

**Waupaca Foundry, Inc.  
Mobile Crane Operation**

**1.0 Purpose and Scope**

This compliance work instruction applies to all Waupaca Foundry, Inc. employees, contractors and subcontractors that are involved in mobile crane operations on Waupaca Foundry, Inc. property. This compliance work instruction applies to any mobile crane used by Waupaca Foundry, Inc., and its contractors and subcontractors, including Waupaca Foundry, Inc. owned and rented cranes, and rental company operated cranes.

**2.0 Responsibility**

**2.1 Waupaca Foundry, Inc. Supervisors**

The “Crane Supervisor” is the competent person; responsible for ensuring a safe lift takes place. They have the authority to stop the lift if there is a risk to safety. The “Crane Supervisor” is not necessarily the direct supervisor of the crane operator; instead they are the person with overall responsibility for the project requiring crane operation.

2.1.1 Waupaca Foundry, Inc. Supervisors are responsible for employees involved with mobile crane operation and as competent person shall ensure that:

2.1.1.1 Keys to crane safety override controls, e.g., load moment indicator (LMI) are not used without the consent and agreement of the supervisor and operator. This is to ensure that any decision by the crane operator to override controls has been discussed, is understood, and agreed upon with the supervisor.

2.1.1.2 Employees are properly trained in accordance with this Compliance Work Instruction and national and local regulatory requirements.

2.1.1.3 the operator is physically and mentally capable of operating in a safe manner.

2.1.1.4 All safe mobile crane operating, inspection, and maintenance procedures are followed.

2.1.1.5 The correct load weight, boom length, and load radius are determined and the operator informed prior to the lift being made.

2.1.1.6 Critical lifts are identified and handled in accordance with section 6.0 of this work instruction.

2.1.1.7 The signal person is identified and capable of directing the movements of the crane and The load safely. Only trained crane operators, or those persons trained in hand and radio signals may be used as the signal person.

2.1.1.8 Site hazards, such as underground utilities, overhead power lines, etc. are identified and proper precautions are put in place, e.g. barricades, warning signs, wire watchers, etc.

2.1.1.9 Any crane support requirements are identified and in place, such as matting.

2.1.1.10 All nonessential personnel are clear of the hoisting activities.

2.1.1.11 All repairs to mobile cranes are done by qualified personnel.

2.1.1.12 All safety precautions for the job are taken, Safe Plan of Actions are developed and followed, and job site-specific rules are followed.

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2.2. Mobile Crane Operator

2.2.1 The crane operators are responsible for operating the lift safely and are responsible for the following rules, practices, and operations and shall assure that:

- 2.2.1.1 They are physically and mentally capable of operating in a safe manner.
- 2.2.1.2 They are trained and qualified as operators.
- 2.2.1.3 They have read and understood the operation manual for the crane being operated.
- 2.2.1.4 They are familiar with the function and operation of all controls and operator aids.
- 2.2.1.5 The crane is assembled, moved, and set up properly.
- 2.2.1.6 All safety equipment is operational.
- 2.2.1.7 They wear the crane seat belt if supplied.
- 2.2.1.8 Accessible areas within the swing radius of the superstructure of the crane are barricaded to prevent personnel from being struck or crushed.
- 2.2.1.9 They do not place toolboxes, oil cans, choker racks, water coolers, or similar objects or allow personnel in the barricaded radius of the swing of the counterweight, where a person could possibly be crushed while the crane is operating.
- 2.2.1.10 Truck and crawler-type cranes will not be moved unless a designated signal-person is in full view of the operator giving signals.
- 2.2.1.11 Are aware of site hazards and that proper precautions are followed.
- 2.2.1.12 They do not engage in any activities that will distract their attention while operating the crane. Cranes in use of Waupaca Foundry, Inc. property shall be equipped and use signage on the crane that clearly states, "Caution: Do not distract the crane operator".
- 2.2.1.13 Daily inspections and Load Chart calculation worksheets are completed, documented, and signed before each shift.
- 2.2.1.14 All other inspections and required maintenance is properly completed.
- 2.2.1.15 Notify managers and supervisors of all defects, repairs, or required maintenance for the crane.
- 2.2.1.16 Know the sequence of tasks involved in each lift.
- 2.2.1.17 Know the *total lifted load weight*, boom configuration and angle, lift radius, selects proper number of parts of line for each lift and verifies with the crane load chart that the lift is within capacity.
- 2.2.1.18 The mobile crane operator shall always make the final "go" or "no-go" decision for every lift.

**3.0 Definitions**

3.1 **Anti-Two Block (A2B).**

A device, which is automatically activated when the crane hook/block approaches the boom or jib tip and disengages all crane functions whose movement could cause the crane hook/block to impact with the boom or jib.

3.2 **Competent Person/Supervisor.**

A person who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authority to take prompt corrective measures to eliminate them.

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3.3 **Crane Safety Over Ride Keys:** A key that is used to override the A2B or LMI safety functions.

3.4 **Lift Plan/Load Chart Calculation.**

The documented plan that is made prior to a lift to assure the lift at maximum radius and boom length does not exceed the capacity of the crane for the specified conditions during the lift. The plan should include but is not limited to the following information: total lifted load weight (see definition below), required rigging equipment, rigging equipment weight, maximum lift radius, lift height, boom clearance, crane configuration details, e.g. boom length required, on outriggers/rubber, tracks extended/retracted, weight of load blocks, weight of cable and lifting quadrant (over the front, back, or side), and the capacity of the crane for the set up.

3.5 **Lift Radius.**

The horizontal distance between the center of rotation of the crane and the center of gravity of the load being lifted. See the manufacturers' instructions.

3.6 **Load Chart.**

A chart of the crane's capacity for various operational modes as listed in the capacity chart notes. The load chart shall be maintained in the crane cab. (The load chart should be specific to the crane and contain the crane's serial number.)

3.7 **Load Chart Notes.**

The detailed instructions and limitations for use of the capacity chart given by the crane manufacturer for each use of crane configuration e.g. over the side, on outriggers, on rubber, tracks retracted, tracks extended, counterweight size, hoisting while traveling, etc.

3.8 **Load Movement Indicator (LMI).**

Refers to an electronic sensing system designed to alert the operator that conditions are approaching or have reached the capacity of the crane. An LMI is not a weight scale. The LMI generally provides the operator with boom angle, load radius, and a constant display of the crane's relative load. When maximum rated load conditions are sensed, the LMI gives a visual and audible warning as well as deactivated the control levers that extend the boom, lower the boom or raise the main or auxiliary hoist lines. In an overload condition, the LMI does not deactivate the controls that will make the crane safe, it will allow the load to be lowered, the boom to be pulled in or raised to decrease the radius.

3.9 **LMI Calibration.**

Checks involve radius indicator accuracy, boom length indicator accuracy, and weight accuracy of the LMI.

3.10 **LMI Mode Configuration.**

Match the crane configuration with the LMI operating mode, e.g. if the crane is on outriggers, then the LMI should be set for the on outrigger operation chart, etc. The crane configuration is set with a mode indicator switch. See the LMI manufacturers' instructions.

3.11 **Maximum Lift Radius.**

The greatest horizontal distance that will be encountered during the lift between the cranes center of rotation and the center of gravity of the lifted load.

3.12 **Qualified Mobile Crane Operator.**

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A crane operator who meets the training requirements of Waupaca Foundry, Inc.. This employee must be trained, tested and qualified prior to operation.

**3.13 Qualified Person.**

A person, who by possession of a recognized degree in an applicable field, certificate of professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter and work.

**3.14 Operator Aids.**

Refers to electronic or manual instruments or tools used by the operator to aid in safe operation of the crane, e.g. A2B, boom angle indicator, LMI, tape measure, hand level, etc.

**3.15 Total Lifted Load Weight.**

The total weight of the following: the material or equipment being hoisted, any attachments to that load, the weight of the rigging, the weight of the crane cable below the boom tip (see manufacturer instructions), the weight of any crane blocks suspended from the crane tip, the weight of any jibs stored or erected that are not being used for the lift, and any other weight that is specified by the crane manufacturer in their crane notes.

**4.0 Inspection**

**4.1 Annual Inspections.**

A thorough annual inspection of each mobile crane will be made by a Competent and Trained Person. Any cranes assembled on site shall receive an annual inspection prior to being put into service. The annual inspection shall include all items listed under the monthly inspections (4.3), and a Complete inspection of bolts, rivets, sheaves, gears, pins, shafts, sprockets, electrical, etc. A record of the date and result of this inspection shall be maintained by Waupaca Foundry, Inc.'s Plant Safety Department for the life of the crane.

**4.2 Daily Inspections (Frequent).** A daily inspection of items specified by the manufacturer shall be completed prior to start of each shift. The crane operator is responsible for ensuring that the daily inspection is completed, documented, and signed before operating the crane.

The daily inspection shall include examination of:

- All control mechanisms for maladjustment interfering with proper operation,
- All control mechanisms for excessive wear of components and contamination by lubricants or other foreign matter.
- All safety devices (including but not limited to boom angle indicators, boom stops, boom kick out devices, anti-two block devices, and load moment indicators) for malfunction
- Air, hydraulic, and other pressurized lines for deterioration or leakage, particularly those that flex in normal operation.
- Crane hooks with deformations or cracks. For hooks with cracks or having more than 15% in excess of normal throat opening or more than 10 degree twist from the plane of the un-bent hook.
- Rope reeving for noncompliance with manufacturer's recommendations.
- Electrical apparatus for malfunctioning, signs of excessive deterioration, dirt, and moisture accumulation.
- Hydraulic system for proper fluid level.

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Tires for proper inflation and condition.

Ground conditions around the hoisting equipment for proper support, including ground settling under and around outriggers, ground water accumulation, or similar conditions.

The hoisting equipment for level position (after each set up and move)

- 4.3 Monthly Inspections (Periodic). Prior to use, a Competent and Trained Person shall be designated by Waupaca Foundry, Inc. to conduct monthly inspections on crane machinery and equipment. The inspection shall contain the date and signature of the person completing the inspection. Defective equipment will be repaired before use. A record of the results of this inspection will be maintained by the Waupaca Foundry, Inc. Plant Safety Department for the life of the crane.

The Monthly inspection shall include all items examined during the daily inspection AND examination of:

All functional operating mechanisms

Deformed, cracked, or corroded members in the crane structure and boom.

Loose bolts or rivets.

Cracked or worn sheaves and drums.

Worn, cracked, or distorted parts such as pins, bearings, shafts, gears, rollers and locking devices.

Excessive wear on brake and clutch system parts, linings, pawls, and ratchets.

Load, boom angle, and other indicators over their full range, for any significant inaccuracies.

Gasoline, diesel, electric, or other power sources for improper performance or noncompliance with safety requirements.

Excessive wear of chain-drive sprockets and excessive chain stretch.

Travel steering, braking, and locking devices, for malfunction.

Excessively worn or damaged tires.

Hooks, hoist chains, wire rope/cable.

- 4.4 Load and Boom Lines and Cables. Load and boom lines and cables shall be checked routinely and thoroughly and action shall be taken, as set forth below.

4.4.1 The line shall be taken out of service, if there are six randomly distributed broken wires on one lay or three broken wires in any one strand in one lay of a running line.

4.4.2 If there is wear of one-third of the original diameter of outside wires, kinking, crushing, "bird-caging," heat damage, core damage, or any other distortion of the rope structure, the rope shall be taken out of service.

4.4.3 For standing ropes, such as pendant lines, the line shall be taken out of service if there is more than two broken wires in one lay in sections beyond end connections or more than one broken wire at an end connection.

4.4.4 Replacement cables shall meet the manufacturer's requirements.

- 4.5 Electronic Load Indicating System. On a monthly basis, verify that the electronic load indicating system (operator aids) is performing accurately. To check the calibration of the LMI or similar device follow these general steps (consult manufacturers' instructions and current version of SAE 1180, 375, or 159, as appropriate).

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4.5.1 Check Boom Length Readings

4.5.2 Retract the boom completely, and record the system reading. Extend to its maximum length and record the system computer reading. Both readings should be those found in the Operators Manual. The LMI is in calibration if the boom length indicator reads within plus or minus 2% of actual length.

4.5.3 Check Boom Angle Readings. With boom retracted, lower boom to lowest angle and raise boom to highest angle and verify readings correct. The angle indicator is in calibration if for angles *below* 65° the angle does not read *more than* the actual angle or 3° less than the actual angle. For angles *above* 65° the boom angle indicator cannot read more than the actual angle or greater than read 2° less than actual angle.

4.5.4 Check Boom Radius Readings. Raise the boom to a known radius, that is, one the operator has physically measured. Verify the boom angle shown on the system computer with that shown in the crane manual. The radius is in calibration if radius of load is not less than 100% of actual radius or 10% more than actual radius.

Hoist a known weight and verify the load on the system computer. The computer should read not less than 100% nor more than 110% of the load weight at the capacity of the machine.

4.5.4.1 Example 1: If you pick 5,000 pounds at the allowable maximum radius and boom length for 5,000 pounds your computer should read 5,000 lbs. It could read up to 5,500 lbs. and still be within the acceptable safety range.

4.5.4.2 Example 2: You have a 20-ton capacity crane and you are picking 1,000 lb. at 10-foot radius and your crane has a capacity of 40,000 lbs. The load may read 20 or 30% more than the 1,000 lbs., i.e. up to 1,300 lbs. since the plus 10% requirement only occurs at or near capacity lifts. For light loads, your LMI will be less accurate. The LMI is not a weight scale.

4.5.5 Guidelines for the use of the electronic load indicating system are listed as follows:

4.5.5.1 Contact a qualified person to calibrate the system when the load indicator does not show the values listed within allowable calibration limits in the LMI manual.

4.5.5.2 The lift radius must be known for all lifts.

4.5.5.3 For each set-up during the day the LMI must be accurately set for its intended operation, i.e. the crane configuration mode, the number of parts of line, etc.

4.5.5.4 When the LMI is out of calibration, physical measurements must be taken and calculations must be done to verify that the crane is operating within its capacity.

4.5.6 Deficiencies. Any deficiencies found during an inspection shall be carefully examined and a determination shall be made by a competent person whether or not to take the crane out of service. Any malfunctioning safety device shall be cause for removing the crane from service, e.g. counter balance/load hold valves, anti-two block device, backup alarms, etc. Where there are malfunctioning operator aids, such as load indicators, if physical measurements for boom angle, length, and radius, and actual total load weights are known and within the crane's capacity, you may proceed with the lift, after Crane Supervisor approval for use of override key.

4.6 When the crane equipment is leased and/or operated by a contracted company, it is the sole responsibility of that contracted company to perform and provide documentation of required safety inspections of the crane and hoisting equipment.

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**5.0 Mobile Crane Safe Operation**

- 5.1 Cranes will only be operated by qualified mobile crane operators. Refer to supervisor responsibilities, and mobile crane operator responsibilities above (2.1 and 2.2)
- 5.2 Conspicuously post in all cranes, hoists, and other equipment the:
- 5.2.1 Rated load capacity charts matching the serial number of the crane,
  - 5.2.2 Recommended operating speeds,
  - 5.2.3 Special hazard warnings, and other essential information, including contact information of those who may assist in crane operation.
- 5.3 Lifts exceeding 75 % of the crane's capacity, based on its configuration capacity for the greatest radius the load will achieve during the lift, are considered to be a Critical Lift and require written approval by the Plant Safety Manager. If a critical lift can be avoided by changing the crane configuration within manufacturer specifications (removing extra boom, removing stored jibs, etc.) or moving the crane closer (decreasing radius) increasing the capacity is possible, the change shall be made. If not, a larger capacity crane shall be obtained and used.
- 5.4 Telescopic boom cranes (hydraulic cranes) shall be equipped with an anti-two-block device (A2B), for all points of potential two-blocking, e.g., jibs, boom extensions, main booms.
- 5.5 Lattice boom cranes shall be equipped with an anti-two-block device or a two-block warning feature with both an audible and visual alarm for all points of potential of two-blocking.
- 5.6 Cranes are designed to lift freely suspended loads which are loads hanging freely with no direct external force applied to them except by the lift cable. Cranes should not be used to lift loads with unknown external loads such as pulling embedded piling, etc. Load lines should be kept vertical so that no side pull is exerted on the crane's boom.
- 5.7 Wind speed and other weather conditions such as cold conditions affect crane capacity.
- 5.7.1 It is the responsibility of the crane operator and supervisor to know the weather conditions that may affect the cranes performance. Tools such as the internet/intranet weather, the airport weather, a flag on the boom, and/or on site wind indicators etc. shall be used to assist in determining these conditions.
  - 5.7.2 Crane capacity is generally based on a maximum 20 mph/12.4 kmph wind speed. At wind speeds above 20 mph the crane should be appropriately de-rated and additional loads caused by the wind on the load itself should be added to the weight of the lift.
  - 5.7.3 At 30 mph/18.6 kmph, lifting operations should be stopped unless otherwise indicated. See Manufacturer specification for your specific crane.
  - 5.7.4 Long booms may experience higher wind speeds above ground level and buildings/structures near the lifting are can increase the wind speed in the work area.
  - 5.7.5 Gusting winds may also make it hard to control the load even when they are below 20 mph, and lifting operations may need to be stopped.
  - 5.7.6 No out door lifts shall be made in electrical storms.
  - 5.7.7 Ice build-up on booms and cables should be removed before use.

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- 5.8 Accessible areas within the swing area of the counterweight or equipment must be barricaded to prevent personnel from being crushed.
- 5.9 An approved fire extinguisher must be available at all operator stations or cabs of cranes.
- 5.10 No less than two full wraps of load line cable or boom line cable shall remain on the load/boom drum when the hook is in the extreme low position or the boom is lowered to its lowest position level with the crane-supporting surface.
- 5.11 Safety latches are required on all crane hooks.
- 5.12 Cranes with suspended loads shall never be left unattended.
- 5.13 The operator shall not leave the cab of the crane with the crane's motor running. If there are unique circumstances that require the operator to leave the crane cab multiple times, the engine may be left running only if the following conditions are met:
  - 5.13.1 The operator is situated where unauthorized entry of the crane can be observed and The crane is located within an area protected from unauthorized entry. (Signs, barriers, etc.)
  - 5.13.2 Secure the crane door to prevent unauthorized entry.
- 5.14 A qualified person or rigging engineering specialist must approve spreader bars, eye pads, personnel baskets and lifting devices of all kinds. Follow company policy and national/local engineering requirements.
- 5.15 Routine maintenance, fueling, or repairs must not be performed while the equipment is in use.
- 5.16 Never attempt to lift more than the rated capacity of any crane or its rigging. Add the weight of hooks, blocks, load line cable, and all rigging as part of the total lifted load. On most cranes, the manufacturer's effective weight of jibs must also be part of the total lifted load. Always consult the crane's operation manual for a list of items that must be added to the actual weight of the item being lifted to obtain the total lifted weight.
  - 5.16.1 Take into account the weight of the wire weight if picking load from below the level of the crane tires.
- 5.17 A joint decision to use the crane override key must be made by the operator and supervisor; and not the sole decision of just one person. This key may be used only after the capacities have been checked and determination the crane is safe to use, within its limitations and the problem is only a defect of the safety device itself.
- 5.18 Safe crane cab and engine compartment access with adequate hand holds and steps must be provided, maintained free of mud and oil, and used by personnel.
- 5.19 The crane manufacturer's recommendations (engine idle speeds, lift capacities, assembly configurations, maintenance, inspections, etc.) shall be followed.
- 5.20 Operators must take signals from only one person. In an emergency, however, a STOP signal can be given by anyone. Only mobile crane operators, or those personnel who have been trained in hand and radio signals, shall be used as "signal" persons at Waupaca Foundry, Inc..
- 5.21 Only standard hand or agreed-upon radio signals, will be acknowledged. Copies of the proper hand signals shall be kept in the crane cab and made available to signal person.

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- 5.22 Never allow anyone to ride the hook or the load.
- 5.23 Never allow personnel to be suspended from another line on a crane that is lifting a load.
- 5.24 Taglines must be used when handling loads. As a general rule, it is recommended that a height-of-load to horizontal-distance-to-load ratio of 2 to 1 be maintained between tagline personal and suspended loads that are less than 50 feet off the ground or above employees on the structure. Thus, for a 40-foot-high load, a 20-foot horizontal distance to the edge of the load should be maintained. For loads above 50 feet in height, use a 30% ratio of load-height to horizontal-distance or a 25-foot minimum, whichever is greater. For special lifts, such as those involving tall thin structures, greater distances should be utilized to ensure personnel safety.
- 5.25 The operator shall not swing loads over the heads of personnel. All non-essential personnel shall be removed from the lifting area.
- 5.26 When machines are equipped with outriggers, they shall be fully extended (unless partially extended outriggers are allowed by manufacturer's load chart) and the tires will be raised free of the ground.
- 5.27 Truck and crawler-type cranes will not be moved unless a designated flag-person in full view of the operator is giving signals.
- 5.28 The hook shall be brought over the load in a controlled manner to minimize swinging.
- 5.29 Multiple-part lines shall not be twisted around each other.
- 5.30 The crane operator must not attempt to make any lift for which the operator feels conditions are inadequate.
- 5.31 Check brakes and machine stability when load is still only inches above the ground.
- 5.32 The load, boom, or other parts of the crane shall not contact any obstructions.
- 5.33 The lift will be made in a smooth controlled manner so there is no sudden acceleration or deceleration of the moving load.
- 5.34 When the operator leaves the mobile crane control station, the operator shall:
  - 5.34.1 Lower the load to the ground or know that the load is secured in its final position.
  - 5.34.2 Set safety pawls on all drums, where such are manually operated.
  - 5.35.3 Set the swing brake and both traction brakes and/or locks to prevent machine movement.
  - 5.36.4 Shut off the engine.
  - 5.37.5 Not get on or off a machine when it is in motion. Adjustment, repair, or lubrication is not permitted on moving machinery.

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**6.0 Critical Lifts**

Certain situations require additional attention, crew coordination, use of additional equipment and possibly different equipment, changing for larger equipment if deemed necessary. These situations are considered to be “critical lifts”.

6.1 A critical lift occurs when one or more of the following conditions exist:

6.1.1 All lifts over 50 tons.

6.1.2 When the load exceeds 75% (OSHA 1926.751) of the cranes rated capacity, as shown on applicable crane manufacturer’s load capacity charts for the configuration to be used.

6.1.3 If the percent of capacity is greater than 95%, the lift requires written approval by the Director of Safety and Health.

6.1.3.1 If, when calculating the total load to be lifted, including all applicable “component weights”, it is determined the lift equals or exceeds 95% of the cranes capacity in its current configuration for the greatest radius the load will achieve during a pick, swing, or set – this lift shall not be made.

6.1.3.2 If, by changing the crane configuration within the manufacturer’s specifications a greater gross capacity may be gained, the configuration shall be changed to keep the lift less than 95% capacity.

6.1.3.3 If, less than 95% cannot be achieved, a larger crane shall be obtained and used.

6.1.4 Lifts involving more than one crane lifting a common load.

6.1.5 Tandem Lifts where two or more pieces of equipment (one of which is a crane) are used to make a pick.

6.1.6 Lifts involving non-rigid (flexible) objects such as tank shells.

6.1.7 Lifts over occupied production work areas, office buildings, or roadways.

6.1.8 Lifts of highly valuable or hazardous material.

6.1.9 When replacement time for a damaged load, or property damage to facilities or equipment adjacent to the lift exceeds \$500,000 or the item being lifted is unique and, if damaged, would be irreplaceable, or not repairable and is vital to a system, facility, or project operation.

6.1.10 Lifts where the crane is supported on a structure.

6.1.11 Lifts that will use an occupied man basket to hoist personnel.

6.1.12 Non-standard or specially modified crane configurations are used.

6.1.13 Lifts using helicopters.

6.1.14 Lifts involved in demolition work. Historically demolition work has resulted in lifts of unknown weight, unusual stress on the crane etc. Because of the often-unknown nature of the work, demolition work shall be considered a critical lift.

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6.1.15 Crane picks that must be made in the dark, or with inadequate lighting will be considered "critical lifts". Picks made at night time (dusk to dawn), or in dark conditions that will be safely lit with permanent or temporary lighting etc. will not be included in the critical lift criteria.

6.2 A Critical Lift Plan must be prepared by the Supervisor and Operator prior to the lift and presented to the Plant Safety Manager. The Critical lift plan must be documented, and the contents of the lift plan must include at a minimum:

6.2.1 The identity of the item(s) to be lifted.

6.2.2 The Plan shall specify the exact size (dimensions) and weight of the load to be lifted and all crane and rigging components that add to the weight (rigging, hoist line, crane hook, etc.)

6.2.3 The manufacturers maximum load limits for the entire range of the lift as listed in the load charts shall also be specified.

6.2.4 The plan shall specify the lift geometry, center of gravity, and procedures including the crane position, height of the lift, the load radius, and the boom length and angle for the entire range of the lift.

6.2.5 The plan shall designate the Crane Operator, Supervisor, and Rigger - and state their qualifications.

6.2.6 The plan shall include a rigging plan that shows the lifts points , method of attachment(s), load angle factors (vertical and horizontal vectors of sling loads), sling angles, accessories used, and other factors affecting the equipment capacity.

6.2.7 The plan shall describe the ground conditions, outrigger or crawler track requirements, and if necessary, the design of mats necessary to achieve a level, stable foundation of sufficient bearing capacity for the lift.

6.2.8 The plan shall list environmental conditions under which lift operations are to be stopped. It should be determined in advance what environmental conditions will cancel the lift including wind speed, visibility, rain/snow, or lighting. The maximum wind speed for the crane shall be determined by consulting the manufacturers owners' manual.

6.2.9 The plan shall specify coordination and communication requirements for the lift operation.

6.2.10 The plan shall note the years of experience of the operator. The crane operator of a critical lift may not be a "trainee" and must have a minimum of 3 years operating experience.

6.3 Pre Lift Review Meeting.

On the day of the critical lift, before performing a critical lift or immediately following a field revision, participating personnel, including the crane operator, shall meet to accomplish the following:

6.3.1 Review the documented Critical Lift Plan. Discuss the intended lift sequence and load path.

6.3.2 Discuss any identified hazards, controls, hold points, coordination with other work groups, unique conditions, and emergency conditions.

6.3.3 Discuss the methods of hazard mitigation and the importance of stopping work if conditions change and become unsafe.

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6.3.4 Resolve any questions prior to initiating the lift.

The operator must be present at the pre-lift review meeting to provide input and understanding of the criteria of the project.

**7.0 Mobile Crane Lift Planning**

All crane lifts require a written lift plan. Lift calculations shall be written on the “Load Chart” Capacity Calculation Sheet (HSF 4-0036) or, if required, the Critical Lift Permit (HSF 4-0065)

A pre-lift meeting must be held immediately prior to the lift that includes all personnel involved in the lift. Lift planning will include the methods to be used for hooking to and unhooking the load to the crane.

7.1 The total lifted weight and maximum lift radius must be established and communicated to the operator prior to lifting to verify capacity.

7.2 A trained signal person shall be assigned to direct the crane movements for the lift.

7.3 Multiple lifts of similar nature, made by the same operator may be grouped into one lift plan. This lift plan is good for the duration of one day.

**8.0 Mobile Crane Assembly and Set-up**

8.1 The crane shall be assembled and set up for lifts under the direction of a qualified person. A crane specific assembly checklist must be prepared and followed for assembly of all cranes and booms. Cranes assembled on site shall receive an annual inspection prior to being put into service. The crane should always be set up within 1% of level when lifting.

8.2 A firm, uniform, level-operating area capable of supporting the load and crane shall be provided. Be aware of recently excavated and backfilled areas and verify the bearing capacity prior to setting up on them. Also, it is very important to check for underground pipelines, vessels, valve vaults, etc. that might not support the crane loads and require special support.

8.3 Use approved matting and or blocking under outrigger pads/floats to stay within the bearing capacity of supporting soil.

8.3.1 Matting must be made of through bolted hard wood or heavy duty 12” x 12” crane timbers.

8.3.2 Outrigger Mats/Pad should be

8.3.2.1 At least three times larger in surface area than the float they support,

8.3.2.2 At a 90-degree angle to the outrigger cylinder to prevent the crane from sliding off of them, and

8.3.2.3 Strong enough to withstand the loads imposed by the outrigger.

8.4 All outriggers on all mobile cranes must be fully extended when the crane is used to lift or support loads. Outriggers shall hold all tires within the boundary of the outriggers off the ground and the crane shall be level for all lifts.

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8.4.1 An exception to this would be “pick and carry” situations using a crawler crane, rough terrain crane, or carry deck crane.

**9.0 Mobile Crane Signals**

It is important that the operator and the assigned signal-person work together as a team. At Waupaca Foundry, Inc. only trained mobile crane operators, and those personnel with training in hand and radio signals, may act as the signal person.

Quick and understandable communication between the signal-person and the operator is required for safe and efficient operation. No response by the operator shall be made unless signals are clearly understood. The signal person must:

- 9.1 Keep persons outside the crane's operating area.
- 9.2 Have an unobstructed view of the load and the crane, or use a second signal person.
- 9.3 Never direct a load over a person.
- 9.4 Keep the load clear of obstructions.
- 9.5 Never let the boom come in contact with the load or any other object.
- 9.6 Anyone seeing a problem can stop the lift by giving the emergency stop signal.
- 9.7 Hand Signals:

9.7.1 Standard hand signals are shown in HSF 4-0071, “Standard Hand Signal Chart for Controlling Crane Operations”, and must be posted on the site. It is recommended that they also be posted on the crane, and copies available in the crane to distribute to the signal person for reference.

9.7.2 The operator and the signal-person shall both be proficient in the use of these hand signals.

9.7.3 The signal-person must:

9.7.3.1 Be in clear view of the crane operator and maintain an unobstructed view of the load and the crane boom. If this cannot be done, additional intermediate signal person(s) shall be assigned.

9.7.3.2 Give the signals accurately and distinctly.

9.7.3.3 When special conditions arise and additional signals are required that are not shown on the chart, both the operator and the signal person shall agree upon the special signals in advance.

9.8 Voice and Radio Signals

9.8.1 Prior to beginning lifting operations using voice signals, the signals shall be discussed and agreed upon by the person directing lifting operations, the crane operator, and the appointed signal person.

9.8.2 Telephones, radios, or equivalent, if used, shall be tested before lifting operations begin. If the system is battery-powered, extra batteries should be available at the job site.

9.8.2.1 If multiple cranes are in operation, different crane channels and frequencies must be used for each crane.

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9.8.3 Prior to commencing a lift, the operator and signal person shall contact and identify each other.

9.8.4 All directions given to the crane operator by the signal person shall be given from the operator's direction perspective (e.g., swing right).

9.8.5 Each series of voice signals shall contain three elements stated in the following order:

1. Function and Direction
2. Distance and/or Speed
3. Function Stop

Some examples of signals are:

1. swing right 50 feet, 25 feet, 15 feet, 10 feet, 5 feet, 2 feet, swing stop
2. load down 100 feet, 50 feet, 40 feet, 30 feet, . . . 2 feet, load stop
3. load up slow, slow, slow, load stop

9.8.6 For lifting operations using voice signals, the person directing lifting operations shall consider the complexity of the lift, the capabilities of the particular crane, the experience and skill of the operator and signal person, and the ability to communicate the necessary signals before permitting multiple simultaneous crane function signals.

9.8.7 Radio voice signals should be considered when making blind picks or for craning operations with obstructed views.

**10.0 Crane Work Near Overhead Electric Lines**

10.1 Any overhead line must be considered energized unless it is disconnected and physically grounded. All power lines must be barricaded or flagged when there is danger of contact by mobile equipment.

10.2 No lifting should be done "over" high voltage power lines (220 V or greater) regardless of distance.

10.3 No part of the lifting equipment, including the load, may be allowed to be closer to live high voltage lines or apparatus than the spacing indicated below:

<b>Normal Voltage, kV (Phases to Phase)</b>	<b>Minimum Required Clearance</b>
	<b>*Note: environmental conditions such as fog, smoke or precipitation may require increased clearances.</b>
	<b>Ft (m)</b>
<b>Operation Near High-Voltage Power Lines</b>	
To 50 kV	10 feet (3.05 meter)
Over 50 to 200 kV	15 feet (4.60 meter)
Over 200 to 350 kV	20 feet (6.10 meter)
Over 350 to 500 kV	25 feet (7.62 meter)

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Over 500 to 750 kV	35 feet (10.67 meter)
Over 750 to 1000 kV	45 feet (13.72 meter)
<b>Operation in Transit with No Load and Boom and Mast Lowered</b>	
To 0.75 kV	4 feet (1.22 meter)
Over 0.75 to 50 kV	6 feet (1.83 meter)
Over 50 to 345 kV	10 feet (3.05 meter)
Over 345 to 750 kV	16 feet (4.87 meter)
Over 750 to 1000 kV	20 feet (6.10 meter)

10.4 No crane or similar equipment shall be swung, worked, or moved (including during transit between worksites) within the clearances stated above.

10.5 When it becomes necessary for a crane boom or any part of a crane or similar equipment to be swung, worked, or moved (including transit between worksites) within the clearances stated above, the work is to be stopped immediately. The Site Manager and Director of Safety and Health are to be contacted. These individuals, after consultation with the client, will decide which of the following steps must be taken.

10.6 The line must be identified, de-energized, and properly tagged and locked-out. The line must also be visibly grounded at the point of work. If such is not possible, the following minimum precautions shall be taken if the above individuals agree that the work can be done safely:

The crane must be grounded with #2/0 wire to a permanent ground or a temporarily installed ground rod.

A wire watcher must be stationed to warn the operator while the crane, boom, or load is in motion.

No one can be allowed to come in contact with the crane or load while the crane is in motion.

Tag lines must be constructed of “dry” non-conductive material.

10.7 Additional precautions, which may be needed to avoid contact with the line, include the following:

10.7.1 Warning flags, signs, or other suitable devices to mark power line location.

10.7.2 Temporary Installed Sleeves On The Power Line

Note that there is also considerable potential hazard involved in this procedure, and the use of temporary sleeves must be evaluated on a case-by-case basis.

With sleeves installed approach distance is limited to those shown in HSEP 19.4, Energized Electrical Work.

10.7.3 Insulated links (or dry synthetic slings) can be used between the crane hook and the load. If a power line contact occurs with the boom or hoist line, the insulated link will prevent electricity from passing into the load, but it will not prevent electricity from passing through the boom and back to the ground from the crane.

No one should be allowed to touch the crane from the ground. Insulated links are subject to load failure as well as losing their insulating qualities and should be inspected daily prior to use and annually per manufacturer insulation test requirements.

Note insulating links protect either the crane or the load depending on where electrical contact is made never both.

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**11.0 Crane lifts using Helicopters**

- 11.1 Pre-approval from the Director of Safety and Health must be obtained prior to any helicopter lifts.
- 11.2 The Plant Safety Manager must be present for all helicopter lifts.
- 11.3 Helicopter lifts and operations shall be performed in accordance with the following regulations:
- 12.3.1 29 CFR 1926.551 (OSHA)
  - 12.3.2 14 CFR 133.1 thru 133.51 (FAA, Rotorcraft External Load Operations)
  - 12.3.3 ASME B30.12 (Handling loads suspended from rotorcraft)
- 11.4 The following permits must be provided to the Waupaca Foundry, Inc. safety department during the pre-lift planning.
- 11.4.1 A copy of the operator's FAA issued Rotorcraft External-Load Operator Certificate, including the name of the chief pilot who is approved by the FAA for conducting Rotorcraft External-Load operations.
  - 11.4.2 Registration number of the Rotorcraft(s) that will be used for lifting.
  - 11.4.3 Copy of the city or local permit (or application) required to perform the helicopter operation if one is required.
- 11.5 In addition to the above noted documents, the following must be included with the Critical Lift Plan:
- 11.5.1 Maximum gross weight of the rotorcraft-load combination.
  - 11.5.2 FAA approved hook load rating for the helicopter to be used for this operation, per the flight manual.
  - 11.5.3 Hook load rating for the hook that will actually be used.
  - 11.5.4 Rated load of the hoist and load line, if a hoist is used.
  - 11.5.5 Sketch of rigging arrangement, with dimensions.
  - 11.5.6 Size and rated capacity of all slings, shackles, spreaders.
  - 11.5.7 Written statement regarding how static charge protection will be provided.
  - 11.5.8 Pre-flight inspection checklist form specifically indicating hoist, hook, pendant, sling inspection and criteria.
  - 11.5.9 If power lines are present in the area of the lift, the location and elevation of the power lines shall be detailed on a sketch of the lift area. A determination must be made if the power lines need to be de-energized and visibly grounded, or, if the lift can be performed safely in accordance with the electrical clearance requirements in OSHA 1926.550 (15).
- 11.6 Pre-Lift Job briefing
- The helicopter crew, Waupaca Foundry, Inc. personnel, and any other contractors involved in the lift must participate.
- The lift plan shall be reviewed including flight paths, release method of load etc. The briefing shall set forth the plan of operation for the pilot and ground personnel.

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11.7 Site Security during helicopter lifts

No unauthorized persons shall be allowed in the loading area, setting area, or under the flight path of the loaded helicopter during lifting operations. Effective barricading methods must be utilized to prevent the general public from entering into the work area during the lift.

**12.0 Mobile Crane Maintenance**

12.1 Routine maintenance, fueling, or repairs must not be performed while the equipment is in use.

12.2 For maintenance operations:

12.2.1 All maintenance and repair is to be done per the manufacturer's recommendations and with the correct parts.

12.2.2 Place the crane where it will cause the least interference to ongoing operations.

12.2.3 Lower the boom if possible.

12.2.4 Set all controls in the off position and secure all operating features from inadvertent motion by engaging brakes, pawls, etc.

12.2.5 Lockout and tagout the engine or power system when necessary to eliminate potentially hazardous energy sources.

12.2.6 Relieve pressure components and properly block equipment or loads before repairing associated equipment.

12.2.7 Maintain all ladders and walkways in a clean, safe condition.

12.2.8 Adequately guard engine fans and all other dangerous moving parts.

12.2.9 Be sure controls, clutches, cables, sheaves, switches, safety devices, operator aids, and other operating parts such as axle lockouts, tires, tracks, brakes, ring gear, etc. are in good condition, properly lubricated, and functioning properly.

12.2.10 Run load blocks and the boom up and down to make sure the wire rope winds on the drum(s) correctly, is not kinked, and has no damaged components.

12.2.11 Regularly lubricate lifting and boom cables per manufacturer recommendations.

12.2.12 After adjustments and repairs have been made, the crane shall not be returned to service until all guards have been reinstalled, trapped air removed from hydraulic system, safety devices reactivated and maintenance equipment removed.

**13.0 Environmental Considerations**

13.1 Diesel engines should receive periodic tune-ups and inspections to ensure that they are operating properly and are not polluting. Air filters should be changed routinely, especially in dusty work environments.

13.2 Check with local environmental staff to determine if there are any special operating conditions.

13.3 Use of low sulfur (less than 500 ppm) or ultra low sulfur (less than 15 ppm) diesel fuel.

13.4 Hydraulic lines and hoses should be periodically inspected for leaks and repaired immediately when a leak is found. Records of inspections and maintenance shall be retained.

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13.5 The accidental release of hydraulic fluid, lubricant, or diesel fuel from the crane must be reported to environmental staff in accordance with client directives. The contractor shall contact the Waupaca Foundry, Inc. project manager immediately or call the ERT team per the number at each plant.

13.6 Any release onto a waterway or body of water must be reported to the appropriate regulatory agency. For work over or adjacent to waterways, a biodegradable lubricant, such as vegetable oil, should be considered for replacement for standard hydraulic fluids. Spilled or released fluid must be collected immediately along with any impacted soil or water and be handled in accordance with Federal, state, and local regulations.

13.7 Equipment service should be performed by authorized mechanics and all removed fluids must be disposed of or recycled in accordance with Federal, State, and local law. Maintenance should not be done on Waupaca Foundry, Inc. property unless necessary. Use of spent oil for weed control is a prohibited practice.

13.8 Local City limitations must be evaluated with regard to crane use.

13.9 Airport considerations must also be evaluated and necessary steps taken to prevent an in air collision with the crane (ie: lights, flag etc.).

**Forms**

HSF 4-0036 Mobile Crane Pre-Operation Inspection

HSF 4-0061 Mobile Crane Suspended Personnel Basket Pre-lift Inspection and Meeting

HSF 4-0064 Mobile Crane Load Chart Calculation

HSF 4-0065 Mobile Crane Critical Lift Plan

HSF4-0071 Hand Signals for Controlling Crane Operations