GROVE by Manitowoc

SHUTTLELIFT by Manitowoc

OPERATOR MANUAL

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

YB4411

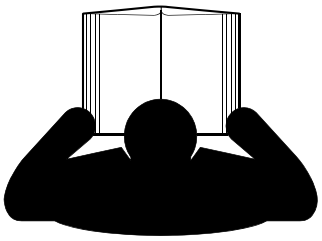
Crane Model Number

This Manual is divided into the following sections:

NOTICE

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

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



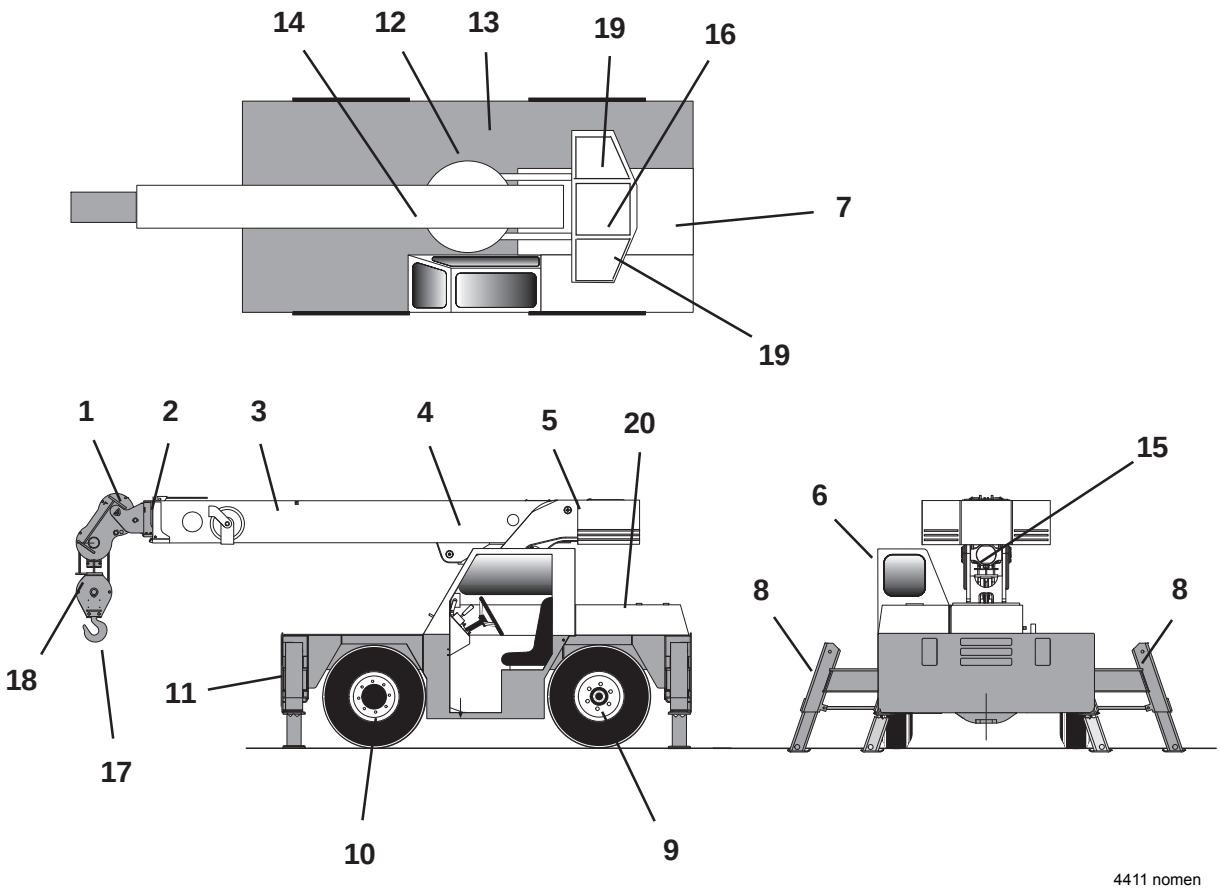
⚠DANGER

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

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

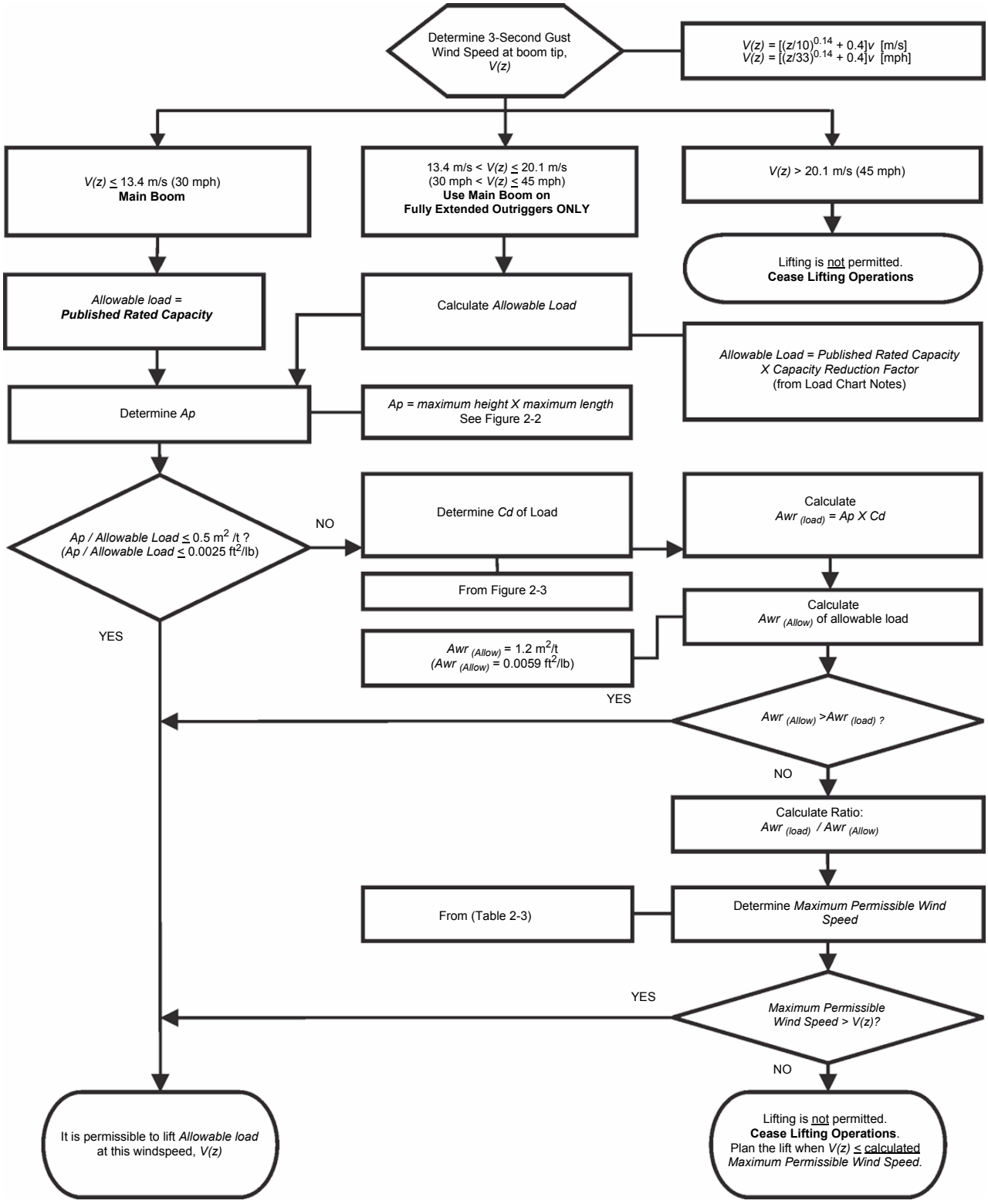
09-28-2017 CTRL #657-00

NOMENCLATURE



Item	Description	Item	Description
1	Inner Boom (3rd. Section)	11	Recess Mounted Auxiliary Winch Location (Optional)
2	Intermediate Boom (2nd Section)	12	Hydraulic Valve Location
3	Main Boom (1st. Section)	13	Fuel Tank Location
4	Crowd Cylinder Location	14	Swing Gearbox and Motor Location
5	Mast	15	Lift Cylinder
6	Operator's Compartment	16	Hoist Gearbox, Motor and Brake
7	Engine Compartment	17	Drop Block
8	Outrigger	18	Double-Blocking Cutout Switch
9	Steering Axle	19	Counterweight
10	Drive/Steer Axle	20	Hydraulic Tank

Simplified Method to Determine Maximum Permissible Wind Speed



V(z) = 3 second gust wind speed at boom tip, m/s (mph)
Ap = Projected Wind Area of Load, m^2 (ft^2)

$Awr_{(load)}$ = Actual Wind Resistance Area for the Load, m^2(ft)
$Awr_{(Allow)}$ = Allowable Wind Resistance Area of the Load, m^2 (ft2
Cd = air drag coefficient of load

FIGURE 2-1

Lifting Limits at wind speed V(z) **> 30 mph and ≤ 45 mph** at this configuration:

- Maximum load 20,160 lb
- Maximum wind resistance area of load 119 ft^2

Example, wind speeds greater than 13.4 m/s is NOT permissible to lift a load greater than 20,160 lb, even if the wind resistance area of the load is less than 119 ft^2.

Refer to the above crane configuration for the following load conditions:

Load example 2.1:

With known Wind Drag Coefficient of the load ***Cd***,

- load to be lifted of 19,500 lb,
- Projected Wind Area ***Ap*** = 70 ft^2,
- Wind Drag Coefficient ***Cd*** = 1.5

then the wind resistance area of load can be estimated as

$Awr_{(load)}$ = ***Ap*** x ***Cd*** = 70 x 1.5 = 105 ft^2

Refer to the above ***Lifting Limits at wind speed V(z) > 30 mph and ≤ 45 mph***. Comparing the load and wind resistant area to the allowable:

- Is the load to be lifted less than allowable load?
  19,500 lb ≤ 20,160 lb YES
- Is $Awr_{(load)}$ less than $Awr_{(allow)}$?
  105 ft^2 ≤ 119 ft^2 YES

Conclusion: This load is permissible to lift in wind speed up to 45 mph.

Load example 2.2:

With unknown Wind Drag Coefficient of the load ***Cd***,

- Load to be lifted of 18,000 lb,
- Projected Wind Area ***Ap*** = 45 ft^2,
- Wind Drag Coefficient ***Cd*** = unknown

NOTE: If exact Wind Drag Coefficient is not known, it shall be assumed as 2.4.

the wind resistance area of load can be estimated as

$Awr_{(load)}$ = ***Ap*** x ***Cd*** = 45 x 2.4 = 108 ft^2

Refer to the above ***Lifting Limits at wind speed V(z) > 30 mph and ≤ 45 mph***. Comparing the load and wind resistant area to the allowable:

- Is the load to be lifted less than allowable load?
  18,000 lb ≤ 20,160 lb YES
- Is $Awr_{(load)}$ less than $Awr_{(allow)}$?
  108 ft^2 ≤ 119 ft^2 YES

Conclusion: This load is permissible to lift in wind speed up to 45 mph.

Load example 2.3a:

With large wind resistance area of the load $Awr_{(load)}$,

- Load to be lifted of 22,000 lb,
- Projected Wind Area ***Ap*** = 180 ft^2,
- Wind Drag Coefficient ***Cd*** = 1.2

the wind resistance area of load can be estimated as:

$Awr_{(load)}$ = ***Ap*** x ***Cd*** = 180 x 1.2 = 216 ft^2

Refer to the above ***Lifting Limits at wind speed V(z) > 30 mph and ≤ 45 mph***. Comparing the load to the allowable:

- Is the load to be lifted less than allowable load?
  22,000 lb ≤ 20,160 lb NO

Conclusion: This load is NOT permissible to lift in wind speed up to 45 mph.

Refer to the above ***Lifting Limits at wind speed V(z) up to 30 mph***. Comparing the load to the allowable:

Is the load to be lifted less than allowable load?
22,000 lb ≤ 25,200 lb . . . . . YES

The permissible wind speed for this load is 30 mph, depending on the wind resistance area of the load.

- Is $Awr_{(load)}$ less than $Awr_{(allow)}$,?
  216 ft^2 ≤ 149 ft^2 . . . . . NO

Conclusion: This load is NOT permissible to lift in wind speed at 30 mph, but permitted to lift at a reduced wind speed calculated as follows:

Ratio $\frac{Awr_{(load)}}{Awr_{(allow)}} = \frac{216}{149}$ = 1.45

From Table 2-7, the maximum permissible wind speed at ratio of 1.45 (rounded to next higher table value of 1.6) is 23.7 mph.

Conclusion: This load is permissible to lift in wind speed up to 23.7 mph only.

Load example 2.3b:

With large wind resistance area of the load $Awr_{(load)}$,

- Load to be lifted of 12,000 lb,
- Projected Wind Area ***Ap*** = 125 ft^2,
- Wind Drag Coefficient ***Cd*** = 1.3

the wind resistance area of load can be estimated as:

$Awr_{(load)}$ = ***Ap*** x ***Cd*** = 125 x 1.3 = 162 ft^2

Tires

WARNING

Possible equipment damage and/or personal injury!

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

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

Ensure all lug nuts are properly torqued.

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

HOIST ROPE

Synthetic Hoist Rope

For detailed information concerning synthetic hoist rope, refer to K100™ Synthetic Crane Hoist Line Manual P/N 9828100734 available by contacting Manitowoc Crane Care.

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

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

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

NOTE: Example; if usage of a wire rope has cut grooves with sharp edges in a wear pad, they need to be addressed before the synthetic hoist rope is used in that same position.

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

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

Wire Rope

Always make daily inspections of the rope, keeping in mind that all wire rope will eventually deteriorate to a point where it is no longer usable. Refuse to work with worn or damaged wire rope. Rope shall be taken out of service when any of the following conditions exist:

- For rotation-resistant running ropes: more than two (2) broken wires in a length of rope equal to six (6) times the rope diameter, or more than four (4) broken wires in a length of rope equal to thirty (30) times the rope diameter.
- For running ropes other than rotation resistant: six (6) broken wires in one rope lay or three (3) broken wires in one strand.
- One valley break where the wire fractures between strands in a running rope is cause for removal.
- Abrasion of the rope resulting in a 5% reduction in the original wire diameter.
- Any kinking, bird caging, crushing, corrosion, or other damage resulting in distortion of the rope structure.
- Rope that has been in contact with a live power line or has been used as a ground in an electric circuit (eg. welding) may have wires that are fused or annealed and must be removed from service.
- In standing ropes, more than three (3) breaks in one rope lay in sections beyond the end connection or more than two (2) broken wires at an end connection.
- Core deterioration, usually observed as a rapid reduction in rope diameter, is cause for immediate removal of the rope.

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

- Wire ropes wear out. The strength of a rope begins to decrease when the rope is put to use and continues to decrease with each use. Rope will fail if worn-out, overloaded, misused, damaged or improperly maintained.
- The nominal strength, sometimes called catalog strength, of a wire rope applies only to a new, unused rope.
- The nominal strength of a rope should be considered the straight line pull which will actually break a new unused rope. The nominal strength of a rope should never be used as its working load.
- Each type of fitting attached to a rope has a specific efficiency rating which can reduce the working load of the rope assembly or rope system.

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

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

Never store flammable materials on the crane.

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

TEMPERATURE EFFECTS ON HOOK BLOCKS

The following information applies to Gunnebo Johnston crane hook blocks:

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

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

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

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

75% of the WLL must not be exceeded, when lifting in temperatures below -40°C (-40°F).

TEMPERATURE EFFECTS ON HYDRAULIC CYLINDERS

Hydraulic oil expands when heated and contracts when cooled. This is a natural phenomena that happens to all liquids. The coefficient of expansion for API Group 1 hydraulic oil is approximately 0.00077 cubic centimeters per cubic centimeter of volume for 1°C of temperature change (0.00043 cubic inches per cubic inch of volume for 1°F of temperature change). **Thermal contraction will allow a cylinder to retract as the hydraulic fluid which is trapped in the cylinder cools.**

The change in the length of a cylinder is proportional to the extended length of the cylinder and to the change in temperature of the oil in the cylinder. For example, a cylinder extended 7.6 m (25 ft) in which the oil cools 15.5°C (60°F) would retract approximately 196 mm (7 3/4 in) [see Table 2-9 and Table 2-8]. The rate at which the oil cools depends on many factors and will be more noticeable with a larger difference in oil temperature verses the ambient temperature.

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

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

This situation will also occur in reverse. If a crane is set up in the morning with cool oil and the daytime ambient temperature heats the oil, the cylinders will extend in similar proportions.

Table 2-8 and Table 2-9 have been prepared to assist you in determining the approximate amount of retraction/extension that may be expected from a hydraulic cylinder as a result of change in the temperature of the hydraulic oil inside the cylinder. The chart is for dry rod cylinders. If the cylinder rod is filled with hydraulic oil, the contraction rate is somewhat greater.

NOTE: Operators and service personnel must be aware that load movement, as a result of this phenomena, can be easily mistaken as leaking cylinder seals or faulty holding valves. If leaking seals or faulty holding valves are suspected to be the problem, refer to Service Bulletin dealing with testing telescope cylinders. (*Service Bulletin 98-036* applies to TMS700 and *Service Bulletin G06-005A* applies to RT890 and RT9130.

SECTION 3
OPERATING CONTROLS AND PROCEDURES

SECTION CONTENTS

CONTROLS, SWITCHES, GAUGES

Cab Controls

Swing Control

Refer to Figure 3-1 for the following procedure.

The swing control operates the boom/mast rotation function. The boom and mast will rotate continuously through a full 360° circle.

Telescope Control

Refer to Figure 3-1 for the following procedure.

The telescope control extends and retracts the boom sections.

Hoist Control

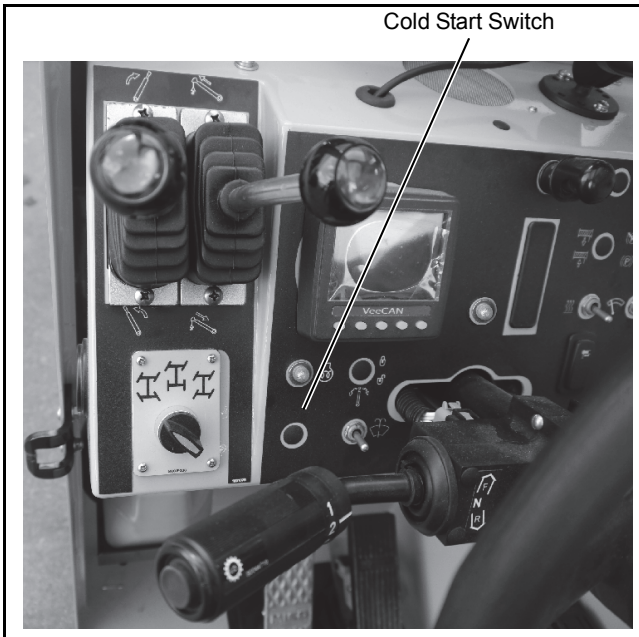
Refer to Figure 3-1 for the following procedure.

The hoist control raises and lowers the drop block or hook and ball.

Boom Control

Refer to Figure 3-1 for the following procedure.

The boom control raises or lowers the boom assembly.



9087-3a **FIGURE 3-12**

Outrigger Controls

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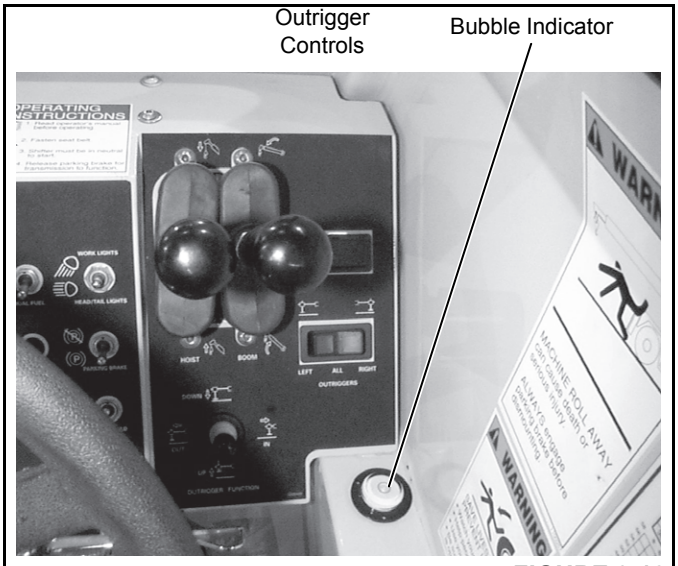
DO NOT allow any persons to stand near extending or lowering outriggers. Foot crushing could occur.

NOTE: For maximum lift and stability, fully extend and lower the outriggers. Be sure the crane is level before lifting a load. The bubble indicator (Figure 3-13) located below the outrigger controls is to be used to determine when the crane is level. The bubble must be in the center of the indicator circle. Use the outriggers to level the crane. If this is not possible, reposition the crane until the bubble is centered.



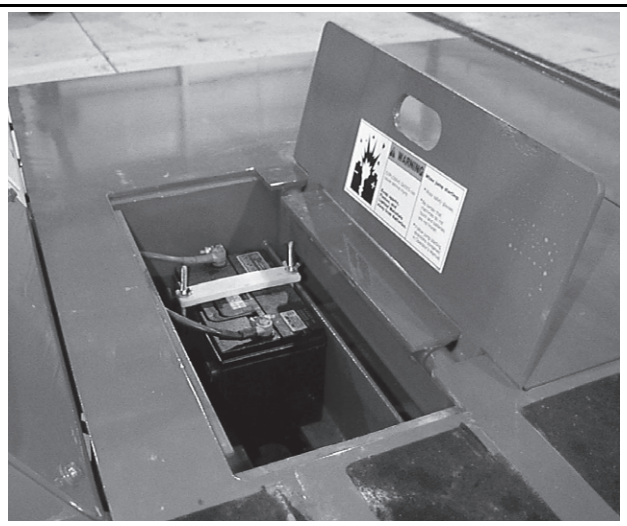
p0263 **FIGURE 3-13**

3

Jump Starting the Engine

Follow the recommended jump starting procedure below when using booster batteries to start the engine.

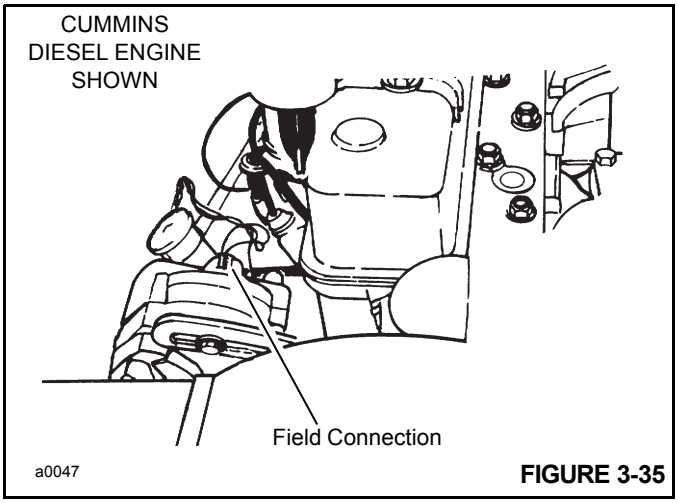
1. Wear eye protection.
2. Engage the parking brake.
3. Place the travel select lever in the Neutral (N) position.
4. Stop all electrical loads (lights, heaters, etc.).
5. Lift the battery access cover (Figure 3-34). If the battery has removable fill caps, remove the fill caps being careful not to contaminate the battery fluid. Removing the battery caps reduces the danger of explosion of the battery gases.



p0299 **FIGURE 3-34**

NOTE: **NEVER** jump start the engine directly to the starter or starter solenoid. Serious injury could result from the crane moving forward or back and running over the person performing the jump starting procedure.

6. Disconnect the FIELD connection from the alternator (Figure 3-35). The connection is generally marked with an “F”.



a0047 **FIGURE 3-35**

NOTE: If a battery charger is used, disconnect the field connection from the alternator before connecting the battery charger to the battery. Do not install the field connection until the battery charger is removed.

7. If a booster battery is used, it must be a 12 Volt battery. If a vehicle is used, it must have a negative ground electrical system.
8. Connect one end of the positive (+) jumper cable (usually red) to the positive (+) post on the discharged battery. See Figure 3-36.
9. Connect the other end of the positive cable to the positive (+) post on the booster battery.
10. Connect one end of the negative (–) jumper cable (usually black) to the negative (–) post on the booster battery.

Boom Lift Operation

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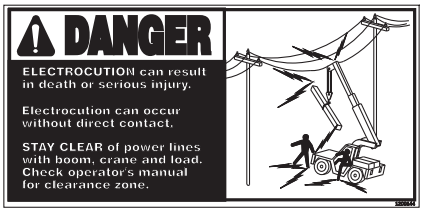
Know the capacity of the crane. The operator must be familiar with the crane's capacity chart before lifting a load. See how to read the capacity chart in Section 4. A falling load or machine tip-over can cause injury or death.



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NOTE: Look for overhead obstructions before raising the boom. Possible damage or electrocution could occur if the boom comes in contact with over head power lines.

NOTE: Always operate the hoist control to unwind the wire rope when raising the boom. Do not let the drop block touch the boom head. An automatic cutout device is installed on this crane to inhibit the drop block from being pulled into the boom head. When the drop block touches the anti-double blocking bracket (Figure 3-48) hanging from the boom head, a switch is activated and the hydraulic flow to extend the lift cylinder is stopped. A horn will sound, warning the operator that the block has touched the bracket. The operator must then lower the drop block to stop the horn and allow for the raising of the boom.

The above information also pertains when a boom extension is attached to the boom.

To Raise the Boom

Press the accelerator pedal to increase the engine speed to maximum rpm. Slowly pull back on the boom control lever (Figure 3-51) until the desired raising speed is obtained. The further the control is pulled back the faster the boom will raise.

NOTE: If the crane is equipped with an RCL system, **DO NOT** fully raise the boom and dead end the cylinder. If the cylinder dead ends, the RCL will sense an overload situation and shutdown the hoist operation. The bypass switch on the RCL must then be actuated in order to resume operation.

To Stop Boom Movement

Slowly move the control lever to the neutral position and decrease the engine speed to idle.

To Lower the Boom

Press the accelerator pedal to increase the engine speed to maximum rpm. Slowly push forward on the boom control lever (Figure 3-51) until the desired lowering speed is obtained. The further the control is pushed forward the faster the boom will lower.

LOAD RATING and RANGE DIAGRAM

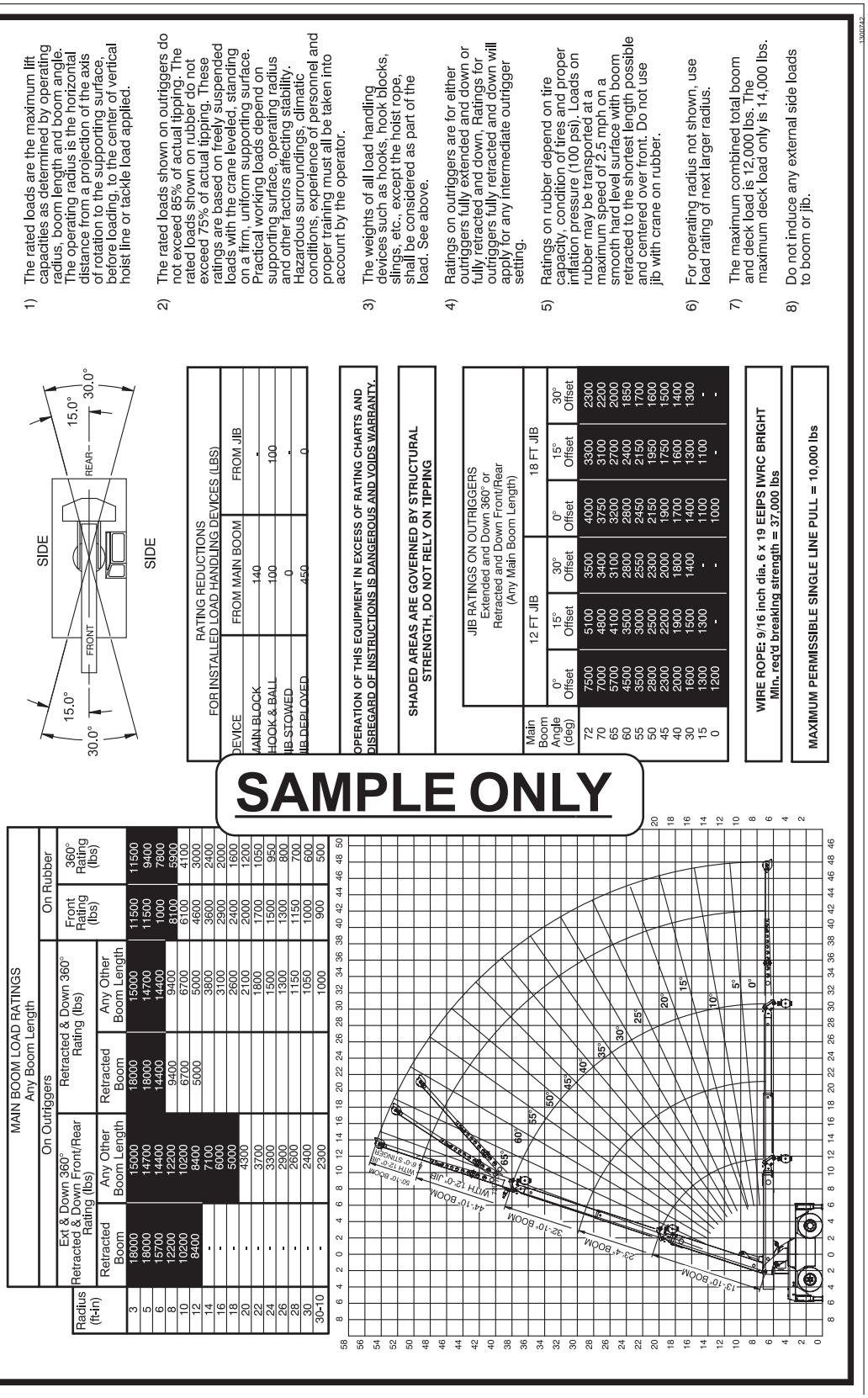

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FIGURE 4-3

WIRE ROPE WEDGE SOCKET

1. Inspect the wedge and socket. Remove any rough edges and burrs.
2. The end of the wire rope should be seized using soft, or annealed wire or strand. If the end of the rope is welded, the welded end should be cut off. Do not weld on size 6X37 rope. This will allow the distortion of the rope strands, caused by the bend around the wedge, to adjust themselves at the end of the line. Refer to SECTION 1 - INTRODUCTION in the Service Manual for wire rope procedures.
3. Make sure the live-end (Figure 5-10) of the rope is directly in line with the ears of the socket and the direction of pull to which the rope will be subjected. If the rope is loaded into the socket incorrectly, under a load the rope will bend as it leaves the socket, and the edge of the socket will wear into the rope causing damage to the rope and eventual failure.

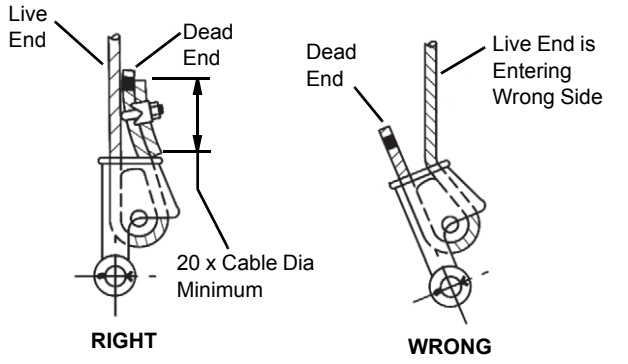


FIGURE 5-10

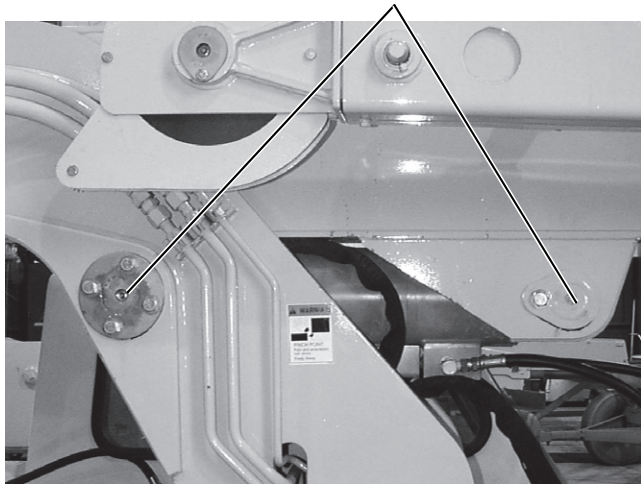
4. Insert the end of the wire rope into the socket, form a loop in the rope, and route the rope back through the socket allowing the dead-end (Figure 5-10) to protrude from the socket. Ensure the dead-end of the rope is of sufficient length to apply end treatment to the dead-end after the wedge has been seated.
5. Insert the wedge into the loop and pull the live-end of the rope until the wedge and rope are snug inside the socket. It is recommended that the wedge be seated inside the socket to properly secure the wire rope by using the crane's hoist to first apply a light load to the live-end.
6. After final pin connections are made, increase the loads gradually until the wedge is properly seated.
7. The wire rope and wedge must be properly secured inside the socket before placing the crane into lifting service. It is the wedge that secures the wire rope inside the socket. The dead-end treatment is used to restrain the wedge from becoming dislodged from the socket should the rope suddenly become unloaded due to the headache ball or hook block striking the ground, etc.

Sketches A through F (Figure 5-11) illustrate various ANSI approved methods for treating the dead-ends of wire ropes which exit a wedge socket assembly. While use of the loop-back method is acceptable, care must be exercised to avoid the loop becoming entangled with tree branches and other components during crane transport and with the anti-two block system and other components during use of the crane.

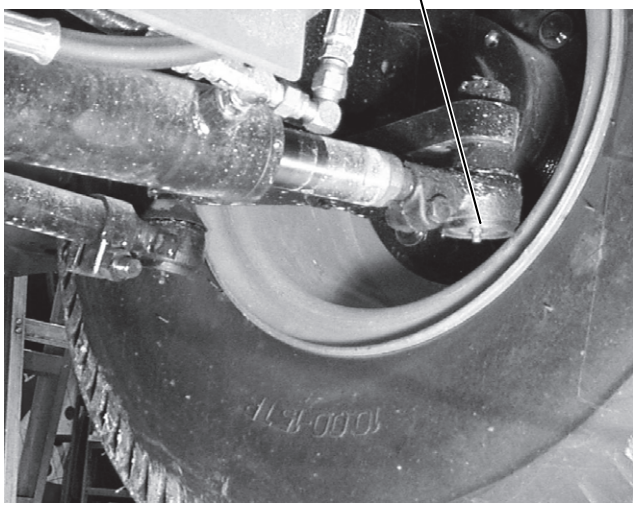
Of the methods shown below, Manitowoc prefers that method A or F be used, i.e., clipping a short piece of wire rope to the dead-end or using a commercially available specialty clip or wedge. Typically, it is recommended that the tail length of the dead-end should be a minimum of 6 rope diameters but 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 table titled Wire Rope Clip Torque Values (Table 5-1).

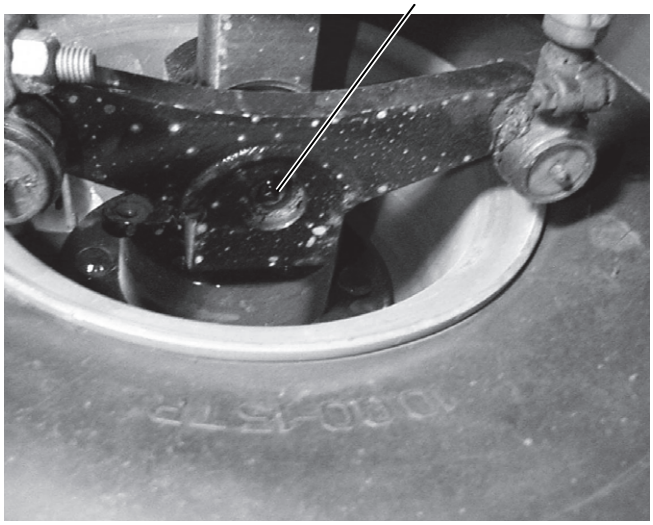
Other sources for information with which crane users should be familiar and follow is provided by the American Society of Mechanical Engineers, American National Standard, ASME B30.5, latest revised. ASME (formerly ANSI) B30.5 applies to cableways, cranes, derricks, hoists, hooks, jacks, and slings.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



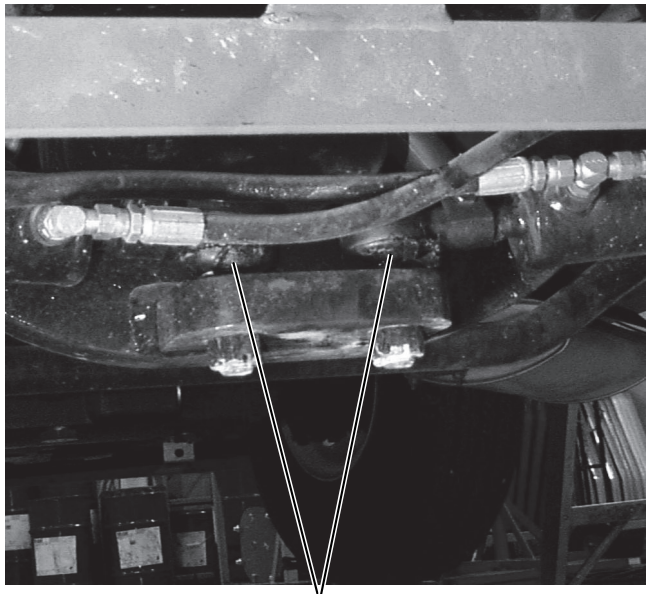
p0307 **FIGURE 6-6**



p0309 **FIGURE 6-8**



p0308 **FIGURE 6-7**



p0310 **FIGURE 6-9**

6

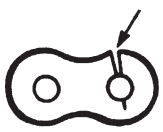
250 HOURS OF OPERATION

Inspect the Boom Chains

1. Place the booms in the fully lowered position.
2. Extend the booms to expose all of the side access holes.
3. Visually inspect the chains through the access holes. A light may be needed to see most of the chain. Look for any damage to the chains.

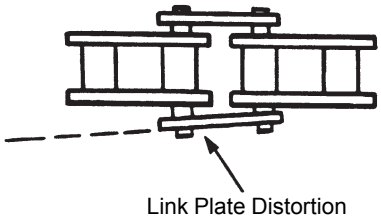
NOTE: If chain damage is found during the inspection, **DO NOT USE THE CRANE**. Cease operation and replace the damaged chain before placing the crane back in service. A damaged chain could break, causing boom to not function properly. Personal injury or property damage could result.

4. Damage could be any of the following:
   - **a.** A crack or complete break of a link plate, particularly an outer plate on either side of the chain (Figure 6-24).



a0158 **FIGURE 6-24**

   - **b.** Distortion or spreading of an outside link plate, evidenced by increasing clearance between overlapping link plates, or between the inner link plates and the roller. This indicates a hidden break in a pin (Figure 6-25).

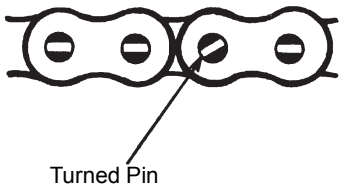


a0159 **FIGURE 6-25**

   - **c.** Looseness between the riveted ends of a chain pin and the outer link plates. If a pin is broken, the normal rigid riveting may loosen, leaving a visible clearance around the exposed ends of the pin (Figure 6-26).

a0160 **FIGURE 6-26**

   - **d.** The pin head rivets should be examined to determine if the V-flats are still in the correct alignment. Chain with rotated or displaced heads or abnormal protrusion (Figure 6-27) should be replaced immediately.



a0161 **FIGURE 6-27**

Inspect Boom Chain Tension

The boom chains should be checked for the correct tension to ensure proper extension and retraction of the boom sections.

To check for correct tension:

1. Visually check the boom chain through the side access hole in the boom with the booms completely retracted. There should be no slack in the chain. If there is slack in the boom chain, refer to Section 6 and adjust the boom chain tension
2. Remove the top boom cover and visually inspect that 2nd and 3rd boom sections have bottomed out against each other and the 1st boom section. If the booms sections are not bottomed out, adjust the boom chains as described in Section 6.

Check Boom Hoist Lubricant Level (Model PD12C)

NOTE: Two different model boom hoists have been used on the Model 4411. Before performing any maintenance on the hoist gearbox, verify the type of hoist that is installed. Model 1250W hoist use a plug in the center of the drum to check the lubricant level (Figure 6-46). Model PD12C hoist use a sight gauge to check lubricant level (Figure 6-48).

1. Lower the boom to its lowest position.
2. Engage the parking brake and shutoff the engine.
3. Clean the lubricant level sight gauge (Figure 6-48).
4. Using a mirror, and light if needed, check the lubricant level in the sight gauge. Lubricant must be visible in the sight gauge.
5. If lubricant must be added, rotate the hoist drum until the drain/fill plug is visible in the access hole aligned with the level sight gauge. Clean around the drain/fill and then remove the plug. Add recommended lubricant through the plug hole until it exits the fill plug hole. Install the plug.

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WARNING

Failure to use the proper type and viscosity of planetary gear oil may contribute to intermittent brake clutch slippage which could result in property damage, severe personal injury or death.

Some gear lubricants contain large amounts of EP (extreme pressure) and anti-friction additives which may contribute to brake clutch slippage and damage to brake friction discs and seals.

Oil viscosity with regard to ambient temperature is also critical to reliable brake clutch operation. Tests have indicated that excessively heavy or thick gear oil may contribute to intermittent brake clutch slippage.

Make certain that the gear oil viscosity in the hoist is correct for prevailing ambient temperature.

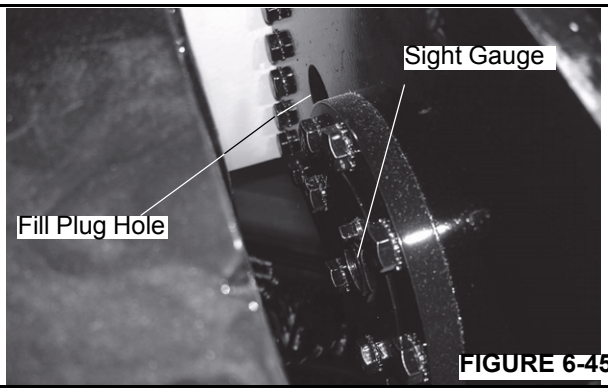

FIGURE 6-45

6

MISCELLANEOUS MAINTENANCE

Batteries/Charging System

NOTE: Lead-acid batteries produce flammable and explosive gases. To avoid personal injury, when checking, testing or charging batteries:

- **DO NOT** use smoking materials near batteries.
- Keep arcs, sparks and flames away from batteries.
- Provide ventilation and wear safety glasses.
- Never check battery charge by placing a metal object across the posts. The sparks could explode battery gases and cause injury or death. Use a voltmeter or hydrometer.

Checking the Charging System

Check the voltmeter reading on the instrument panel. Normal voltmeter readings are as follows:

Normal Operating Ranges

Engine above idle - 14 to 16 volts
Engine stopped - 10 to 14 volts

A reading of less than 10 volts with the engine at low idle indicates a low battery charge.

A reading of less than 14 volts with the engine speed above low idle indicates a problem in the charging system. The system should be checked out by a qualified service technician.

When the voltmeter on the instrument panel indicates a low battery charge, attach a battery charger and increase the battery charge.

Charging the Battery

Under normal conditions, the engine's alternator will have no problem keeping a charge on the battery. The only condition in which the battery may cause a problem is when it has been completely discharged for a long period of time. Under this condition the alternator may not be able to recharge the battery and a battery charger will be required for charging the battery.

Before using a battery charger, an attempt can be made to recharge the battery using the engine alternator by first jump starting the crane (Refer to Jump Starting, in Section 3) and letting the engine run.

DO NOT charge a frozen battery; it may explode and cause injury. Let the battery warm up before attaching a charger.

Charging rates between 3 to 50 amperes are satisfactory if no excessive gassing or spewing of electrolyte occurs or the battery does not feel excessively warm (over 52°C [125°F]). If spewing or gasing occurs or temperatures exceed 52°C (125°F), the charging rate must be reduced or temporarily stopped to permit cooling.

Replacing The Battery

NOTE: The fluid in an electric storage battery contains sulfuric acid, which is a **POISON** and can cause **SEVERE CHEMICAL BURNS**. Avoid all contact of fluid with eyes, skin or clothing. Use proper protective gear when handling a battery. **DO NOT** tip any battery beyond a 45° angle in any direction. If fluid contact does occur, perform the following First Aid suggestions.

Battery Electrolyte First Aid

- **External Contact** - Flush with water.
- **Eyes** - Flush with water for at least 15 minutes and get immediate medical attention.
- **Internal** - Drink large quantities of water. Follow with Milk of Magnesia, beaten egg or vegetable oil. Get immediate medical attention.

NOTE: In case of internal contact, **DO NOT** give fluids that would induce vomiting.

Remove the battery very carefully to avoid spillage of battery fluid. Properly dispose of the battery.

Fuel System

6