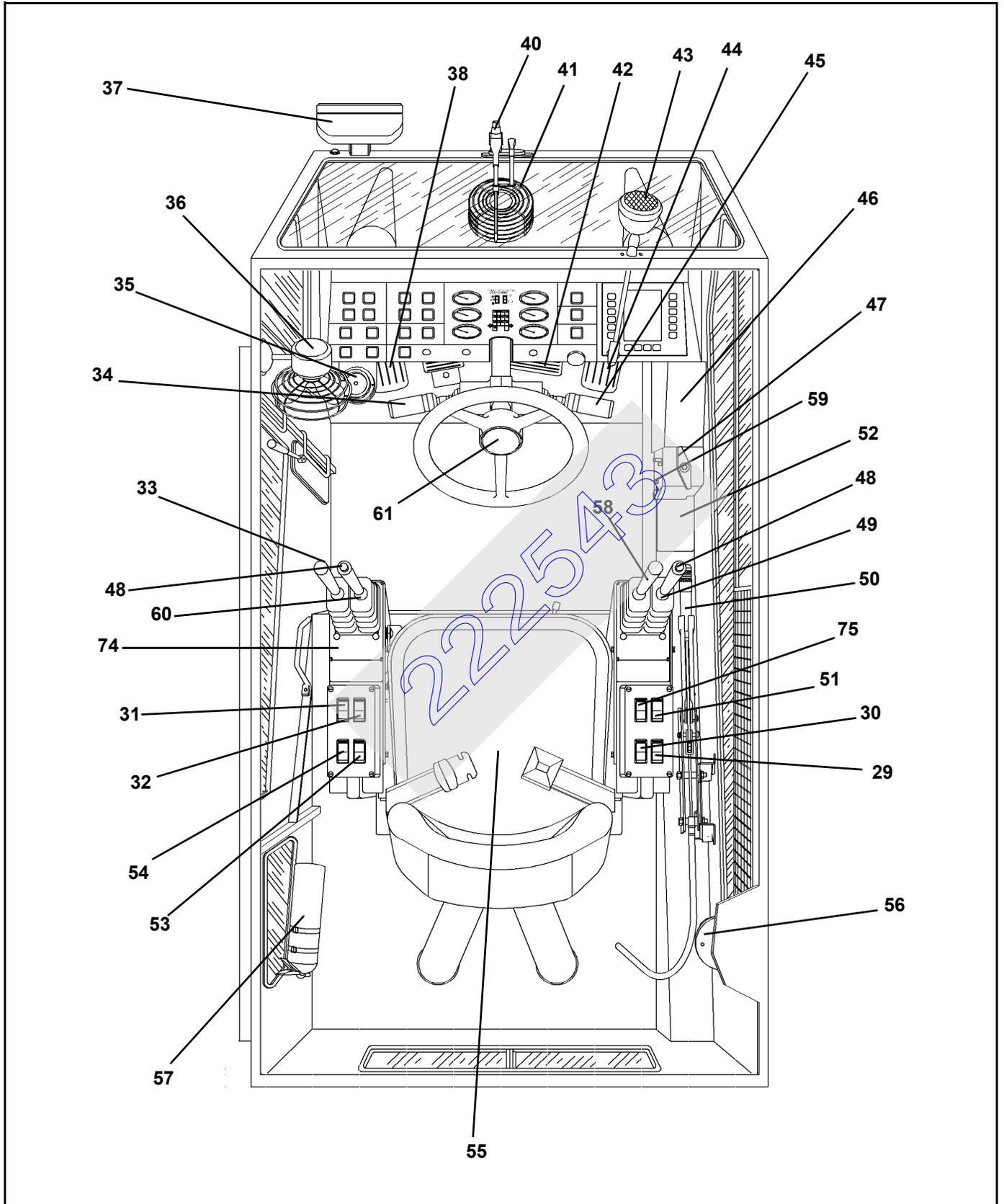
The voltmeter (BATTERY) gauge (4) is located in the center of the front console. The voltmeter indicates the voltage being supplied to or from the battery and has a scale of 10 to 16 volts.

### TRANSMISSION OIL TEMPERATURE GAUGE

The transmission oil temperature (TRANS TEMP) gauge (5) 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.

### HEAT CONTROL KNOB

The HEAT control knob (6) is located on the left side of front console. The knob is a push-pull control that positions a flow diverter valve in the hot water heater supply line. Pull out on the knob (PULL ON) to allow hot water to flow through the heater coil and push in on the knob (PUSH OFF) to shut off the flow of hot water to the coil.



Cab Controls and Indicators (Sheet 1 of 3)



1. Defroster Switch	40. Windshield Wiper
2. Hand Throttle Control Knob	41. Defroster Fan
3. Ignition Switch	42. Brake Foot Pedal
4. Voltmeter	43. Spotlight (Optional)
5. Transmission Oil Temperature Gauge	44. Foot Throttle Pedal
6. Heat Control Knob	45. Transmission Shift Lever
7. Fan Control Switch	46. Circuit Breaker Panel
8. Park Brake Control Switch	47. Pin Swing Lock Control (Pin Type)
9. Air Conditioner Control Switch	48. Hoist Rotation Indicators
10. Swing Brake Control Switch	49. Main Hoist Control Lever
11. Differential Lock Control Switch (Optional)	50. 360 Degree Swing Lock Control (Positive Lock Type)
12. Swing Speed Control Switch	51. Main Hoist Speed Selector Switch
13. Drive Axle Selector Switch	52. Engine and System Diagnostic Connector (Not Shown)
14. Cab Tilt Switch	53. Luffing Jib Raise/Lower Switch
15. Outrigger Control Switches	54. Luffing Jib On/Off Switch
16. Work Light Switch	55. Seat Switch (Not Shown)
17. Headlights Switch	56. Cab Dome Light
18. Boom Lights Switch (Optional)	57. Fire Extinguisher
19. Hazard Lights Switch	58. Boom Lift Control Lever
20. Hose Reel Brake On Indicator	59. 12 VDC Accessory Outlet
21. Fuel Gauge	60. Auxiliary Hoist Control Lever
22. Engine Diagnostics Test Mode Switch	61. Horn
23. Engine Diagnostics Idle Switch	62. Turn Signal Indicators
24. Engine Coolant Temperature Gauge	63. Rear Wheels Not Centered Indicator
25. Tachometer	64. Hoist Third Wrap Indicator (Optional W/CE)
26. Crane Function Power Switch	65. Engine Stop Indicator
27. Outrigger Extend/Retract Switch	66. Engine Warning Indicator
28. Load Moment Indicating (LMI) and Work Area Definition System Control Panel	67. Engine Service Indicator
29. Auto/Manual Boom Telescope Mode Switch	68. Wait To Start Indicator
30. Center Mid/Inner Mid Boom Telescope Section Select Switch	69. Low Brake Pressure Indicator
31. Rear Steer Control Switch	70. Transmission Service Indicator (XMSN)
32. Auxiliary Hoist Speed Selector Switch	71. Water In Fuel Indicator
33. Swing Control Lever	72. Boom Not Sync Indicator
34. Turn Signal Lever and Windshield Wiper/Washer Controls	73. Throttle Mode Switch
35. Bubble Level Indicator	74. Armrest Switch (Not Shown)
36. Cab Circulating Fan	75. Boom Telescope Mode A/B Select Switch
37. Work Light	76. Low Steer Pressure Indicator
38. Swing Brake Pedal	77. Electrical System Diagnostics Indicator
39. Telescope Control Foot Pedal	

Cab Controls and Indicators (Sheet 3 of 3)

**FAN CONTROL SWITCH**

The FAN control switch (7) 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.

**PARK BRAKE CONTROL SWITCH**

The PARK BRAKE control switch (8) 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 has a lock to prevent accidental activation.

**NOTE**

**When the park brake switch is positioned to the "ON" position, the crane will default to four wheel drive, regardless of the position of the drive axle switch.**

**AIR CONDITIONER CONTROL SWITCH**

The air conditioner (AIR COND) control switch (9) is located on the left side of the front console. The switch is a two-position rocker switch (ON/OFF) that controls the

operation of the 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.

### SWING BRAKE CONTROL SWITCH

The SWING BRAKE control switch (10) 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 has a lock to prevent accidental activation.

### DIFFERENTIAL LOCK CONTROL SWITCH (OPTIONAL)

#### NOTE

**The differential lock will only work when the crane is in the 4WD mode.**

The differential lock (AXLE DIFF) control switch (11) 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.

### SWING SPEED CONTROL SWITCH

The SWING SPEED CONTROL switch (12) is located on the left side of the console. This two position (fast/slow) locking rocker switch, determines the speed of swing. When in fast position, it energizes the SWING SPEED high solenoid.

### DRIVE AXLE SELECTOR SWITCH

The DRIVE AXLE selector switch (13) is located on the left side of the front console. This two-position rocker switch is placarded 2WD HI (high range) and 4WD LO (low range). The switch controls a solenoid valve (energized for 2WD HI) that operates the speed range and axle disconnect cylinders on the transmission. When the switch is in the 4WD LO position, the square LED on the switch is illuminated.

### CAB TILT SWITCH

The CAB TILT switch (14) is located on the far left side of the front console. It is a three position, momentary spring centered to off rocker switch. It has two placarded positions, (up and down), allowing the cab to be tilted either up or down.

#### NOTE

**Park brake must be engaged to operate the cab tilt feature and cab must be completely down for the drive functions to be enabled.**

### OUTRIGGER CONTROL SWITCHES

The outrigger control switches (15) are located on the left side of the front console. There are four three-position, momentary, spring centered to off rocker switches on the panel. These switches, in conjunction with the OUTRIGGER Extension/Retraction switch (27), 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.

### WORK LIGHT SWITCH

The WORK light switch (16) is a two-position rocker switch (ON/OFF), located on the left side of the front console. The switch controls the operation of the crane's work light (37). When the switch is in the ON position, the square amber LED on the switch is illuminated.

### HEADLIGHTS SWITCH

The HEADLIGHTS switch (17) is located on the left side of the front console. This two-position rocker switch (ON/OFF) controls operation of the instrument lights, switch LED's, and the headlights on the front of the crane. When the switch is in the ON position, the square amber LED on the switch is illuminated.

#### NOTE

**When the front outrigger box is electrically disconnected, only the headlights located on the carrier fender and decking will illuminate.**

**When the front outrigger box is electrically connected, only the headlights in the outrigger box will illuminate.**

When the headlight switch is in the ON position and the transmission shifter is in the reverse position, only the two backup lamps on the rear fender and decking will illuminate if the rear outrigger box is electrically disconnected.

If the rear outrigger box is electrically disconnected and the above conditions are met, only the backup lamps in the rear outrigger box will illuminate.

### BOOM LIGHTS SWITCH (OPTIONAL)

The BOOM LIGHTS switch (optional) (18) is located on the left side of the front console. This two-position rocker switch (ON/OFF) controls operation of the boom flood lights. When the switch is in the ON position, the square amber LED on the switch is illuminated.

### HAZARD LIGHTS SWITCH

The HAZARD lights switch (19) is located on the left side of the front console. The switch is a two-position rocker switch (ON/OFF) that causes the four turn signal lights and two turn signal indicator lamps 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.

### HOSE REEL BRAKE ON INDICATOR

The HOSE REEL BRAKE ON indicator (20) is located on the lower section of the console. It illuminates red when the HOSE REEL BRAKE is applied. Do not telescope boom in or out when indicator light is on.

### FUEL GAUGE

The fuel (FUEL) gauge (21) 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.

### ENGINE DIAGNOSTICS SWITCHES

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

#### Test Mode Switch

The TEST MODE switch (22) is used when servicing the engines electronic control system. It is a two position on/off toggle 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 (23) is used when servicing the engines electronic control system. It is a two position (+/-) momentary rocker switch that provides idle-control inputs that increases 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 COOLANT TEMPERATURE GAUGE

The engine coolant temperature (WATER TEMP) gauge (24) 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 the engine ECM and a temperature sending unit in the engine cooling system.

### TACHOMETER

The tachometer (25) is located in the center of the front 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.

### CRANE FUNCTION POWER SWITCH

The CRANE FUNCTION power switch (26) 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. When the red LED switch is in the ON position, the red LED square will be illuminated and the crane function solenoid will be energized allowing crane functions controlled by the hydraulic remote controllers to be performed.

#### NOTE

**The seat switch must be activated and the LH armrest must be in the down position before the crane function solenoid may be energized.**

### OUTRIGGERS EXTEND/RETRACT SWITCH

The OUTRIGGERS EXTEND/RETRACT switch (27) 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 switches (15) to control the operation of the stabilizer and extension cylinders. After positioning the outrigger selector switch, 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.

### **LOAD MOMENT INDICATING (LMI) AND WORK AREA DEFINITION SYSTEM CONTROL PANEL**

The LMI and Work Area Definition System control panel (28) 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.

### **AUTO/MANUAL BOOM TELESCOPE MODE SWITCH**

The boom auto/manual telescope mode switch (29) is located on the right armrest. The switch is a two-position rocker switch placarded auto and manual. This switch has a lock to prevent accidental activation.

When the switch is in the auto mode, the boom sections extend in a predetermined sequence when telescoping the boom. The sections retract in the same manner in reverse order.

When in the manual mode, the red LED square in the switch will illuminate and the boom telescope section select switch is positioned to either the center mid or inner mid position in order to extend or retract the selected section until it is returned to the proper position for normal boom synchronization to occur.

### **CENTER MID/INNER MID BOOM TELESCOPE SECTION SELECT SWITCH**

The center mid/inner mid boom telescope section select switch (30) is located on the right armrest. This switch is a three position rocker switch that is used in conjunction with the boom auto/manual telescope mode switch. When the boom mode switch is positioned to manual, the boom telescope section select switch is positioned to either of the two positions. When placed in the upper position, the center mid can be extended. When the center mid is fully extended, the outer mid and fly can be controlled. The red LED square will illuminate when the

switch is positioned in either inner mid or center/mid position.

### **REAR STEER CONTROL SWITCH**

The REAR STEER control switch (31) is a three-position, momentary, spring centered to off, rocker switch, located on the left armrest. 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**

The auxiliary hoist (AUX HOIST) switch (32) is a three position rocker switch (HIGH/OFF/LOW) located on the left armrest. The auxiliary hoist switch must be in either HIGH or LOW 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 either HIGH or LOW position, the amber LED square in the switch will be illuminated.

### **SWING CONTROL LEVER**

The SWING control lever (33), 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.

### **TURN SIGNAL LEVER AND WINDSHIELD WIPER/WASHER CONTROLS**

The turn signal lever and windshield wiper/washer controls (34) are located on the left side of the steering column. Pushing the turn signal lever down causes the left turn signal indicator lamp and the left front and left rear turn signals to flash. Pushing the turn signal lever up causes the right turn signal indicator lamp and 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.

**BUBBLE LEVEL INDICATOR**

The bubble level indicator (35) 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.

**CAB CIRCULATING FAN**

The cab circulating fan (36) 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.

**SWING BRAKE PEDAL**

The swing brake pedal (38) 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.

**TELESCOPE CONTROL FOOT PEDAL**

The telescope control foot pedal (39) is located on the left side of the cab floor. Pushing forward on the top of the pedal will extend the boom and pushing down on the bottom of the pedal will retract the boom.

**WINDSHIELD WIPER**

A windshield wiper (40) 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.

**DEFROSTER FAN**

A defroster fan (41) is located at the front of the dashboard. The fan is controlled by the defroster switch on the front console, and is used to circulate air to remove moisture and fog from the inside of the windshield.

**BRAKE FOOT PEDAL**

The brake foot pedal (42) is the second pedal from the right on the cab floor. Depressing the pedal controls the application of the service brakes.

**SPOTLIGHT (OPTIONAL)**

The spotlight (43) 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.

**FOOT THROTTLE PEDAL**

The foot throttle pedal (44) is located directly under the LMI display module on the cab 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.

**NOTE**

The throttle mode switch must be in the "foot" position.

**TRANSMISSION SHIFT LEVER**

The transmission shift lever (45) 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 first, second, third, fourth, fifth, or sixth gear, rotate the knob to 1, 2, 3, 4, 5, or 6.

**CIRCUIT BREAKER PANEL**

The circuit breaker panel (46) is located on the right side of the cab in front of the pin house lock control. It contains 18 circuit breakers and 1 fuse that protect the various electrical components of the crane.

**PIN SWING LOCK CONTROL (PIN TYPE)**

The pin swing lock control handle (47) 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 or rear. When the control handle is turned to the right (clockwise) and the superstructure is directly over the front or rear, it will lock the superstructure in place. When the control handle is turned to the left (counterclockwise), the superstructure will be unlocked.

### HOIST ROTATION INDICATORS

The hoist rotation indicators (48) 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.

### MAIN HOIST CONTROL LEVER

The MAIN HOIST control lever (49) is located on the right armrest. The lever, when positioned forward (lowers the cable) or back (raises the cable), actuates the control valve through hydraulic pilot pressure to raise or lower the main hoist cable.

### 360 DEGREE SWING LOCK CONTROL (POSITIVE LOCK TYPE)

The 360 degree swing lock control lever (optional) (50) 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 lbs) of force to move the lever into the engaged position.

### MAIN HOIST SPEED SELECTOR SWITCH

The MAIN HOIST SPEED selector rocker switch (51) is located on the right armrest. It is a three position switch (HIGH/OFF/LOW) placarded HIGH, OFF, and LOW. Positioning the switch to HIGH energizes a solenoid controlled valve on the main hoist to direct the flow of hydraulic oil to the hoist motors. When the switch is in either the HIGH or LOW position, the amber LED square in the switch will be illuminated.

### ENGINE AND SYSTEM DIAGNOSTIC CONNECTOR (NOT SHOWN)

This connector is provided for troubleshooting and/or monitoring engine or electrical system faults or conditions.

#### NOTE

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

### LUFFING JIB RAISE/LOWER SWITCH

The luffing jib raise/lower switch (53) is located on the left armrest. It is a three position, momentary switch (LOWER/OFF/RAISE) that will energize a solenoid to raise or lower the JIB, if the jib ON/OFF switch is ON.

### LUFFING JIB ON/OFF SWITCH

The luffing jib two position on/off switch (54) is located on the left armrest. When in the ON position and used in conjunction with the luffing jib RAISE/LOWER switch, this switch will allow operation of the luffing jib. When in the ON position, the red LED square will illuminate. It has a lock to prevent accidental activation.

### SEAT SWITCH (NOT SHOWN)

This switch (55) is located in the seat. An operator is required to be sitting in the seat before crane functions can be activated.

### CAB DOME LIGHT

The cab dome light (56) 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.

### FIRE EXTINGUISHER

The fire extinguisher (57) 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.

### BOOM LIFT CONTROL LEVER

The boom LIFT control lever (58) is located on the right armrest. The lever, when positioned forward (lowers the boom) or back (raises the boom), actuates the control valve through hydraulic pilot pressure to raise or lower the boom.

### 12 VDC ACCESSORY OUTLET

The 12 vdc accessory outlet (59) 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 circuit breaker with an 8 amp maximum allowable load.

### AUXILIARY HOIST CONTROL LEVER

The auxiliary hoist (AUX) control lever (60) is located on the left armrest and controls auxiliary hoist functions. Positioning the lever forward actuates the control valve to let out the hoist cable and pulling the lever back reels the cable in.

**HORN**

The horn button (61) is a push-button type switch located in the center of the steering wheel. Depressing the horn button will sound the horn on the cab exterior.

**RIGHT TURN SIGNAL INDICATOR**

The right turn signal indicator (62) is located at 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 (62) is located at 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.

**NOTE**

See **Electrical System Diagnostic Indicator in Section 15 in the Service Manual - Electrical System.**

**REAR WHEELS NOT CENTERED INDICATOR**

The REAR WHEELS NOT CENTERED indicator (63) is located on the right side of the front console on the indicator light alert display. The indicator is an amber light that will illuminate any time the rear wheels are not centered.

**HOIST 3RD WRAP INDICATOR (OPTIONAL W/CE)**

The HOIST 3RD WRAP indicator (64) (optional w/CE) is located on the lower section of the front console on the indicator light alert display. The indicator is a red light that will illuminate when three wraps or less of cable remains on either hoist. This light is controlled by the LMI System.

**ENGINE STOP INDICATOR**

The ENGINE STOP indicator (65) is located on the upper left 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 (66) is located on the upper section 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 (67) is located on the upper section 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.**

**WAIT TO START INDICATOR**

The WAIT TO START indicator (68) is located on the top right side 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 light is controlled by the engine ECM.

**LOW BRAKE PRESSURE INDICATOR**

The LOW BRAKE PRESSURE indicator (69) is located at the center of the console on the indicator light display. It illuminates red and a warning buzzer is activated when the pressure in the dual accumulator charge valve falls below normal operating requirements.

**TRANSMISSION SERVICE INDICATOR (XMSN)**

The TRANSMISSION SERVICE (XMSN) indicator (70) is located at the center of the console on the indicator light display. It illuminates amber and a warning buzzer is activated during low transmission oil pressure or high transmission oil temperature conditions.

**WATER IN FUEL INDICATOR**

The WATER IN FUEL indicator (71) is located on the left side of the console on the indicator light display. It illuminates amber when the engine's fuel water separator needs maintenance. Maintenance should be performed as soon as possible when this lamp is illuminated. This light is controlled by the engine ECM.

**BOOM NOT SYNC INDICATOR**

The BOOM NOT SYNC indicator (72) is located on the left side of the console on the indicator light display. It illuminates red when the boom sections are no longer telescoping in the correct synchronization. The boom mode and boom telescope section select switches must then be used to correct synchronization. This light is controlled by the LMI System.

**THROTTLE MODE SWITCH**

The THROTTLE MODE switch (73) 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.

**HOURLY METER (NOT SHOWN)**

The hourmeter is located on the right rear side of the engine hood. The hourmeter is used to register hours of engine operation.

**SKYLIGHT WIPER (NOT SHOWN)**

The electrically-operated skylight wiper is installed to remove moisture from the skylight. The single-speed wiper is located on the left side of the skylight frame. The skylight wiper is controlled by a switch on the wiper motor.

**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 transmission reverse solenoids. It is activated when the transmission shifter is in

the reverse position. The backup alarm is installed inside the right rear of the engine hood.

**ARMREST SWITCH (NOT SHOWN)**

The armrest switch (74) is a proximity switch located in the LH armrest. The LH armrest must be in the down position before crane functions can be activated.

**BOOM TELESCOPE MODE A/B SELECT SWITCH**

The BOOM TELESCOPE MODE A/B select switch (75) is located on the right armrest. The five section boom is operated either automatically or manually. The manual mode of operation is used mainly to place the boom back into synchronization or for rigging and maintenance purposes. In manual operation, the operator selects which boom section is to be extended or retracted. The automatic mode has two modes; A and B. These two modes are used when lifting and are controlled by the LMI System. The A mode retains the inner mid section fully retracted until all other sections are fully extended. The B mode begins by extending the inner mid first.

**LOW STEER PRESSURE INDICATOR (CE OPTION)**

The LOW STEER PRESSURE indicator (76) is located at the bottom of the front console on the indicator light display. The indicator illuminates red and a buzzer is activated when the hydraulic pressure is low.

**ELECTRICAL SYSTEM DIAGNOSTIC INDICATOR**

The ELECTRICAL SYSTEM DIAGNOSTIC indicator is located in the cab 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 cab buss system. Refer to the Electrical System in the Service Manual for more detailed information.

NOTES \_\_\_\_\_



## SECTION 4

# OPERATING PROCEDURES

### 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 ensure it is secure.

#### **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.

#### **BOOM**

Ensure the large access cover on top of the boom base section is in place. The boom should not be operated unless it is installed.

#### **AIR CLEANER**

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

### 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.

**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**

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

**DANGER**

**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.**

Use the correct grade of oil for the prevailing temperature in the crankcase to prevent hard cranking. Diesel fuel should have a pour point of 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. This will prevent clogging of filters and small passages by wax crystals. The addition of kerosene is NOT recommended for general use.

**Warm Engine**

**DANGER**

**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 shift lever is in neutral.**

- 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.

**CAUTION**

**IF TEMPERATURE INDICATOR(S) DO NOT DISPLAY PROPER READINGS, SHUT DOWN THE ENGINE AND CORRECT THE MALFUNCTION BEFORE RESUMING OPERATION.**

- Allow the engine to warm up at least five minutes before applying a load. Do not race the engine for a faster warm up.

**Cold Engine****DANGER**

**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.

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

**NOTE**

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

- 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.
- 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.

**CAUTION**

**IF TEMPERATURE INDICATOR(S) DO NOT DISPLAY THE PROPER READINGS, SHUT DOWN ENGINE AND CORRECT MALFUNCTION.**

- Allow the engine to warm up at least 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.

**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**

- Allow the engine to operate at fast idle for about five minutes to avoid high internal heat rise and allow for heat dissipation.
- Turn the ignition switch to OFF.

**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.**

**CAUTION**

**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**

**DO NOT TOW OR PULL IN 1ST GEAR WITH THE DRIVE AXLE SELECTOR SWITCH IN 2 WHEEL DRIVE POSITION. SEVERE DAMAGE TO THE DRIVE TRAIN WILL RESULT.**

**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 AND/OR INSERT ERECTED**

**11 m (36.1 ft)/18 m (59.1 ft) Extension**

Travel is permissible under the following conditions.

1. The 11.1 m (36.1 ft) or 18 m (59.1 ft) boom extension shall be erected at minimum offset. If traveling with just the 11.1 m (36.1 ft) extension, the stinger section must be stowed on the boom base section, not on the extension base section.
2. Jobsite travel only on firm, level surface.
3. Main boom shall be fully retracted.
4. Main boom angle: 0 degrees minimum, 30 degrees maximum.

5. Maximum travel speed: 24 km/h (2.5 mph).
6. Main counterweight shall be installed.
7. The boom shall be over the front.
8. Swing lock and pin shall be engaged.
9. Hookblock must be removed from main boom nose.
10. Headache ball may be reeved over boom extension, hanging 0.9 m (3 feet) below sheave.

### 18 m (59.1 ft) Extension Plus 8 m (26 ft)/ 16 m (52 ft) Inserts

Travel is permissible under the following conditions.

1. The 18 m (59.1 ft) boom extension plus 8 m (26 ft)/ 16 m (52 ft) inserts shall be erected at minimum offset.
2. Jobsite travel only on firm, level surface.
3. Main boom shall be fully retracted.
4. Main boom angle: -0 degrees minimum, 20 degrees maximum.
5. Maximum travel speed: 4 km/h (2.5 mph).
6. Main counterweight shall be installed.
7. The boom shall be over the front.
8. Swing lock and pin shall be engaged.
9. Hookblock must be removed from main boom nose.
10. Headache ball may be reeved over 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).

### 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 turning 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.

### 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**

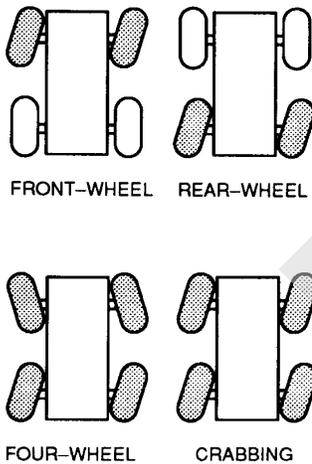
**OPERATE THE REAR STEER ONLY FOR ADDED JOB SITE MANEUVERABILITY.**

**REAR WHEEL STEERING**

Rear wheel steering is controlled by the REAR STEER control switch. 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.



**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.

**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-HI or 4WD-LO.

**CAUTION**

**USE FOUR WHEEL DRIVE ONLY WHEN MORE TRACTION IS REQUIRED.**

**CAUTION**

**IF THE HEAVY COUNTERWEIGHT PACKAGE (18143 KG [40,000 LB]) IS INSTALLED, THE MAXIMUM TRAVEL SPEED IS 16 KPH (10 MPH).**

**NOTE**

**If service brake hydraulic accumulator pressure is low, the parking brake cannot be released.**

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 third (3) gear position and so forth until the desired travel speed is attained.

**CAUTION**

**DO NOT DOWNSHIFT TO A LOWER GEAR IF THE ROAD SPEED IS GREATER THAN 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 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.**

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

## PROPER OPERATION OF DIFFERENTIAL LOCK

### **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.

### **NOTE**

**Turning on hard surfaces with locked differentials should be avoided.**

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.

### **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).

- The wheels are not spinning at the time of engagement.

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

- When operating the differential lock, position the switch to the locked position with the crane stationary or at slow speed.
- 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.
- Proceed over the poor road condition cautiously.

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

- Position the differential lock (AXLE DIFF) switch to the UNLOCK position while maintaining slow speed.
- 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.
- 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.**

- Ensure the tires are inflated to the recommended pressure. Refer to the Load Chart Book in the crane cab for proper inflation pressures.
- 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.

- 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.
- 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.
- 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.**

- 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**

The main hydraulic pumps are mounted on the torque converter drive pad. The hydraulic oil cooler pump is mounted on the engine. 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.**

#### 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.

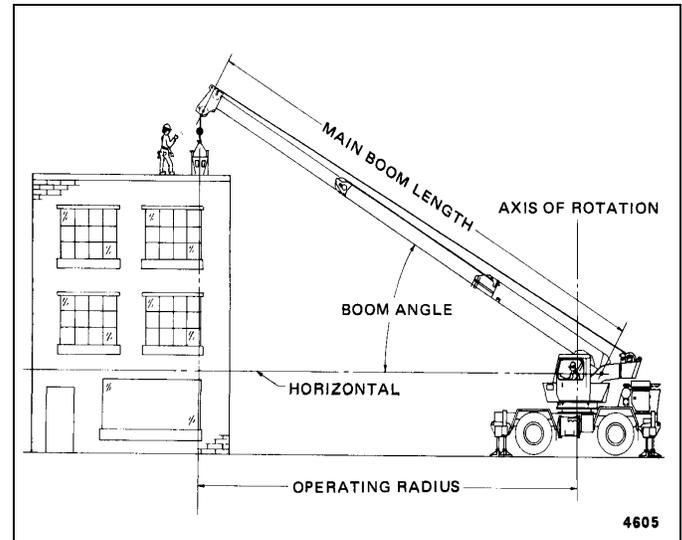
#### USING YOUR LOAD CHART

#### NOTE

**One of the most important tools of every Grove crane is the load chart found in the crane operator's cab.**

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

The load chart contains outrigger capacity charts for fully extended, mid extended, outriggers for the main boom and boom extension, and fully retracted outrigger beams for main boom only. In addition, the load chart contains two on-rubber capacity charts: 360° stationary, and pick and carry over front.



#### Terms to Know

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 or boom extension lengths and offsets. The number at the intersection of the left column and top row is the total load capacity for that load radius and boom length or boom extension lengths offset. 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 cylin-

ders in the fully 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.

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, FULLY RETRACTED, 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 OR RETRACTED 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.**

**CAUTION**

**THE CAB MUST BE LEVEL WHEN DRIVING MACHINE.**

**NOTE**

**Cab must be in lowered position while leveling machine.**

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.
  - 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.

**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.**

**NOTE**

**Stabilizer floats weigh approximately 43 kg (95 lb).**

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.

**SWINGING THE BOOM**

**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.

**DANGER**

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**

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, the SWING control lever is pushed forward, away from the operator, to swing CLOCKWISE, or pulled back, toward the operator, to swing 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.

**ELEVATING AND LOWERING THE BOOM**

**Elevating the Boom**

**DANGER**

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**

**DANGER**

KEEP THE AREA BENEATH THE BOOM CLEAR OF ALL OBSTRUCTIONS AND PERSONNEL WHEN LOWERING THE BOOM.

**DANGER**

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****Extending the Boom****DANGER**

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**

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

To extend the boom, push on the top of the TELESCOPE control foot pedal.

**Retracting the Boom****DANGER**

WHEN RETRACTING THE BOOM, THE LOAD WILL LOWER UNLESS THE HOIST CABLE IS TAKEN IN AT THE SAME TIME.

To retract the boom, push on the bottom of the TELESCOPE control foot pedal.

**LOWERING AND RAISING THE HOIST CABLE****DANGER**

KEEP THE AREA BENEATH THE LOAD CLEAR OF ALL OBSTRUCTIONS AND PERSONNEL WHEN LOWERING OR RAISING THE CABLE (LOAD).

**DANGER**

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.

**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

**RAISING AND LOWERING THE HYDRAULIC BOOM EXTENSION**

The normal operating range for lifting loads with the hydraulic boom extension is an extension offset of 5 - 40 degrees. The extension must be retracted to 0 degree offset for stowage on the side of the boom.

The hydraulic luffing boom extension is controlled by two switches in the seat on the left hand seat armrest. The extension is controlled by an ON/OFF switch and a RAISE/LOWER switch. See SECTION 3 - CAB CONTROLS AND INDICATORS for location and description of these switches.

The boom extension may also be controlled by two remote stations on the extension. The first station is located on the boom extension adapter section, while the second station is located at the head of the boom extension base section.

To raise the extension at the remote stations, press switch 2401 at the extension adapter or switch 2403 at the head of the base section.

**Raising the Hydraulic Boom Extension**

The luffing jib ON/OFF switch must be in the ON position. Push the luffing jib RAISE/LOWER switch to the RAISE position and hold until the extension is raised to the desired position or a switch-off point is reached.

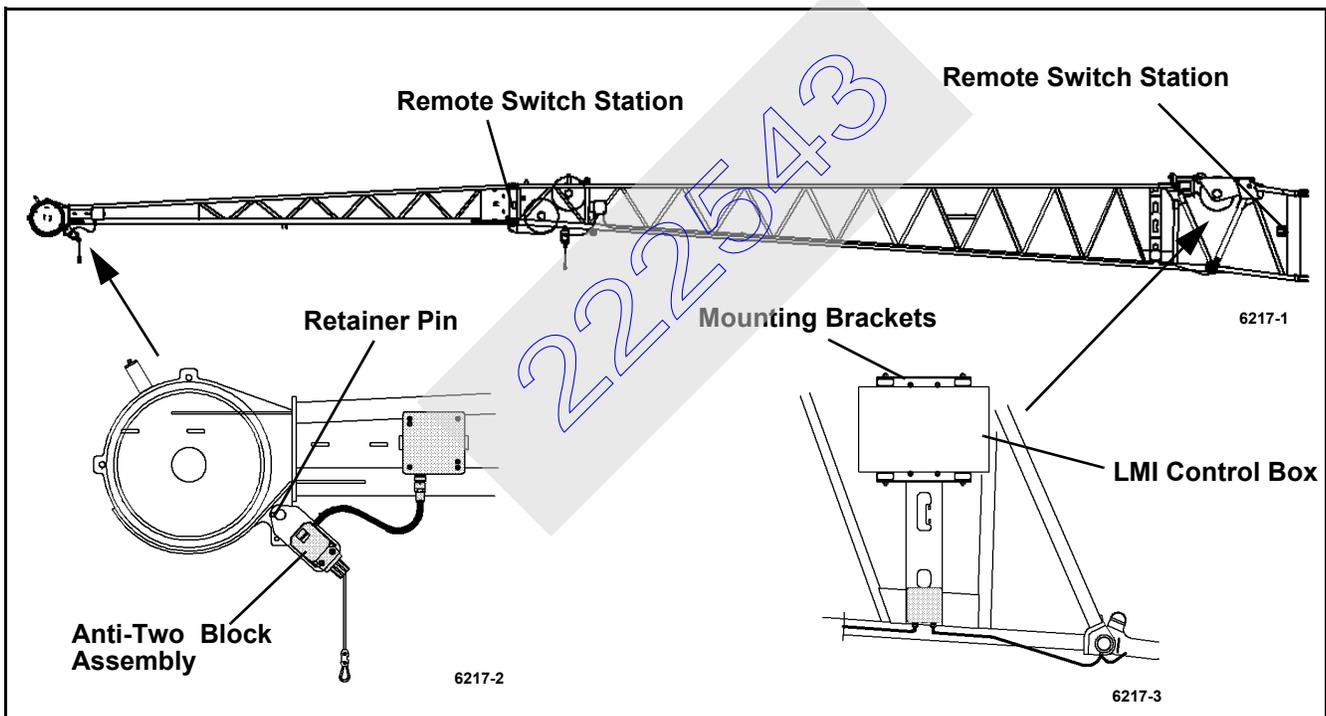
**Lowering the Hydraulic Boom Extension**

**DANGER**

**WHEN LOWERING THE BOOM EXTENSION, SIMULTANEOUSLY LET OUT THE HOIST CABLE TO PREVENT TWO-BLOCKING THE EXTENSION SHEAVE AND THE HOOKBLOCK OR HEADACHE BALL.**

To raise the extension to 0 degree offset for extension stowage, the load moment indicating (LMI) system must be overridden. See the manufacturer’s LMI Operating Manual supplied with the crane for instructions.

The luffing jib ON/OFF switch must be in the ON position. Push the luffing jib RAISE/LOWER switch to the LOWER position and hold until the extension is lowered to the desired position or a switch-off point is reached.



LMI Luffing Extension

To lower the extension at the remote stations, press switch 2402 at the extension adapter or switch 2404 at the head of the base section.

**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.**

**OPERATIONAL AIDS**

**DANGER**

**ELECTRONIC EQUIPMENT ON THIS CRANE IS INTENDED AS AN AID TO THE OPERATOR. UNDER NO CONDITION**

**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 front console of the operator's cab. When an overload condition is sensed, the system provides the operator with a visual and audible warning, and locks out the control levers to prevent lowering the boom, extending the boom, or raising the main or auxiliary hoist cables.

Three additional features are included within the 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 (located in the directional control valves) which are in series between the hydraulic remote control valves in the cab and the pilot-operated directional control valves. When the valves are actuated, they prevent pilot flow between the hydraulic remote control valve in the cab and the appropriate directional control valve. The valves are activated in such a manner as to prevent worsening the condition, i.e. boom down, telescope out, or hoist up. The control lever lockout system is used with the anti-two-block system or the 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.
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.

NOTES \_\_\_\_\_



## 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 Grove Crane Care.

#### CAUTION

**CHASSIS GREASE LUBRICANTS MUST NOT BE APPLIED WITH AIR PRESSURE DEVICES AS THIS LUBRICANT IS USED ON SEALED FITTINGS.**

#### CAUTION

**THE MULTIPURPOSE GREASE INSTALLED DURING MANUFACTURE IS OF A LITHIUM BASE. USE OF A NONCOMPATIBLE GREASE COULD RESULT IN DAMAGE TO EQUIPMENT.**

#### **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 Grove Crane Care.

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.

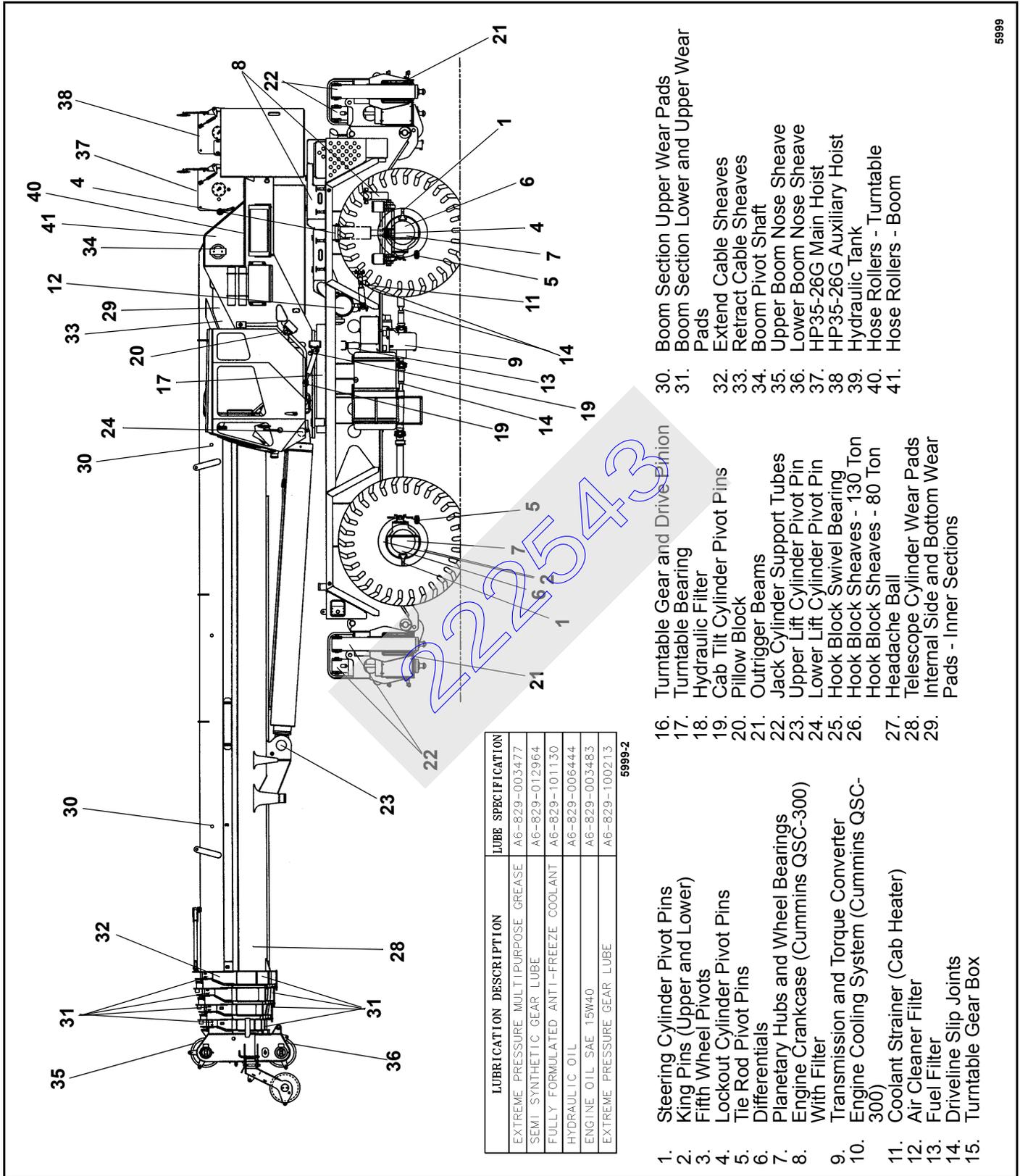
Where wear pads are used, cycle the components and relubricate to ensure complete lubrication of the entire wear area.

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.

### LUBE SYMBOL CHART

Symbol	Description
AFC	Antifreeze/Coolant - SAE J1034, Cummins Engine 85T8-2, Federal Specification O-A-548.
EO	Engine Oil - SAE 15W-40, API Service Classification CE/SG.
AGMA EP-4	Extreme Pressure Gear Lubricant.
EP-MPG	Extreme Pressure Multipurpose Grease - Lithium Soap Base, NLGI Grade 2.
HYDO	Hydraulic Oil - Must meet John Deere Standard JDM-J20C (Anti-brake chatter) and ISO 4406 level 17/14.
SSGL-5	Semi-Synthetic Gear Lubricant - SAE Grade 80W-90, API Service Designation GL-5.

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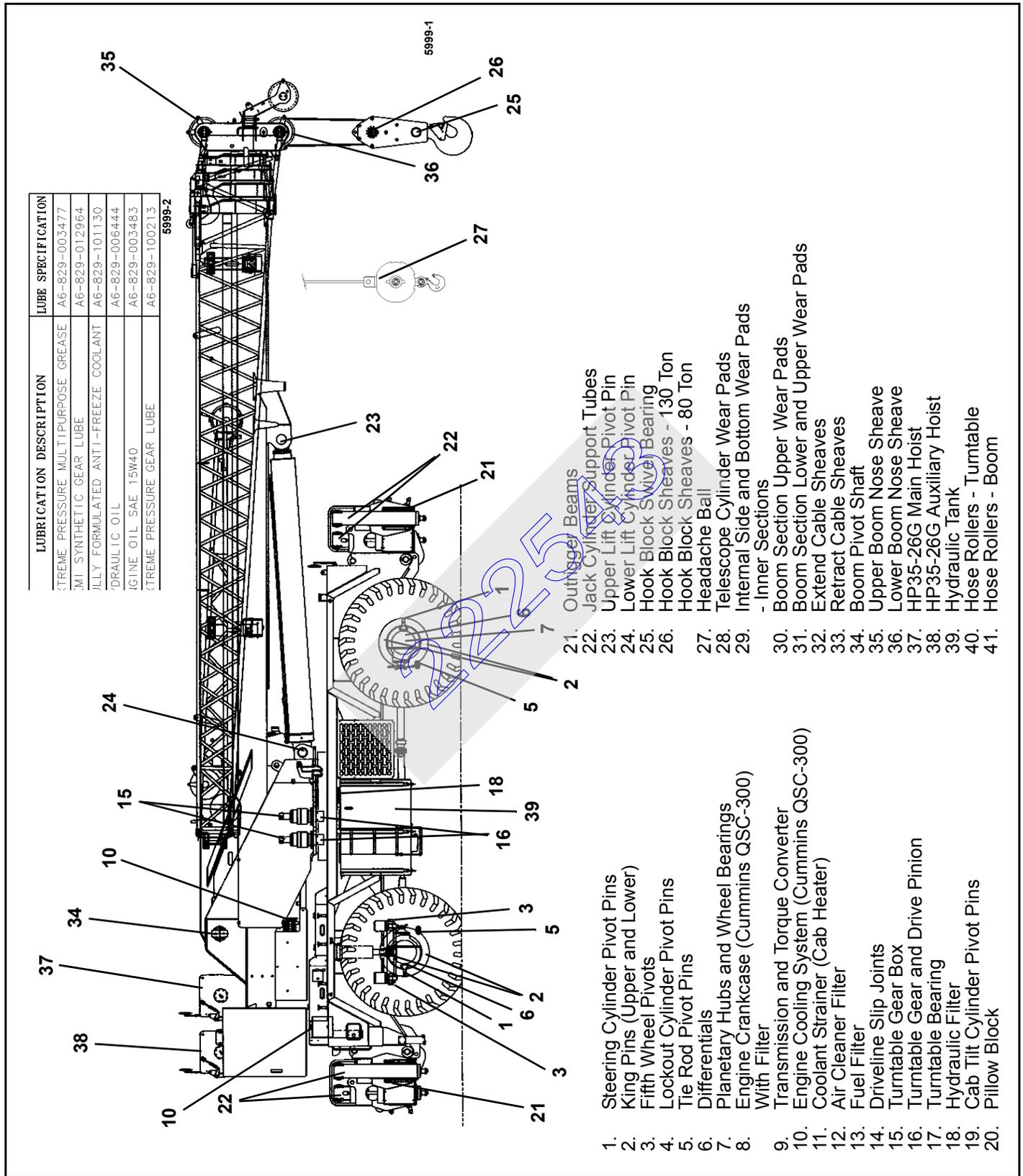
LUBRICATION DESCRIPTION	LUBE SPECIFICATION
EXTREME PRESSURE MULTI PURPOSE GREASE	A6-829-003477
SEMI SYNTHETIC GEAR LUBE	A6-829-012964
FULLY FORMULATED ANTI-FREEZE COOLANT	A6-829-101130
HYDRAULIC OIL	A6-829-006444
ENGINE OIL SAE 15W40	A6-829-003483
EXTREME PRESSURE GEAR LUBE	A6-829-100213

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- |  |  |   |
|--|--|---|
| <ul style="list-style-type: none"> <li>1. Steering Cylinder Pivot Pins</li> <li>2. King Pins (Upper and Lower)</li> <li>3. Fifth Wheel Pivots</li> <li>4. Lockout Cylinder Pivot Pins</li> <li>5. Tie Rod Pivot Pins</li> <li>6. Differentials</li> <li>7. Planetary Hubs and Wheel Bearings</li> <li>8. Engine Crankcase (Cummins QSC-300) With Filter</li> <li>9. Transmission and Torque Converter</li> <li>10. Engine Cooling System (Cummins QSC-300)</li> <li>11. Coolant Strainer (Cab Heater)</li> <li>12. Air Cleaner Filter</li> <li>13. Fuel Filter</li> <li>14. Driveline Slip Joints</li> <li>15. Turntable Gear Box</li> </ul> | <ul style="list-style-type: none"> <li>16. Turntable Gear and Drive Union</li> <li>17. Turntable Bearing</li> <li>18. Hydraulic Filter</li> <li>19. Cab Tilt Cylinder Pivot Pins</li> <li>20. Pillow Block</li> <li>21. Outrigger Beams</li> <li>22. Jack Cylinder Support Tubes</li> <li>23. Upper Lift Cylinder Pivot Pin</li> <li>24. Lower Lift Cylinder Pivot Pin</li> <li>25. Hook Block Swivel Bearing</li> <li>26. Hook Block Sheaves - 130 Ton</li> <li>27. Headache Ball</li> <li>28. Telescope Cylinder Wear Pads</li> <li>29. Internal Side and Bottom Wear Pads - Inner Sections</li> </ul> | <ul style="list-style-type: none"> <li>30. Boom Section Upper Wear Pads</li> <li>31. Boom Section Lower and Upper Wear Pads</li> <li>32. Extend Cable Sheaves</li> <li>33. Retract Cable Sheaves</li> <li>34. Boom Pivot Shaft</li> <li>35. Upper Boom Nose Sheave</li> <li>36. Lower Boom Nose Sheave</li> <li>37. HP35-26G Main Hoist</li> <li>38. HP35-26G Auxiliary Hoist</li> <li>39. Hydraulic Tank</li> <li>40. Hose Rollers - Turntable</li> <li>41. Hose Rollers - Boom</li> </ul> |
|--|--|---|

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Lubrication Chart (Sheet 1 of 2)



Lubrication Chart (Sheet 2 of 2)

**CAUTION**

**THE FOLLOWING LUBE INTERVALS ARE TO BE USED AS A GUIDELINE ONLY. ACTUAL LUBE INTERVALS SHOULD BE FORMULATED BY THE OPERATOR TO CORRESPOND ACCORDINGLY TO CONDITIONS SUCH AS CONTINUOUS DUTY CYCLES AND/OR HAZARDOUS ENVIRONMENTS.**

**1. Steering Cylinder Pivot Pins.**

Lube Type - EP-MPG  
Lube Interval - 500 hours or 3 months  
Lube Amount - Until grease extrudes  
Application - 8 grease fittings

**2. 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

**3. Fifth Wheel Pivots.**

Lube Type - EP-MPG  
Lube Interval - 500 hours or 3 months  
Lube Amount - Until grease extrudes  
Application - 2 grease fittings

**4. Lockout Cylinder Pivot Pins.**

Lube Type - EP-MPG  
Lube Interval - 500 hours or 3 months  
Lube Amount - Until grease extrudes  
Application - 4 fittings

**5. Tie Rod Pivot Pins**

Lube Type - EP-MPG  
Lube Interval - 500 hours or 3 months  
Lube Amount - Until grease extrudes  
Application - 4 fittings

**6. 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.**

**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](http://www.arvinmeritor.com) or by contacting Grove Customer Support.**

Lube Amount - Capacity - 27.3 liters (58 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.

**7. 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.  
Lube Amount - 11.3 liters (24.0 pints)  
Application - Fill to the bottom of the level hole in the housing with the fill plug and the oil level mark horizontal.

**8. Engine Crankcase (Cummins QSC-300).**

Lube Type - EO - 15W40  
Lube Interval - Check fluid level every 10 hours or daily; drain, fill and replace filter every 500 hours.  
Lube Amount - Capacity - 19.9 liters (21 quarts)  
Application - Fill to full mark on dipstick.

**9. Transmission, Torque Converter and Filter.**

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:

1. Fill to FULL mark on dipstick.
2. Run engine at 800 rpm to prime torque converter and lines.
3. 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.

**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 32.2 liters (34 quarts).  
Application - Through fill pipe to FULL mark on dipstick.

**10. Engine Cooling System (Cummins QSC-300).**

Lube Type - AFC-50/50  
Lube Interval - Check coolant level every 10 hours or daily; drain and refill cooling system every 2000 hours or 12 months.  
Lube Amount - Capacity - 34.1 liters (36 quarts)  
Application - Fill surge tank to bottom of filler neck with AFC50/50. Run engine through two (2) thermal cycles. Check coolant level and refill as required.

**11. Coolant Strainer (Cab Heater).**

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

**12. Air Cleaner Filter.**

Replace air cleaner filter element when indicator shows red (25" H<sub>2</sub>O).

**13. Fuel Filter.**

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

**14. 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

**15. 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 200 hours or 12 months thereafter.  
Lube Amount - Capacity - 5 liters (5.28 quarts)  
Application - Fill mark on dipstick.

**16. Turntable Gear and Drive Pinion.**

Lube Type - EP-MPG  
Lube Interval - 500 hours or 6 months  
Lube Amount - Coat all teeth  
Application - Brush on

**17. 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.

**18. Hydraulic Filter.**

Change the filter when the indicator is red.

**19. Cab Tilt Cylinder Pivot Pins.**

Lube Type - EP-MPG  
 Lube Interval - 500 hours or 3 months  
 Lube Amount - Until grease extrudes  
 Application - 2 grease fittings

**20. Pillow Block.**

Lube Type - EP-MPG  
 Lube Interval - 500 hours or 3 months  
 Lube Amount - Until grease extrudes  
 Application - 2 grease fittings

**21. Outrigger Beams.**

Lube Type - EP-MPG  
 Lube Interval - 500 hours or 6 months  
 Lube Amount - Thoroughly coat the area the beam moves on.  
 Application - By brush; 16 places; extend beams fully and coat the bottom plate.

**22. Jack Cylinder Support Tubes.**

Lube Type - EP-MPG  
 Lube Interval - 500 hours or 6 months  
 Lube Amount - Spread grease on ID of jack cylinder support tubes before installing jack cylinders.  
 Application - By brush; 4 places

**23. Upper Lift Cylinder Pivot Pin.**

Lube Type - EP-MPG  
 Lube Interval - 500 hours or every 3 months  
 Lube Amount - Until grease extrudes  
 Application - 1 grease fitting

**24. Lower Lift Cylinder Pivot Pin.**

Lube Type - EP-MPG  
 Lube Interval - 500 hours or 3 months  
 Lube Amount - Until grease extrudes  
 Application - 2 grease fittings

**25. Hook Block Swivel Bearing.**

Lube Type - EP-MPG  
 Lube Interval - 250 hours or 3 months

Lube Amount - Until grease extrudes  
 Application - 1 grease fitting

**26. 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  
 (8 fittings total - 130 ton)  
 (5 fittings total - 80 ton)

**27. Headache Ball.**

Lube Type - EP-MPG  
 Lube Interval - 250 hours or 3 months  
 Lube Amount - Until grease extrudes  
 Application - 1 grease fitting

**28. Telescope Cylinder Wear Pads.**

Lube Type - EP-MPG  
 Lube Interval - Every boom teardown.  
 Lube Amount - Thoroughly coat all areas the wear pad moves on.  
 Application - By brush; 5 places

**NOTE**

Should boom chatter or rubbing noises in the boom occur, it will be necessary to lubricate the telescope cylinder wear pads. By adding an extension adapter to a grease gun the wear pads and wear areas can be reached through the lubrication access holes in the side of the boom and through the access hole in the boom nose between the sheaves.

**NOTE**

Lubricate more frequently than interval indicated in table if environmental conditions and/or operating conditions necessitate.

**29. Internal Side and Bottom Wear Pads.**

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

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

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

**30. Boom Section Upper Rear Wear Pads.**

Lube Type - EP-MPG

Lube Interval - 50 hours or 1 week

Lube Amount - Until grease extrudes

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

**31. Boom Section Upper and 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; 6 places; with boom in extended position.

**32. Extend Cable Sheaves.**

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

Lube Amount - Until grease extrudes

Application - 1 grease fitting; extend boom for entry through access holes in fly and outer mid sections.

**33. Retract Cable Sheaves.**

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

Lube Amount - Until grease extrudes

Application - 2 grease fittings; extend boom for entry through access holes in front of inner mid section.

**34. 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

**35. 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

**36. 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

**37. Main Hoist.**

Lube Type - AGMA EP-4

Lube Interval - Every 1000 hours or 12 months

Lube Amount - Capacity - 20.8 liters (22 quarts)

Application - Fill until level with the check plug opening.

**38. Auxiliary Hoist.**

Lube Type - AGMA EP-4

Lube Interval - Every 1000 hours or 12 months

Lube Amount - Capacity - 20.8 liters (22 quarts)

Application - Fill until level with the check plug opening.

**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 - 1226.5 liters (324 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. Hose Rollers - Turntable.**

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

Lube Amount - Until grease extrudes

Application - 2 grease fittings

**41. Hose Rollers - Boom.**

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

Lube Amount - Until grease extrudes

Application - 8 grease fittings

**WIRE ROPE LUBRICATION**

Wire rope is lubricated during manufacturing so that the strands, and individual wires in strands, may move as the rope moves and bends. A wire rope cannot be lubricated sufficiently during manufacture to last its entire life.

Therefore, new lubricant must be added periodically throughout the life of a rope to replace factory lubricant which is used or lost. For more detailed information concerning the lubrication and inspection of wire rope, refer to WIRE ROPE in Chapter 1, Section 2 - GENERAL MAINTENANCE in the Service Manual.

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*NOTES*

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## SECTION 6

# 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.**

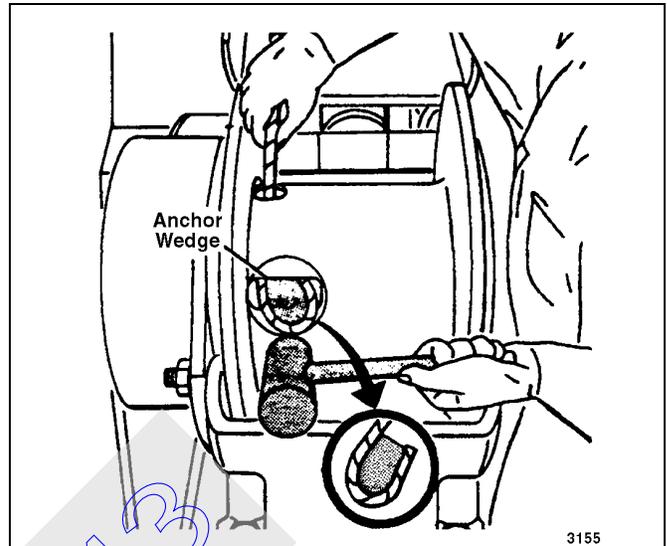
Install cable on the hoist drum in accordance with the following procedure.

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.

#### 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.



Installing the Cable Anchor Wedge

#### NOTE

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

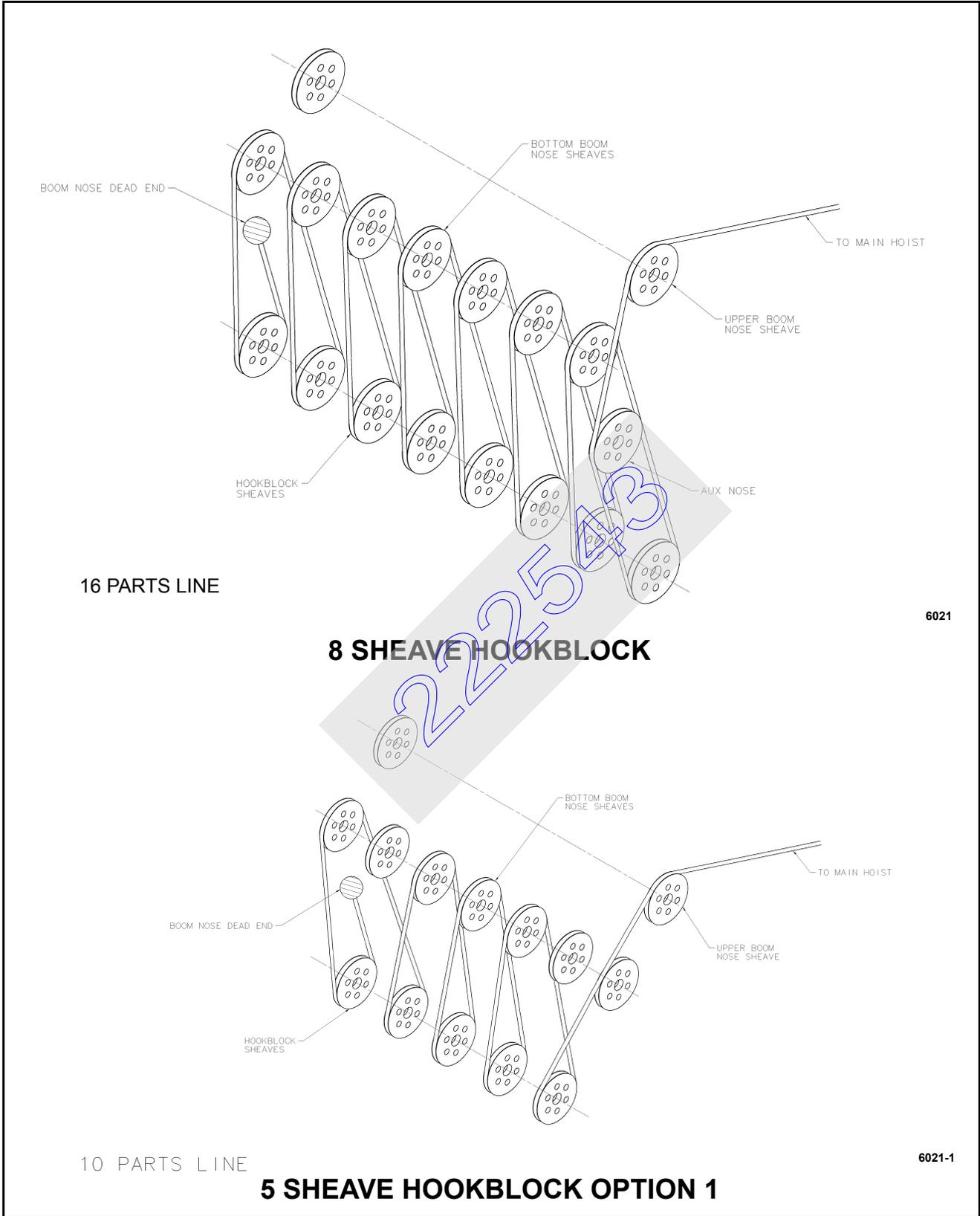
5. Slowly rotate the drum, ensuring the first layer of cable is evenly wound onto the drum.
6. Install the remainder of the cable, as applicable.

### CABLE REEVING

#### NOTE

**There are two types of cable (wire rope) available on this crane; 6 x 36 WS and 35 x 7 (non-rotating).**

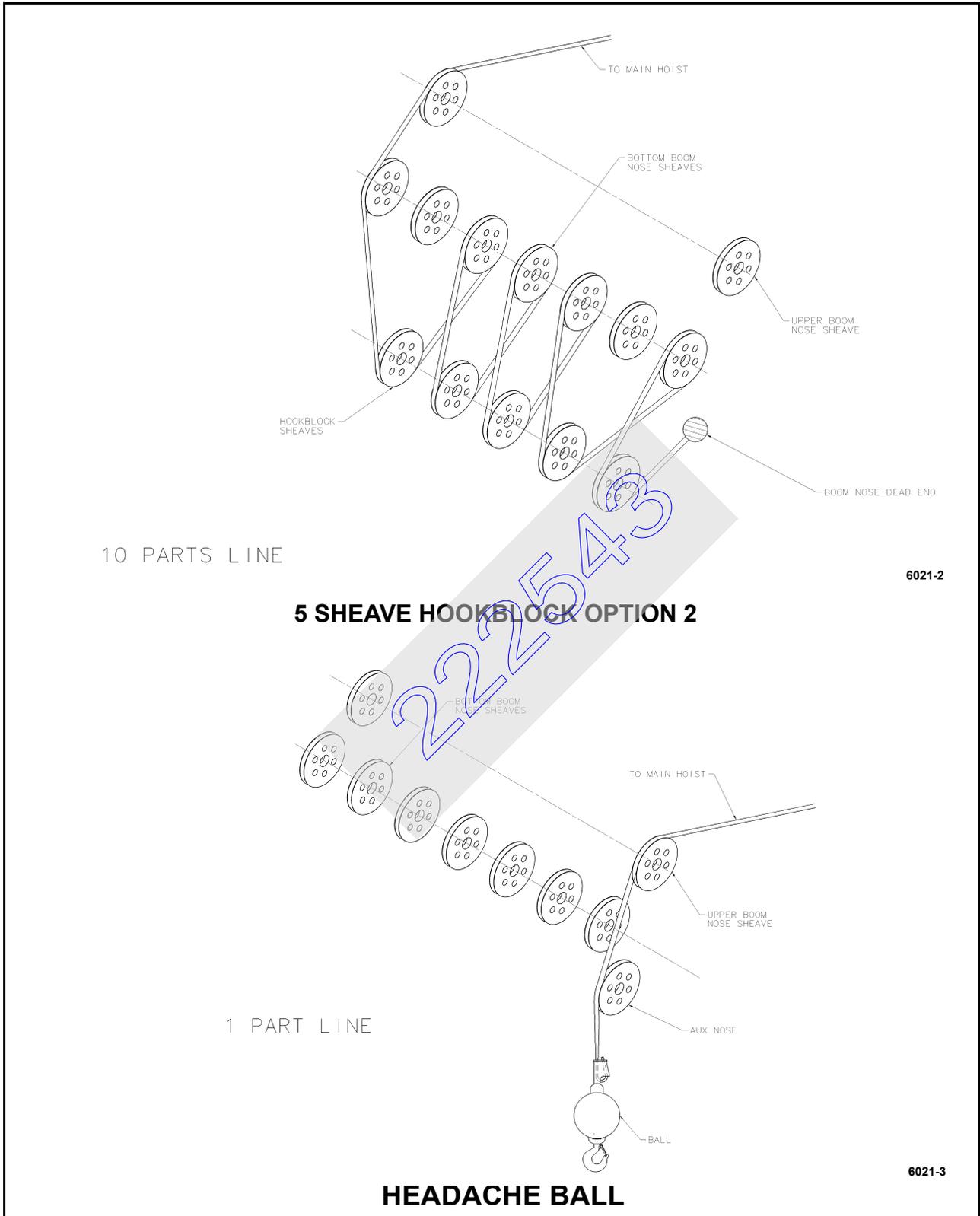
Within the limits of the load and range charts and permissible line pull, multi-part lines allow the operator to raise a greater load than can be raised with a single part line. Various cable reeving (part line) is possible with the boom nose and hook block. This reeving should be accomplished by a qualified rigger using standard rigging procedures (see figure titled Reeving).



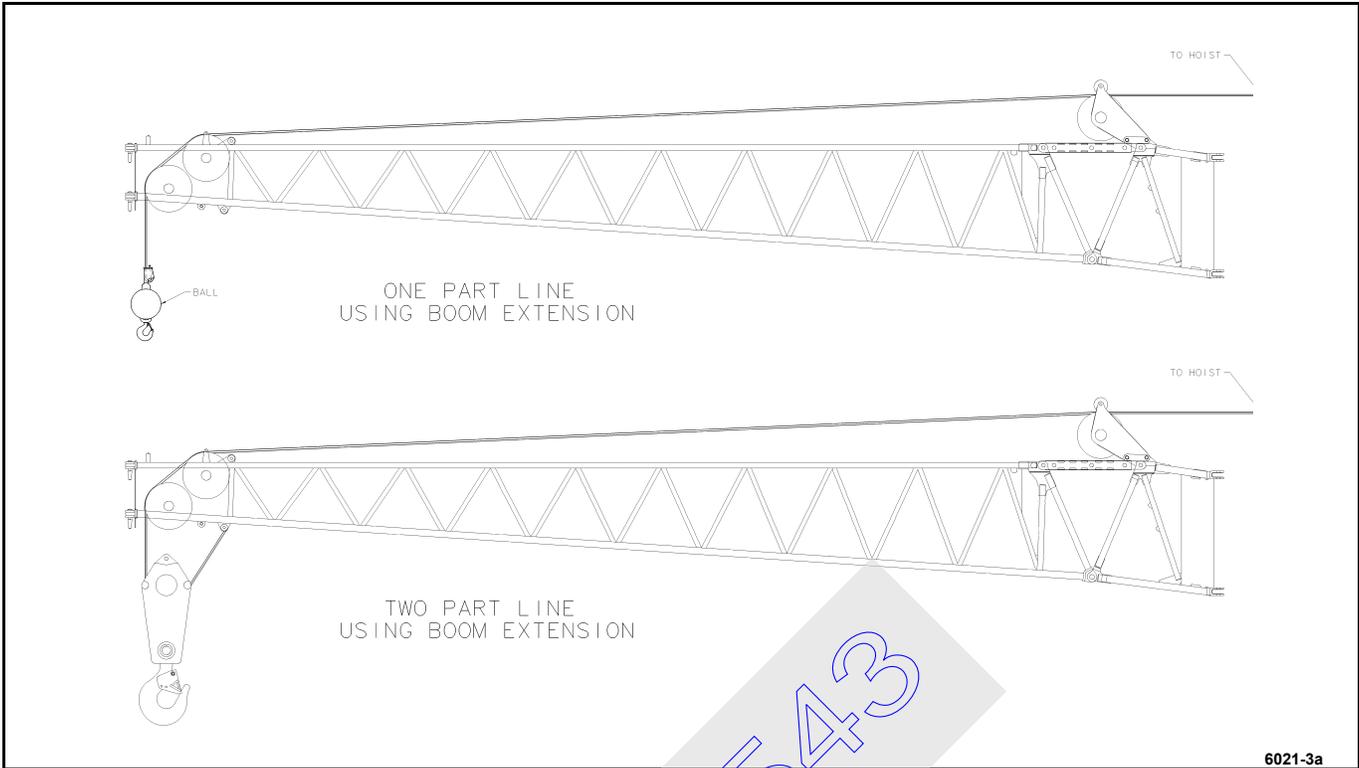
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Reeving Diagram (Sheet 1 of 3)



Reeving Diagram (Sheet 2 of 3)



Reeving Diagram (Sheet 3 of 3)

**STANDARD COUNTERWEIGHT AND AUXILIARY HOIST MOUNTING STRUCTURE****Removal**

1. Position the crane on a firm, level surface. Fully extend and set the outriggers. Level the crane.
2. Install the counterweight supports on the front of the carrier. Pin each support to the frame rails using the hitch pins and rotate until supports come to rest on top of the outrigger box.
3. Swing the superstructure over the rear with the counterweight positioned over the carrier deck counterweight locating pins. Engage the swing lock pin.
4. Remove any load handling device from the auxiliary hoist cable and retract all cable onto the hoist drum. Secure the cable.
5. Disconnect the auxiliary hoist hydraulic lines and secure. Do not disconnect the counterweight removal hydraulic lines.

**NOTE**

**It may be necessary to retract the counterweight removal cylinders to relieve weight from the upper counterweight/auxiliary hoist mounting pins.**

6. Remove the retaining pins and the counterweight/auxiliary hoist mounting pins which are accessible through the holes in the back of the counterweight.

**DANGER**

**DO NOT ACTIVATE THE CONTROL LEVER FOR THE AUXILIARY HOIST MOUNTING STRUCTURE AT THIS TIME.**

7. Using the control levers, extend the counterweight removal cylinders and carefully lower the counterweight to the counterweight supports.
8. Remove the retaining pins for the auxiliary hoist mounting structure pin.
9. Activate the pinning **control lever** to unpin the auxiliary hoist structure, then retract the counterweight

removal cylinders and carefully lower the auxiliary hoist structure onto the counterweight.

10. Disconnect the counterweight removal hydraulic lines and auxiliary hoist electrical cables and secure them.

**DANGER**

**TRAVEL IS NOT PERMITTED WITH ANY COUNTERWEIGHT ON THE CARRIER.**

11. Replace the counterweight/auxiliary hoist mounting pins and retaining pins.

**DANGER**

**DO NOT ATTEMPT TO SEPARATE THE AUXILIARY HOIST STRUCTURE FROM THE COUNTERWEIGHT WHILE ON THE COUNTERWEIGHT STAND. THE AUXILIARY HOIST STRUCTURE MAY HIT THE COUNTERWEIGHT AND KNOCK IT OFF THE STAND.**

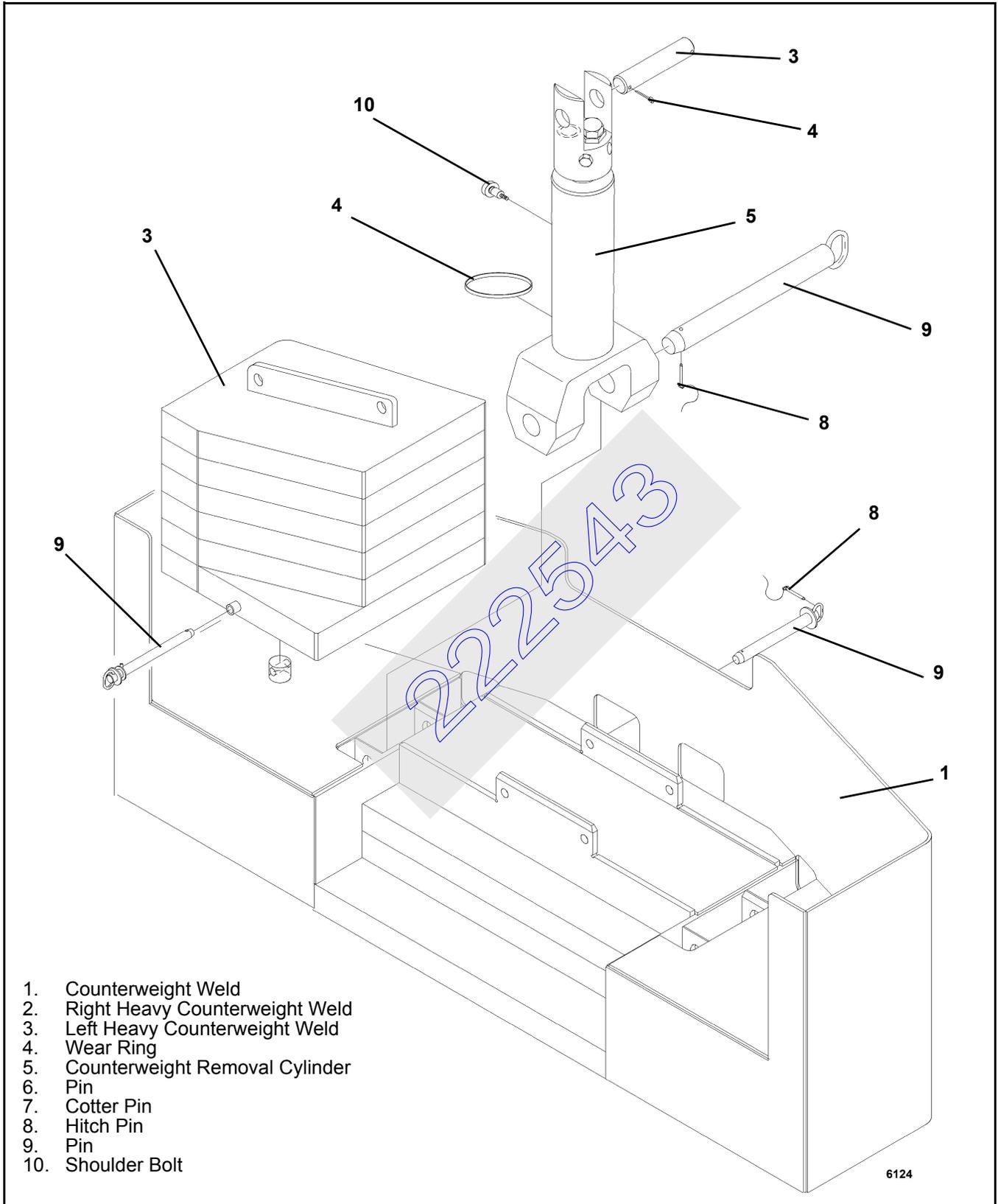
12. Disengage the swing lock pin and swing the superstructure over the front.
13. Properly attach the supplied slings to the auxiliary hoist structure and use the crane to carefully transfer the auxiliary hoist structure and counterweight to the ground or suitable transport vehicle.
14. **Remove the counterweight supports on the front of the carrier.**

**Installation**

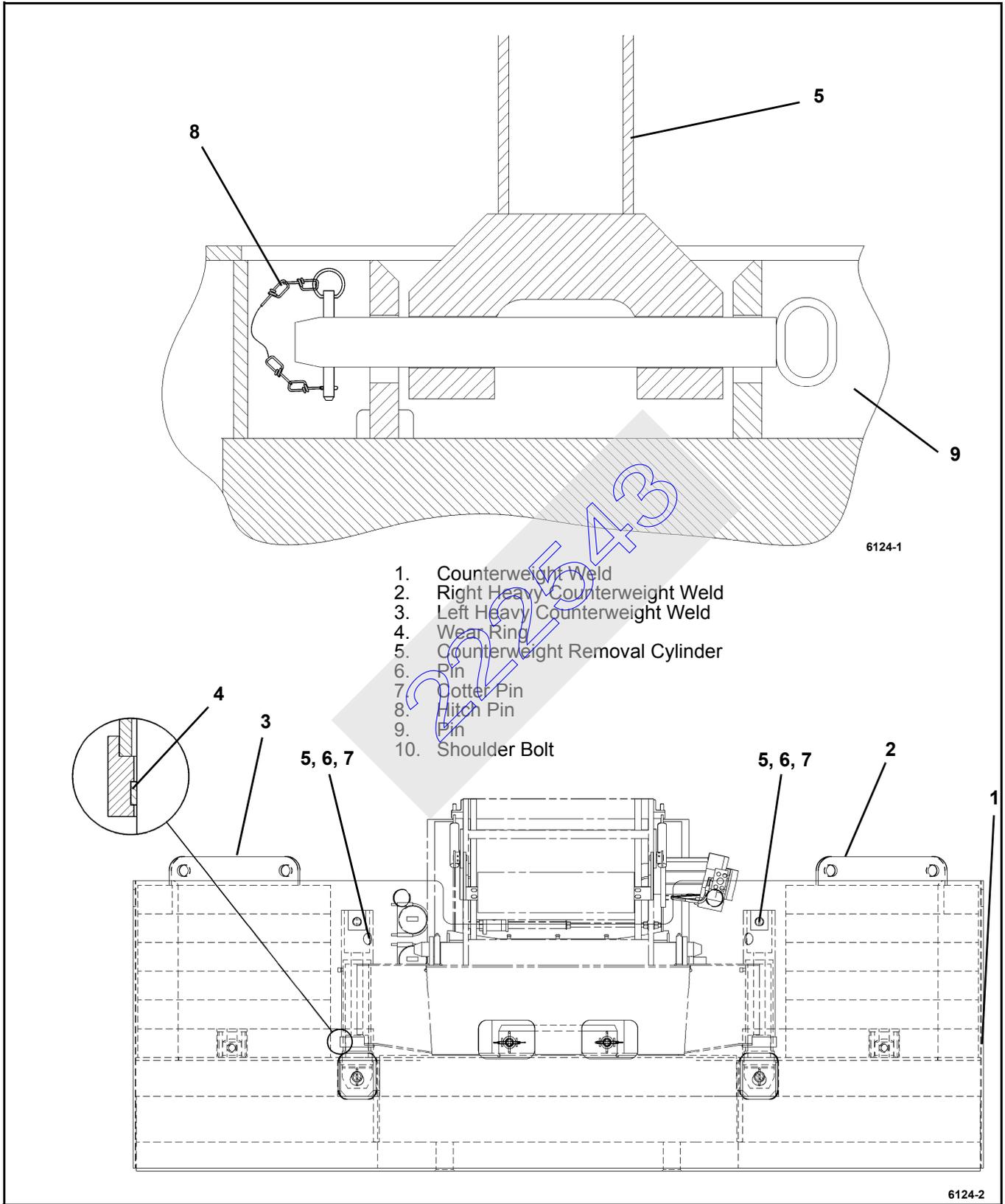
1. Position the crane on a firm, level surface. Fully extend and set the outriggers. Level the crane.

**DANGER**

**ASSEMBLE THE COUNTERWEIGHT AND AUXILIARY HOIST STRUCTURE ON THE GROUND OR ON A SUITABLE TRANSPORT VEHICLE. DO NOT ATTEMPT TO ASSEMBLE ON THE COUNTERWEIGHT STAND. THE AUXILIARY HOIST STRUCTURE MAY HIT THE COUNTERWEIGHT AND KNOCK IT OFF THE STAND.**



Counterweight Removal and Installation (Sheet 1 of 2)



Counterweight Removal and Installation (Sheet 2 of 2)

2. Properly attach the supplied slings to the auxiliary hoist structure and use the crane to carefully transfer the auxiliary hoist structure to the counterweight.
3. Install the counterweight removal cylinder/counterweight pins and retaining pins. Install the counterweight/auxiliary hoist mounting pins and retaining pins.

**DANGER**

**THE MAIN BOOM MUST NOT BE LOWERED BELOW HORIZONTAL WHILE SWINGING OVER THE FRONT WHILE THE COUNTERWEIGHT SUPPORTS ARE INSTALLED.**

4. Install the counterweight supports on the front of the carrier. Pin each support to the frame rails using the hitch pins and rotate until supports come to rest on top of the outrigger box.
5. Properly attach the supplied slings and use the crane to carefully transfer the auxiliary hoist and counterweight to the counterweight stand.

**DANGER**

**THE MAIN BOOM MUST NOT BE ELEVATED ABOVE HORIZONTAL WHILE SWINGING INTO THE AUXILIARY HOIST MOUNTING STRUCTURE.**

6. Swing the superstructure over the rear and engage the swing lock pin.
7. Connect the counterweight removal cylinder hydraulic lines and auxiliary hoist electrical cables.
8. Remove the retaining pins and counterweight/auxiliary hoist mounting pins.
9. Using the control levers, fully extend the counterweight removal cylinders and carefully raise the auxiliary hoist structure to meet the mating plates on the turntable.
10. Activate the control lever to pin the auxiliary hoist structure and install the retaining pins. Then retract the counterweight removal cylinders and carefully raise the counterweight to the working position.
11. Replace the counterweight/auxiliary hoist mounting pins and retaining pins.

**CAUTION**

**DO NOT POWER THE COUNTERWEIGHT INTO THE COUNTERWEIGHT/AUXILIARY HOIST MOUNTING PINS.**

12. Slowly extend the counterweight removal cylinders so the counterweight/auxiliary hoist mounting pins take the weight of the counterweight.
13. Connect the auxiliary hoist hydraulic lines.

**HEAVY COUNTERWEIGHT ASSEMBLY AND AUXILIARY HOIST MOUNTING STRUCTURE****Removal**

1. Position the crane on a firm, level surface. Fully extend and set the outriggers. Level the crane.
2. Install the counterweight supports on the front of the carrier. Pin each support to the frame rails using the hitch pins and rotate until supports come to rest on the top of the outrigger box.
3. Swing the superstructure over the rear with the counterweight positioned over the carrier deck counterweight locating pins. Engage the swing lock pin.
4. Remove any load handling device from the auxiliary hoist cable and retract all cable onto the hoist drum. Secure the cable.
5. Disconnect the auxiliary hoist hydraulic lines and secure. Do not disconnect the counterweight removal hydraulic lines.

**NOTE**

**It may be necessary to retract the counterweight removal cylinders to relieve weight from the upper counterweight/auxiliary hoist mounting pins.**

6. Remove the retaining pins and the counterweight/auxiliary hoist mounting pins which are accessible through the holes in the back of the counterweight.

**DANGER**

**DO NOT ACTIVATE THE CONTROL LEVER FOR THE AUXILIARY HOIST MOUNTING STRUCTURE AT THIS TIME.**

7. Using the control levers, extend the counterweight removal cylinders and carefully lower the heavy counterweight assembly to the counterweight supports.
8. Remove the retaining pins for the auxiliary hoist mounting structure pin.
9. Activate the control lever to unpin the auxiliary hoist structure, then retract the counterweight removal cylinders and carefully lower the auxiliary hoist structure onto the counterweight.
10. Disconnect the counterweight removal hydraulic lines and auxiliary hoist electrical cables and secure them.

**DANGER**

**TRAVEL IS NOT PERMITTED WITH ANY COUNTERWEIGHT ON THE CARRIER.**

11. Replace the counterweight/auxiliary hoist mounting pins and retaining pins.

**DANGER**

**DO NOT ATTEMPT TO SEPARATE THE AUXILIARY HOIST STRUCTURE OR DISASSEMBLE THE HEAVY COUNTERWEIGHTS WHILE THE COUNTERWEIGHT ASSEMBLY IS ON THE COUNTERWEIGHT STAND. THE AUXILIARY HOIST STRUCTURE OR THE HEAVY COUNTERWEIGHTS MAY HIT THE ASSEMBLY AND KNOCK IT OFF THE STAND.**

12. Disengage the swing lock pin and swing the superstructure over the front.

**DANGER**

**DO NOT USE THE LIFTING LUGS ON THE HEAVY COUNTERWEIGHTS TO LIFT THE ENTIRE HEAVY COUNTERWEIGHT/AUXILIARY HOIST ASSEMBLY. THE HEAVY COUNTERWEIGHT LIFTING LUGS ARE DESIGNED TO LIFT THE HEAVY COUNTERWEIGHT ONLY.**

**LIARY HOIST ASSEMBLY. THE HEAVY COUNTERWEIGHT LIFTING LUGS ARE DESIGNED TO LIFT THE HEAVY COUNTERWEIGHT ONLY.**

13. Properly attach the supplied slings to the auxiliary hoist structure and use the crane to carefully transfer the auxiliary hoist structure and heavy counterweight assembly to the ground or to a suitable transport vehicle.

**Installation**

1. Position the crane on a firm, level surface. Fully extend and set the outriggers. Level the crane.

**DANGER**

**ASSEMBLE THE HEAVY COUNTERWEIGHTS AND AUXILIARY HOIST STRUCTURE ON THE GROUND OR ON A SUITABLE TRANSPORT VEHICLE. DO NOT ATTEMPT TO ASSEMBLE ON THE COUNTERWEIGHT STAND. THE AUXILIARY HOIST STRUCTURE OR HEAVY COUNTERWEIGHTS MAY HIT THE ASSEMBLY AND KNOCK IT OFF THE STAND.**

2. Properly attach the supplied slings to the auxiliary hoist structure and use the crane to carefully transfer the auxiliary hoist structure to the standard counterweight.
3. Install the counterweight removal cylinder/counterweight pins and retaining pins. Install the counterweight/auxiliary hoist mounting pins and retaining pins.

**DANGER**

**THE HEAVY COUNTERWEIGHT ASSEMBLY MUST BE INSTALLED WITH BOTH HEAVY COUNTERWEIGHTS. USING ONLY ONE HEAVY COUNTERWEIGHT MAY CAUSE THE CRANE TO BECOME UNSTABLE.**

4. Properly attach the supplied slings to the heavy counterweight lift lug and use the crane to carefully transfer the heavy counterweight to the standard counterweight. Install the heavy counterweight/standard counterweight pin and lock into position. Repeat this step for the second heavy counterweight.

**DANGER**

**THE MAIN BOOM MUST NOT BE LOWERED BELOW HORIZONTAL WHILE SWINGING OVER THE FRONT WHILE THE COUNTERWEIGHT SUPPORTS ARE INSTALLED.**

5. Install the counterweight supports on the front of the carrier. Pin each support to the frame rails using the hitch pins and rotate until supports come to rest on top of the outrigger box.

**DANGER**

**DO NOT USE THE LIFTING LUGS ON THE HEAVY COUNTERWEIGHTS TO LIFT THE ENTIRE HEAVY COUNTERWEIGHT/AUXILIARY HOIST ASSEMBLY. THE HEAVY COUNTERWEIGHT LIFTING LUGS ARE DESIGNED TO LIFT THE HEAVY COUNTERWEIGHT ONLY.**

6. Properly attach the supplied slings and use the crane to carefully transfer the auxiliary hoist and counterweight assembly to the counterweight stand.

**DANGER**

**THE MAIN BOOM MUST NOT BE ELEVATED ABOVE HORIZONTAL WHILE SWINGING INTO THE AUXILIARY HOIST MOUNTING STRUCTURE.**

7. Swing the superstructure over the rear and engage the swing lock pin.
8. Connect the counterweight removal cylinder hydraulic lines and auxiliary hoist electrical cables.
9. Remove the retaining pins and counterweight/auxiliary hoist mounting pins.
10. Using the control levers, fully extend the counterweight removal cylinders and carefully raise the auxiliary hoist structure to meet the mating plates on the turntable.
11. Activate the control lever to pin the auxiliary hoist structure and install the retaining pins. Then retract the counterweight removal cylinders and carefully raise the heavy counterweight assembly to the working position.

12. Replace the counterweight/auxiliary hoist mounting pins and retaining pins.

**CAUTION**

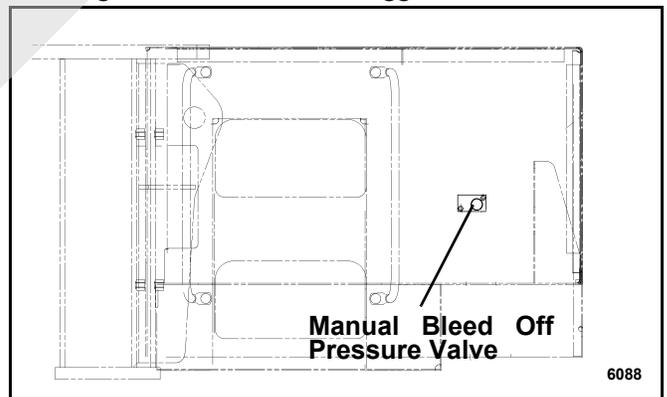
**DO NOT POWER THE COUNTERWEIGHT INTO THE COUNTERWEIGHT/AUXILIARY HOIST MOUNTING PINS.**

13. Slowly extend the counterweight removal cylinders so the counterweight/auxiliary hoist mounting pins take the weight of the heavy counterweight assembly.
14. Connect the auxiliary hoist hydraulic lines.
15. Remove the counterweight supports on the front of the carrier.

**OUTRIGGER REMOVAL AND INSTALLATION**

**Bleed Valve Operation**

The manual bleed off pressure valve is located on the back of the right rear fender. The purpose of the valve is to reduce the effort required to separate and connect the hydraulic quick disconnect couplers when removing or installing the front and rear outrigger boxes.



**Procedure**

1. Shut off the engine.
2. Turn the handle counterclockwise to open the bleed valve.
3. Wait approximately 20 to 30 seconds.
4. As necessary, separate or connect the quick disconnects.
5. Immediately close the bleed valve.

- Restart the engine if necessary.

**CAUTION**

**WHEN LIFTING THE OUTRIGGER BOX WHILE ON RUBBER, THE BOOM MUST BE FULLY RETRACTED AND LIMITED TO A 6 M (20 FT) MAXIMUM RADIUS.**

**CAUTION**

**NO COUNTERWEIGHTS ARE TO BE INSTALLED ON THE SUPERSTRUCTURE IF SWINGING OVER THE SIDE ON RUBBER.**

**CAUTION**

**WITH NO LOAD, THE BOOM ANGLE MUST NOT BE LESS THAN 35° WHEN OVER SIDES OF THE MACHINE SINCE LOSS OF STABILITY WILL OCCUR CAUSING A TIPPING CONDITION. TO LOWER BOOM BELOW 35° BOOM ANGLE, BOOM MUST BE SWUNG OVER FRONT OR REAR AND LMI BYPASS ACTIVATED.**

**CAUTION**

**ONCE ONE OUTRIGGER BOX IS INSTALLED, DO NOT SWING OVER THAT END OF THE MACHINE WHILE INSTALLING THE OTHER OUTRIGGER BOX.**

**REMOVAL**

- Remove the snapper pins in the end of each outrigger pinning cylinder rod ends.
- Using the crane boom for the lifting operation, fasten lifting slings to the lifting lugs provided on each end of the outrigger box.
- Using the remote mounted pinning cylinder control box located on either the left front or the right rear side of the carrier, position and hold the power switch to the "pin Enable" position and the engage/disengage switch to the disengage position until the pinning cylinder rods are fully retracted.
- Disconnect the carrier external electrical connector from the outrigger external connection.
- Disconnect the carrier hydraulic quick disconnects from the external connections of the outrigger. Stow the carrier lines inside the fender.
- Lift the outrigger box from the carrier.

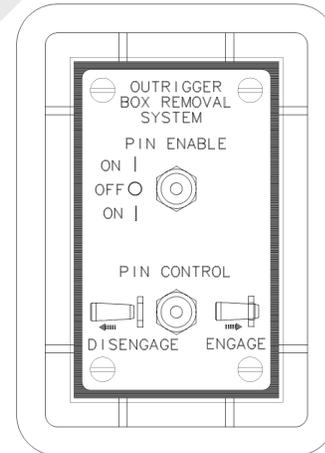
- Stow the snapper pins in the stowage clamps on the outrigger box.

**INSTALLATION**

**NOTE**

**The front and rear outrigger box weighs approximately 4306.8 kg (9494.7 lb).**

- Using the lifting slings supplied with the crane and fasten them to the lifting lugs provided on each end of the outrigger box.
- Lift and position the outrigger box parallel with the rear/front of the carrier.
- Install the carrier external electrical connector to the outrigger external connection.
- Install the carrier hydraulic quick disconnects to the external connections of the outrigger.
- Lower the outrigger box and align the hydraulic outrigger mounting pins with the attach points on the carrier frame.



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Remote Mounted Pin Control Box

- Using the remote mounted pin control box located on either the left front or the right rear side of the carrier, position and hold the Power Switch to the "Pin Enable" position and the Engage/Disengage Switch to the ENGAGE or DISENGAGE position.

**DANGER**

**THE RETAINING PINS MUST BE PROPERLY INSTALLED AND SECURED IN THE POWER CYLINDER ROD ENDS WHENEVER THE OUTRIGGER BOX IS ON THE CARRIER.**

7. After the hydraulic cylinder rods have been activated, install the snapper pin in the end of each power cylinder rod ends.

**CAUTION**

**IF SWINGING THE OUTRIGGER BOX OVER THE SIDE WHILE ON RUBBER, THE BOOM MUST BE FULLY RETRACTED AND LIMITED TO A 6 M (20 FT) MAXIMUM RADIUS.**

**CAUTION**

**FULLY EXTEND THE FRONT AND REAR OUTRIGGER BEAMS AND JACK CYLINDERS BEFORE INSTALLING THE COUNTERWEIGHTS.**

**ERECTING AND STOWING THE SWINGAWAY BOOM EXTENSION**

**DANGER**

**BEFORE ATTEMPTING TO ERECT OR STOW THE BOOM EXTENSION, READ AND STRICTLY ADHERE TO ALL DANGER DECALS INSTALLED ON THE SWINGAWAY AND STOWAGE BRACKETS.**

**DANGER**

**ALWAYS SECURE THE BOOM EXTENSION WITH A GUIDE ROPE ON THE MAIN BOOM BEFORE REMOVING ANY CONNECTIONS TO PREVENT UNCONTROLLED SWINGING OF BOOM EXTENSION.**

**NOTE**

**The hydraulic boom extension must be at 0 degree offset for erecting and stowing the boom extension.**

**ERECTING**

**NOTE**

**If an adequate lifting device is available, the swingaway boom extension can be dismantled directly from the side of the boom.**

1. Fully extend and set the outriggers.
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) must be in stowed position or removed.**

4. Pull downwards against the spring force of the eye bolt and fold out the guide rail and release the eye bolt to lock the guide rail in the out position (See Detail B).

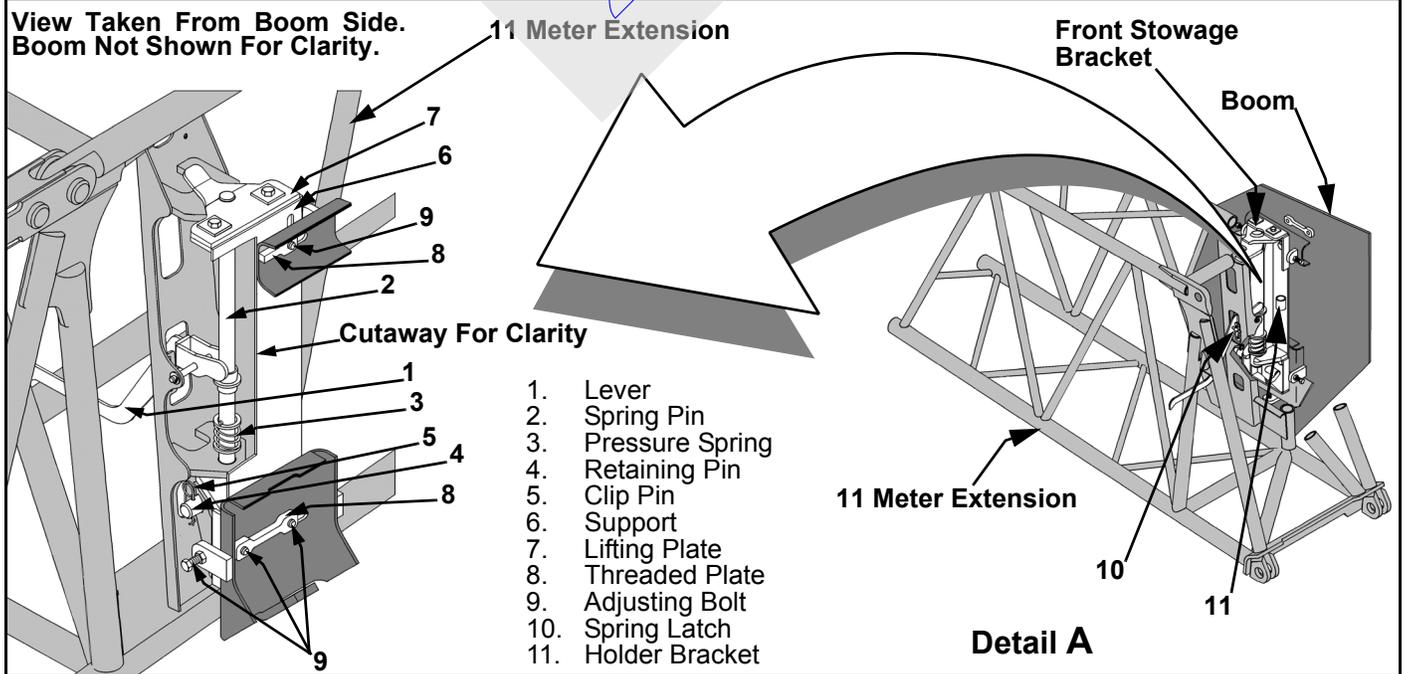
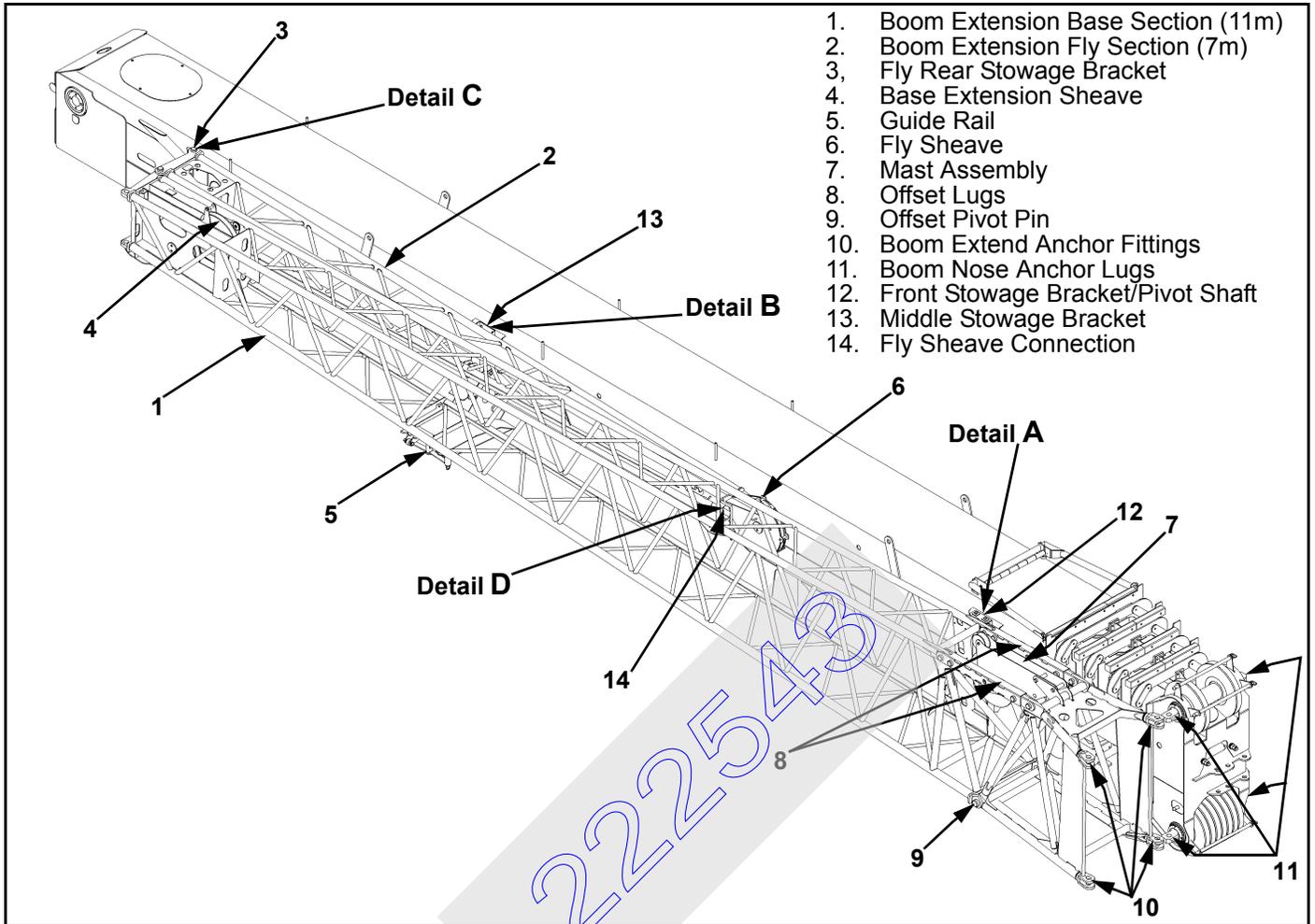
**CAUTION**

**IF THE 7M SECTION (FLY) IS NOT TO BE REMOVED, IT SHOULD REMAIN ON THE STOWAGE BRACKETS ON THE SIDE OF THE BOOM.**

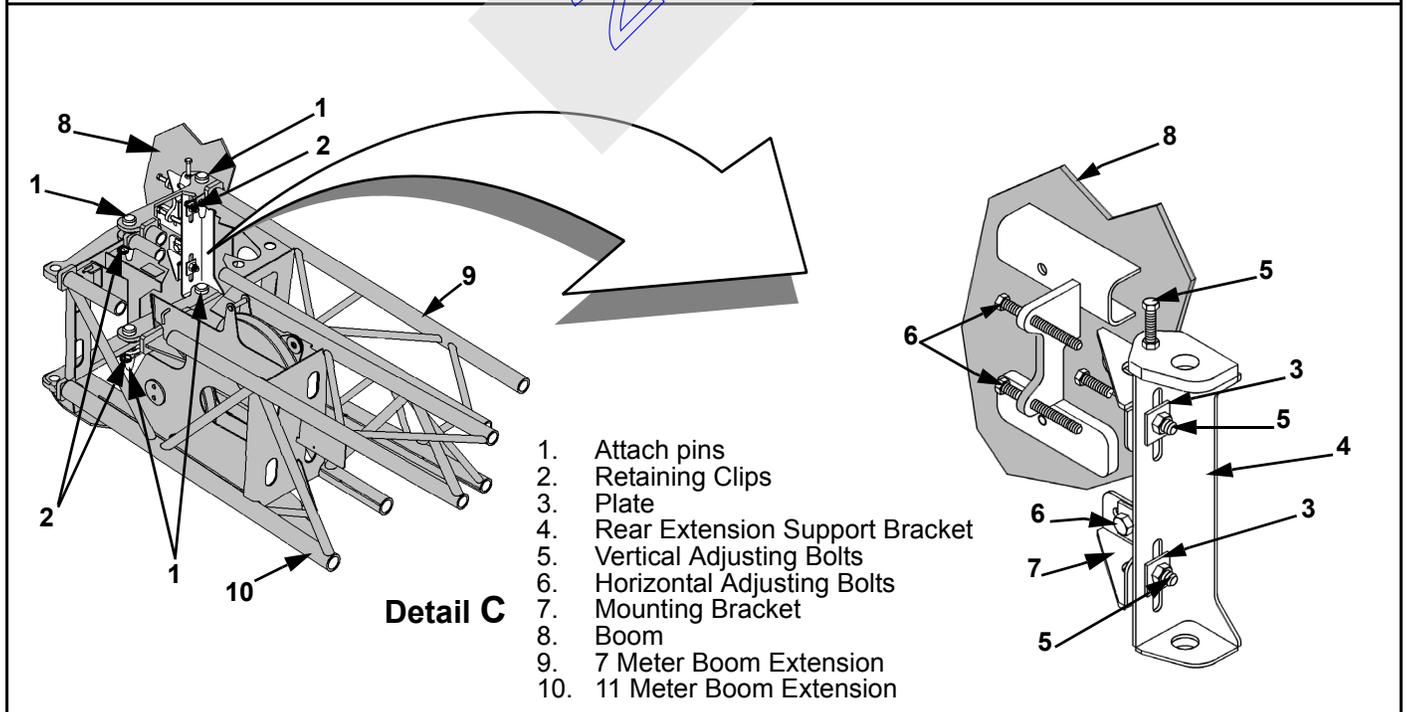
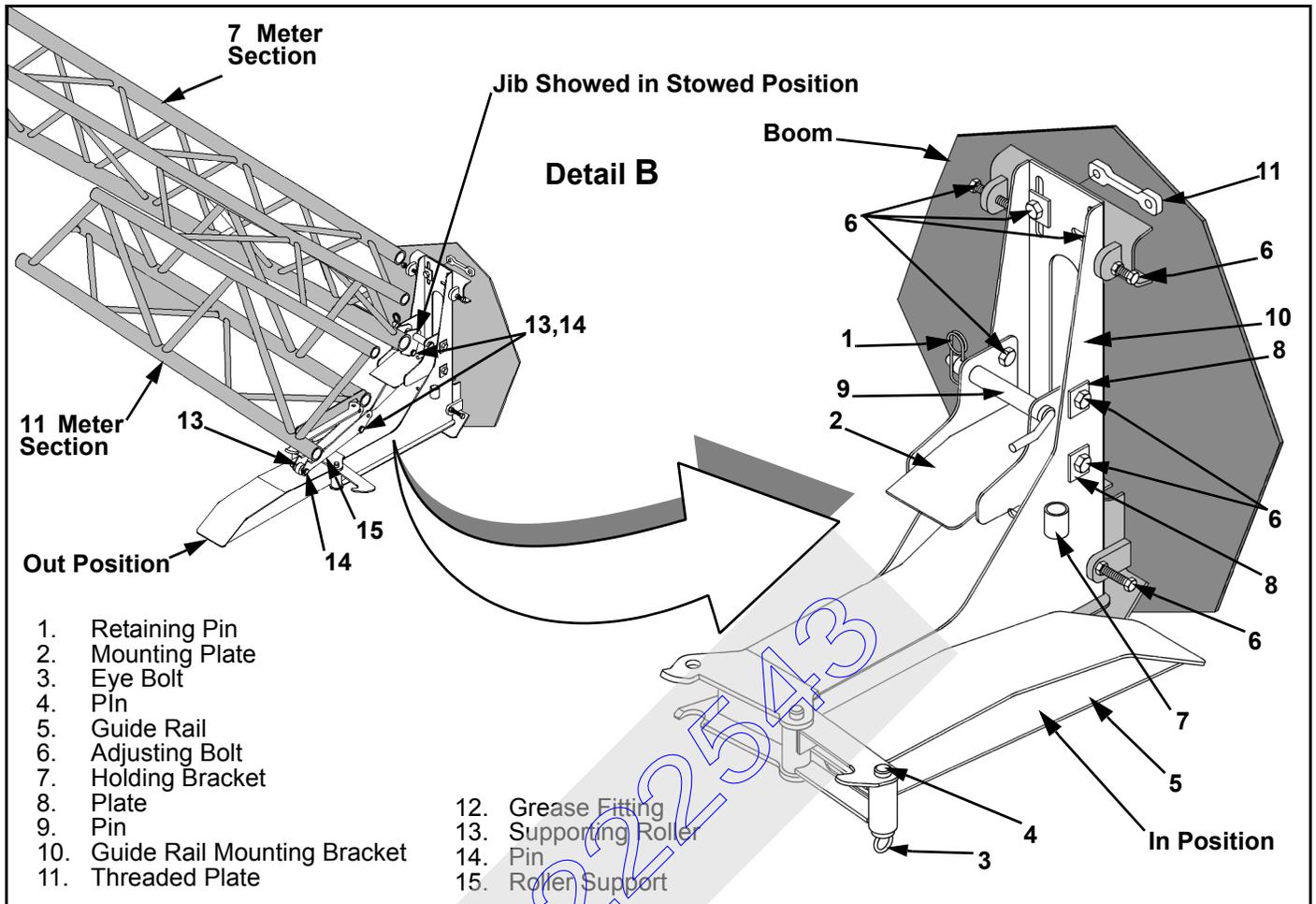
**NOTE**

**If removing the 7m section (fly) with the 11m section (boom extension base) skip to step 10. If not removing the 7m section (fly) with the 11m section (boom extension base), perform steps 5 thru 9 and skip steps 10 and 11.**

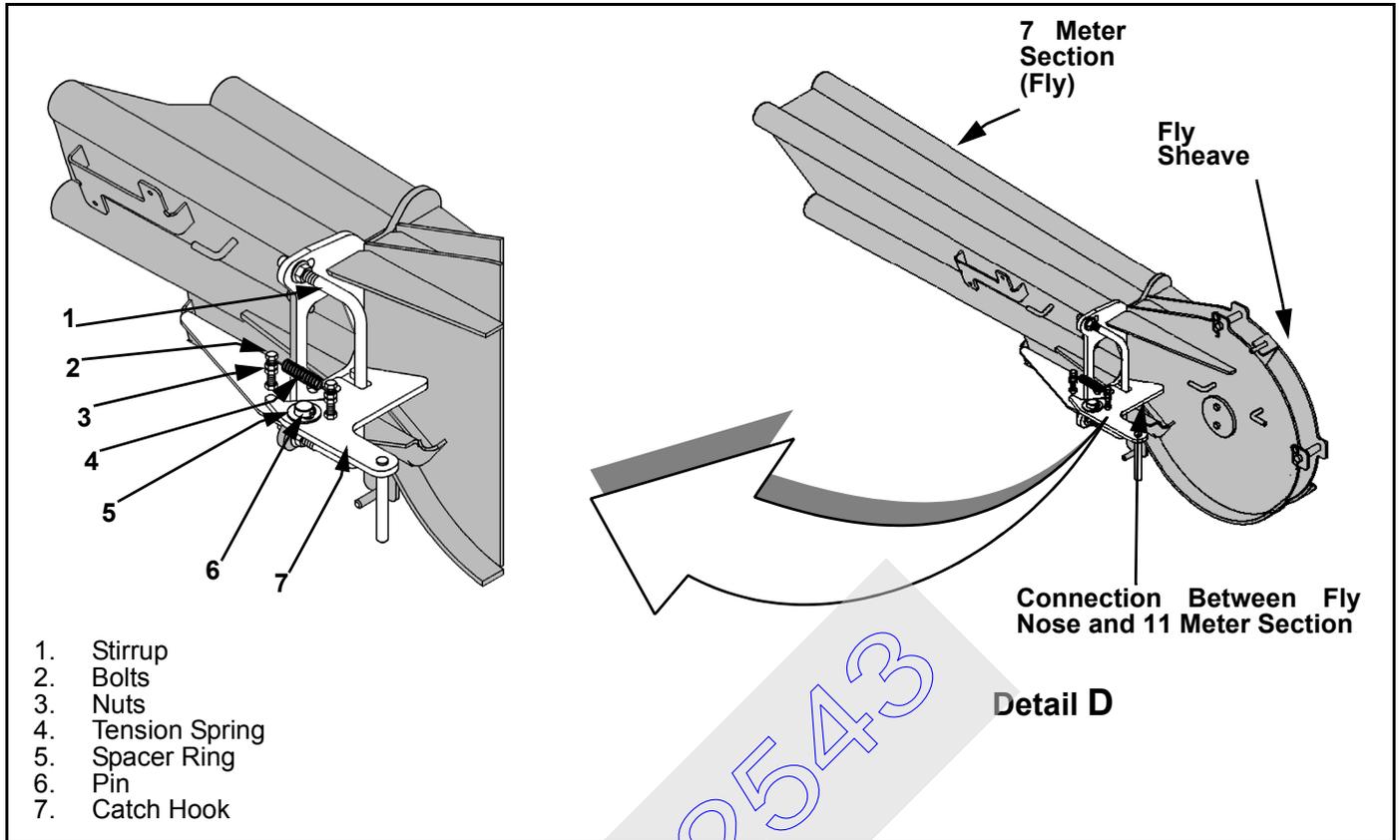
5. At the rear boom extension support bracket (see Detail C) remove the two retainer clips from the two attach pins and remove attach pins from the 11m section to the 7m section (fly) attaching connection.
6. Stow the pins on the fly section in the stowage lugs.
7. Ensure the pins attaching the fly section to the boom base section rear extension support bracket (see detail C) are in place.
8. Ensure the pin and retaining pin attaching the fly section to the guide rail bracket (see detail B) is in place.
9. At the fly section sheave end (see detail D) swivel the catch hook out to release the latch allowing the 11m section to separate from the fly at the sheave end.
10. Remove the retaining pin and pin attaching the 7m section (fly) to the guide rail bracket (see detail B) and place in holding bracket.



Removing and Installing the Swingaway Boom Extension (Sheet 1 of 3)



Removing and Installing the Swingaway Boom Extension (Sheet 2 of 3)



Removing and Installing the Swingaway Boom Extension (Sheet 3 of 3)

11. Remove the retaining clips and attach pins connecting the 7m section (fly) to the boom base section rear stowage bracket (see detail C).
12. Swing the 11m section extension (pivoting on the front boom extension stowage connection, Detail A) until contact is made between the main boom anchor lugs and the 11m extension anchoring holes. Align the boom anchor lugs with the 11m extension anchors. Remove the retaining pins from the front of the 11m extension and hammer the two short pins into the anchoring lug holes securing the extension to the right side of the boom nose.
13. On the front boom extension stowage bracket, remove the clip pin and retaining pin and place in pin holder (see detail A). Lift the lever and hold it, push the spring latch out and let the lever rest on the spring latch.
14. Attach a length of rope to the swingaway tip to aid in swinging the 11m section into place ahead of the boom nose.

**DANGER**

**WHEN ERECTING THE SWINGAWAY, ENSURE THAT ALL PERSONNEL**

**AND EQUIPMENT ARE KEPT CLEAR OF THE SWING PATH.**

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

**DANGER**

**DO NOT MODIFY THE ATTACH POINTS TO PERMIT THE INSTALLATION OF THE ATTACH PINS.**

16. Install the short attach pin into the upper extension anchor fitting and boom anchor lug on the left side of the boom nose. Install retainer clip in attach pin.
17. Hammer the long attach pin in the lower extension anchor fitting and boom anchor lug on the left side of the boom nose. Install the retainer clip in the attach pin.

18. Extend and lower the boom until blocking can be placed under the swingaway. Remove the rope from the tip of the swingaway base.
19. Lower the swingaway onto the cribbing. Remove and stow the pins securing the 11m section to the boom nose.
20. Retract the boom, freeing the swingaway from the boom nose.

**STOWING**

1. Position the crane so the swingaway lies in front of the crane with the swingaway base facing the crane. Fully extend and set the outriggers.
2. Extend and lower the boom to engage the boom anchor lugs and the extension anchor fittings.
3. Install the attach pins and retainer clips to secure the 11m extension section to the boom nose. Attach a length of rope to the extension tip. Raise the boom, lifting the extension from the cribbing on which it was resting. Retract the boom.
4. Remove the retainer clips from the attach pins on the left side of the boom at the anchor fittings for the boom extension. Hammer the pins out of the lower and upper anchor lugs and anchor fitting. Install both attach pins into holders on the base of the boom extension and secure with retainer clips.

**DANGER**

**MAKE SURE THE CONNECTION BETWEEN THE BOOM 11M EXTENSION AND THE MAIN BOOM EXTENSION STOWAGE BRACKET IS ENGAGED AND SECURE BEFORE REMOVING THE ATTACH PINS ON THE RIGHT HAND SIDE BOOM NOSE. THIS WILL PREVENT THE BOOM EXTENSION FROM FALLING.**

**DANGER**

**WHEN STOWING THE SWINGAWAY, ENSURE THAT ALL PERSONNEL AND EQUIPMENT ARE KEPT CLEAR OF THE SWING PATH.**

**CAUTION**

**DO NOT ALLOW THE SWINGAWAY TO SLAM INTO THE STOWAGE BRACKETS WHEN SWINGING INTO THE STOWED POSITION.**

5. Raise and/or lower the boom to help control the 11m extension and using the rope attached to the tip of the extension, swing the extension to the side of the boom.
6. Swing the 11m extension until it contacts the front stowage bracket. Lift up on the lever and push the boom extension until its mounting holes align with the extension hanger pivot mounting holes on the main boom (see Detail A). Pull downward on the lever to insert the spring pin into its mounting holes. Make sure the spring pin is secure and engaged properly between the boom extension and main boom. Secure the connection with retaining pin and clip pin.
7. Remove the retaining clips from the attaching pins at the boom anchor lugs and extension anchor fittings on the right side of the boom nose. Hammer the two attach pins out of the attaching points and insert them into the holders on the base of the boom extension, securing them with retaining clip.
8. With the guide rail in the out position, push the 11m extension onto the guide rail until it comes in contact with all of the boom extension to main boom stowage connections.

**NOTE**

**If the 7m section (fly) remained on the boom stowage brackets, perform steps 9 and 10, if not skip to step 11.**

9. At the rear stowage support bracket, insert the pins and retaining pins stowed in the 7m section stowage lugs and into the connection between the 11m extension and 7m section (fly) attaching fittings (see Detail C)
10. At the fly section sheave end (see Detail D), swivel the catch hook to engage the latch securing the base extension to fly section.
11. Ensure the attach pins and retaining clips attaching the 7m section (fly) to the guide rail bracket (see Detail B) are in place.

12. Ensure the pin and retaining pin attaching the fly section to the boom base section rear support bracket (see Detail C) are in place.
13. At the guide rail, pull downwards against the spring force of the eye bolt and fold in the guide rail and release the eye bolt to lock the guide rail in the stowed position (see Detail B).
14. Rig the boom nose and hoist cable as desired and operate the crane using normal operating procedures.

### CONNECTING AND DISCONNECTING THE HYDRAULIC BOOM EXTENSION

#### CONNECTING

#### **DANGER**

**IF THE HOSE COUPLINGS ARE DETACHED FROM THE BOOM AFTER THE HOSE DRUM LOCK PIN HAS BEEN RELEASED, DO NOT RELEASE THE HOSE COUPLINGS UNTIL THEY HAVE BEEN ATTACHED TO THE BOOM. IF THE HOSE COUPLINGS ARE RELEASED**

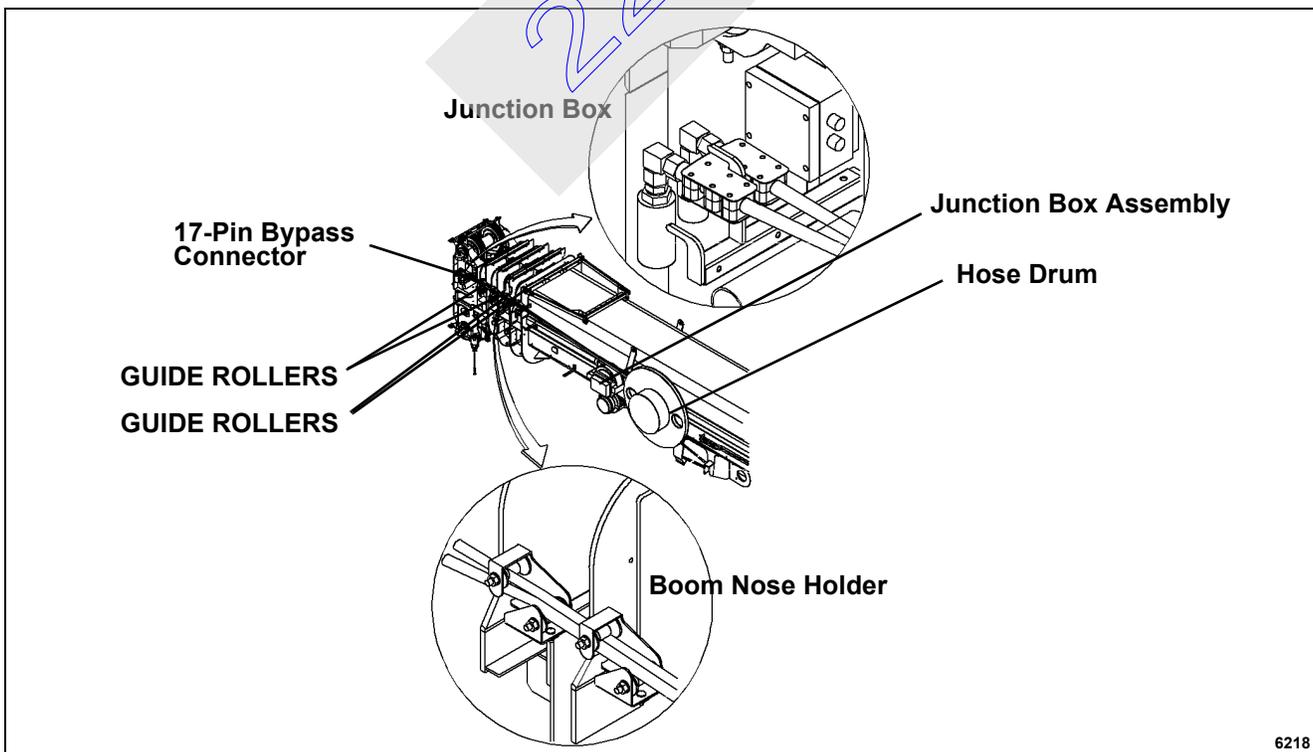
**AFTER BEING DETACHED FROM THE BOOM, THE HOSES WILL SPRING BACK UNCONTROLLABLY DUE TO THE SPRING FORCE IN THE HOSE DRUM.**

When working with the main boom for longer periods of time, the hydraulic connection between the hose drum and the main boom should be disconnected. This prevents unnecessary reeling and unreeling of the hose.

#### **Establish a hydraulic connection between the lattice extension and the main boom.**

If the hoses are stowed on the holder on the boom base section, release the hose drum lock pin and pull the hydraulic hoses toward the boom nose. Anchor the hydraulic couplings at the holder on the boom nose. Guide the hydraulic hoses through the guide rollers.

1. Unwind the hoses on the lattice extension.
2. Remove the dust caps from the couplings on the lattice extension and the drum hoses.
3. Connect the hose drum hoses to the hoses on the lattice extension. Do not detach the drum hoses from the holder on the boom nose.



Boom Luffing Extension

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**Establish an electrical connection between the lattice extension and the main boom.**

1. Remove the 17 pin bypass plug from the electrical junction box on the boom nose.
2. Unwind the electrical cable from the lattice extension.
3. Disconnect the cable from the dummy plug on the boom extension adapter.
4. Connect the boom extension cable to the boom nose junction box.

**Establish an electrical connection between the lattice extension and anti-two block switch.****NOTE**

The anti-two block switch supplied with the boom extension is used for operation of the 11 m and 18 m sections. The junction box connection for the section that is not in use must be overridden with a bypass plug.

1. Install the anti-two block switch on the appropriate pin near the nose sheave of the section being used. Secure the switch to the boom extension with a retaining pin.
2. Remove the bypass plug and connect the wire for the anti-two block switch to the junction box located near the nose sheave.

**DISCONNECTING****Disconnect the electrical connection between the lattice extension and the main boom.**

1. Disconnect the boom extension cable from the boom nose junction box.
2. Wind the cable onto the boom extension for storage.
3. Connect the cable to the dummy plug on the boom extension adapter.
4. Install the 17 pin bypass plug into the open connector on the boom nose junction box.

**Disconnect the hydraulic connection between the lattice extension and the main boom.****DANGER**

**IF THE HOSE COUPLINGS ARE DETACHED FROM THE BOOM AFTER THE HOSE DRUM LOCK PIN HAS BEEN RELEASED, DO NOT RELEASE THE HOSE COUPLINGS UNTIL THEY HAVE BEEN ATTACHED TO THE BOOM. IF THE HOSE COUPLINGS ARE RELEASED AFTER BEING DETACHED FROM THE BOOM, THE HOSES WILL SPRING BACK UNCONTROLLABLY DUE TO THE SPRING FORCE IN THE HOSE DRUM.**

1. Disconnect the hoses from the lattice extension from the drum hoses. Do not detach the drum hoses from the boom nose.

When working with the main boom for longer periods of time, the hydraulic connection between the hose drum and the boom nose should be disconnected. This prevents unnecessary reeling and unreeling of the hose.

2. Remove the hoses from the boom nose. Retract the hydraulic hoses to the holder on the boom base section.
3. Engage hose drum lock pin into hole on drum.
4. Wind the hoses onto the boom extension for storage.
5. Install dust caps attached to all couplings on the lattice extension and the drum hoses.

**SWINGAWAY MOUNTING ADJUSTMENT.**

For the referenced details, refer to the figure titled Removing and Installing the Swingaway Boom Extension.

1. Set the 11m section with the 7m section stowed on the side, on cribbing. Use an adequate lifting device to place the boom extension at the side of the boom. Make the connection at the front stowage bracket and support with lifting device (see Detail A).
2. Refer to Detail A (front stowage bracket) and pivot the boom extension on the front support bracket. Adjust the front support bracket adjustment bolts to maintain a loose condition when the boom extension anchor fittings engage the boom anchor lugs.

3. Secure the guide rail on the middle boom extension stowage bracket in the out position.
4. Swing the boom extension until it contacts the guide rail at the middle boom extension stowage bracket (see Detail B).

**NOTE**

**When pushing the jib extension onto the guide rail, make sure contact does not occur at the rear boom extension mounting bracket and prevent proper alignment.**

5. Adjust the middle stowage bracket so the roller supports on the 11m section role on the guide rail and aligns the roller support on the 7m section. This should align the hole in the mounting lug on the 7m section with the hole in the mounting piece on the stowage bracket. When adjusted properly, the pin can be inserted to make the stowage connection.
6. Refer to Detail C (rear stowage bracket) and adjust the adjustment bolts on the rear support bracket to support the boom extension and provide installation of attach pins.
7. Remove the lifting device used for support when the boom extension is secured.

**BOOM EXTENSION (WITH INSERTS)**

**Identification**

The boom extension consists of the 18 m two-stage swingaway lattice extension and two boom extension sections. The boom extension is designed for the crane it was delivered with. The parts belonging to the crane have the same serial number as the crane.

The following parts are labelled with the serial number:

- all parts of the 128 m two-stage swingaway lattice extension
- both sections of the boom extension (8 m sections)

**CAUTION**

**OPERATE THE CRANE ONLY WITH THOSE SECTIONS OF THE BOOM EXTENSION WHICH HAVE THE SAME SERIAL NUMBER AS THE CRANE. THIS PREVENTS MALFUNCTIONS AND DAMAGE.**

**NOTE**

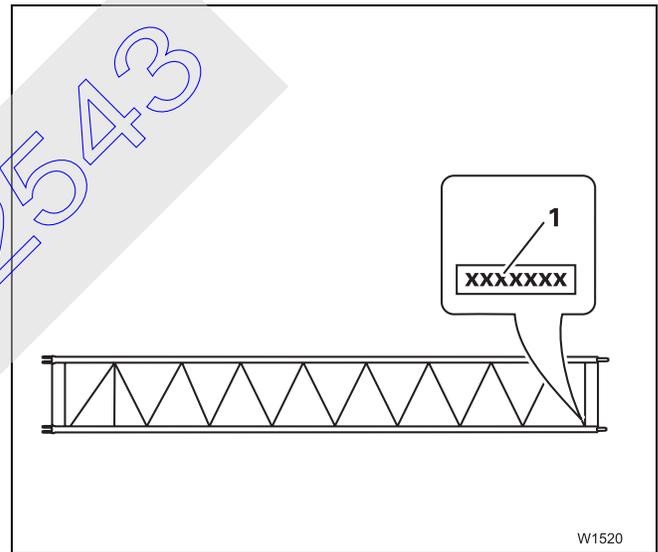
**For technical reasons a crane may only be set with one boom extension.**

If you wish to use the boom extension on several GROVE cranes, the parts of the boom extension must be adjusted for these cranes and labelled with all of the respective serial numbers.

**CAUTION**

**HAVE THE ADJUSTMENT OF THE BOOM EXTENSION CARRIED OUT ONLY BY YOUR LOCAL MANITOWOC CRANE CARE.**

**Serial numbers on the 8m sections**



**On the 8 m sections the serial number (1) is at the front on a sheet.**

**Slinging points**

**DANGER**

**THIS SECTION SHOWS THE SLINGING POINTS ON THE 8 M SECTIONS. ATTACH THE SECTIONS ON THESE SLINGING POINTS ONLY. THEY WILL THEN AUTOMATICALLY HAVE THE CORRECT CENTER OF GRAVITY. USE ONLY LIFTING GEAR WITH SUFFICIENT LOAD BEARING CAPACITY.**

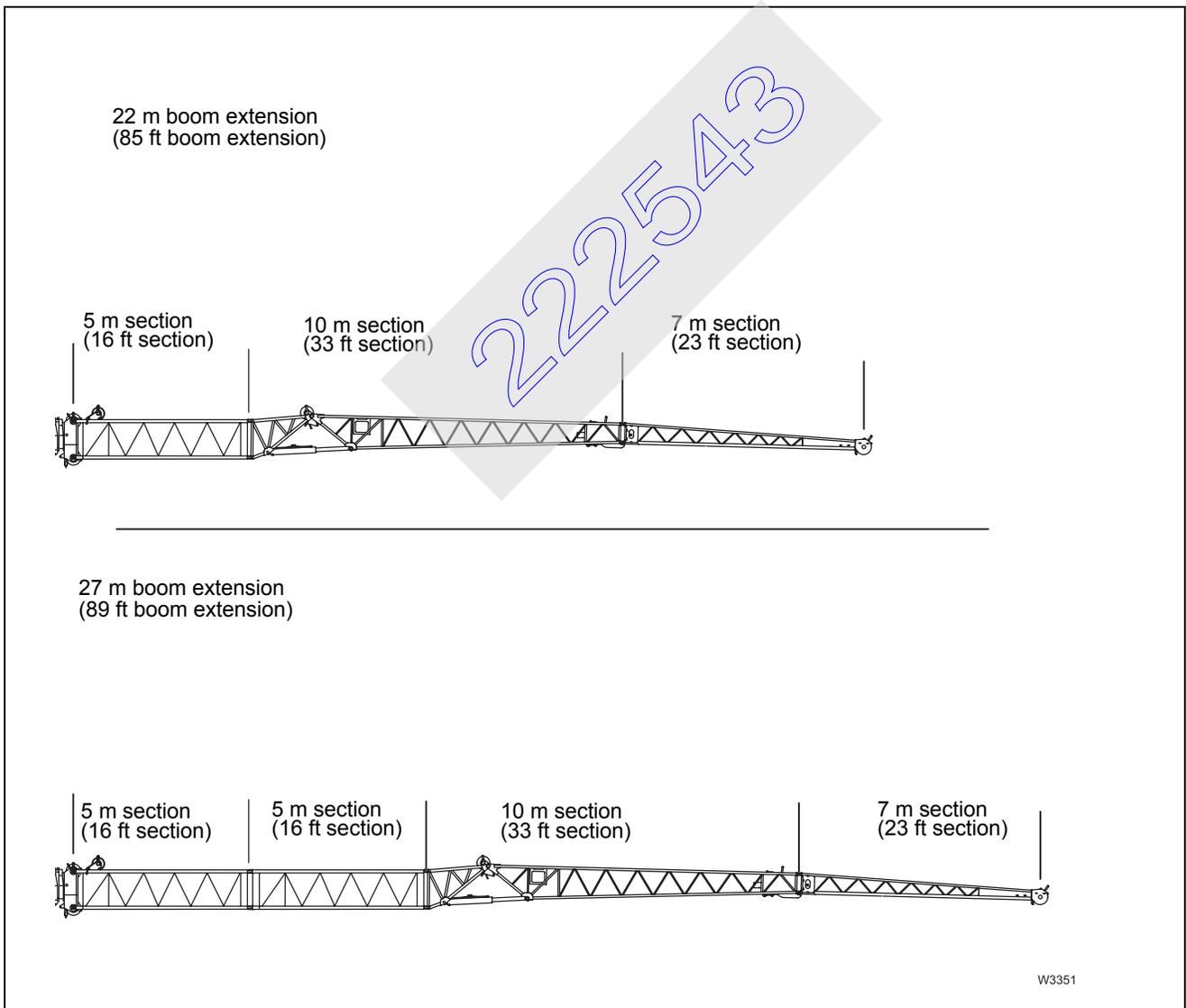
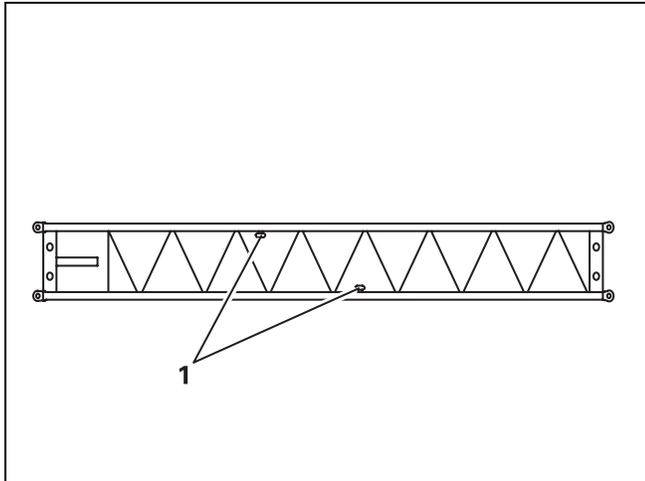
The 8 m sections have two slinging points (1) (each slightly offset on each side).

**ASSEMBLY OF BOOM EXTENSIONS**

**NOTE**

The lengths of 26 m and 34 m respectively equal the distance between the center of the locking pin (on the main boom head) and the front edge of the head sheave.

The designations 11 m section, 7 m section and 8 m section have been adapted to these lengths. The total lengths of the individual sections are greater.



**CHECKLISTS FOR RIGGING WORK**

**Installing the 26 m/34 m boom extension**

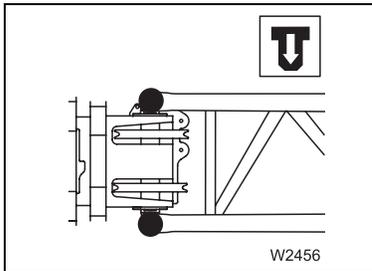
**Requirements**

- An auxiliary crane must be ready

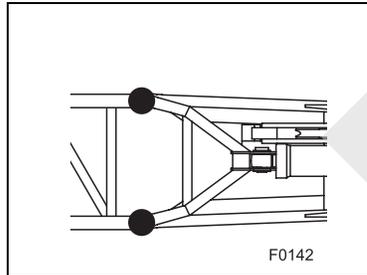
1. If the lattice extension is folded up at the side of the main boom, remove the lattice extension.
2. Installing 8 m sections in front of the main boom:

For 26 m boom extension an 8 m section

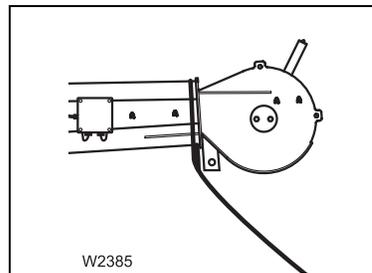
For 34 m boom extension both 8 m sections



3. Attach folded two-stage swingaway lattice extension in front of 8 m section.



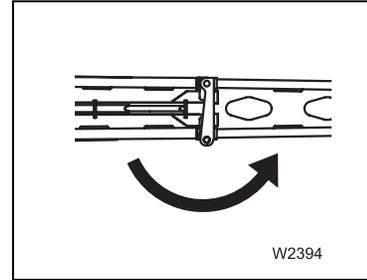
4. Attach guide rope to the head of the 7 m section.



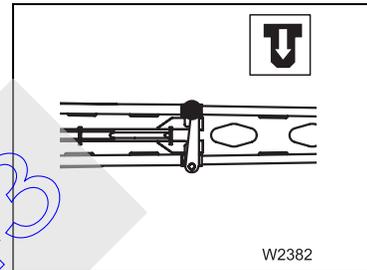
5. Release connection between 7 m section and 11 m

section.

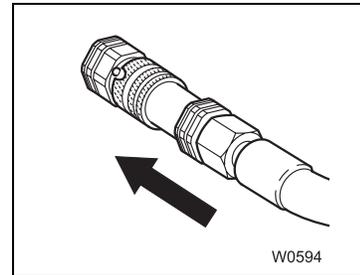
6. Swivel the 7 m section in front of the 11 m section.



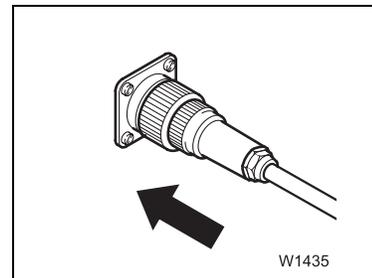
7. Fasten 7 m section with pin on left-hand side in front of 11 m section.



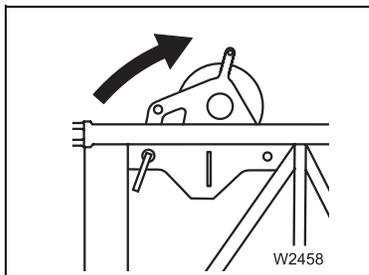
8. If unit is equipped with a hydraulic luffing boom extension, establish a hydraulic connection between lattice extension and main boom.



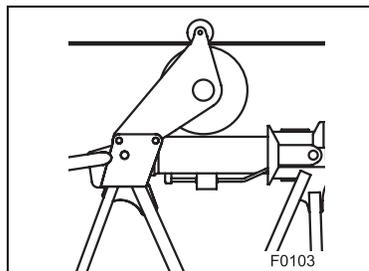
9. Establishing electrical connections.



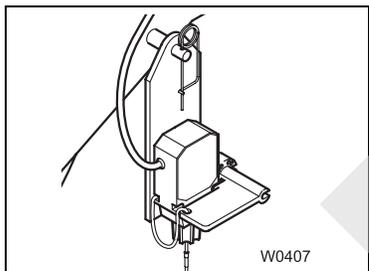
10. Fold out deflection sheaves on all sections.



11. Place hoist cable over all the deflection sheaves and the head sheave of the 7 m section.

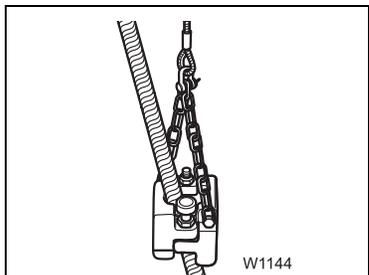


12. Install the limit switch to the head of the 7 m section.



13. Reeve the hoist cable on the hook block.

14. Attach lifting limit switch weight and guide hoist cable through the weight.

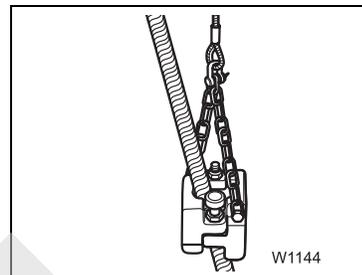


**Removing the 26 m/34 m boom extension**

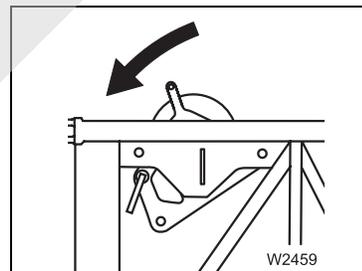
**Requirements**

- The crane is on outriggers or the main boom.
- An auxiliary crane must be ready

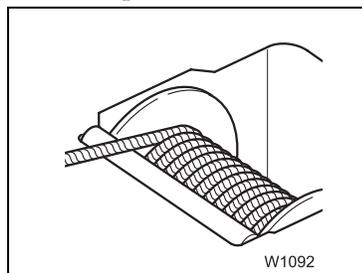
1. Fully retract and set down main boom.
2. Remove lifting limit switch weight.



3. Reeve out hoist cable from the hook block.
4. Remove hoist cable and fold in deflection sheaves on all parts of the boom extension.

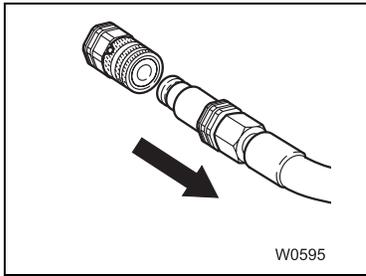


5. Reel hoist cable up to the main boom head.

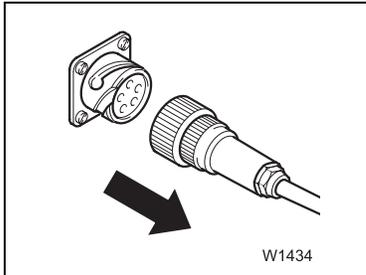


6. If necessary, raise the lattice extension to the 0° position.
7. If equipped with hydraulic luffing boom extension, disconnect the hydraulic connection between lattice extension and main boom.

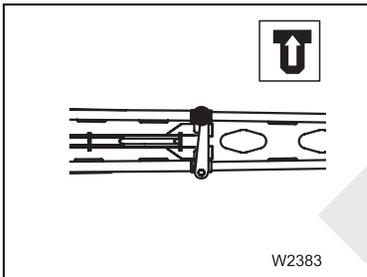
If necessary, also disconnect the hydraulic connection to the hose drum.



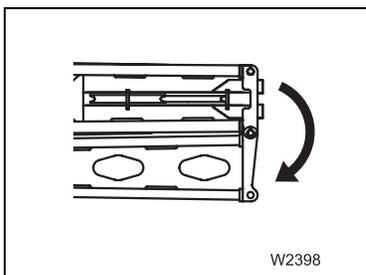
8. Disconnecting electrical connections.



9. Remove the locking pins on the left-hand side between 7 m section and 11 m section.

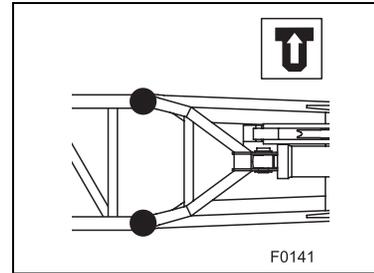


10. Swivel the 7 m section onto the 11 m section side until the connection between the two sections engages.



11. Establish connection between 7 m section and 11 m section.

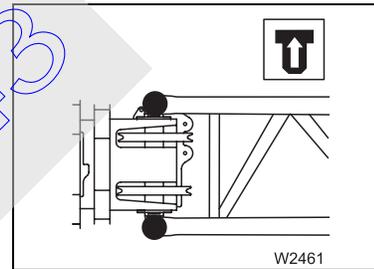
12. Remove folded two-stage swingaway lattice extension from 8 m section.



13. Remove 8 m sections from the main boom:

For 26 m boom extension and 8 m section

For 34 m boom extension both 8 m sections



**DESCRIPTION OF RIGGING WORK**

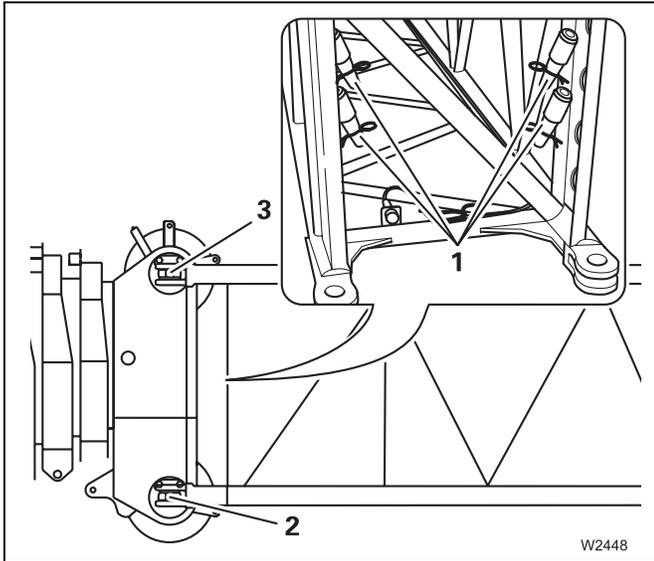
**Installing/Disassembling 8 m Sections**

- In order to rig the 26 m boom extension you must install the 8 m section with support roller in front of the main boom head.
- To rig the 34 m boom extension you must also mount the 8 m section without support roller in front of the 8 m section with support roller.

**NOTE**

**An auxiliary crane must be used to install and remove the 8 m sections.**

The securing pins (1) for the connection are in the holders on the foot of the 8 m sections and are secured with retaining pins.



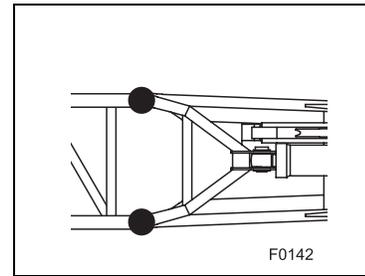
**Installing 8 m sections**

- Sling the 8 m section with support roller on an auxiliary crane and lift it in front of the main boom head so that the bearing points (2) and (3) sling on both sides.
- Insert the securing pins on both sides into the bearing points.
- Secure all pins with retaining pins.
- For the 34 m boom extension, install the second 8 m section in the same way as the first 8 m section.

**Removing 8 m sections**

- Sling the 8 m section on an auxiliary crane and fit it until the weight has been taken off the bearing points (2) and (3).
- Release the pins and knock them out of the bearing points (2) and (3) on both sides.
- Insert the pins into the holders on the foot of the 8 m sections and secure them with retaining pins.

**INSTALLING/REMOVING TWO-STAGE SWINGAWAY LATTICE EXTENSION FOR BOOM EXTENSION**



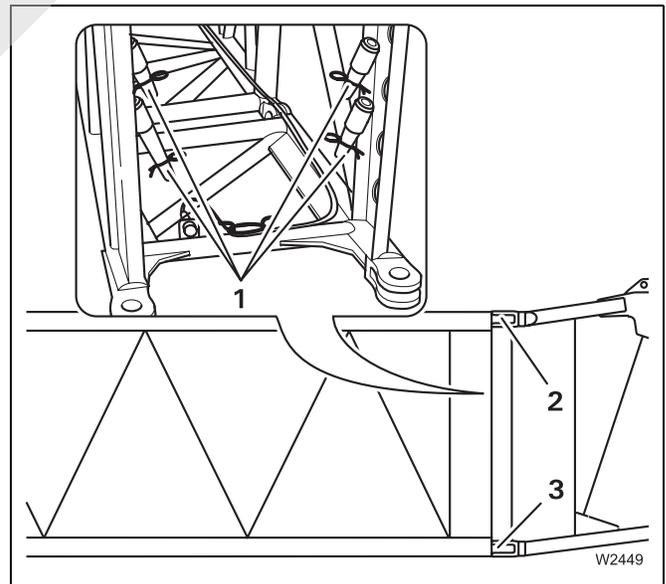
This section described the installation and removal of the folded two-stage swingaway lattice extension.

You can also install the two-stage swingaway lattice extension which has been folded in front of the other in front of an 8 m section (e.g. when you are changing directly from the 18 m two-stage swingaway lattice extension to a boom extension).

**NOTE**

An auxiliary crane must be used to install and remove the two-stage swingaway lattice extension.

The securing pins (1) for the connection are in the holders on the foot of the 11 m sections and are secured with retaining pins.



**Installation**

- Sling the two-stage swingaway lattice extension onto an auxiliary crane.

- Lift the two-stage swingaway lattice extension in front of the 8 m section so that the bearing points (2) and (3) align on both sides.
- Insert the securing pins on both sides into the bearing points (2) and (3).
- Secure all pins with retaining pins.

### Removing

- Sling the two-stage swingaway lattice extension onto an auxiliary crane.
- Lift the two-stage swingaway lattice extension until the load has been relieved from the bearing points.
- Release the pins and knock them out of the bearing points (2) and (3) on both sides
- Insert the pins into the holders on the 11 m section and secure them with retaining pins.

### HYDRAULIC CONNECTION ON THE BOOM EXTENSION (IF UNIT IS EQUIPPED WITH HYDRAULIC LUFFING BOOM EXTENSION)

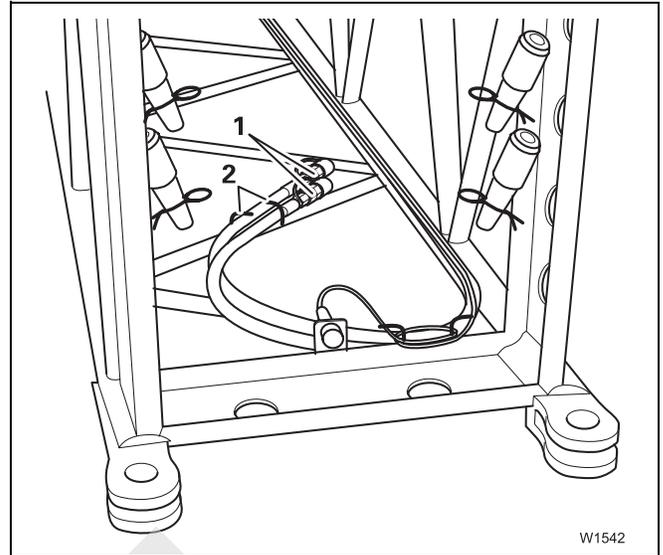
The hydraulic connection is required for derricking the lattice extension. If the hydraulic connections for the hose drum were separated on the left side, they have to be re-established.

#### NOTE

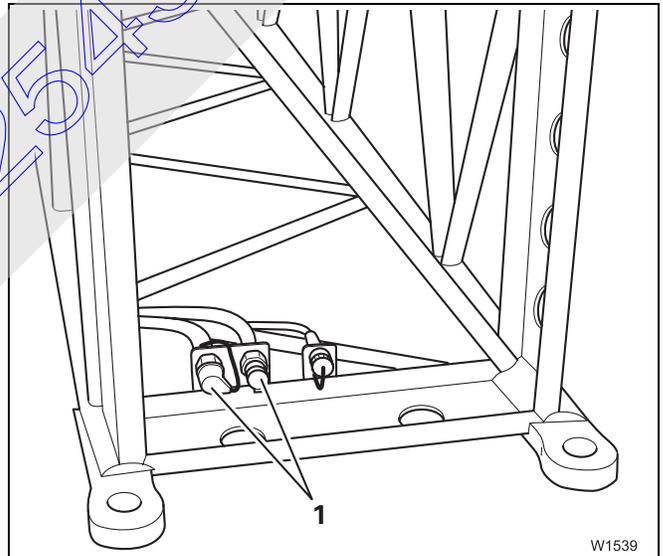
The connections are made via quick couplings. Half couplings which belong together are color coded.

### Connections on the 8 m sections

At the rear of the 8 m sections there are two hydraulic hoses (1) with quick couplings. These hydraulic hoses can be connected on the main boom head or on a second 8 m section.



For transportation, the hydraulic hoses are clamped in the holders (2).



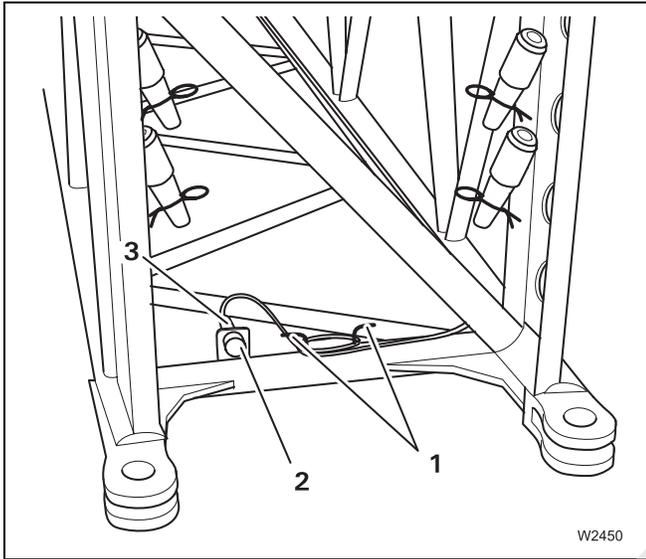
At the front of the 8 m sections there are two quick couplings (1).

Here you can connect the hydraulic hoses of the 11 m section or a second 8 m section.

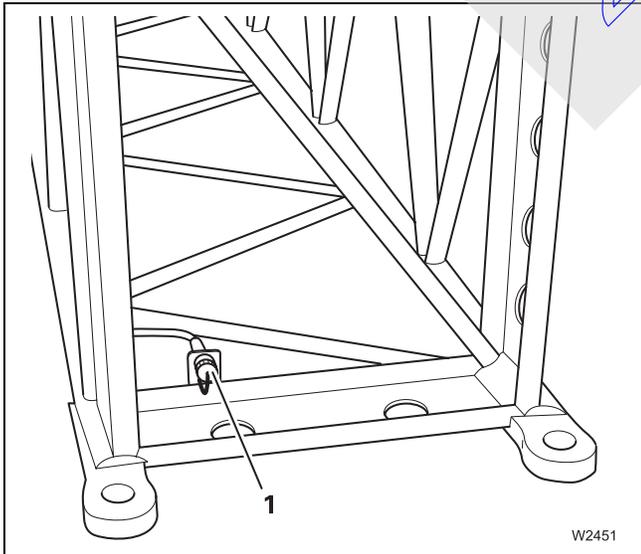
**ELECTRICAL CONNECTION ON THE BOOM EXTENSION**

This section describes the electrical connections on the 8 m sections. For establishing electrical connection on the two-stage swingaway lattice extension.

**Connections on the 8 m sections**



At the rear of the 8 m sections there is a cable with a plug (3).



For transportation, the cable is wound around the holders (1) and the plug is inserted in the dummy socket (2).

At the front of the 8 m sections there is a plug socket (1).

Here you can connect the cable of the 11 m section or a second 8 m section.

**Establishing Electrical Connections**

**For the 26 m boom extension**

- Connect the cable of the 8 m section to the socket on the main boom head.
- Connect the cable of the 11 m section on the socket at the front of the 8 m section.

**For the 34 m boom extension**

- Connect the cable of the first 8 m section to the socket on the main boom head.
- Connect the cable of the second 8 m section to the socket at the front of the first 8 m section.
- Connect the cable of the 11 m section on the socket at the front of the second 8 m section.

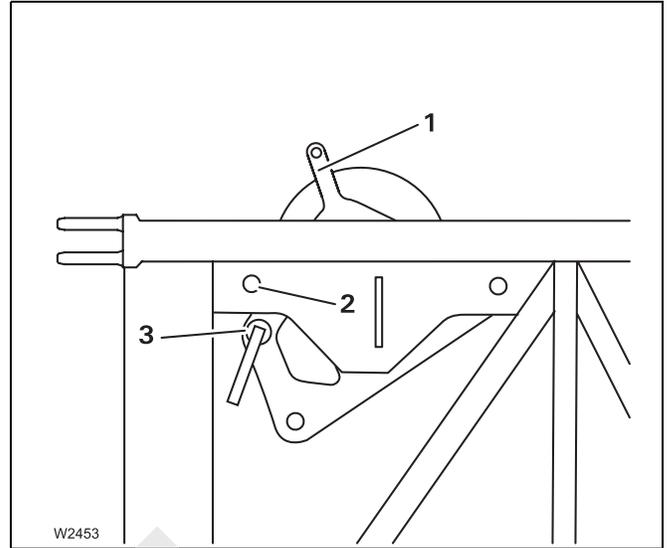
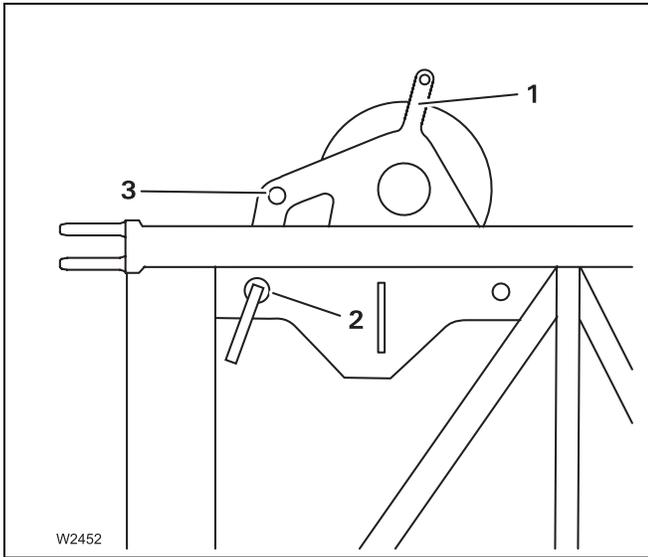
**FOLDING OUT/IN THE DEFLECTION SHEAVES ON THE 8 M SECTIONS**

This section describes only the folding in and out of the deflection sheave on the 8 m section. To fold the deflection sheaves in and out on the 11 m section.

If you intend to work with the boom extension, you need to fold out the deflection sheaves on the rear 8 m sections.

Fold the deflection sheave in for transportation.

**Folding out deflection sheave**



- Hold the deflection sheave by the strut (1) and remove the pin from the bore (3).
- Fold the deflection sheave up and secure it by inserting the pin into the bore (2).
- Secure the pin with a retaining pin.

**Folding in deflection sheave**

- Hold the deflection sheave by the strut (1) and remove the pin from the bore (2).
- Fold the deflection sheave down and insert the pin in the bore (3).

- Secure the pin with a retaining pin.

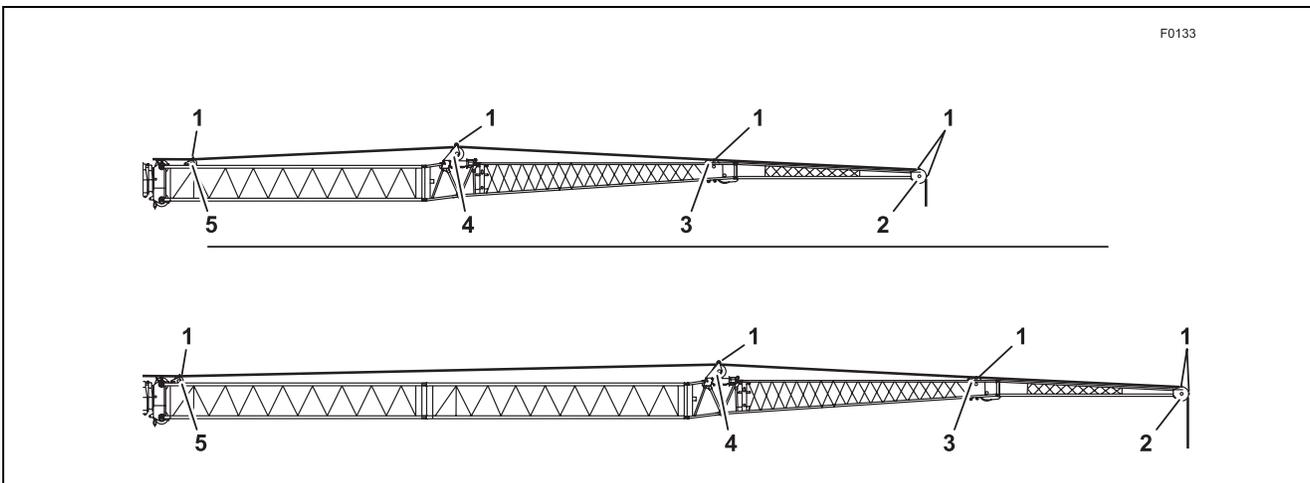
**POSITIONING/REMOVING THE HOIST CABLE**

**DANGER**

**ALWAYS SECURE THE HOIST CABLE HOLDING ROLLERS AND RODS WITH RETAINING PINS. THIS PREVENTS ELEMENTS COMING LOOSE, FALLING DOWN AND INJURING PEOPLE.**

**Positioning the hoist cable**

- Remove the hoist cable holding rollers and rods (1).
- 



- Guide the hoist cable via the deflection sheaves (5), (4), (3) and via the head sheave (2) on the 7 m section for both boom extensions.
- Put all hoist cable holding rollers and rods back in place and secure these with retaining pins.
- Attach the hook tackle. The hoist rope can only be reeved once.

**Removing the hoist cable**

Reverse the sequence of operations to remove the hoist cable.

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