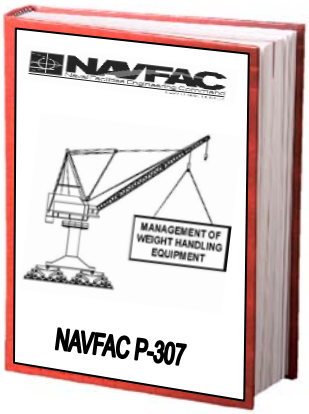
Navy Crane Center



NAVFAC P-307 Training

CONTRACTOR CRANE AWARENESS

WEB BASED TRAINING

STUDENT GUIDE

NCC-CCA-01

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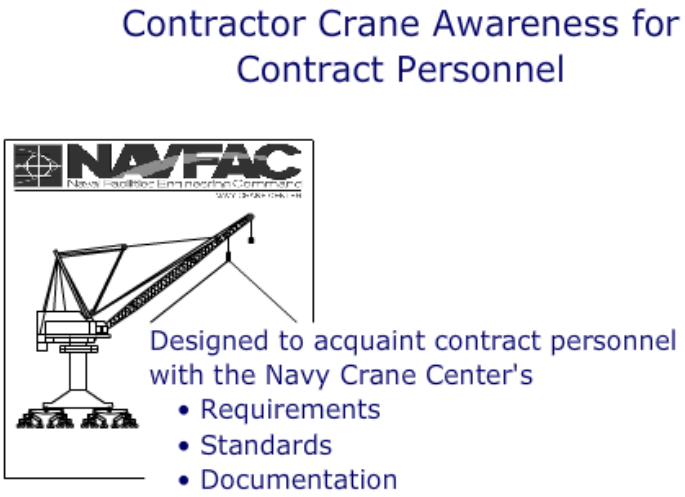
INTRODUCTION

COURSE INTRODUCTION

Contractor Crane Awareness is designed to acquaint personnel who write, administrate, and/or inspect Navy contracts involving weight handling equipment with Navy Crane Center and NAVFAC P-307 requirements for contractors and provide a knowledge base on which to build upon with on-the-job experience. Topics covered include NAVFAC P307 familiarization, 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.



REFERENCES

Support materials for this course can be found and obtained from the course reference area.

NCC Overall Responsibilities

The Navy Crane Center has overall responsibility for Navy shore based Weight Handling Equipment, or WHE, program direction and policy, including engineering, safety, training, and acquisition requirements. It investigates crane accidents, communicates lessons learned, provides in-service technical support, and assists in the procurement of new cranes.

Navy Weight Handling Program

The Navy Crane center can be broken into two distinct groups: acquisition and field support.

Navy Crane Center Field Office Locations

Navy Crane Center field offices are strategically located near major centers of crane activity.

VIDEO

Video Text

Most crane accidents result from personnel errors. Crane accidents can be spectacular such as this crane boom freefall. Cranes have been known to topple from the decks of aircraft carriers, drop their loads, collide with stationary objects, overturn while traveling, tip over because the outriggers were not fully extended. Many crane accidents are near misses with no real consequences. 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 in some form or another. 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 lucky. To improve crane safety, there is a program in place that addresses the operation and safety of Navy weight handling operations.

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.

Accidents and close calls are reported to and investigated by the Navy Crane Center with the expectation of enhancing safe crane operations.

CRANE ACCIDENT GALLERY

Fwd

This crane overturned while traveling. The rotate lock was not properly engaged for travel. 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.

CRANE ACCIDENT GALLERY

Fwd

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!

CRANE ACCIDENT GALLERY

Fwd

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

CRANE ACCIDENT GALLERY

Fwd

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.

CRANE ACCIDENT GALLERY

Fwd

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

CRANE ACCIDENT GALLERY

Fwd

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.

CRANE ACCIDENT GALLERY

Fwd

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

CRANE ACCIDENT GALLERY

Fwd

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

CRANE ACCIDENT GALLERY

Fwd

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

CRANE ACCIDENT GALLERY

Fwd

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.

CRANE ACCIDENT GALLERY

Fwd

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.

CRANE ACCIDENT GALLERY

Fwd

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

CRANE ACCIDENT GALLERY

Fwd

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.

CRANE ACCIDENT GALLERY

Fwd

This crane overturned while traveling. The rotate lock was not properly engaged for travel. 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.

CONTRACTOR ACCIDENTS: CAUSES

Some of the most common causes of contractor crane accidents include: 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. Another factor that has contributed to contractor crane accidents is operating cranes with obvious deficiencies such as bent or damaged booms, defective welds, or heavy corrosion.

COMMON CAUSES OF CONTRACTOR CRANE ACCIDENTS

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

Crane operators have made lifts when they did not know the load weight.

Operating mobile cranes on barges without properly securing the crane to the barge has contributed to several accidents.

Operating cranes set up on poor soil or foundation conditions and /or outriggers not properly deployed is a common cause of accidents that result from the loss of stability.

Another common cause of set up related accidents is the failure to observe counter weight and boom clearances.

NOTES

CRANES: TYPES, STANDARDS, TERMINOLOGY

STANDARDS

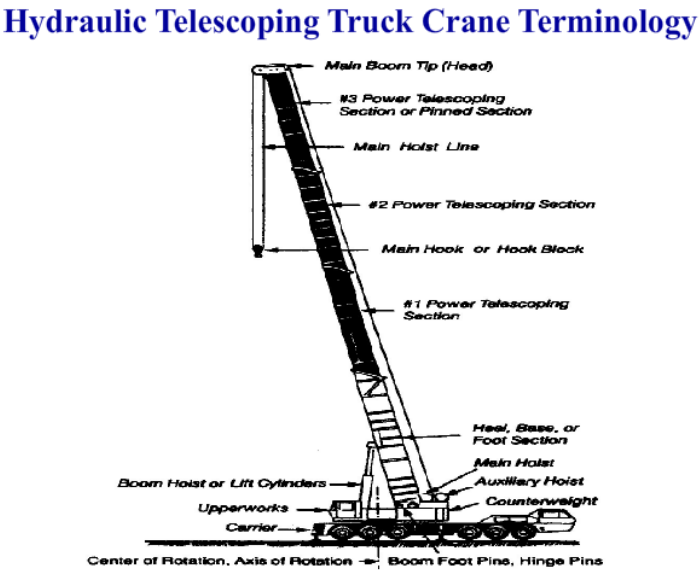
Contractors operating cranes within Naval facilities are required to comply with specific activity regulations pertaining to crane safety and operation. Contractors are also required to comply with the applicable ASME standards discussed in this module. ASME B-30 standards are written and maintained by the American Society of Mechanical Engineers to establish crane safety standards.

MOBILE CRANES

ASME B30.5 covers mobile cranes including: hydraulic telescoping boom, truck mounted, rough terrain, crawlers, and locomotives. Mobile cranes consist of a fixed or telescoping boom and machinery house mounted on a mobile platform. The platform, also known as the carrier, may be on rails, wheeled, or caterpillar tracks

MOBILE CRANE TERMINOLOGY

The main components of a Hydraulic Telescoping Truck Crane are shown.



COMMERCIAL TRUCK MOUNTED CRANES

Telescoping boom cranes mounted on commercial trucks or trailers are also covered by ASME B30.5. Commercial truck mounted cranes with articulating booms, fall under ASME B30.22.

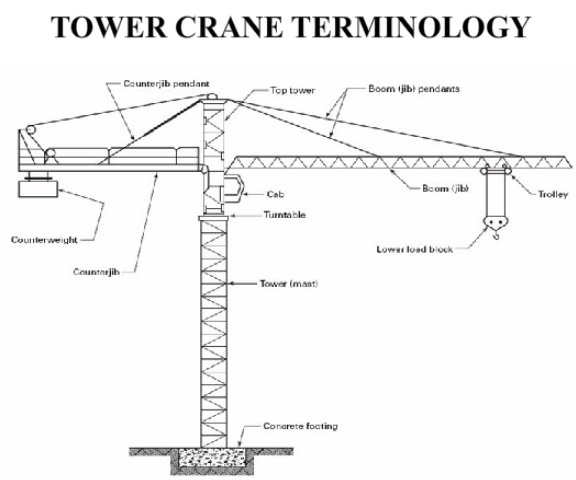
FLOATING CRANES

Floating cranes are covered under ASME B30.8.

Floating cranes consist of a fully rotating upper structure containing: the operating machinery, operator's station, and a boom capable of raising and lowering. The upper structure is mounted on a specially constructed barge. As required by NAVFAC P-307, barge-mounted mobile cranes must have a third party certification from an OSHA accredited organization. Barge-mounted mobile cranes also require: a load indicating device, a wind indicating device, and a marine type list and trim indicator.

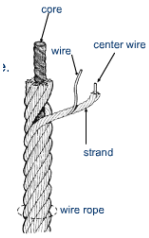
TOWER CRANES

Tower cranes are covered by ASME B30.3. Tower cranes are very popular in construction world-wide.



TOWER CRANE ILLUSTRATION

This illustration shows the main components of a tower crane. Tower cranes are very safe when properly operated. Many 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.



Wire Rope

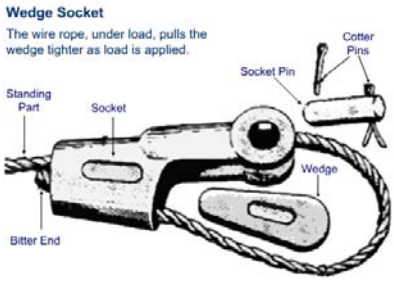
Wire rope used in crane operations is a highly specialized precision product, adaptable to a wide variety of operational uses and conditions. To meet the specified requirements of different types of service, wire rope is designed and manufactured in a variety of constructions and grades. Typically, wire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

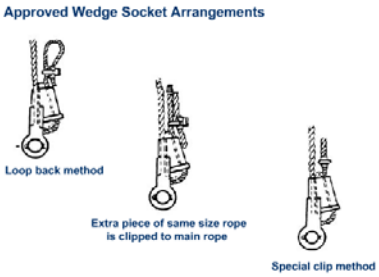
Wire Rope End Connections

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 load is applied.





Approved Wedge Socket Arrangements

These illustrations from the NAVFAC P-307 show some acceptable methods of securing the dead end of the wire rope on a wedge socket.

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 Wire Rope Clips

Forged wire rope clips are required for lifting. The wire rope clip on the left is forged from alloy steel. Notice the expanded saddle. The clip on the right is malleable cast iron.

Forged Wire Rope Clip

Forged wire rope clips are required for lifting applications. This illustration shows that malleable cast iron clips were used where forged steel clips are required.

Boom Angel Indicators

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

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.

NOTES

REQUIREMENTS AND RESPONSIBILITIES

RESPONSIBILITIES OF THE CONTRACTING OFFICER

Responsibilities of the Contracting Officer include ensuring document requirements are included and followed, and oversight of contractor crane operations. The level of oversight is based on risk to government personnel and property. Use the checklist found in NAVFAC P-307, Appendix "P" for documentation of oversight and designate a local representative as appropriate. Note that EM 385-1-1 requirements apply to construction contracts – not SUPSHIP contracts.

CONTRACTOR CRANE OPERATION CHECKLIST

		YES	NO
1	Is the Certificate of Compliance P-1, in the operator's cab with the current		
2	Does the operator know the weight of the load to be lifted?		
3	Is the load to be lifted within the crane manufacturer's rated capacity in its present		
4	Is the crane level and on firm ground?		
5	Are outriggers required?		
6	If so, are outriggers fully extended and down, and the crane load off the wheels?		
7	If blocking is required, is the entire surface of the outrigger pad supported and is the blocking material of sufficient strength to safely support the loaded outrigger pad?		
8	If outriggers are not used, is the crane rated for on-rubber lifts by the manufacturer's load chart?		
9	Is the swing radius of the crane counterweight clear of people and obstructions and		
10	Has the hook been centered over the load in such a manner to minimize swing?		
11	Is the load well secured and balanced in the sling or lifting device centre it is also more than a few inches!		
12	Is the lifting swing path clear of obstructions?		
13	If rotation of the load being lifted is hazardous, is a tag or restraint line being used?		
14	Are personnel prevented from standing or passing under a suspended load?		
15	Is the crane operator's attention diverted?		
16	Are proper signals being used at all times?		
17	Do the operators ensure that side loading is prohibited?		
18	Are personnel prevented from riding on a load?		
19	Are start and stop motions in a smooth fluid motion (no sudden acceleration or deceleration)?		
20	If operating near electric power lines, are the rules and guidelines understood and adhered to?		
21	Is the lifts critical lift?		
22	If so, are all regulations understood and check-off sheets initialed and signed off?		
23	Is rigging gear undamaged and acceptable for the application?		

Contractor: Subcontractor:

Location: Date:

Notes:

Signature of Contracting Officer's Representative:

FIGURE P-2

P-2

SOME IMPORTANT DOCUMENTS FOR CONTRACTING OFFICER

These are examples of the documents used by the contracting officer.

Important Documents For Contract Representatives

- **NAVFAC P-307**
- **EM 385-1-1**
- **29 CFR 1926**
- **ASME B30**
- **UFGS 01525**
- **Host Activity instructions for controlling contractor cranes**

IN CASE OF ACCIDENT

In the event of a crane accident, the contracting officer has the following responsibilities:

Notify the host activity of the accident upon notification by the contractor.

Provide the Navy Crane Center and the host activity with a copy of accident reports, regardless of severity, upon receipt from the contractor.

Notify the Navy Crane Center of any accident involving a fatality, in-patient hospitalization, overturned crane, collapsed boom, or any other major damage to the crane, load, or adjacent property as soon as possible, preferably within 24 hours of notification by the contractor. Notify the Navy Crane Center within 3 days for all other accidents.

Provide oversight of contractor crane accident investigations and corrective actions.

When the contracting office is not in the local area, the contracting officer shall designate a local representative to ensure compliance with the above noted requirements. The above requirements are in addition to those published in OPNAVINST 5100.23 and related local instructions.

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.
- Crane operations shall not proceed until cause is determined and corrective actions have been implemented to the satisfaction of the contracting officer.
- Within 30 days of any WHE accident, contractors shall provide to the contracting officer a Crane and Rigging Gear Accident Report using the form provided in NAVFAC P-307 Section 12.

The accident report shall consist of a summary of circumstances, an explanation of cause(s), photographs (if available), and corrective actions taken.

HOST ACTIVITY RESPONSIBILITIES

The host activity shall:

- develop and issue a policy for crane safety and operation on base,
- ensure contracting officers include the contractor requirements in all contracts,
- concur with the contracting officer's oversight plan, and
- ensure that the oversight plan is carried out.

In the event of an accident, the host activity provides oversight of accident investigations and corrective actions.

CONTRACTOR CRANES

Contractor cranes must conform to 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.

MOBILE CRANE REQUIREMENTS

Contracting officers will ensure cranes are equipped with the following and that these devices are in working order:

- Load indicating device or a load moment indicator,
- Radius or boom angle indicator,
- Anti 2-block device,
- Boom length indicator for cranes with telescoping booms,
- Drum rotation indicators on cranes manufactured after 1990,
- Boom hoist upper limit device or boom stops for lattice boom cranes, and a
- Fire extinguisher in the cab.

- Contracting officials will ensure all required documentation is present and accurate including:
    - Certification documentation,
    - OEM Operator's manual,
    - Safety plan, and an
    - Accident prevention plan.

Note:
According to Unified Guide Spec UFGS 05125N and Equipment Manual EM 385, articulating boom cranes and cranes used in duty cycle operations, such as clamshell and bucket operations, do not require a load indicating device or a load moment indicator.

BARGE MOUNTED MOBILE CRANES

For mobile cranes operated on barges, the contracting officer must address the following issues. In cases where mobile cranes are operated on barges, the mobile crane shall be secured to the barge to prevent shifting. OEM load charts and certification established from shore based load testing are invalid when mounting mobile cranes on barges requiring specialized load charts be developed. New load charts shall be developed according to barge stability calculations, based on anticipated loading and barge list and trim characteristics. Barge mounted cranes shall be equipped with a load indicating device, a wind indicating device, and a marine type list and trim indicator readable in one-half degree increments . The amount of list and trim shall be within the crane manufacturer's requirements. A third party certification from an OSHA accredited organization shall be obtained.

The contracting officer has the overall responsibility to verify that the crane and barge are in compliance with these requirements and that the load charts have been revised as required.

CONTRACTOR CRANE OPERATORS

EM 385-1-1 requires that "operators must be qualified by a source that qualifies operators" (e.g., an independent testing and qualifying company, a union, a governmental agency, or a qualified consultant). Operators shall be instructed in and qualified for each type of crane or derrick he/she is to operate. Qualification shall be valid for no longer than 5 years from the date of license issuance. Prior to reissuance of qualification, operators must have attended at least 8 hours of crane/derrick safety training; passed an operational examination; and pass a physical examination within 2 years. Proof of operator qualification shall be provided to the contracting officer.

Required Documentation

A Certificate of Compliance for each crane entering an activity must be provided. The certificate must state that the crane and rigging gear meet applicable OSHA regulations, and that the operators are qualified and trained in the operation of the crane to be used, including training in the proper use of all safety devices. Written reports of performance testing shall be maintained with the crane or at the on-site project office (EM 385-1-1, Section 16) including records of crane inspections and load tests and the load test procedures conducted prior to initial use, and after load-sustaining parts have been altered, replaced, or repaired. A hazard analysis plan must be developed and implemented for crane set-up and tear-down. A Critical Lift Plan is required for all lifts meeting the critical lift criteria discussed in the next section.

Critical Lift Plan (NAVFAC P-307)

All critical lifts must have a critical lift plan.
NAVFAC P-307 defines a critical lift as any lift over 75% of crane or hoist capacity (50% for barge mounted mobile cranes), multiple crane or multiple hoist lifts, personnel lifts, non routine rigging or operations, lifts of sensitive equipment and lifts involving unusual safety risks.

Critical Lift Plan (EM 385-1-1)

A Critical Lift Plan is required according to EM385-1-1 for the following: any lift 75% or more of the crane's rated capacity, multiple crane or hook lifts, personnel lifts, non-routine or technically difficult rigging, lifts where the center of gravity could change, multiple lift rigging, lifts the operator believes should be considered critical, lifts without the use of outriggers using rubber tire load charts, lifts involving submerged loads, and lifts out of the operator's view. Note: EM 385-1-1 allows multiple lift rigging practices for the purpose of erecting/placing structural steel only.

Critical Lift Plans

Critical lift plans must include the size and weight of the load, the maximum load capacity for the entire lift range of the crane/hoist, the lift geometry and procedures, a rigging plan including lift points, rigging gear, and rigging procedures, ground conditions, outrigger requirements, and, if necessary, the design of mats (cribbing) to ensure a level and stable foundation. The environmental boundaries such as wind restrictions, as well as coordination and communication requirements must also be included.

CERTIFICATE OF COMPLIANCE

Contractors operating cranes are required to complete the Certificate of Compliance found in NAVFAC P-307 appendix P-1. This certificate is to be signed by the appropriate contractor company official and shall be posted in the crane cab. The company official shall certify that the crane operators are qualified and trained for operation of the cranes to be used, the operators are trained not to bypass safety devices, the crane and rigging comply with OSHA 29 CFR 1926, and the operators, riggers, and company officials are aware of the actions required in the event of an accident as specified in the contract.. The contracting officer should review the certificate for accuracy, ensuring that the company official and title are identified, and that the completed and signed certificate is posted in the crane cab.

CERTIFICATE OF COMPLIANCE	
This certificate shall be signed by an official of the company that provides cranes for any application under this contract. Post a completed certificate on each crane brought onto Navy property.	
CONTRACTING OFFICER'S POINT OF CONTACT (Government Representative)	PHONE
PRIME CONTRACTOR/PHONE	CONTRACT NUMBER
CRANE SUPPLIER/PHONE (if different from prime contractor)	CRANE NUMBER (i.e., ID number)
CRANE MANUFACTURER/TYPE/CAPACITY	
CRANE OPERATOR'S NAME(S)	
I certify that 1. The above noted crane and associated rigging gear conform to applicable OSHA regulations (host country regulations for naval activities in foreign countries) and applicable ASME B30 standards. The following OSHA regulations and ASME standards apply:_____	
2. The operators noted above have been trained and are qualified for the operation of the above noted crane.	
3. The operators noted above have been trained not to bypass safety devices 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.	
COMPANY OFFICIAL SIGNATURE	DATE
COMPANY OFFICIAL NAME/TITLE	
POST ON CRANE (IN CAB OR VEHICLE)	

REQUIRED ON CRANE (EM 385-1-1)

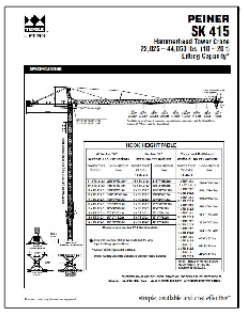
In addition, operating instructions, a list of safety devices, proper load charts, and the certificate of compliance shall be kept on the crane.

NOTES

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.



GENERAL DOCUMENTATION

The following requirements shall be specified in contracts where tower cranes may be utilized:

Installation preparation instructions which shall provide:
Wind restrictions/limitations; Data or tower (mast) height limitations based on several wind velocity levels for out-of-service conditions; The maximum distance between horizontal reaction support levels for internal climbing cranes; 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 dimensional data.

Assembly and dismantling instructions which shall provide:
Weight and dimensions for components and subassemblies; Recommended lifting attachment points; Center of gravity location for non-uniform components and subassemblies; The method and recommended sequence of assembly and disassembly of components and subassemblies; Warnings should be given alerting assembly personnel when member strength or stability requires particular methods or sequencing; Details, including diagrams where necessary, of critical component connections describing and identifying bolts, pins, and other parts needed, the method of assembling the joint, the torque or tension to be applied to pre-stressed (traction) bolts, the point in time in the assembly process for applying torque or tension, and the means for retaining pins, etc.; and the means for installing stabilizers.

The operating manual, any limitations for operation and operation precautions are required and shall be provided by the contractor.

MAINTENANCE DOCUMENTATION

Maintenance requirements including identification of those members or locations that should be periodically observed, or tested, for the purpose of detecting the onset of metal fatigue, the loosening of pre-stressed (traction) bolts, or wear affecting the ability of the crane to support rated loads should be given by the manufacturer.

Repair recommendations including advice on welding procedures, and the type of metal used for load sustaining members shall be identified.

Design characteristics affecting safety, such as location, proper settings and adjustments, and functioning of limiting and indicating devices; high and low ambient temperature limitations; permitted variations in electrical supply and circuit parameters; location and required settings of hydraulic or pneumatic pressure relief valves and locations of points where circuit pressures can be checked.

Limitations on service life of load bearing members and mechanisms including recommendations of frequency of inspection as a function of severity of service; for internal climbing cranes, identification of those portions of the tower (mast) intended to accommodate wedge reactions, or means to be employed at wedge reaction points.

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
- 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 to prevent potential damage to the crane.

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.

Check all parts of high-strength threaded connections prior to installation. All parts of threaded connections must be cleaned and visually inspected prior to their 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. Never use a threaded fastener (including nuts) with any sign of rust on its shank or threads (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).

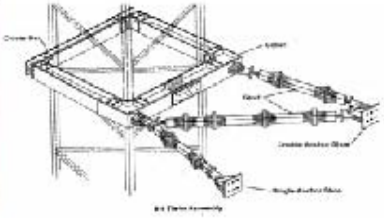
NOTE: Failure to torque to the manufacturer's specified torque value is extremely dangerous and could lead to an accident resulting in property damage, serious injury or loss of life!

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. The schedule should indicate each level at which the crane will be mounted for operation giving the locations of supports for both horizontal and vertical crane reactions and the maximum height to which construction can be carried before the crane must climb again. 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. 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

After assembly, the crane shall be load tested, before placing the crane in service, using test loads that are 110% of rated load at the radius producing the greatest load moment or as specified by the manufacturer. Stationary tower or pedestal cranes shall be tested with the load rotated slowly to those positions that cause maximum loading of each foundation and then held for at least 15 min at each critical position. Before placing a crane in service, all functional motions, locking devices, and brakes shall be checked for operation. Limiting devices shall be checked for proper setting and operation. Functional motion tests shall be performed first without load and then at rated load, or where appropriate, with the overload test load boomed-in to rated radius. The tests shall include load hoisting and lowering, boom hoisting and lowering, or traversing the trolley, swing motion, brakes and clutches, and limits, locking, and safety devices. The order in which tests of a newly assembled crane are to be performed is as follows: (1) functional motion test without load (2) functional motion tests at rated load (3) overload tests of supports (110%). Written reports listing the load test procedures used along with any repairs or alterations performed on the crane shall be available for review.

MAINTENANCE AND REPAIR

The manufacturer shall furnish 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.

SAFE OPERATION

Cranes required to weathervane when not operated/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. Operators shall be required by the employer to pass a practical operating examination and meet physical qualifications as required. 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

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 except for test purposes

NOTES

OPERATIONS

PRE-USE INSPECTIONS BY CONTRACTORS - REGULATIONS

The pre-use inspections shall be done in accordance with 29 CFR 1926.550 (a) (5) by contractors operating cranes on Navy activities. All rigging gear shall be inspected prior to use in accordance with 29 CFR 1926.251. The load shall be inspected prior to the lift for stability and integrity.

PRE-USE INSPECTIONS BY CONTRACTORS - 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.

PRE-USE INSPECTION BY CONTRACTORS – SHEAVE SHAFT

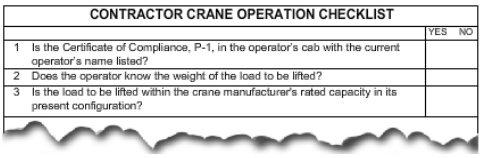
This sheave shaft does not appear to be secured properly. If something does not look right, have a qualified crane inspector evaluate the components in question.

PRE-USE INSPECTIONS BY CONTRACTORS – WIRE ROPE

Observe for properly reeved wire rope. Look for obvious signs of wire rope damage. The wire rope on the drum in the top photo is not properly reeved. The drum below contains several damaged wire rope sections.

PRE-USE INSPECTIONS BY CONTRACTORS – LIMIT SWITCH

Ensure the limit switch weight is properly installed and the limit switch is operational.



CONTRACTOR CRANE OPERATION CHECKLIST		
	YES	NO
1 Is the Certificate of Compliance, P-1, in the operator's cab with the current operator's name listed?		
2 Does the operator know the weight of the load to be lifted?		
3 Is the load to be lifted within the crane manufacturer's rated capacity in its present configuration?		

CONTRACTOR CRANE OPERATION CHECKLIST

A copy of the Contractor Crane Operation Checklist is found in NAVFAC P-307, Appendix P, Figure P-2. This checklist is an excellent oversight tool for Contracting Officer's Representatives and shall be used during oversight of contractor crane operations. The host activity shall concur with the oversight plan and copies of the checklist shall be kept on file for one year. In the following screens we will explain each of the items on the contractor crane operation checklist.

CONTRACTOR CRANE OPERATION CHECKLIST – ITEM 1

The first item on the Contractor Crane Operation checklist asks: Is the Certificate of Compliance in the operator's cab with the current operator's name listed? As mentioned earlier, Contractors operating category 1 or 4 cranes are required to complete the certificate of compliance found in NAVFAC P-307, appendix P-1.

CONTRACTOR CRANE OPERATION CHECKLIST – ITEMS 2 AND 3

Does the operator know the weight of the load to be lifted? If the load weight is unknown, it cannot be lifted safely. Is the load to be lifted within the crane manufacturer's rated capacity in its present configuration?

CONTRACTOR CRANE OPERATIONS CHECKLIST ITEMS 4, 5 AND 6

Is the crane on level and firm ground? If a crane is not level, additional stresses and changes in the center of gravity will reduce the crane's capacity. Outriggers, when used, must be fully deployed with the weight of the tires free of the ground. Some crane manufacturers allow intermediate outrigger positions. These cranes shall have appropriate load charts for each allowable outrigger position. Cranes set up on outriggers shall always have all outriggers fully deployed in accordance with the OEM load chart in use. Under no circumstances should "On Outrigger Capacities" be utilized when all outriggers are not fully and properly deployed as specified in the OEM load chart package and operation manuals.

CONTRACTOR CRANE OPERATION CHECKLIST ITEM 7

When working on outriggers, adequate blocking or cribbing is essential. Proper support materials underneath the outrigger pads allow greater ground load distribution. The

cribbing must have enough surface area to spread out the weight of the crane and load and must be strong enough to support the load without failure. Check local instructions for specific ground loading and/or cribbing requirements. If any travel route or crane set-up location is in question, involve local engineering oversight.

CONTRACTOR CRANE OPERATION CHECKLIST - ITEM 8

When outriggers are not used, the crane must be rated and certified for "on rubber" or "On Tires" lifting. Lifts made without outriggers shall be per OEM load charts. "On rubber" over-the-side lifts require extreme caution. Tire size, condition, and pressure are critical. When operating "on rubber" it is a good idea to extend outriggers, where clearances permit, for a safety backup (unless prohibited by OEM).

CONTRACTOR CRANE OPERATION CHECKLIST - ITEM 9

The swing radius of the counterweight must clear personnel and obstructions. Accessible areas within the swing radius must be barricaded to prevent injury or damage.

CONTRACTOR CRANE OPERATION CHECKLIST - ITEM 10

Ensure the hook has been centered over the load in such a manner as to minimize swing. This illustration shows a load that will swing inward toward the crane boom if freely suspended and may result in an accident.

CONTRACTOR CRANE OPERATION CHECKLIST - ITEM 11

Ensure the load is well secured and balanced in the sling or lifting device before it is lifted more than a few inches. It is good practice to stop after the load has been lifted a few inches clear of the ground and check the stability of the load. This also allows the crane operator to check the crane's hoist brake prior to raising the load to a more dangerous height.

CONTRACTOR CRANE OPERATION CHECKLIST - ITEM 12

Ensure the lift and swing path are clear of obstructions, before beginning the lift

CONTRACTOR CRANE OPERATION CHECKLIST - ITEMS 13 AND 14

If rotation of the load being lifted is hazardous, a tag line must be used. Windy conditions may make otherwise stable loads hard to keep under control and may require more than one tag line. It is important to assure that personnel are prevented from standing or passing under or near any suspended loads.

CONTRACTOR CRANE OPERATION CHECKLIST - ITEMS 15 AND 16

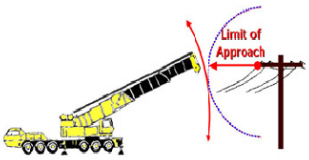
Is the crane operator's attention diverted? The work site should be free of disruptions or disturbances which may interrupt the focus of the crane team. When signaling the crane operator, ANSI standard hand signals shall be used to direct the crane movements. The use of approved radios and direct voice communication is also acceptable when appropriate. When making "blind lifts" the signalman and crane operator shall maintain constant communication throughout the lift.

CONTRACTOR CRANE OPERATION CHECKLIST - ITEMS 17 AND 19

Ensure there is no side loading on the boom or swinging of the load on lift-off. Never side-load the boom by dragging loads or lifting off center. Starting and stopping motions of the crane boom should be slow and smooth to prevent excessive side loading

CONTRACTOR CRANE OPERATION CHECKLIST - ITEM 18

The practice of riding loads suspended by cranes shall not be allowed.



CONTRACTOR CRANE OPERATION CHECKLIST - ITEM 20

If operating near electric power lines, the rules and guidelines regarding power line safety and limits of approach, as outlined in NAVFAC P-307 Section 10, must be understood and adhered to.

When operating near power lines, they should be de-energized and visibly grounded whenever possible. Even when power lines are known to be de-energized, absolute limits of approach shall be observed. The following manuals provide specific guidelines on power line safely and limits of approach:

- OSHA 29 CFR Part 1910
- ASME B30 applicable to the crane type
- EM 385-1-1 Section 11
- NAVFAC P-307, Section 10

CONTRACTOR CRANE OPERATION CHECKLIST - ITEMS 21 AND 22

Critical Lifts are described as:
Lifts over 75 percent of the capacity of the crane or hoist or in the case of a barge mounted mobile crane, lifts over 50 percent of the crane's capacity,
Lifts involving more than one crane or hoist,
Lifts of personnel, and
Lifts involving non-routine rigging or operation, sensitive equipment, or unusual safety risks.

CONTRACTOR CRANE OPERATION CHECKLIST - ITEM 23

The last item on the Contractor Crane Operation Checklist is the rigging gear check off.
Contractors must verify that the rigging gear in use is undamaged and conforms to all applicable OSHA regulations (host country regulations for naval activities in foreign countries) and applicable ASME B30 standards.

Understanding Crane Capacities

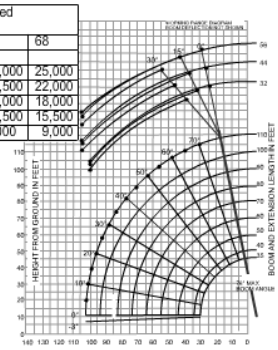
The crane's capacity must be adequate for the greatest weight, radius, and boom length that is to be used. A crane's maximum rated capacity rarely gives a practical indication of the load that the crane can actually lift. The OEM maximum rated capacity is based on a configuration involving minimum length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

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.

Examples of load charts:

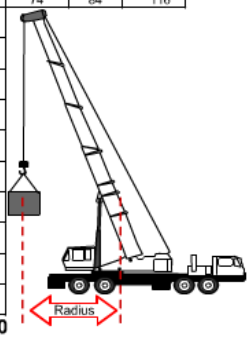
Radius in Feet	Manual Fly Section Retracted Boom Length in Feet						
	32	33	44	50	56	62	68
12	50,000	47,000	44,000	41,000	38,000		
15	42,000	40,000	39,000	36,000	33,000	27,000	25,000
20	31,800	31,400	31,000	29,500	28,000	25,500	22,000
25	21,800	21,800	21,700	21,100	20,000	19,000	18,000
30		15,500	15,500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

Radius in Feet	ON OUTRIGGERS FULLY EXTENDED – OVER REAR 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)			

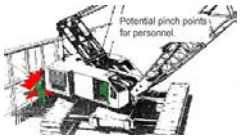


Understanding Crane Capacities: Load Chart Interpretation

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.

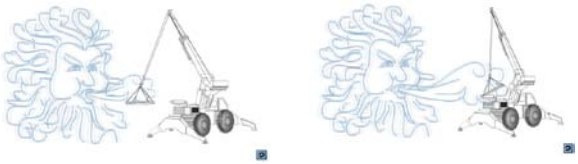
Operating Hazards

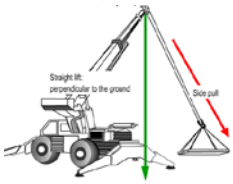
Always remain aware of operating hazards, overhead congestion, counterweight clearance and pinch points, when observing crane operations.



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.



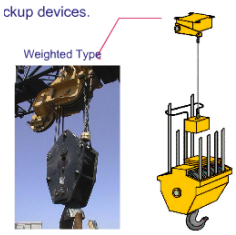


Hoisting and Lowering

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

Limit Switches

Limit switches are not to be used as operational devices. You would not use your emergency brake to stop your car on a regular basis. Limit switches are emergency back-up devices.



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 outriggers are fully extended, an approved lifting platform is used, and a trial lift, proof test, and inspection are performed prior to lifting personnel

Lifting Personnel with Cranes

Body harnesses must be used whenever personnel are suspended in a personnel lifting device and a shock absorbing lanyard must be attached to an approved attachment point on the lift platform. The use of restraint belts are prohibited by OSHA. Remember, when lifting personnel with cranes, the criteria for a Critical Lift must be observed.

Lifting Personnel with Cranes: Trial Lifts 1

A trial lift is required at each job site, immediately prior to lifting any personnel and/or after any repairs or modifications have been made to the lifting platform. The operator shall determine that all systems, controls and safety devices are activated and functioning properly; that no interference exists; and that all configurations necessary to reach those work locations will allow the operator to remain under the 50 percent limit of the hoist's rated capacity.

Lifting Personnel with Cranes: Trial Lifts 2

The trial lift must be performed with the unoccupied personnel platform loaded with a minimum of the anticipated weight of personnel and all gear to be placed in the platform. The trial lift shall be made from ground level, or any other location where personnel will enter the platform, to each location at which the personnel platform is to be hoisted and positioned. For mobile cranes, the trial lift shall be repeated prior to hoisting personnel whenever the crane is moved and set up in a new location or returned to a previously used location. A proof test is required at each job site, prior to any personnel lift and after any repair or modification to the lifting basket. Perform the proof test at 125% of the platform capacity for 5 minutes. This test may be done concurrently with the trial lift. Inspect the platform and rigging after the test and repeat the proof test if repairs are made.

LIFTING PERSONNEL WITH CRANES: INSPECTION AFTER TRIAL LIFT

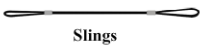
A visual inspection of the crane, rigging, personnel platform, and the crane base support or ground shall be conducted immediately after the trial lift. The crane operator shall inspect all hoist ropes to ensure they are free of kinks, that multi-part lines are not twisted, the primary attachment is centered over the platform and hoist ropes are properly seated on drums and sheaves. The visual inspection is performed to determine whether the testing has exposed any defects or produced any adverse effect upon any component or structure. Defects found during inspections that create a safety hazard, shall be corrected before hoisting personnel.

NOTES

BASIC RIGGING

RIGGING RESPONSIBILITIES

Rigging plays a significant role in weight handling operations. A basic understanding of rigging is necessary to help ensure crane and rigging operations are conducted safely. The Lead Rigger or “Lift Supervisor” on the job has overall responsibility for the safety and success of the lift or rigging evolution. Responsibilities include: Accurately determining the weights of loads to be moved or lifted.
Determining the center of gravity and stability of the load.
Planning the crane or load path and checking for clearances.
Selecting and properly using appropriate rigging equipment.
Determining the allowable capacity of rigging configurations.
Selecting appropriate attachment points on loads to be lifted.
Pre-use inspection of rigging gear. Establishing method of Crane signaling and communications.



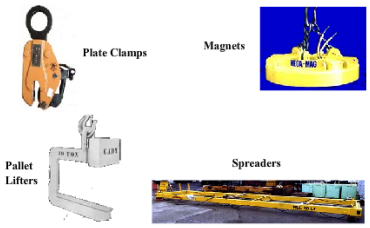
COMMON RIGGING GEAR

These are examples of commonly used rigging gear :
Shackles - U-Shaped fitting with a pin across the throat used to connect slings to loads or to attach other fittings.
Eye-bolts - A bolt with a loop forged on one end and threaded on the other end.
Swivel Hoist Rings - Use is similar to eyebolts, but the hoist ring rotates 360 degrees and swivels 180 degrees without downgrading of the hoist rings' capacity.
Various slings - Fabricated from wire rope, chain, metal mesh, and synthetic material such as nylon.

BELOW-THE-HOOK LIFTING DEVICES

Below-the-hook lifting devices are also equipment covered by NAVFAC P-307. Some common examples include:

- Plate clamps
- Spreader bars, Strongbacks, and Equalizer beams. These devices may help distribute the total load weight to attachment points on the load. They may also help minimize sling angle loading on large dimension loads.
- Powered Lift Magnets
- Pallet Lifters



Other examples can be found in ASME B30.20.

SLING MARKING REQUIREMENTS

ASME B30.9 requires the following information be marked on wire rope slings:

- Name or trademark (logo) of the manufacturer
- WLL of the hitch configurations and the angle upon which it is based for:
    - Vertical Lifts
    - Choker Hitch
    - Basket Hitch
- The size

*In addition synthetic slings must include the material type.

Note: EM-385-1-1 requires the following marking requirements: Wire rope slings shall have affixed a durable permanent identification tag stating the diameter, rated load, lifting capacity in vertical, choker, basket configuration, and date placed in service.

Rigging gear that is not correctly marked must be removed from service!

Manufacturer Markings

Manufacturer markings make it possible to identify the maker of new equipment and ensure it is a creditable product.

ASME B30.26, "Rigging Hardware", requires the following markings on shackles:

- The name, logo, or trademark of the manufacturer
- Rated Load
- Size

Pre-Use Inspection

Inspecting rigging gear prior to use is just as important as inspecting the crane.

All rigging gear used for lifting must be inspected before use to:

- Ensure gear is in good condition
- Ensure Personnel safety
- Ensure damaged gear is removed from service so no one else uses it

Documentation of these "pre-use" inspections is not required.
A more detailed Periodic Inspection is required to be documented and kept on file by the contractor
Damaged items must be removed from service and turned in to be evaluated by a trained rigging gear inspector.

Hardware Inspection

Hardware should be inspected for:

- Physical Damage: such as corrosion, cracks, nicks, gouges, heat damage, distortion or stretching, wear, damage to threads (internal and external) on the rigging and on the equipment to be lifted
- Proper Operation: All moving parts must work freely. Hoist ring bases shall swivel 360 degrees and the bail must pivot at least 180 degrees

As mentioned earlier, damaged items must be removed from service and turned in to be evaluated by a trained rigging gear inspector.

Wire Rope Sling Inspection

The entire length of wire rope slings should be inspected for:

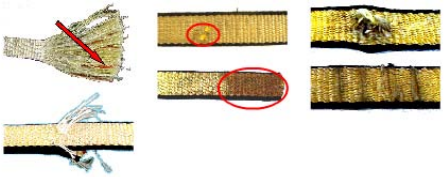
- Broken wires
- Knots (A knot in any part of a sling is cause for rejection)
- Heat damage
- Excessive Corrosion
- Kinks
- Abrasion
- Core Protrusion
- Damage to End fittings

*The allowable number of broken wires depends on the type of rope used to make the sling. Refer to ASME B30.9 for rejection criteria.

Synthetic Sling Inspection

Synthetic Slings are more susceptible to damage than wire rope slings and should be inspected for:

- Abnormal wear
- Ultra-violet light damage
- Rotting or decay
- Embedded particles
- Knots
- Exposed core warning yarns
- Heat damage
- Chemical damage
- Snags or punctures
- Cuts
- Variations in size (synthetic rope slings)
- Broken or damaged stitches, splices or seizing



Additional Sling Inspection

Additional slings include Chain and Metal Mesh slings.

When inspecting Chain slings check each link and attachment for:

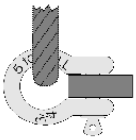
- Excessive wear
- Deformation
- Severe nicks or cracks

One area to pay particular attention to when inspecting chain slings is the hammer link. This is the only thing holding the sling together, so we want to ensure it's in good shape.

When inspecting Wire Mesh slings check for:

- Distorted, cracked or severely worn fittings
- Broken welds or broken brazed joints along the sling edge
- Broken or worn wires in any part of the mesh
- Lack of flexibility due to distortion of the mesh

Again, as with any type of rigging gear, if you have concerns about the overall condition of the sling, remove it from service and have it evaluated.



Shackles

Side loading is allowed for some types of shackles. Side loading of screw-pin or bolt-type shackles is allowed, however; you must reduce the working load limit to 50 percent, or more if required by the OEM if it is more restrictive. Round pin shackles are not designed for side loads and must not be side loaded. If it is side loaded, it will likely spread. The cotter pin keeps the shackle pin in position but does not provide a positive support for the bow. This shackle must be used in vertical or straight pulls only.

Non-Shouldered Eyebolts

There are two basic types of eyebolts you may find at your worksite.
Shouldered and non-shouldered eyebolts.
All eyebolts must be used in accordance with the OEM's instructions.

Non-shouldered Eyebolts can be used in a vertical application only (0 to 5 degrees from vertical).
No side or angular pulls are allowed.

A minimum thread engagement is required:

- When installing eyebolts into hard metals the minimum thread engagement is 1 and 1/2 times the diameter of the threaded shank of the eyebolt
- When installing eyebolts into soft metals such as aluminum the minimum thread engagement is 2 times the diameter of the threaded shank of the eyebolt
- When installing eyebolts into other materials such as plastic or zinc use OEM or engineering guidance.

If the threaded hole is not sufficient to meet the requirements above, eyebolts can not be used.

SHOULDERED EYEBOLTS

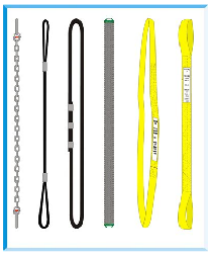
For shouldered eyebolts angular pulls are allowed, but the eyebolt capacity must be downgraded per OEM requirements. Shouldered eyebolts must be installed with the shoulder seated flush against the mounting surface. The eye must be aligned with the plane of pull (shims may be used for alignment). The total thickness of the shims shall not exceed one thread pitch (the distance between the crowns of two adjacent threads). This allows the eyebolt to be rotated up to 360 degrees for orientation with the plane of pull. A minimum thread engagement is also required for shouldered eyebolts.

- When installing eyebolts into hard metals the minimum thread engagement is 1 and 1/2 times the diameter of the threaded shank of the eyebolt
- When installing eyebolts into soft metals such as aluminum the minimum thread engagement is 2 times the diameter of the threaded shank of the eyebolt
- When installing eyebolts into other materials such as plastic or zinc use OEM or engineering guidance.

If the threaded hole is not sufficient to meet the requirements above, eyebolts can not be used. Eyebolts must be used in accordance with the OEM's instructions. As with all types of eyebolts, no side pulls are allowed.

Swivel Hoist Rings

Swivel Hoist Rings must be installed with the shoulder flush against the mounting surface. If the engaging hole is not sufficient to allow the shoulder to seat flush against the mounting surface the hoist ring cannot be used. Check the OEM requirements or instructions prior to installation. Most manufacturers do not allow the use of shims for hoist ring installation. Angular pulls do not reduce the rated capacity of swivel hoist rings. They must be tightened to the Manufacturer's torque specification, which is usually marked on the hoist ring.



Sling Types

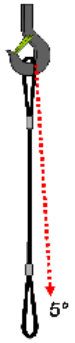
Slings are commonly made from wire rope, synthetic material, chain or metal mesh. Wire rope slings are good general duty slings, but like chain or metal mesh slings, they may not be appropriate for electrical hazard areas or for handling fragile equipment. Synthetic slings are a good choice for fragile loads, but are more susceptible to damage.

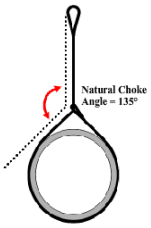
Sling Use Considerations

Almost all slings share common use and application rules. All slings (wire rope, synthetic, chain, etc.) must meet the selection, use, and inspection criteria of ASME B30.9. Slings must not be used at angles of less than 30 degrees from horizontal, unless specifically authorized by engineering. Never tie knots in, or use a sling which has been knotted. Consider additional stresses in slings due to using at an angle whenever selecting and using slings. This also applies to all other rigging gear used in the lift such as shackles, turnbuckles, eyebolts, chain hoists, etc. Use chafing gear when necessary to protect slings and the items being lifted from damage.

WLL Considerations - 1

When using slings in a vertical position, the wire rope sling is good for 100% of its rated “working load limit” or safe working load. Whenever there is an angle of more than 5° off the vertical, sling angle stress must be taken into consideration and a reduction in capacity must be factored in.



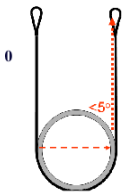


Choker Hitches

The Working Load Limit of a sling is always reduced when using a choker hitch. A natural choke angle is 135 degrees if a choker hitch is allowed to tighten itself as the load is lifted. At this angle, the sling's capacity must be reduced to 75% of its vertical Working Load Limit. When choke angles are less than 120 degrees the WLL must be reduced further.

Basket Hitches

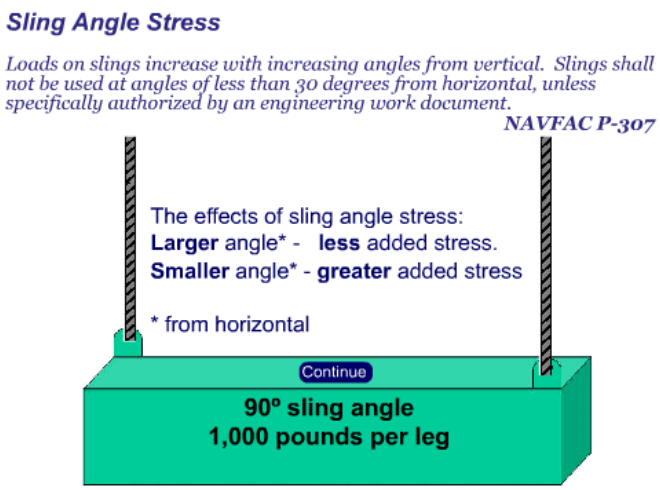
Slings used in a basket hitch configuration have a basic capacity equal to 200% of the sling's vertical working load limit only when:



- The sling angle of each leg is less than 5 degrees from vertical
- The sling is not twisted
- For wire rope slings, the ratio of the diameter of the object to the diameter of the wire rope, the D/d ratio, must be greater than 40.

Sling Angle Stress Example

This example demonstrates how sling angle stress affects sling loading. In the configuration shown you have a lift that weighs 2,000 pounds. If the slings are attached directly above the attachment points at a 90 degree angle from horizontal, the weight seen in each attachment is 1,000 pounds, or half of the load weight.



Protection - Hazards to Rigging Gear

Rigging gear may be affected by 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.

Protection

All slings can be damaged by cuts and abrasions. Do not drag gear across the deck or ground if possible. Also, do not allow the load to be set down on slings. Place loads on blocking and remove the slings by hand to prevent damage. Use chafing gear between the rigging gear and the load when necessary. Damaged gear must be removed from service.

Chafing Protection

Chafing gear can be quickly fabricated from many different types of material and can be used in many different ways. Here are some common examples: Wood blocks may be used to keep the sling away from sharp edges. Shoring up against the item being handled so the sling only comes in contact with the wood blocking is a great way to protect a sling from sharp edges. Old fire hose can be placed between gear and sharp edges or a sling can be passed through the hose and used as a protective sleeve. Be sure to remove the hose to inspect for damage before and after each use. The hose can hide sling damage if left on the sling! Liberal use of these protective materials will save gear and could ultimately save a life by preventing a sling from being cut in two.

Improper Rigging

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.

Stretched Shackle Bow

Overloaded rigging gear can lead to failure! Personnel must know the weight of the load prior to lifting and the rigging gear and crane must have adequate capacity to safely lift the load. Personnel must also ensure loads are free and clear of all obstructions prior to lifting. Lifting objects that are still bolted down is a sure fire way to overload gear

Damaged Synthetic Slings

The sling shown on the top left had a damaged cover and core due to inadequate chafing used. The sling shown on the bottom left was cut and parted during a lift due to inadequate chafing used. The slings shown on the right were found during a crane inspection. They were damaged, frayed, knotted, cut, worn, and had faded labels. Abuse, poor work practices, and improper storage methods contributed to their condition. All of the slings shown need to be removed from service and destroyed.

NOTES

CRANE AND RIGGING GEAR ACCIDENTS

CRANE OPERATING ENVELOPE

In order to define a crane accident, you must first understand the crane operating envelope. The operating envelope includes the crane, the operator, the riggers and crane walkers, other personnel, the rigging gear between the hook and the load, the load itself, the supporting structures, such as the rails or the ground, and the lift procedure.

RIGGING GEAR ENVELOPE

The rigging gear operating envelope contains the rigging gear and miscellaneous equipment covered by NAVFAC P-307 section 14, the user of the gear, the load itself, other personnel involved in the operation, the structure supporting the gear, the load rigging path, and the rigging procedure.

CRANE ACCIDENT

A crane accident occurs when any of the elements in the operating envelope fail to perform correctly during operations, including operations during maintenance or testing, resulting in the following: personnel injury or death, material or equipment damage, dropped load, derailment, two-blocking, overload or collision.

Rigging Gear Accidents

Rigging gear accidents occur when any of the elements in the operating envelope fails to perform correctly during weight handling operations resulting in the following: personnel injury or death, material or equipment damage, dropped load, two blocking, or overload.

Rigging Gear Accidents occur:

*...when any of the elements in the **rigging gear operating envelope** fails to perform correctly during weight handling operations resulting in the following:*

- Personnel injury or death
- Material or equipment damage
- Dropped load
- Two-blocking
- Overload

Accident Examples

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

Component Failure

Component failure such as motor burnout, gear tooth breakage, bearing failure, etc.,

... is **not** considered an accident solely due to material or equipment damage, **unless** the component failure causes other damage such as a dropped boom or dropped load.

Accident Exception

Component failure such as motor burnout, gear tooth breakage, bearing failure, etc. is not considered an accident just because damage to equipment occurred, unless the component failure causes other damage such as a dropped boom or dropped load.

Accident Causes

In most cases, crane accidents are due to inattention to the task, poor judgment, team members having too much confidence in their abilities or operating the crane too fast.

Accident Reporting Procedures

If an accident occurs with a crane or you find damage and suspect an accident has happened, the contractor must stop operations as soon as safely possible. Call emergency services if anyone is injured. Secure the crane and power as required. Notify supervision immediately and preserve the accident scene to aid the investigation. The Supervisor shall notify management personnel as well as the activity safety office. The contractor must notify the contracting officer as soon as practical, but not later than four hours, after any WHE accident. The contractor must secure the accident site and protect evidence until released by the contracting officer. The contractor must conduct an accident investigation to establish the root cause of any WHE accident and crane operations shall not proceed until cause is determined and corrective actions have been implemented to the satisfaction of the contracting officer. The contractor must provide the contracting officer within 30 days of any accident a Crane and Rigging Gear Accident Report using the form provided in section 12 of NAVFAC P-307.

Accident Procedures

- Stop operations as soon as safe
- Call EMS if personnel are injured
- Secure the crane and power as required
- Notify supervision immediately
- Ensure accident scene is preserved
- Supervisor shall notify management personnel as well as the activity safety office

The contractor must notify the contracting officer as soon as practical, but not later than four hours, after any WHE accident. The contractor must secure the accident site and protect evidence until released by the contracting officer. The contractor must conduct an accident investigation to establish the root cause of any WHE accident and crane operations shall not proceed until cause is determined and corrective actions have been implemented to the satisfaction of the contracting officer. The contractor must provide the contracting officer within 30 days of any accident a Crane and Rigging Gear Accident Report using the form provided in section 12 of NAVFAC P-307.

NCC Accident Notification:

- **E-mail:** NFSH_NCC_ACCIDENT@NAVY.MIL
- Alternate contact (should E-mail be unavailable)
  - **Phone:** 757-967-4042
  - **DSN:** 387-4042
  - **FAX:** 757-967-3808

Accident Reporting - Contractor

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(s) of any WHE accident. Crane operations shall not proceed until cause is determined and corrective actions have been implemented to the satisfaction of the contracting officer. Contractors shall provide to the contracting officer, within thirty days of any accident, a Crane and Rigging Gear Accident Report using the form provided in NAVFAC P-307 Section 12 consisting of a summary of circumstances, an explanation of cause or causes, photographs (if available), and corrective actions taken.

ACCIDENT REPORTING - CONTRACTING OFFICER

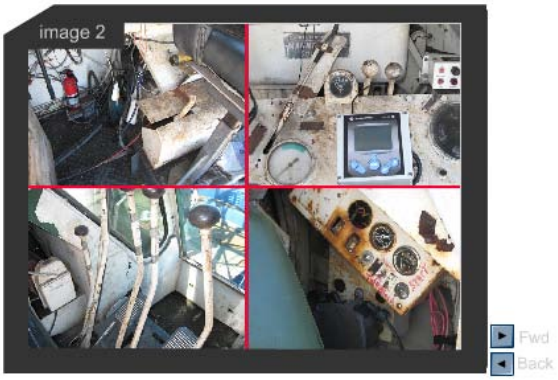
The contracting officer shall notify the host activity of any WHE accident upon notification by the contractor and provide the Navy Crane Center and the host activity a copy of every accident report, regardless of severity, upon receipt from the contractor. The contracting officer shall notify the Navy Crane Center of any accident involving a fatality, in-patient hospitalization, overturned crane, collapsed boom, or any other major damage to the crane, load, or adjacent property as soon as possible, preferably within twenty four hours of notification by the contractor. When the contracting officer is not in the local area, the contracting officer shall designate a local representative to ensure compliance with the above noted requirements. The above requirements are in addition to those promulgated by OPNAVINST 5100.23 and related local instructions.

CASE STUDIES 1

Review these potentially dangerous situations.

What is wrong in this picture?

Consider the picture.
Click on the question to reveal the answer.



What is wrong in this picture?

Consider the picture.
Click on the question to reveal the answer.

What is wrong in this picture?

Consider the picture.
Click on the question to reveal the answer.

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What is wrong in this picture?

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What is wrong in this picture?

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Click on the question to reveal the answer.

What is wrong in this picture?

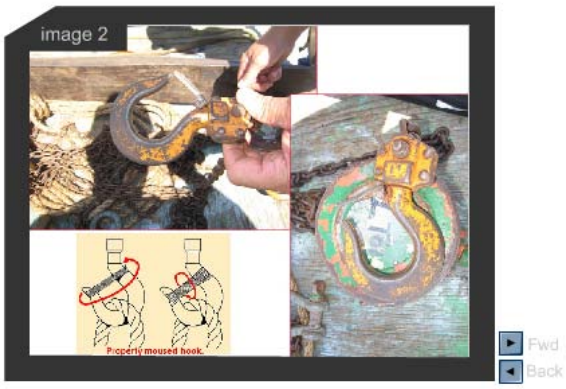
Consider the picture.
Click on the question to reveal the answer.

CASE STUDIES 2

These are examples of potentially dangerous situations.

What is wrong in this picture?

Consider the picture.
Click on the question to reveal the answer.



What is wrong in this picture?

Consider the picture.
Click on the question to reveal the answer.

What is wrong in this picture?

Consider the picture.
Click on the question to reveal the answer.

Back

What is wrong in this picture?

Consider the picture.
Click on the question to reveal the answer.

NOTES

NAVFAC
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_____