

The background of the page is a close-up photograph of a heavily rusted and weathered steel structure, likely part of a crane or industrial machinery. The rust is a mix of dark brown, black, and reddish-brown tones. The lighting is dramatic, with strong shadows and highlights that emphasize the texture and depth of the corrosion. The structure consists of various beams and plates, some of which are bolted together.

Chubb Construction Risk Engineering

Crane Critical Lift Resource Guide
and Lift Plan

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Background

The number of cranes working on construction sites on any given day is a moving number difficult to accurately determine. According to a study completed by OSHA a number of years back, they estimate that there are approximately 125,000 cranes in use in the construction industry.

Cranes tend to be the most expensive pieces of construction equipment on a project site. They also have the potential to be the most deadly pieces of equipment when not properly utilized.

According to a revised study from CPWR - The Center for Construction Research and Training in November of 2009: the study identified a total of 632 crane-related construction worker deaths involving 611 crane incidents from 1992-2006 (including 17 multiple deaths incidents causing 38 deaths) compared to a total of 323 deaths in 307 incidents in the previous 2008 study. The revised average is 42 deaths per year. Four main types of cranes have been associated with crane-related fatalities. Of the 611 fatal crane incidents, only 375 were identified from the CFOI record as to type of crane. Of these, 292 (78%) involved mobile or truck cranes. Forty-five of the fatal incidents involved overhead or gantry cranes (12%), 18 involved tower cranes (5%), and 11 involved floating or barge cranes (3%).¹

The main causes of death were electrocution from overhead power lines, accounting for one-fourth of all crane related fatalities, the second leading cause was being struck by a crane load, which accounted for 21% of all deaths, struck by cranes or crane parts (20%), crane collapses (14%), falls (9%), and caught in/ between crane parts (5%). Seven percent

of crane-related fatalities were listed as “other causes.”¹

More construction laborers were killed in crane-related incidents than any other trade, even operating engineers. They experienced 191 crane-related deaths between 1992 and 2006 (30%), followed by 101 deaths of heavy equipment operators (16%) In addition, 86 supervisors/managers/administrators died in crane-related incidents (14%), as did 42 iron workers (7%), and 41 carpenters (6%). Other trades with fewer numbers of deaths included welders and cutters, electrical workers, mechanics, sheet metal workers, and truck drivers (totaling 27%).¹

These alarming statistics reinforce the importance for construction safety and the urgency that pro-active rather than re-active safety measures are taken. Pre-construction safety planning is essential for every aspect associated with a construction project and the emphasis for pre planning involving crane related activities can not be stressed enough.

To ensure each crane related activity is safely undertaken, it requires proper planning and attention by all involved with the operation regardless of the size of load being hoisted. It is essential that:

- Proper crane selection based on the operation has occurred
- Set up and configuration of the crane is addressed
- Ground and subsurface conditions are reviewed
- Utilities and other subsurface obstructions are identified
- Overhead obstructions and electrical power lines are identified
- Weather related conditions are determined

- The weight of the load being hoisted is determined
- The weight of the ancillary crane components (i.e. head ache ball, jibs, rigging) is determined and
- The levelness of the crane has been addressed.

No hoisted load should ever be taken for granted or taught to be inconsequential. Typically, hoisting large complex loads, generate a great deal of attention (rightfully so) with detailed planning and preparation taking place to ensure no issues arise. Too often smaller, what may be perceived to be less significant picks, do not garner the same level of attention as the larger ones do.

Definitions

A crane term regularly used in the construction industry is **Critical Lift**.

OSHA 1926.751 states; “critical lift means a lift that (1) exceeds 75% of the rated capacity of the crane or derrick or (2) requires the use of more than one crane or derrick”.²

The Army Corps of Engineers Safety and Health Requirements Manual defines a critical lift “as a nonroutine lift requiring detailed planning and additional or unusual safety precautions. Critical Lifts include lifts which require the load to be lifted, swung, or planned out of view of the operator; lifts made with more than one crane; lifts involving non-routine or technically difficult rigging arrangement; hoisting personnel with a crane or derrick; or any lift which the lift or crane operator believes should be considered critical”.³

NIOSH defines a critical lift as one with the hoisted load approaching the crane's maximum capacity (70% to 90%); lifts involving two or more cranes; personnel being hoisted; and special hazards such as lifts within an industrial plant, cranes on floating barges, loads lifted close to power lines, lifts in high winds or with other adverse environmental conditions present.⁴

Although a uniform criteria to designate critical lifts has not been formalized by the construction industry, the following crane related activities warrant consideration of critical lift planning:

- Load weights that exceed 75% of the crane's rated capacity
- Lifts where a failure/loss of control could result in loss of life, serious injury and/or damage to surrounding structures
- The use of two or more cranes to hoist a load
- Extremely expensive and/or long lead equipment
- Lifts operating over railroads
- Lifts involving hazardous environmental materials
- Lifts involving personnel
- Blind lifts
- Any lift which the crane operator believes should be considered critical
- Cranes working from barges on a body of water

Regardless the definition utilized, it is essential that pro-active safety planning is performed to ensure safety measures are in place to successfully complete the operation.

Recommend Procedures

Critical Lift Plan

Prior to commencing a Critical Lift, a Critical Lift Plan should be developed and implemented. The plan must be developed by a qualified person in conjunction with the crane operator(s), master rigger, lift supervisor and project manager. The plan should be in writing and documented. Once the plan has been completed and approved, it should be reviewed with all members involved with the operation prior to commencement of the operation. The plan should be kept on site as well a copy of the plan at the location of the lifting activity. The Critical Lift Plan should include at a minimum the following information:

- Description of the lift and object being lifted
- Crane size, make, type and model
- The cranes location and configuration
- Weight of the object being hoisted
- Description and weight of all rigging equipment and crane attachment deductions from the load chart
- Total weight of object, rigging and load chart deductions
- Maximum crane operating radius
- Planned operating radius
- Boom length and angle
- Height of the lift
- Levelness of crane
- Quadrants of operation
- Jib utilization
- Determination of the lifted loads
Center of Gravity
- Rigging equipment
- Allowable lifted load based on cranes load chart
- Percent of the lift to the cranes rated capacity
- Ground conditions/stability
- Subsurface obstructions (i.e., utilities, man holes, etc.)
- Overhead power lines including voltage information

- Weather conditions
- Wind speeds
- Environmental conditions
- Crane operators certification
- Riggers certification
- Flagging /traffic control requirements
- Critical lift involves working on or adjacent to water
- Critical lift involves hoisting personnel
- Inspection procedures

Understanding Crane Load Charts and Crane Capacity

When working with cranes it is important to understand strength and stability factors associated with those cranes. Every mobile crane must be equipped with a substantial and durable load chart. Crane load charts are manufacturer's guidelines and requirements developed for each specific model of crane.

Load charts outline crane information related to set up, operations and limitations. Load charts list the gross capacity the crane can pick based on the factors including boom length, operating radius, counter weights, out rigger deployment, boom angle, jibs stowed/erected, hook blocks, line pull, reeving and rigging. Load charts also assume ideal conditions. This includes but not limited to the crane being perfectly leveled and ideal weather conditions including no wind. Wind plays an important role in crane related operations as the hoisted loads can be impacted by winds, which may result in dynamic loading occurring that is not factored into the load chart rating. Side loading can also occur as a result of wind related conditions. Load chart ratings apply when the load is picked directly under the boom tip. If the load is to either side of the boom tip, side loading occurs and could decrease the cranes rated capacity. This applies to both lattice and telescopic booms and is one of the most common causes of boom failure.⁵

Strength and stability factors limit the manufacturers rated capacity and load charts on most cranes. Capabilities limited by structural strength are based on the yield strength of components with a safety factor. Stability means the ability of the crane to resist tipping. Most crane load charts utilize a bold line to divide the chart into two parts. Ratings above the line are based on structural strength and the ratings below the line are based on the stability of the crane. It is important to understand the distinction. If a crane is overloaded in one case, it could result in the failure of a structural or mechanical component of the crane and in the other circumstance the crane could have a stability issue and tip over.⁵

Another significant and often overlooked segment of the load chart is the lifting area diagram. Characterized as quadrants or arcs-- they define the permissible lifting area. These working areas for the crane are identified as "over front", "over side", "over rear", or "360". Permissible loads shown on machine capacity charts may differ from lifting quadrant to lifting quadrant.⁵

Pre-Lift Meeting

Once the Critical Lift plan has been completed by a qualified person and prior to commencing the lift, a pre-lift meeting should be conducted. This meeting should include participating personnel involved with the lift (i.e., operating engineer, riggers, signal persons, lift superintendent, project manager and any other participants involved with the lift) to review in detail the critical lift plan. The purpose of the meeting is to ensure all participants understand the safety measures that must be implemented and executed to safely perform the task at hand. This meeting should be documented with each participant signing the plan, acknowledging understanding and participation in the meeting.

References/Acknowledgements:

1. <http://www.cpwr.com/sites/default/files/CPWR%20Crane%20Rept%20Recmmdtns%20Nov-2009-BLS%20UPDATED.pdf> (Crane-Related Deaths in Construction and 29 CFR 2926.751 Definitions - http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10787, 10/15/12)
2. The Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1, 3 November 2003.
3. NIOSH Alert; Preventing Worker Injuries or Deaths From Mobile Crane Tip-Over, Boom Collapse, and Uncontrolled Hoisted Loads, <http://www.cdc.gov/niosh/docs/2006-142/pdfs/2006-142.pdf>
4. Bob's Rigging & Crane Handbook

For additional information regarding these and other exposures, please visit the Chubb Construction Risk Engineering Portal

Crane Critical Lift Plan

General Information

Project Name Address

City State Zip Code

Date Plan Completed Scheduled of Lift

Specific Location of Lift

Personnel

Project Manager

Crane Operator(s)

Crane Operator Certifications (Certifications, qualifications, exp. dates)

Rigger(s)

Rigger Certifications (Certifications, qualifications, exp. dates)

Signal Person(s)

Signal Person Certifications (Certifications, qualifications, exp. dates)

Lift Superintendent

Hoisting Personnel

Critical Lift Criteria

Load exceeds 75% of load chart for crane or derrick	yes	no	n/a
Two or more cranes required to perform the lift	yes	no	n/a
Lift is near power lines	yes	no	n/a
Lift is on barges located in waterways	yes	no	n/a
Lift involves hoisting personnel	yes	no	n/a
Lift adjacent too or over occupied structures	yes	no	n/a
Extremely expensive or long lead item being lifted	yes	no	n/a
Lift involves hazardous material	yes	no	n/a
Loads Center of Gravity is determined	yes	no	n/a
Lift is over active rail road lines	yes	no	n/a

Other - *Specify*

Description of Object To Be Hoisted

Weight of object to be hoisted

Certified Scale Weight

Copy of Mfr. Invoice Documenting Weight of Item Attached yes no n/a

Description & Weight of All Rigging Equipment & Crane Attachment Deductions From Load Chart

Item	<input style="width: 380px; height: 25px;" type="text"/>	Weight of item	<input style="width: 150px; height: 25px;" type="text"/>
Item	<input style="width: 380px; height: 25px;" type="text"/>	Weight of item	<input style="width: 150px; height: 25px;" type="text"/>
Item	<input style="width: 380px; height: 25px;" type="text"/>	Weight of item	<input style="width: 150px; height: 25px;" type="text"/>

Total Weight of Load - (Object, Rigging and Load Chart Deductions)

Crane Information

Crane #1 Model Capacity

Crane #2 Model Capacity

Boom Length Crane #1 Crane #2

Max. Operating Radius Crane #1 Crane #2

Planned Operating Radius Crane #1 Crane #2

Allowable Load (based on load chart) Crane #1 Crane #2

Ratio of Lift To Allowable Load Crane #1 Crane #2

Has Crane Been Inspected and Approved By Qualified Person Crane #1 Crane #2

There is a Clear Route for Crane Travel

All Lifting Equipment and Rigging Has Been Properly Selected, Inspected & Approved For the Lift

Describe Means of Communication b/t Operator(s) and Lift Personnel

Site Conditions

Soil Bearing Capacity Referenced Source

Are Mats Required Size and Number

Will Subsurface Utilities or Obstructions Be Encountered

If Yes, provide detail

Are Overhead Power Lines In The Area

If Yes, provide detail

Degree of Level Crane #1 (%) Crane #2 (%)

Wind Speeds At Time of Lift

Weather Conditions At Time of Lift

Obstructions Impacting Swing or Lift

Lift Completed In Day Time or Night Time

Special Conditions That Lift Personnel Need To Be Aware Of

Approvals

Crane Inspection	<input type="text"/>
Rigging Inspector	<input type="text"/>
Master Rigger	<input type="text"/>
Lift Superintendent	<input type="text"/>
Crane Operator(s)	<input type="text"/>
Signal Person(s)	<input type="text"/>

Final Lift Plan Approval

Project Manager	<input type="text"/>	Date	<input type="text"/>
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PLEASE READ CAREFULLY; This sample Crane Critical Lift form is being provided to you as a tool that you may wish to use in providing a safety and risk management program. You are responsible for providing safety and risk management services. We at the ACE Companies are providing this tool to you in support of our underwriting objectives and we hereby disclaim any obligation to oversee or monitor the adherence to required or otherwise reasonable safety and risk control practices. We further disclaim liability for claims or suits relating to the alleged or actual failure to conduct reasonable safety control practices, or relating to the use of or failure to use this document. Please note that neither this tool or any of its components contain every possible operation, inspection requirement or other detail that may be relevant to your project or that may be required by federal or state law, or by local building codes, statutes, or other requirements. This tool is intended only as a guideline, and not as a substitute for consultation with your insurance broker, or for engineering, legal or other professional advice.
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