

RiskTopics

Crane safety

Zurich Resilience Solutions - Risk Engineering

Cranes can be found in a wide variety of sizes and types. There are significant safety issues for the operator, other workers in the area, materials being lifted and the surrounding areas.

Introduction

Crane accidents have occurred with some frequency since the invention of lifting machinery. Recent accidents that have involved the loss of lives and significant property damage have focused industry attention on cranes. Contrary to popular belief, there is no central repository of crane loss data.

Discussion

United States crane accidents that cause loss of life to workers, or injuries to multiple workers, must be reported to OSHA. Outside of those mandatory reporting criteria and a few local ordinances, most accidents are not reported. Because many crane operators carry large insurance deductibles, smaller losses may not be reported to insurance carriers. While there has been some discussion about national loss reporting requirements, workable solutions are not imminent.

Guidance

The definition of a crane "accident" is not universal. Some include only events that result in injury or death. Some do not include liability considerations. Others include only select industry segments, while others exclude some loss categories. Even the definition of a crane is not in agreement. Some exclude non-construction cranes such as industrial gantry, bridge, and jib cranes. Some exclude longshore or mining operations.

Three basic types of crane accidents:

- Tip over
- Structural Failure
- Collision

Five basic causes of crane accidents:

- Operations
- Assembly/disassembly
- Rigging
- Maintenance
- Weather

Steps to take to help reduce crane accidents:

Critical documentation:

- Annual crane inspection report – any deficiencies that affect safe operations should be noted as having been corrected
- Monthly crane inspections – documents for the preceding three months should be available, with issue resolution as indicated above
- Pre-shift safety inspections (documentation not required by OSHA)
- Crane operator's certification for the class of equipment in use
- Crane operator's qualification document that lists the operator's name; printed name and signature of the person who qualified the operator; date of the qualification; specific make, model and configuration(s) of the crane.
- Load chart – on durable material; serial number on the chart must match the crane and be legible (computer-generated capacity information is an acceptable alternative)
- Critical lift plans (if appropriate)

Supplemental reference material:

- Crane operator's manual (should be in the crane cab)
- Crane maintenance manual (often kept on file at the shop)
- OSHA Standards – Part 1926, Subpart CC (1926.1400-1442)
- ASME B30.5 (mobile cranes)
- ASME B30.3 (tower cranes)

Assess operator knowledge – for qualification, the operator should be able to:

- Identify the load chart page(s) that match the crane configuration
 - Boom type and length
 - Boom extensions (if any)
 - Base configuration
 - Counterweight configuration
- Produce and interpret inspection reports
- Accurately identify weights of attachments
 - Ball
 - Block
 - Stowed or idle jibs
- Calculate crane NET HOOK CAPACITY
- Describe critical operational requirements and limitations for the equipment
- Program and operate the crane's computer (if equipped)

Additional, recommended responses to critical questions for the crane operator:

- What is your radius? Answer should be the horizontal distance in feet from the center of rotation to the center of the hook.
- What is your boom length? Answer is a fixed number for lattice booms, measured from the boom heel pin to the center of the tip sheave. For a telescopic boom, length is given by an indicator.
- How much weight is on the hook? Answer should be the load weight plus all attached rigging.
- May I see your load chart? Answer should be an offer of a durable chart such as laminated paper, or a metal data plate riveted to the inside of the cab. Newer cranes may have a digital chart on a screen similar to a computer screen.
- What is the weight of your block (or ball)? Answer should be on a data plate on the block or ball, but the operator must know this number.
- What is your rope type, size, and weight? Answer should be type RB, or ZB, or similar code plus rope structure (such as 6x19), plus a rope diameter, plus a weight per foot of the rope. The answer should match one of the rope specifications on the load chart.
- What is your net hook capacity? Answer should be the gross capacity from the load chart less deductions for all attachments, including blocks, balls, unused jibs, excess rope.
- When was your last crane inspection? Answer should be today's date.
- When was your last annual inspection? Answer should be available on a sticker, certificate, or document on the crane.
- When did you last check your level? Answer should be today and should not have been made with the target level in the crane. A carpenter's level should have been used each shift; plus any time the crane is moved to a new location.

Crane setup:

- The crane should be level, within 1% (0.57 degrees) unless manufacturer states otherwise
- Crawlers or outriggers level and fully supported (no gaps)
- Outriggers fully extended, or matching chart in use
- All boom pins secured in place
- Extended outriggers will usually require blocking below the floats set on soil to spread the load over a larger area. Inadequate cribbing has contributed to many crane accidents.
- Obstructions – Careful planning is needed when potential obstructions are within the crane's radius of operation. Any obstruction is a potential threat to crane safety. These include structures, bridges, other cranes, and the big one – power lines. No crane boom, load line or pendant should contact any obstruction, especially when under load. For power lines, a clearance of ten feet or more should always be maintained from any energized overhead power line.

Equipment condition:

- Cab glass clean and in good condition
- Running rope free of wear and broken wires
- Anti-two-block in place and in service
- Pendant lines in good condition
- Portable fire extinguisher available
- Steps and hand holds in good condition
- Drum brakes will hold loads
- Power line warning sticker visible to the operator

Signaling:

- The OSHA crane standard, effective November 2010, contains specific requirements to be met by anyone who signals a crane operator. Certification is not required, but qualification is.
- Signal person qualification requires training, passing either a written or oral test on the method(s) to be used, and a practical test, providing signals to an examiner and receiving/interpreting same.
- Signal persons should be visibly distinct. Common methods include unique gloves, vests, hard hat covers or hard hat stickers.
- There should be written evidence readily available that indicates that each signal person was trained and has passed both written and practical examinations.

Rigging:

- Trained riggers – **OSHA does not specify certifications or specific training requirements** for riggers. However, all riggers must be "**qualified.**" Each rigger should be thoroughly trained on selection, inspection, and application of the rigging equipment. They should be able to determine load weights, load attachment, types of hitches, sling angles and sling protection.
- Rigging equipment – Only approved rigging equipment, in good condition, should be used. Each piece of equipment should be inspected immediately prior to each use. All equipment should be marked with capacities. Rigging equipment should be stored out of the weather and should be protected from damage.

Critical picks:

- Many critical picks are made that go unrecognized.
- A critical pick could be a huge, heavy load, but it could be a very small, fairly light load.
- Most crane accidents occur with light loads that were not recognized as critical or overload picks.
- There is no universally accepted critical pick criteria. Neither OSHA, EM 385 nor the ASME B30 standards provide definitions. There is limited guidance to help identify potential scenarios that warrant special considerations.
- Theoretically, cranes can make picks up to 100% of their gross capacity. The gross capacity includes the weight of the load, plus the rigging, blocks and balls, excess rope below the boom (some manufacturers say all rope), unused boom attachments (jibs), and certain other attachments such as added sheaves, upper boom points, etc.
- **NO CRANE CAN PICK THE WEIGHT SHOWN ON THE LOAD CHART.**

Crane pick plans

- Many companies have them.
- There is no universal standard or format.
- Does a qualified person review them?
- Does the field crew understand what a critical pick is?
- Are pre-pick meetings held?
- Does safety attend critical pick meetings?
- Does safety audit critical pick plans?

Critical pick considerations:

- Crane load charts list gross capacity for the crane for static conditions. This means that there will be no movement of the crane or load. Picks are not made that way, as a crane is used to move loads. This movement adds dynamic loading, which is not contemplated in the load charts.
- Load charts assume perfect conditions. This includes correct assembly, brand new equipment, zero wear, perfect inspection results, new rope, perfectly level, and perhaps the toughest of all – zero wind conditions.
- The effects of wind are never included in the chart capacities due to the infinite combinations of wind factors.
- Because of the many factors that are normally present that act to reduce a crane's operating capacity, prudent operation calls for backing off the crane's theoretical capacity. An unofficial crane capacity limit commonly used for mobile cranes in construction is 75% of the crane's net hook capacity. Anything higher should trigger a critical pick plan. Even when conditions are nearly ideal, prudent operation suggests backing off a bit from the manufacturer's limits. Anything higher than 90% should be considered a very risky undertaking.

Definitions of common critical picks:

- Load weight, including rigging, exceeds 75% of the crane's net hook capacity
- Very expensive loads
- Loads that would take significant time to replace
- Loads with unusual characteristics
- Dangerous materials
- Liquid filled containers
- Multi-crane picks
- Crane set on a structure such as a bridge deck, pier or platform
- Unusual hazards
- Over open highways or rail lines
- Near high hazard environments
- Project owner's requirements
- Picks of personnel are not necessarily considered to be critical

Critical planning:

- Written planning is essential. Usually, the most qualified entity performs the planning for all crane picks, including critical picks. This is often done by the crane owner, as the owner knows the equipment, manufacturer's requirements and is usually the employer of the operator. Sometimes, a team approach is appropriate. Often a review of the pick plans by a general contractor or project owner may be a contractual requirement.

Critical picks – required information:

- Exact weight of the load
- Additional weight of rigging, bracing, extras
- Special characteristics (possible center of gravity shifts)
- Rigging plan:
 - Type, size and capacity of slings including lengths; sling hitch types and angles; shackles; hooks; spreaders; balancers (come-along's) - all hardware capacity equal or greater than slings
- Personnel: Crane operator(s); Riggers; Lift Director; Signaler(s)

Critical pick technical information:

- Most plans come in two parts, preparation, and calculation
- Description of the load and proposed date of the pick
- Crane details: Make, model and serial number; Crane base (crawlers, outriggers, rubber); Verification of correct load chart; Required operating radius; Quadrant(s) of operation; Lowest gross capacity at minimum height, maximum radius, weakest quadrant; Jibs (if used) Type, length, capacity and offset; Structural capacity of jib
- Site details: Pick elevations at start, max and landing
 - Above ground hazards (power lines and obstructions)
 - Underground hazards (buried objects)
 - At grade hazards (roadways, pedestrians, water and rail lines)
 - Soil conditions (bearing capacity - mats required?)
 - Engineered base capacity (bridge decks, piers)

Conclusion

The Planning and education go a long way toward helping reduce crane accidents. Contractors who have cranes on their projects need to be educated on the use, safety, and limitations of cranes. They should not rely on the crane supplier or operator.

Supplemental guides and reference material

Crane operator's manual (should be in the crane cab)

Crane maintenance manual (often kept on file at the shop)

OSHA Standards – Part 1926, Subpart CC (1926.1400-1442)

ASME B30.5 (mobile cranes)

ASME B30.3 (tower cranes)

Other related Zurich RiskTopics

- Crane operator certification, licensing, and qualification
- Cranes – critical picks
- Rigging – synthetic web slings
- Rigging – wire rope slings

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