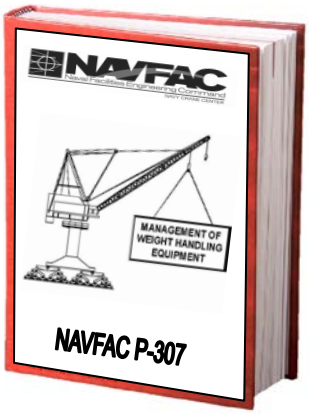
Navy Crane Center



NAVFAC P-307 Training

CONTRACTOR CRANE AWARENESS

WEB BASED TRAINING STUDENT GUIDE

NCC-CCA-03

Naval Facilities Engineering Command
Navy Crane Center
Norfolk Naval Shipyard, Bldg. 491
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INTRODUCTION

Course Introduction

Contractor Crane Awareness is designed to acquaint personnel who write or administer Navy contracts and work involving weight handling equipment with NAVFAC P-307 and industry requirements for contractors and provide a knowledge base on which to build upon with on-the-job experience.
Topics covered include equipment types and terminology, responsibilities, operations, requirements, documentation, and accident identification and reporting.
This course is not totally inclusive of all requirements. Please review NAVFAC P-307 and other documents pertinent to your work for specific and up-to-date requirements.

VIDEO

Video Text

Most crane accidents result from personnel error. Crane accidents can be spectacular such as this crane boom free-fall.

Cranes have been known to topple from the decks of aircraft carriers, overturn while traveling, and tip over because the outriggers were not fully extended. Two-blocking has been the cause of several fatalities at navy shore activities.

Many crane accidents occur due to unplanned contact between the load, crane, or other objects with no substantial damage or injuries. Some have resulted in serious injuries or fatalities.

Many are costly in terms of equipment damage. All have an effect on the Navy's mission and the efficiency of your command.

Near misses are often signs of what might happen if we let the same mistake happen again. Near misses with cranes are often just catastrophes that didn't happen because we were fortunate.

Contractor Crane Accidents

The following screens show some examples of contractor crane accidents.
While not all crane and rigging gear accidents are this extreme, all accidents involving weight handling equipment at Naval Facilities are taken seriously.

Contractors are required to investigate and report all weight handling accidents (crane and/or rigging accidents), near misses, and unplanned occurrences, and identify causal information to develop meaningful corrective actions to prevent similar events from recurring.

Crane Accident History Gallery

Select the navigation buttons to view several crane accidents.

First 1 of 13

This crane overturned while traveling. The rotate lock was not properly engaged for travel and when a tire dipped into a depression in the road, the counterweight caused the machinery house to rotate to the low side and ultimately resulted in the overturned crane.

2 of 13

A contractor's crane was overloaded and overturned while lifting a Navy owned crane. The white bottles in the photo contain propane. The silver bottles contain liquid oxygen. The translucent drum contains waste oil. The 440 volt shore power cables on the right were damaged and sparking. Imagine what could have happened!

3 of 13

This crawler crane was overloaded while using a pile driver attachment.

4 of 13

This crane was overloaded and fell from the flight deck of an aircraft carrier where it was lowering buckets of shot into the trailer. The operator jumped clear of the crane before it went over.

5 of 13

This crane also overturned while traveling. The rotate lock was not engaged.

6 of 13

Here a civilian contractor was moving a 175 ton crane with the boom partially extended. The crane house began a slow rotation clock-wise. The operator saw the bed of the truck begin to tilt, stopped the crane, and attempted to lower the outriggers.

7 of 13

This crane overturned while lifting pre-cast concrete panels. The crane was working on soft ground with a lack of proper cribbing.

8 of 13

Another accident that occurred while lifting pre-cast concrete panels. The load contacted the boom, causing the boom to fail.

9 of 13

The scene the morning after a construction tower crane collapsed due to a foundation problem. One person was killed and several buildings were damaged.

10 of 13

This 19-story crane broke away from an apartment tower while being prepared for jumping. During the lifting of the climbing assembly/section, the rigging failed, causing the section to fall and damage the building ties and the crane to fall. Six construction workers, including the crane operator were killed, along with a tourist visiting the city.

11 of 13

During preparations for jumping a construction tower crane, a 20 foot long tower section of the crane plummeted 30 floors at the site of a high-rise condominium, killing two workers and smashing into a home that the contractor used for storage. Five other workers were injured.

12 of 13

This construction tower crane collapsed, smashing into a high-rise apartment building, killing 2 people and injuring two others.

A contractor employee was operating a boom truck to lift a scissor lift. The crane was overloaded and structural failure of the jib occurred. The load fell approximately six feet to the ground and sustained extensive damage. The operator was not familiar with the crane capacities and load charts.

Accident Causes

Most crane accidents occur due to personnel error.

Accidents have occurred due to personnel operating cranes that are not equipped with properly functioning safety devices, such as load moment indicators, anti two-block devices, load indicating devices and boom length indicators.

In some cases accidents occurred when rigging sketches or lift plans were available but not followed, or were changed without approval.

Overloads have occurred because operators were unaware of load weights.

Accidents have occurred because critical lifts were not identified as such, or because cranes were set up on poor soil or foundation conditions.

Operating cranes with obvious deficiencies such as bent or damaged booms, defective welds, or heavy corrosion, has resulted in accidents.

Operating mobile cranes on barges without tying the crane down to the barge has also contributed to several accidents.

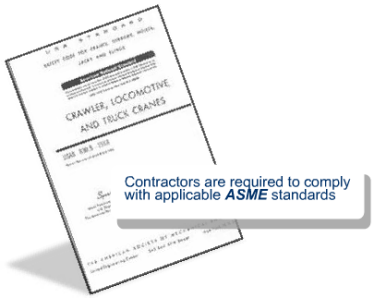
NOTES

CRANE TYPES, STANDARDS, AND COMPONENTS

Welcome

Welcome to Contractor Crane Awareness: Crane Types, Standards, and Components.

Standards



Contractors operating cranes within Naval facilities are required to comply with NAVFAC P-307 Section 11 (Contractor and Other Non-Navy Owned Weight Handling Equipment) and specific activity regulations pertaining to crane safety and operation. Contractors are also required to comply with the applicable ANSI or ASME standards discussed in this module. ASME B-30 standards are written and maintained by the American Society of Mechanical Engineers to establish crane safety standards.

For cranes, machines, and rigging equipment at naval activities in foreign countries, the cranes, machines, and rigging equipment shall comply with the appropriate host nation safety standards.

Mobile Cranes

ASME B30.5 covers mobile cranes including: commercial truck-mounted cranes, wheel-mounted cranes with single or multiple control stations, crawler cranes, and locomotive cranes.

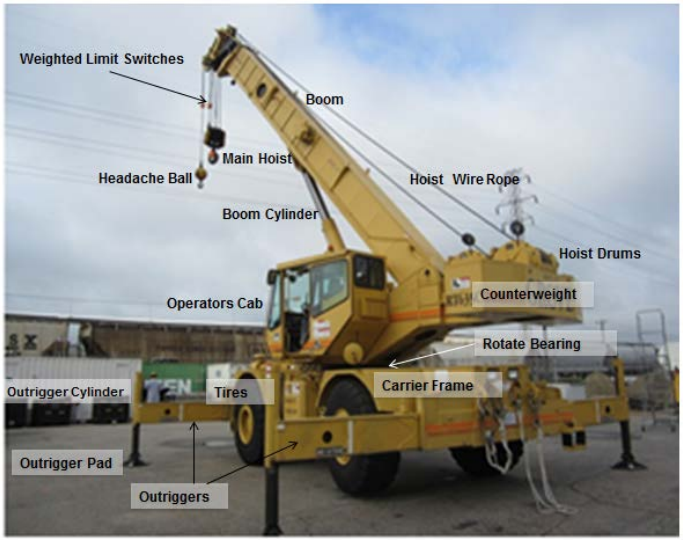
Mobile cranes consist of a fixed or telescoping boom, machinery house or power plant, and one or more operator stations mounted on a mobile frame, base, or platform. The platform, also known as the carrier, may be on rails, wheeled, or crawler treads for travel.

Mobile cranes are the most common type of crane used by contractors at naval installations.

The next screen shows an example of a mobile crane and the main components.

Mobile Crane Terminology

Shown here is a rough-terrain mobile crane with a telescoping boom.

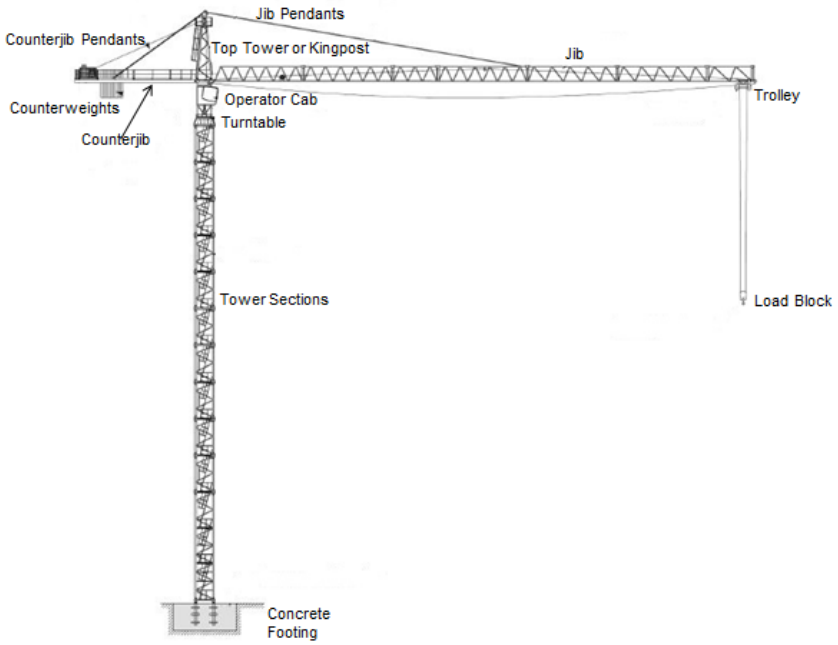


Tower Cranes

Tower cranes are covered by ASME B30.3.
A construction tower crane is a hammerhead, luffing, or other type of tower crane that is regularly assembled and disassembled for use at various sites. It is usually characterized by the ability to climb or telescope (raise or lower by adding or subtracting tower sections).
Tower cranes may also be permanently mounted at one location. The configuration usually remains unchanged during the entire installation period.
Tower cranes are very popular in construction world-wide.
Self-erecting tower cranes are covered by ASME B30.29.

Tower Crane Components

Shown are the main components of a tower crane.



Tower cranes are very safe when properly operated. Most tower crane accidents occur during assembly or disassembly. Jumping, the process of adding or removing sections in order to achieve the required height is another process where accidents occur.
It is vital that OEM guidelines and requirements are followed in this process.

Floating Cranes

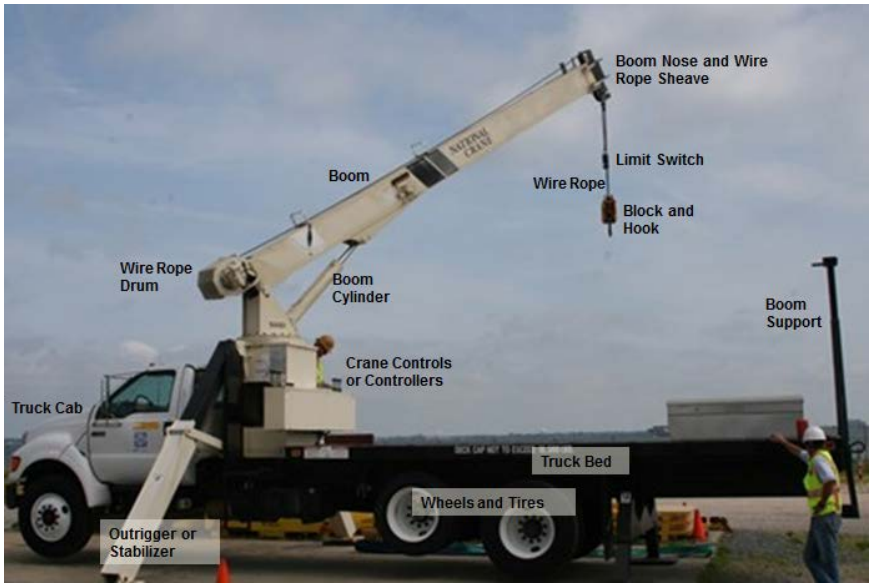
Floating cranes are covered under ASME B30.8.
Floating cranes consist of a rotating superstructure, power plant, operating machinery, and boom mounted on a barge or pontoon. As required by NAVFAC P-307, floating cranes and barge-mounted mobile cranes require a third party certification from an OSHA accredited organization, a wind speed indicating device, and a marine type list and trim indicator readable in one-half degree increments.
Note: Third party certification is not required at Navy activities in foreign countries.

Additional Crane Types

Additional crane types used by contractors include: Commercial truck mounted cranes; Articulating boom cranes, mobile or stationary, including ammunition handling truck/cranes; Pedestal-mounted commercial boom assemblies (fixed length and telescoping types) attached to stake trucks, trailers, flatbeds, barges, or railcars, or stationary mounted to piers, etc.; and hydraulic telescoping boom cranes (stationary or barge-mounted).

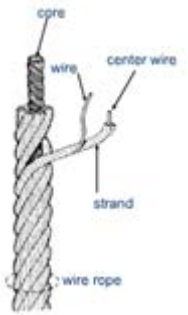
Crane Components

Shown here is a commercial truck mounted crane with a telescoping boom.



Wire Rope

Wire rope used in crane operations is a highly specialized precision product, adaptable to a wide variety of operational uses and conditions.
To meet the specified requirements of different types of service, wire rope is designed and manufactured in a variety of constructions and grades.
Typically, wire rope is made up of six or more strands of wire wrapped around a core. A strand is a group of wires twisted together around a single wire.
Remember to use the proper terminology when describing a suspected wire rope condition.

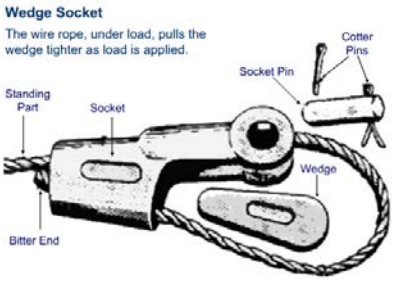


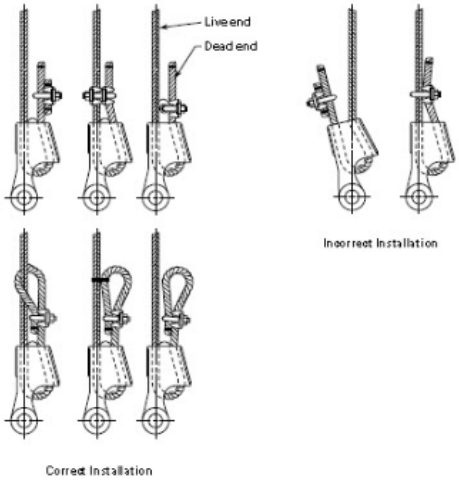
Wire Rope End Connections

Wedge sockets are the most common end fitting for use on mobile cranes, where block and reeving changes may be frequently performed. Poured sockets, either zinc spelter or synthetic resin, are popular where the block configuration is normally unchanged.
Note the improper attachment of the wire rope clip attaching the dead end to the live end of the wire rope on this wedge socket.

Wedge Socket

This diagram of a wedge socket helps to illustrate how the wire rope, under load, will pull the wedge tighter as a load is applied.





Wedge Socket Installation

These illustrations from ASME B30.5 show some correct and incorrect wedge socket installations.

Other Wedge Socket Arrangements

The products shown here may be used to secure the dead end of the wire rope.
The product on the right may actually be used to secure the dead end of the wire rope to the live end. Standard wire rope clips shall not be used for this purpose.

Forged Alloy Steel
Notice the expanded saddle

Malleable Cast Iron

Wire Rope Clips

Drop-forged steel wire rope clips may be used where required for securing wire rope on cranes. Malleable cast iron clips shall not be used.
The wire rope clip on the left is drop-forged from alloy steel. Notice the expanded saddle.
The clip on the right is malleable cast iron.

Improper Installation

This illustration shows that malleable cast iron clips were used where drop-forged steel clips are required.

Boom Angle Indicators

Some boom angle indicators are simple, weighted, mechanical, devices. They should be checked daily as part of the crane operator's daily pre-operational check.

Another Type

This illustration shows a different type of boom angle indicator found on some mobile cranes.

Load Moment Indicators (LMI's)

A load moment indicator (or LMI) aids the crane operator in determining how much weight may be lifted in any crane configuration.

The weight of the load being lifted is calculated by the load moment indicator by using sensors and crane operator inputs.

The load moment indicator is intended to be used as an aid to operation and should never be relied upon to replace the OEM capacity charts and the good judgment of the crane operator.

If either the sensors or the operator supplied inputs are not accurate, the results could be catastrophic.

Crane Level Indicators

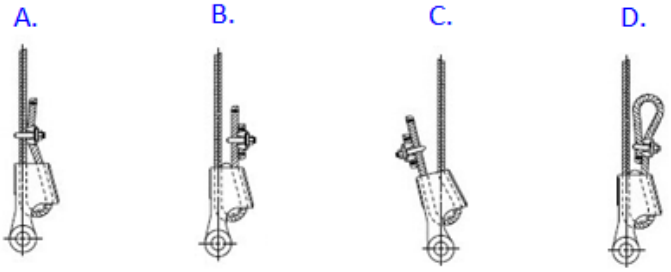
Mobile crane capacity chart values are based on the crane being level in all directions. When the operator's cab-mounted level indicator is centered, the crane should be level within 1 degree, but only if the level indicator is properly installed and calibrated. A crane that is out of level by as little as 3 degrees may lose 50% of its capacity.

Knowledge Check

1. Select the best answer. Which ASME B30 standard contains the requirements for mobile cranes?
   A. ASME B30.5
   B. ASME B30.2
   C. ASME B30.1
   D. ASME B30.9

2. Select the best answer. What is the ASME standard that provides the requirements for Tower cranes?
   A. ASME B30.3
   B. ASME B30.5
   C. ASME B30.9
   D. ASME B30.2

3. Select the two correct wedge socket installation methods from the pictures below.



4. True or False. Malleable cast iron wire rope clips can be used to secure wire rope end connections on cranes.
   A. True
   B. False

5. Select the best answer. Which ASME B30 standard contains the requirements for floating cranes?
   A. ASME B30.5
   B. ASME B30.8
   C. ASME B30.2
   D. ASME B30.1

NOTES

REQUIREMENTS AND RESPONSIBILITIES

Welcome

Welcome to Contractor Crane Awareness - Requirements and Responsibilities.

Contracting Officer Responsibilities

The contracting officer shall include the minimum requirements of NAVFAC P-307 paragraph 11.1 in contracts, ensure compliance with contract requirements, provide oversight of contractor crane and rigging operations, and provide oversight of contractor accident investigations and corrective actions.

The degree of oversight shall be based upon the risk to personnel and property; however, oversight shall be performed at least once and the minimum periodicity shall be not more than every 30 days. When critical lifts are involved, oversight periodicity shall be not more than every 14 days. Appendix P, figure P-2, provides a checklist that shall be used during oversight of contractor crane and rigging operations. Copies of appendix P, figure P-2, shall be kept on file for one year.

For construction contracts, except for the accident notification and reporting requirements of NAVFAC P-307 paragraphs 11.1.h and 11.1.i, contractors must follow UFGS-01 35 26 and USACE EM 385-1-1 in lieu of paragraphs 11.1.a through 11.1.m.

Accident Notification and Reporting

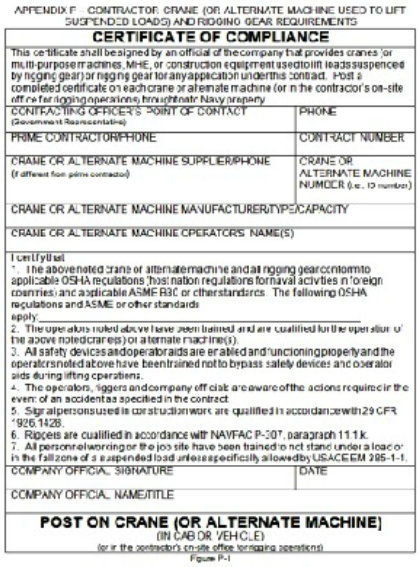
The contracting officer shall notify the host activity of any Weight Handling Equipment accident upon notification by the contractor. Additionally, the contracting officer shall notify the Navy Crane Center, by e-mail of an accident involving a fatality, in-patient hospitalization, overturned crane, collapsed boom, or any other major damage to the crane or adjacent property as soon as possible, preferably within 8 hours of notification by the contractor. For all other accidents, notify the Navy Crane Center as soon as practical but no later than three working days after the accident.

The contracting officer shall provide the Navy Crane Center and host activity a copy of every accident and near miss report, regardless of severity, upon receipt from the contractor, designate a local representative if the office is not in the local area to ensure compliance with these requirements, and sign all crane and rigging accident and near miss reports to indicate that they are satisfied that the contractor's investigation and corrective actions are sufficient.

Contractor Requirements

Contractors are required to comply with the following regulations, standards and requirements:
NAVFAC P-307 (Section 11); U.S. Army Corps of Engineers (USACE) EM-385-1-1 and UFGS-01 35 26 (for NAVFAC contracts); ASME B30 standards for cranes and rigging equipment; applicable OSHA regulations (29 CFR 1926 for cranes/multi-purpose machines used in construction, demolition, or maintenance, 29 CFR 1915 for cranes/multi-purpose machines used in shipbuilding, ship repair, or shipbreaking, and 29 CFR 1917 for cranes/multi-purpose machines used in cargo transfer); applicable ANSI and ASSE standards; and host activity regulations pertaining to crane safety and operation. At naval activities in foreign countries, cranes, machines, and rigging equipment shall comply with the appropriate host nation safety standards.
The contracting officer and/or contracting officer representatives should be familiar with these requirements when crane or applicable operations will be performed.

Certificate of Compliance



APPENDIX F - CONTRACTOR CRANE (OR ALTERNATE MACHINE USED TO LIFT SUSPENDED LOADS) AND RIGGING GEAR REQUIREMENTS

CERTIFICATE OF COMPLIANCE

This certificate shall be signed by an official of the company that provides cranes (or multi-purpose machines, MHE, or construction equipment used to lift loads suspended by rigging gear) or rigging gear for any application under this contract. Post a completed certificate on each crane or alternate machine (or in the contractor's on-site office for rigging operations) brought onto Navy property.

CONTRACTING OFFICER'S POINT OF CONTACT (Government Representative)	PHONE
PRIME CONTRACTOR/PHONE	CONTRACT NUMBER
CRANE OR ALTERNATE MACHINE SUPPLIER/PHONE (if different from prime contractor)	CRANE OR ALTERNATE MACHINE NUMBER (i.e., ID number)
CRANE OR ALTERNATE MACHINE MANUFACTURER/TYPE/CAPACITY	
CRANE OR ALTERNATE MACHINE OPERATORS' NAME(S)	

I certify that:
1. The above-noted crane or alternate machine and all rigging gear conform to applicable OSHA regulations (host nation regulations for naval activities in foreign countries) and applicable ASME B30 or other standards. The following OSHA regulations and ASME or other standards apply: _____
2. The operators noted above have been trained and are qualified for the operation of the above noted crane(s) or alternate machine(s).
3. All safety devices and operator aids are enabled and functioning properly and the operators noted above have been trained not to bypass safety devices and operator aids during lifting operations.
4. The operators, riggers and company officials are aware of the actions required in the event of an accident as specified in the contract.
5. Signal persons used in construction work are qualified in accordance with 29 CFR 1926.1428.
6. Riggers are qualified in accordance with NAVFAC P-307, paragraph 11.1.k.
7. All personnel working on the job site have been trained to not stand under a load or in the fall zone of a suspended load unless specifically allowed by USACE EM 385-1-1.

COMPANY OFFICIAL: SIGNATURE	DATE
COMPANY OFFICIAL: NAME/TITLE	

POST ON CRANE (OR ALTERNATE MACHINE)
(IN CAB OR VEHICLE)
(or in the contractor's on-site office for rigging operations)

Figure P-1

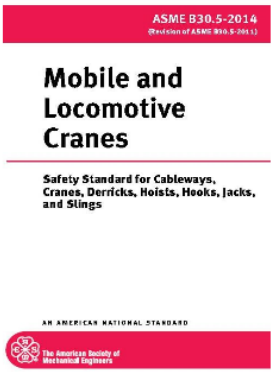
Contractors operating cranes or multi-purpose machines, material handling equipment (MHE), or construction equipment used to lift loads suspended by rigging gear are required to complete the Certificate of Compliance found in NAVFAC P-307 appendix P-1. (For construction contracts, the Certificate of Compliance found in EM 385-1-1 shall be used.)
This certificate is to be signed by the appropriate contractor company official and shall be posted on each crane or alternate machine brought onto Navy property (or in the contractor's on-site office for rigging operations).
The certificate of compliance states, and the company official certifies that the noted crane or alternate machine and all rigging gear conform to applicable OSHA regulations (host nation regulations for naval activities in foreign countries) and applicable ASME B30 or other standards, the operator or operators have been trained and are qualified for the operation of the noted crane(s) or alternate machine(s), all safety devices and operator aids are enabled and functioning properly and the operators have been trained not to bypass safety devices and operator aids during lifting operations, the operators, riggers and company officials are aware of the actions required in the event of an accident as specified in the contract, signal persons used in construction work are qualified in accordance with 29 CFR 1926.1428, riggers are qualified in accordance with NAVFAC P-307, paragraph 11.1.k, and all personnel working on the job site have been trained to not stand under a load or in the fall zone of a suspended load unless specifically allowed by USACE EM 385-1-1.
The contracting officer reviews the certificate for accuracy, ensuring that the company official and title are identified, and that the completed and signed certificate is posted on each crane or alternate machine.

Contractor Accidents

In the event of a contractor accident, the contractor shall:
Notify the contracting officer as soon as practical, but no later than four hours after any WHE accident.
Secure the accident site and protect evidence until released by the contracting officer.
Conduct an accident investigation to establish the root cause or causes of any WHE accident, near miss, or unplanned occurrence. Crane operations shall not proceed until the cause is determined and corrective actions have been implemented to the satisfaction of the contracting officer.
Provide the contracting officer a report for an accident or near miss within 30 days using the appropriate form provided in NAVFAC P-307, section 12 consisting of a summary of circumstances, an explanation of causes, photographs (if available), and corrective actions taken.

Host Activity Responsibilities

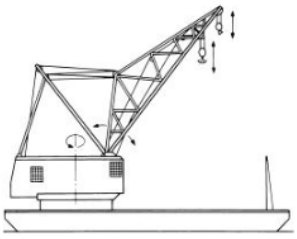
The host activity shall: ensure contracts contain the requirements in NAVFAC P-307 section 11, concur with the contracting officer's oversight plan, ensure that the oversight plan is being carried out, and provide oversight of contractor accident and near miss investigations and corrective actions.



Contractor Crane Requirements

Contractor cranes must comply with applicable ASME B30 standards. Contract personnel should be familiar with project specific B30 standards, including: B30.3 Tower cranes; B30.5 Mobile cranes; B30.8 Floating cranes; and B30.22 Articulating boom cranes.
Mobile cranes are widely used by contractors, therefore, knowledge of B30.5 is particularly important.

Additional Floating Crane Requirements



In addition to ASME B30.8 requirements, floating cranes and barge-mounted mobile cranes require a third party certification from an OSHA accredited organization (or a third party certification from a state accredited organization for those states with OSHA approved state plans), a load indicating device, a wind speed indicating device, and a marine type list and trim indicator readable in one-half degree increments.
Third party certification is not required for floating cranes and barge-mounted mobile cranes at Navy activities in foreign countries.

Multi-purpose Machines

Multi-purpose machines, Material Handling Equipment (MHE), and construction equipment used to lift loads suspended by rigging equipment, require proof of authorization from the machine original equipment manufacturer (OEM) that the machine is capable of making lifts of loads suspended by rigging equipment. Written approval from a qualified registered professional engineer, after a safety analysis is performed, is allowed in lieu of the OEM's approval.
The contractor must demonstrate that the equipment is properly configured to make such lifts and is equipped with a load chart.

Hooks

Hooks used on cranes, hoists, other machines, and rigging gear shall have self-closing latches or the throat opening shall be "moused" (secured with wire, rope, heavy tape, etc.) or otherwise secured to prevent the attached item or rigging equipment from coming free of the hook under a slack condition.

Critical Lift Plan

A critical lift plan is required for each of the following lifts: lifts over 75 percent of the capacity of the crane, hoist, or other machine (lifts over 50 percent of the capacity of a barge-mounted mobile crane's hoists) at any radius of lift; lifts involving more than one, crane, hoist, or other machine; lifts of personnel (lifts of personnel suspended by rigging equipment from multi-purpose machines, MHE, or construction equipment shall not be permitted); lifts made in the vicinity of overhead power lines; erection of cranes; lifts of submerged or partially submerged objects; lifts involving binding conditions; lifts of hazardous materials; and lifts involving non-routine rigging or operation, sensitive equipment, or unusual safety risks.

Critical Lift Plan (EM 385-1-1)

For construction contracts governed by EM385-1-1 requirements, the following lift types require a critical lift plan. Critical lifts are defined as: lifts involving hazardous materials (e.g., explosives, highly volatile substances); hoisting personnel with Load Handling Equipment (LHE); lifts made with more than one LHE; lifts where the center of gravity could change; lifts made when the load weight is 75% of the rated capacity of the LHE load chart or more (not applicable to gantry, overhead or bridge cranes); lifts without the use of outriggers using rubber tire load charts; lifts using more than one hoist on the same LHE; lifts involving Multiple Lift Rigging (MLR) Assemblies or other non-routine or technically difficult rigging arrangements; lifts involving submerged loads (Exception: lifts that were engineered to travel in guided slots throughout the lift and have fixed rigging and/or lifting beams, i.e., intake gates, tailgates/logs); lifts out of the operator's view (Exception: if hand signals used by a signal person in view of the operator or radio communications are available and in use, load does not exceed two tons, and is determined a routine lift by the lift supervisor; load tests; when land-based LHE mounted on barges, pontoons or other means of flotation are required to travel while lifting the load; and any lift the operator believes should be considered critical.

Critical Lift Plan Requirements

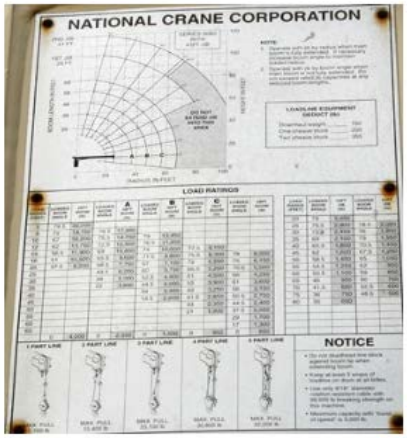
A critical lift plan shall include the following as applicable:
The size and weight of the load to be lifted, including crane (or other machine) equipment and rigging equipment that add to the weight. The OEM's maximum load capacities for the entire range of the lift shall also be provided.
The lift geometry, including the crane position, boom length and angle, height of lift, and radius for the entire range of the lift.
A rigging plan, showing the lift points, rigging equipment, and rigging procedures.
The environmental conditions under which lift operations are to be stopped.
For lifts of personnel, the plan shall demonstrate compliance with the requirements of 29 CFR 1926.1431.
For barge mounted mobile cranes, barge stability calculations identifying crane placement/footprint; barge list and trim based on anticipated loading; and load charts based on calculated list and trim specific to the barge the crane is mounted on.
For lifts in the vicinity of overhead power lines, the plan shall demonstrate compliance with 29 CFR 1926.1408 through 1411.
For Navy activities in foreign countries, follow host nation requirements as applicable in lieu of the CFR's.

Tower Crane Requirements

The following additional documentation is required for contracts involving tower cranes: foundation design and requirements; installation instructions; assembly and disassembly instructions including climbing/jumping instructions if applicable; operating manual, limitations, and precautions; and periodic inspection and maintenance requirements.
For tower cranes at Navy activities in foreign countries, the tower cranes shall comply with the appropriate host nation safety standards and industry consensus safety standards.

Required Documentation (EM 385-1-1)

EM 385-1-1 requires that the following documents be kept on the crane or Load Handling Equipment (LHE) when operated: a copy of the operating manual developed by the manufacturer for the specific make and model of equipment; a copy of the load-rating chart; a durable load chart with legible letters and figures shall be readily available to the operator at the control station; the crane log book; and all inspections, test, maintenance and repairs for the LHE.



Telecommunication Towers

Base mounted drum hoists used in communication tower work shall comply with TIA-1019, TIA-222G, ASME B30.7, and 29 CFR 1926.552 and 29 CFR 1926.553.

When used for hoisting personnel, base mounted drum hoists shall comply with OSHA Instruction CPL 02-01-056; National Association of Tower Erectors standard "Base Mounted Hoist Mechanism Design Use Standard for Lifting Personnel While Working on Telecommunication Structures"; ANSI/ASSE A10.22; and ASME B30.23.

Additional requirements that apply to contracts involving work on telecommunication towers or with personnel hoists on telecommunication towers include:

The use of a pickup truck or any other equipment besides a base mounted drum hoist for hoisting materials and/or personnel is prohibited.

Rough-terrain forklifts, bulldozers, and similar equipment may be utilized for towing and anchorage purposes of guys. The use of such equipment for trolley/tag and load lines is prohibited.

Rigging gear utilized in communication tower work shall comply with the applicable ASME/OSHA standards. Operator, signal person, and rigger qualifications shall be in accordance with OSHA standards and NAVFAC P-307 section 11.

Knowledge Check

1. Select the best answer. Who is responsible to include the requirements of NAVFAC P-307 paragraph 11.1 in contracts?
   A. The contractor
   B. The Load Test Director
   C. The Commanding Officer
   D. The Contracting Officer

2. Select the best answer. When critical lifts are being performed, the minimum oversight periodicity shall be no more than _____ days?
   A. One
   B. Fourteen
   C. Seven
   D. Thirty

3. Select the best answer. Which of the following is used to document oversight of contractor crane and rigging operations for non-construction work?
   A. NAVFAC P-307
   B. Contractor Crane or Rigging Operation Checklist (Figure P-2)
   C. EM 385-1-1
   D. Certificate of Compliance (Figure P-1)

4. Select the best answer. What form is required to be completed, signed by the contractor company official, and posted on each crane or alternate machine used to lift loads suspended by rigging gear?
   A. Contractor Crane or Rigging Operation Checklist (Figure P-2)
   B. Certificate of Compliance
   C. Operator's Daily Checklist (ODCL)
   D. Certificate of Load Test and Inspection

5. Select the best answer. The contractor is required to notify the contracting officer as soon as practical, but no later than _____ hours after any Weight Handling Equipment (WHE) accident.
   A. One
   B. Four
   C. Two
   D. Twenty-four

6. True or False. Word-of-mouth from a contractor official is adequate for verification that a multi-purpose machine or construction equipment is authorized to lift a load suspended by rigging equipment.
   A. True
   B. False

7. Select the best answer. What type of crane requires a third party certification from an OSHA accredited organization?
   A. A Floating crane
   B. A Mobile crane
   C. An Overhead Electric Traveling (OET) crane
   D. A Portal crane

8. True or False. Hooks used on cranes, hoists, other machines, and rigging gear shall have self-closing latches or the throat opening shall be "moused".
   A. True
   B. False

9. Select the best answer. What is required to be completed by the contractor prior to performing a lift that is over 75 percent of the capacity of a crane or hoist at any radius?
   A. Contractor Crane or Rigging Operation Checklist (Figure P-2)
   B. A Critical Lift Plan
   C. A Critical Lift Request Form
   D. A complex lift briefing

10. True or False. A pickup truck may be used for hoisting materials on a telecommunication tower.
   A. True
   B. False

NOTES

TOWER CRANES

Welcome
Welcome to Contractor Crane Awareness - Tower Cranes.

Introduction
Tower Cranes are very popular in building construction world-wide. Here we will discuss required documentation, assembly, testing, maintenance, inspection and operation. Construction Tower Cranes are covered by ASME B30.3.

Documentation
NAVFAC P-307 requires the following information in contracts where tower cranes will be utilized:
Foundation design and requirements; installation instructions; assembly and disassembly instructions including climbing/jumping instructions if applicable; operating manual, limitations, and precautions; and periodic inspection and maintenance requirements.
For tower cranes at Navy activities in foreign countries, the tower cranes shall comply with the appropriate host nation safety standards and industry consensus safety standards.

Foundation
A correctly designed and constructed foundation is essential for the safe assembly and operation of the tower crane.
The foundation design must take into account: local site conditions, soil bearing pressures, and tower crane foundation loading forces for the specific crane configuration to be assembled.
All bolts used must meet the quality specified by the manufacturer and be torqued to the crane manufacturer's specified torque value.
Material/Equipment should not be stored on the crane foundation. Boundary off the area to keep material and vehicles out and prevent potential damage to the crane.

Installation Instructions
When cranes are erected or dismantled, written instructions shall be developed by the manufacturer or qualified person and shall be available at the site.
Crane erection and dismantling shall be performed under the direct supervision of a designated person.
Installation instructions shall provide:
Wind restrictions/limitations; tower (mast) height limitations based on several wind velocity levels for out-of-service conditions; Locations where tower (mast) sections have sufficient strength for internal climbing wedging and external Climbing collar installation; Anchorage arrangements for cranes to be installed on fixed bases; and Crane component weights and dimensional data.

Installation

The bolt connection surfaces between the foundation anchors, the base-tower section and other tower sections and all bolt holes must be free of dirt, paint and any other foreign material as required by the manufacturer.
Only manufacturer specified bolts/fasteners should be used.
All parts of high-strength threaded connections must be cleaned and visually inspected prior to installation. This applies in particular to the threads of nuts, bolts and screws, the seating of nuts on bolts, and the transition between the shanks and heads. Threaded fasteners (including nuts) with any sign of rust on its shank or threads must not be used (light surface rust of no visible peeling or flaking is acceptable). In fact, any nut, bolt or screw showing any sign of damage at all must be rejected.
Only approved/proper equipment should be used for installation (e.g., calibrated).
NOTE: Failure to torque to the manufacturer's specified torque value is extremely dangerous and could lead to an accident resulting in property damage, serious injury or loss of life!

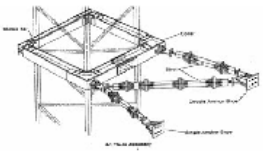
Bolting Assemblies

Review manufacturer requirements for bolting assemblies and installation. The manufacturers procedure must be followed. Lubrication of bolting assemblies should be performed per manufacturer requirements. All tower bolting assemblies at each connection must be torqued/tensioned as required by the manufacturer. Impact wrenches are not allowed to be used to torque or install bolts. The pictures shown are bolts that were found during inspection of a slew ring on a 450 foot high 2003 Tower Crane, subsequent to the tower crane failures in New York in 2008. The inspector found the bolts by tapping them. The top right photo shows a broken bolt found in the slew ring. The bottom right photo shows a loose bolt that was found: note that the damage to this bolt matches that of the broken bolt.

Assembly and Disassembly

When cranes are assembled/disassembled, detailed written instructions by the manufacturer or qualified person and a list of the weights of each sub-assembly to be assembled/disassembled shall be at the site. Assembly and dismantling shall be performed under the supervision of a qualified person.
Wind velocity should not exceed the limit set by the manufacturer, or 20 mph at the crane superstructure if no such limit has been set.
A climbing schedule should be prepared in advance of the installation.
Written climbing instructions should be kept at the site and all climbing operations shall be performed under the supervision of a qualified person. Manufacturer requirements/instructions must be followed. Before climbing, the crane shall be balanced in accordance with the manufacturer requirements.

Assembly and Disassembly 2



Slings and lifting accessories should be selected and arranged so as to avoid damaging or marring crane members during assembly and dismantling. Check manufacturer requirements for vertical tower misalignment tolerances.

During Climbing operations the tower crane **must not** be slewed/rotated nor used or operated in any way which is not part of the climbing operation. Check manufacturer requirements for guide section (if applicable) location and/or removal requirements prior to operation of the crane. The guide section may have to be lowered (climbed down to the bottom of the tower) or removed.

Tie-in assemblies may be used to provide a structural attachment between the crane tower and an adjacent structure. If tie-in assemblies are used, check manufacturer requirements for installation procedures and wind speed maximum requirements during installation.

Visual Inspection

Before crane components are assembled, they shall be visually inspected for damage from shipping and handling. Dented, bent, torn, gouged, or otherwise damaged structural members shall not be assembled until repaired in accordance with the manufacturer's or a qualified person's instructions, or replaced.

Before reusing bolts, pins, or other connection parts, they should be inspected for condition. Visible cracks, difficulty in threading a nut by hand, or visible necking down of the shank are indications of yielding or damage and reason for rejection.

Before initial use and before each climb, load bearing members of the climbing and support system shall be inspected. Defects impairing the ability of a member to support load shall be repaired, or the member replaced.

The manufacturer shall furnish operation and maintenance information.

Inspection and Documentation

Prior to initial use, all new, reinstalled, altered, or extensively repaired cranes shall be inspected by a qualified person.

In addition, an operational and load test should also be performed.

A visual examination of the crane by the operator or other designated person shall be performed daily prior to operation, and periodically as required by the manufacturer.

Records shall be kept of apparent external conditions to provide a basis for continuing evaluation.

Cranes used for construction require a shift, monthly, and annual inspection.

Inspections must be documented and maintained for a minimum of 12 months, or the life of the contract, whichever is longer.

High strength bolts used in connections and at the slewing bearing shall be checked for proper tension (torque) at intervals recommended by the manufacturer.

Inspection records which include the date of inspection, signature of the person performing the inspection, and the serial number or other identifier of the crane that was inspected shall always be available for review.

Testing

EM 385-1-1 requires the following:
Written reports of tests, showing test procedures and confirming the adequacy of repairs or alterations, shall be maintained with the crane and hoisting equipment or at the on-site project office.
A Qualified Person (QP) shall conduct operational tests in accordance with ANSI/ASME and the manufacturer's recommendations.
If the manufacturer has no procedures, the requirements in Section 16, as a minimum, must be performed.
Load tests shall be performed under the direction of a QP in accordance with appropriate ASME standards and the manufacturer's recommendations.

Maintenance and Repair

The contractor shall furnish crane operation and maintenance information.
A preventive maintenance program based on the crane manufacturer ’s recommendations should be established. Dated records should be kept available. Replacement parts should ordinarily be obtained from the original equipment manufacturer. Replacement parts shall be at least equal to the original manufacturer’s specifications. All moving parts of the crane, for which lubrication is specified, should be regularly lubricated. Care should be taken to follow manufacturer’s recommendations as to points of lubrication, maintenance of lubricant levels, and types of lubricant to be used.

Maintenance Documentation

The following information should be provided by the manufacturer of the crane:
Maintenance requirements and recommendations, including proper settings, adjustments, and functioning of all mechanical drives and systems, and identification of those members or locations that require periodic observation, or testing;
Repair instructions including specific welding procedures; and design characteristics affecting safety.

Safe Operation

Cranes required to weathervane when not operated or out-of-service shall be installed with clearance for boom (jib) and superstructure to swing through a full 360 degree arc without striking any fixed object or other weathervaning crane. The crane operator must remain in the operator’s cab during lifting and climbing operations. The operator shall be familiar with the equipment and its proper care. All controls shall be tested by the operator at the start of a new shift. If any controls do not operate properly, they shall be adjusted or repaired before operations are begun.

Safe Operation 2

Cranes shall not be operated when wind speeds exceed the maximum velocity recommended by the manufacturer. For night operations, lighting shall be adequate to illuminate the working areas while not interfering with the operator’s vision. No crane shall be loaded beyond the rated loads given in the rating chart.

Knowledge Check

1. Select the best answer. What equipment is not allowed for tensioning bolting assemblies during tower crane installation?
   A. Torque wrenches
   B. Impact wrenches
   C. Electric tensioners

2. Select the best answer. When tower cranes are assembled or disassembled, what is the wind velocity limit that should not be exceeded if the manufacturer of the crane does not specify a limit?
   A. 40 mph
   B. 10 mph
   C. 30 mph
   D. 20 mph

3. Select the best answer to fill in the blank. Tower crane assembly, disassembly, and climbing operations shall be performed under the supervision of a _____.
   A. Contractor representative
   B. Contracting officer
   C. Crane operator
   D. Qualified person

4. True or False. During climbing operations the tower crane may be operated to lift a load that is not part of the climbing operation if a contractor representative approves it.
   A. True
   B. False

5. Select the best answer. During assembly, what shall be done if a structural component of the crane is found to be damaged?
   A. Finish assembly using the damaged structural component, then notify your supervisor
   B. Replace the component as directed by your supervisor
   C. Have the component repaired or replaced in accordance with the manufacturer's instructions

6. Select the best answer. For cranes used in construction, when is an inspection of the crane required to be performed?
   A. At the end of the shift and when the operator is replaced
   B. At the beginning of each shift, monthly, and annually
   C. Prior to operation if the operator has time to complete the inspection
   D. When the site supervisor assigns personnel to perform the inspection

7. True or False. After assembly, a crane is required to have a functional test and load test prior to being placed in service.
   A. True
   B. False

8. Select the best answer. The crane operator is responsible for all of the following except:
   A. Approving all critical lifts
   B. Performing a visual and operational inspection at the beginning of the shift
   C. Remaining in the cab during lifting and climbing operations
   D. Being familiar with the crane and its proper care

NOTES

CRANE OPERATIONS

Welcome

Welcome to Contractor Crane Awareness – Crane Operations.

Pre-Use Inspections

Crane pre-use inspections shall be performed in accordance with OSHA 29 CFR 1926 Subpart CC, Cranes and Derricks in Construction, standard 1926.1412 Inspections, EM 385-1-1 for construction contracts, and in accordance with applicable ASME B30 standards.
All rigging gear shall be inspected prior to use in accordance with OSHA 29 CFR 1926.251 and applicable ASME B30 standards.
The load shall be inspected prior to the lift for stability and integrity.

Bent lattice member

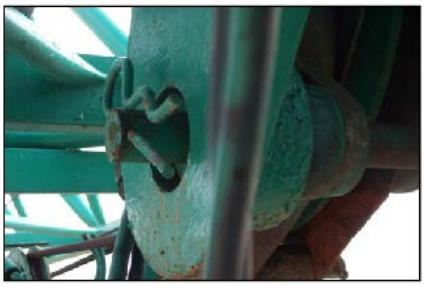
Deteriorated hydraulic hose

Discrepancies

Here are some examples of discrepancies found while performing a crane inspection. A thorough engineering evaluation followed by necessary repairs would be necessary prior to putting this crane to work.

Sheave Shaft

This sheave shaft does not appear to be secured properly. If something does not look right, have a qualified crane inspector evaluate the components in question.



Wire Rope

Observe for properly reeved wire rope. Look for obvious signs of wire rope damage. This wire rope should be inspected for damage and the drum should be properly re-reeved prior to operation.

Contractor Crane Operation Checklist

NAVFAC P-307, figure P-2 provides a checklist that shall be used during oversight of contractor crane and rigging operations.

Copies of the checklist shall be kept on file for one year.

CONTRACTOR CRANE OR RIGGING OPERATION CHECKLIST

		YES	NO	N/A
1	Is the Certificate of Compliance, P-1, in the operator's cab (or in the contractor's on site office for rigging operations) with the current operator's name listed?			
2	Is the crane/machine transited to and from the jobsite correctly? Are the OEM instructions for travel being followed?			
3	Does the operator know the weight of the load to be lifted?			
4	Is the load to be lifted within the crane/machine manufacturer's rated capacity in its present configuration?			
5	Are outriggers/stabilizers required and, if so, are they properly extended and down?			
6	If outriggers/stabilizers are used, and the wheels are not off the ground is this the correct setup in accordance with the OEM?			
7	Is the crane/machine level and on firm ground, or if the ground is not firm are adequate supporting materials provided?			
8	If supporting materials are provided, is the entire surface of the outrigger/stabilizer pad supported and is the supporting material of sufficient strength to safely support the loaded outrigger/stabilizer pad?			
9	If outriggers/stabilizers are not used, is the crane/machine rated for on-rubber lifts by the OEM's load chart?			
10	Is the swing radius of the crane counterweight clear of people and obstructions and are accessible areas within the swing area barricaded to prevent injury or damage?			
11	Has the hook been centered over the load in such a manner to minimize swing?			
12	Is the load well secured and balanced in the sling or lifting device after it is lifted a few inches for verification?			
13	Is the lift and rotation path clear of obstructions?			
14	If rotation of the load being lifted is hazardous, is a tagline or other restraint being used?			
15	Are personnel prevented from standing or passing under a suspended load?			
16	Is the operator paying full attention to the signal person?			
17	Are proper signals being used? Is the operator responding properly to the signals? Are radios used for blind lifts?			
18	Are empty hooks lashed or otherwise secured during travel to prevent swinging?			
19	Does the operator remain at the controls while the load is suspended?			
20	Does the operator ensure that side loading is prohibited?			
21	Are personnel prevented from riding on a load?			
22	Are start and stop motions in a smooth fluid motion (no sudden acceleration or deceleration)?			
23	Is the lift a critical lift?			
24	If so, is a lift plan provided and understood and check-off sheets initialed and signed off?			
25	If overhead power lines are in the vicinity, is a critical lift plan provided addressing the requirements of 29 CFR 1926.1427-1411?			
26	If pick and carry operations are allowed and performed, are OEM directions followed (e.g. rotation lock engaged, boom centered over front or rear, etc.)?			
27	When the crane/machine is left unattended, is it in a safe condition?			
28	Is rigging gear undamaged and acceptable for the application?			

Understanding Crane Capacities

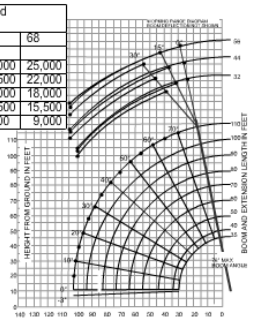
The crane's capacity must be adequate for the greatest weight, radius, and boom length that is to be used. A crane's maximum rated capacity rarely gives a practical indication of the load that the crane can actually lift. The OEM maximum rated capacity is based on a configuration involving minimum length booms at maximum boom angles which would normally be impractical for most typical industrial crane operations.

Examples of load charts:

Radius in Feet	Manual Fly Section Retracted Boom Length in Feet						
	32	33	44	50	56	62	68
12	50,000	47,000	44,000	41,000	38,000		
15	42,000	40,000	39,000	36,000	33,000	27,000	25,000
20	31,800	31,400	31,000	29,500	28,000	25,500	22,000
25	21,800	21,800	21,700	21,100	20,000	19,000	18,000
30		15,500	15,500	15,500	15,500	15,500	15,500
40			9,000	9,000	9,000	9,000	9,000

Load charts show:

- gross capacities
- allowable operating radii
- potential boom lengths



Understanding Crane Capacities: Load Charts

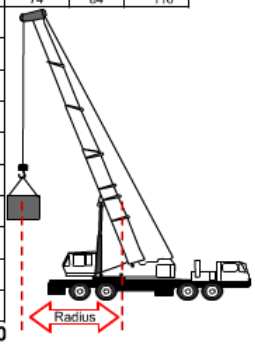
Every mobile crane must have a load chart or a rated capacity chart. Typically, a capacity chart will show the potential boom lengths and allowable operating radii and the gross capacities that lie within these variables. The crane's operating radius is defined as the distance from the crane's point of rotation to the centerline of the suspended hook. A crane's actual capacity is affected by changes in its boom length and operating radius. Other capacity influencing factors include wire rope strength, types and weight of ancillary equipment, whether or not outriggers are used, and deductions from capacity.

Understanding Crane Capacities: Load Chart Interpretation

As a crane's working radius increases, there is greater leverage on the boom resulting in a reduction of actual capacity. In the upper left, this load chart shows a maximum rated gross capacity of one hundred thousand pounds. If you follow the radius column down the left side and read across to the required boom length, you would find that with the longer boom length and greater radius, the gross capacity is reduced to 10,440 pounds. A 90% reduction in capacity. At this configuration, with the added weight of hooks, wire rope and ancillary equipment factored in, there may very little, if any, net capacity remaining.

ON OUTRIGGERS FULLY EXTENDED – OVER REAR

Radius in Feet	Boom Length in Feet							84 ft + 32 ft. Ext
	34	40	44	54	64	74	84	** 116
10	100,000 (70)	74,000 (73)	72,000 (76)					
12	90,000 (66.5)	70,000 (70)	67,500 (732.5)	64,000 (76.5)				
15	72,000 (61)	63,700 (65.5)	61,000 (69)	55,000 (73)	44,700 ((76)			
20	53,000 (50.5)	52,200 (57.5	49,800 (62)	44,000 (67.5)	37,900 (71)			
25	41,000 (38.5)	41,000 (48)	41,000 (54)	36,300 (61.5)	31,900 (66)			
30	29,690 (21.5)	29,690 (37.5)	29,690 (45)	29,690 (55.5)	27,000 (60.5)			
35		22,650 (23)	22,650 (34.5)	22,650 (48.5)	22,650 (55)			
4			18,090 (19)	18,090 (41)	18,090 (49)			
4				14,840 (31.5)	14,840 (42)			
				12,330 (17.5)	12,330 (35)			
55					10,440 (26)			



Operating Hazards

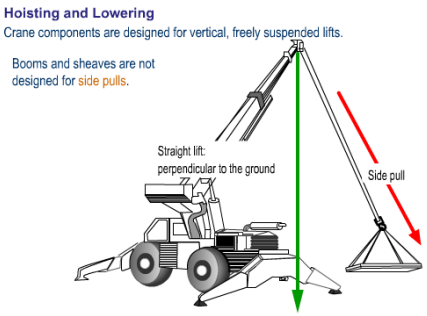
Always remain aware of operating hazards such as: congestion, counterweight clearance, pinch points, and other cranes or equipment when observing crane operations.
Do not stand or walk under a suspended load.

Environmental Considerations

Environmental considerations such as wind and the operational limits for each crane, ice hazards including icing of the sheaves or structure and ice on barges supporting mobile cranes, visibility impairment and lightning strike potential should all be considered before any lift is put into motion.

Hoisting and Lowering

Loads shall be lifted vertically. The practice of side-loading the crane is dangerous and prohibited.



Limit Switches

The purpose of a hoist upper limit switch is to prevent overtravel of the hook block and the possibility of two-blocking. Two-blocking occurs when the hook block comes in contact with the upper sheave block during hoisting of the hook (or lowering the boom). Two-blocking is dangerous because it could result in damage to the crane, parting of the hoist lines, and dropping of the load.
Operators are required to check upper limit switches during the pre-use or pre-operational check of the crane.
Limit switches must be properly installed and are not to be used as operational devices. In other words, the crane operator should not be relying on the upper limit switch to stop
movement of the hoist or load.

Lifting Personnel with Cranes

Cranes shall not be used to lift personnel unless there are no safer options to accomplish the job.
When lifting of personnel by crane is necessary, ensure that a critical lift plan has been developed and that the plan demonstrates compliance with the requirements of OSHA 29 CFR 1926.1431.
For Navy activities in foreign countries the host nation requirements must be followed in lieu of the CFR.

Fall Protection

Body harnesses are required to be worn, with a shock absorbing lanyard attached to a structural member within the platform, whenever personnel are suspended in a personnel platform.
The fall arrest system, which includes the harness, lanyard, and attachment point (anchorage), must meet the requirements in 29 CFR 1926.502.
The use of restraint belts is prohibited by OSHA.

Knowledge Check

1. True or False. The crane and rigging gear is required to be inspected prior to use.
   A. True
   B. False

2. Select the best answer. The Contractor Crane or Rigging Operation Checklist (P-2) is used to:
   A. Document oversight of contractor crane and rigging operations
   B. Provide contractors a sheet or checklist to document crane and rigging gear certification
   C. Provide the contractor crane operator qualifications and rigger training

3. Select the best answer. How long are copies of the Contractor Crane or Rigging Operations Checklist (P-2) required to be kept on file?
   A. 2 years
   B. 3 years
   C. 1 year
   D. 4 years

4. Select the best answer. The capacities shown on a load chart are:
   A. Wire rope capacities
   B. Gross capacities
   C. Net capacities
   D. Hook block capacities

5. True or False. Personnel are allowed to stand or walk under a suspended load.
   A. True
   B. False

6. Select the best answer. What is the purpose of a hoist upper limit switch?
   A. To prevent over-travel of the hook block and the possibility of two-blocking
   B. To stop upward movement of the boom
   C. To stop movement of the hoist and prevent contact with obstructions
   D. To aid the operator in knowing the location of the hook block or hoist

7. Select the best answer. What is required to be developed by the contractor prior to making a personnel lift?
   A. A Contractor Crane and Rigging Operations Checklist (P-2)
   B. A critical lift plan
   C. A complex lift plan
   D. A personnel lift plan

8. Select the best answer. What fall protection equipment is required to be worn in a suspended personnel platform?
   A. A full body harness and a restraint lanyard
   B. A full body harness and a shock absorbing lanyard
   C. A restraint belt and shock absorbing lanyard
   D. A restraint belt and a restraint lanyard

9. Select the best answer. In a suspended personnel platform, the fall protection lanyard should be attached to:
   A. A structural member within the platform
   B. A pad eye on the lifting platform
   C. A sling attached to the crane hook
   D. The crane hook

10. True or False. The Contractor Crane or Rigging Operation Checklist (P-2) is required to be signed and approved by the contractor.
    A. True
    B. False

NOTES

BASIC RIGGING

Welcome
Welcome to Contractor Crane Awareness – Basic Rigging.

Personnel Qualifications


NAVFAC P-307 requires the contractor to certify (using appendix P, figure P-1) that the riggers are qualified to perform the work by either signing a statement of compliance, providing proof of successful completion of a rigging apprenticeship, or proof of successful completion of training courses from a recognized source that tests and qualifies riggers.
EM 385-1-1 requires that any worker engaged in the duties and performance of rigging shall be designated in writing and the specific rigging tasks for which they are qualified shall be provided.

Knowledge and Experience
A rigger or qualified rigger is a person that: has extensive knowledge, training and experience sufficient to calculate loads, load weights, safe capacities and apply other safe rigging principles and procedures; demonstrates the ability to utilize rigging materials and principles, and; is capable of safely inspecting and performing rigging operations.
In addition, a qualified rigger must: be able to communicate effectively with the crane operator, the lift supervisor, signal person and affected personnel on site; and have a basic knowledge and understanding of equipment-operating characteristics, capabilities, and limitations.

Rigging Gear Inspection and Use
Rigging gear shall be inspected prior to initial use and before use each shift to ensure that it is safe. An annual periodic inspection is also required.
Defective rigging shall be removed from service.
The use, inspection and maintenance of rigging equipment shall be in accordance with the rigging equipment manufacturer and applicable ASME B30 standards.
Rigging equipment, when not in use, shall be removed from the immediate work area and properly stored and maintained in a safe condition.

Hardware
Rigging hardware includes: shackles, links, rings, swivels, turnbuckles, eyebolts, hoist rings, wire rope clips, wedge sockets, rigging blocks, and load-indicating devices.
All rigging hardware shall be inspected for defects prior to use on each shift and periodically as necessary during use. Periodic inspections shall not exceed 1 year.
Note: EM385-1-1 requires periodic inspections to be documented.
All rigging hardware shall be constructed, installed, used, inspected and maintained in accordance with ASME B30.26.

Shackles

Each shackle body shall have durable markings by the manufacturer to show: the name or trademark of the manufacturer, the working load limit or rated load, and the size.
The pin shall show the name or trademark of the manufacturer and grade, material type or load rating.
Some general requirements for use include: the rated load shall not be exceeded; shackles should be stored in an area where they will not be subjected to damage, corrosive action, or extreme heat; the screw pin threads shall be fully engaged and tight, and the shoulder should be in contact with the shackle body; if a shackle is designed for a cotter pin, the cotter pin shall be used and maintained in good working condition; shock loading should be avoided; the load applied to the shackle should be centered in the bow of the shackle to prevent side loading of the shackle; multiple sling legs should not be applied to the shackle pin; and screw pin shackles shall not be rigged in a manner that would cause the pin to unscrew.

Sling Types

There are many types of slings used in rigging. Several types are shown here.
Sling types include: chain slings, wire rope slings, metal mesh slings, synthetic fiber rope slings, synthetic web slings, and synthetic round slings.
Synthetic slings are one of the most popular types of slings used in construction work. They are flexible and not as heavy as chain, wire rope, and metal mesh slings. But, they are also easily damaged and abused.

Sling Identification

All slings must have an affixed durable permanent identification tag that includes the following as a minimum: the name or trademark of the manufacturer (country identification only is not acceptable); the Working Load Limit (WLL) or rated load for a given type of hitch and configuration; and the number of legs if more than one.
Some sling types require additional markings or information.
Chain slings require the grade and nominal chain size.
Wire rope slings require the diameter or size.
Metal mesh slings require individual sling identification (e.g. serial number).
Synthetic slings require the manufacturer's code or stock number and the type of material used.

Sling Use

Slings shall be manufactured, used, inspected and maintained in accordance with ASME B30.9.
Natural fiber rope shall not be used to fabricate slings.
Some common sling use rules include: adequate and appropriate protection shall be used to protect slings from sharp edges, abrasion, and excessive bearing; slings shall not be knotted, shortened, or adjusted unless approved by the manufacturer or qualified person; the load shall not be landed on the sling and a sling shall not be pulled from under the load when the load is resting on the sling; slings shall not be dragged over abrasive surfaces; and shock loading is not allowed.
Additional rules include: all slings shall be hitched or attached in a manner providing control of the load and so that the load is positively secured; and slings shall not be twisted or kinked.

Sling Removal Criteria

Synthetic and wire rope slings are the two most common sling types used on construction sites.
Slings shall be removed from service if any of the removal criteria conditions listed in ASME B30.9 for the applicable sling type are discovered.
Wire rope removal criteria conditions include: broken wires; severe localized abrasion or scraping; kinking, crushing, bird caging or any other damage to the rope structure; evidence of heat damage; crushed, deformed, or worn end attachments; severe corrosion of the rope, and attachments or fittings; missing or illegible sling identification; and other conditions that cause doubt as to safe use of the sling.
Synthetic sling removal criteria conditions include: acid or caustic burns; melting or charring; snags, holes, tears, or cuts; broken or worn stitches; excessive abrasive wear; knots in any part of the sling; excessive pitting or corrosion, or cracked, distorted, or broken fittings; or other visible damage that causes doubt as the strength of the sling.

Rigging Gear Hazards

The first major hazard we must talk about is abuse. Here the biggest hazard is the user!
Slings should not be dragged on the ground. Cement or paved surfaces will quickly abrade slings and gear.
Contact with the ground can embed grit and abrasives into the sling, which will cause damage.
The load should not be placed or landed on slings and slings should not be pulled from under a load while the load is resting on them.
Loads should be placed on blocking to keep from crushing or damaging slings.

Hazards (Corrosives and Heat)

Gear should be kept away from corrosives, acids, paint thinners, and any other harmful chemicals.
Chemicals that may have a corrosive effect on one type of gear may not affect another. For example, acids would quickly destroy a nylon sling but might not harm another synthetic material.
Gear should be protected from all heat sources such as welding, burning, grinding, or heat-treating.
Rigging gear should be stored in an area where it will not be subjected to mechanical, chemical, or environmental damage. Gear should not remain outside after use.

Hazards (Sharp Edges)

Another common hazard is sharp edges.
No matter what type of gear is used, sharp edges will leave their mark if the gear is not protected.
Slings can be easily cut at corners or edges or otherwise damaged by abrasion or excessive bearing stress (especially synthetic slings).
Adequate and appropriate sling protection shall be used where there is a possibility of the sling being cut or otherwise damaged by abrasion or bearing.
Sling protection material must be of sufficient thickness and strength to prevent sling damage.

Improper Rigging

This picture shows a web sling improperly attached to a load. Web slings must be installed flat around the load without kinks or twists. Kinks and twists prevent even loading of the fabric in the sling. Additionally, when shackles are used with web slings the shackle size must allow the sling to lay relatively flat without much curling. Excessive curling at the edges causes uneven loading of the sling.

Poor Rigging Practices

This is an example of potentially dangerous rigging practice. Here, bolts are used for attaching and shortening a chain sling. In addition non-shouldered eyebolts are being used for angular lifting and are not engaged properly (nuts are being used). Failure of the bolts, the chain or the eyebolts are all possible as a result of these poor rigging practices. Failure of any of these components could be catastrophic.

Overloaded Rigging

This picture shows a shackle that was overloaded.
Overloading rigging gear can lead to failure!
Personnel performing rigging and crane operations must ensure that rigging gear has the capacity to carry the weight of the load and that the items to be lifted are not attached or secured to another item, or bolted down.

Sling Abuse

This picture shows a synthetic web sling that was abused and damaged.
The sling contains numerous rips, tears and cuts, and must be removed from service.
Personnel should not be using slings that are damaged.

Knowledge Check

1. Select all that apply. Rigging gear is required to be inspected:
   A. When the contracting officer requires inspection
   B. After subjected to extreme weather conditions
   C. Periodically
   D. Prior to use

2. True or False. A manila tag attached with a string should be used to provide sling identification.
   A. True
   B. False

3. Select the best answer. What identification markings are required on wire rope slings?
   A. The name or trademark of the manufacturer, the manufacture date, and the WLL
   B. The WLL, the manufacture date, and the sling diameter
   C. The WLL, the manufacture date, and the sling length
   D. The name or trademark of the manufacturer, the WLL, and the sling diameter

4. True or False. Natural fiber rope shall not be used to fabricate slings.
   A. True
   B. False

5. Select all that apply. What markings are required on the body of a shackle?
   A. The name or trademark of the manufacturer
   B. The date of manufacture
   C. The size
   D. The periodic inspection due date
   E. The working load limit or rated load

6. Select the best answer. What markings are required on the pin of a shackle?
   A. The WLL and serial number
   B. The manufacture date, WLL, and size
   C. The name or trademark of the manufacturer, the WLL, and the size
   D. The name or trademark of the manufacturer and grade, material type or load rating

7. Select the best answer. What is the proper method used for installing a screw pin in a shackle?
   A. The user should screw the pin in fully with the shoulder flush against the shackle body, then back the pin out a half of a turn to prevent binding during lifting.
   B. The screw pin threads shall be fully engaged and the shoulder shall be in contact with the shackle body
   C. The user should screw the pin in fully with the shoulder flush against the shackle body, then back the pin out a quarter of a turn to prevent binding during lifting.

8. True or False. It is okay to land a load on slings as long as the slings will not be pulled out from under the load.
   A. True
   B. False

NOTES

CRANE AND RIGGING ACCIDENTS

Welcome

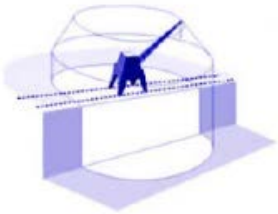
Welcome to Crane and Rigging Accidents.

Learning Objectives

Upon successful completion of this module you will be able to identify the elements in the crane and rigging operating envelopes, define a crane accident, define a rigging accident, identify the primary causes of accidents and explain the procedures to follow when an accident happens.

Accident Categories

There are two general categories of weight handling accidents: Crane Accidents and Rigging Accidents.
Crane accidents are those that occur during operation of a crane.
Rigging accidents are those that occur when rigging gear or equipment is used by itself in a weight handling operation, i.e., without a crane, or, when rigging gear is used with multi-purpose machines or material handling equipment (MHE)(e.g., forklifts) in a weight handling operation.
In addition, accidents that occur during the operation of entertainment hoists shall be reported as rigging accidents.



Crane Operating Envelope

In order to define a crane accident, you must first understand the crane operating envelope.
The operating envelope includes the following elements: the crane, the operator, the riggers, other personnel involved in the operation, the rigging gear between the hook and the load, the load, the crane's supporting structure, and the lift procedure.

Crane Accident

A crane accident occurs when any of the elements in the crane operating envelope fails to perform correctly during a crane operation, including operation during maintenance or testing, resulting in any of the following: personnel injury or death, material or equipment damage, dropped load (includes any part of the load or rigging gear and any item lifted with the load or rigging gear), derailment, two-blocking, overload (this includes load tests when the test load tolerance is exceeded), or collision.

Rigging Operating Envelope

The rigging operating envelope around any rigging or rigging equipment operation contains the following: rigging gear, the user of the gear or equipment (including operators of multi-purpose machines, MHE, and construction equipment), other personnel involved in the operation, the load, the gear or equipment's supporting structure, the load's rigging path, and the rigging or lift procedure.

Rigging Accidents

A rigging accident occurs when any of the elements in the operating envelope fails to perform correctly during a rigging operation resulting in any of the following: personnel injury or death, material or equipment damage that requires the damaged item to be repaired because it can no longer perform its intended function, a dropped load (including any part of the load or rigging gear and any item lifted with the load or rigging gear, two-blocking of cranes and powered hoists, or overload (including load tests when the test load tolerance is exceeded).

Accident Examples

Some common examples of accidents include: dropped loads, damage to rigging gear or equipment, injuries from a shifting load, failure of rigging gear resulting in a dropped load, overloads, and improperly secured loads falling from pallets.

Accident Exception

Component failure such as motor burnout, gear tooth breakage, bearing failure, etc. is only considered an accident if damage to the load or another component occurs as a result of the failure.

Near Misses and Unplanned Occurrences

A near miss is an unplanned event during a weight handling operation that did not result in a definable accident, but easily had the potential to do so.
Only a break in the chain of events prevented an accident.
Near-miss reporting provides an opportunity to identify risks and mitigate the potential for an accident.
It is not intended that a near miss investigation and report be as thorough as that for a crane or rigging accident; however, the investigation and report should be commensurate with the significance of the event.
An unplanned occurrence describes an event that does not meet the definition of a crane or rigging accident but results in injury, or damage to a crane, crane component, or related equipment due to an event not directly related to a weight handling operation.
Examples include, but are not limited to, injury or damage caused by weather, damage to a parked or stationary crane caused by another moving object (e.g., vehicle, forklift), significant maintenance errors, and flooding or fire damage.
Near misses and unplanned occurrences shall be reported using NAVFAC P-307, Section 12, Figure 12-2 (Near Miss and Unplanned Occurrence Report).
These reports shall be submitted within 30 days of the event.

Accident Causes

In most cases, accidents result from personnel error and can be avoided.
Some accident causes include: inattention to the task, poor judgment, bad communication, team members having too much confidence in their abilities, or operating the crane or equipment too fast.

Accident Actions

Upon having an accident or having seen evidence of damage (suspected accident), the crane team, riggers, equipment users, etc., shall stop all operations and notify immediate supervision.
If there is impending danger to the equipment or personnel, the crane and/or load shall be placed in a safe position prior to notifying supervision.
Personnel shall ensure the accident scene is secured and undisturbed so as to facilitate the investigation.
The supervisor shall review the situation and take any further emergency action, including stopping production work or other operations that could aggravate the situation.
The supervisor shall notify management personnel as well as the activity safety office.

Accident Reporting - Contractor

The contractor is required to notify the contracting officer as soon as practical, but not later than four hours, after any WHE accident. The contractor is required to secure the accident site and protect evidence until released by the contracting officer. The contractor must conduct an investigation to establish the root cause(s) of any WHE accident, near miss, or unplanned occurrence. Crane operations shall not proceed until the cause is determined and corrective actions have been implemented to the satisfaction of the contracting officer.

The contractor is required to provide the contracting officer a report for an accident or near miss within 30 days using the appropriate form provided in NAVFAC P-307, Section 12, and corrective actions taken.

Accident Reporting - Contracting Officer

The contracting officer shall notify the host activity of any WHE accident upon notification by the contractor and provide the Navy Crane Center by e-mail (m_nfsh_ncc_accident@navy.mil) of an accident involving a fatality, in-patient hospitalization, overturned crane, collapsed boom, or any other major damage to the crane or adjacent property as soon as possible, preferably within 8 hours of notification by the contractor. For all other accidents, notify the Navy Crane Center as soon as practical but no later than three working days after the accident.

The contracting officer shall provide the Navy Crane Center and host activity a copy of every accident and near miss report, regardless of severity, upon receipt from the contractor.

When the contracting office is not in the local area, the contracting officer shall designate a local representative to ensure compliance with the above requirements.

The contracting officer or designated weight handling representative shall sign all crane and rigging accident and near miss reports to indicate that they are satisfied that the contractor's investigation and corrective action are sufficient.

Knowledge Check

1. Select the best answer. During maintenance the rigging gear between the crane hook and the load fails and results in equipment damage. This is reported as a:
   A. Rigging gear deficiency
   B. Crane accident
   C. Operator error
   D. Rigger error

2. Select the best answer. During crane operations the load shifts. The operator reacts quickly and saves the load but causes the crane to derail. This is reported as a:
   A. Load configuration error
   B. Crane accident
   C. Operator error
   D. Crane walker’s error

3. Select all that apply. The crane operating envelope includes the crane, the operator, the riggers, the crane walkers, and …
   A. The area where the load will be landed
   B. The load
   C. Rigging gear between the hook and the load
   D. Any supporting structures

4. Select all that apply. The rigging operating envelope contains the rigging gear, the load itself and …
   A. Other personnel involved in the operation
   B. The user of the gear or equipment
   C. The gear or equipment's supporting structure
   D. The load rigging path
   E. The rigging procedure
   F. The crane removal procedure

5. Select the best answer. When rigging gear fails while suspended from a structure and drops the load it is a:
   A. Load configuration error
   B. Rigging error
   C. Rigging accident
   D. Crane accident

6. Select the best answer. If component failure occurs, such as motor burnout, and does not result in damage, the component failure is considered:
   A. A crane accident
   B. Crane maintenance's responsibility
   C. A non-accident
   D. A rigging accident

7. Select the best answer. To whom or to what are the majority of crane accidents attributed?
   A. Equipment failure
   B. Crane operators
   C. Riggers or signalmen
   D. Personnel error
   E. Weather conditions

8. Select all that apply. Over-confidence and poor judgment among team members can contribute to crane and rigging accidents. Select additional factors that can contribute to accidents:
   A. The crane operating envelope
   B. Engineering lift specifications
   C. Operating the crane too fast
   D. Inattention to the task

9. Select the best answer. If you have an accident with a crane or you find damage and suspect an accident has happened, your first step is to:
   A. Notify your supervisor immediately
   B. Call emergency services if anyone is injured
   C. Secure the crane and power as required
   D. Stop operations as soon as safely possible

NOTES

Naval Facilities Engineering Command
NAVY CRANE CENTER

CONTRACTOR CRANE AWARENESS COURSE EVALUATION

Student Name: _____

Command/Activity/Organization: _____

Instructor: _____ Date: _____

Directions: To assist in evaluating the effectiveness of this course, we would like your reaction to this class. Do not rate questions you consider not applicable.

Please rate the following items:	Excellent	Very Good	Good	Fair	Poor
Content of the course met your needs and expectations.					
Content was well organized.					
Materials/handouts were useful.					
Exercises/skill practices were helpful.					
Training aids (slides, videos, etc) were used effectively.					
Instructor presented the material in a manner, which was easy to understand.					
Instructor was knowledgeable and comfortable with the					
Instructor handled questions effectively.					
Instructor covered all topics completely.					
Probability that you will use ideas from the course in					
Your opinion of the course.					
Your overall opinion of the training facilities.					

What were the key strengths of the training? How could the training be improved? Other comments?

_____

_____

_____

_____

List other training topics in which you are interested: _____

_____

_____

Note: If you would like a staff member to follow up and discuss this training, please provide your phone number_____