Introduction

- Crane Safety Basics
- Welcome to this training session on Crane and Derrick Safety.
- This course is designed to provide basic information regarding the selection, set-up, inspection, and use of cranes in construction activities.
- The primary reference for this course is the Occupational Safety & Health Administration (OSHA) standard found in 29 CFR 1926 Subpart N and 29 CFR 1926 Subpart CC, Cranes and Derricks.
- Approximately 70 minutes.
Introduction

• Course Objectives
  • The student will be able to recognize hazards associated with Cranes, Derricks, Hoist, Elevators and Conveyors
  • Specifically, the student will be able to:
    • 1: Identify common hazards associated with cranes, derricks, hoists and conveyors
    • 2: Describe processes designed to protect workers in proximity to cranes, derricks, hoist, and conveyors
    • 3: Protect themselves from safety & health hazards
    • 4: Recognize employer requirements to protect workers from exposure to hazards associated with cranes, hoist, and conveyors
Introduction

- Fatalities
- Causes of fatalities identified in new OSHA standard:
  - Struck by load (other than failure of boom/cable) ...................... 32%
  - Electrocution ................................. 27%
  - Crushed during assembly/disassembly ............................. 21%
  - Failure of boom/cable .................. 12%
  - Crane tip-over .............................. 11%
  - Struck by cab/counterweight .... 3%
  - Falls ........................................... 2%
• Human Error
  – Root cause of 90% of construction accidents.
  – The focus of efforts to learn from past mistakes.
Introduction

• Human Error
• Moving Loads
  – Moving large, heavy loads is crucial to today's construction industry.
  – Much technology has been developed for these operations, including careful training and extensive workplace precautions.
  – Are significant safety issues to be considered, both for the operators of the diverse "lifting" devices, and for workers in proximity to them.
  – Crane, derrick, and hoist safety hazards are addressed in specific standards for the general industry, marine terminals, longshoring, gear certification, and the construction industry.

Introduction

• New OSHA Standard
• Effective November 8, 2010, OSHA issued a new rule addressing the use of cranes and derricks in construction.
  – OSHA noted that this rule affects approximately 267,000 construction, crane rental, and crane certification establishments employing roughly 4.8 million workers.
• New OSHA Standard
  – Designed to prevent the leading causes of fatalities, including electrocution, crushed-by/struck-by hazards during assembly/disassembly, collapse and overturn.
  – Sets requirements for ground conditions and crane operator assessment.
  – Rule addresses tower crane hazards, addresses the use of synthetic slings for assembly/disassembly work, and clarifies the scope of the regulation by providing both a functional description and a list of examples for the equipment that is covered.
• New OSHA Standard
• OSHA considers ...
  – The newly released standard historic, addressing the use of cranes and derricks in construction and replacing a decades-old standard.
  – The significant number of fatalities associated with the use of cranes and derricks in construction, and the considerable technological advances in equipment since the publication of the old 1971 rule, led the Labor Department to update the standard.
Introduction

- New OSHA Standard
- In 1998, OSHA's expert Advisory Committee on Construction Safety and Health (ACCSH) ...
  - Established a workgroup to develop recommended changes to the old standard for cranes and derricks.
  - After several years of committee including regulatory, industry, labor experts and public meetings and comment, a new rule was developed.
  - The rule became effective On November 8, 2010. Certain provisions have delayed effective dates ranging from 1 to 4 years.

Introduction

- New OSHA Standard
- Again, this new, comprehensive standard addresses ...
  - Key hazards related to cranes and derricks on construction worksites, including the four main causes of worker death and injury: electrocution, crushed by parts of the equipment, struck-by the equipment/load, and falls.
  - Significant requirements in this new rule include: a pre-erection inspection of tower crane parts, use of synthetic slings in accordance with the manufacturer's instructions during assembly/disassembly work, assessment of ground conditions, qualification or certification of crane operators, qualification of riggers and signalpersons, and procedures for working in the vicinity of power lines.
• New OSHA Standard
• Final standard is expected to ...
  – Prevent 22 fatalities and 175 non-fatal injuries each year.
  – Some other key elements of this rule specify:
    • Employers must comply with local and state operator licensing requirements.
    • Employers must pay for certification or qualification of their currently uncertified or unqualified operators.
    • Written certification tests may be administered in any language understood by the operator candidate.
    • When employers with employees qualified for power transmission and distribution are working in accordance with the power transmission and distribution standard (§ 1910.269), that employer will be considered in compliance with this final rule's requirements for working around power lines.
    • Employers must use a qualified rigger for rigging operations during assembly/disassembly.
    • Employers must perform a pre-erection inspection of tower cranes.
Introduction

• New OSHA Standard
• Operation Qualification/Certification
• Final rule requires ...
  – Operators of most types of cranes to be qualified or certified under one of the options set forth in § 1926.1427.
  – Employers have up to 4 years to ensure that their operators are qualified or certified, unless operating in a state or city that has operator requirements.
  – If a city or state has its own licensing or certification program, OSHA mandates compliance with that city or state's requirements only if the requirements meet the minimum criteria set forth in the new OSHA standard.
  – Certification requirements in final rule designed to work in conjunction with state and local laws.
  – Rule clarifies that employers must pay for all training required and for certification of equipment operators employed.
General Requirements for All Cranes

• Guidelines
• Application
• This standard applies to power-operated construction equipment that can hoist, lower, and horizontally move a suspended load. Such equipment includes, but is not limited to:
  – Articulating cranes (e.g., knuckle-boom cranes)
  – Crawler cranes
  – Floating cranes
  – Cranes on barges
  – Locomotive cranes
  – Mobile cranes (e.g., wheel-mounted, rough-terrain, all-terrain, commercial truck-mounted, and boom truck cranes)
  – Multi-purpose machines when configured to hoist and lower (by means of a winch or hook) and horizontally move a suspended load
  – Industrial cranes (e.g., carry-deck cranes)
  – Dedicated pile drivers
  – Service/mechanic trucks with a hoisting device
  – Crane on a monorail
  – Tower cranes (e.g., fixed jib “hammerhead boom”, luffing boom and self-erecting)
  – Pedestal cranes
  – Portal cranes
  – Overhead and gantry cranes
  – Straddle cranes
  – Sideboom cranes
  – Derricks
• ... and variations of such equipment.
General Requirements for All Cranes

• Guidelines

• Exclusions
  – Specific exclusions (e.g., power shovels, excavators, and backhoes)
  – Limited exclusions (e.g., digger derricks, articulating/knuckle-boom truck cranes)
General Requirements for All Cranes

- Guidelines
- State OSHA Plans
- It is important to note ...
  - Some states have their own state OSHA programs, which may immediately not be affected by the new rule.
  - State Plans must issue job safety and health standards within 6 months of federal issuance that are “at least as effective as” comparable federal standards.
  - State Plans also have the option to promulgate more stringent standards or standards covering hazards not addressed by federal standards.
General Requirements for All Cranes

TIP: What is a State OSHA Program?
Section 18 of the Occupational Safety and Health Act of 1970 (the Act) encourages States to develop and operate their own job safety and health programs. OSHA approves and monitors State plans and provides up to 50 percent of an approved plan's operating costs.

There are currently 22 States and jurisdictions operating complete State plans (covering both the private sector and State and local government employees) and 5 - Connecticut, Illinois, New Jersey, New York and the Virgin Islands - which cover public employees only. (Eight other States were approved at one time but subsequently withdrew their programs).

LINK: http://www.osha.gov/dcsp/osp/faq.html#oshaprogram
General Requirements for All Cranes

• Guidelines
  – Stay within crane’s design limits.
  – Consult manufacturer’s manual.
  – Manual must be kept on each crane.
General Requirements for All Cranes

• Guidelines
• Assembly / Disassembly
• When assembling or disassembling equipment (or attachments),
  – Employer must comply with all applicable manufacturer prohibitions and must comply with either:
    • a) Manufacturer procedures applicable to assembly and disassembly, or
    • (b) Employer procedures for assembly and disassembly.
    • Employer procedures may be used only where the employer can demonstrate that the procedures used meet the requirements in § 1926.1406 (open the tip to learn more). Note: The employer must follow manufacturer procedures when an employer uses synthetic slings during assembly or disassembly rigging.
TIP: § 1926.1406 Assembly/Disassembly—employer procedures—general requirements.
(a) When using employer procedures instead of manufacturer procedures for assembly/disassembly, the employer must ensure that the procedures:
(1) Prevent unintended dangerous movement, and prevent collapse, of any part of the equipment.
(2) Provide adequate support and stability of all parts of the equipment.
(3) Position employees involved in the assembly/disassembly operation so that their exposure to unintended movement or collapse of part or all of the equipment is minimized.
(b) Qualified person. Employer procedures must be developed by a qualified person.

Tip
Why is this section important?
On January 30, 2006, an employee was crushed by the lower end section of the lattice boom on a truck-mounted crane while working from a position underneath the boom to remove the 2nd lower pin. When the 2nd lower pin was removed, the unsecured/uncribbed boom fell on the employee.
General Requirements for All Cranes

• Guidelines
• Assembly / Disassembly
  – The standard supplies a number of definitions helpful to understanding certain applications. We’ve provided several of the new ones. In addition, we’ve provided four fact sheets from OSHA on Assembly/Disassembly, Operator Certification, Qualified Rigger and Qualified Signal person for viewing or download as well. Click on the tabs for this information.
General Requirements for All Cranes

A/D director (Assembly/Disassembly director) means an individual who meets this subpart’s requirements for an A/D director, irrespective of the person’s formal job title or whether the person is non-management or management personnel.

Competent person means one 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 authorization to take prompt corrective measures to eliminate them.

Qualified person means a person who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training and experience, successfully demonstrated the ability to solve/resolve problems relating to the subject matter, the work, or the project.

Qualified rigger is a rigger who meets the criteria for a qualified person.
General Requirements for All Cranes

• Guidelines
• Assembly / Disassembly
  – A/D Director = “competent & qualified person”
  – A/D Director must:
    • Understand procedures
    • Review procedures (unless A/D Director has used them before)
    • Check that crew members understand their tasks, hazards
  – Follow manufacturer’s prohibitions
  – All rigging work is done by a Qualified Rigger
  – When using outriggers, the equipment must fully extend or deploy as per the load chart.
General Requirements for All Cranes

**TIP #1:** A *Qualified rigger is a rigger who meets* the criteria for a qualified person. A *Qualified person means a person who*, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training and experience, successfully demonstrated the ability to solve/resolve problems relating to the subject matter, the work, or the project.

**TIP #2:** When rigging is used for assembly/disassembly, the employer must ensure that:

1. The rigging work is done by a qualified rigger.
2. Synthetic slings are protected from: Abrasive, sharp or acute edges, and configurations that could cause a reduction of the sling’s rated capacity, such as distortion or localized compression. **Note:** Requirements for the protection of wire rope slings are contained in 29 CFR 1926.251(c)(9).
3. When synthetic slings are used, the synthetic sling manufacturer’s instructions, limitations, specifications and recommendations must be followed.
General Requirements for All Cranes

• Pre-Use Inspection
• For modified equipment, repaired/adjusted equipment, and post-assembly prior to each use, a qualified person (designated by the employer) must inspect the crane. The typically operator conducts this inspection.
• Any items noted for repair or maintenance should be documented and followed up to ensure completion.
• Mandatory annual inspection
  – Required by OSHA.
  – Must be documented.
  – Specific to each crane.
  – Must be readily available.
  – Typically kept on board crane.

Tip: Some states, like California, mandate that a current copy of the annual inspection and certification be kept in the cab of each crane.
General Requirements for All Cranes

• Modifications/additions
  – Need manufacturer approval
  – Done by authorized mechanic or facility
  – Must meet or exceed original strength
General Requirements for All Cranes

• Surrounding Hazards
  – Above/beside: watch out for
    • Contact with power lines
    • Contact with other cranes or buildings
General Requirements for All Cranes

- Electrical Hazards
  - Look for wires and other hazards within the swing area of the boom
  - Maintain a minimum 10 ft. Clearance (Up to 50 kV only)
  - Higher voltage needs more clearance

TIP: Nearly 30% of the approximately 350 electrical-related fatalities that occur each year involve cranes and overhead power lines.
General Requirements for All Cranes

- Electrical Hazards
- Power Lines
- When working around power lines,
  - It is critical that a safe work zone is identified. OSHA requires hazard assessments and precautions inside the work zone.
  - Before beginning equipment operations, the employer must:
    - (1) Identify the work zone by either:
      - (i) Demarcating boundaries (e.g., with flags, a range limit device, or range control warning device) and prohibiting the operator from operating the equipment past those boundaries, or
      - (ii) Defining the work zone as the area 360 degrees around the equipment, up to the equipment’s maximum working radius.
Could you get within 20 feet of power line?

YES

**Option #1**
Deenergize & Ground

**Option #2**
20-foot clearance

**Option #3**
Ask Utility for Voltage and Use Table A (with minimum clearance distance)

---

**Encroachment Prevention Measures (Equipment Operations)**

- Planning meeting
- If tag lines used = non-conductive
- Elevated warning lines, barricade or line of signs

**PLUS (Choose one):**

- Proximity alarm, spotter, warning device, range limiter, or insulating link

---

NO

No further action
<table>
<thead>
<tr>
<th>Voltage (nominal, kV, alternating current)</th>
<th>Minimum clearance distance (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 50</td>
<td>10</td>
</tr>
<tr>
<td>over 50 to 200</td>
<td>15</td>
</tr>
<tr>
<td>over 200 to 350</td>
<td>20</td>
</tr>
<tr>
<td>over 350 to 500</td>
<td>25</td>
</tr>
<tr>
<td>over 500 to 750</td>
<td>35</td>
</tr>
<tr>
<td>over 750 to 1000</td>
<td>45</td>
</tr>
<tr>
<td>over 1000</td>
<td>(as established by the power line owner/operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution)</td>
</tr>
</tbody>
</table>
Intentionally Working Closer Than Table A Zone

**Must Show:**
- Staying outside zone is infeasible
- Infeasible to de-energize and ground

**All of the following are required:**

1. Power line owner – **sets minimum approach distance**
2. Planning meeting – minimum procedures
   - Dedicated spotter
   - Elevated warning line or barricade
   - Insulating link/device
   - Nonconductive rigging
   - Range limiter (if equipped)
   - Nonconductive tag line (if used)
   - Barricades - 10 feet from equipment
   - Limit access to essential workers
   - Prohibit non-operator workers from touching above insulating link
   - Properly ground crane
   - Deactivate automatic re-energizer
   - Insulating line cover-up installed
General Requirements for All Cranes

• What do I do if the crane contacts an energized line?
  – Stay in the cab if at all possible.
  – Do Not touch the ground and the crane at the same time.
  – Once on the ground, shuffle your feet. DO NOT RUN!!!!!

**LINK:** http://www.osha.gov/SLTC/etools/construction/electrical_incidents/cranes.html

Tip: Range limiter or range control limit device is a device that can be set by an equipment operator to limit movement of the boom or jib tip to a plane or multiple planes.
General Requirements for All Cranes

• Stability
• Ground Conditions
• The controlling entity must:
  – Ensure that necessary ground preparations are met and include, but are not limited to, firm, drained, and graded ground that is sufficient to support the crane (in conjunction with blocking, mats, etc.).

TIP: Controlling entity means an employer that is a prime contractor, general contractor, construction manager or any other legal entity which has the overall responsibility for the construction of the project—its planning, quality and completion.
General Requirements for All Cranes

- Stability
- Ground Conditions
- Controlling entity must:
  - Inform the user of the equipment, as well as the operator of the location, of hazards beneath the equipment set-up area (e.g., voids, tanks, utilities) if those hazards are identified in documents (such as site drawings, as-built drawings, and soil analyses) that are in the possession of the controlling entity (whether at the site or off-site) or the hazards are otherwise known to that controlling entity.

TIP: Information about ground conditions now includes all information known about ground conditions, including written information in possession of the controlling employer, whether on site or off site.

Tip: Key information to determine the capacity of the soil to handle a load and to characterize the site can often be found in the soils engineer's report.
General Requirements for All Cranes

• Stability
  – Cranes must:
    • Be set up on firm, stable, level ground.
    • With outriggers/stabilizers, use solid pads.
    • Be verified for level set up.
General Requirements for All Cranes

• Configurations
  – Each configuration has a load chart.
  – Chart must be visible to operator.
  – Load charts must be downgraded for:
    • Older equipment/poor conditions.
General Requirements for All Cranes

- Load Charts
  - Charts/Ratings differ by crane type/make
  - Charts/Ratings differ by situation:
    - Outriggers fully-extended
    - Outriggers half-extended
    - Picking from rubber (no outriggers)
General Requirements for All Cranes

- Signals
- Signal Person
- A signal person must be provided in each of the following situations:
  - The point of operation, meaning the load travel or the area near or at load placement, is not in full view of the operator.
  - When the equipment is traveling, the view in the direction of travel is obstructed.
  - Due to site-specific safety concerns, either the operator or the person handling the load determines that it is necessary.
• Signals
• Signal types include:
  – Hand
  – Voice
  – Audible or
  – “New”
  – Note: Operators must refrain from engaging in any practice that would divert their attention while operating a crane. This includes the use of cell phones except when the cell phones are used for signal communications. OSHA in their crane safety training program identifies that when using a cell phone for signal purposes, the cell phone must be of a hands free type.
Signals

- Signal Person Qualification Requirements:
  - Know & understand signals
  - Competent in using signals
  - Basic understanding of crane operation
  - Verbal or written test plus practical test
General Requirements for All Cranes

• Signals
• Signal person qualifications.
• The employer of the signal person must ...
  – Ensure that each signal person meets OSHA requirements prior to giving any signals. Requirement met by using:
  – Third party qualified evaluator. The signal person has documentation from a third party qualified evaluator, or
  – Employer’s qualified evaluator. The employer’s qualified evaluator assesses the individual and determines that the individual meets the Qualification Requirements of OSHA’s regulation and provides documentation of that determination.

**TIP:** An assessment by an employer’s qualified evaluator under this option is not portable—other employers are not permitted to use it to meet the requirements of this section.
General Requirements for All Cranes

• Signals
• Signal Person Qualifications
• The employer must ...
  – Make the training documentation for whichever option is used available at the site while the signal person is employed by the employer.
  – The documentation must specify each type of signaling (e.g. hand signals, radio signals, etc.) for which the signal person meets the requirements.

General Requirements for All Cranes

• Signals

• Hand Signals
  – Hand signals have been established within the industry.
  – Can be viewed in Appendix A of Subpart CC, Standard Hand Signals.
  – If anyone involved in the operation is uncertain of the signal, the load must not be lifted until a clarification is made.
General Requirements for All Cranes

Operations

• Operations procedures must be developed by a qualified person when the manufacturer’s procedures are unavailable.

• Procedures related to the capacity of the equipment must be developed by a registered professional engineer (familiar with the equipment) when the manufacturer’s procedures are unavailable.

• This information must be readily available in the cab of the crane.
• Operations
• No Distractions
  – Operators cannot be engaged in activities that distract her or his attention while operating the equipment (for example, no cellular phone use unless used for signaling).
General Requirements for All Cranes

- Operations
- Keeping Clear of the Load
- When workers must be in the fall zone to handle a load,
  - the load must be rigged by a qualified rigger.
  - A qualified rigger is a rigger who meets the criteria for a qualified person.
TIP #1: Fall zone means the area (including but not limited to the area directly beneath the load) in which it is reasonably foreseeable that partially or completely suspended materials could fall in the event of an accident.

TIP #2: Qualified person means a person who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training and experience, successfully demonstrated the ability to solve/resolve problems relating to the subject matter, the work, or the project.
General Requirements for All Cranes

- Operations
- Safety devices
  - (1) Crane level indicator.
    - (i) built into the equipment or is available on the equipment.
  - (2) Boom stops, except for derricks and hydraulic booms.
  - (3) Jib stops (if a jib is attached), except for derricks.
  - (4) Equipment with foot pedal brakes must have locks.
  - (5) Hydraulic outrigger jacks and hydraulic stabilizer jacks must have an integral holding device/check valve.
  - (6) Equipment on rails must have rail clamps and rail stops, except for portal cranes.
  - (7) Horn
General Requirements for All Cranes

**Crane level indicator**
The equipment must have a crane level indicator that is either built into the equipment or is available on the equipment. If a built-in crane level indicator is not working properly, it must be tagged-out or removed. If a removable crane level indicator is not working properly, it must be removed. This requirement does not apply to portal cranes, derricks, floating cranes/derricks, and land cranes/derricks on barges, pontoons, vessels, or other means of flotation.

**Horn**
The equipment must have a horn that is either built into the equipment or is on the equipment and immediately available to the operator. If a built-in horn is not working properly, it must be tagged-out or removed. If a removable horn is not working properly, it must be removed.
General Requirements for All Cranes

• Operations
• Operations must not begin ...
  – Unless all of the devices required are in proper working order.
  – If a device stops working properly during operations, the operator must safely stop operations.
  – If any of the devices are not in proper working order, the equipment must be taken out of service and operations must not resume until the device is again working properly.
  – Alternative measures are not permitted to be used.
General Requirements for All Cranes

- Operations
- Operational Aids
- Devices that assist the operator in the safe operation of the crane by providing information or automatically taking control of a crane function.
  - These include, but are not limited to:
    - Category 1 include:
      1. Boom hoist limiting device.
      2. Luffing jib limiting device.
      3. Anti two-blocking device.

**TIP:** Category 1 operational aids replace parts must be repaired within 7 days of discovery of deficiency. Beware as there are exceptions.

**Tip:** The anti-two blocking device prevents the main block or headache ball from jamming into the head of the boom and possibly pulling the boom over backwards or breaking the load line, causing an accident.
General Requirements for All Cranes

- Operations
- Operational Aids
- Category II operational aids include but not limited to:
  - Boom angle or radius indicator.
  - Jib angle indicator if the equipment has a luffing jib.
  - Boom length indicator if the equipment has a telescopic boom.
  - Load weighing and similar devices.
  - Outrigger/stabilizer position (horizontal beam extension) sensor/monitor.
  - Hoist drum rotation indicator.

**TIP #1:** Replacement of parts for Category II, operations aids OSHA specifies that they must be repaired within 30 days of discovery of deficiency.

**TIP #2:** There are exemptions and much more specifics on operational aids in the standard and your encouraged to review those specifics in § 1926.1416 Operational aids.
General Requirements for All Cranes

- Operations
- Repairs/Adjustments
- When any necessary repairs or adjustments are needed for the equipment and alternative methods are being implemented, the employer must communicate this information to all affected employees at the beginning of each shift.
General Requirements for All Cranes

- Operations
- Fall Protection
- Fall protection requirements are specified in the OSHA’s Cranes and Derricks final rule.
  - Training is required regarding the criteria and use of fall protection systems that is consistent with 29 CFR 1926 subpart M.
  - Anchor points for fall protection systems must meet subpart M requirements and criteria.
  - Is this photo an example of a good practice or bad practice? Use your mouse to find out.

**LINK:** http://www.osha.gov/SLTC/fallprotection/construction.html
General Requirements for All Cranes

• Operations
• Tag Lines Required in some states
  – Easy to use
  – Allows for extra control
  – Adds to worker safety

**TIP:** If tag lines are used, they should and in certain cases must be nonconductive. Tag lines must never be wrapped around the hand, wrist or body of the holder.
General Requirements for All Cranes

• Overhead Loads: Operators
  – Crane operators:
    • Cannot always see the load.
    • Must rely on the rigger for sight-lines.
    • And riggers must communicate constantly.
    • Must ensure that no load is carried directly over workers.

General Requirements for All Cranes

- Overhead Loads: Riggers
  - Riggers:
    - must maneuver a load safely when operator cannot see it
    - must warn workers of overhead exposure
    - hooks are required by OSHA to use spring-loaded keeper for hook

Tip: Sorting hooks do not have safety latches. Sorting hooks must never be used for lifting overhead loads.
General Requirements for all Cranes

Review Crane Regulations
• Required Documentation
• Monthly & annual inspection reports for the equipment and wire rope
• Modifications that affect the safe use of the equipment
• Operator and signal person qualifications
• Tower crane foundation/support design
• When repairs or adjustments of the equipment are needed
• Employer-developed procedures (i.e., assembly/disassembly, operational, and other procedures related to the safe operation of the equipment)
• Power line encroachment procedures/plan, and more.
Types of Cranes

• Rough Terrain Crane

• Light- to medium-capacity:
  – High mobility without load.
  – Limited capacity to maneuver with load.
  – Refer to load chart for guidelines.
Types of Cranes

- Rough Terrain Crane
  - All-wheel drive
  - All-wheel steering
  - Independent front and rear steering
Types of Cranes

• Truck Mounted Crane
  – Mounted on truck chassis
  – Either lattice or hydraulic boom
  – Medium- to high-capacity
  – Not for muddy conditions
Types of Cranes

- Crawler Crane
  - Also called “conventional”
  - Steel tracks
  - Lattice Booms
  - High capacity and reach
Types of Cranes

- **Tower Crane (CRA_5Ejpg)**
  - Used on high-rise projects
  - Crane erected on “tower” or mast
  - Some able to be “jacked up”
  - Medium duty over wide area
Rough Terrain Cranes

• Outriggers (CRA_6Ajpg)
  – Should be fully extended
  – Should lift crane tires clear of ground contact
  – Rule of thumb: outrigger pads should be used and should be 3 times the area of the outrigger float.
Rough Terrain Cranes

- Extra Pads for Outriggers
  - May be required for uneven ground
  - When no pads available, jobsite materials can be used instead
  - Materials should be solid wood
    - Do not use loose timbers
    - Never use masonry products
Rough Terrain Cranes

• Wheels off the ground
• Outriggers need to lift the crane tires off the ground
  – Load chart must be reviewed before picking
  – Any weight bearing contact on tires reduces lifting capacity

Tip: Any weight on the tires makes a pick "on rubber" and reduces load capacity of the crane by as much as 50%.
Rough Terrain Cranes

• Boom Design and Capacity
  – Modern cranes structurally lighter and stronger
  – Older cranes failed mostly from stability problems
  – Modern cranes fail mostly from structural collapse
  – Full-capacity picks only possible when all guidelines can be followed
Rough Terrain Cranes

• Boom Failure: Sideloadening
  – Uneven crane set-up can cause boom to sideload
  – Swinging loads can sideload the boom
  – Wind can sideload the boom
Rough Terrain Cranes

• Load Lines: Main Block
  – Main block has multiple pulleys or “sheaves”
  – Block can be reeved multiple times with main line to lift maximum capacity
  – Main block used for heavy loads
Rough Terrain Cranes

• Whip Line Safety
  – Single line
  – Headache ball and hook attached to whip line by wedge socket
  – Inspect wedge socket and clamps for wear or contact to main line
  – Bolt a clamp to dead end of cable
    • Nuts of clamp should always face away from the main line to prevent contact
Rough Terrain Cranes

- Anti-Two Block Weighted safety device
  - Weights keep switch active
  - If weight is lifted, switch shuts down hoist

Tip: The anti-two blocking device prevents the main block or headache ball from jamming into the head of the boom and possibly pulling the boom over backwards or breaking the load line, causing an accident.
Rough Terrain Cranes

- Anti-Two Block (contd.)
- The anti-two block device prevents the main block or headache ball from jamming into the head of the boom and possibly pulling the boom over backwards or breaking the load line, causing an accident.
  - OSHA requires use when workers are suspended in basket from crane
  - Many companies require use at all times
Rough Terrain Cranes

• Visibility

• Windows and Mirrors
  • Operator must have clear vision
  • All glass must be free of damage
  • Must be safety glass
  • Mirrors must be adjusted and clean
Truck Mounted Cranes

• Lattice Booms
  – Inspect for proper set-up/outrigger use
  – Use fifth outrigger when necessary
  – No counterweight unless by manufacturer specs
Truck Mounted Cranes

– Lattice Booms: Short Boom
  • Notice short length of boom
  • For high-capacity lift
  • Boom can be lengthened by adding sections
  • Overall length maximum determined by manufacturer
Truck Mounted Cranes

- Truck-mounted Crane with Hydraulic Boom
  - High-capacity hydraulic
  - Notice folded boom section and jib
  - Requires solid, level surface for set up
Truck Mounted Cranes

- Hydraulic boom
  - Note head of boom
  - Note number of sheaves for reeving

- Now look at the photo of this truck crane. Do you spot any hazards? Use your mouse to verify.
Crawler Cranes

• Crawler Cranes: Lattice Booms
• Typically have highest picking capacity
  – May have several hundred feet of boom
  – Being level is critical for long booms
Crawler Cranes

• Counterweight Flag off swing area
  – 360 degree swing
  – OSHA requires “worker safety zone”
Crawler Cranes

- Tower Cranes
- New Supplemental Requirements
- Supplemental tower crane requirements include, but are not limited to:
  - Foundations & structural supports
    - Design & Inspection
  - Plumb tolerance
    - Specification & verification
  - Climbing procedures
    - Host structure strength verification
    - Wind
  - Post-erection load test; and
  - Monthly Inspection:
    - Tower mast bolts, upper-most tie-in, braces, floor supports, floor wedges

TIP: Wind speed. Wind must not exceed the speed recommended by the manufacturer or, where manufacturer does not specify this information, the speed determined by a qualified person.
• Tower Cranes
  – Medium-duty, but versatile
  – 360-degree rotation
  – Good capacity along entire length of boom
  – Components are mast, main jib, and counter jib
• Crane Manual
  – Verify load charts with respect to crane model
Load Charts

- Heavy line separates structural performance from stability
- Structural values above line
- Stability values below line
- Values must never be exceeded
Load Charts

• Load Chart: Stability
  – If values below line are exceeded, tip-over failure can occur
  – Stability values on chart are:
    • 85% of load failure values while on outriggers
    • 75% of load failure values while on rubber
  – Critical pick penetrates 85% of load chart value
Load Charts

- Load Charts
- Load charts must contain at least the following information:
  - (i) Rated capacity at corresponding ranges of boom angle or operating radii
  - (ii) Specific lengths of components to which the rated capacities apply
  - (iii) Required parts for hoist reeving
  - (iv) Size and construction of rope must be included on the load chart or in the operating manual
Load Charts

- Load Charts:
- On-board Computers
  - Will depict boom length, radius angle, and capacity at all times
  - Will display weight of load
Load Charts

• On-board Computers
  – Back-up systems not intended to replace load chart
  – Limit-switches prevent bad picks.
## Inspections and Certifications

<table>
<thead>
<tr>
<th>Type of Inspection</th>
<th>Who Inspects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modified or</td>
<td>Qualified person</td>
</tr>
<tr>
<td>repaired/adjusted</td>
<td></td>
</tr>
<tr>
<td>Post-assembly</td>
<td>Qualified person</td>
</tr>
<tr>
<td>Shift</td>
<td>Competent person</td>
</tr>
<tr>
<td>Monthly</td>
<td>Competent person</td>
</tr>
<tr>
<td>Annual</td>
<td>Qualified person</td>
</tr>
</tbody>
</table>
Inspections and Certifications

• Inspections
• Documentation and Tower Cranes
• All documentation required by the inspection provisions of the standard must be available to inspectors performing required inspections (including wire rope inspections).
• With respect to pre-erection inspection for tower cranes, a new requirement to include inspection of crane components after transportation to the work site and prior to erection of the crane.
Inspections and Certifications

- Inspections
- Inspections of Modified Equipment.
- Equipment that has had modifications or additions which affect the safe operation of the equipment or capacity must be inspected by a qualified person after such modifications/additions have been completed, prior to initial use.
- Inspection must meet specific OSHA requirements and must include functional testing of the equipment.
- Equipment must not be used until required inspection has been met.
Inspections and Certifications

- Inspections
- Worker Participation
- Worker Training
  - Workers must be trained to recognize and avoid hazards.
  - Workers must understand this training
    - Provided in a manner they understand
      - Oral/written training
    - Provided in a language they understand
      - Some Spanish language materials are already available through OSHA
Inspections and Certifications

- Competent and Qualified Persons
- OSHA definitions:
  - “Competent person” means one who is capable of identifying existing and predictable hazards in surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate those hazards.
  - “Qualified person” means a person who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training and experience, successfully demonstrates the ability to solve/resolve problems relating to the subject matter, the work, or the project.
• Certification

• Who needs to be certified or qualified?
  – Any person engaged in a construction activity who is operating a crane covered by the new cranes and derricks rule, except:
    • sideboom cranes*
    • derricks*
    • equipment with a rated hoisting/lifting capacity of 2,000 pounds or less*

• Operators of the listed equipment must meet the criteria for minimum expertise described in the applicable section in subpart CC.
Inspections and Certifications

• Certification
• Digger Derricks
• Operators of digger derricks ...
  – are required to be qualified or certified
    • (unless the digger derrick is being used to auger holes for poles carrying electric or telecommunication lines, place or remove the poles, or handle associated materials to be installed on or removed from the poles).
Inspections and Certifications

- Certification
- Costs
- OSHA specifies that whenever operator qualification or certification is required under the OSHA requirements, the employer must provide the qualification or certification at no cost to operators who are employed by the employer.
Conclusion

- **Employer Responsibilities**
- Provide a workplace free from serious recognized hazards and comply with standards, rules and regulations issued under the OSHA Act.
- Examine workplace conditions to make sure they conform to applicable OSHA standards.
- Make sure employees have and use safe tools and equipment and properly maintain this equipment.
- Use color codes, posters, labels or signs to warn employees of potential hazards.
- Establish or update operating procedures and communicate them so that employees follow safety and health requirements.
- Provide medical examinations and training when required by OSHA standards.
- Keep records of work-related injuries and illnesses.

[LINK](http://www.osha.gov/as/opa/worker/employer-responsibility.html)
• Employer Responsibilities
• Additionally, employers who operate cranes on a construction site are ...
  – responsible for complying with all aspects of the crane standards, but other employers whose personnel work at the site have responsibilities as well.
  – These employer duties are consistent with OSHA’s multi-employer policy, which recognizes that the Occupational Safety and Health Act imposes compliance duties on:
    • (1) employers who create or control hazards,
    • (2) employers whose employees are exposed to hazards, and
    • (3) employers with general supervisory authority over a worksite.
Conclusion

• Conclusion
• Take Away Information from this training
• Nearly 6.5 million people work at approximately 252,000 construction sites across the nation on any given day. The fatal injury rate for the construction industry is higher than the national average in this category for all industries.
• The Hazard: Significant and serious injuries may occur if cranes are not inspected before use and if they are not used properly. Often these injuries occur when a worker is struck by an overhead load or caught within the crane's swing radius. Many crane fatalities occur when the boom of a crane or its load line contact an overhead power line.
Conclusion

- Conclusion
- Solutions:
  - Check all crane controls to insure proper operation before use.
  - Inspect wire rope, chains and hook for any damage.
  - Know the weight of the load that the crane is to lift.
  - Ensure that the load does not exceed the crane's rated capacity.
  - Raise the load a few inches to verify balance and the effectiveness of the brake system.
  - Check all rigging prior to use; do not wrap hoist ropes or chains around the load.
  - Fully extend outriggers.
  - Do not move a load over workers.
  - Barricade accessible areas within the crane's swing radius.
  - Watch for overhead electrical distribution and transmission lines and maintain a safe working clearance of at least 10 feet from energized electrical lines.
• Conclusion

• Worker participation ...
  – Is a vital component of any crane and derrick operation and any workplace injury and illness prevention program; workers are the best eyes and ears for identifying hazards
  – Workers must be trained on the hazards they face and ways to prevent the hazards
• Conclusion
• Summary
  – This completes your training session on crane safety. We have covered the basic safety-related elements of crane operation including:
    • General requirements for all cranes
    • Inspections
    • Electrical hazards
    • Stability and ground conditions
    • Load charts
    • Signaling requirements
    • Certifications
    • Special emphasis on the new 2010 OSHA crane regulation
Material Hoists

• Material Hoists and Conveyors
• This short discussion is designed to be a supplement to the crane safety module just completed. We will discuss basic safety requirements, hazard recognition and hazard mitigation with respect to material hoists and conveyors.
Material Hoists

- Material Hoists
- Shall be constructed and installed in accordance with ANSI A10.5
- Shall be erected and dismantled under the direct supervision of a qualified individual.
- Material hoist towers, masts, guy or braces, counterweights, drive machinery supports, sheave supports, platforms, supporting structures, and accessories shall be designed by a licensed engineer.
- All hoists shall be and operated and maintained in compliance with the manufacturers specifications.
Material Hoists

- Daily Inspection
- Check for any loose or missing parts.
- Identify the location of the electrical disconnect switch and ensure it works, is readily accessible and has free access
- Evaluate wire rope to ensure it is properly seated on the drum and sheave grooves without any slack or overlapping.
- Validate crane operates correctly by operating several feet in each direction that it travels.
  - Listen for any unusual noises and look for jerky movements.
• Daily Inspections

• Check the wire rope by lowering the block to the lowest level and looking for the following conditions:
  – Reduced diameter of the rope.
  – Any number of broken strands of wires.
  – Kinked, crushed, cut, or “bird caged” wiring, or wiring with heat damage.
Material Hoists

• Daily Inspections
• Check all hooks. Hooks should not be cracked, stretched, bent, or twisted.
• Each hook must have a safety latch that automatically closes the throat of the hook.
• Hooks should rotate freely in block assembly without any “grinding” felt or heard.
• Check the block for damage and ensure the sheaves operate smoothly.
Material Hoists

• Operating Controls

• While hoisting equipment is in operation, the operator shall not perform any other work and shall not leave his/her position at the controls until the load has been safely landed or returned to ground level.
Conveyors

- Conveyor Safety
- Conveyor systems can be very dangerous if you don’t follow specific requirement when working on or around them.
- Taking the time to understand the hazards can save your life or the life of your co-worker.
- Never climb, sit, stand, walk, ride, or touch the conveyor at any time, even when it appears to be “off”.
- Not following this basic rule has caused many deaths and even more serious injuries that include permanent disabilities and amputations.
- It’s your job to ensure you don’t learn this lesson that hard way.
Conveyors

• Conveyor Safety
  – Never perform any maintenance until all hazardous energies are disconnected or blocked out. These include:
    – Electrical
    – Air (Pneumatic), and
    – Hydraulic power sources
  Block the incline on a gravity conveyor before working on it.

• Think BEFORE you Work!
Conveyors

- Conveyor guards
- One commonly noted safety hazard is removal of safety covers and guards
- Manufacturers build conveyors with safety guards for one reason... to help ensure that you go home safely everyday!
- Operating equipment without the guards is adding unnecessary risk to your live and livelihood.
- Make a commitment to always replace every safety device that you remove... doing so will save lives and prevent severe injuries.
Conveyors

• General Safety
• Do not load a stopped conveyor or overload a running conveyor as this helps preserve your conveying equipment because it helps prevent overheating.
• Ensure that all personnel are clear of equipment before starting
• Allow only authorized personnel to operate or maintain material handling equipment
• Only workers who have been trained should be permitted to operate and perform maintenance on conveyors.
Conveyors

• General safety

• How important it is to keep clear of conveyors?
  – What is the value of your life?

• Workers should:
  – Keep their hands and feet away from conveyors.
  – Those with long hair, loose clothes, or ties should never work near any operating equipment... your chances to get “caught” in the moving parts is exponentially higher.
  – Visitors should be briefed on safety and inspected for potential clothes or hair that could be caught before being allowed near the conveyor line.
• Summary
• Hoists
• Erect and dismantle all hoists under the direct supervision of a qualified individual.
• Material hoists and component parts shall be designed by a licensed engineer.
• Operate and maintain all hoists in compliance with the manufacturers specification and have an operating manual.
• Inspect daily including the wire rope, rigging and hook.

Safety Tip: Make sure the hook has a safety latch.
Summary

Conveyors:

– Never climb, sit, stand, walk, ride, or touch the conveyor at any time, even when it appears to be “off”.
– Never perform any maintenance, or open a panel or guard, until all hazardous energies have been safely locked and tagged out.
– Do not load a stopped conveyor or overload a running conveyor.
– Always ensure that all personnel are clear of equipment before starting a conveyor system.
– Allow only authorized personnel to operate or maintain conveyors.
– Keep all body parts and clothing clear of conveying equipment while it is in operation.