GROVE

OPERATOR'S MANUAL

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

RT890E

Crane Model Number

6-828-100170
Part Number

This Manual is divided into the following sections:

NOTICE

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

The crane serial number is stamped on the top of the outrigger box. ***Always furnish crane serial number*** when ordering parts or communicating service problems with your distributor or the factory.

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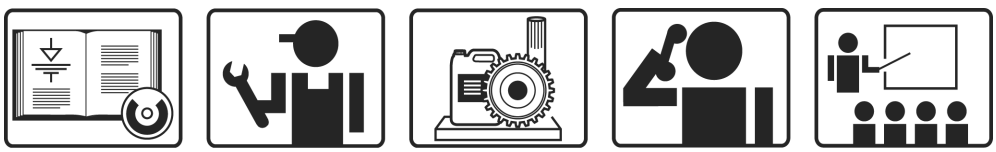

Technical Publications | **Field Service** | **Parts** | **Factory Service** | **Training**

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INTRODUCTION

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SECTION 1
INTRODUCTION

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

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

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

GENERAL

NOTE: Throughout this handbook, reference is made to left, 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 RT890E Series Manitowoc/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.

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.

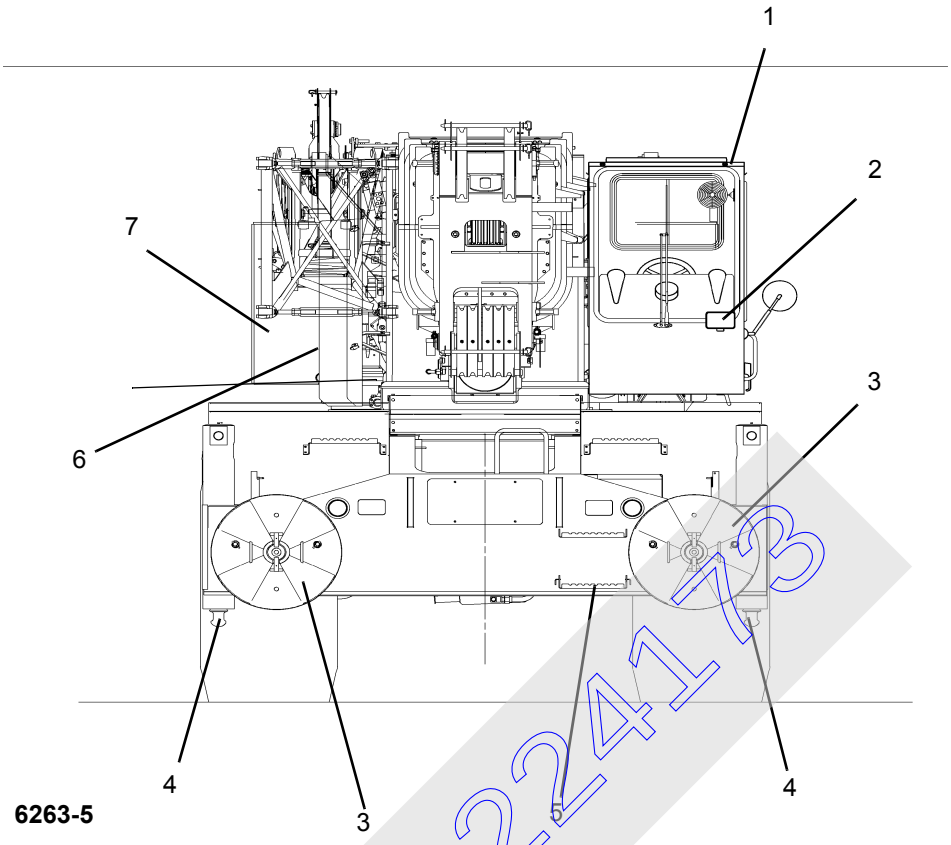

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FIGURE 1-1

Item	Description
1	Cab
2	Work Light
3	Outrigger Float
4	Outrigger Jack Cylinder
5	Steps
6	Valve Cover
7	Counterweight

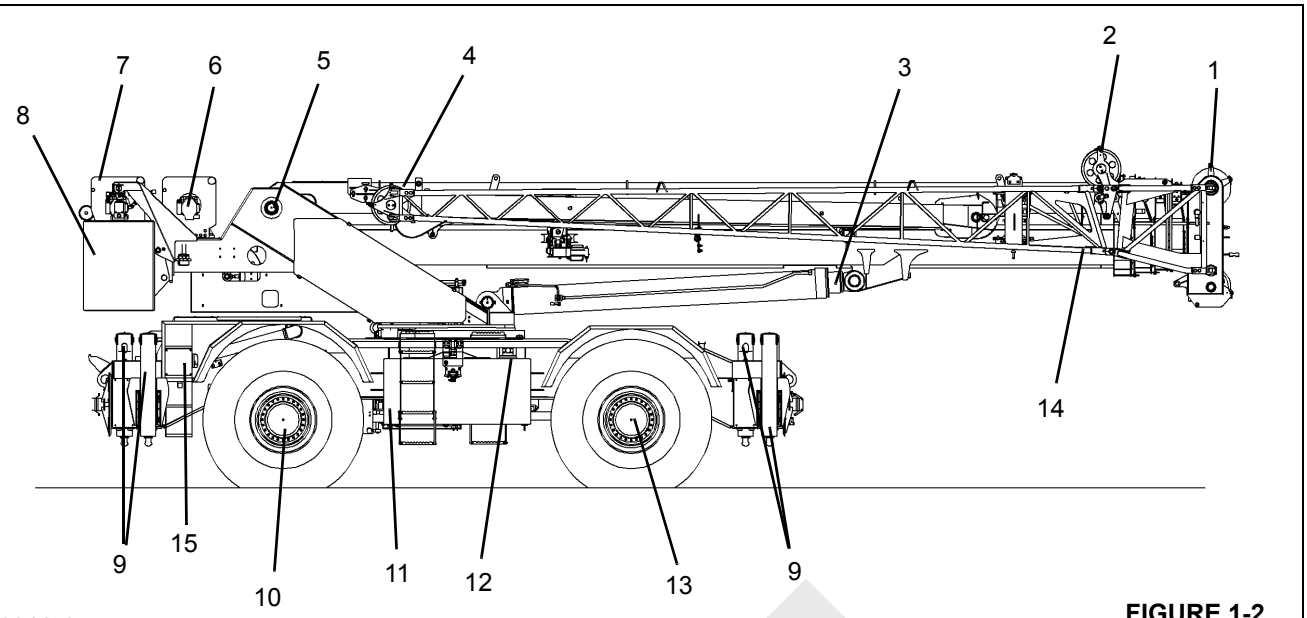

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FIGURE 1-2

Item	Description
1	Boom Nose Sheaves
2	Boom Extension Mast Sheave
3	Lift Cylinder
4	Swingaway Nose
5	Boom Pivot
6	Main Hoist
7	Auxiliary Hoist
8	Counterweight
9	Outrigger Jack Cylinder
10	Rear Axle
11	Hydraulic Tank
12	Hydraulic Filter
13	Front Axle
14	Swingaway Extension
15	Air Cleaner

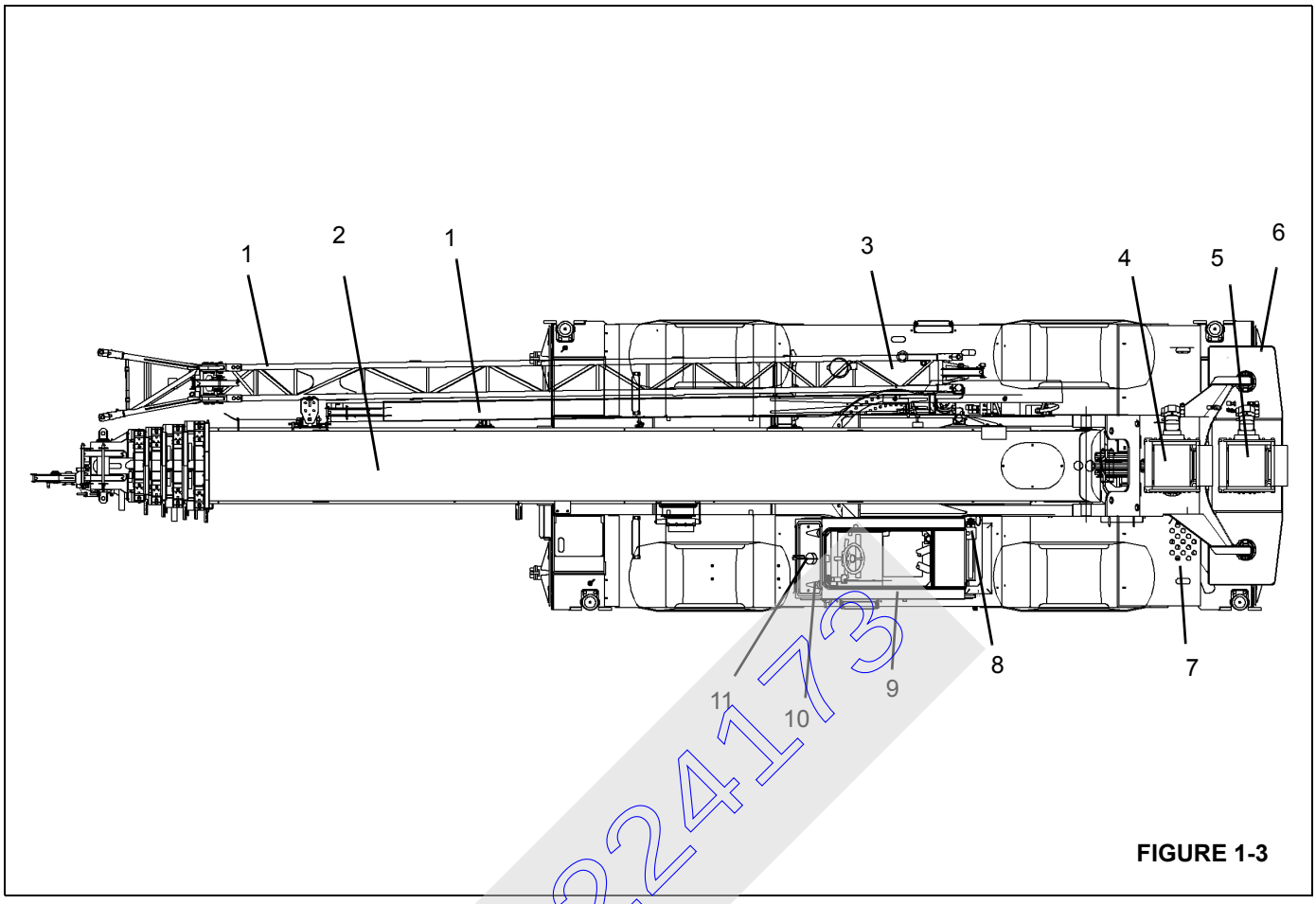

FIGURE 1-3

Item	Description
1	Swingaway Extension
2	Boom
3	Hydraulic Tank
4	Main Hoist
5	Auxiliary Hoist
6	Counterweight
7	Muffler
8	Windshield Washer Fluid Container
9	Cab
10	Work Light
11	Spotlight

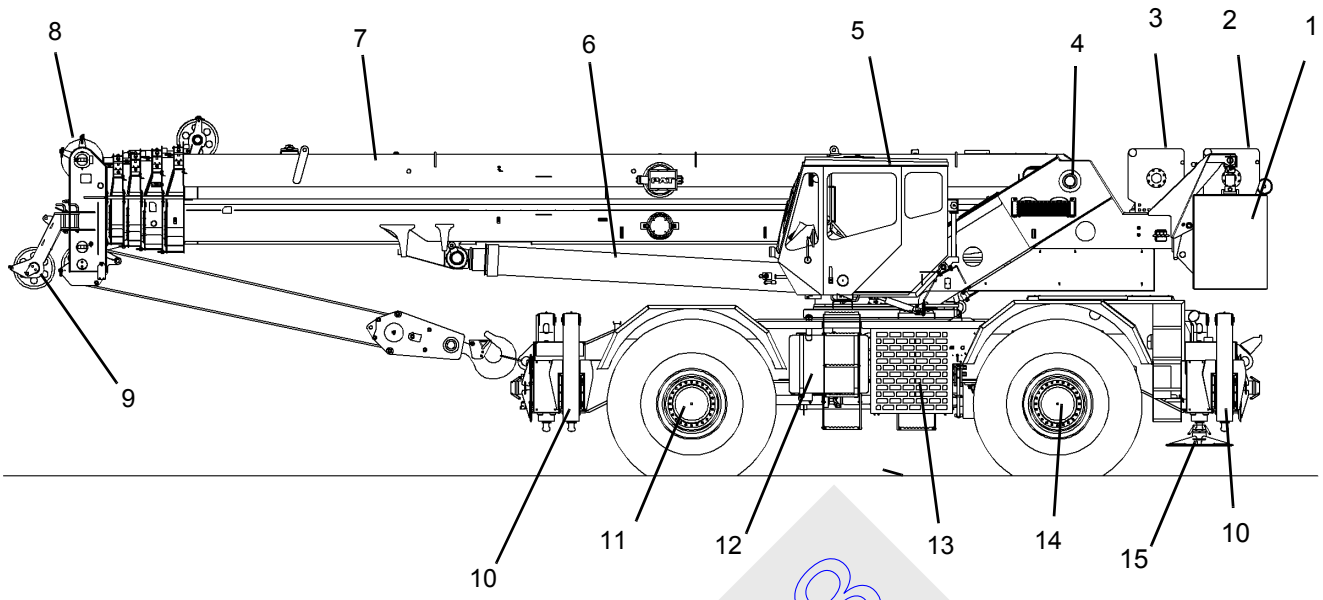

FIGURE 1-4

Item	Description
1	Counterweight
2	Auxiliary Hoist
3	Main Hoist
4	Boom Pivot
5	Cab
6	Lift Cylinder
7	Boom
8	Boom Nose Sheaves
9	Auxiliary Boom Nose
10	Outrigger Jack Cylinder
11	Front Axle
12	Fuel Tank
13	Oil Cooler
14	Rear Axle
15	Outrigger Float

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SECTION 2
SAFETY INFORMATION

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SECTION 2
SAFETY PRECAUTIONS

DIESEL ENGINE EXHAUST

CALIFORNIA PROPOSITION 65 WARNING

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

BATTERY POSTS, TERMINALS, AND RELATED ACCESSORIES

CALIFORNIA PROPOSITION 65 WARNING

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

SAFETY MESSAGES

General

The importance of safe operation and maintenance cannot be overemphasized. Carelessness or neglect on the part of operators, job supervisors and planners, rigging personnel, and job site workers can result in their death or injury and costly damage to the crane and property.

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

Safety Alert Symbol

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

Signal Words

DANGER

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

WARNING

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

CAUTION

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

CAUTION

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

NOTE: Highlights operation or maintenance procedures.

GENERAL

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 Manitowoc/Grove distributor. Following any accident or damage to equipment, the local Manitowoc/Grove distributor must be immediately advised of the incident and consulted on necessary inspections and repairs. Should the distributor not be immediately available, contact should be made directly with Manitowoc Crane Care. 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 Manitowoc/Grove distributor and/or Manitowoc Crane Care.

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.

OPERATIONAL AIDS

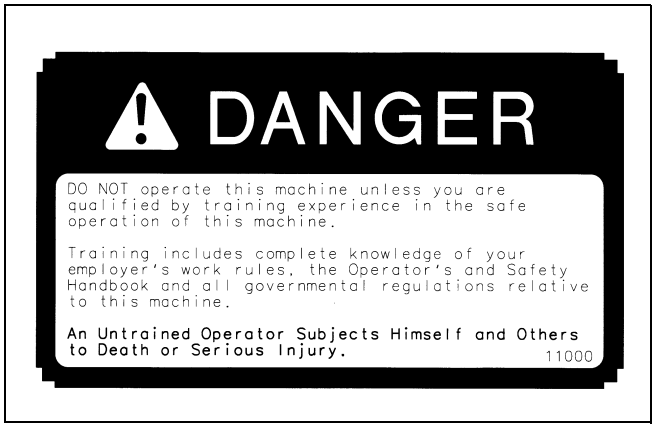
Grove remains committed to providing reliable products that enable users and operators to safely lift and position loads. Grove has been an industry leader in the incorporation of operational aids into the design of its cranes. Federal law requires that cranes be properly maintained and kept in good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

OPERATOR'S QUALIFICATIONS



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

YOU MUST NOT OPERATE THIS MACHINE UNLESS:

- You are qualified by training in the safe operation of this machine.
- Your training includes complete knowledge of your employer's work rules, the Operator's and Safety Handbook and all governmental regulations relative to this machine.

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.

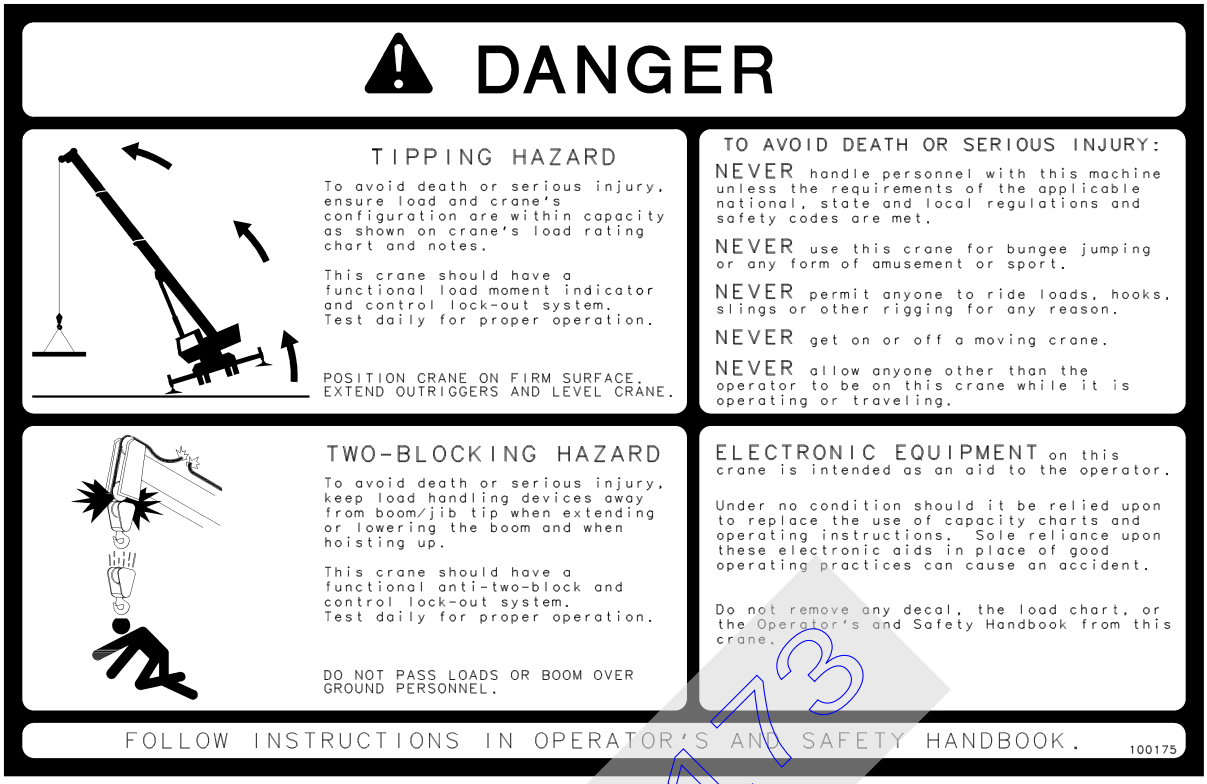
Long cantilever booms can create a tipping condition when in an extended and lowered position. Retract the boom proportionally with reference to the capacity of the applicable Load Chart.

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.

The RT890E on rubber load charts have a minimum radius of 12 feet with a load. Without a load, a radius of 10 feet is safe for 360 degrees on rubber. A radius of less than 10 feet must be avoided on rubber because of backward stability considerations.

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.



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

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

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

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

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

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

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

Load Charts

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

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

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

Do not remove the Load Charts from the crane.

Work Site

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

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

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

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

Wind can have a significant affect on loads that may be lifted by a crane. Wind forces act differently on a crane depending upon the direction from which the wind is blowing (e.g., wind on the rear of the boom can result in decreased forward stability, wind on the underside of the boom can result in decreased backward stability, wind on the side of the boom can result in structural damages, etc.). To assist you in determining prevailing wind conditions, refer to the "WIND VELOCITY CHART" on page 2-6.

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 2-6.

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

The crane is equipped with a removable counterweight and auxiliary structure. Ensure the counterweight is properly installed before making any lifts.

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

Do not add material to the counterweight to increase capacity.

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

Multiple Crane Lifts

Multiple crane lifts are not recommended.

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

If it is necessary to perform a multi-crane lift, the operator shall be responsible for assuring that the following minimum safety precautions are taken.

1. Secure the services of a qualified engineer to direct the operation.
2. Use one qualified signal person.
3. Coordinate lifting plans with the operator, engineer, and signal person prior to beginning the lift.
4. Communication between all parties must be maintained throughout the entire operation. If possible, provide approved radio equipment for voice communication between all parties engaged in the lift.
5. Use cranes and rigging of equal capabilities and use the same boom length.

6. Use outriggers on cranes so equipped.
7. Be certain cranes are of adequate lifting capacity.
8. Calculate the amount of weight to be lifted by each crane and attach slings at the correct points for proper weight distribution.
9. Ensure the load lines are directly over the attach points to avoid side loading and transfer of loading from one crane to the other.
10. DO NOT TRAVEL. Lift only from a stationary position.

LOAD MOMENT INDICATING (LMI) SYSTEMS

Electronic equipment on this crane is intended as an aid to the operator.

Under NO CONDITION should it be relied upon to replace the use of capacity charts and operating instructions. Sole reliance upon these electronic aids in place of good operating practices can cause an accident.

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

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

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

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

Two-Blocking

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

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

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

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

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

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

Do not pass loads or boom over ground personnel.

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

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

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

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

Work Area Definition System

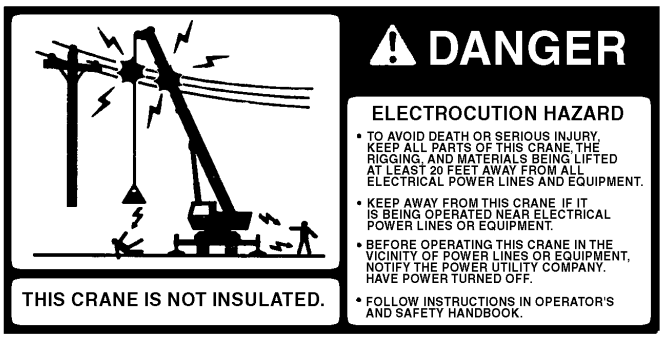
You must read and understand the manufacturer's Operator's Handbook before operating the system. Become familiar with all proper operating procedures and with the identification of symbol usage.

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.

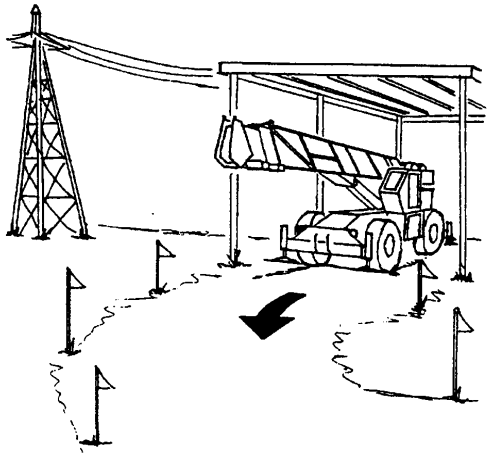
Federal law prohibits the use of cranes closer than 3 m (10 ft) to power sources up to 50,000 volts and greater distances for higher voltages [29CFR1910.180 and 29CFR1926.550]. Grove recommends keeping cranes twice the minimum distance [e.g., 6 m (20 ft)] as specified by US Department of Labor - Occupational 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, Manitowoc/Grove distributor must be immediately advised of the incident and consulted on necessary inspections and repairs. Thoroughly inspect the wire rope and all points of contact on the crane. Should the distributor not be immediately available, contact Manitowoc CraneCARE. The crane must not be returned to service until it is thoroughly inspected for any evidence of damage and all damaged parts are repaired or replaced as authorized by Manitowoc CraneCARE or your local Manitiwoc/Grove distributor.

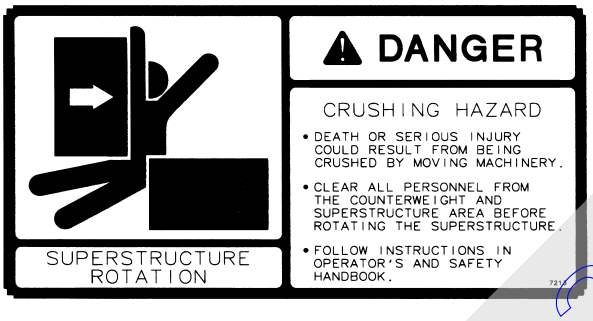
Special Operating Conditions and Equipment

Never operate the crane during an electrical thunderstorm.

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

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

Crushing Hazards



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

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

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

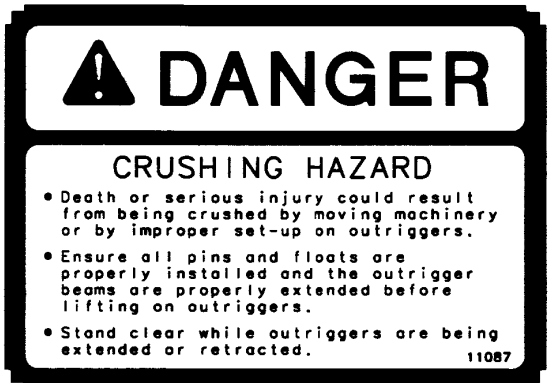
Never allow anyone to stand or work on or near the superstructure while the crane is in operation. Always barricade the tail-swing of the rotating superstructure.

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

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

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

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



Clear all personnel from the outrigger area before extending or retracting the outriggers.

Carefully follow the procedures in this handbook when extending or retracting the outriggers. Death or serious injury could result from improper crane set up on outriggers.

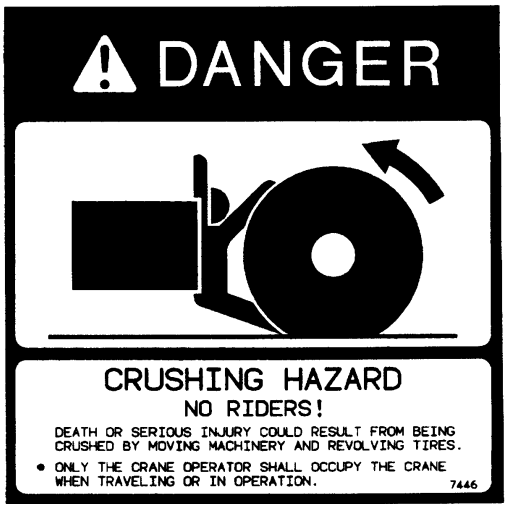
Be sure the outriggers are properly extended, set and the crane is level for operation on outriggers.

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 29CFRI926.550(g)(2): "General requirements. The use of a crane or derrick to hoist employees on a personnel platform is prohibited, except when the erection, use, and dismantling of conventional means of reaching the worksite, such as a personnel hoist, ladder, stairway, aerial lift, elevating work platform or scaffold, would be more hazardous or is not possible because of structural design or worksite conditions." Additional requirements for crane operations are stated in ASME B30.5, Mobile And Locomotive Cranes, and in OSHA regulations 29CFRI910.180 for General Industry and 29CFRI926.550 for Construction.

Use of a Manitowoc/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.

Manitowoc/Grove CraneCARE continues to recommend that cranes be properly maintained, regularly inspected and repaired as necessary. Manitowoc/Grove reminds crane owners to ensure that all safety decals are in place and legible. Manitowoc/Grove continues to urge Manitowoc/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 befor operation. Check for proper functioning of all controls and operator aids (e.g. HCAS).
- 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 Manitowoc/Grove CraneCARE Maintenance and Inspection Manual. Any questions regarding procedures and specifications should be directed to the your local, authorized Manitowoc/Grove CraneCARE 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 Manitowoc/Grove approved.

Any modification, alteration, or change to a crane which affects its original design and is not authorized and approved by Manitowoc/Grove CraneCARE 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 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. When inflating tires, use a tire gauge, clip-on inflator, and extension hose which will permit standing clear of the tire while inflating.

Wire Rope

Use ONLY the wire rope specified by Manitowoc/Grove CraneCARE 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 valley break where the wire fractures between strands in a running rope is cause for removal.
3. Abrasion of the rope resulting in wear of the individual outside wires of 1/3 of the original wire diameter.
4. Any kinking, bird caging, crushing, corrosion, or other damage resulting in distortion of the rope structure.
5. 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.
6. 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.
7. 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.

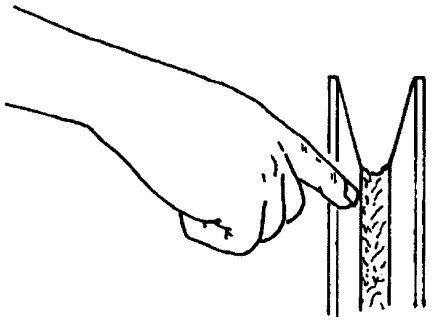
When installing a new rope:

- 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. Turn the battery disconnect switch on. Then, 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.

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 climbing onto the crane. 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 CraneCARE.

Job Preparation

You must inspect the crane prior to your work shift - checking for cracked welds, damaged components, and evidence of improper maintenance (consult Manitowoc/Grove CraneCARE 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 and stabilizers are properly extended and set before performing any lifting operations.

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

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

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

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

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 station.

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.

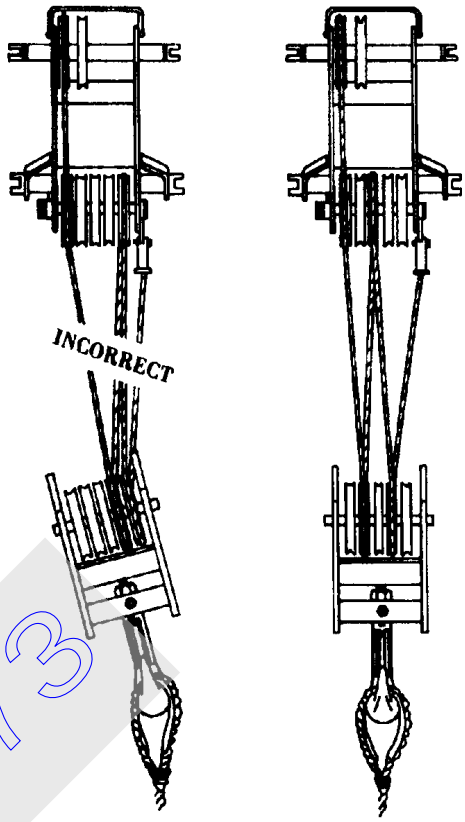
A good practice is to make a "dry run" without a load before making the first lift. Become familiar with all factors peculiar to the job site.

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. When swinging from one working area to another, ensure load chart capacities are not exceeded. Know your crane!

Stop the hook block from swinging when unhooking a load.

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

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

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.

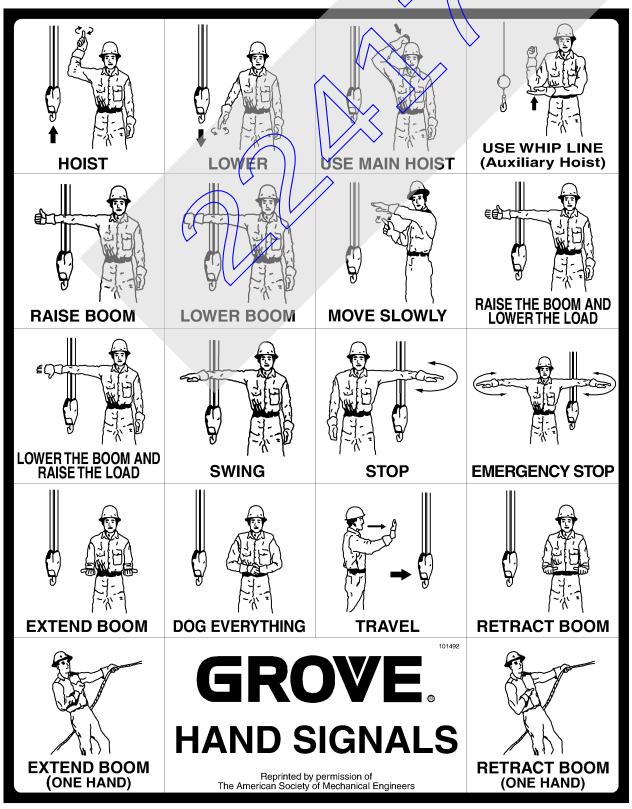
At all times use standardized hand signals - previously agreed upon and completely understood by the operator and signal person.

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.



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.
- Place controls in neutral position.
- Shut down the engine and remove the ignition key.
- Lock the truckcab 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, and should not be used on engines with electric intake heaters.

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.

Table 2-1BOOM DRIFT CHART (Cylinder length change in inches)

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

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

SECTION 3
OPERATING CONTROLS AND PROCEDURES

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SECTION 3
OPERATING CONTROLS AND PROCEDURES

NOTE: The following paragraphs describe all the available (standard and optional; some machines may not be equipped with the optional controls shown) controls and indicators located in the cab. The numbers in parenthesis () represent the index number from Cab Controls and Indicators (*Refer to Figure 3-1)*.

NOTE: All rocker switches, except for engine diagnostics and throttle, contain one or two LED lighted slots in the switch for illumination. In addition, all but the outrigger and rear steer switches contain a LED lighted square to indicate when the switch/function is activated. The numbers in parenthesis () represent the index number from Cab Controls and Indicators (*Refer to Figure 3-2).*

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 to the right of the steering column. The voltmeter indicates the voltage being supplied to or from the battery and has a scale of 10 to 16 volts.

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 to the left of the steering column. 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.

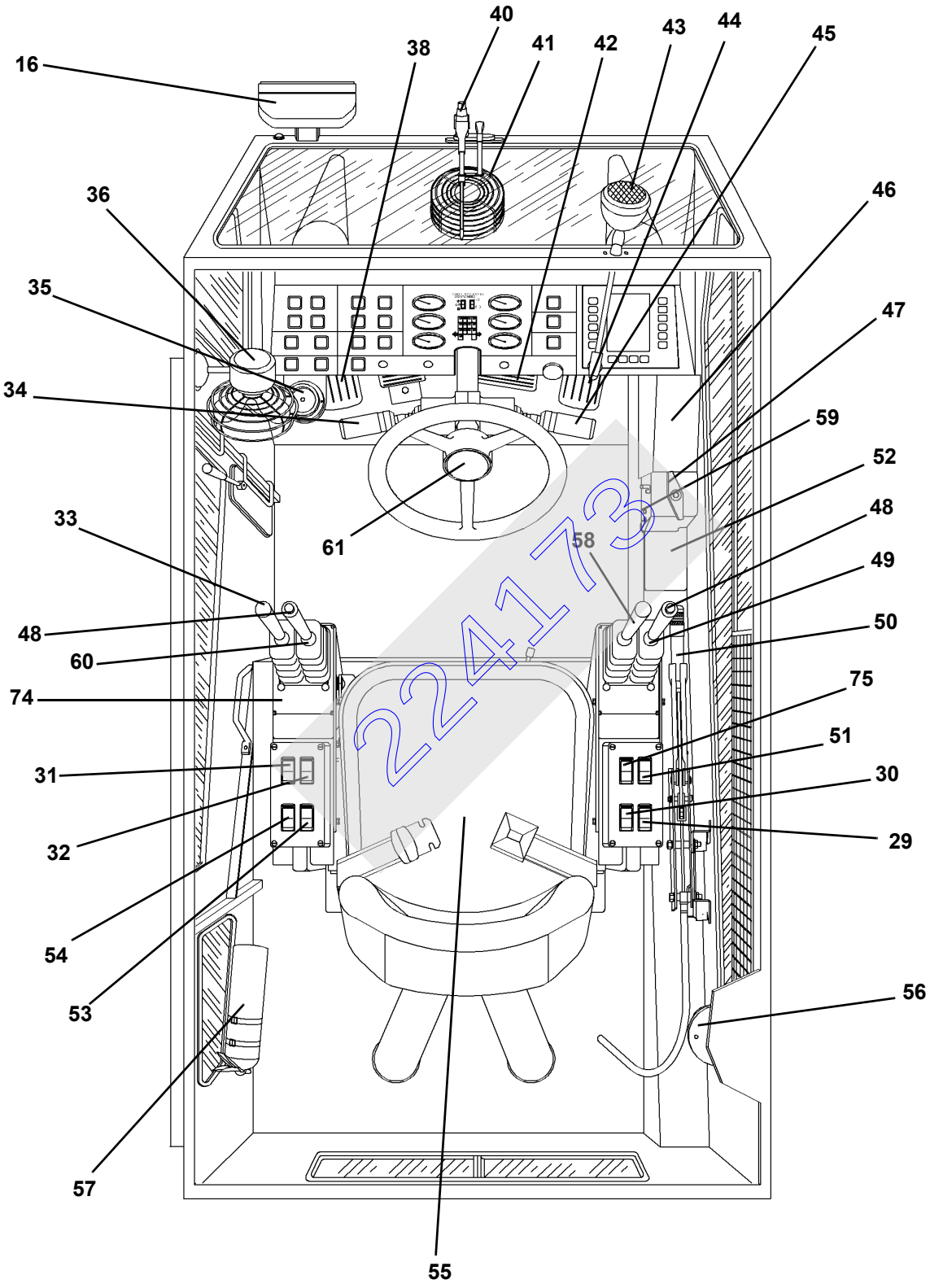

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FIGURE 3-1

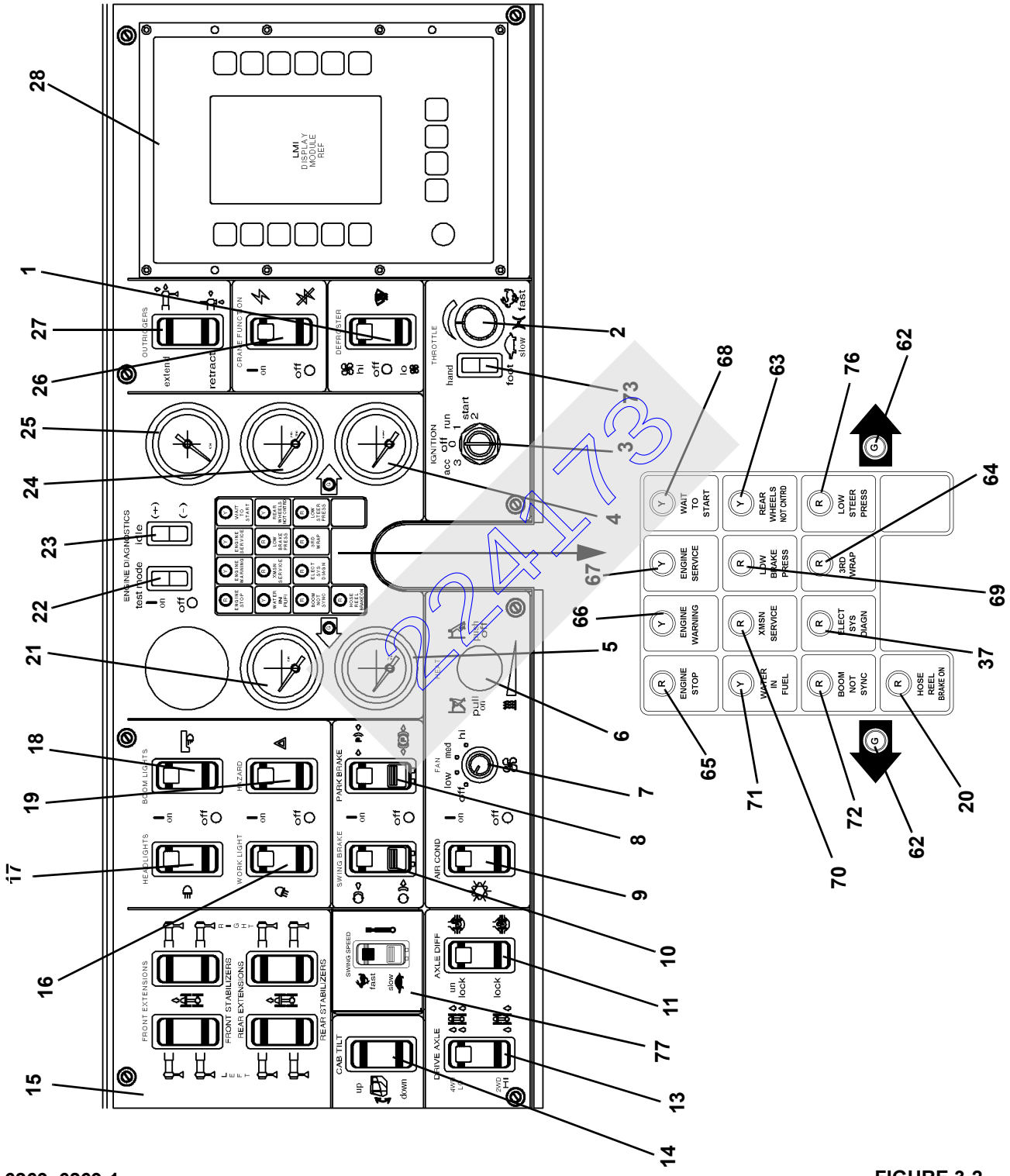

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FIGURE 3-2

Item	Description
1	Defroster Switch
2	Hand Throttle Control Knob
3	Ignition Switch
4	Voltmeter
5	Transmission Oil Temperature Gauge
6	Heat Control Knob
7	Fan Control Switch
8	Park Brake Control Switch
9	Air Conditioner Control Switch
10	Swing Brake Control Switch
11	Differential Lock Control Switch (Optional)
13	Drive Axle Selector Switch
14	Cab Tilt Switch
15	Outrigger Control Switches
16	Work Light Switch
17	Headlights Switch
18	Boom Lights Switch (Optional)
19	Hazard Lights Switch
20	Hose Reel Brake On Indicator
21	Fuel Gauge
22	Engine Diagnostics Test Mode Switch
23	Engine Diagnostics Idle Switch
24	Engine Coolant Temperature Gauge
25	Tachometer
26	Crane Function Power Switch
27	Outrigger Extend/Retract Switch
28	Load Moment Indicating (LMI) and Work Area Definition System Control Panel
29	Auto/Manual Boom Telescope Section Select Switch
30	Center/Inner Mid Boom Telescope Section Select Switch
31	Rear Steer Control Switch
32	Auxiliary Hoist Speed Selector Switch (Optional)
33	Swing Control Lever
34	Turn Signal Lever and Windshield Wiper/ Washer Controls
35	Bubble Level Indicator

Item	Description
36	Cab Circulating Fan
37	Electrical System Diagnostics Indicator
38	Swing Brake Pedal
39	Telescope Control Foot Pedal
40	Windshield Wiper
41	Defroster Fan
42	Service Brake Pedal
43	Spotlight (Optional)
44	Foot Throttle Pedal
45	Transmission Shift Lever
46	Circuit Breaker Panel
47	Pin Swing Lock Control (Pin Type)
48	Hoist Rotation Indicators
49	Main Hoist Control Lever
50	360 Degree Swing Lock Control (Positive Lock Type)
51	Main Hoist Speed Selector Switch
52	Engine and System Diagnostic Connector (Not Shown)
53	Luffing Jib Raise/Lower Switch (Optional)
54	Luffing Jib On/Off Switch (Optional)
55	Seat Switch (Not Shown)
56	Cab Dome Light
57	Fire Extinguisher
58	Boom Lift Control Lever
59	12 VDC Accessory Outlet
60	Auxiliary Hoist Control Lever
61	Horn
62	Turn Signal Indicators
63	Rear Wheels Not Centered
64	Hoist Third Wrap Indicator (Optional W/CE)
65	Engine Stop Indicator
66	Engine Warning Indicator
67	Engine Service Indicator
68	Wait To Start Indicator
69	Low Brake Pressure Indicator
70	Transmission Service Indicator (XMSN)
71	Water In Fuel Indicator

Item	Description
72	Boom Not Sync Indicator
73	Throttle Mode Switch
74	Armrest Switch (Not Shown)
75	Boom Telescope Mode A/B Select Switch
76	Low Steer Pressure Indicator
77	2 Speed Swing Switch

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 axle. The red square LED on the switch is illuminated when the pressure switch in the brake release system is activated and the brake is applied. The switch has a lock to prevent accidental release.

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.

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.

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 turnsignal 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 and the telescope control foot pedal is in neutral.

NOTE: Do not telescope boom in or out when indicator light is on and the telescope control foot pedal is depressed.

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 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 (Optional)

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.

Service Brake Pedal

The service brake 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, or third gear, rotate the knob to 1, 2, or 3.

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.

Turntable Lock Control (Pin Type)

The turntable lock control handle (47) is located beside the front console on the right side of the cab. The purpose is to lock or unlock the turntable. To lock the superstructure, the cable must be depressed and the knob must be turned to the right (clockwise). To unlock the superstructure, the cable must be pulled and the knob turned to the left (counterclockwise).

NOTE: Turning the knob only locks and unlocks the cable.

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 (52) is provided for troubleshooting and/or monitoring engine or electrical system faults or conditions. It is mounted on the side console by the operator's right leg.

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

Luffing Jib Raise/Lower Switch (Optional)

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 (Optional)

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. 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 auxiliary hoist cable.

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 turned to 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.

Hourmeter (Not Shown)

The hourmeter is located on the left side of the carrier to the rear of the hydraulic oil cooler. 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.

2 Speed Swing Switch

The 2-speed swing switch is located on the left side of the front console. This two-position (fast/slow) locking rocker switch determines the swing motor speed. When in fast position, the swing speed high solenoid is energized.

Electrical System Diagnostic Indicator

The ELECTRICAL SYSTEM DIAGNOSTIC indicator (37) 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 can bus system. Refer to the Electrical System in the Service Manual for more detailed information.

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, 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 restriction 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

WARNING

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

WARNING

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

WARNING

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

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

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

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

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

2. 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.

3. Immediately check the engine instruments for proper indication after starting. Shut down the engine if the oil pressure gauge does not reach the proper reading within 15 seconds.

CAUTION

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

4. 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

WARNING

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

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

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

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

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

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

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

4. Turn the IGNITION switch to START and release immediately when the engine starts. Do not push or hold the throttle down. The ECM will automatically provide the proper amount of fuel to start the engine.

5. Immediately check the engine instruments for proper indication after starting. Shut down the engine if the oil pressure gauge does not reach the proper reading within 15 seconds

.

CAUTION

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

6. 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

1. Allow the engine to operate at idle for about five minutes to avoid high internal heat rise and allow for heat dissipation.

2. Turn the ignition switch to OFF.

Crane Travel Operation

Traveling - General

WARNING

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.

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.

WARNING

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

DANGER

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

WARNING

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

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

WARNING

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

CAUTION

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

CAUTION

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

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

Extended Travel

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).

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.

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.

WARNING

Operate the rear steer only for added job site maneuverability.

Rear Wheel Steering

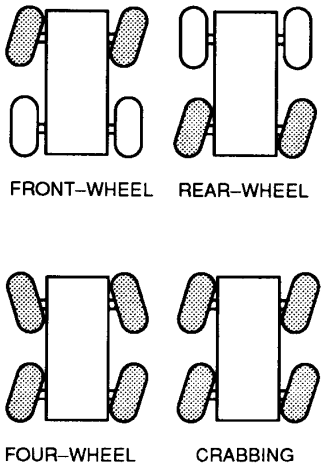
Rear wheel steering is controlled by the REAR STEER control switch. Moving the control switch to the desired position activates the rear steer cylinders, thereby steering the crane in the selected direction.

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

CAUTION

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.

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

3. Put the transmission shift lever knob to the forward (F) and 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.

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 and crane motion has stopped.

Proper Operation of Differential Lock

CAUTION

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 10 mph; 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).
2. 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.

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

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

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

Proper Operation of Axle Oscillation Lockouts

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

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

CAUTION

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

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

General Crane Operation

Pump Drive

The main hydraulic pumps are mounted on the torque converter drive pad. The pumps operate any time the engine is running.

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.

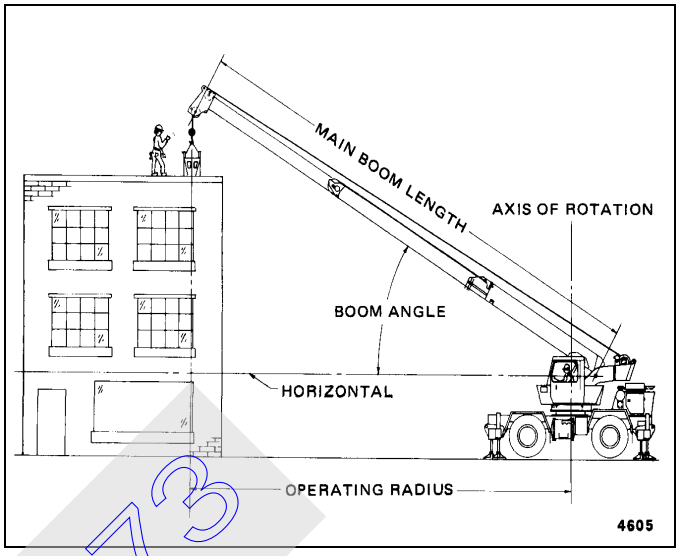
1. Extend and set outriggers.
2. Raise, lower, and swing the boom a minimum of 45° right and left.
3. Telescope the boom in and out.
4. Raise and lower the cable a few times at various boom lengths. Ensure there is no kinking.

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. When the boom length or lift radius or both are between values listed, the smallest load shown at either the next larger radius or next longer or shorter boom length shall be used.

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

A lifting diagram is included to describe over side, over rear, and over front lifting areas. The lifting area diagram shows that the locations of the outrigger stabilizer cylinders in the

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

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.

WARNING

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).

CAUTION

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

CAUTION

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 the 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 45 kg (99 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.

WARNING

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

CAUTION

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

CAUTION

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

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

To swing the boom, 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

WARNING

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

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

Lowering the Boom

WARNING

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

WARNING

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

CAUTION

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

CAUTION

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

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

Telescoping the Boom

Extending the Boom

WARNING

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

DANGER

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

CAUTION

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

NOTE: 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

WARNING

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

WARNING

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

WARNING

Do not jerk the control lever when starting or stopping the hoist. Jerking the lever causes the load to bounce, which could result in possible damage to the crane.

NOTE: When the load is stopped at the desired height, the automatic brake will engage and hold the load as long as the control lever remains in neutral.

Lowering the Cable

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

Raising the Cable

Pull the MAIN or AUX hoist control lever back, toward the operator, and hold until the hook or load is raised to the desired height.

Hoist Speed Range Selection

CAUTION

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 - OPERATING CONTROLS AND PROCEDURES 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.

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.

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.

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 (see Figure 4-1).

Lowering the Hydraulic Boom Extension

WARNING

When lowering the boom extension, simultaneously let out the hoist cable to prevent two-blocking the extension sheave and the hook block or headache ball.

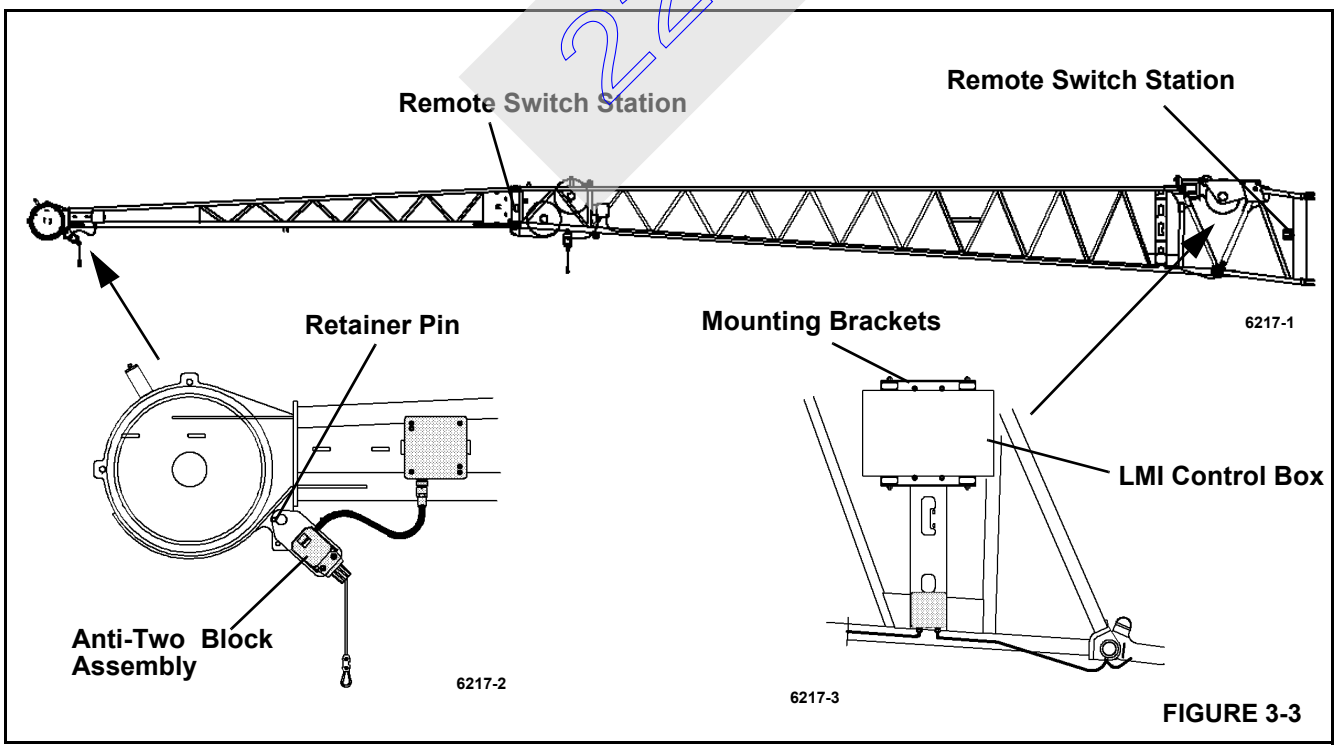


FIGURE 3-3

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.

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.

Operational Aids

WARNING

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

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

WARNING

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.

SECTION 4
SET-UP AND INSTALLATION

TABLE OF CONTENTS

4

SECTION 4
SET-UP AND INSTALLATION

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 (refer to Figure 4-1).

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.

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.

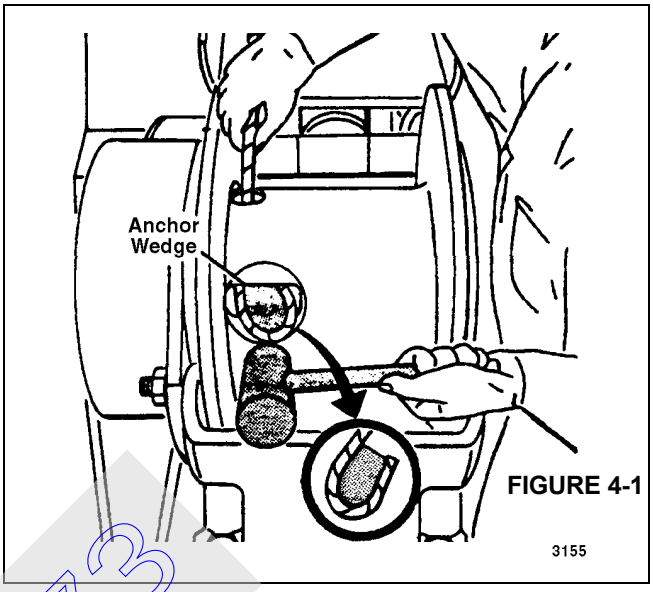


FIGURE 4-1

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 4-2).

In order to quick reeve the hook block without removing the wedge socket on the end of the cable, see figure titled Quick Reeving Hook Block.

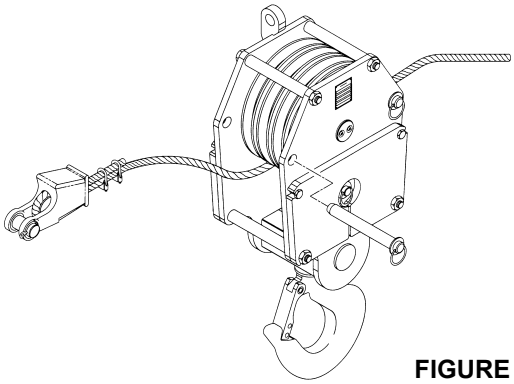


FIGURE 4-2

4

DEAD-END RIGGING/WEDGE SOCKETS

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

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

Do not mix components from different manufacturers. The selection, installation and use of a wedge socket assembly must be in accordance with the requirements of the wedge socket manufacturer and the wire rope manufacturer upon whose wire rope the wedge socket assembly will be used.

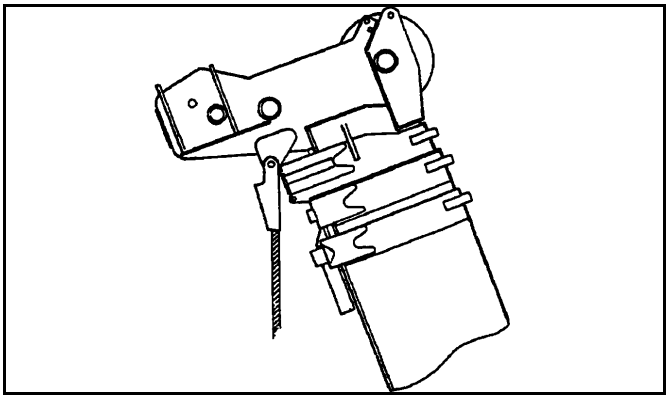
Manitowoc/Grove Crane specifies the size, type, class and line pulls for wire rope, predominately rotation resistant wire rope, and rigging accessories such as overhaul balls and hook blocks for use with each new crane that it manufactures. Other wire ropes and rigging accessories are available from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

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

CAUTION

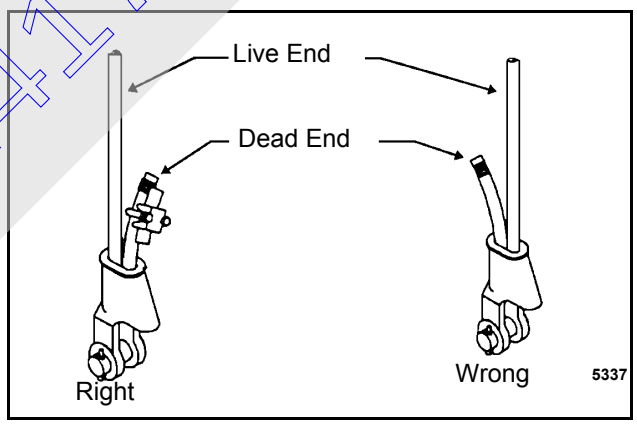
If the socket is not positioned with the flat face toward the boom sections, structural damage will occur.

When anchoring the socket to the boom, ensure the flat face of the socket is in position, as shown, toward the boom sections



Installing Wedge and Socket

1. Inspect the wedge and socket. Remove any rough edges and burrs.
2. The end of the wire rope should be seized using soft, or annealed wire or strand. If the end of the rope is welded, the welded end should be cut off. This will allow the distortion of the rope strands, caused by the bend around the wedge, to adjust themselves at the end of the line.



3. Make sure the live-loaded side of the rope is directly in line with the ears of the socket and the direction of pull to which the rope will be subjected. If the rope is loaded into the socket incorrectly, under a load the rope will bend as it leaves the socket, and the edge of the socket will wear into the rope causing damage to the rope and eventual failure.
4. Insert the end of a wire rope into the socket, form a loop in the rope, and route the rope back through the socket allowing the “dead” end to protrude from the socket. Ensure the dead end of the rope is of sufficient length to apply end treatment to the dead end after the wedge has been seated.
5. Insert the wedge into the loop and pull the live end of the rope until the wedge and rope are snug inside the

socket. It is recommended that the wedge be seated inside the socket to properly secure the wire rope by using the crane's hoist to first apply a light load to the live line.

6. After final pin connections are made, increase the loads gradually until the wedge is properly seated.

7. The wire rope and wedge must be properly secured inside the socket before placing the crane into lifting service. It is the wedge that secures the wire rope inside the socket whereas the dead-end treatment is used to restrain the wedge from becoming dislodged from the socket should the rope suddenly become unloaded from the headache ball or hook block striking the ground, etc.

Sketches A through F (Figure 4-3) illustrate various methods for treating the dead-ends of wire ropes which exit a wedge socket assembly. While use of the loop-back method is acceptable, care must be exercised to avoid the loop becoming entangled with tree branches and other components during crane transport and with the anti-two block system and other components during use of the crane.

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

When using method A, place a wire rope clip around the dead end by clamping a short extra piece of rope to the rope dead end. DO NOT CLAMP THE LIVE END. The U-bolt should bear against the dead end. The saddle of the clip should bear against the short extra piece. Torque the U-bolts according to the figures listed in the chart titled Wire Rope Clip Torque Values.

Other sources for information with which crane users should be familiar and follow is provided by the American Society of Mechanical Engineers, American National Standard, ASME B30.5, latest revised. ASME (formerly ANSI) B30.5 applies to cableways, cranes, derricks, hoists, hooks, jacks, and slings. It states, in section 5-1.7.3, "(c) Swagged, compressed, or wedge socket fittings shall be applied as recommended by the rope, crane or fitting manufacture." Wire ropes are addressed in ASME B30.5, section 5-1.7.2, ROPES, It states, in pertinent part, "(a) The ropes shall be of a construction recommended by the rope or crane manufacturer, or person qualified for that service." Additional information is published by the Wire Rope Technical Board in the Wire Rope Users Manual, latest revised.

Table 4-1

WIRE ROPE CLIP TORQUE VALUES

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

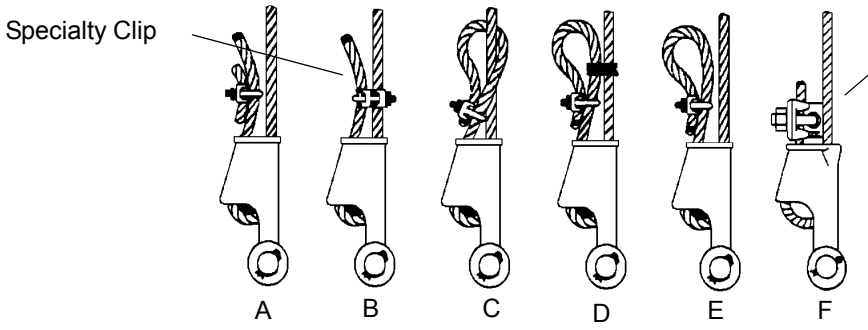


FIGURE 4-3

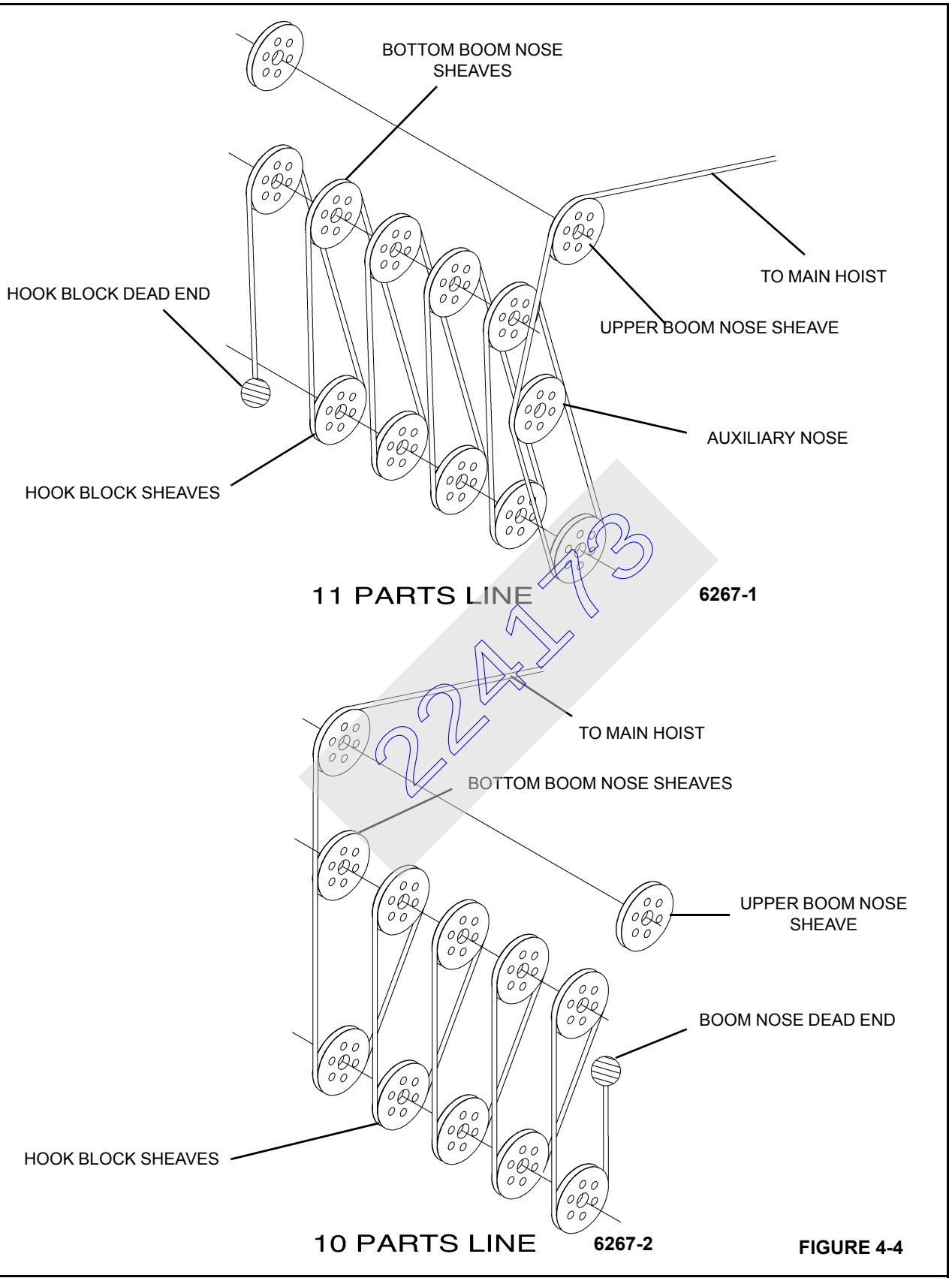
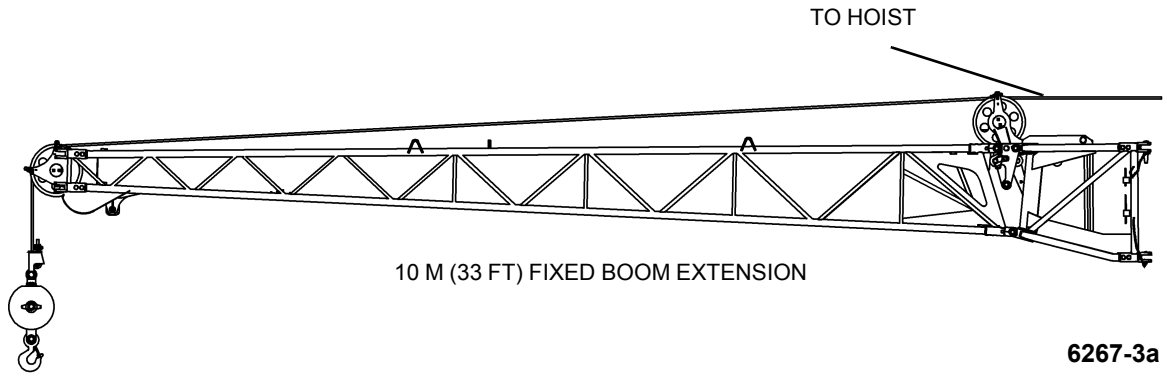
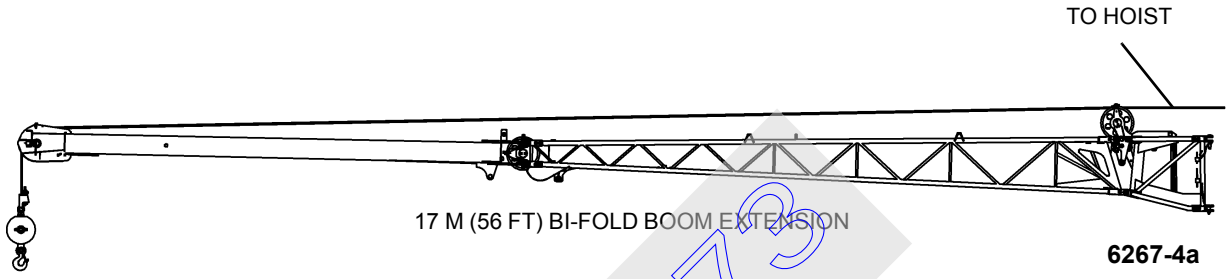


FIGURE 4-4



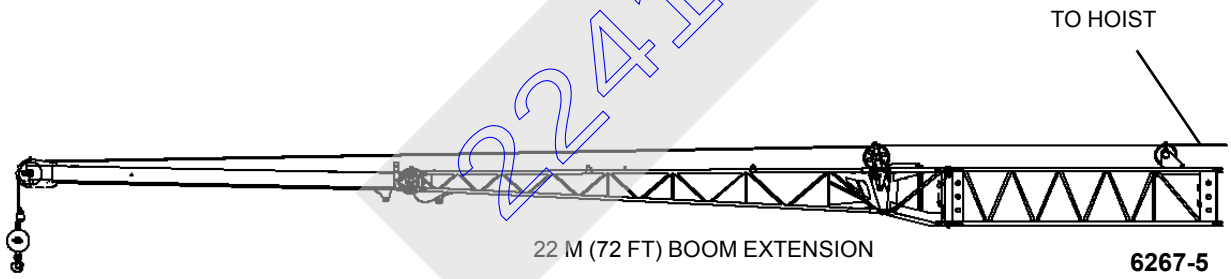
10 M (33 FT) FIXED BOOM EXTENSION

6267-3a



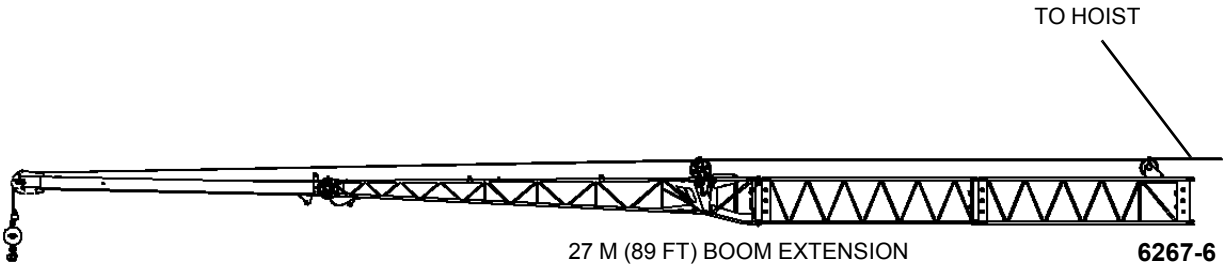
17 M (56 FT) BI-FOLD BOOM EXTENSION

6267-4a



22 M (72 FT) BOOM EXTENSION

6267-5



27 M (89 FT) BOOM EXTENSION

6267-6

6267-3/4/5/6

FIGURE 4-5

4

Counterweight and Auxiliary Hoist

Removal

1. Position the crane on a firm, level surface. Fully extend and set the outriggers. Level the crane.
2. Position the superstructure over the front of the machine and engage the turntable lock.
3. Remove any load and handling device from the auxiliary hoist cable and retract all cable onto the hoist drum. Secure the cable.
4. Disconnect the auxiliary hoist hydraulic lines and electrical harness and secure. Do not disconnect the counterweight removal cylinder hydraulic lines.
5. Remove the ball detent pins which secure the counterweight mounting pins.
6. Ensure that the counterweight removal cylinder support pins are securely attaching the counterweight to the turntable wing-support brackets. Disengage the counterweight mounting pins using the pinning control lever (center).

NOTE: It may be necessary to retract the counterweight removal cylinders to relieve weight from the counterweight mounting pins.

7. Using the control levers (left and right), simultaneously extend (lower) the counterweight onto the frame counterweight supports. Feather individual controls as required to lower the counterweight in a level position.
8. Remove the counterweight removal support pins from turntable wing-support brackets and using the control levers (left and right), retract the counterweight removal cylinders fully.
9. Disconnect and secure the counterweight removal cylinder hydraulic lines and replace the counterweight removal cylinder support pins on the turntable wing-support brackets.
10. Properly attach chains with clevis to the counterweight lifting holes (see Figure 4-7) and use a crane to carefully transfer the counterweight and auxiliary hoist to the ground or a suitable transport vehicle.

Installation

1. Position the crane on a firm, level surface. Fully extend and set the outriggers. Level the crane.
2. Position the superstructure over the front of the machine and engage the turntable lock.
3. Properly attach chains with clevis to the counterweight lifting holes (see Figure 4-7) and use a crane to carefully transfer the counterweight and auxiliary hoist to the frame counterweight supports over the rear outrigger box.
4. Attach the counterweight removal cylinder hydraulic lines.
5. Using the control levers (left and right), extend the counterweight removal cylinders, one at a time, guiding them into the turntable wing/support brackets and pin securely.
6. Using the control levers (left and right), simultaneously retract (raise) the counterweight removal cylinders until the counterweight round bar engages the lugs on the turntable and the counterweight pinning holes are aligned with the counterweight mounting pins. Feather individual controls as required to raise the counterweight in a level position.
7. Engage the counterweight mounting pins using the control lever (center).
8. Attach the ball detent pins securing the counterweight mounting pins.
9. Relieve pressure on the counterweight removal cylinder so that weight is fully supported by the counterweight mounting pins.
10. Attach the auxiliary hoist hydraulic lines and electrical harness.

Counterweight Without Auxiliary Hoist

Removal

1. Position the crane on a firm, level surface. Fully extend and set the outriggers.
2. Position the superstructure over the front of the machine and engage the turntable lock.
3. Remove the ball detente pins which secure the counterweight mounting pins.
4. Ensure that the counterweight removal cylinder support pins are securely attaching the counterweight to the turntable wing/support brackets. Disengage the counterweight mounting pins using the pinning control lever (center).

NOTE: It may be necessary to retract the counterweight removal cylinders to relieve weight from the counterweight mounting pins.

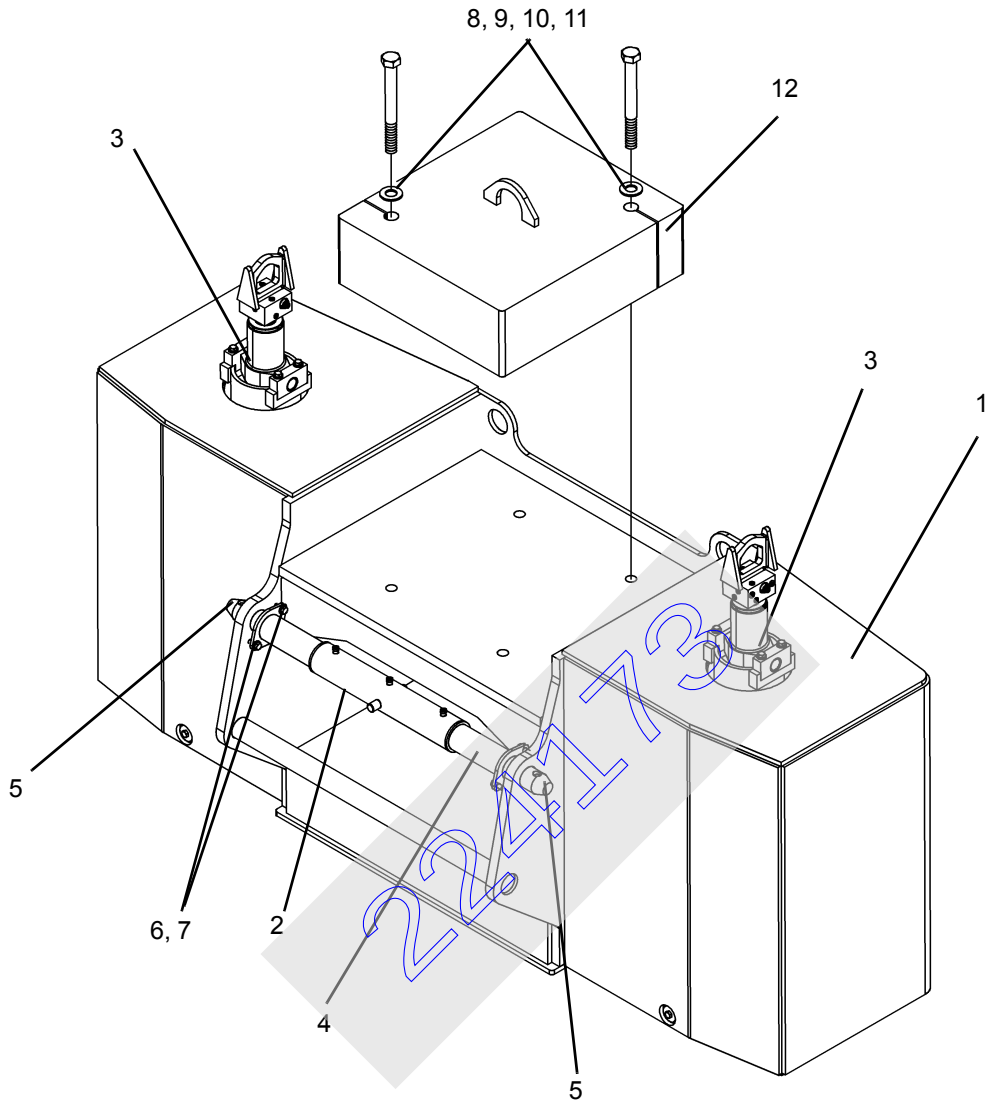


FIGURE 4-6

Item	Description
1	Counterweight Weld
2	Counterweight Pin Cylinder
3	Counterweight Removal Cylinder
4	Cylinder Support Weld
5	Ball Detent Pin
6	Screw

Item	Description
7	Washer
8	Bolt
9	Flatwasher
10	Lockwasher
11	Hex Nut
12	IPO Counterweight

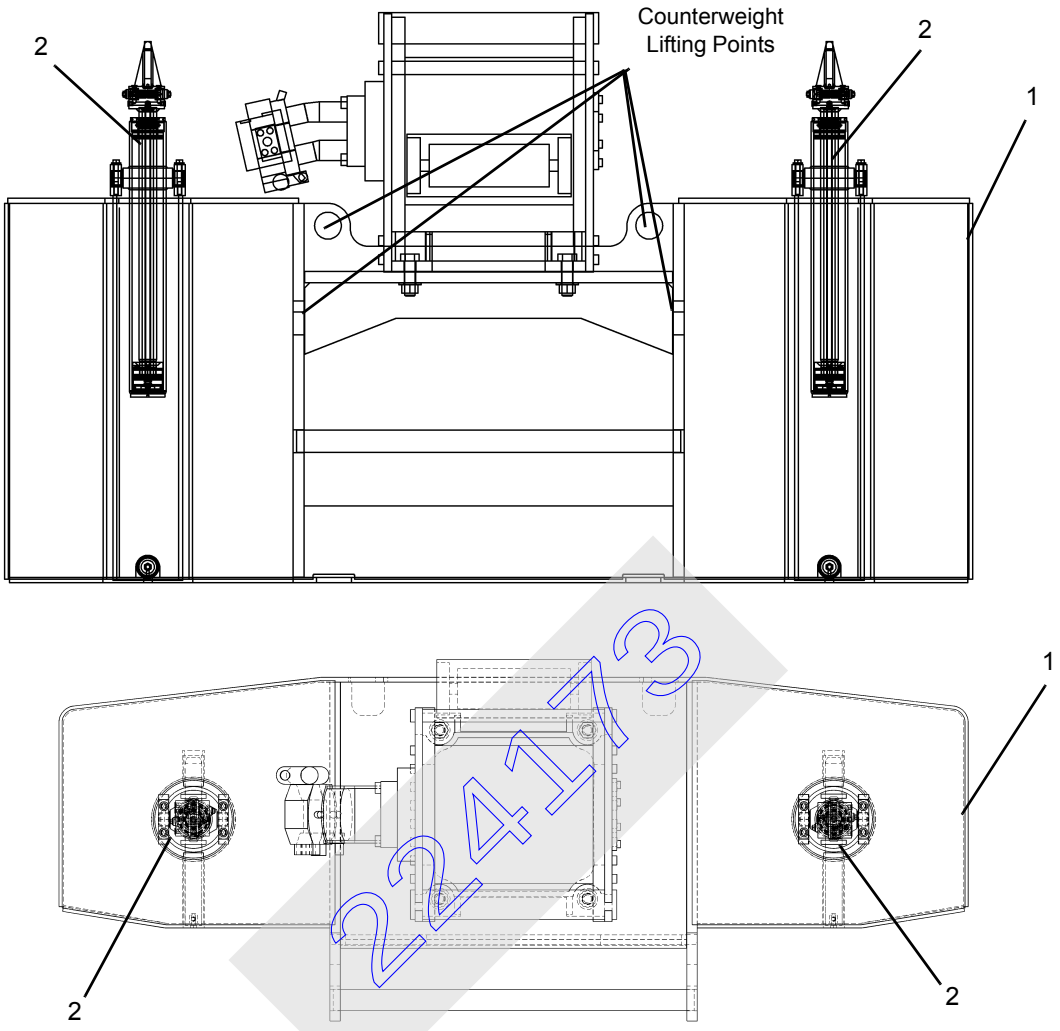


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FIGURE 4-7

Item	Description
1	Counterweight
2	Counterweight Cylinder Assembly

5. Using the control levers (left and right), simultaneously extend (lower) the counterweight onto the frame counterweight supports. Feather individual controls as required to lower the counterweight in a level position.

6. Remove the counterweight removal cylinder support pins from turntable wing/support brackets and using the control levers (left and right), retract the counterweight removal cylinders fully.

7. Disconnect and secure the counterweight removal cylinder hydraulic lines and replace the counterweight removal cylinder support pins on the turntable wing/support brackets.

8. If applicable, properly attach chains with clevis to the counterweight lifting holes (see Figure 4-7) and use a crane to carefully transfer the counterweight to the ground or a suitable transport vehicle.

Installation

1. Position the crane on a firm, level surface. Fully extend and set the outriggers. Level the crane.
2. Position the superstructure over the front of the machine and engage the turntable lock.
3. If applicable, properly attach chains with clevis to the counterweight lifting holes (see Figure 4-7) and use a crane to carefully transfer the counterweight to the frame counterweight supports over the rear outrigger box.
4. Attach the counterweight removal cylinder hydraulic lines.
5. Using the control levers (left and right) extend the counterweight removal cylinders, one at a time, guiding them into the turntable wing/support brackets and pin securely.
6. Using the control levers (left and right) simultaneously retract (raise) the counterweight removal cylinders until the counterweight round bar engages the lugs on the turntable and the counterweight pinning holes are aligned with the counterweight mounting pins. Feather individual controls as required to raise the counterweight in a level position.
7. Engage the counterweight mounting pins using the control lever (center).
8. Attach the ball detent pins securing the counterweight mounting pins.
9. Relieve pressure on the counterweight removal cylinder so that weight is fully supported by the counterweight mounting pins.

CHECKLISTS FOR RIGGING WORK

Overview of the Required Rigging Work

There are different initial states for rigging the lattice extension, depending on whether

- the lattice extension is folded at the side of the main boom or
- the lattice extension has been dismantled for on-road driving.

The following table shows you which checklist describes the required rigging work for your initial state.

Table 4-2

	Initial State	Corresponding Rigging Work
before the crane operation	The lattice extension is located at a side on the main boom	Check Lists: Rigging the 33 ft (10.1 m) swingaway lattice extension.
	The lattice extension was removed completely	Check List: Installing two-stage swingaway lattice extension
after the crane operation	The lattice extension must be folded to the side of the main boom	Check List: Unrigging the 33 ft (10.1 m) swingaway lattice extension. Unrigging the 56 ft (17.1 m) two-stage swingaway lattice extension.
	The lattice extension is to be removed for on-road driving	Check List: Removing the two-stage swingaway lattice extension.

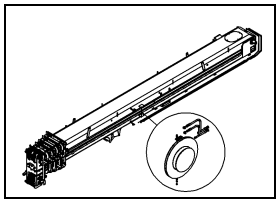
Checklist: Installing the (Two-Stage) Manual Swingaway Lattice Extension

Prerequisites:

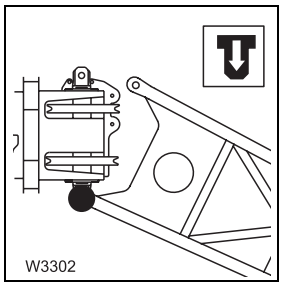
- The crane is on outriggers or the main boom is placed on the boom support.
- An auxiliary crane is available.

4

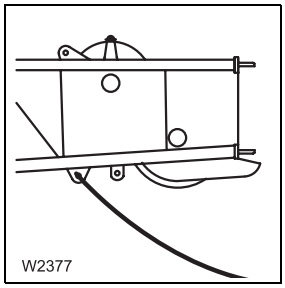
1. If necessary, connect the hose drum for hydraulic supply.



2. Check the transport condition of the (two-stage) swingaway lattice extension.
3. Sling two-stage swingaway lattice extension on auxiliary crane.
4. Lift (two-stage) swingaway lattice extension in front of the main boom with the auxiliary crane and lock the 33 ft (10.1 m) section to the right of the main boom head.



5. Establish hydraulic connection between the lattice extension and the main boom.
6. Establish electrical connection between the lattice extension and the main boom.
7. Attach the guide rope to the head of the 33 ft (10.1 m) section.



NOTE: If the lattice extension needs to be rigged in front of the main boom, proceed as from point 10.

8. If the lattice extension is to be folded up at the side of the main boom, fold out run-up rail.
9. The other types of rigging work for folding up the lattice extension at the side are described in the Check List: Unrigging the 33 ft (10.1 m) swingaway lattice extension as from point 12.
10. If the lattice extension needs to be rigged in front of the main boom, attach guide ropes to the head of the 33 ft (10.1 m) section.

    The other types of rigging work for the 33 ft (10.1 m) swingaway lattice extension are described in the Check List: Rigging the 33 ft (10.1 m) swingaway lattice extension as from point 14.

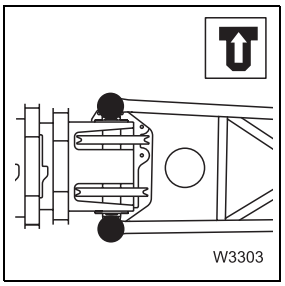
    The other types of rigging work for the 56 ft (17.1 m) two-stage swingaway lattice extension are described in the Check List: Rigging the 56 ft (17.1 m) swingaway lattice extension as from point 13.

Checklist: Removing the (Two-Stage) Swingaway Lattice Extension

Prerequisites:

- The crane is on outriggers.
- An auxiliary crane is available.

1. Carry out all of the rigging work for a rigged 33 ft (10.1 m) swingaway lattice extension listed in the Check List: Unrigging 33 ft (10.1 m) swingaway lattice extension up to and including point 9 in this section.
2. Carry out all of the rigging work for a rigged 56 ft (17.1 m) two-stage swingaway lattice extension listed in the Check List: Unrigging 56 ft (17.1 m) two-stage swingaway lattice extension up to and including point 15.
3. Disconnect hydraulic connection between the lattice extension and the main boom.
4. Disconnect electrical connection between the lattice extension and the main boom.
5. Slinging (two-stage) swingaway lattice extension on auxiliary crane.
6. Remove locking pins on both sides between 33 ft (10.1 m) section and main boom head and place (two-stage) swingaway lattice extension onto separate vehicle using auxiliary crane.

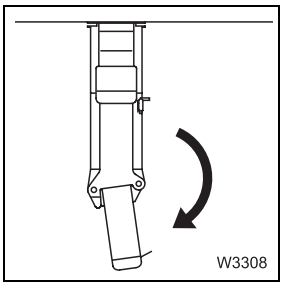


7. Check the transport condition of the (two-stage) swingaway lattice extension.

8. If necessary, remove hose drum connection for hydraulic supply.

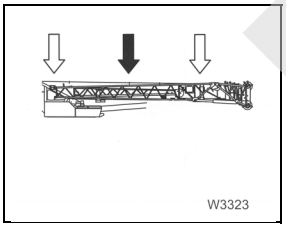
Checklist: Rigging the 33 Ft (10.1 m) Swingaway Lattice Extension

1. Prepare the crane for rigging the swingaway lattice extension.
2. If necessary, connect the hose drum for hydraulic supply.
3. Check if the lattice extension was unrigged properly and is in transport condition.
4. Folding out the run-up rail.

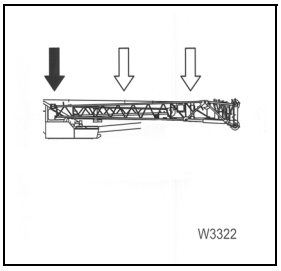


NOTE: If only the 33 ft (10.1 m) section is folded at the side of the main boom - proceed from point 7.

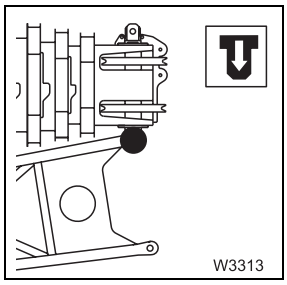
5. Move the connection in the middle area on 33 ft (10.1 m) section.



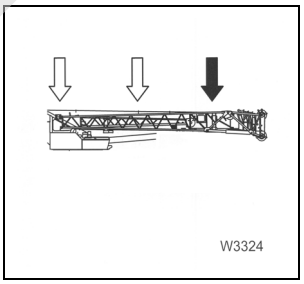
6. Release connection at the pivot point between 33 ft (10.1 m) section and 23 ft (7 m) section.
7. If only the 33 ft (10.1 m) section is folded at the side of the main boom, remove connection between 33 ft (10.1 m) section and main boom (rear).



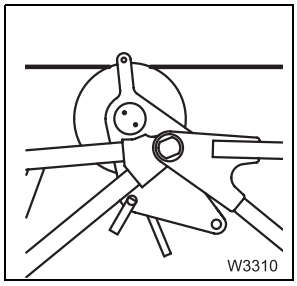
8. Establish electrical connection between the lattice extension and the main boom.
9. Establish hydraulic electrical connection between the lattice extension and the main boom.
10. Swing 33 ft (10.1 m) section onto the main boom head.
11. Fasten 33 ft (10.1 m) section onto the main boom head with pins on right-hand side.



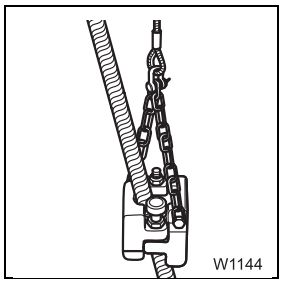
12. Secure the lattice extension on the main boom with guide rope.
13. Release the connection in the front area. If necessary, press down the slewing axle mechanically.



14. Swing the 33 ft (10.1 m) section in front of the main boom head.
15. Pin the 33 ft (10.1 m) section in front of the main boom head on the left-hand side.
16. Fold out both deflection sheaves on the 33 ft (10.1 m) section if offset angle is 20° or 40°.
17. Place the hoist cable over both deflection sheaves and head sheave of the 33 ft (10.1 m) section if angle is 20° or 40° offset.

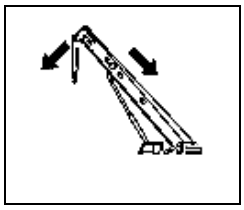


18. Move the lifting limit switch from the head of the main boom to the head of the 33 ft (10.1 m) section.
19. Reeve the hoist cable on the hook block.
20. Attach the lifting limit switch weight and guide hoist rope through the weight.

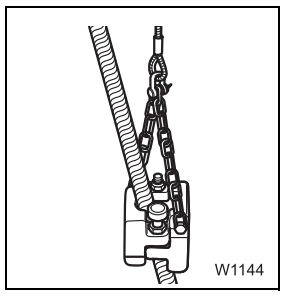


Checklist: Unrigging the 33 Ft (10.1 m) Swingaway Lattice Extension

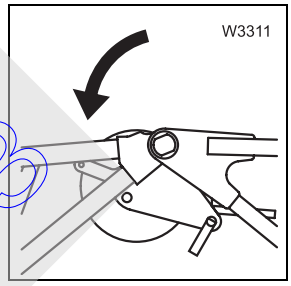
1. Prepare the crane for unrigging.
2. Retract the main boom completely and lower it into the horizontal position.



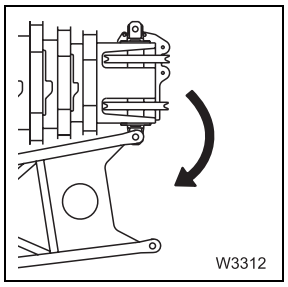
3. Remove the lifting limit switch weight and move lifting limit switch from the head of the 33 ft (10.1 m) section to the head of the main boom.



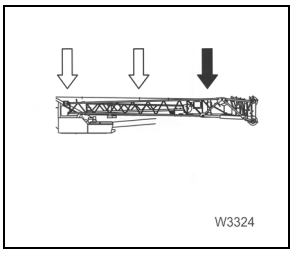
4. Unreeve the hoist cable from the hook block and remove it from the lattice extension.
5. Fold in both deflection sheaves on the 33 ft (10.1 m) section.



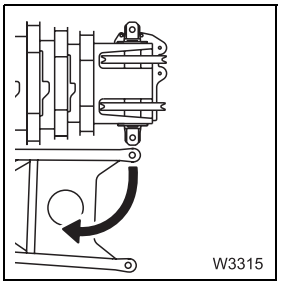
6. Reel hoist cable up to the main boom head.
7. Attach the guide rope to the head of the 33 ft (10.1 m) section.
8. Remove the left-hand locking pin between the 33 ft (10.1 m) section and the main boom head.
9. Raise the main boom completely.
10. Swing the 33 ft (10.1 m) section onto the main boom.



11. Lower the lattice extension so that it is positioned on the run-up rail.
12. Establish the connection in the front area.



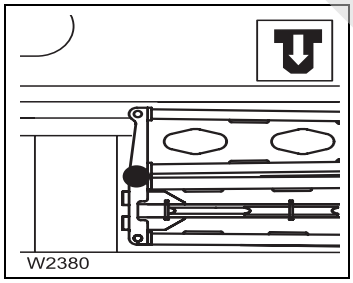
13. Remove the right hand locking pin between the 33 ft (10.1 m) section and the main boom head.
14. Swing the 33 ft (10.1 m) section on the run-up rail onto the main boom.



15. Secure the connection in the front area.

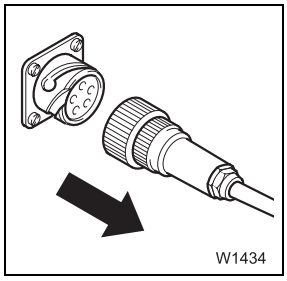
If the 23 ft (7 m) section is not attached to the main boom, proceed to step 20.

16. Move the connection in the middle area 23 ft (7 m) section/33 (10.1 m) ft section.
17. Establish the connection at the pivot point between 33 ft (10.1 m) section and 23 ft (7 m) section.

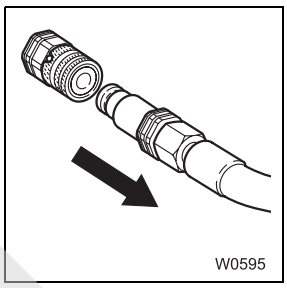


If the 23 ft (7 m) section is attached to the main boom, proceed to step 21.

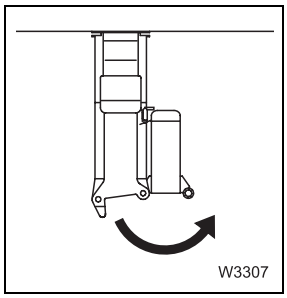
18. Establish the connection between 33 ft (10.1 m) section and the main boom in the rear area.
19. Remove electrical connection between the lattice extension and the main boom.



20. Disconnect hydraulic connection between the lattice extension and the main boom.



21. Check whether the lattice extension is in transport condition.
22. Fold in the run-up rail.

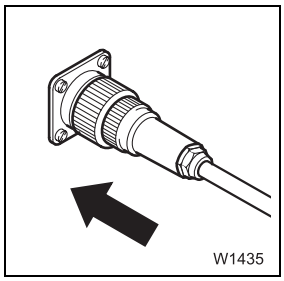


23. If necessary, remove hose drum connection for hydraulic supply.

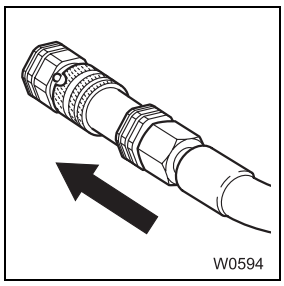
Checklist: Rigging the 56 ft (17.1 m) two-stage swingaway lattice extension

1. Prepare the crane for rigging the swingaway lattice extension.
2. If necessary, connect the hose drum for hydraulic supply.
3. Check if the lattice extension was unrigged properly and is in transport condition.
4. Fold out the run-up rail.
5. Move the connection in the middle area 23 ft (7 m) section/33 ft (10.1 m) section.

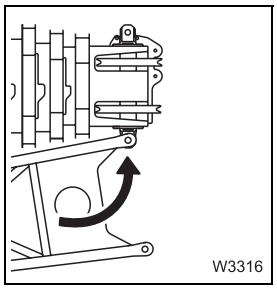
6. Remove the connection between 23 ft (7 m) section and the main boom in the rear area.
7. Establish electrical connection between the lattice extension and the main boom.



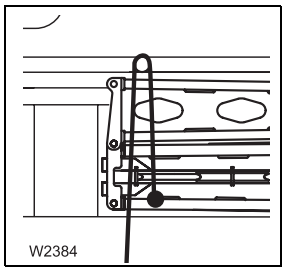
8. Establish hydraulic connection.



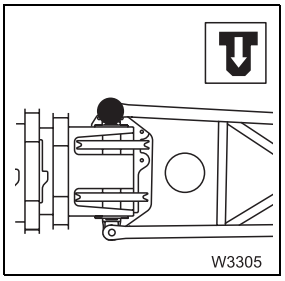
9. Swing the lattice extension onto the main boom head.



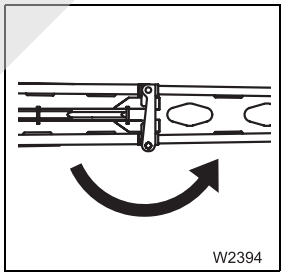
10. Fasten 33 ft (10.1 m) section onto the main boom head with pins on the right-hand side.
11. Secure the lattice extension on the main boom with guide rope.



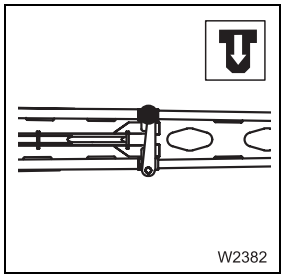
12. Remove the connection in the front area. If necessary, press down the slewing axle mechanically.
13. Swing the lattice extension in front of the main boom head.
14. Pin the 33 ft (10.1 m) section onto the main boom head on the left-hand side.



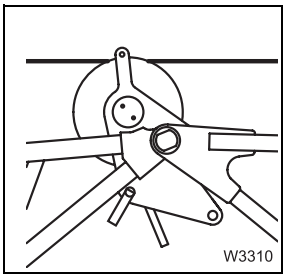
15. Attach the guide rope to the head of the 23 ft (7 m) section.
16. Move the connection in the middle area of the 33 ft (10.1 m) section.
17. Swing the 23 ft (7 m) section in front of the 33 ft (10.1 m) section.



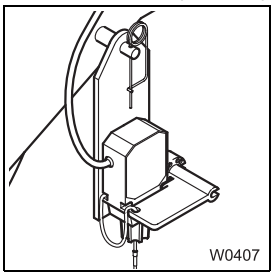
18. Fasten the 23 ft (7 m) section on the left-hand side of the 33 ft (10.1 m) section with a pin.



19. Establish electrical connection between the 33 ft (10.1 m) and the 23 ft (7 m) sections.
20. Fold out both deflection sheaves on the 33 ft (10.1 m) section if offset angle is 20° or 40°.
21. Place the hoist cable over both deflection sheaves and head sheave of the 23 ft (7 m) section.



22. Move the lifting limit switch from the head of the main boom to the head of the 33 ft (10.1 m) section.



23. Reeve the hoist cable on the hook block.

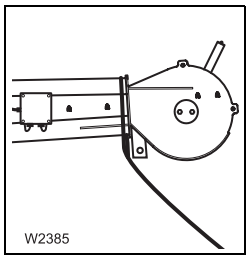
24. Attach the lifting limit switch weight and guide hoist rope through the weight.

Checklist: Unrigging the 56 ft (17.1 m) two-stage swingaway lattice extension

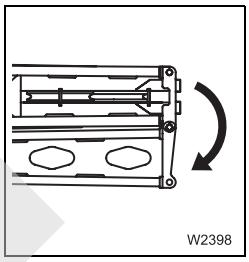
1. Prepare the crane for unrigging.
2. Retract the main boom completely and lower it into he horizontal position.
3. Remove the lifting limit switch weight and move lifting limit switch from the head of the 23 ft (7 m) section to the head of the main boom.
4. Unreeve the hoist cable from the hook block and remove it from the lattice extension.
5. Remove hoist rope from the head sheave and guide it to the ground on the left-hand side of the lattice extension.

NOTE: If the 23 ft (7 m) section needs to be removed and only the 33 ft (10.1 m) section at the side of the main boom needs to be folded, proceed to point 12.

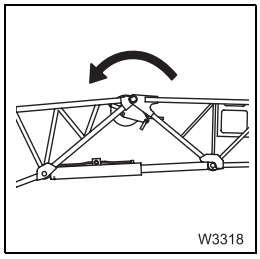
6. Attach the guide rope to the head of the 23 ft (7 m) section.



7. Remove the locking pins on the left-hand side between 23 ft (7 m) section and 33 ft (10.1 m) section.
8. Swing the 23 ft (7 m) section in front of the 33 ft (10.1 m) section.

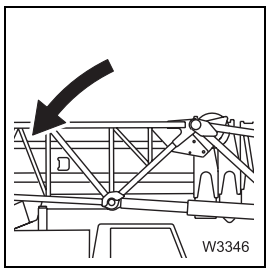


9. Move the connection in the middle area 23 ft (7 m) section/33 ft (10.1 m) section.
10. If the 23 ft (7 m) section needs to be removed, attach 23 ft (7 m) section on the auxiliary crane, remove all locking pins between the 23 ft (7 m) section and the 33 ft (10.1 m) section and place 23 ft (7 m) section on a separate vehicle.
11. Fold in both deflection sheaves on the 33 ft (10.1 m) section.
12. Reel hoist cable up to the main boom head.
13. Attach the guide rope to the head of the 33 ft (10.1 m) section.
14. Remove the left-hand locking pin between the 33 ft (10.1 m) section and the main boom head.
15. Raise the main boom completely.



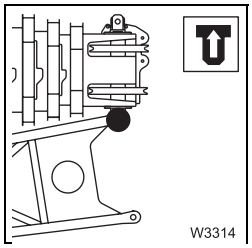
16. Swing the lattice extension onto the main boom.

17. Lower the lattice extension so that it is positioned on the run-up rail.



18. Establish the connection in the front area.

19. Remove right hand locking pin between the 33 ft (10.1 m) section and the main boom head.



20. Swing the lattice extension on the reap rail onto the main boom.

21. Secure the connection in the front area.

NOTE: If the 23 ft (7 m) section has been removed, proceed to step 23.

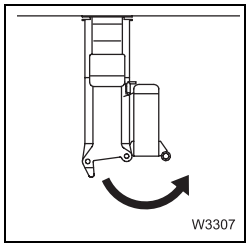
22. If the 23 ft (7 m) section has been removed, establish a connection between the 33 ft (10.1 m) and the main boom.

23. Remove electrical connection between the lattice extension and the main boom.

24. Disconnect the hydraulic connection between the lattice extension and the main boom.

25. Check whether the lattice extension is in transport condition.

26. Fold in the run-up rail.



27. If necessary, remove the hose drum connection for hydraulic supply.

DESCRIPTION OF RIGGING WORK

Preparing the Crane for Rigging

NOTE: The data is this section also applies to the rigging of the boom extension.

Requirements for rigging

Before you rig a lattice extension or the boom extension, the following requirements must be met:

- The swingaway lattice extension is mounted on the side of the main boom and is in transport condition.
- The counterweight version required according to the *lifting capacity table* for the planned operation with the lattice extension is rigged.
- The crane is supported by the outrigger span required according to the *lifting capacity table* for the planned operation with the lattice extension and is aligned horizontally.
- The main boom is completely retracted and has been lowered into horizontal position.
- If the crane is equipped with two hoists with additional equipment, the hook block is unreeved on the hoist, which is not used for working with the lattice extension.

Requirements for unrigging

Before you lower a lattice extension or the boom extension into a horizontal position, the following requirements must be met:

- No other load is raised apart from the hook block.
- The counterweight version required according to the *lifting capacity table* for the planned operation with the lattice extension is rigged.
- The crane is supported with the outrigger span prescribed for operation with the rigged lattice extension according to the *lifting capacity table*.
- The main boom is fully retracted.

Securing lattice extension with cord

If the crane is not well aligned, the lattice extension may swing out of its own accord when you remove the last connection that held the lattice extension at the side of the main boom.

You must therefore secure the lattice extension before you begin with the rigging work.

DANGER

Always secure the lattice extension with a guide rope on the main boom before removing any connections. This will prevent the lattice extension from slipping off the run-up rail, swinging around and knocking you off the carrier or injuring other persons in the slewing range.

Secure the lattice extension as follows:

- Attach a cord at the front of the lattice extension.
- Guide the cord underneath the lattice extension, via the holding rod on the main boom and back again.
- Have a helper hold the cord tight while you are removing the last connection.

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

Checking the Transport Condition

For transportation you must establish certain connections between both parts of the lattice extension. The connections which need to be established depend on whether the lattice extension:

- is folded up at the side of the main boom for transportation or
- is completely removed for transportation.

DANGER

Be careful not to damage the lattice extension and the main boom. Always put the lattice extension into transport condition folded at the side or working with the main boom. Only then is the lattice extension secured against slipping. This way you prevent the partly fastened lattice extension hitting the main boom or the individual components of the lattice extension hitting each other and becoming damaged.

You must check transport condition:

- After unrigging the lattice extension, before you drive the crane with the lattice extension folded at the side or work with the main boom.
- Before installation and before rigging the lattice extension.

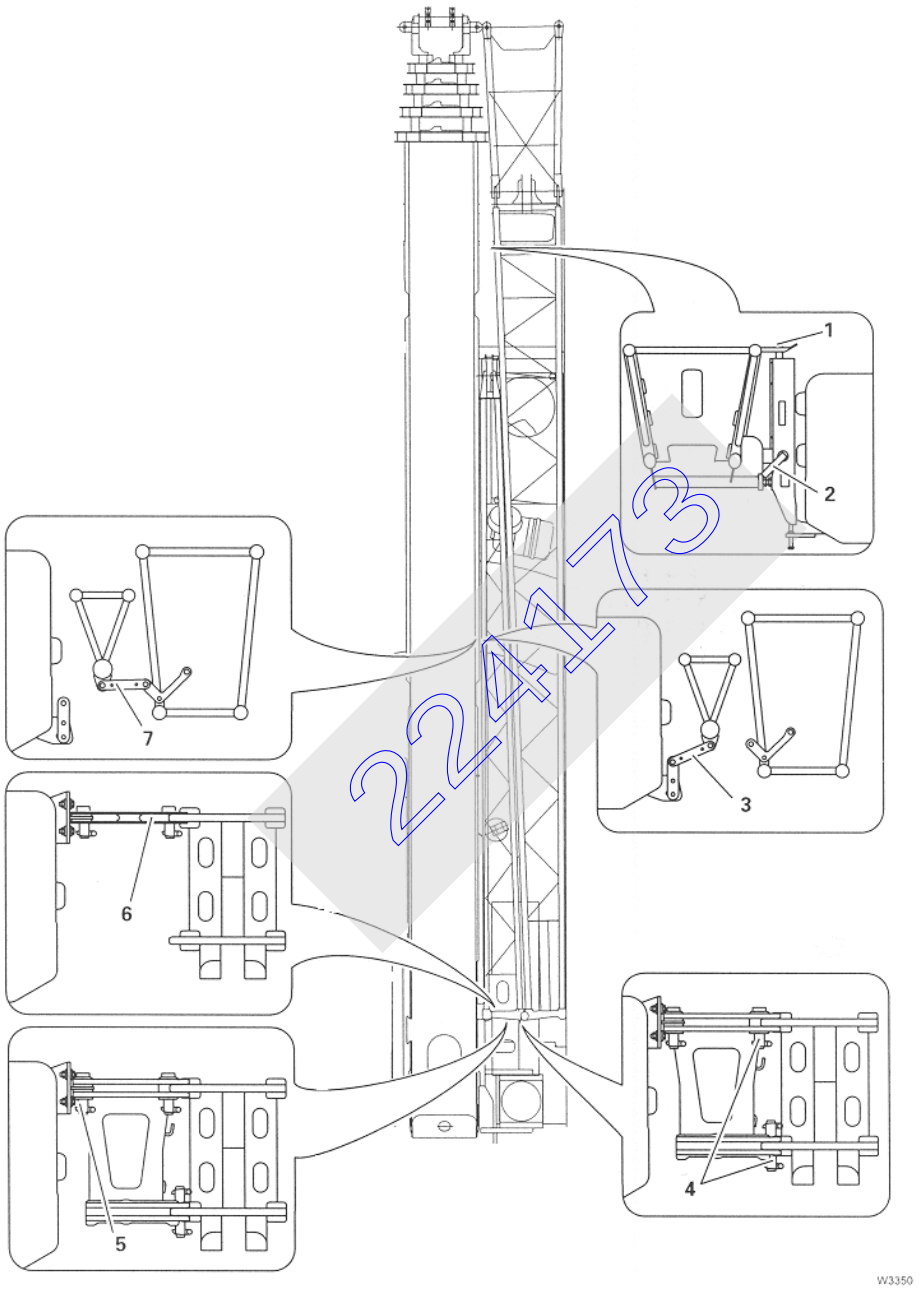


FIGURE 4-8

Transport condition with lattice extension folded at the side

The transport condition with the lattice extension folded at the side is created when all of the following connections are established.

- Check the connections and establish them if necessary.

If 23 ft (7 m) section and 33 ft (10.1 m) section are folded at the side:

- The 33 ft (10.1 m) section is locked at the slewing axle (1) in front on the main boom and the slewing axle is secured with a retaining pin (2)
- The pins (4) are inserted on the pivot point between the 23 ft (7 m) section and the 33 ft (10.1 m) section.
- The connection (7) in the middle area is in the position 23 ft (7 m) section/33 ft (10.1 m) section.
- The connection (5) between 23 ft (7 m) section and main boom in the rear area is established.

If the 33 ft (10.1 m) section only is folded at the side:

- The 33 ft (10.1 m) section is locked at the slewing axle (1) in front on the main boom and the slewing axle is secured with a retaining pin (2).
- The connection between the 33 ft (10.1 m) section and the main boom in the rear area is established (6),

If the 23 ft (7 m) section only is folded at the side:

- The connection in the middle area is in the position 23 ft (7 m) section/main boom (3).
- The connection between the 23 ft (7 m) section and the main boom in the rear area is established.

Transport condition with removed lattice extension

The transport condition for the removed lattice extension is established when all of the following connections have been made.

- Check the connections and establish them if necessary.
- The connections on the pivot point between the 23 ft (7 m) section and the 33 ft (10.1 m) section have been established (4).
- The connection in the middle area is in the position 23 ft (7 m) section/33 ft (10.1 m) section (7).

Hose Drum for Hydraulic Supply

The hydraulic supply for the lattice extension is provided through a hose drum on the left-hand side of the main boom.

If the main boom is used for longer periods of time, the hose drum's hydraulic connections should be brought into the main boom operation position.

This prevents unnecessary reeling and unreeling of the hose.

The following rigging processes are described in this section:

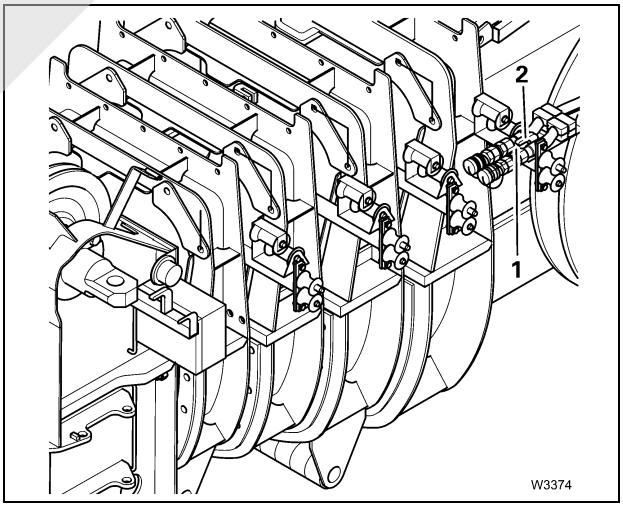
- Locking device for transportation.
- Hydraulic connection.

Locking devices for transportation

The hose drum is equipped with an anti-twist device. The anti-twist device prevents the hose drum twisting unchecked against the holder when releasing the strain relief because of initial tension.

DANGER

Risk of accidents from uncontrolled turning of hose drum. You may release the anti-twist device only when you have attached the strain relief on the main boom beforehand. By doing this, you prevent the hose drum from twisting uncontrollably against the holder and the turning hydraulic hoses injuring other people.



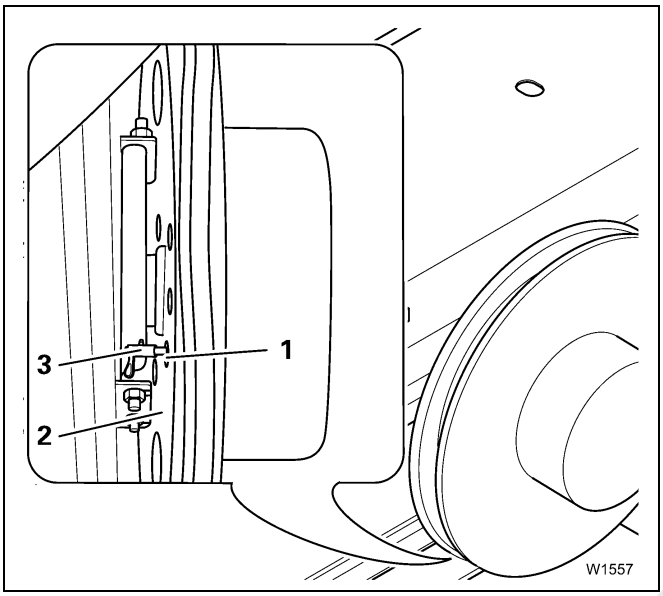
You must always insert the anti-twist device before releasing the strain relief (1) from the holder (2) on the main boom.

You may release the anti-twist device only after you have attached the strain relief (1) back in the holder (2) on the main boom.

There are eight bores (1) distributed over the radius on the inner flanged wheel (2) of the hose drum.

Inserting anti-twist device

- Turn the hose drum until a bore is in front of the spring latch (3).
- Move the spring latch into the bore, the hose drum is secured against twisting.



Removing anti-twist device

- Attach the strain relief on the main boom before removing.
- Withdraw spring latch (3) from the bore in the flanged wheel.

Hydraulic connection

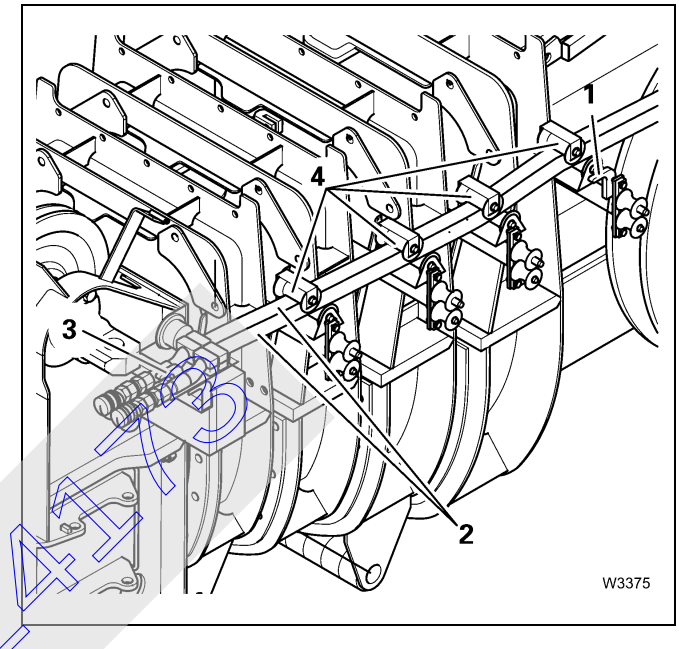
Before operating the lattice extension, you must establish the hydraulic connection. Before working with the main boom for longer periods, you must disconnect the hydraulic connections.

DANGER

Risk of accidents from hydraulic hoses springing back! If you detach the strain relief after the anti-twist device has been released, do not under any circumstances let go of the strain relief before it has been reattached. If you let go of the strain relief, the hydraulic hoses will spring back uncontrollably due to the spring force in the hose drum and may injure persons or damage parts of the truck crane.

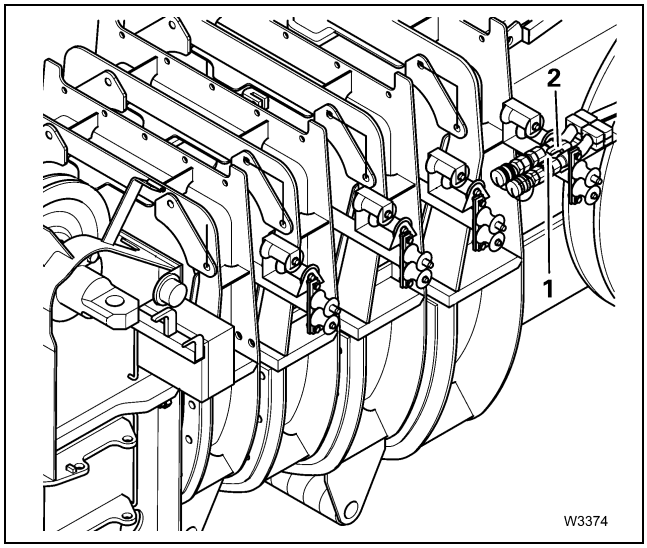
Position for working with the lattice extension

- Take the strain relief out of the holder (1) and pull the hydraulic hoses (2) towards the main boom head.
- Hook the strain relief onto the holder.
- Guide the hydraulic hoses through the guide rollers (4).



Position for working with the main boom

- Remove the hydraulic hoses from the guide rollers (5).
- Release the strain relief on the holder (3) and attach the strain relief to the holder (1).

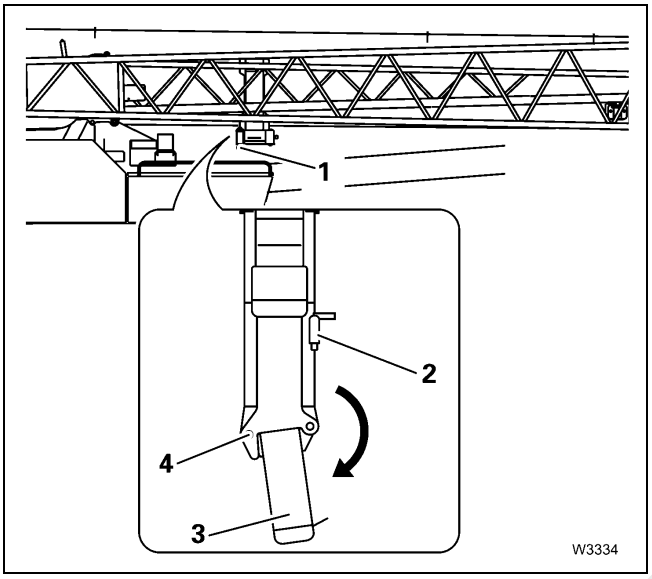


Folding the Run-Up Rail Out/In

The run-up rail is folded out for rigging and folded back in for on-road driving after derigging.

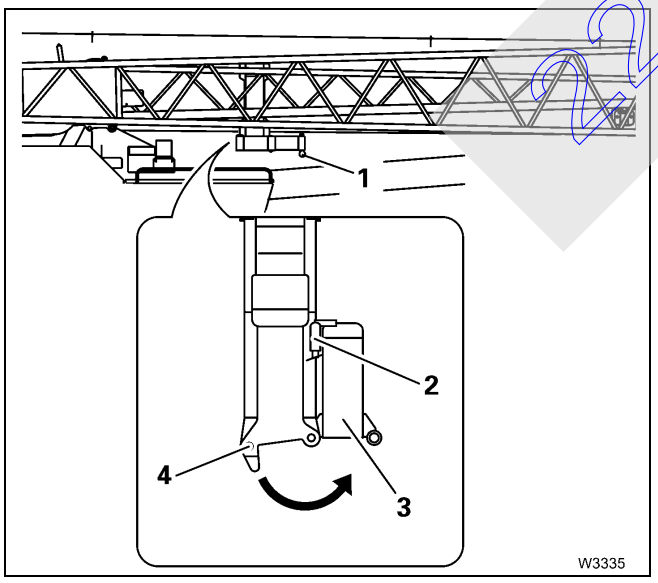
Fold out the run-up rail

- Unscrew the spring latch (2).



- (1) engages in the bore hole (4).

Folding in the run-up rail



- Pull the locking bar (1) downwards against the spring force, and out of the bore hole (4).
- Fold out the run-up rail (3) to a small extent and let go of the locking bar (1).
- Fold in the run-up rail completely.
- Secure the run-up rail with the spring latch (2).

Connections With Folded Lattice Extension

The lattice extension is turned sideways to the main boom in the folded position.

In this position there are four areas on the main boom basic section, where various connections have to be disconnected and reconnected again during rigging and unrigging.

- in the front area, in front of the locking point at 100%,
- in the middle area, in front of the locking point at 50%,
- in the rear area, over the side panelling.

In each area there are bearing points that can be used for establishing connections. Depending on the rigging mode and job, different parts of the lattice extension must be connected to each other or connected to the main boom basic section.

DANGER

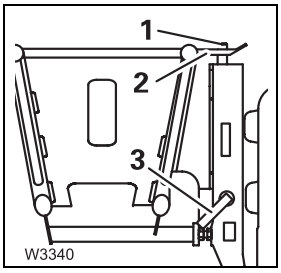
Risk of accidents due to falling parts. Always secure the pins both in the bearing points and in the holders using retaining pins. This prevents unsecured pins from becoming loose, falling out and causing injuries.

Connections in the front area

In the front area there is a connection between the 33 ft (10.1 m) section and the main boom.

This connection must be disconnected when the lattice extension is being rigged or removed.

The connection is made of retaining pins (3), slewing axle (1), at the basic section and the holders (2) at the 33 ft (10.1 m) section.



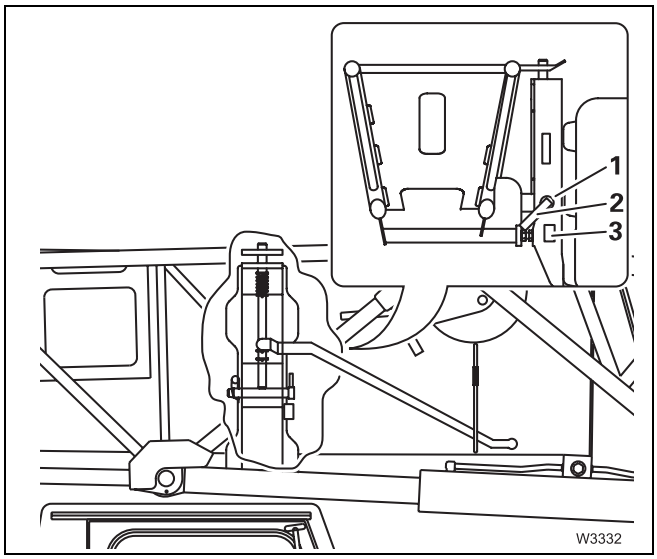
For removing the connection, the 33 ft (10.1 m) section is locked in the slewing axle.

For establishing the connection, the 33 ft (10.1 m) section is locked in the slewing axle and is secured with locking pins.

4

Securing the connection

- Swing the lattice extension on the run-up rail onto the main boom until the bores on the 33 ft (10.1 m) section and the main boom are aligned.
- Release the retaining pin and remove the locking pin (2) from the holder (3).



- Insert the locking pin in the bore holes (1) and secure it with a retaining pin.

DANGER

Risk of accidents from a falling lattice extension.

The locking pin prevents mechanical pressing down of the slewing axle and secures the 33 ft (10.1 m) section to the main boom. Therefore, always secure the laterally folded lattice extension in the front area with the locking pin. This will prevent the lattice extension (e.g. for main boom operation) from sliding from the slewing axle and falling.

Removing the connection

DANGER

Risk of accidents from a falling lattice extension.

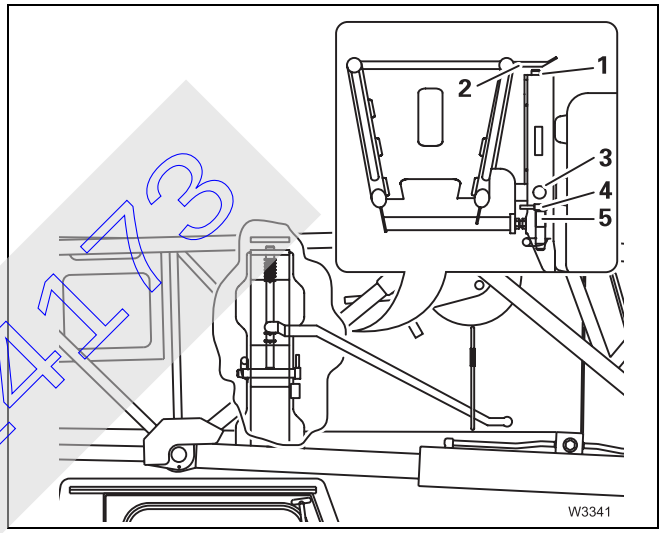
Before removing the connection, make sure that the 33 ft (10.1 m) section is pinned on the main boom head. This will prevent the lattice extension from falling and causing injury to you or other persons.

DANGER

Risk of accidents from lattice extension swinging of its own accord.

Always secure the lattice extension with a guide rope on the main boom before derricking out the lattice extension from the slewing axle. This will prevent the lattice extension from slipping off the run-up rail, swinging around and knocking you off the carrier or injuring other persons in the slewing range.

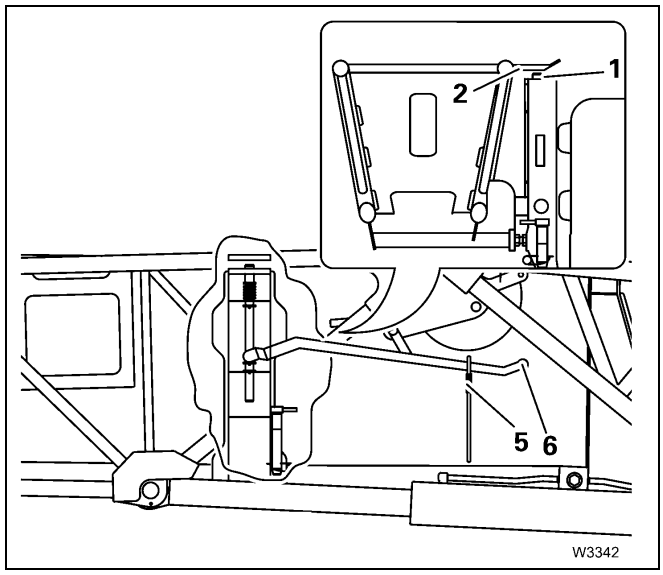
- Secure the lattice extension with a guide rope.



- Remove the locking pin (4) from the bore hole (3) and secure it in the holder (5) with a retaining pin.
- Derrick the lattice extension fully on one of the control units.
- Ensure the holder (2) on the 33 ft (10.1 m) section is fully derricked downwards from the slewing axle (1).

If the slewing axle is still partly in the holder, then you must push it downwards mechanically:

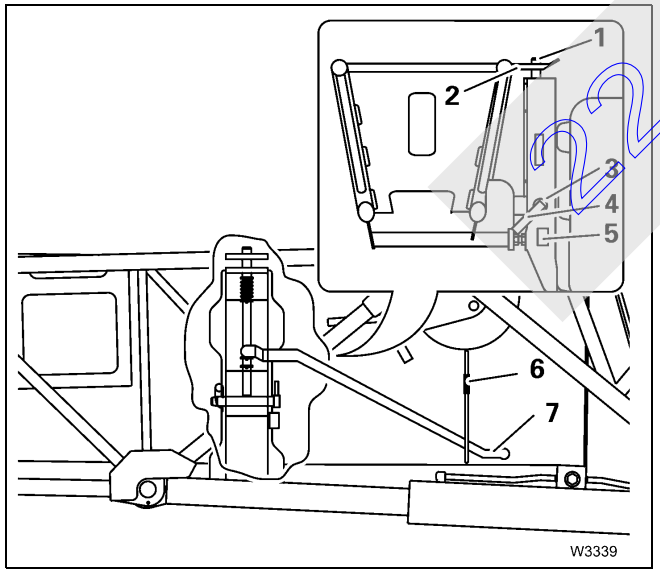
- Lift the lever (6) against the spring force and hold it in the bracket (5). During this, the slewing axle (1) is pressed downwards.
- Swing the lattice extension outward until the bracket (2) is no longer above the slewing axle (1).
- Lift the lever sideways from the bracket and slowly yield to the spring force. Once again the slewing axle is pressed upwards.



With this, the connection is in the correct position for next unrigging.

Establishing a connection

- Place the lattice extension on the run-up rail.



- Check if the locking pin (4) is pulled out of the bore hole (3).
- Check if the lever (7) is under the bracket (6).
- Swing the lattice extension on the run-up rail sideways onto the main boom. First the slewing axle (1) is pressed down by the holder (2) and then it is locked in the holder.
- Check if the slewing axle projects upwards from the bracket.
- Remove the locking pin (4) from the holder (5), insert it in the bore holes and secure it with the retaining pin.

Connections in the middle area

When connecting in the middle area, three different joints can be established:

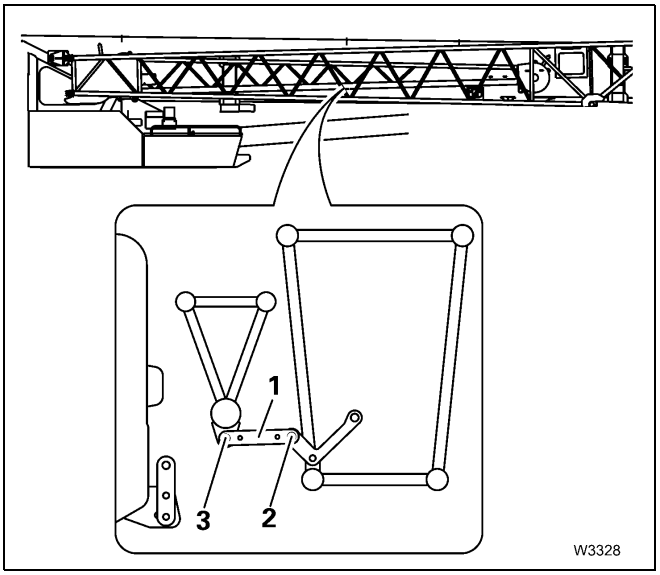
- 23 ft (7 m) section/33 ft (10.1 m) section joint
- 23 ft (7 m) section/main boom joint
- Joint at the 33 ft (10.1 m) section

23 ft (7 m) section/33 ft (10.1 m) section joint

This joint has to be established:

- when rigging the 56 ft (17.1 m) two-stage swingaway lattice extension - before the lattice extension is swung onto the main boom head,
- when rigging the 56 ft (17.1 m) two-stage swingaway lattice extension - after the 23 ft (7 m) section was folded onto the 33 ft (10.1 m) section,
- when rigging the 33 ft (10.1 m) swingaway lattice extension - after the 33 ft (10.1 m) swingaway lattice extension was swung sideways onto the main boom,
- before removing the two-stage swingaway lattice extension.

Fasten the locking bar (1) with a pin (2) onto the 33 ft (10.1 m) section and with a pin (3) onto the 23 ft (7 m) section.

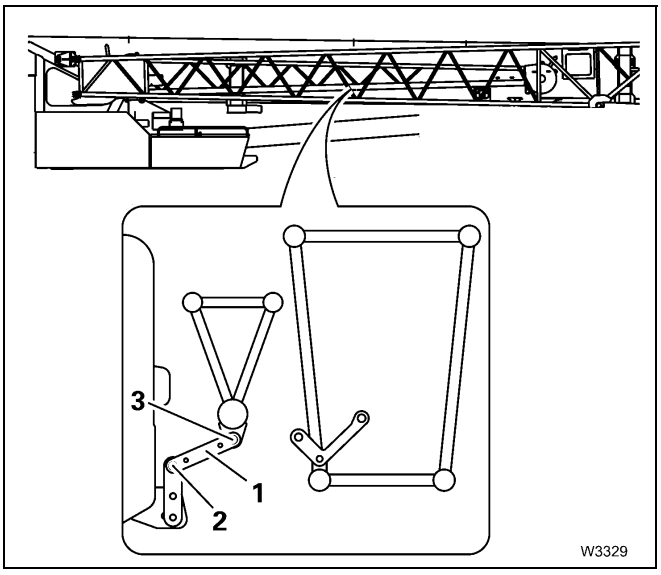


- Secure both the pins, each with one retaining pin.

33 ft (10.1 m) section/main boom joint

This joint has to be established:

- Fasten the locking bar (1) with a pin (3) onto the 23 ft (7 m) section and with a pin (2) onto the 23 ft (7 m) section.

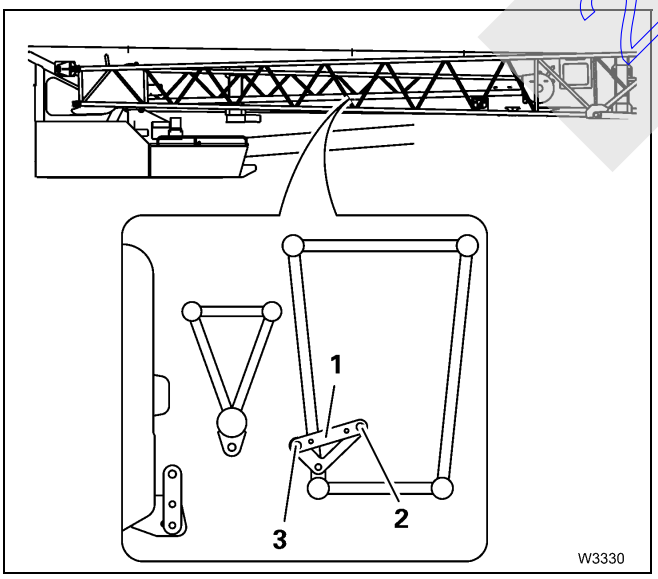


- Secure both the pins, each with one retaining pin.

Joint at the 33 ft (10.1 m) section

This joint has to be established:

- when rigging the 56 ft (17.1 m) two-stage swingaway lattice extension - before the 23 ft (7 m) section is folded before 33 ft (10.1 m) section.



- Before operating with the 33 ft (10.1 m) swingaway lattice extension, if the 23 ft (7 m) section is removed.
- Fasten the locking bar (1) with a pin (2) and (3) onto the 33 ft (10.1 m) section.
- Secure both the pins, each with one retaining pin.

Connections in the rear connection

Connection between 23 ft (7 m) section and main boom

The connection must be made:

- when unrigging of the 56 ft (17.1 m) two-stage swingaway lattice extension,
- for operation with the 33 ft (10.1 m) swingaway lattice extension.

The connection must be removed:

- when rigging the 56 ft (17.1 m) two-stage swingaway lattice extension,
- for unrigging the 56 ft (17.1 m) two-stage swingaway lattice extension.

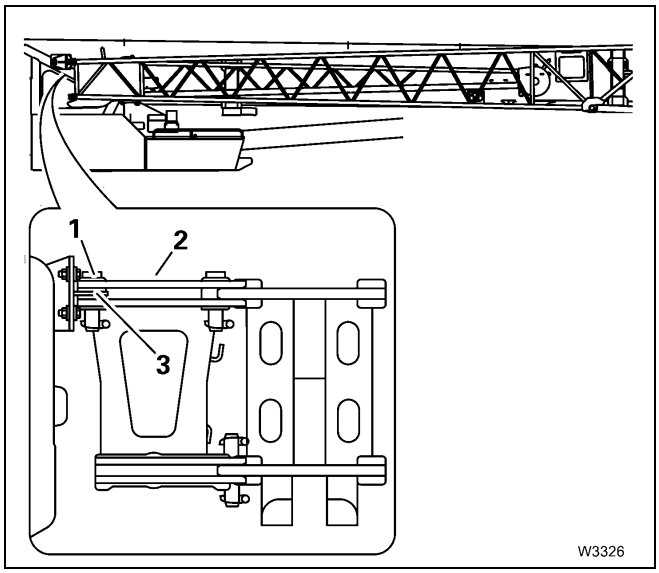
Removing the connection

DANGER

Risk of accidents from falling 23 ft (7 m) section.

Make sure the connection is established at the pivot point between the 23 ft (7 m) section and the 33 ft (10.1 m) section before you remove the connection between the 23 ft (7 m) section and the main boom. This will prevent the 23 ft (10.1 m) section from falling down when releasing the connection.

- Release the retaining pin and remove the pin (1) from the bearing point (3).
- Insert the pin in the retaining sheet (2) and secure it with a retaining pin.



Establishing a connection

- Swivel the lattice extension into the main boom until the bearing point (3) is aligned.
- Release the retaining pin and take one pin out of the retaining sheet (2).
- Insert the pin into the bearing points (3) and secure it with a retaining pin.

Connection between 33 ft (10.1 m) section and main boom

NOTE: This connection does not apply to truck cranes that are supplied with an 56 ft (17.1 m) two-stage swingaway lattice extension.

This connection must be established if the 33 ft (10.1 m) swingaway lattice extension is folded in to the side during unrigging.

The connection must be removed before the 33 ft (10.1 m) swingaway lattice extension is swiveled onto the main boom head, when the 23 ft (7 m) section is removed.

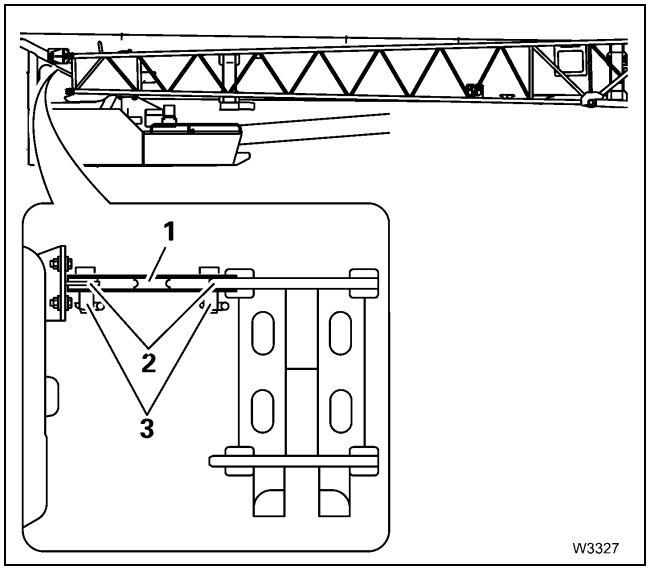
If the crane was delivered only with a 33 ft (10.1 m) swingaway lattice extension (without 23 ft [7 m] section), the connection between the 33 ft (10.1 m) section and the main boom is established using a retaining strut with two pins.

Removing the connection

DANGER

Risk of accidents from falling 33 ft (10.1 m) section.

Make sure that the connection in front area is established and is secured. This will prevent the 33 ft (10.1 m) section from falling down when releasing the connection.



- Loosen the retaining pin and remove the pins (3) from the bearing points (2).
- Remove the retaining strut.
- Stow the retaining strut and the pins with the retaining pins for operation (e.g. in the storage box).

Establishing a connection

Correct original position is reached, when the connection in front area is established and is secured.

- Put the retaining strut (1) onto the bearing point (2) on the main boom and 33 ft (10.1 m) section.
- Fasten the retaining strut with pins (3) and secure the pin with retaining pins.

Pin Connections on the Main Boom Head

The lattice extension and main boom head are connected on the bearing points using pins. The pins can be found in holders on the lattice extension and are secured there with retaining pins.

DANGER

Risk of accidents due to falling parts.

Always secure the pins both in the bearing points and in the holders using retaining pin. This prevents unsecured pins from becoming loose, falling out and causing injuries.

DANGER

Risk of accidents from lattice extension swinging of its own accord.

Always secure the lattice extension with a guide rope before removing any connections. This will prevent the lattice extension from swinging around of its own accord and causing injury to you or other persons.

DANGER

Risk of accidents from a falling lattice extension.

Make sure that the connection in the front area is established before you release the connection on the right side of the main boom head. This will prevent the lattice extension from falling and causing injury to you or other persons.

Connections on the left side

The connection needs to be established after the lattice extension has been swiveled in front of the main boom head during rigging.

The connection has to be removed so that the lattice extension can be swiveled onto the main boom side during unrigging.

Connections on the right side

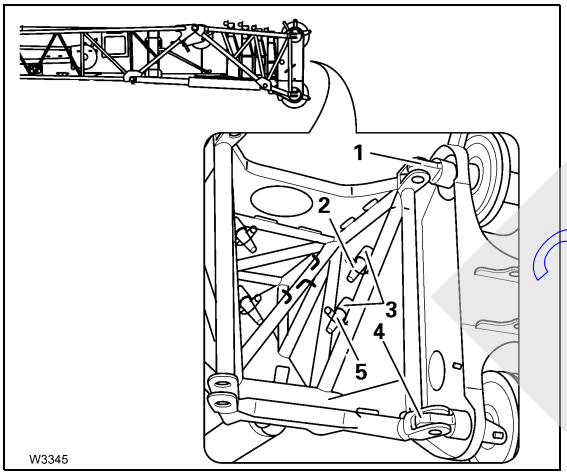
The connection needs to be established so that the lattice extension can be swiveled in front of the main boom head for rigging.

The connection needs to be removed so that the lattice extension can be swiveled onto the main boom when it is on the run-up rail during unrigging.

Establishing connections

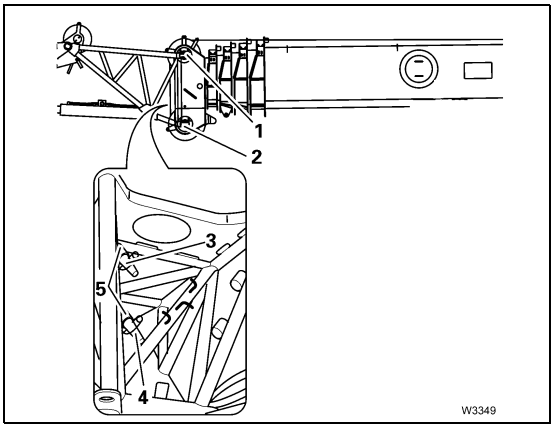
For these connections you will find are three short pins and one long pin in holders on the fixed part of the 33 ft (10.1 m) section.

Connections on the right side



- Swing the lattice extension onto main boom head, until the bearing points (1) and (4) are in alignment.
- Remove the retaining pins and take the two pins (2) and (5) out of the holders (3).
- Insert the two pins into the bearing points (1) and (4) and secure them with retaining pins.

Connection on the left side

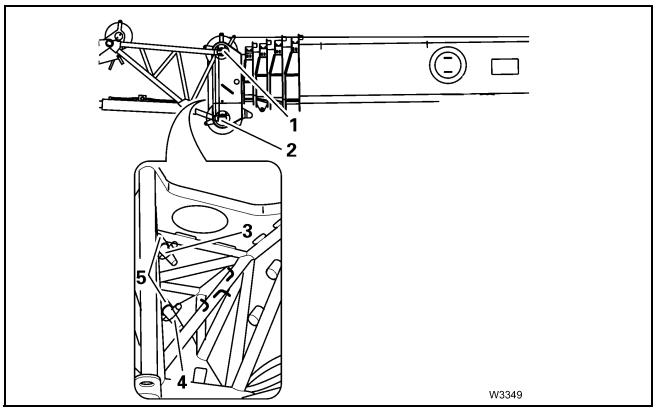


- Swing the lattice extension in front of the main boom head, until the bearing points (1) and (2) are in alignment.
- Remove the retaining pins from the pins in the holders (5)
- First, insert the pin (3) in the upper bearing point (1).
- Then insert the long pin (4) into the bottom bearing point (2). If the bearing points do not align, you can take the weight off the bearing points.
- Use retaining pins to secure the pins in the bearing points.

Connections remove

Secure the lattice extension with a guide rope before removing any connections.

Connections on the left side



- Remove the retaining pins from pins in the bearing points.
- First hammer the pin out of the lower bearing point. If the pin cannot be hammered out, you can unload it.
- You may then hammer the pin out of the upper bearing point.

- Insert both pins into the holders and secure them with retaining pins.

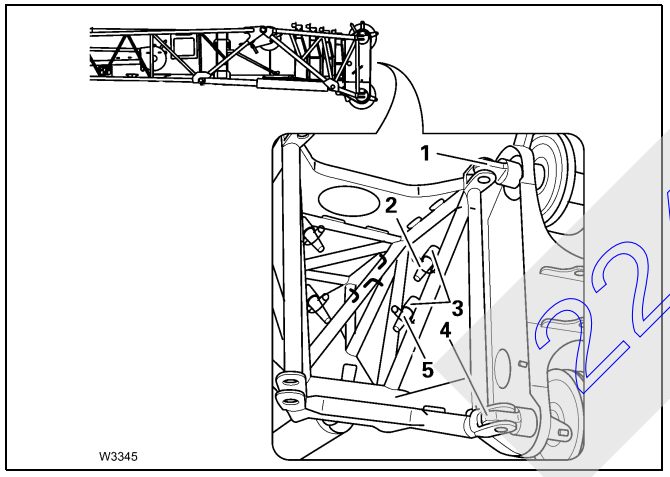
Connection on the right side

DANGER

Risk of accidents from a falling lattice extension.

Make sure that the connection in the front area is established before you release the connection on the right side. This will prevent the lattice extension from falling and causing injury to you or other persons.

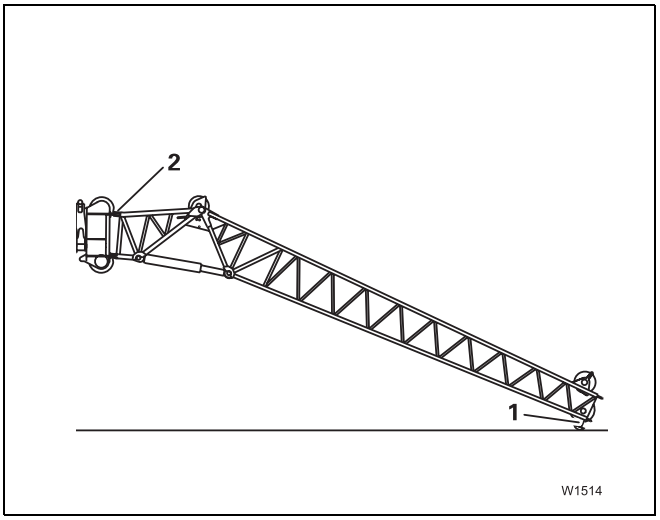
- Swing the lattice boom onto the main boom, and establish the connection in the front area.
- Remove the retaining pins from the pins (2) and (5) in the bearing points (1) and (4).
- Hammer the two pins out of the bearing points.



- Insert both the pins (2) and (5) into the holders (3) and secure them with retaining pins.

Relieving the load on bearing points

The dead weight of the lattice extension can cause the bearing points on the left side to be misaligned or the pins to get weighted which makes it impossible to knock them out.



When establishing or disconnecting the connections, proceed as follows:

- Lower the lattice extension until it is on the ground with the supports (1) (if necessary, override the lifting limit switch).
- Continue to lower carefully until the connecting points (2) align or until the load has been removed from the pins.

Pin Connections on the Lattice Extension

The 33 ft (10.1 m) section and the 23 ft (7 m) section are connected on the bearing points using pins. The pins are inserted into the 23 ft (7 m) section, at the rear of the retaining sheet on the upper boom.

DANGER

Risks of accidents due to falling parts.

Always secure the pins both in the bearing points and in the holders using retaining pins. This prevents unsecured pins from becoming loose, falling out and causing injuries.

DANGER

Risk of accident due to 23 ft (7 m) section swinging of its own accord.

Always secure the 23 ft (7 m) section with a guide rope before removing any connections. This will prevent the 23 ft (7 m) section from swinging around of its own accord and causing injury to you or other persons.

DANGER

Risk of accidents from falling 23 ft (7 m) section.

Make sure that the connections between the 23 ft (7 m) section and the main boom (in the rear area) and between the 23 ft (7 m) section and the main boom have been made before you release the connection on the right side of the pivot point. In this way, you prevent the 23 ft (7 m) section from falling when this connection is released and causing injury to you or others.

Connection on the left side

The connection needs to be established after the 23 ft (7 m) section has been swiveled in front of the 33 ft (10.1 m) section during rigging.

The connection needs to be removed so that the 23 ft (7 m) section can be folded at the side of the 33 ft (10.1 m) section during unrigging.

Connection on the pivot point, on the right side

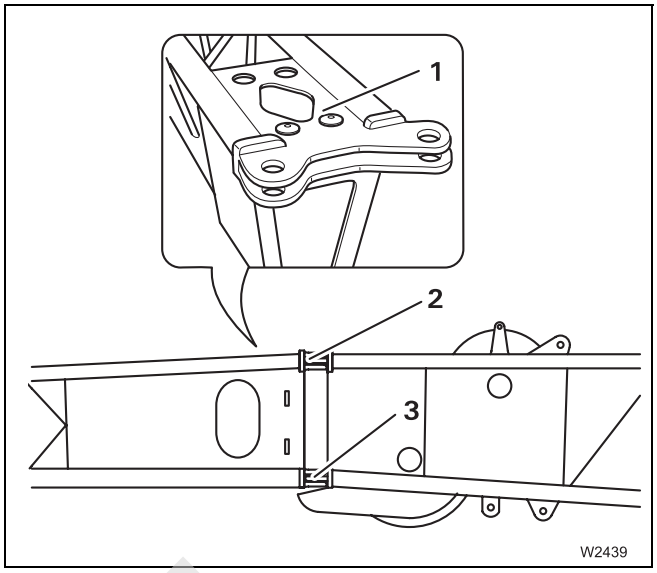
This connection must be established if the 33 ft (10.1 m) swingaway lattice extension is unrigged and the 23 ft (7 m) section is attached to the main boom.

This connection must be removed if the 33 ft (10.1 m) swingaway lattice extension is rigged and the 23 ft (7 m) section is attached to the main boom.

Connection on the left side

- Swivel the 23 ft (7 m) section in front of the 33 ft (10.1 m) section until the bearing points on the left side are in alignment. If necessary, you can unload the bearing points in the same way, as in the case of pin connections on the main boom.

Establishing a connection



- Loosen the retaining pins and remove the pins from the retaining sheet (1).
- Insert the two pins into the bearing points (2) and (3) on the left side and secure the pins with retaining pins.

Removing the connection

- Remove the retaining pins and take pins out of the bearing points (2) and (3) on the left side.
- Insert both pins into the top of the retaining sheet (1) and secure them with retaining pins.

Connection on the pivot point

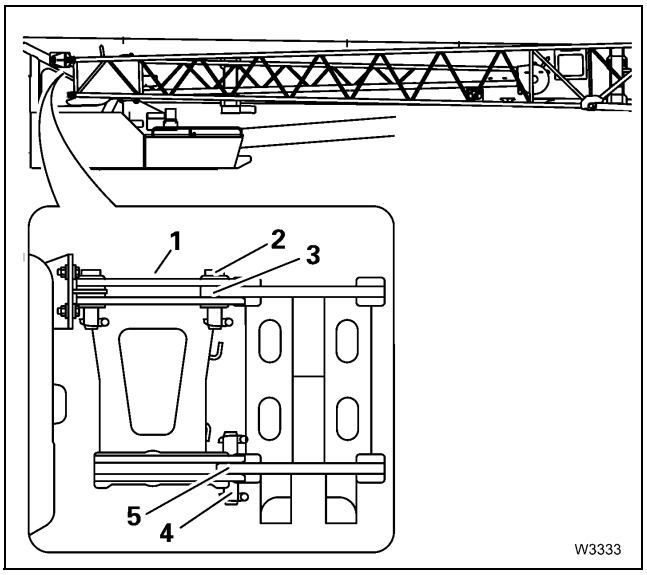
Before removing this connection, the connections between the 23 ft (7 m) section and the main boom in the rear area must be established and the connection in the middle area must be in position.

Removing the connection

- Remove the retaining pins and pull the pins (2) and (4) out of the bearing points (3) and (5).
- Insert both pins into the retaining sheet (1)and secure them with retaining pins.

Establishing a connection

Remove the retaining pins and take the conical pin (4) and another bolt (2) out of the retaining sheet.



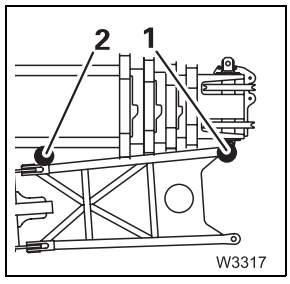
- Insert the two pins into the bearing points (3) and (5), the conical pin (4) is designed for the lower bearing point.
- Secure the pins using retaining pins.

NOTE: Always insert the conical pin in the lower bearing point, so that you can knock it down while removing the connection.

Swinging the Lattice Extension onto the Main Boom Head

This section describes slewing the lattice extension

- onto the main boom head when rigging and
- onto the main boom basic section when unrigging.



The lattice extension must be swung out of the transport position onto the main boom head so that the 33 ft (10.1 m) section can be fastened to the right side of the main boom head with pins.

Prerequisites

- The lattice extension is in transport position when the lattice extension is folded at the side.
- The required connections among the individual lattice extension sections or the lattice extension sections and the main boom have been removed.

Swinging the Lattice Extension

When swung, the lattice extension rolls on the run-up rail, turns around the connection in the front area and makes contact at the front at the bearing points.

- When rigging, pull the lattice extension at the back away from the basic section until it is at the front and the bearing point are aligned.
- When unrigging, push the lattice extension onto the run-up rail until the connection in the front area is ensured. Secure the connection with the retaining pins.

Swiveling the Lattice Extension when Rigging

NOTE: This section describes the swinging of the lattice extension during rigging. If you want to swing the lattice extension for unrigging, proceed in the opposite order.

When rigging the 33 ft (10.1 m) swingaway lattice extension and the 56 ft (17.1 m) two-stage swingaway lattice extension, you have to swing the 33 ft (10.1 m) section in front of the main boom head.

When rigging the 56 ft (17.1 m) two-stage swingaway lattice extension, you must also swing the 23 ft (7 m) section in front of the 33 ft (10.1 m) section.

DANGER

Danger of accident due to lattice extension turning of its own accord.

Always secure the lattice extension with a guide rope before you swing it from the run-up rail. Ensure that there are no people or objects in the slewing range of the lattice extension and always swing out the lattice extension with a guide rope from the ground.

Swinging the 33 ft (10.1 m) section in front of the main boom

Prerequisites

- The lattice extension has been swiveled onto the main boom head.
- The 33 ft (10.1 m) section is fastened to the right side of the main boom head.
- The lattice extension is secured on the head of the 33 ft (10.1 m) section with a guide rope.
- Disconnect the connection between the 33 ft (10.1 m) section and the main boom.

- Swing the lattice extension until it is no longer above the run-up rail.
- Carefully lower the lattice extension from the control unit on the foot of the 33 ft (10.1 m) section until it starts to swing out.

If a helper is holding the guide rope, he can now swing the lattice extension in front of the main boom head.

If you are alone and when securing you fixed the guide rope to the crane, the lattice extension turns only so far until the guide rope is taught. You can now turn the lattice extension with the guide rope in front of the main boom head.

Proceed in the opposite order for unrigging.

Swing the 23 ft (7 m) section in front of the 33 ft (10.1 m) section

Prerequisites

- The 33 ft (10.1 m) section is locked in front of the main boom head.
- The lattice extension is secured on the head of the 23 ft (7 m) section with a guide rope.
- Move the connection on the 33 ft (10.1 m) section middle area.
- Turn the 23 ft (7 m) section using the guide rope in front of the 33 ft (10.1 m) section.

Proceed in the opposite order for unrigging.

Electrical Connections on the Lattice Extension

The lifting limit switch and the lowering limit switch are connected via the electrical connection on the lattice extension.

33 ft (10.1 m) Swingaway Lattice Extension

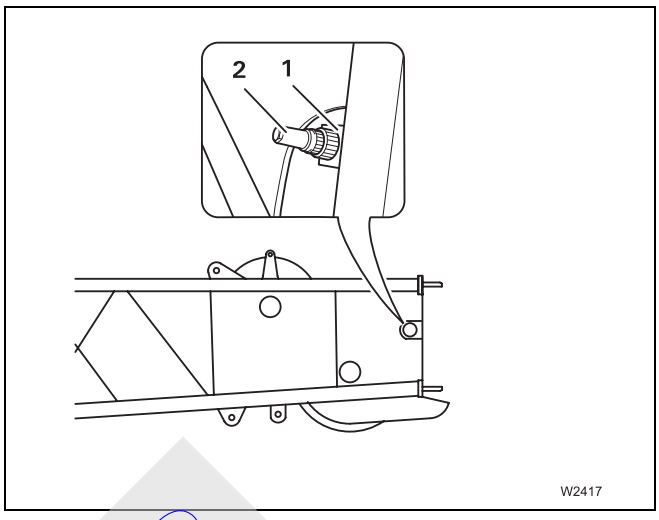
For the 33 ft (10.1 m) swingaway lattice extension the electrical connection is made or disconnected on the left side of the main boom head.

Establishing the electrical connection

- Remove the short-circuit plug from the socket on the main boom and plug it in the dummy socket.
- Unwind the cable from the roll.
- Remove the plug from the dummy socket and insert it in the socket on the main boom head.

Disconnecting electrical connection

- Remove the plug from the socket on the main boom head and insert it in the dummy socket on the 33 ft (10.1 m) section.
- Remove the short-circuit plug from the dummy socket and plug it in the socket on the main boom.
- Wind the cable onto the take-up reel.

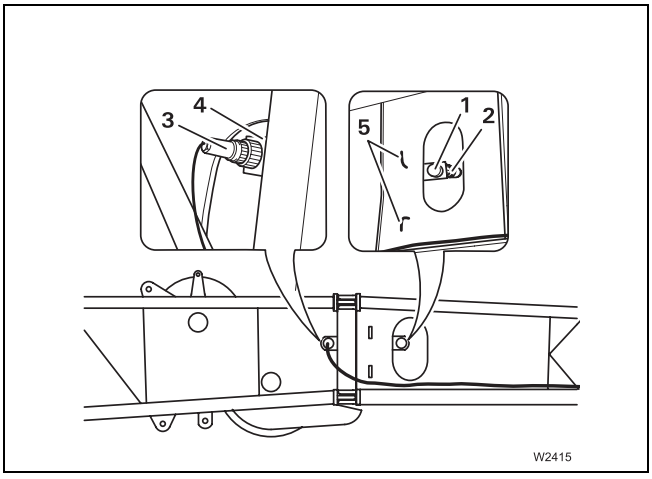


- Check if the dummy plug (2) is inserted in the socket (1) at the front of the 33 ft (10.1 m) section.

56 ft (17.1 m) Two-Stage Swingaway Lattice Extension

For the 56 ft (17.1 m) swingaway lattice extension an additional connection is made or disconnected between the 33 ft (10.1 m) section and the 23 ft (7 m) section as well as the electrical connection of the 33 ft (10.1 m) swingaway lattice extension.

- First make the electrical connection for the 33 ft (10.1 m) swingaway lattice extension.

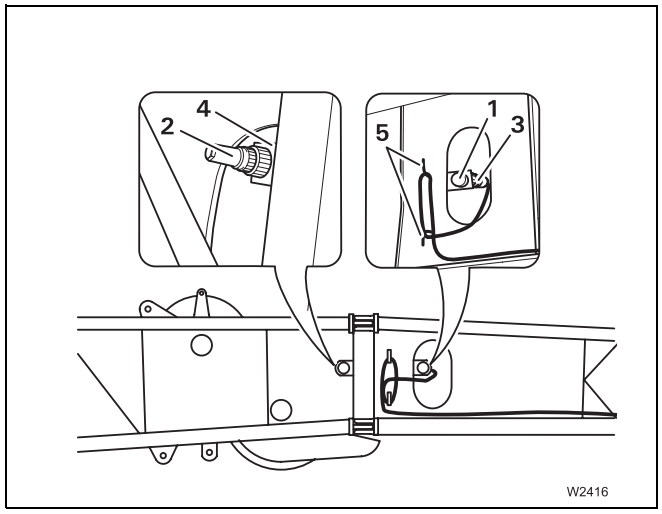


Establishing the Electrical Connection

- Remove the plug (3) from the dummy socket (1) on the 23 ft (7 m) section.
- Unwind the cable from the roll (5).

- Remove the dummy plug (2) from the socket (4) on the 33 ft (10.1 m) section and insert it in the dummy socket (1) on the 23 ft (7 m) section.
- Insert the plug (3) in the socket (4) on the 33 ft (10.1 m) section.

Disconnecting electrical connection



- Remove the plug (3) from the socket (4) on the 33 ft (10.1 m) section.
- Remove the dummy plug (2) from the dummy socket (1) on the 23 ft (7 m) section and insert it in the socket (4) on the 33 ft (10.1 m) section.
- Insert the plug (3) in the dummy socket on the 23 ft (7 m) section.
- Wind the cable onto the take-up reel (5).

Establishing/Disconnecting the Hydraulic Connection

The hydraulic supply is required for derricking the lattice extension. Before establishing the connection, the connections on the hose drum must be in the working with the lattice extension position.

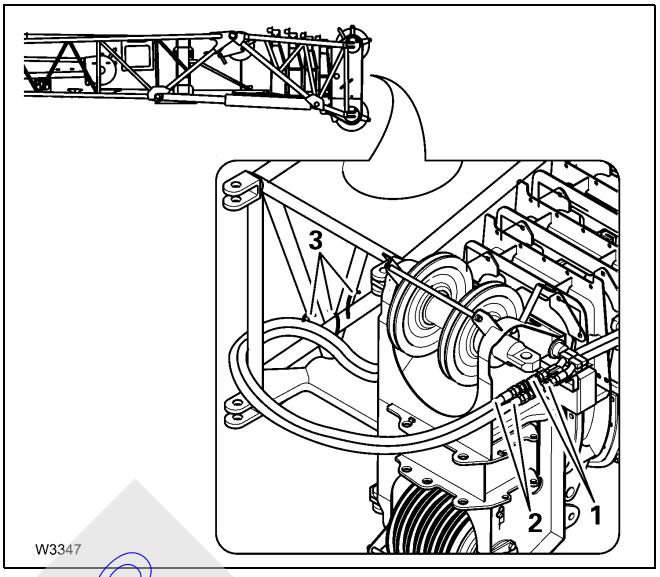
CAUTION

Risk of damage to hydraulic hoses!

When establishing the connection, always move the hoses right out of the 33 ft (10.1 m) section. If the hoses are moved out of the front of the 33 ft (10.1 m) section, they will be damaged if the lattice extension turns.

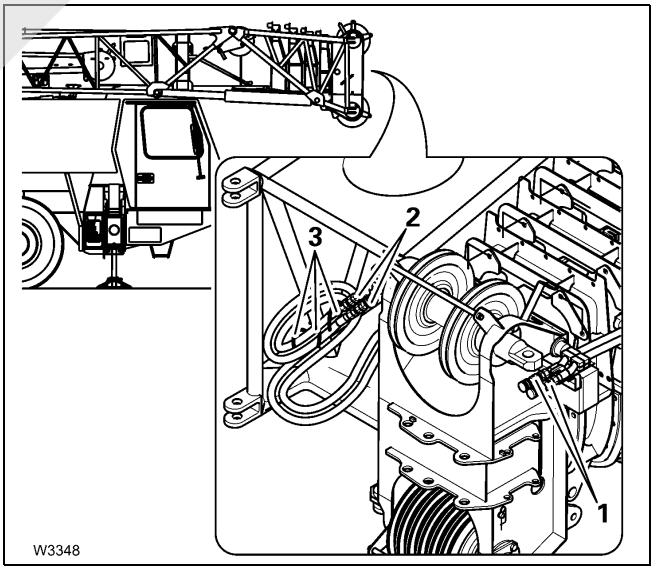
Establishing the Hydraulic Connection

- Take the hose line (2) out of the holders (3) on the 33 ft (10.1 m) section and remove the protective cap.



- Pull the hose lines right out of the 33 ft (10.1 m) section and guide the hose lines to the left side of the main boom head.
- Remove the protective caps from the quick couplings (1) and connect the hose lines there (observe color code).

Remove the Hydraulic Connection



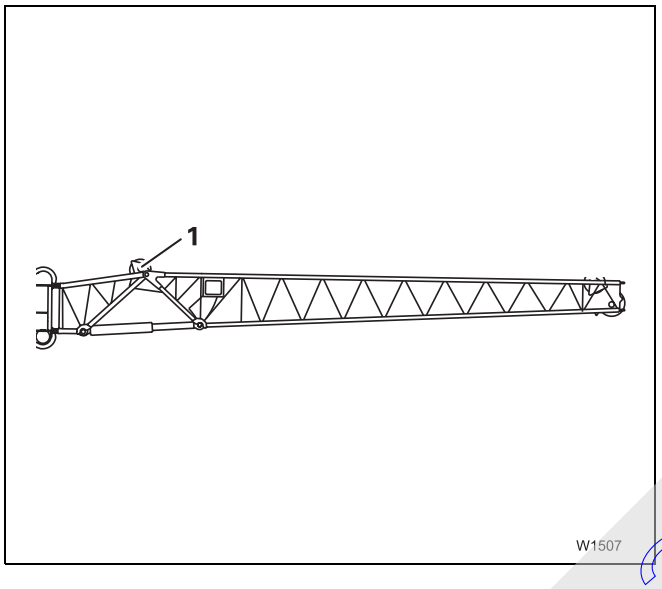
- Remove the hose pipes (3) from the quick couplings (2) on the main boom head.
- Seal the quick couplings with the protective caps.
- Squeeze the hose pipes into the holders (1) on the 33 ft (10.1 m) section.
- Close the hose ends with the protective caps.

4

Folding Out/In the Deflection Sheaves on the 33 ft (10.1 m) Section

To prevent the hoist rope dragging on the main boom or lattice extension during operation with the lattice extension or boom extension, the hoist rope is guided via deflection sheaves.

On the 33 ft (10.1 m) section, there is a deflection sheave at the rear (1). Fold out the deflection sheave if the boom extension offset angle is 20° or 40°.



Both sheaves must be folded out:

- for operation with the swingaway lattice extension.
- for operation with the 56 ft (17.1 m) two-stage swingaway lattice extension.

For transportation both deflection sheaves must be folded in.

Folding Rear Deflection Sheave

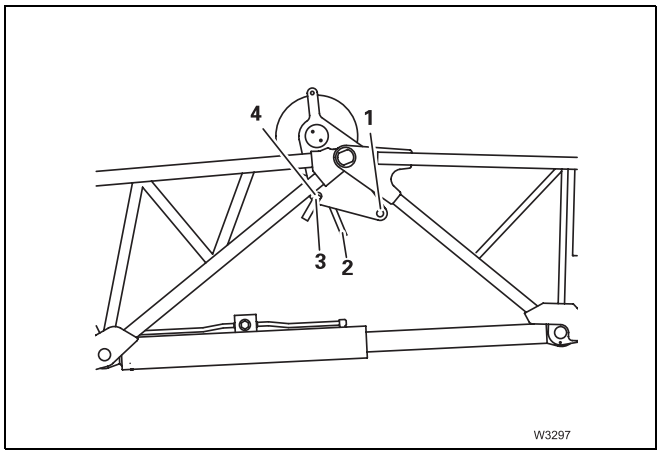
DANGER

Risk of crushing.

Always hold the deflection sheave by the handle, when removing the pin. You might get your fingers crushed if you hold the sheave by the side plates.

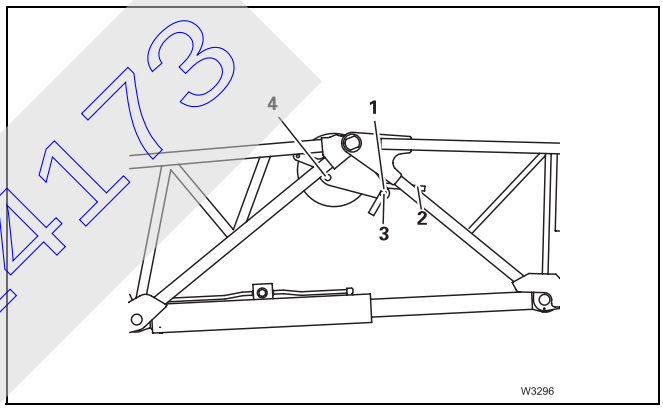
Folding Out Deflection Sheave

- Hold the deflection sheave by the handle (2) and remove the pin (3) from the bore (1).
- Fold the deflection sheave up and secure it with the pin in the bore (4).



- Secure the pin with a retaining pin.

Folding In Deflection Sheave



- Hold the deflection sheave by the handle (2) and remove the pin (3) from the bore (4).
- Fold the deflection sheave down and insert the pin in the bore (4).
- Secure the pin with a retaining pin.

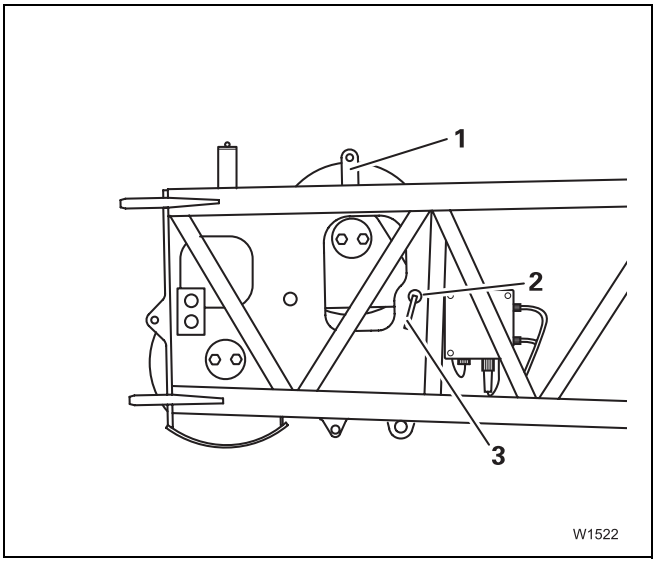
Folding Front Deflection Sheave

DANGER

Always hold the deflection sheave by the strut on the top when removing the pin. You might get your fingers crushed if you hold the sheave by the side plate.

Folding Out Deflection Sheave

- Unscrew the retaining pin on the pin (3).



- Hold the deflection sheave by the strut (1) and remove the pin (3) from the bore (2).
- Fold the deflection sheave up until the pin can be inserted through the bore (2) again.
- Insert the pin through the bore and secure it with a retaining pin.

Folding In Deflection Sheave

- Unscrew the retaining pin on the pin (3).
- Hold deflection sheave by the strut (1) and remove the pin (3) from the bore (2).
- Fold the deflection sheave down until the pin can be inserted through the bore (2) again.
- Insert the pin through the bore and secure it with a retaining pin.

Positioning/Remove the Hoist Cable.

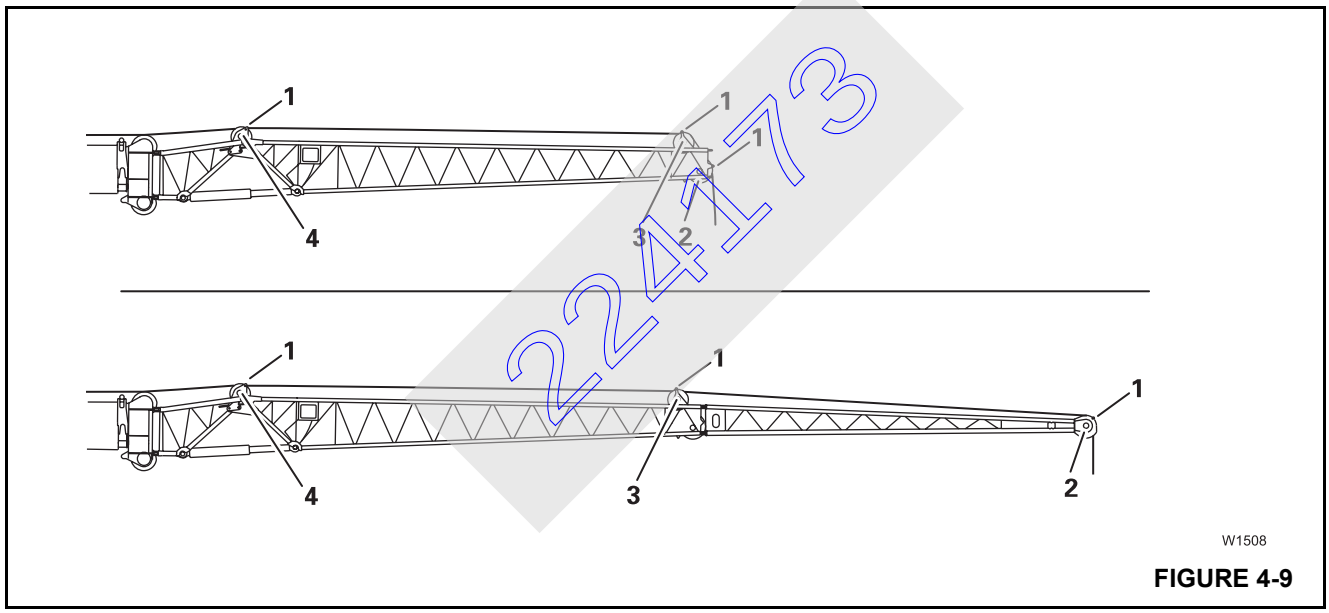


FIGURE 4-9

DANGER

Risk of accidents due to falling parts.

Always secure the hoist cable holding rollers and rods with retaining pin. This prevents elements from coming loose, falling down and injuring people.

Positioning Hoist Cable (Refer to Figure 4-9)

- Remove the hoist cable holding rollers and rod (1).
- Guide the hoist rope via the deflection (10.1 m) section or on the 23 fm (7 m) section. Put all hoist cable holding rollers and rods back in place and secure these with retaining pins.
- Attach the hook tackle or the hook block. The hoist rope may now, depending on the length or lattice extension, be reeved once or twice.

Removing Hoist Cable

- Unreeve the hook block.
- Remove the hoist cable holding rollers and rods (1).
- Take the hoist cable off the head sheave (2) and the deflection sheaves (4), (3) and place it onto the ground on the left side.
- Put all hoist cable holding rollers and rods back in place and secure these with retaining pins.

Possible Reeving Methods on the Lattice Extension

The hoist cable can be reeved once or twice.

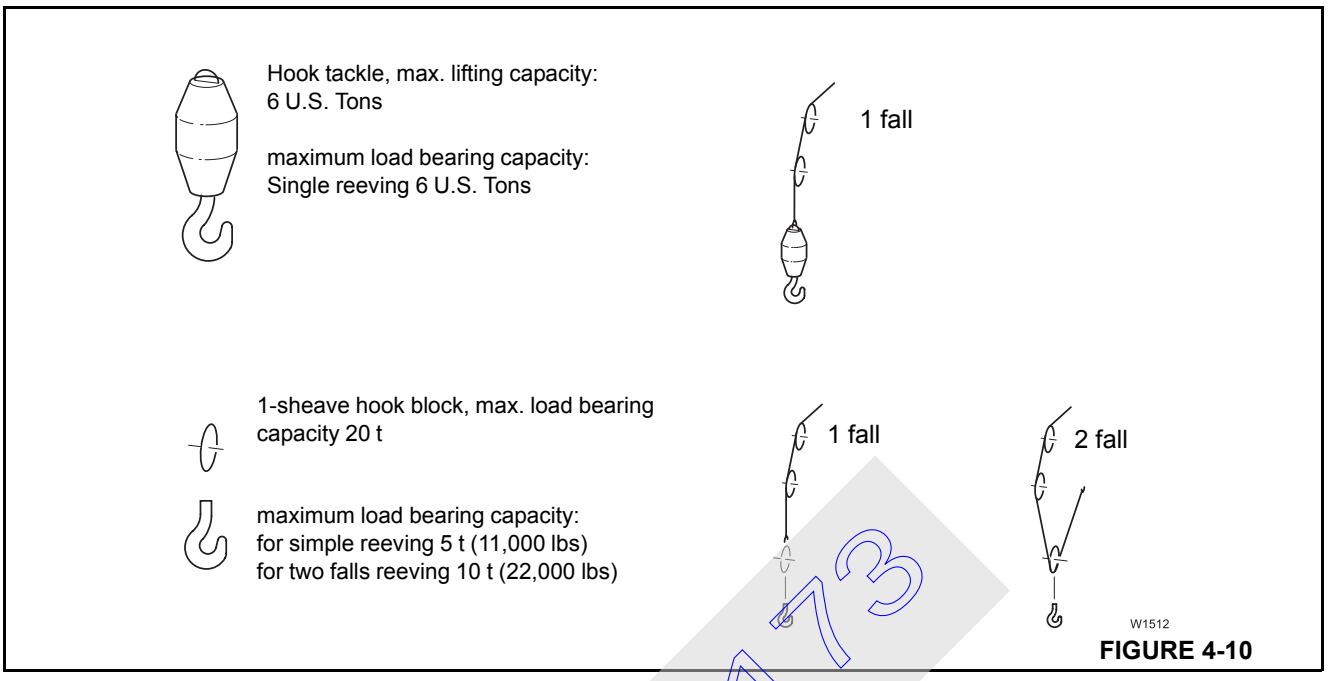


FIGURE 4-10

The hoist rope can be reeved a maximum of two falls on the 33 ft (10.1 m) swingaway lattice extension (see Figure 4-10).

On the 56 ft (10.1 m) two-stage swingaway lattice extension and on the 72/89 ft (22/27 m) boom extension the hoist cable can only be reeved once.

Reeving the hoist rope in the hook block.

- Fasten with a 2-fall reeving, the rope end clamp on the attachment plate (1), in front on 33 ft (10.1 m) section.

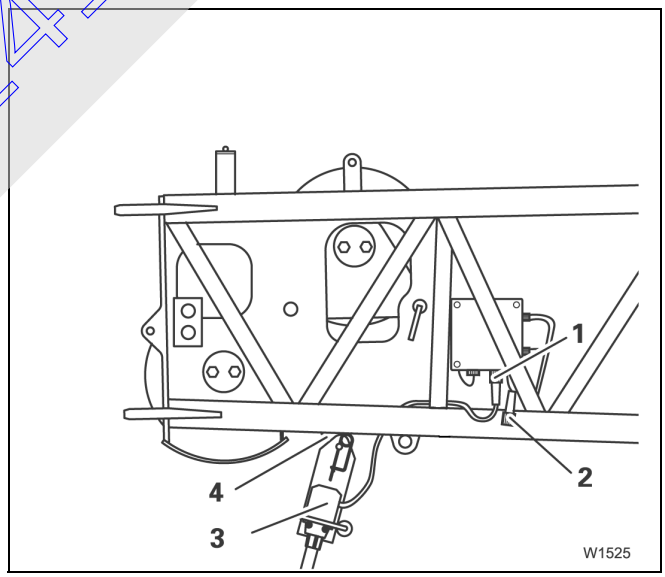
Lifting Limit Switch on the Lattice Extension

The functions raise hoist, extend main boom and lower main boom are monitored during operation with the lattice extension by the lifting switch on the lattice extension and are switched off when the lifting limit switch is actuated.

NOTE: The same lifting limit switch is used for lattice extension and main boom.

Overriding Connection on Main Boom

For operation with the lattice extension you must remove the lifting limit switch on the main boom and override the connection.



- Insert the short-circuit plug (1) in the socket for the connection of the lifting limit switch.

The connection is now overridden.

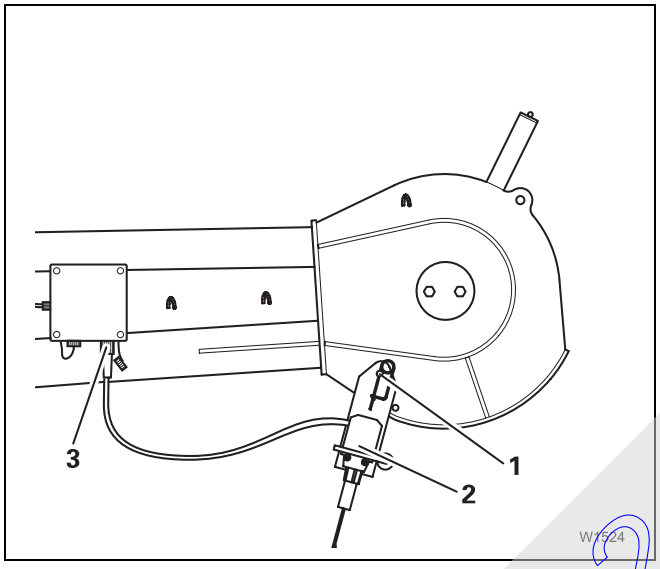
On 33 ft (10.1 m) swingaway lattice extension

- Attach the lifting limit switch (3) in the holder (4) and secure it with a retaining pin.
- Remove the short-circuit plug (2) from the socket (1).

- Connect the lifting limit switch on the socket (1).
- When unrigging you must insert the short-circuit plug (2) back in the socket (1).

On the 56 ft (17.1 m) Two-Stage Swingaway Lattice Extension

NOTE: For operation with the 56 ft (17.1 m) two-stage swingaway lattice extension the connection for the lifting limit switch on the 33 ft (10.1 m) section must be overridden with a short-circuit plug.



- Attach the lifting limit switch (2) on the shackle (1) and secure it with a retaining pin.
- Connect the lifting limit switch on the socket (3).
- When unrigging, close the socket (3) with the protective cap.

Derricking the Lattice Extension

When rigging

To derrick the lattice extension when rigging there are two control units each with two push buttons on the 33 ft (10.1 m) section.

- To raise, press the top push-button raise lattice extension (1).
- To lower, press the bottom push-button lower lattice extension (2).

During operation

During operation the lattice extension is derricked from the crane cab. The lattice extension can be derricked, only when the derricking gear for the lattice extension is switched on.

When the derricking gear is switched on:

- The indicator lamp in the rocker switch derricking lattice extension on/off lights up brightly and
- is shown on the display crane control and in the main menu the indicator lamp derricking lattice extension on/off lights up **green**.

- If necessary, switch on the derricking gear of the lattice extension, for this once press the rocker switch derricking lattice extension on/off.

To **raise**, press the right control lever to the l**eft**.

To **lower**, press the right control lever to the **right**.

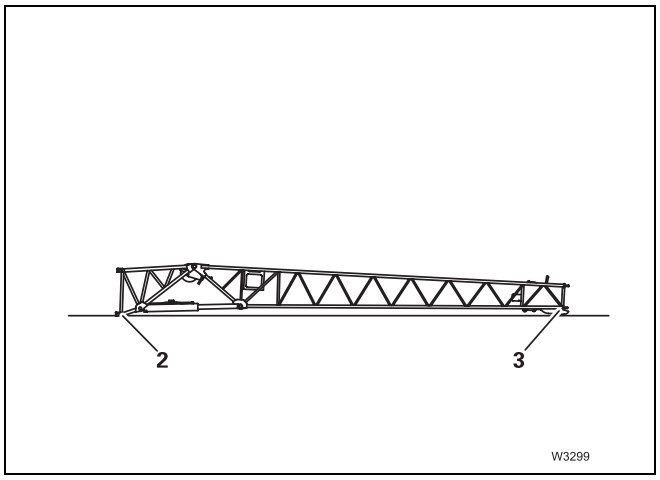
Transportation on a Separate Vehicle

DANGER

Risk of accidents from a falling lattice extension.

Only attach the lattice extension in such a way that it is positioned in the center of gravity and always use lifting gear with sufficient lifting capacity. This prevents the lattice extension from falling and injuring people while loading.

- Check if all the required connections for transport condition are established.



- For transportation, place the lattice extension on the skid (1) at the front and onto the lower cross strut (2) at the rear of the 33 ft (10.1 m) section.

4

- Always secure the lattice extension on the separate vehicle with belts as well as to prevent slipping and overturning.

CAUTION

Risk of damaging the lattice extension.

Always secure the lattice extension by tying it down with suitable belts when it is transported on the separate vehicle. This prevents the two-stage swingaway lattice extension tipping and becoming damaged during transportation.

RAISING AND SETTING DOWN THE MAIN BOOM WITH RIGGED LATTICE EXTENSION

NOTE: The information in this section also applies for raising and setting down the main boom with a rigged boom extension.

NOTE: To raise and lower the main boom with a rigged lattice extension, the main boom must be fully retracted.

For raising and lowering, the following prerequisites must be fulfilled:

- The current reeving of the hoist cable on the lattice extension is entered.
- Apart from the hook block there is no load on the lattice extension.

- Derrick the main boom in to raise.
- Derrick the main boom out to lower.

TELESCOPING WITH RIGGED LATTICE EXTENSION

CAUTION

The main boom may become overloaded!

If you telescope the main boom with a rigged lattice extension or boom extension. You must not rotate the superstructure at the same time. This prevents the main boom being subjected to additional side forces and increased vibration and becoming overloaded.

NOTE: Do not actuate the slewing gear when telescoping.

OPERATION WITH THE LATTICE EXTENSION

NOTE: The information in this section also applies to operation with the boom extension. Observe the following safety instruction before working with the boom extension.

CAUTION

Risk of overturning when working with the boom extension!

No hook block may be reeved on the main boom during operation with the boom extension. It is not permitted to work with the main boom if the boom extension is rigged.

NOTE: If a hook block is reeved on the main boom during operation with the lattice extension, the loads given in the lifting capacity tables decrease. The values which must be deducted form the load capacities depend on the length of the lattice extension and the weight of the hook block and are entered in their own table in the lifting capacity tables.

NOTE: The hoisting, lowering, slewing, derricking and telescoping movements are done in the same way as when operating with the main boom. Telescoping is permitted only at main boom angles of approximately 75° - 80°, depending on the length of the lattice extension.

Procedure if the Permissible Wind Speed is Exceeded

Strong winds can overstrain the crane. Therefore, closely observe the instructions in table.

If the maximum permissible wind speed according to the lifting capacity table is exceeded during the main boom operation, proceed as follows:

with wind speed up to 66 ft/s	with wind speed over 66 ft/s
• Set down the load. • Slew the superstructure so that the main boom creates as little wind resistance as possible.	• Set down the load. • Fully retract the main boom. • Set down the lattice extension.

DRIVING WITH RIGGED CRANE AND INSTALLED LATTICE EXTENSION

This section describes how you can move the crane with an installed counterweight and rigged lattice extension (e.g. when the lattice extension cannot be rigged on the site due to lack of space).

DANGER

Risk of accidents!

It is forbidden to move the crane with a load on the hook. Put the load down before you move the crane. Secure the hook block so that it cannot swing.

Driving Route

The route must be a flat, even surface. The level adjustment system cannot compensate for uneven surfaces. If the surface pressure of the tires exceeds the permissible load on the ground, the surface pressure must be increased using packing made of durable material (e.g. wooden planks).

CAUTION

Risk of tire damage!

Check the pressure in the tires before the rigged crane is moved. The crane may be moved only if tire pressures are at the prescribed levels. Do not reduce the tire pressure!

Driving the Rigged Crane

Locking the Superstructure and Engaging the Slewing Gear Permanent Brake

Before the crane is moved, the superstructure must be locked to the carrier.

Retracting the Outrigger

- Retract the outrigger cylinders until the wheels are just above the ground.

DANGER

Risk of overturning!

Ensure that the crane does not overturn when the outriggers are being retracted. Retract all the outrigger cylinders as uniformly as possible.

Driving

CAUTION

Risk of damage!

Check the pressure in the tires before the rigged crane is moved. The crane may be moved only if the tire pressures are at the prescribed levels. Do not reduce the tire pressure!

NOTE: The wind speed must be checked before the rigged crane is moved. The same maximum permissible wind speeds apply as when working with the crane.

- Before driving, switch to the starting gear from the driver's cab and switch to manual after starting, whereby you push the switch level gears one to the left.

  This prevents upshifting of the gears and the speed is kept to a minimum.

Please observe the following points while driving:

- Drive only with a minimum speed.
- The turning radius should be as large as possible when turning corners.
- Steer the crane only when it is moving and avoid sudden steering movements.

Extending the Outrigger

Before starting with the crane work, it must be rigged.

DANGER

The crane must be raised until no wheels touch the ground.

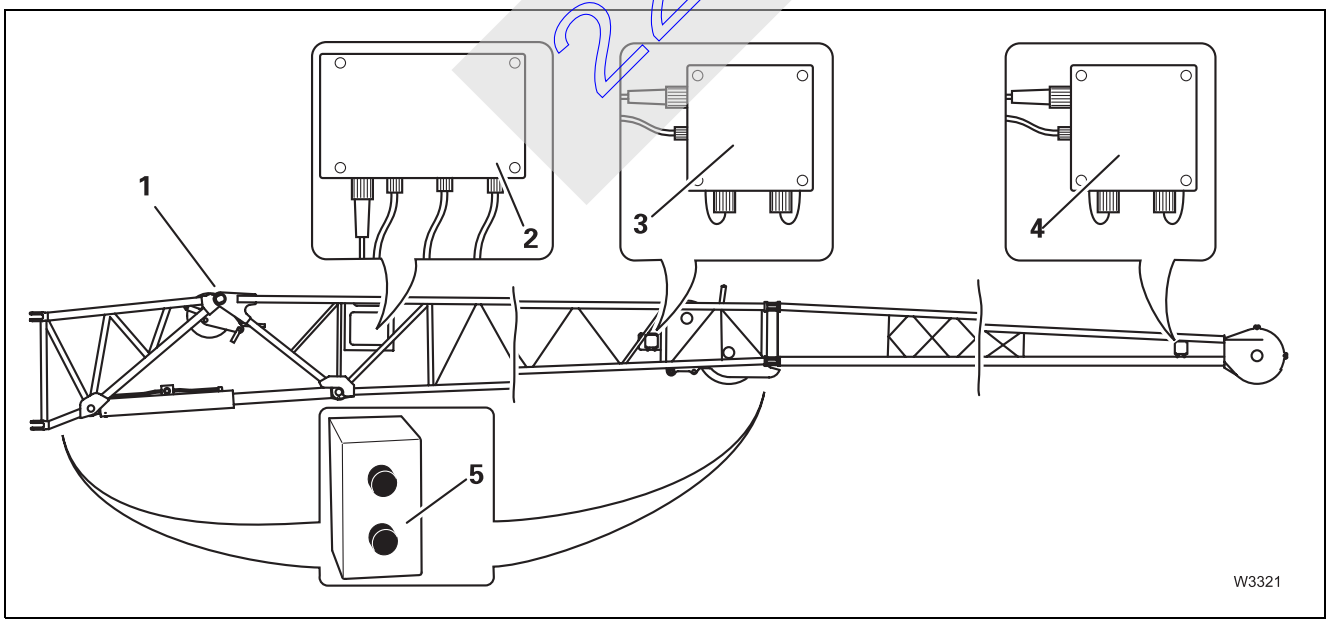
MALFUNCTION WHEN WORKING WITH LATTICE EXTENSION

NOTE: The information in the following table applies to malfunctions during operation with the 33/56 ft (10.1/17.1 m) lattice extension.

Malfunction	Cause	Remedy
No function of the lifting limit switch	Lifting limit switch not connected	Connect the lifting limit switch.
	Electrical connection between the boom head and lattice extension and between 33 ft (10.1 m) section and 23 ft (7 m) section is not established.	Establishing electrical connection.
	Lifting limit switch on the main boom head not overridden.	Override the lifting limit switch on the main boom head.
	When operating with a 56 ft (17.1 m) lattice extension or boom extension, the short-circuit plug is not inserted on the head of the 41 ft (12.5 m) section.	Insert short-circuit plug.
The main boom cannot be telescoped with the rigged lattice extension or boom extension.	The main boom is derricked to such an angle at which telescoping is not permissible	Derrick the main boom to the required angle.
The lattice extension can not be derricked.	Derricking gear of the lattice extension is switched off.	Switch on the derricking gear of the lattice extension.

MAINTENANCE WORK

Modules in Need of Protection during Cleaning Work



- Provide protection for the following electrical parts during cleaning work:
  - potentiometer in the joint (1) of the 33 ft (10.1 m) section
  - the control box at the rear of the 33 ft (10.1 m) section (2),
  - the control box at the front of the 33 ft (10.1 m) section (3),

- the control box at the front of the 23 ft (7 m) section (4)
- both the control units (5).

Maintenance Work M1, Monthly

Pins

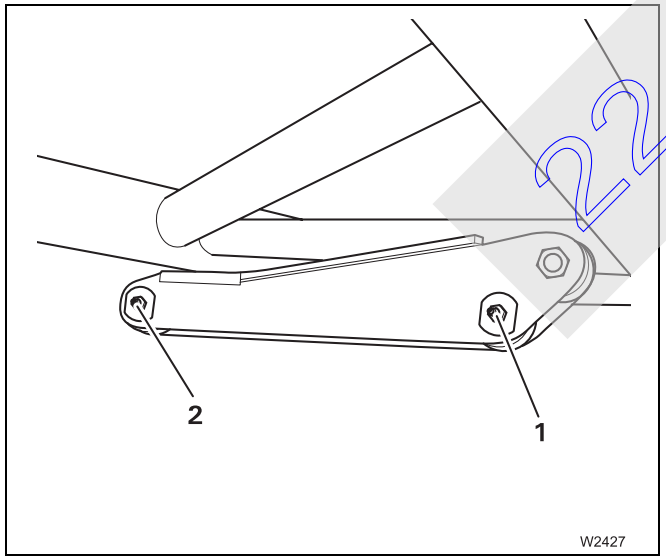
Lubricate all attach, securing and retaining pins, in other words:

- the pins for the pin connection on the lattice extension,
- the retaining pins on the return pulleys,
- the retaining pins used for fastening the lattice extension sections for transport,
- the spring latch on the run-up rail.

NOTE: The maintenance interval applies to average operation. Also, lubricate the pins after high-pressure cleaning and generally at an interval that will prevent them getting dry.

Support Rollers

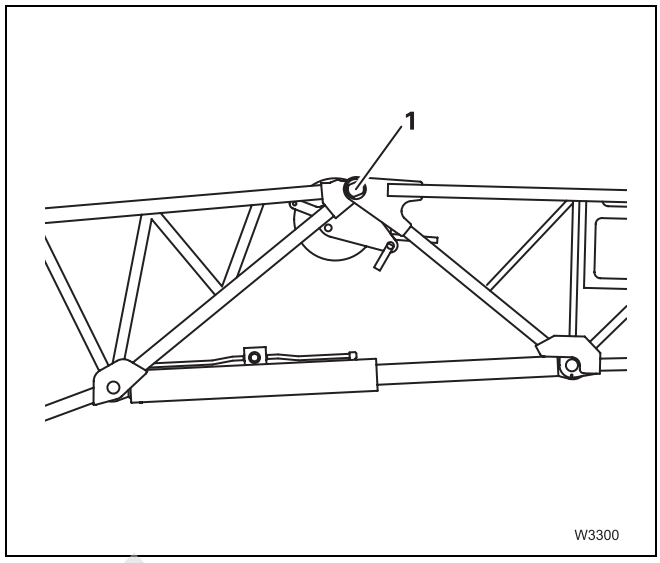
There are two support rollers on the lattice extension that need to be lubricated.



The two support rollers are on the bottom of the 33 ft (10.1 m) section, at the height of the run-up rail.

- Clean the lubricating nipples and insert grease into the lubricating nipple with a grease gun.

Lubricating Joint on 33 ft (10.1 m) Section

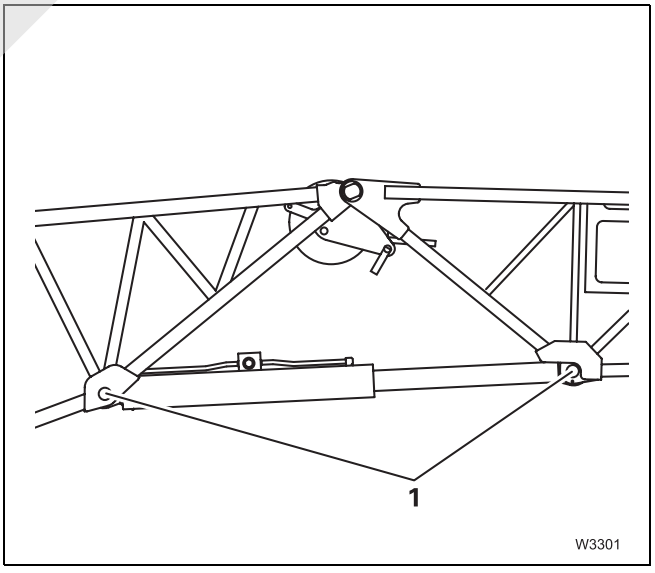


The joints are lubricated via lubricating nipples.

On either side of 33 ft (10.1 m) section, there is a lubricating nipple at the pivot point.

- Clean the lubricating nipple and lubricate it with a grease gun.
- Also lubricate the joint on the other side.

Lubricate the derricking cylinder in 33 ft (10.1 m) section



The derricking cylinder is lubricated via a lubricating nipple.

On head and foot axle there is one lubricating nipple each.

- Clean the lubricating nipples and insert grease into the lubricating nipple with a grease gun.

BOOM EXTENSION (ADDITIONAL EQUIPMENT)

Identification and Slinging Points

Identification

The boom extension consists of the 56 ft (17.1 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 which belong to the crane have the same serial number as the crane.

The following sections are identified by the serial number:

- All parts of the 56 ft (17.1 m) two-stage swingaway lattice extension.
- Both sections of the boom extension 16 ft (4.9 m) sections)
- The hydraulic boom extension must be at 0 degree offset for erecting and stowing the boom extension.

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 Manitowoc/ Grove cranes, the parts of the boom extension must be adjusted for these cranes and labeled with all of the respective serial numbers.

CAUTION

Have the adjustment of the boom extension only carried out on site by Grove CraneCARE!

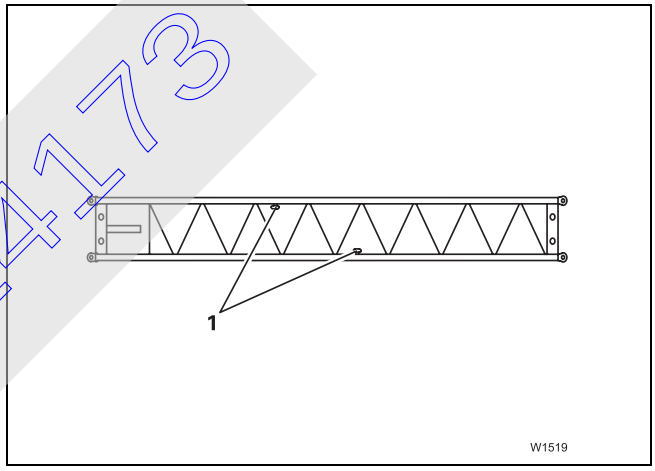
Serial numbers on the 16 ft (4.9 m) sections

The serial number is on a sheet at the front of the 16 ft sections.

Slinging Points

CAUTION

This section shows the slinging points of the 16 ft (4.9 m) sections. Attach the sections only to these slinging points because they will then automatically have the correct center of gravity. Use only lifting gear with sufficient load bearing capacity.



The 16 ft (4.9 m) sections have two slinging points (one slightly offset on each side).

ASSEMBLY OF BOOM EXTENSIONS

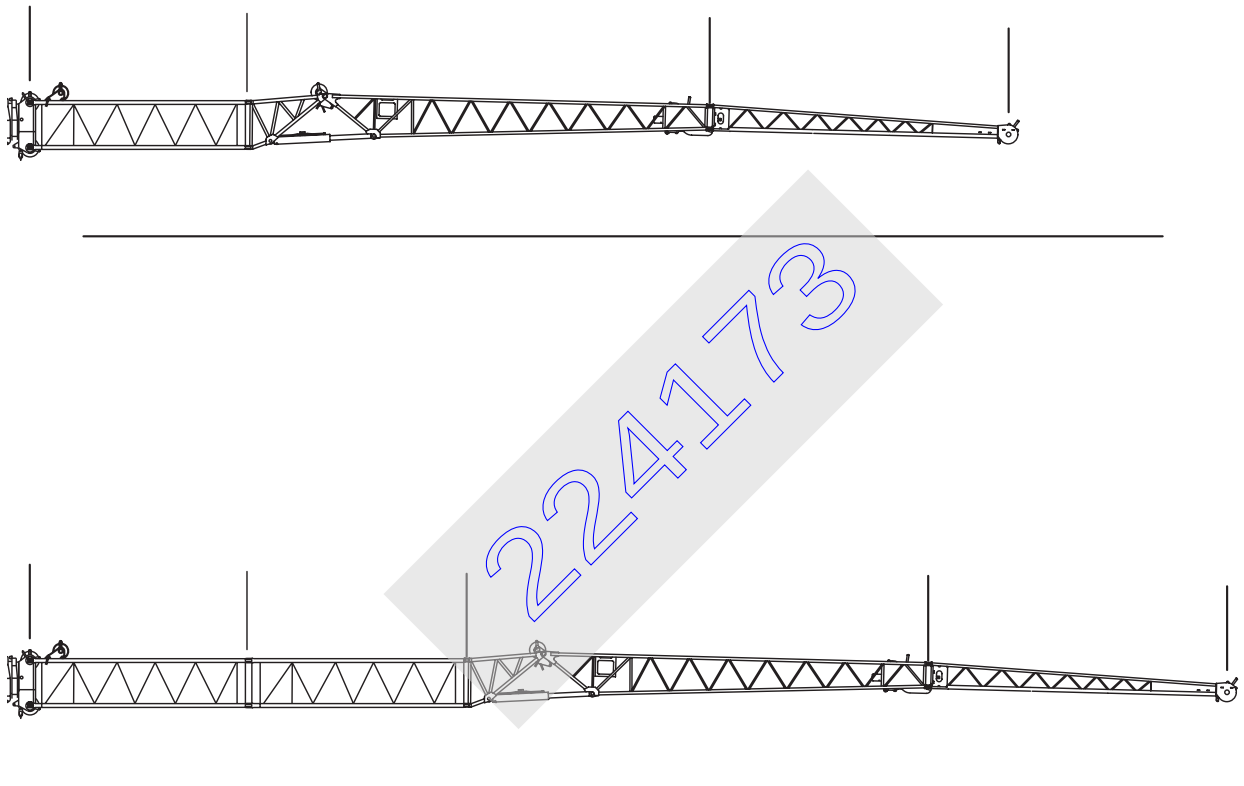


FIGURE 4-11

NOTE: The lengths of 72 ft (22.0 m) and 89 ft (27.1 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 designation 33 ft (10.1 m) section, 23 ft (7 m) section, and 16 ft (4.9 m) section have been adjusted to these lengths.The total length of the individual sections is greater or smaller.

CHECKLISTS FOR RIGGING WORK

Rigging the 72/89 Ft (22.0/27.1 m) Boom Extension

Prerequisites

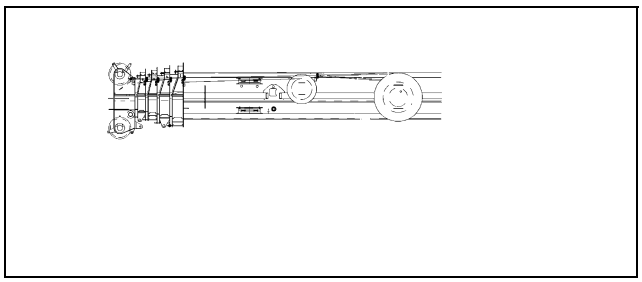
- The crane is on outriggers or the main boom is placed on the boom support.
- An auxiliary crane is available.

1. Prepare the crane for unrigging.
2. If the lattice extension is folded up at the side of the main boom, remove the lattice extension.

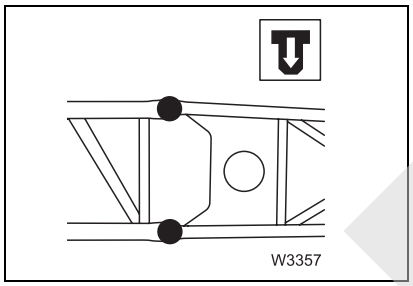
3. If necessary, connect the hose drum for hydraulic supply.
4. Check the transport of the two-stage swingaway lattice extension.
5. Install 16 ft (4.9 m) sections in front of the main boom:

   One 16 ft (4.9 m) section for the 72 ft (22.0 m) boom extension,

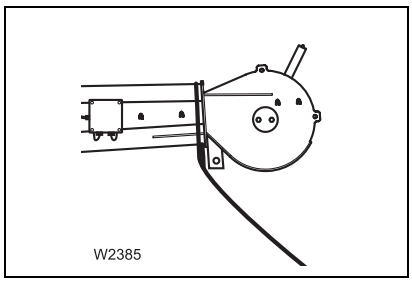
   Both 16 ft (4.9 m) sections for the 89 ft (27.1 m) boom extension.
6. Sling the two-stage swingaway lattice extension on auxiliary crane.



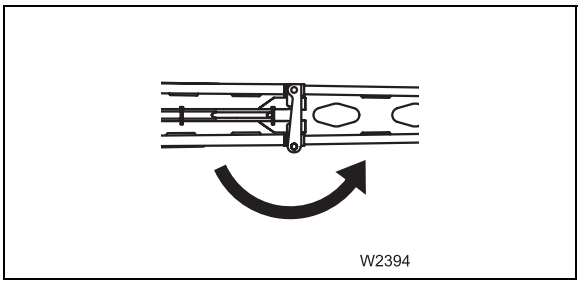
7. Install folded two-stage swingaway lattice extension in front of the 16 ft (4.9 m) section.



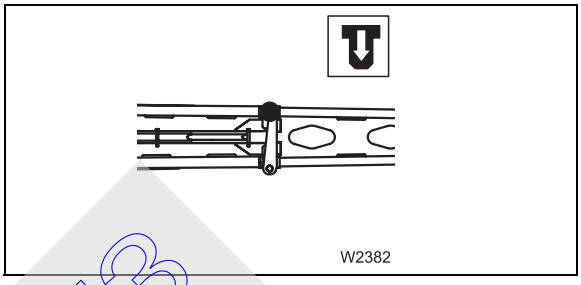
8. Attach the guide rope to the head of the 23 ft (7 m) section.



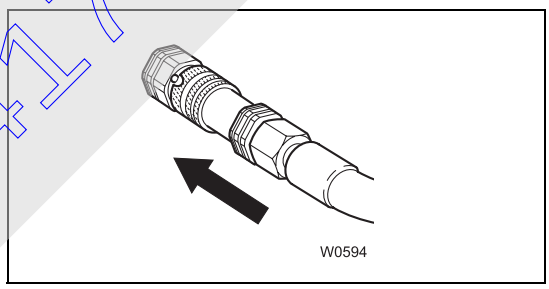
9. Move the connection in the middle area on 33 ft (10.1 m) section.
10. Swinging the 23 ft (7 m) section in front of the 33 ft (10.1 m) section.



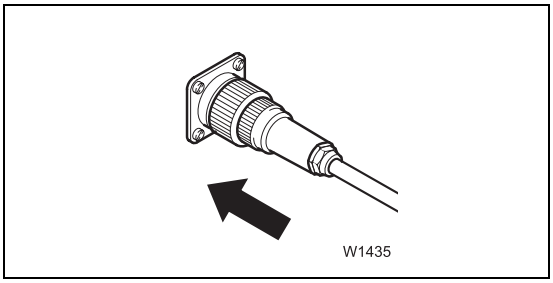
11. Fasten the 23 ft (7 m) section on left-hand side in front of 33 ft (10.1 m) section with a pin.



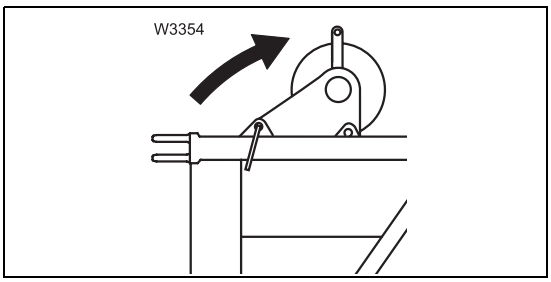
12. Establish a hydraulic connection.



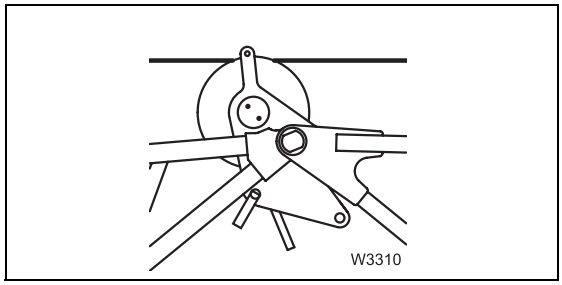
13. Establish electrical connections.



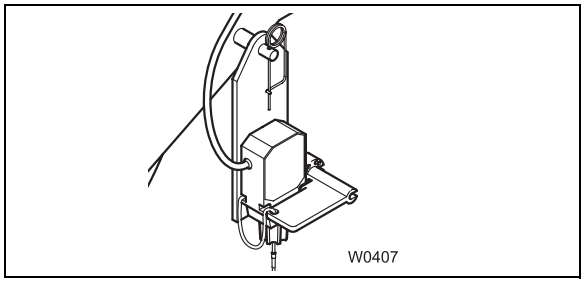
14. Fold out deflection sheaves of all sections.



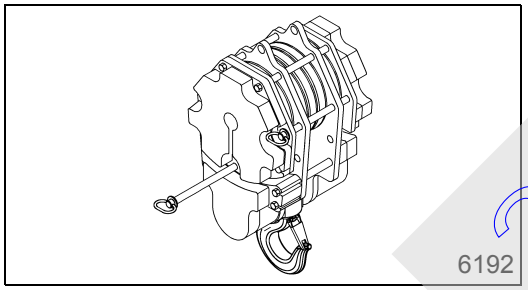
15. Place hoist rope on all deflection sheaves and the head sheave of the 23 ft (7 m) section.



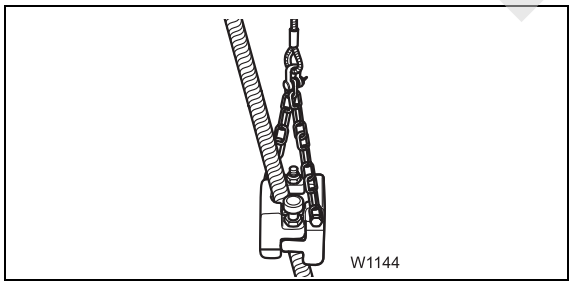
16. Move the lifting limit switch from the head of the main boom to the head of the 33 ft (10.1 m) section.



17. Reeve the hoist cable on the hook block.



18. Attach the lifting limit switch weight and guide hoist rope through the weight.



NOTE: Operation with the boom extension is carried out in the same way as for the lattice extension.

Raising the boom;

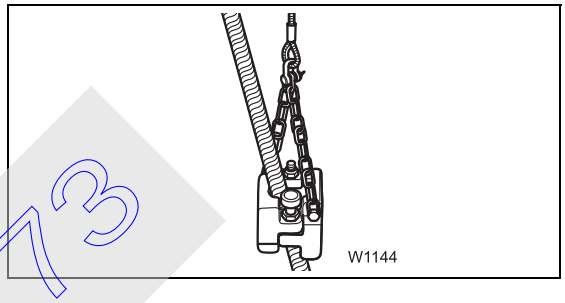
Telescoping;

Unrigging the 72/89 Ft (22/27.1 m) Boom Extension

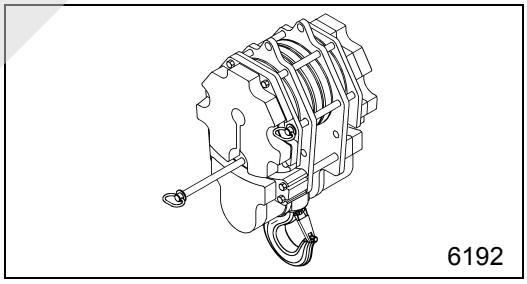
Prerequisites

- The crane is on outriggers or the main boom is placed on the boom support.
- An auxiliary crane is available.

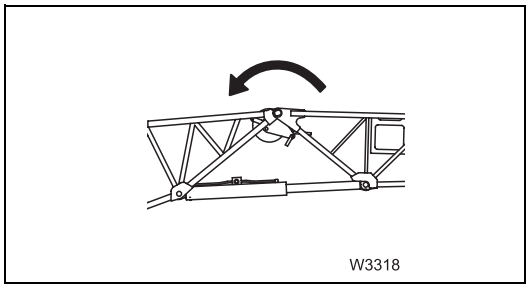
1. Prepare the crane for unrigging.
2. Fully retract and set down the main boom.
3. Remove the lifting limit switch weight and move lifting limit switch from the head of the 23 ft (7 m) section to the head of the main boom.



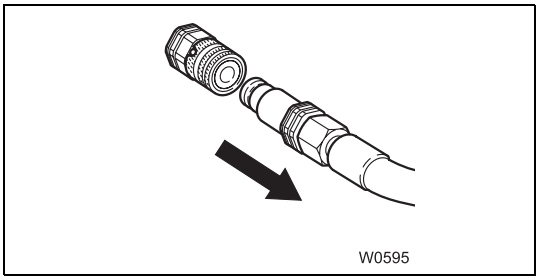
4. Unreeve the hoist cable from the hook block and remove it from the lattice extension.



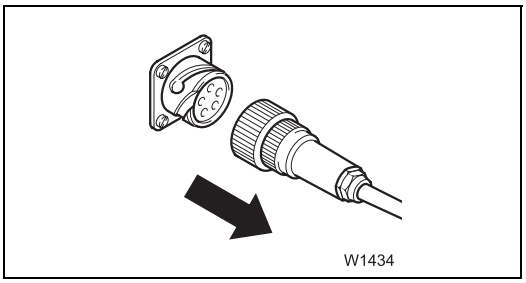
5. Raise the main boom completely.



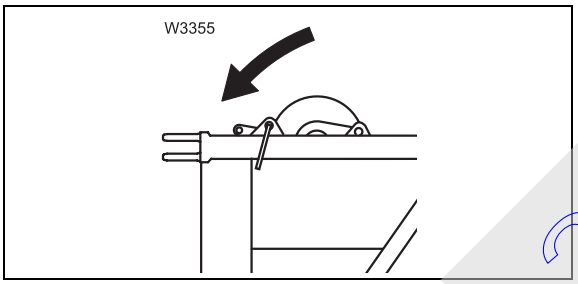
6. Detach the hydraulic connection.



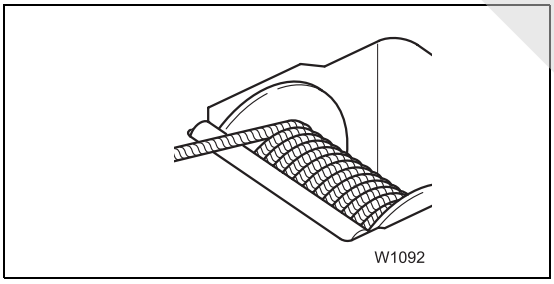
7. Detach electrical connections.



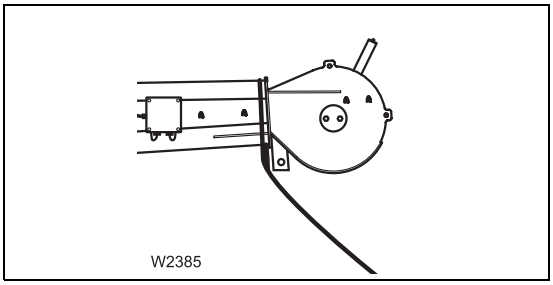
8. Remove hoist rope and hold in deflection sheaves on all parts of the boom extension.



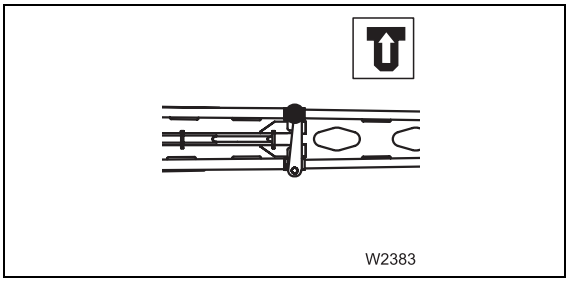
9. Reel hoist cable up to the main boom head.



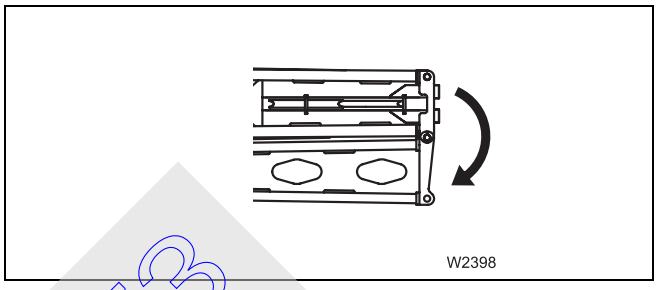
10. Attach the guide rope to the head of the 23 ft (7 m) section.



11. Remove the locking pins on the left-hand sided between 23 ft (7 m) section and 33 ft (10.1 m) section.

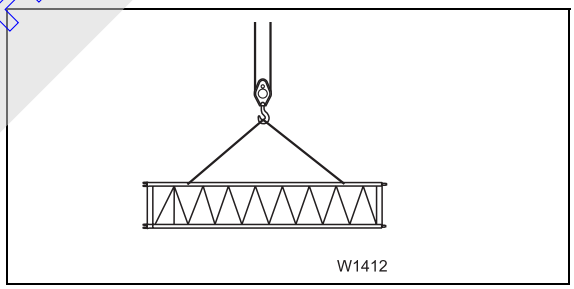


12. Swinging the 23 ft (7 m) section in front of the 33 ft (10.1 m) section.

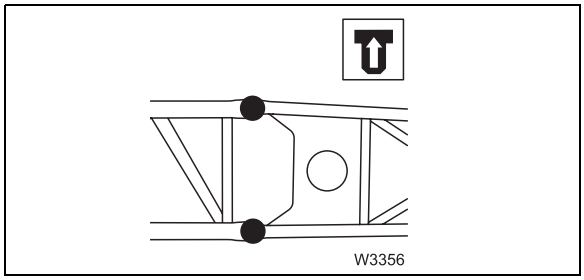


13. Position the central area of the connection 23 ft (7 m) section/33 ft (10.1 m) section position.

14. Sling two-stage swingaway lattice extension on auxiliary crane.



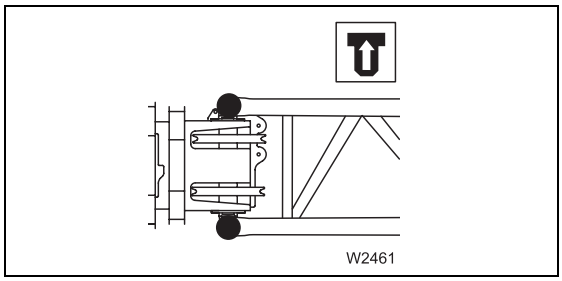
15. Remove folded two-stage swingaway lattice extension from the 16 ft (4.9 m) section.



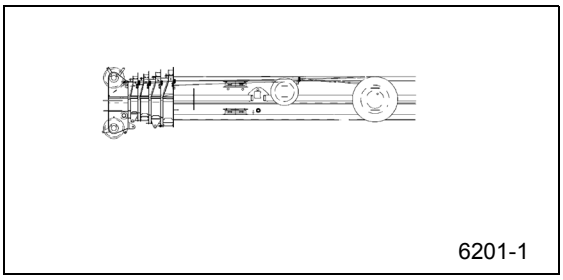
16. Remove 16 ft (4.9 m) sections from the main boom:

One 16 ft section for a 72 ft (22.0 m) boom extension;

Both 16 ft sections for a 89 ft (27.1 m) boom extension.

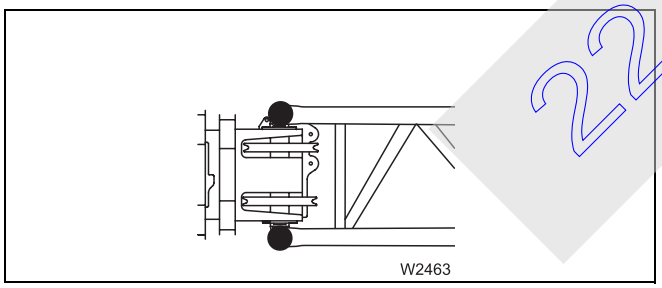


17. If necessary, remove hose drum connection for hydraulic supply.



Description of Rigging Work

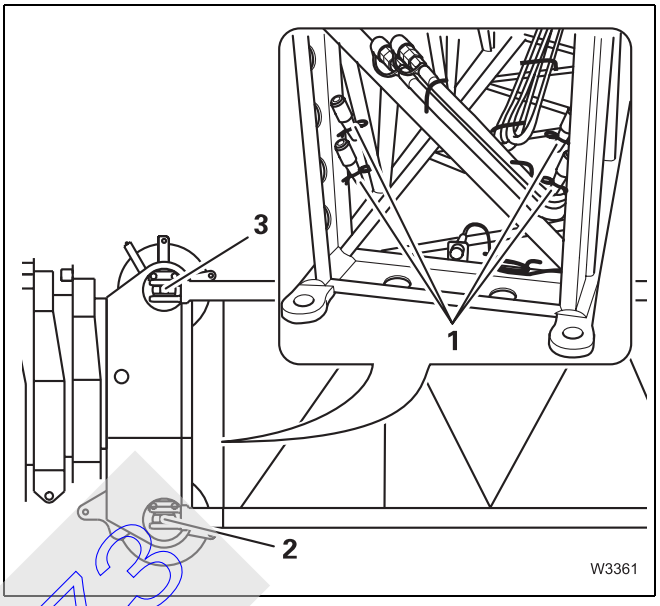
Installing/Removing 16 ft (4.9 m) Sections



- In order to rig the 72 ft (22 m) boom extension, you must install the 16 ft (4.9 m) section with support roller in front of the main boom head.
- In order to rig the 89 ft (27.1 m) boom extension, you must additionally install the 16 ft (4.9 m) section without support roller in front for the 16 ft (4.9 m) section with support roller.

NOTE: An auxiliary crane must be used to install and remove the 16 ft (4.9 m) sections.

The securing pins (1) for the connection are secured with retaining pins in the holders at the foot of the 16 ft (4.9 m) sections.



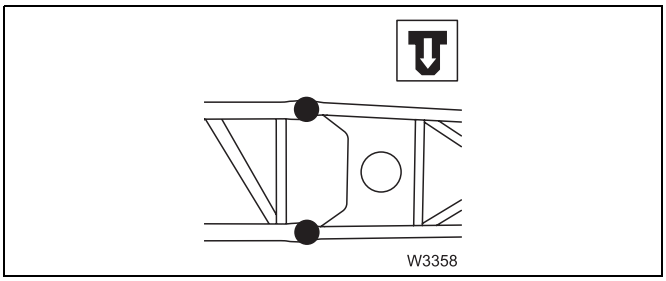
- Sling the 16 ft (4.9 m) section with support roller on an auxiliary crane and lift it in front of the main boom head so that the bearing points (2) and (3) align on both sides.
- Insert the securing pins into the bearing points (2) and (3) on both sides.
- Secure all pins with retaining needles.
- Install the second 16 ft (4.9 m) section in front of the first 16 ft section for the 89 ft (27.1 m) boom extension in the same way.

Removing 16 ft (4.9 m) sections

- Sling the 16 ft (4.9 m) section on an auxiliary crane and lift it until the bearing points (2) and (3) are relieved.
- Release the pins and knock them out of the bearing points (2) and (3) on both sides.
- Insert the pins into the holders at the foot of the 16 ft (4.9 m) sections and secure them with retaining needles.

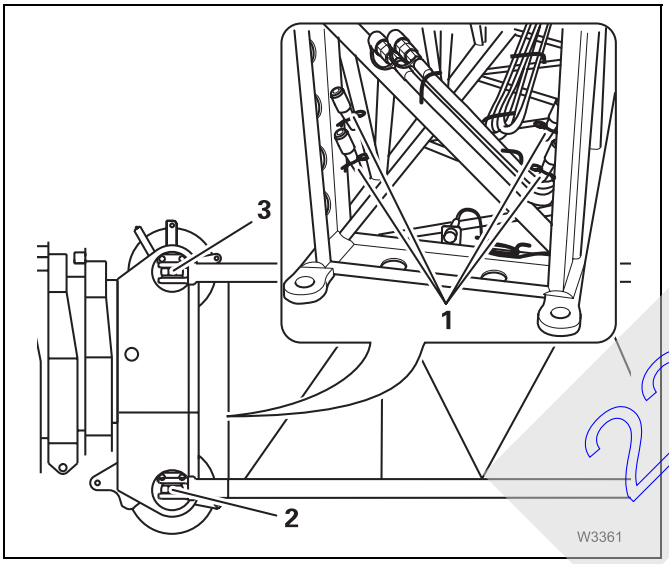
Installing/Removing the Two-Stage Swingaway Lattice Extension for the Boom Extension

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



You can also install the folded two-stage swingaway lattice extension in front of a 16 ft (4.9 m) section (e.g. when you are changing directly from the 56 ft (17.1 m) two-stage swingaway lattice extension to a boom extension).

NOTE: An auxiliary crane is required to install and remove the two-stage swingaway lattice extension.



The securing pins for the connection are in the holders at the foot of the 33 ft (10.1 m) sections and are secured with retaining needles.

Installation

- Sling the two-stage swingaway lattice extension onto an auxiliary crane.
- Lift the two-stage swingaway lattice extension in front of the 16 ft (4.9 m) section so that the bearing points align on both sides.
- Insert the securing pins into the bearing points on both sides.
- Secure all pins with retaining needles.

Removal

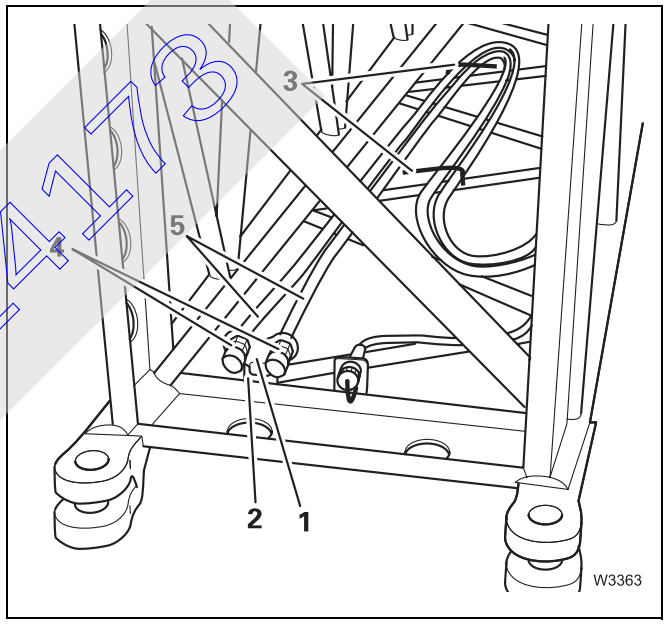
- Sling the two-stage swingaway lattice extension onto an auxiliary crane.
- Lift the two-stage swingaway lattice extension until the bearing points are relieved.
- Release the pins and knock them out of the bearing points on both sides.
- Insert the pins into the holders on the 33 ft (10.1 m) section and secure them with retaining needles.

Hydraulic Connection at the Boom Extension

The hydraulic supply is required for derricking the lattice extension. You must re-establish the hydraulic connection of the hose drum if it has been detached in order to work with the main boom.

Transport Condition of the Connections

For transport, bring the hydraulic connections always into the following condition.



The hydraulic hoses (5) are in the 16 ft (4.9 M) section with deflection sheave. For transport, the hydraulic hoses are clamped in the holders (3).

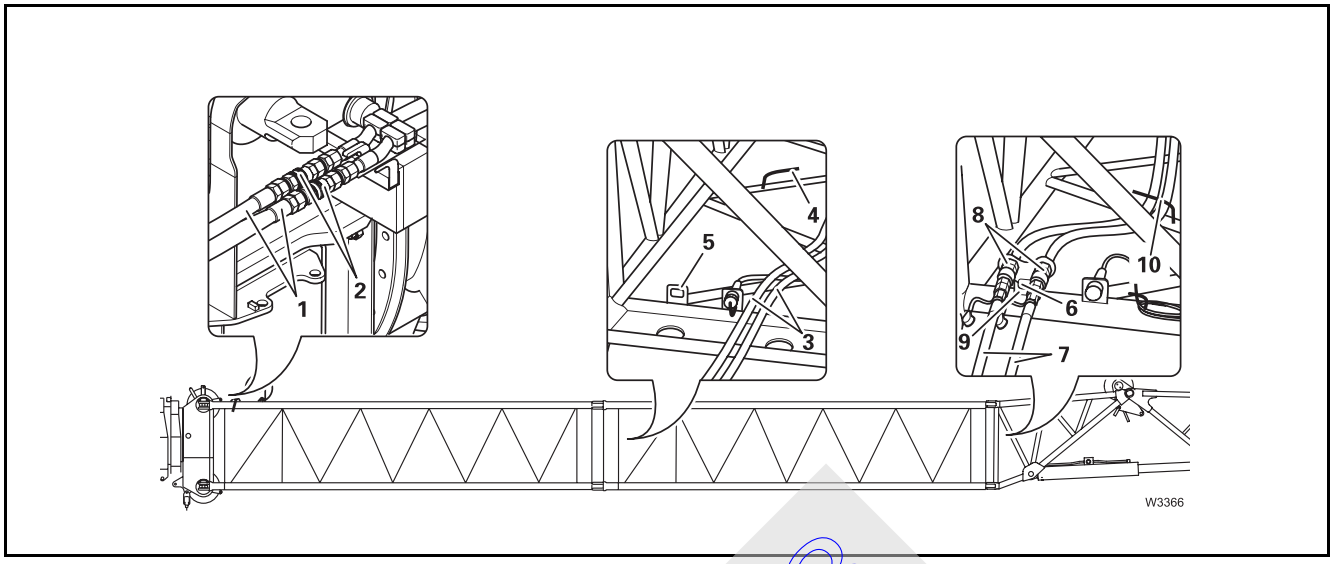
At the two front hose ends, there are two quick-action couplings (4) that are attached to a sheet (1). For transport, the sheet is attached in the holder (2) at the front.

The quick-action couplings (1) are at the rear hose ends (3).

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

At the 72 ft (22.0 m) Boom Extension

All connections are made via quick-action couplings. Half couplings which belong together are color coded.



Establishing a Connection

- Connect the rear hose ends (1) of the 126 ft (38.4 m) section to the quick-action couplings (2) at the main boom head.
- Connect the hydraulic hoses (3) of the 33 ft (10.1 m) section to the quick-action couplings (4) of the 16 ft (4.9 m) section at the front.

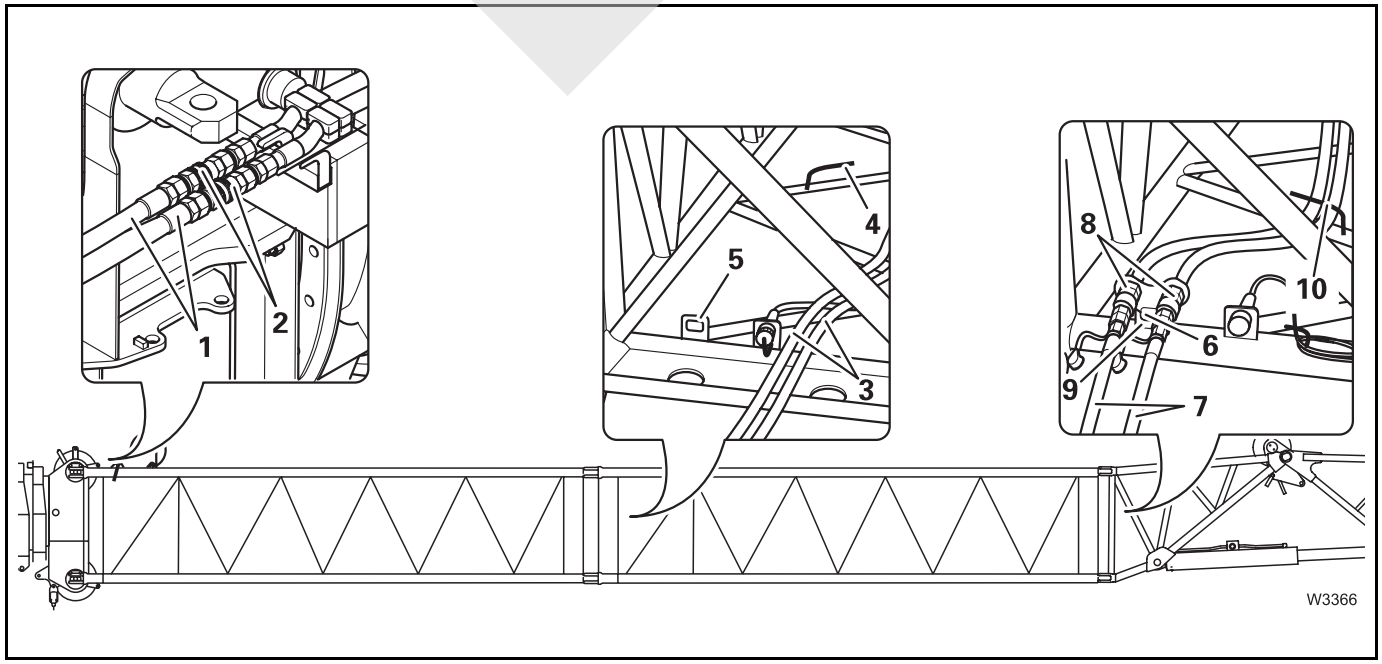
Disconnecting

- Disconnect all the quick-action couplings and cover them with protective caps.
- Make the connections ready for transport.

At the 89 ft (27 m) Boom Extension

All connections are made via quick-action couplings. Half couplings which belong together are color coded.

Establishing a Connection



- Connect rear hose ends (1) of the 16 ft section to the quick-action couplings (2) at the main boom head.
- Detach the hydraulic hose (3) from the holders (4) in the 16 ft (4.9 m) section with deflection sheave.
- Remove the sheet (5) from the holder 16 ft (4.9 m) section.
- Attach the sheet (6) in the holder (9) and clamp the hydraulic hoses into the holders (10) in the front 16 ft (4.9 m) section.
- Connect the hydraulic hoses (7) of the 33 ft (10.1 m) section to the quick-action couplings (8) of the 16 ft (4.9 m) section at the front.

Disconnecting

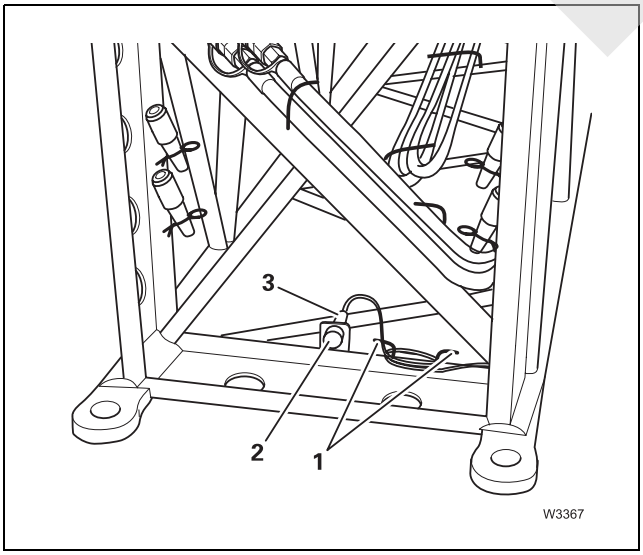
- Disconnect all the quick-action couplings and cover them with protective caps.
- Make the connections of the 16 ft (4.9 m) sections ready for transport.
- Clamp the connections of the 33 ft (10.1 m) section to the holders at the 33 ft (10.1 m) section.

Electrical Connection at the Boom Extension

This section only described the electrical connections at the 16 ft sections. For establishing the electrical connection at the two-stage swingaway lattice extension.

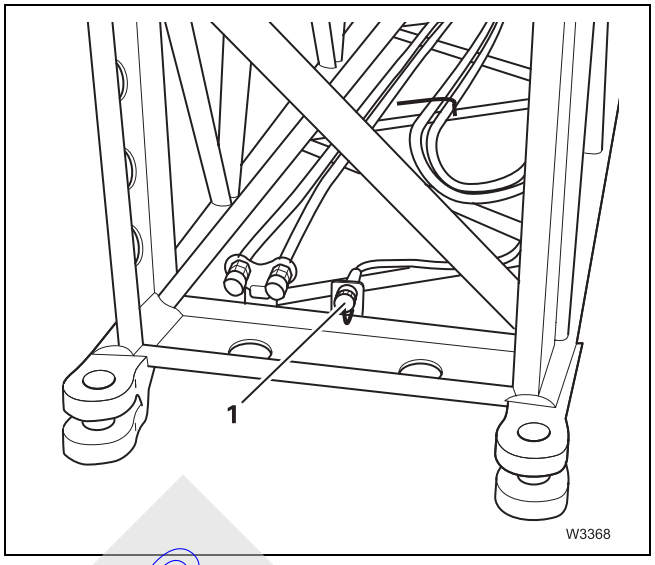
Transport condition of the connection

For transport, bring the electrical connections always into the following condition.



There is a cable with a plug (3) at the rear of the 16 ft sections.

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



There is a plug socket (1) at the front of each 16 ft (4.9 m) section.

For transport, the sockets are covered with protective caps.

At the 72 ft (22.0 m) Boom Extension

Establishing a Connection

- Connect the cable of the 33 ft (10.1 m) section to the socket of the second 16 ft (4.9 m) section at the front.
- Connect the cable of the 16 ft (4.9 m) section to the socket at the main boom.

Disconnecting

- Detach the electrical connection between 33 ft (10.1 m) and 16 ft (4.9 m) section.
- Detach the electrical connection between 16 ft (4.9 m) section and main boom head.
- Prepare the electrical connections at the 33 ft (10.1 m) section for transport.

At the 89 ft (27.1 m) Boom Extension

Establishing a Connection

- Connect the cable of the 33 ft (10.1 m) section to the socket of the second 16 ft (4.9 m) section at the front.
- Connect the cable of the second 16 ft (4.9 m) section to the socket of the first 16 ft (4.9 m) section at the front.
- Connect the cable of the first 16 ft (4.9 m) section to the socket at the main boom head.

Disconnecting

- Detach the electrical connection between the 33 ft (10.1 m) and front 16 ft (4.9 m) section.
- Detach the electrical connection between the two 16 ft (4.9 m) sections.
- Detach the electrical connection between the rear 16 ft (4.9 m) section and the main boom head.
- Prepare the electrical connections at the 16 ft (4.9 m) section for transport.
- Prepare the electrical connections at the 33 ft (10.1 m) section for transport.

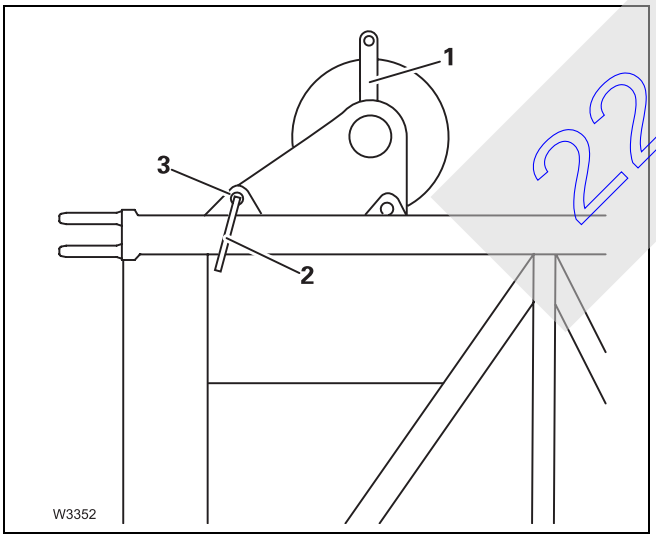
Unfolding/Folding the Deflection Sheave on the 16 ft (4.9 m) Section

This section describes only the unfolding and folding of the deflection sheave on the 16 ft (4.9 m) section.

For work with the boom extension, you must fold out the deflection sheaves on the rear 16 ft (4.9 m) section.

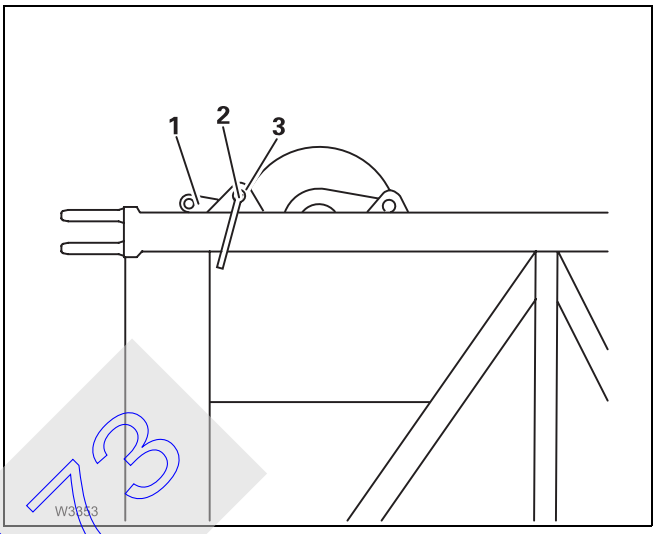
Fold the deflection sheave for transport.

Folding Out Deflection Sheave



- Pull the pin (2) out of the bore (3).
- Fold the deflection sheave on the strut (1) upwards until the locking positions are aligned with the bore hole (3).
- Fasten the deflection sheave for transport.

Folding In Deflection Sheave



- Hold the deflection sheave by the strut (1) and remove the pin (3) from the bore (2).
- Fold the deflection sheave down as far as possible.
- Insert the pin in the bore hole (3) and secure it with a retaining needle.

4

Positioning/Removing the Hoist Cable

DANGER

Risk of accidents due to falling parts.

Always secure the hoist cable holding rollers and rods with retaining pins. This prevents elements from becoming loose, falling down and injuring people.

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

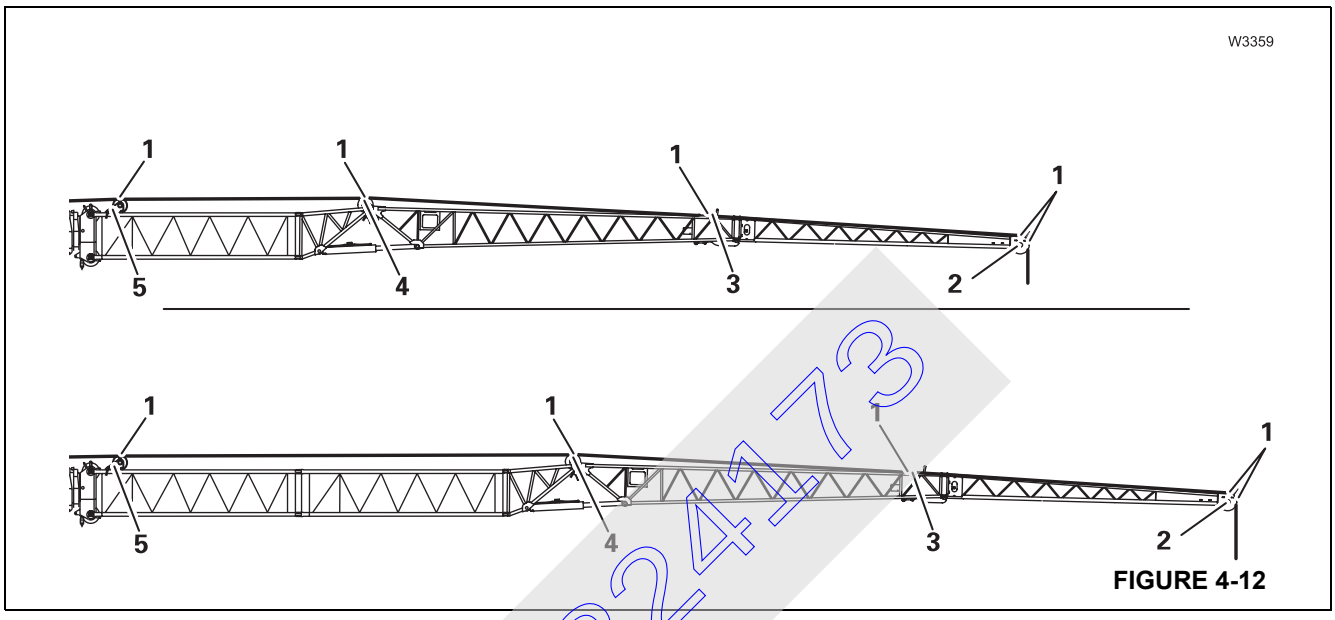


FIGURE 4-12

- For both boom extensions, guide the hoist rope via the deflection sheaves (5), (4), (3), and via the head sheave (2) on the 23 ft (7 m) section (see Figure 4-12).
- Put all hoist cable holding rollers and rods back in place and secure them with retaining pins.
- Attach the hook tackle. The hoist rope can only be reeved once.

DRIVING WITH RIGGED CRANE AND RIGGED BOOM EXTENSION

ThIs section describes how you can move the crane with installed counterweight and rigged boom extension on site (e.g., if because of lack of space, the boom extension can not be directly installed at the site).

CAUTION

It is forbidden to move the crane with a load on the hook. Put the load down before you move the crane. Secure the hook block so that it cannot swing.

CAUTION

Risk of overturning!

Before a rigged crane can be driven, the superstructure must be locked and the slewing gear permanent brake must be engaged.

Driving Route

The route must be a flat, even surface. The level adjustment system cannot compensate for uneven surfaces. If the surface pressure of the tires exceeds the permissible load on the ground, the surface pressure must be increased using packing made of durable material (e.g. wooden planks).

CAUTION

Risk of tire damage!

Check the pressure in the tires before the rigged crane is moved. The crane may be moved only if the tire pressures are at the prescribed levels. Do not reduce the tire pressure!

Traveling with Hydraulic Luffing or Manually Offsettable Boom Extension and/or Inserts Erected

33 ft (10.1 m)/56 ft (17.1 m) Extension Plus 16 ft (4.9 m) or 32 ft (10 m) Inserts

Travel is permissible under the following conditions.

1. The 33 ft (10.1 m) or 56 ft (17.1 m) boom extension shall be erected at minimum offset.
2. Jobsite travel only on firm, level surface.
3. Main boom shall be fully retracted.
4. Main boom angle: 0 degrees minimum, 40 degrees maximum.
5. Maximum travel speed: 2.5 mph (4 km/h).
6. Counterweight shall be installed.
7. The boom shall be over the front.
8. Swing lock and pin shall be engaged.
9. Hookblock must be removed from main boom nose.
10. Headache ball be reeved over boom extension, hanging 3 feet (0.9 m) below sheave.
11. The tires shall be properly inflated.

Adjustment Procedure for Stowage Brackets for Hydraulic Luffing Jib

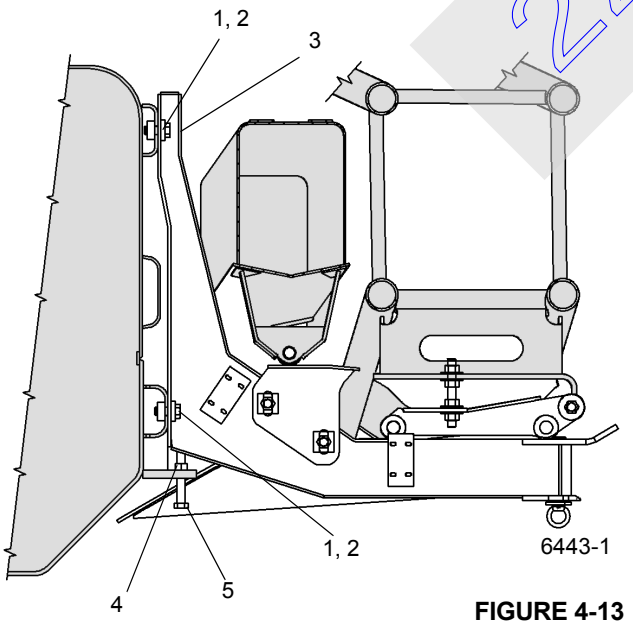


FIGURE 4-13

Item	Description
1	Bolt
2	Flatwasher
3	Rear Hanger Assembly
4	Hex Nut
5	Bolt

1. Loosen items 1 and 2 that secures item 3 (refer to Figure 4-13).
2. Loosen item 4 that secures item 5.
3. Adjust item 5 so as to move item 3 to its highest position on the boom.

NOTE: Caution must be taken during this adjustment so as not to bind up other brackets. This is required to assure that the boom extension nose will clear the valve cover on the side of the turntable.

4. Tighten items 1 and 2 that secures item 3 (refer to Figure 4-13).
5. Tighten item 4 that secures item 5.
6. Using the luffing jib offset cylinder, adjust the boom extension adapter so that the pin holes align with the pin holes in the boom nose.
7. Adjust the other boom extension hanger brackets so as to get proper support and alignment for easy pin installation at the boom nose.

Driving the Rigged Crane

When driving with a rigged boom extension, proceed in the same way as for driving with a rigged lattice extension.

MAINTENANCE WORK

Maintenance Work M1, Monthly

- Lubricate all attach, securing, and retaining pins.

NOTE: The maintenance interval applies to average operation. Also lubricate the pins after high-pressure cleaning and generally at an interval that will prevent them getting dry.

AUXILIARY SINGLE-SHEAVE BOOM TOP (ADDITIONAL EQUIPMENT)

Identification

The auxiliary single-sheave boom top is designed for the crane it was delivered with.

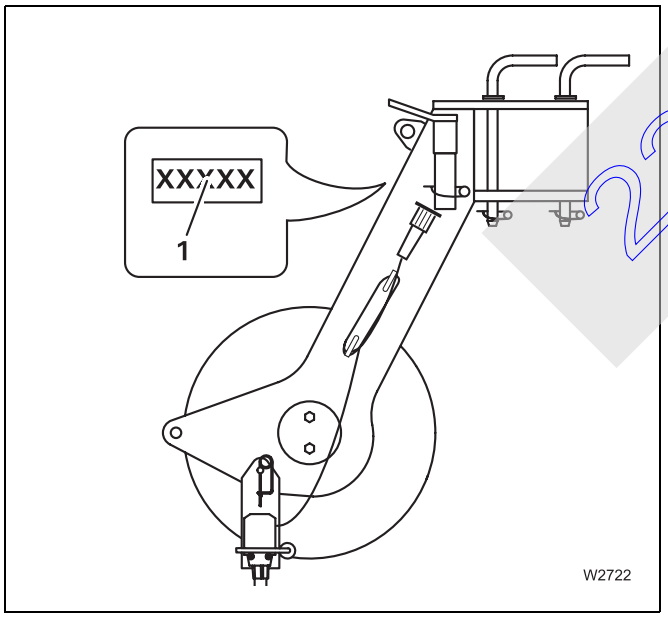
CAUTION

Operate the crane only with the auxiliary single-sheave boom top that has the identical serial number.

If you wish to use the auxiliary single-sheave boom top on several Manitowoc/Grove cranes, it needs to be adapted to the corresponding crane and marked with all the serial numbers.

CAUTION

The auxiliary single-sheave boom top should only be adjusted by Manitowoc CraneCARE at the particular location.



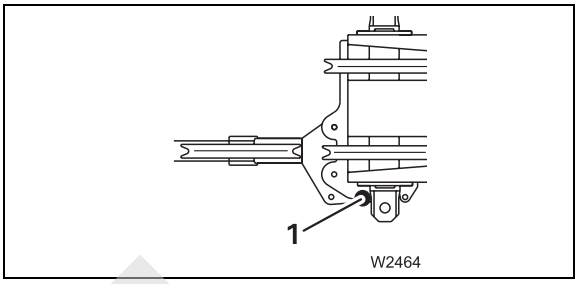
The serial number (a) is on a plate, in the front on the auxiliary single-sheave boom top.

Installing/Removing Auxiliary Single-Sheave Boom Top

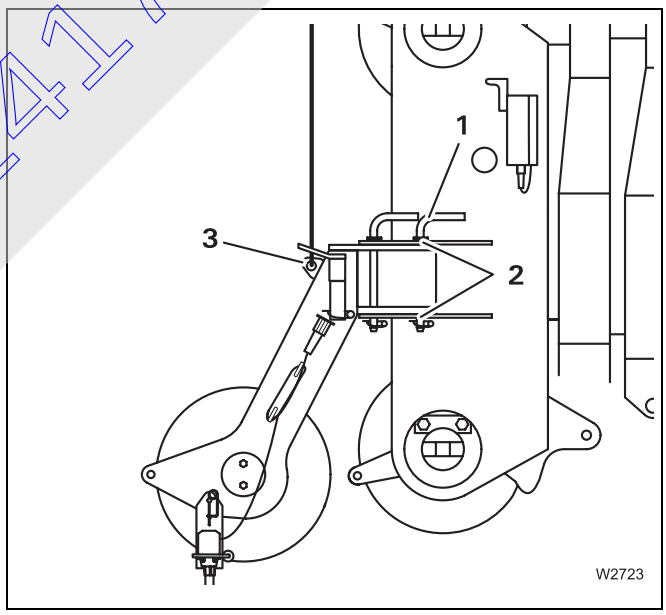
DANGER

Risk of accidents if boom top should fall off! During installation and removal, always use the proper materials with sufficient load bearing capacities.

Installing Auxiliary Single-Sheave Boom Top



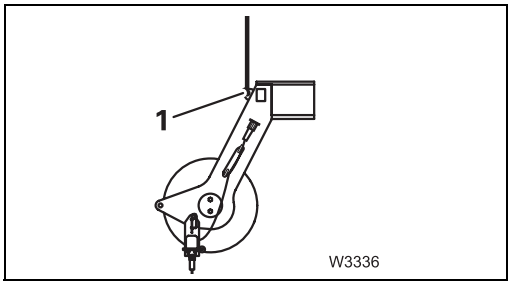
On the left side of the main boom head there is a holding device. When installing, the holding device is connected at the front bore holes.



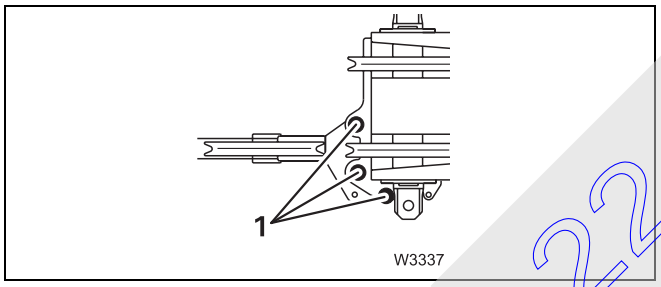
- Loosen the retaining pin and remove the pin (1) from the bearing point (2).
- Use an auxiliary crane to couple to the connection eyes (3) on the auxiliary single sheave boom head and lift it to the left onto the main boom head.
- Align the auxiliary single-sheave boom top so that the bearing point (2) lines up to the front bore holes in the holding device.

- Secure the auxiliary single-sheave boom top to the holding device using a pin (1).
- Secure the pin with a retaining pin.
- Depending on the application, bring the auxiliary single-sheave boom top into transport position or working position.

Removing the Auxiliary Single-Sheave Boom Top

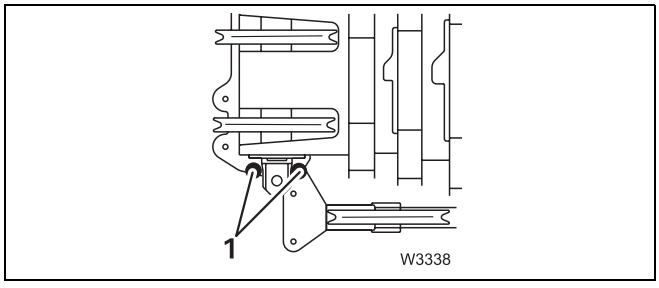


- Attach an auxiliary crane to the connection eyes of the boom top.



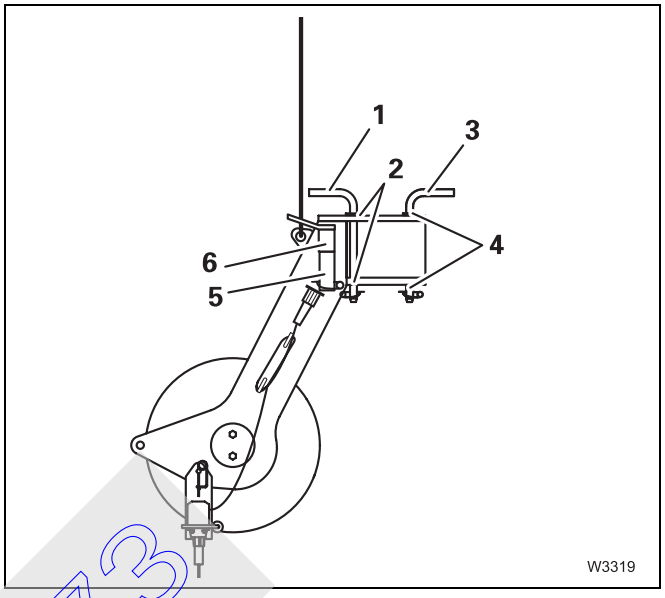
In the working position, the auxiliary single-sheave boom top is positioned in front of the main boom head and is fastened with three pins.

- Remove the retaining pins and draw all the pins out of the bores and bearing points.



In the working position, the auxiliary single-sheave boom top is positioned to the side of the main boom head and is fastened with two pins.

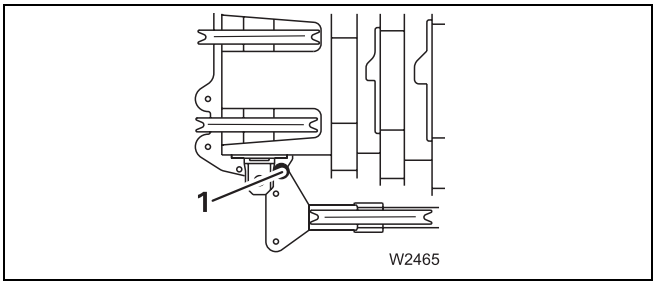
- Remove the retaining pins and draw all the pins out of the bores and bearing points.
- Lift the auxiliary single-sheave boom top from the head of the main boom.



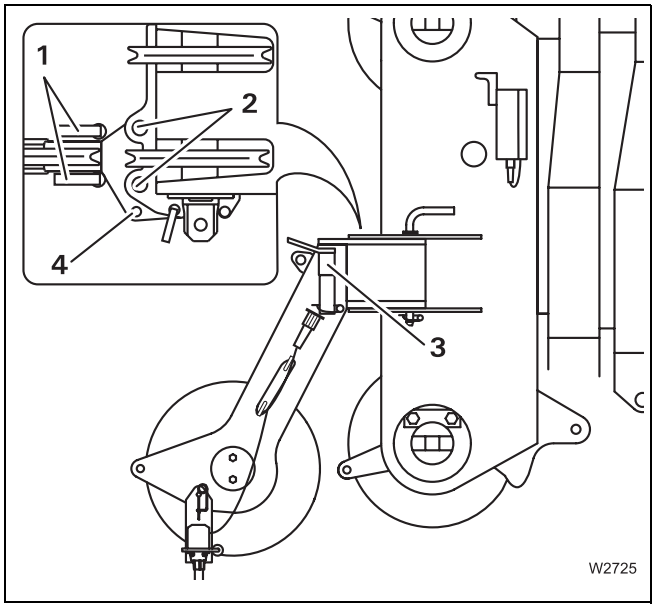
- Insert the two thin pins (1) and (3) into the bearing points (2) and (4) on the auxiliary single-sheave boom top.
- Insert the two pins (5) into the mounting brackets (6) in front on the auxiliary single-sheave boom top.
- Secure all the pins using retaining pins.

RIGGING THE AUXILIARY SINGLE-SHEAVE BOOM TOP

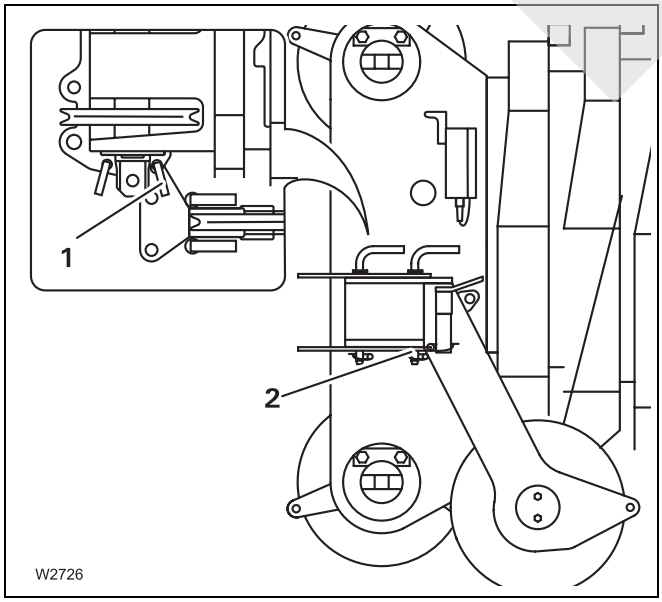
Rigging in Transport Position



On the left side of the main boom head there is a holding device. In transport position, the boom top is connected to the rear bore holes on the holding device.

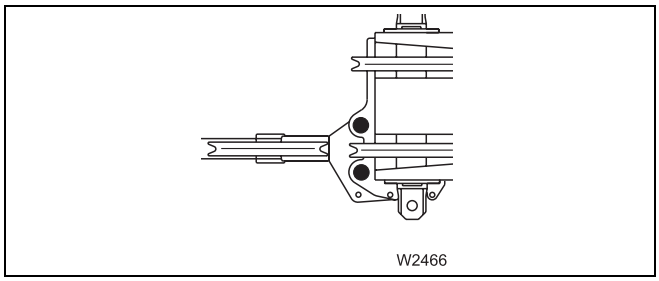


- Remove the retaining pins and take both pins (1) out of the bearing points (2) at the front of the main boom head.
- Insert both pins into the holders (3) and secure them with retaining pins.
- Release the retaining pin and remove the thin pin from the bearing point (4).
- Slew the auxiliary boom top to the side of the main boom head.

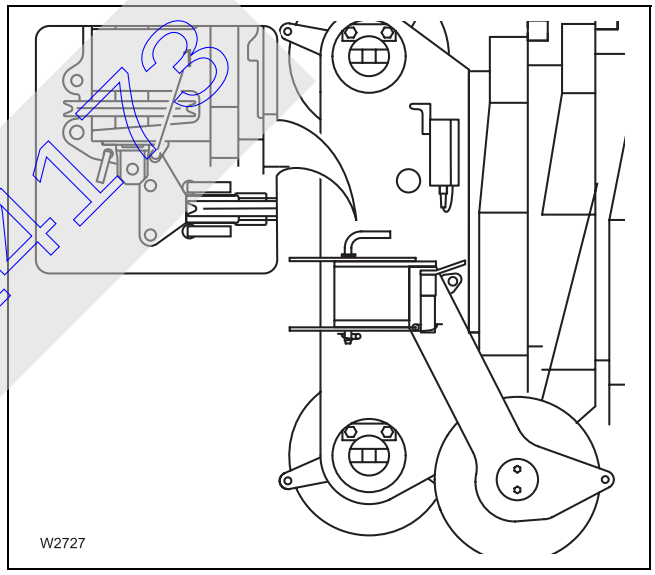


- Using the thin pin (1), fasten the auxiliary single-sheave boom top to the bearing point (2).
- Secure the pin with a retaining pin.
- The auxiliary single-sheave boom top is now in transport position.

Rigging in Working Position

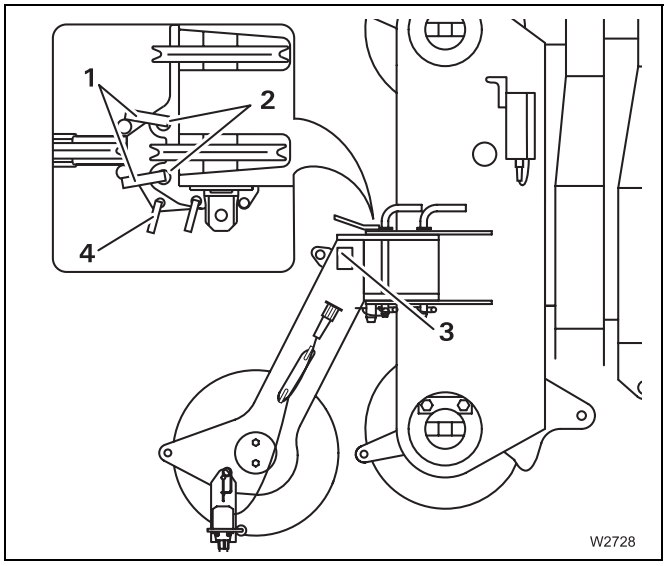


On the left side of the main boom head, there is a holding device. In working position, the auxiliary single-sheave boom top is attached to the main boom head at both bore holes.



- Release the retaining pin and remove the thin pin from the bearing point.

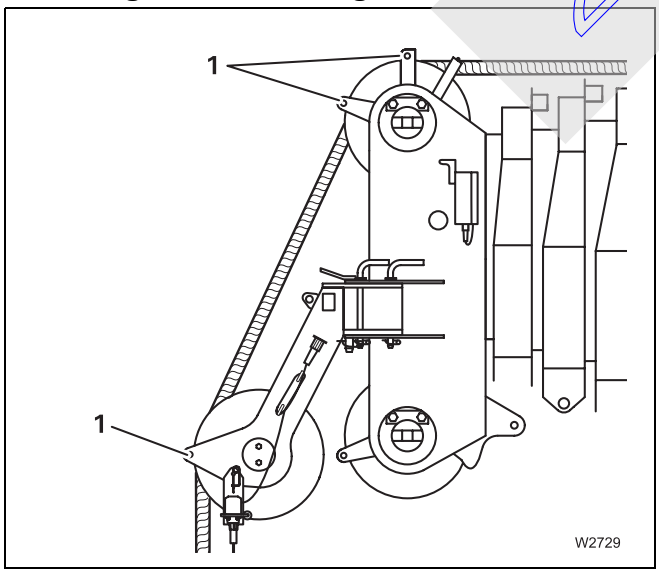
- Swing the auxiliary single-sheave boom top in front of the main boom head.



- Remove the retaining pin and take out both thick pins from the holders.
- Insert both pins into the pivot points at the front of the main boom head and secure them with retaining pins.
- Insert the thin pin into the bearing point and secure it with a retaining pin.

The auxiliary single-sheave boom top is now in working position.

Attaching and Removing Hoist Cable



- Remove the cable holding rods from the head of the main boom and from the auxiliary single-sheave boom top.
- When reeving, guide the hoist cable over the left head sheave of the main boom.
- Insert the rope holding rod into the appropriate bore holes and secure them with the corresponding retaining pins.
- Fasten the cable end clamp on the hook tackle or the hook block.

Reverse the sequence of operations to remove the hoist cable before slewing the auxiliary boom top into transport position.

Possible Reeving Methods on the Auxiliary Single-Sheave Boom Top

NOTE: The hoist cable may only be simply reeved (single drop).

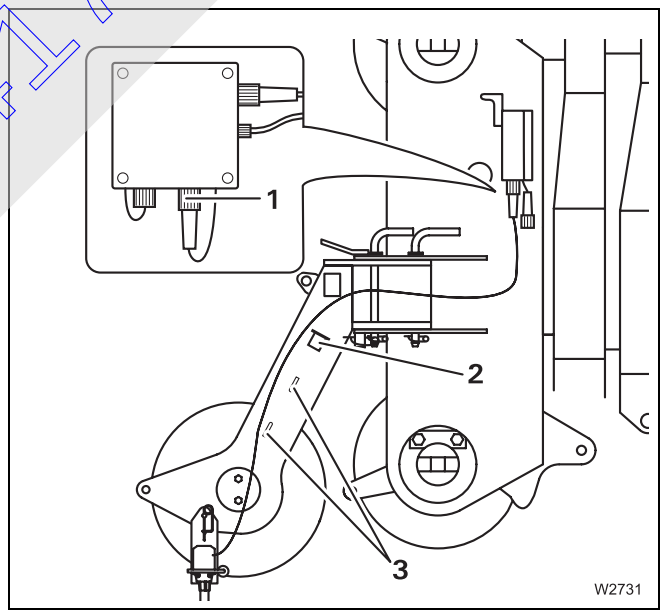
Maximum load bearing capacity: 10 U.S. Tons

- maximum load bearing capacity:

  for single-reeving 16,000 lbs (7.3 t)

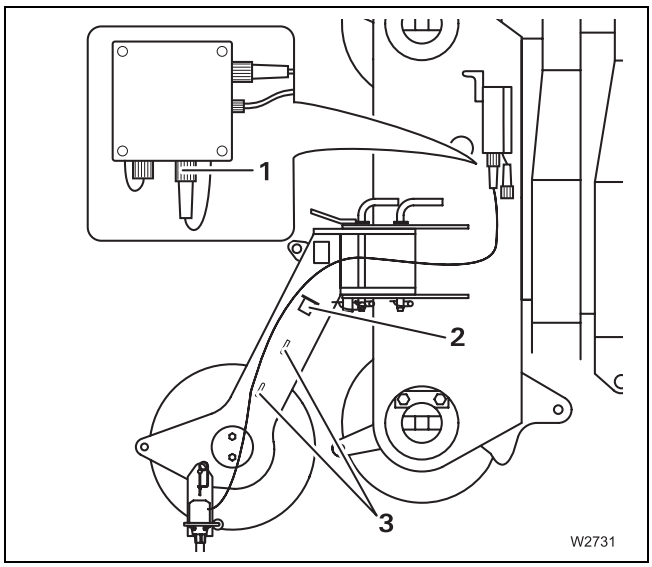
Lifting Limit Switch

In Operation



- Pull the plug of the connecting cable from the dummy socket (2).
- Unwind the connecting cable from the holders (3).
- Insert the plug of the connecting cable into the socket (1) on the main boom head.
- Guide the hoist cable through the lifting limit switch weight.

If, additionally, a hook block is reeved on the main boom, connect the lifting limit switch of the main hoist to the socket on the right side of the main boom head.



During Transport

- Insert the plug of the connecting cable into the dummy socket (2).
- Wind the connecting cable onto the holders (3).
- Plug the short-circuit plug into the socket (1).

Setting the Folding Swingaway Extension Offset

DANGER

Ensure any blocking material used is adequate to support the weight of the extension assembly without tipping or falling.

1. Extend and set the outriggers and swing the boom to over the front. Position the boom to above horizontal.
2. Block up under the tip of the extension assembly section.
3. To set the offset from a lesser degree to higher degree, perform the following procedures.

CAUTION

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

a. Slowly lower the boom until the pressure is relieved on the offset link pins.

NOTE: For 20 or 40 degree offset, make sure the mast is in the raised position.

b. Remove the offset link clip pins and attach pins securing the offset links in the lesser degree offset position. If going to maximum offset, stow them in the stowage lugs. If going to the intermediate (20 degree) offset, install them in the offset links for that degree of offset.

c. Slowly elevate and telescope the boom at the same time so that the extension does not move off of the blocking until the offset links take the full weight of the extension.

d. Reeve the hoist cable as described under normal erecting procedures.

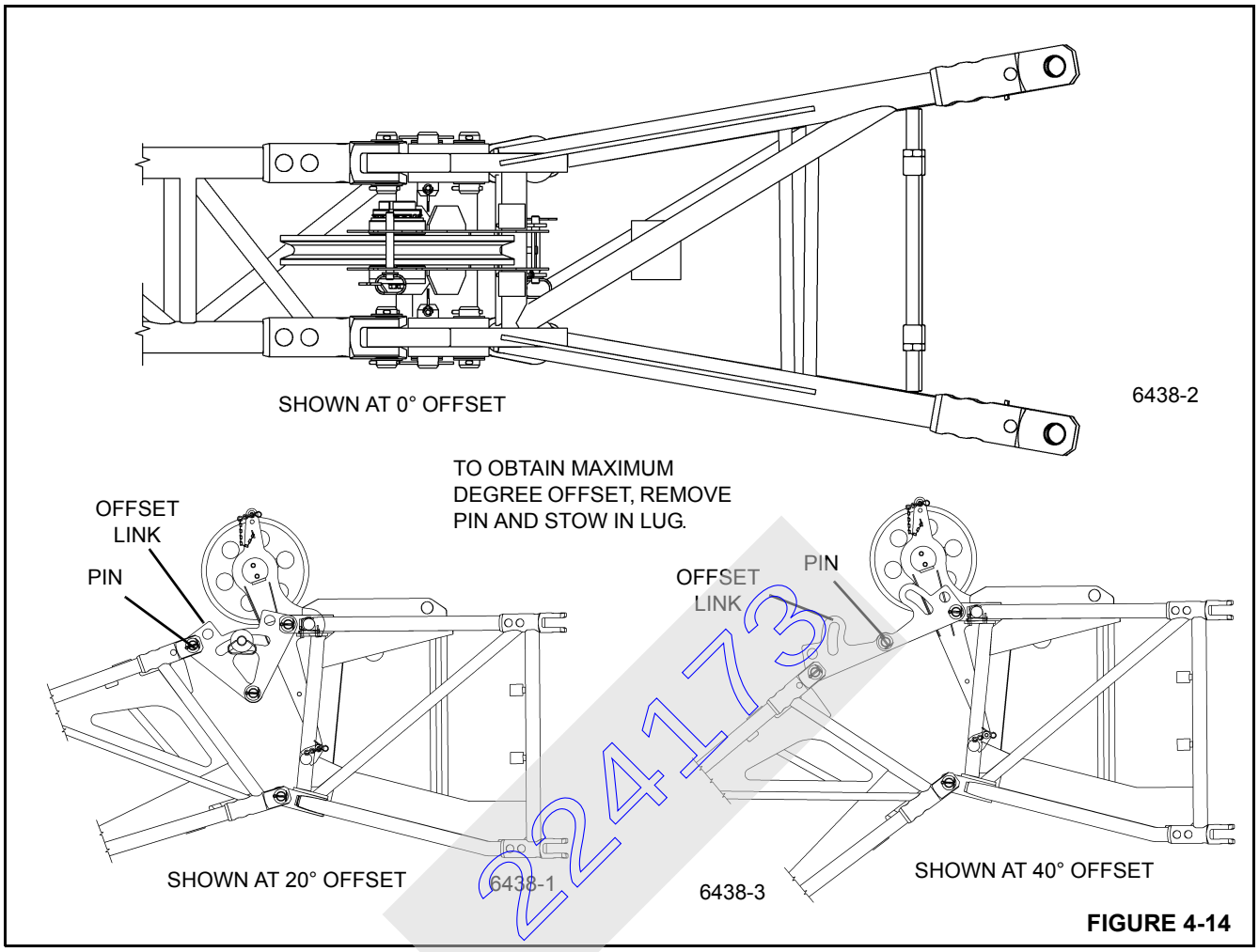


FIGURE 4-14

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 (see Figure 4-15).

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.

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 the hose drum lock pin into hole on the 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.

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.

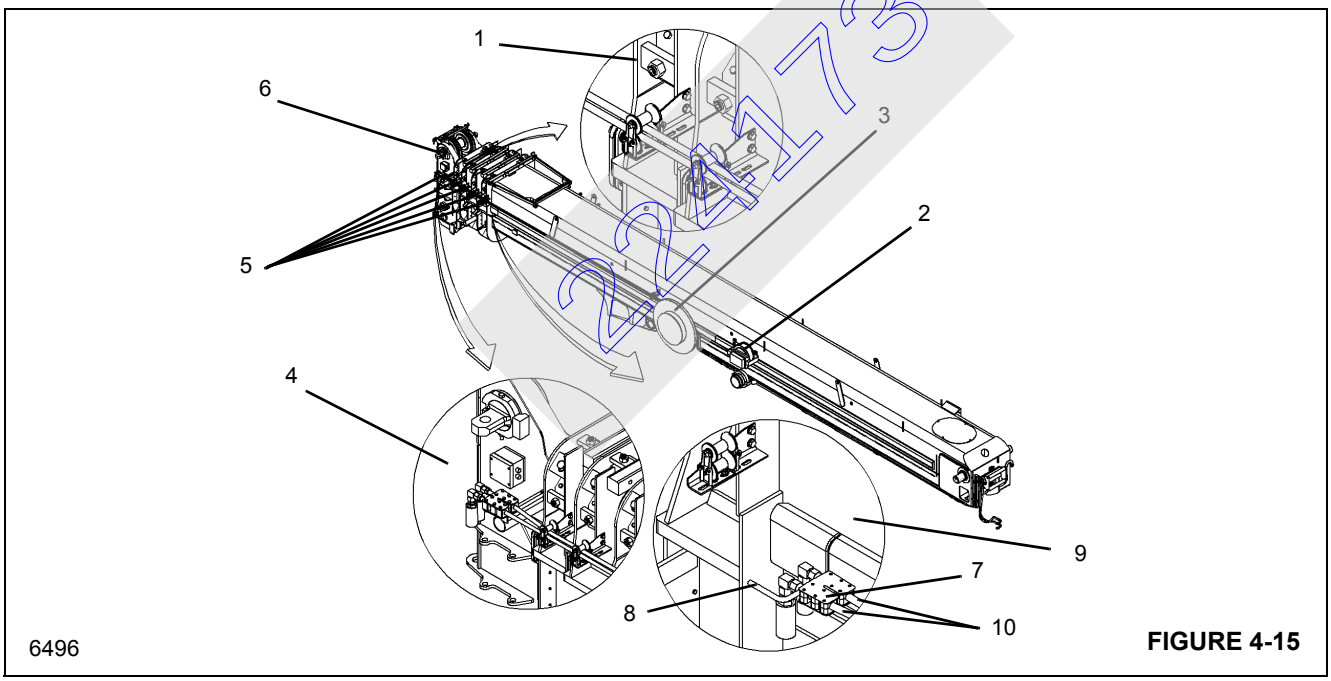


FIGURE 4-15

Item	Description
1	Junction Box
2	Junction Box Assembly
3	Hose Drum
4	Boom Nose Holder
5	Guide Rollers

Item	Description
6	17-Pin Bypass Connector
7	Bar
8	Bracket
9	Base Section
10	Hydraulic Hoses

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 33 ft (10.1 m) and 56 ft (17 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.

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.

Swingaway Mounting Adjustment.

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

1. Set the 29 ft (9 m) section with the 23 ft (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 29 ft (9 m) section role on the guide rail and aligns the roller support on the 23 ft (7m) section. This should align the hole in the mounting lug on the 23 ft (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.

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SECTION 5
LUBRICATION

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SECTION 5
LUBRICATION

GENERAL

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

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

CAUTION

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

CAUTION

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

Arctic Conditions - Below -18°C (0°F)

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

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, tires on the ground, and the suspension set at the proper ride height.

Lubrication checks must be performed while the oil is cool and has not been operated within the past 30 minutes, unless otherwise specified.

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

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 (refer to Figure 5-1, Figure 5-2, Table 5-1 and Table 5-2).

Table 5-1
Lube Symbol Chart

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

Table 5-2
Lube Description

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

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

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

CAUTION

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

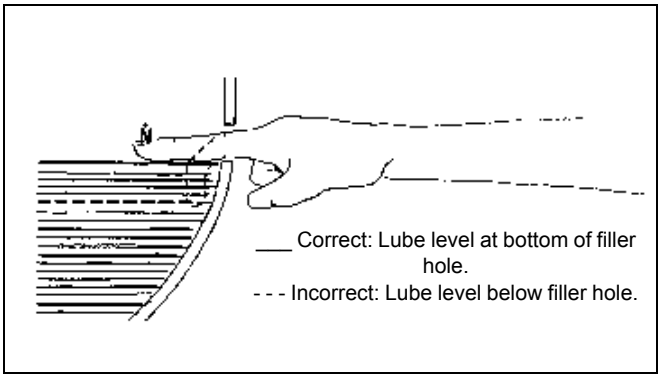
NOTE: Any lubricant used in the field for either top-off or refill of the axles must be an “Extended Drain Lubricant” as approved by ArvinMeritor. These lubricants are listed in ArvinMeritor Technical Bulletin TP-9539 available at www.arvinmeritor.com or by contacting Manitowoc CraneCARE.

Lube Amount - Capacity - 24.6 liters (51.9 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.

NOTE: Lube level close enough to the hole to be seen or touched is not sufficient. It must be level with the hole.

When checking lube level, also check and clean housing breathers.



NOTE: The illustration and instructions pertain to the Differentials and the Planetary Hubs and Wheel Bearings.

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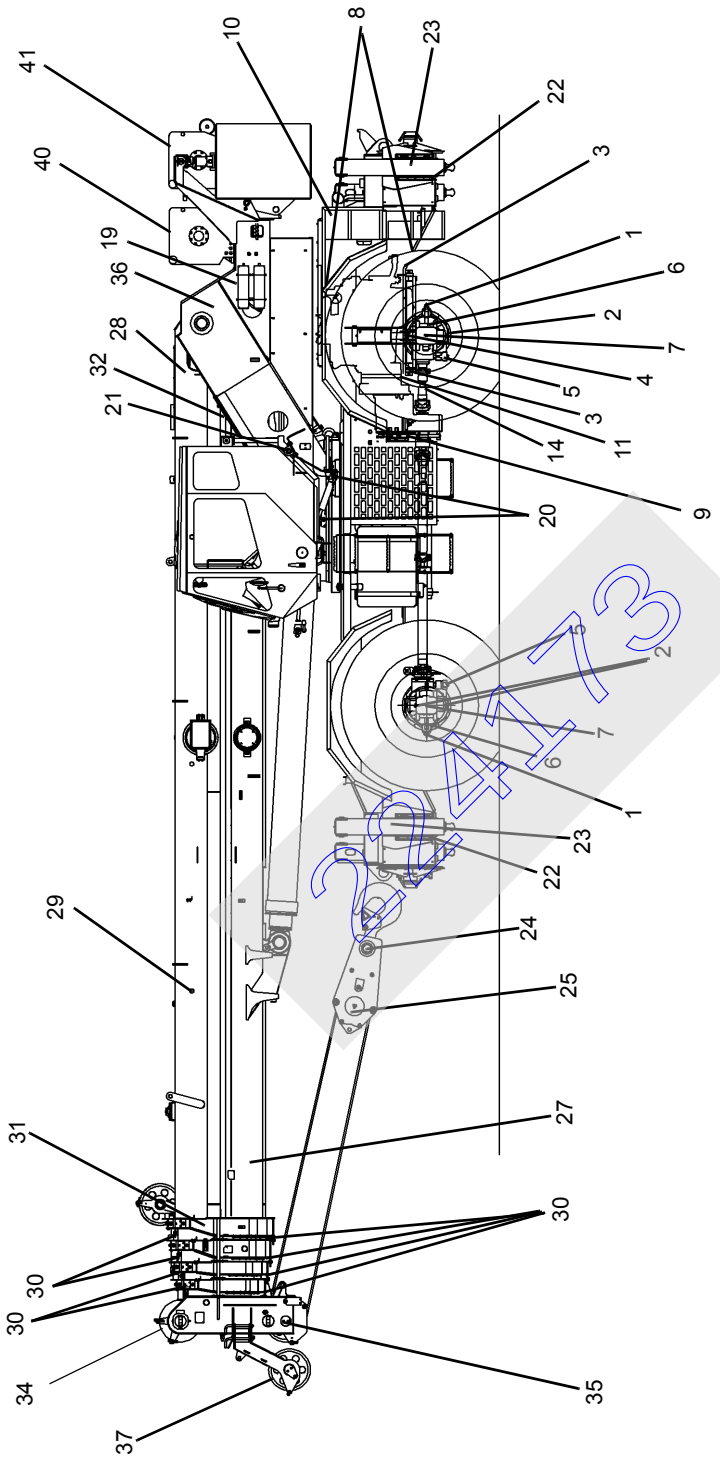

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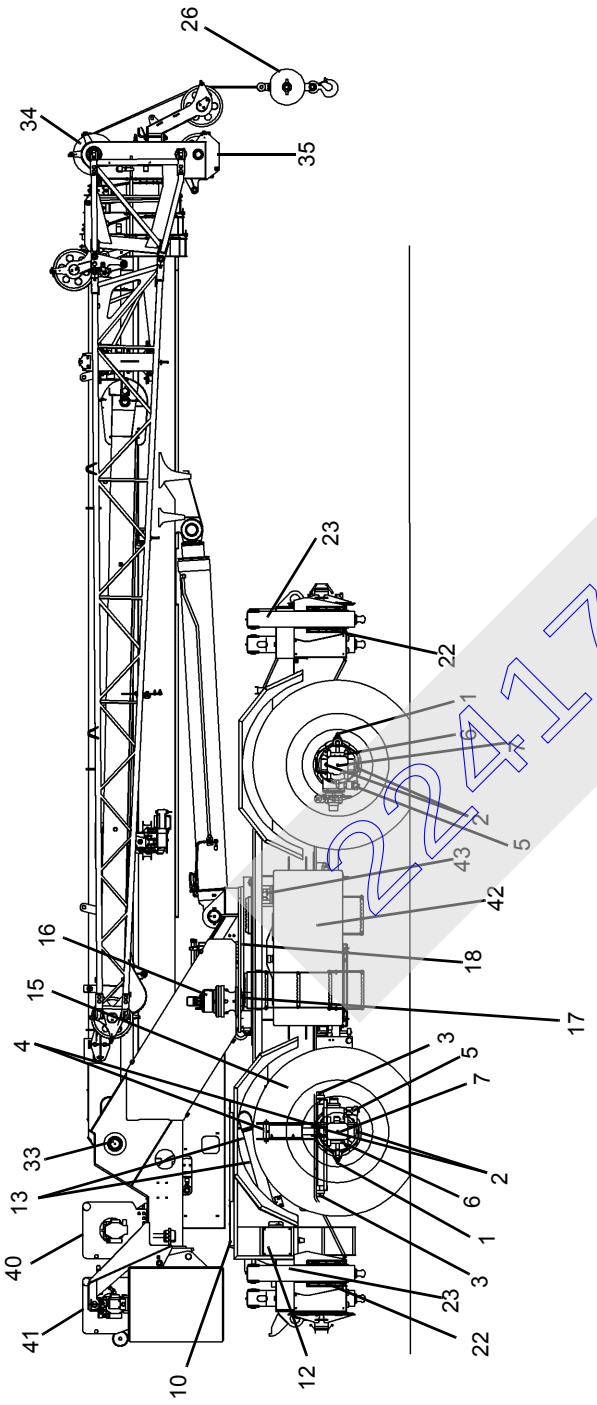
FIGURE 5-1

Item	Description
1	Steering Cylinder Pivot Pins
2	King Pins (Upper and Lower)
3	Fifth Wheel Pivots
4	Lockout Cylinder Pivot Pins
5	Tie Rod Pivot Pins
6	Differentials
7	Planetary Hubs and Wheel Bearings
8	Engine Crankcase (Cummins QSB-275) with Filter
9	Transmission and Torque Converter
10	Engine Cooling System (Cummins)
11	Coolant Strainer (Cab Heater)
12	Air Cleaner Filter
13	Fuel Filter
14	Driveline - Slip Joints
15	Fuel Strainer
16	Turntable Gearbox
17	Turntable Gear and Drive Pinion
18	Turntable Bearing
19	Hose Rollers - Turntable
20	Tilt Cylinder Pivot Pins
21	Pillow Block
22	Outrigger Beams

Item	Description
23	Jack Cylinder Support Tubes
24	Hook Block Swivel Bearing
25	Hook Block Sheaves - 80 Ton
26	Headache Ball
27	Telescope Cylinder Wear Pads
28	Internal Side and Bottom Wear Pads - Inner Sections
29	Boom Section Upper Wear Pads
30	Boom Section Lower and Upper Wear Pads
31	Extend Cable Sheave
32	Retract Cable Sheave
33	Boom Pivot Shaft
34	Upper Boom Nose Sheave
35	Lower Boom Nose Sheave
36	Hose Rollers - Boom
37	Auxiliary Boom Nose Sheave
38	Mast Sheave
39	Boom Extension Sheaves
40	HP30-18G Main Hoist
41	HP30-18G Auxiliary Hoist
42	Hydraulic Tank
43	Hydraulic Filter



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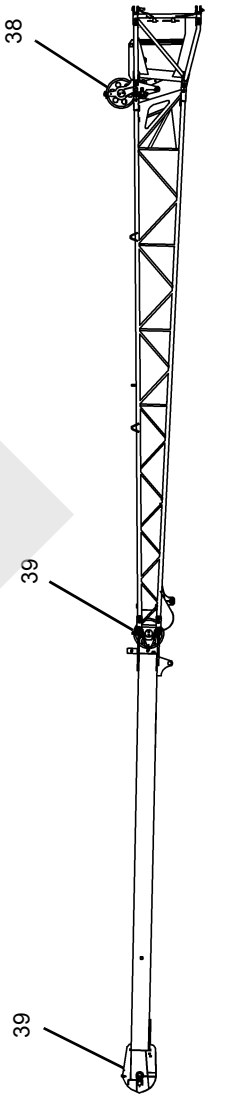

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FIGURE 5-1 continued

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.

CAUTION

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

Lube Amount - 5.2 liters (10.9 pints)

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

NOTE: Refer to illustration and instructions under "Differentials" for proper checking of lube levels.

8. Engine Crankcase (Cummins QSB-275)

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 - 16.1 liters (17 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 1000 rpm idle 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.

NOTE: Transmission filters are located on the outside left hand frame in the area of the hydraulic oil cooler.

To add fluid:

a. Fill to FULL mark on dipstick.

b. Run engine at 1000 rpm to prime torque converter and lines.

c. Check oil level with engine running at 1000 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 required converter temperature is reached and stabilized.

CAUTION

Do not operate the converter at stall condition for longer than 30 seconds at one time. Shift to neutral for 15 seconds and repeat the procedure until the desired temperature is reached. Excessive temperature, i.e., 120°C (250°F) maximum, will cause damage to transmission clutches, fluid, converter, and seals.

NOTE: Do not operate the machine in two wheel drive while the machine is up on outriggers. Serious transmission damage may result.

Lube Amount - Capacity - Torque converter, lines, and transmission as a system - Approximately 38 liters (40 quarts)

Application - Through fill pipe to FULL mark on dipstick.

10. Engine Cooling System (Cummins QSB-275)

Lube Type - AFC-50/50

Lube Interval - Check coolant level every 10 hours or daily; change filter every 500 hours.

Lube Amount - Capacity - 36 liters (38 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" H2O).

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. Fuel Strainer

Change strainer every 500 hours or 6 months

16. Turntable Gear Box

Lube Type - SSGL-5

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

Lube Interval - Check and fill every 50 hours. Drain and fill after first 250 hours and every 500 hours or 12 months thereafter.

Lube Amount - Capacity - 5.4 liters (5.7 quarts)

Application - Fill mark on dipstick.

17. Turntable Gear and Drive Pinion

Lube Type - EP-OGL

Lube Interval - 500 hours or 6 months

Lube Amount - Coat all teeth

Application -Spray on

18. 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.

19. Hose Rollers - Turntable

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

Lube Amount - Until grease extrudes

Application - 2 grease fittings

20. 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

21. Pillow Block

Lube Type - EP-MPG

Lube Interval - 500 hours or 3 months

Lube Amount - Until grease extrudes

Application - 2 grease fittings

22. Outrigger Beams

Lube Type - EP-OGL

Lube Interval - 500 hours or 6 months

Lube Amount - Spray lubricant on bottom of outrigger beams.

Application - Spray on

23. Jack Cylinder Support Tubes

Lube Type - EP-OGL

Lube Interval - 500 hours or 6 months

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

Application - Spray on

24. Hook Block Swivel Bearing

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

Lube Amount - Until grease extrudes

Application - 1 grease fitting

25. 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

(5 fittings total - 80 ton)

26. Headache Ball

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

Lube Amount -Until grease extrudes

Application - 1 grease fitting

27. 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.

28. Internal Side and Bottom Wear Pads (Inner Sections)

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: 14 places; with boom in extended position through access holes in base section.

29. Boom Section Upper Wear Pads

Lube Type - EP-MPG

Lube Interval - 50 hours or 1 week

Lube Amount - Until grease extrudes

Application - 8 grease fittings; with boom in extended position through access holes.

30. 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; 12 places; with boom in extended position.

31. 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.

32. 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.

33. 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

34. Upper Boom Nose Sheave

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

Lube Amount - Until grease extrudes

Application - 2 grease fittings - 1 per sheave

35. Lower Boom Nose Sheave

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

Lube Amount - Until grease extrudes

Application - 5 grease fittings - 1 per sheave

36. Hose Rollers - Boom

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

Lube Amount - Until grease extrudes

Application - 8 grease fittings

37. Auxiliary Boom Nose Sheave

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

Lube Amount - Until grease extrudes

Application - 1 grease fitting

38. Mast Sheave

Lube Type - EP-MPG

Lube Interval - 500 hours or 12 months

Lube Amount - Until grease extrudes

Application - 1 grease fitting

39. Boom Extension Sheaves

Lube Type - EP-MPG

Lube Interval - 250 hours or 3 months

Lube Amount - Until grease extrudes

Application - 2 grease fittings

40. Main Hoist

Lube Type - AGMA EP-4

Lube Interval - Every 1000 hours or 12 months

Lube Amount - Capacity - 14.7 liters (15.5 quarts)

Application - Fill until level with the check plug opening.

41. Auxiliary Hoist

Lube Type - AGMA EP-4

Lube Interval - Every 1000 hours or 12 months

Lube Amount - Capacity - 14.7 liters (15.5 quarts)

Application - Fill until level with the check plug opening.

42. 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 - 894 liters (236 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.

43. Hydraulic Filter

Change the filter when the indicator is red.

WIRE ROPE LUBRICATION

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

SECTION 6
MAINTENANCE CHECKLIST

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SECTION 6
MAINTENANCE CHECKLIST

GENERAL

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

INSTRUCTIONS

See Service Manual for specific maintenance and adjustment procedures.

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

INSPECTION SERVICE LOG

Reference	Items to be Inspected Daily	Interval	DAY OF INSPECTION																												
	December	D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1	Verify Outrigger Float Pads are properly installed & show no signs of structural damage	D																														
2	Verify Tire Condition has no excessive wear and Pressure is at the proper level	D																														
3	Visually check machine for any Hydraulic Components (including Hoses) with excessive wear, loose fittings, or leaks	D																														
4	Visually check for any loose or damaged Wiring	D																														
5	Verify Engine Coolant is at the proper level	D																														
6	Verify Crankcase and Transmission have the proper fluid levels	D																														
7	Verify Hoists are installed properly with no signs of damage, or leaks	D																														
8	Operator's Manual installed properly on machine.	D																														
9	Verify that the "Operator Aids" are working properly - Boom Angle Indicator, Load Moment Indicator (LMI), Antitwo-Block.	D																														
10	Gauges and Instruments are functional	D																														
11	Back-up Alarm operates properly when operating machine	D																														
12	Swing Brake operates properly	D																														
13	Verify Brakes and Air System (if equipped) are working properly																															
14	Lights and Horn are in good working order and not damaged	D																														
15	Verify Hydraulic Reservoir has the proper fluid level	D																														
16	Hydraulic Oil Filter (check back pressure)	D																														
17	Verify Boom and Attachments are properly installed with no signs of damage, or leaks	D																														
18	Verify Wire Rope has no damaged, frayed, or broken strands	D																														
19		D																														
20		D																														
	Inspector's Initials																															
22	0	D																														
23	0	D																														
24	0	D																														
25	0	D																														
	Inspector's Initials																															