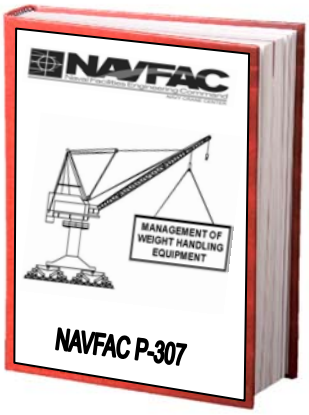
Navy Crane Center



NAVFAC P-307 Training

CATEGORY 2 AND CAB-OPERATED CATEGORY 3 CRANE SAFETY WEB BASED TRAINING STUDENT GUIDE

Naval Facilities Engineering Command
Navy Crane Center
Norfolk Naval Shipyard, Bldg. 491
Portsmouth, VA 23709-5000
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NAVFAC P-307 MODULE

Purpose

The overall purpose of the NAVFAC P-307 is to:

- Maintain the level of safety and reliability that was originally built into the equipment,
- Ensure optimum service life,
- Provide uniform standards for weight handling equipment operator licensing, and
- Ensure safe weight handling operation.

Weight handling equipment includes both cranes and the rigging gear used for lifting operations.

Applicability

NAVFAC P-307 applies to:

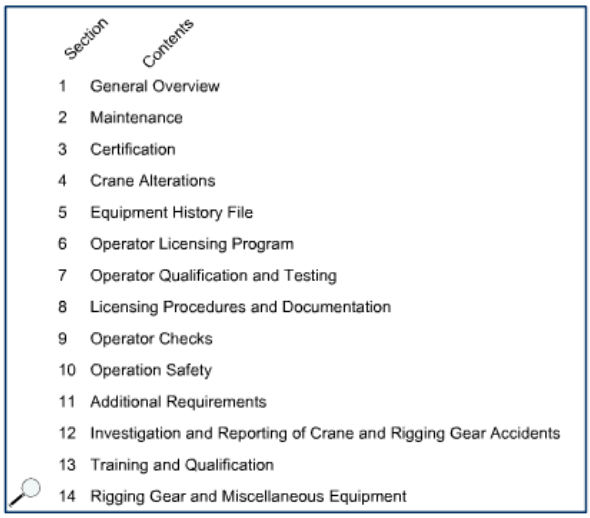
- Naval Shore activities,
- Naval construction forces, including the Naval construction training centers, and
- Naval special operating units.

NAVFAC P-307 meets, or exceeds, all OSHA regulations that apply to the operation of cranes.

NAVFAC P-307 Contents

For an overview of the NAVFAC P-307, review this table of contents.

NAVFAC P-307 Table of Contents



Section	Contents
1	General Overview
2	Maintenance
3	Certification
4	Crane Alterations
5	Equipment History File
6	Operator Licensing Program
7	Operator Qualification and Testing
8	Licensing Procedures and Documentation
9	Operator Checks
10	Operation Safety
11	Additional Requirements
12	Investigation and Reporting of Crane and Rigging Gear Accidents
13	Training and Qualification
14	Rigging Gear and Miscellaneous Equipment

Weight Handling Requirements

NAVFAC P-307 provides requirements for Weight Handling Equipment including:

- Maintenance, repairs and alterations
- Inspection
- Test
- Certification
- Operations
- Training

- Licensing and
- Rigging Gear Use

Maintenance and Inspection Requirements

NAVFAC P-307 also provides requirements for documentation of maintenance and inspection, including:

- Type and frequency of inspection
- Deficiencies to:
  - Load bearing parts
  - Load controlling parts
  - Operational safety devices
- Repairs and alterations made to cranes
- Minimum requirements for record keeping

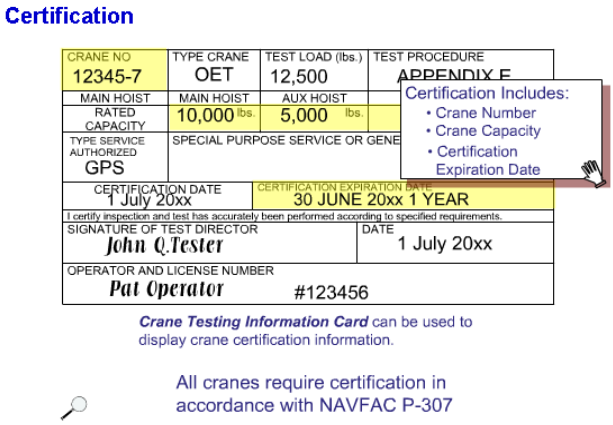
Certification

Certification Posting

- The crane identification number,
- Certified capacity and
- Certification expiration date

Must be posted on or near the crane.

Posting a copy of the actual certification, crane test cards, stickers or signs, are all acceptable methods provided they include the required information.



Types of Equipment Covered

NAVFAC P-307 covers category 1, 2, 3, and 4 cranes, as well as rigging gear.

Detailed descriptions of the cranes are included in Section 1.

Illustrations of individual crane types can be found in Appendix B.

Rigging gear is covered in Section 14.

NAVFAC P-307 General Overview Section 1

Section 1

- Describes cranes and crane-related equipment and
- Lists types of cranes and related equipment used at Naval Shore activities by category.
- Contains detailed descriptions of all four crane categories

Knowledge Check

1. **Select all that apply**. The purpose of the NAVFAC P-307 IS TO:

   a. Ensure safe crane and rigging operations.
   b. Provide standards for crane operations and rigging.
   c. Ensure crane operators become licensed.
   d. Maintain curriculum standards for the NCC.
   e. Maintain built in safety and reliability of equipment.

2. **Select the best answer**. The standards defined in the P-307

   a. Do not pertain to OSHA regulations.
   b. Meet or exceed all OSHA regulations that apply to operating a crane.

Category 1 Cranes

This is a list of category 1 cranes.
All category 1 cranes require a license to operate.

- Portal Cranes
- Hammerhead Cranes
- Locomotive Cranes
- Derricks
- Floating Cranes
- Tower Cranes
- Container Cranes
- Mobile Cranes
- Aircraft Crash Cranes
- Mobile Boat Hoists
- Rubber Tire Gantry Cranes

Category 1 Crane Examples

Floating Crane

Types:
- barge
- pontoon or
- hull-mounted
- rotating superstructure mounted on an integral base

Luffing booms:
- capable of continuous 360° rotation

Primary power
- supplied by a diesel-electric generator or diesel-driven hydraulic pumps
- While some are self propelled, most require tug boat assist to move about

Floating Crane

Hammerhead

Consists of:
- rotating counterbalanced, cantilevered boom equipped with one or more trolleys that move in and out on the boom

Supported by:
- a pintle or turntable mounted atop a traveling or fixed tower

Container Cranes

Consist of:
- hinged boom and main beam
- with a traveling trolley mounted on a rail mounted traveling gantry structure

At military port facilities Used for:
- quickly transferring containers on and off ships

Derrick

Example:
- jib-equipped crane having a boom hinged near the base of a fixed mast

Typically:
- boom may rotate 90° or more between the mast supports or "stiff legs" or members capable of resisting both tensile and compressive forces

Load movement:
- toward the mast by raising the boom
- away from the mast by lowering the the boom

Derrick

Portal

Consist of:
- Rotating superstructure mounted on a gantry structure with:
  - operator's cab
  - machinery
  - luffing boom

Primary power:
- diesel-engine driven generators or hydraulic pumps

Support:
- supported by wide gauge rail allowing the portal crane to move about the facility

Portal

Mobile Crane

Example:
Truck mounted hydraulic Cranes
- most common mobile cranes

Consists of:
- rotating superstructure
- upperworks mounted on an specialized truck chassis equipped with a power plant and cab for traveling over the road

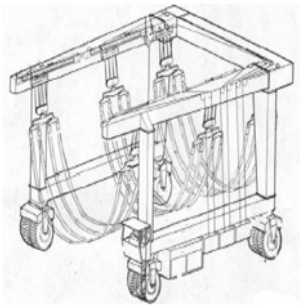
Primary power:
- one engine for both the upper works and the carrier or
- a separate engine for each

Mobile

Mobile Boat Hoist

A Straddle Carrier Hoist is a type of mobile boat hoist with:

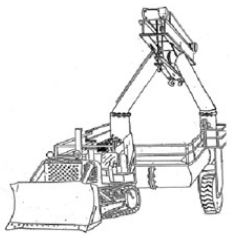
- a steel structure of rectangular box sections,
- supported by four sets of dual wheels capable of straddling and carrying boats.



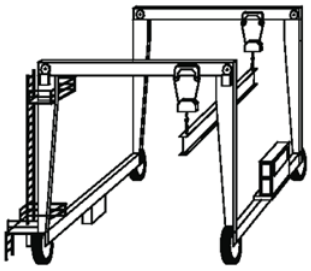
Landing Craft Retrieval Unit

The landing craft retrieval unit is a type of mobile boat hoist with:

- self propelled or towed carriers
- consisting of a wheeled steel structure
- Capable of straddling and carrying boats.



Rubber Tire Gantry Crane



- Portable elevated bridge crane mounted on legs
- Legs are supported by powered or un-powered wheels with rubber tires

Category 2 and 3 Cranes

This is a list of Category 2 and Category 3 cranes.

- Bridge Cranes
- Rail Mounted Gantry
- Pillar Jib
- Wall cranes
- Jib cranes
- Monorail
- Fixed overhead hoists
  - Manual
  - Powered

Portable hoists are covered in Section 14 of the NAVFAC P-307.
The activity may, however, treat them as Category 2 or 3 cranes.

Crane Capacity

The certified capacity of these cranes determines the category.

- Category 2 cranes have a certified capacity of 20,000 lbs. and **greater.**
- Category 3 cranes are those with a certified capacity of **less than** 20,000 lbs.

Category 2 and 3 Crane Examples

These are examples of Category 2 and Category 3 Cranes.

Bridge or OET Crane

Example:
- cab-operated
- can be
  - pendant or
  - radio controlled

Consists of:
- a single or multiple bridge girders spanning a building with top-running
- or under-hung trolleys

Mobility:
- limited to the area between the runways

Bridge or OET Crane

Pillar Jib - Fixed Crane

Consists of:
- a rotating vertical member
- with a horizontal arm carrying a trolley and hoist

Mobility:
- normally be rotated 360°

Jibs

Points:
- normally category 3 cranes
- category 2 if certified capacity of 20,000 pounds or greater

Consist of:
- a rotating horizontal boom (either cantilevered or supported by tie rods) carrying a trolley and hoist.
- usually mounted on a wall or building column

Jib

Trolly Mounted Overhead Hoist

Consist of:
- an under-hung, trolley-
- one or more drums and sheaves for wire rope or they may utilize chain

Powered by:
- manual
- electric
- hydraulic
- or pneumatic powered

Mobility:
- fixed
- or may travel on jib crane booms or monorail track

Trolly Mounted Overhead Hoist

Category 4 Cranes

All Category 4 cranes require a licensed operator.

Category 4 Cranes

Mounts

Category 4 cranes may be attached to:

- flat bed trucks
- trailers
- stake beds or
- rail cars

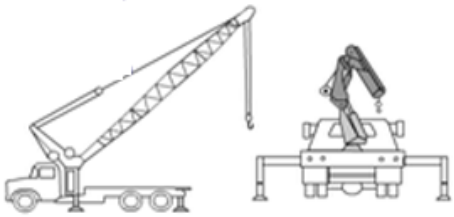
Or stationary mounted

- to piers etc.

Booms

Category 4 Cranes may have a:

- non-telescoping
- telescoping or
- articulating boom.



Pedestal Mounted

Pedestal mounted commercial boom assembly cranes of with less than 2,000 lbs. capacity are considered Category 3 cranes.

Capacities greater than 2,000 lbs. are Category 4 cranes and require a licensed operator.

Pedestal Mounted Commercial Boom Assembly

Pedestal mounted commercial boom assembly:
Category 3 = Capacity less than 2,000 lbs.
Category 4 = Capacity 2,000 lbs. or greater

Special Considerations

Category 4 cranes also include ammunition handling truck cranes with equipment category code 0704.

Note:

- Commercial truck mounted cranes described in ASME B30.5 and
- articulating boom cranes described in ASME B30.22

...of all capacities are Category 4 cranes and require a licensed operator even if the crane is down rated for administrative purposes.

Category 4 Crane Examples

These are examples of Category 4 cranes.

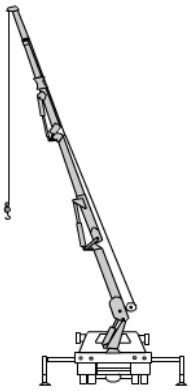
Category 4 Cranes

Boom Assemblies

- Non-Telescoping
- Articulating
- Telescoping

Mounted on:

- Mobile Units
  - flat bed trucks
  - trailers
  - stake beds
  - rail cars
- Stationary Units
  - Piers



Truck Mounted
Commercial Boom Assembly

Hydraulic Boom Crane
- Commercial
- Truck- Mounted
- Standard Ground Control

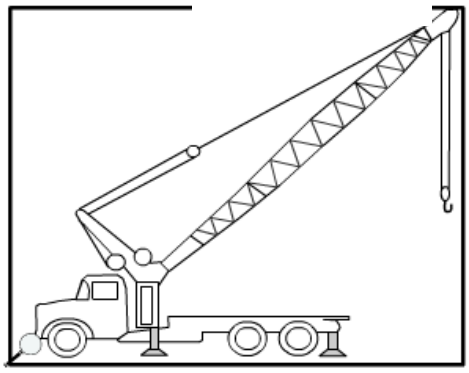
Structure:
- carrier, usually a flatbed truck
- independently operated crane

Power:
Power to operate may be from the truck's engine by way of a power take off unit

Non Telescoping
Boom

Consists of:
- a rotating superstructure (center post or turn-table)
- boom,
- operating machinery
- one or more operator's stations

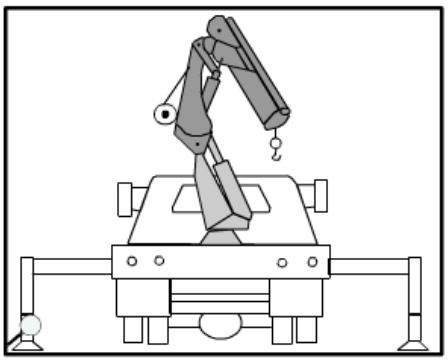
Its function is to lift, lower, and swing loads at various radii.



Articulating Boom

Consists of:
- the carrier, usually a flatbed truck
- independently operated articulating boom crane.

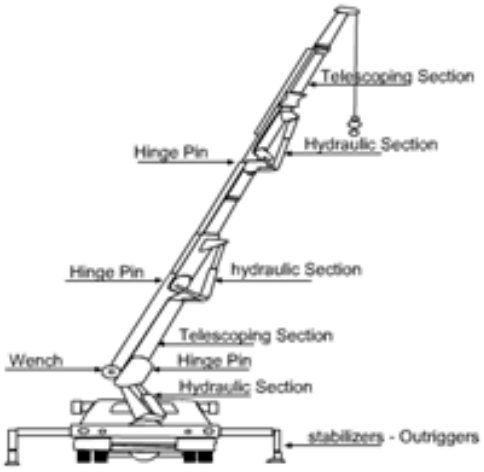
Power:
Power to operate may be from the truck's engine by way of a power take off unit



Truck Mounted
Articulating Boom

Hydraulic
Extendible Boom

Category 4 Crane Components



Licensing

All personnel who work with Navy cranes must be trained in accordance with the NAVFAC P-307 Section 13.

Category 1, 2, cab-operated Category 3, and Category 4 operators must be trained and licensed according to Sections 6, 7, and 8.

Licenses are not required to operate non-cab operated Category 3 cranes. However, training and a demonstration of ability to operate safely is required.

Cab Operated Cat 3 cranes may only be operated by licensed crane operators who are qualified to operate the particular type of crane.

Knowledge Check

1. **True or False**. Non-Cab Operated Cat 3 cranes require a license to operate.

   a. True
   b. False

2. **Select all that apply**. A license is required to operate:

   a. Category 1 cranes
   b. Category 2 cranes
   c. Cab-operated Category 3 cranes
   d. Category 4 cranes

3. **Select the best answer**. Category 2 and 3 cranes are separated by:

   a. Boom capacity and length
   b. Licensing requirements
   c. Certification date
   d. Certified capacity\

Crane and Rigging Accidents (Section 12)

In the event of an accident, activities shall investigate and report the accident in accordance with NAVFAC P-307 Section 12, as well as OPNAV Instructions 5102.1.

Crane and Rigging Gear Accident definitions can be found in Section 12.

Crane Accidents Defined

A crane accident occurs when any of the elements of the operating envelope fail to perform correctly during operations, including operation during maintenance or testing resulting in the following:

- Personnel Injury or death

  Minor injuries that are inherent in any industrial operation, including strains and repetitive motion related injuries, shall be reported by the normal personnel injury reporting process of the activity in lieu of these requirements.

- Material or equipment damage
- Dropped load
- Derailment
- Two-blocking
- Overload
- Collision including unplanned contact between the load, crane, and/or other objects.

Rigging Gear Accident Defined

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

- Personnel injury or death.

  Minor injuries that are inherent in any industrial operation, including strains and repetitive motion related injuries, shall be reported by the normal personnel injury reporting process of the activity in lieu of these requirements.

- Material or equipment damage that requires the damaged item to be repaired because it can no longer perform its intended function.
- Dropped load
- Two-blocking or cranes and powered hoists covered by section 14 (Rigging Gear and Miscellaneous Equipment)
- Overload

Training (Section 13)

Personnel training requirements are found in section 13 of NAVFAC P-307.

Rigging Gear and Miscellaneous Equipment (Section 14)

Section 14 of the NAVFAC P-307 provides:

- Maintenance,
- Inspection, and
- Test requirements

...for rigging gear and miscellaneous equipment not covered in sections 2 -11.

Knowledge Check

1. **Select the best answer**. NAVFAC P-307 uses the term weight handling equipment to refer to:

a. Anything within the crane envelope.
b. Cranes, crane gear, rigging gear, and all equipment.
c. All crane and rigging gear.
d. Only rigging gear.

NOTES

NAVFAC P-307 Module Exam

1. **Select the best answer.** There is no difference in capacity between Category 2 and Category 3 cranes.

   a. True
   b. False

2. **Select the best answer.** What is the category of this crane?

   a. Category 1
   b. Category 2
   c. Category 3
   d. Category 4

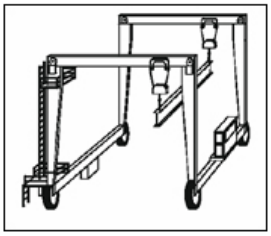
3. **Select the best answer.** What is the category of this crane?

   a. Category 1
   b. Category 2
   c. Category 3
   d. Category 4

4. **Select the best answer.** The purpose of the P-307 is to:

   a. Maintain safety & reliability.
   b. Ensure optimum service life.
   c. Provide standards for crane operations and rigging.
   d. Ensure safe crane and rigging operations.
   e. All of the above.

5. **Select the best answer.** What is the category of this crane?



   a. Category 1
   b. Category 2
   c. Category 3
   d. Category 4

6. **Select the best answer.** The P-307 provides guidance to shore based naval activities for management of weight handling equipment.

a. True
b. False

7. **Select the best answer.** What is the category of this crane?

a. Category 1
b. Category 2
c. Category 3
d. Category 4

8. **Select the best answer.** What is the category of this crane?

a. Category 1
b. Category 2
c. Category 3
d. Category 4

9. **Select the best answer.** What is the category of this crane?

a. Category 1
b. Category 2
c. Category 3
d. Category 4

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CRANE COMPONENTS MODULE

Crane Components

Careful repair and maintenance are essential to safe crane operations.
To ensure repairs are not compromised by **sub-standard** parts critical crane components are clearly identified.

Section 1 and appendix F of NAVFAC P-307 identifies:

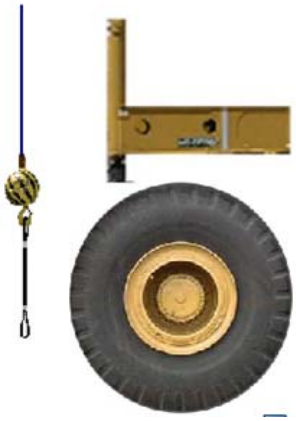
- load-bearing parts
- load-controlling parts and
- operational-safety devices.

Load-Bearing Parts

Load-bearing parts support the load.

Failure of a load-bearing part can cause:

- dropping,
- uncontrolled shifting or
- uncontrolled movement of the load.



Examples

Examples of load-bearing parts are:

- wire rope,
- sheaves,
- hooks,
- hook blocks, and
- hoist drum pawls.

Wire rope, Hooks, & Blocks

Sheaves

The next example screen shows a boom dog, used to prevent unwanted rotation of a boom or hoist drum.

Carrier Frame Structures

The carrier frame provides a working base for the upper works of the crane.

The rotate base supports the upper works and allows it to rotate.

The tires, wheels, and axles support the carrier frame for transporting and for lifting loads on rubber.

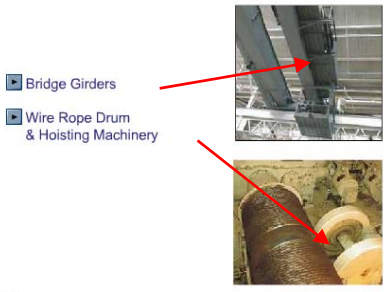
Outriggers, stabilizers, and locking devices provide support for on-outrigger operations.
Failure of any one of these components or systems can cause the load to drop or cause uncontrolled movement of the load.

These are critical components that must be carefully checked before operations or testing.

On Bridge Cranes

Load-bearing parts found on bridge cranes include:

- the bridge girders, that carry the weight of the trolley including hoisting machinery and the load
- the wire rope drum and hoisting machinery that lifts and supports the load.



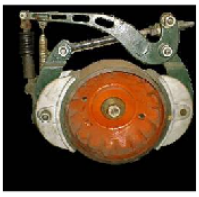
Appendix F of NAVFAC P-307 provides a comprehensive listing of all load-bearing parts.

Load Controlling Parts

Load-controlling parts are crane components that:

- position,
- restrain, or
- control

…movement of the load.



Malfunction of these parts can cause:

- dropping,
- uncontrolled shifting, or
- movement of the load.

Examples

Examples of load-controlling components are:

- foot-controlled brakes used as secondary brakes for hoist speed control,
- travel gear assemblies,
- rotate gear assemblies, and
- rotate locks.

Foot-controlled Brakes

Travel-Gear Assemblies

Rotate-Gear Assemblies

Appendix F of NAVFAC P-307 lists all load-controlling parts.

Additional Examples

Some additional examples are:

- Electrical crane-control circuits related to rotate and travel including brakes and clutches.

Crane-mounted diesel-engines and generators and electrical-power-distribution systems must be treated as **Load Bearing** parts even though they meet the technical definition of **Load Controlling** parts.

Safety Devices

Safety devices are divided into two groups,

- general safety devices and
- operational safety devices.

Operational safety devices affect the safe lifting and handling capability of the equipment. Operational safety devices include:

- interlocks,
- limit switches,
- load moment indicators, and
- over-load indicators with shutdown capability, *as well as*,
- emergency stop switches,
- radius indicating devices, and
- locking devices.

General safety devices:

- provide protection for personnel and
- equipment on, or in the crane operating path.

Operational Safety Devices

Load-moment Indicators are operational aids providing the crane operator necessary information to stay within the capacity of the crane.

Load-moment Indicators that provide shutdown capabilities are operational safety devices.

They may provide the operator with load weight, boom angle, and boom length.

As the operator approaches critical limits **load moment devices** may:

- sound an audible alarm,
- illuminate warning lights, or
- lock out functions that could possibly allow the operator to overload the crane.

If a load moment device has lockout capability, it must be treated as an operational safety device.

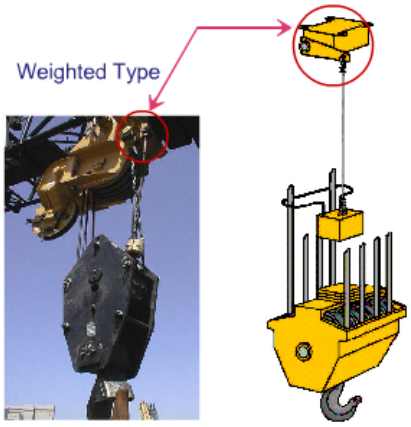
Angle Indicators

Mechanical boom angle indicators are operational safety devices.
These devices provide the operator with the boom angle needed to calculate the radius of the crane.

Mechanical boom angle indicators are usually mounted on the boom where they can easily be read from the cab.

Limit Switches

Limit switches are **operational safety devices** that prevent damage to the crane if a loss of control occurs.



Most cranes are equipped with limit switches.

These images are examples of weighted-type hoist upper-limit switches.

A spring-loaded switch opens the circuit when the hook block raises the weight.
Interruption of power to the hoist function stops the upward movement of the hoist block to prevent two-blocking.

Over-speed Devices

Over-speed, pressure, and temperature devices on crane-mounted engines are **operational safety devices**

When the engine provides the power to move loads, the devices provide shutdown ability to protect the engine from damage.

Appendix F of the P-307 provides a comprehensive list of operational safety devices.

General Safety Devices

General safety devices are those devices that **protect or alert** the operator or personnel working in the vicinity of the crane.

Some general safety devices used to **warn** personnel working on or around the crane are:

- horns,
- bells,
- whistles,
- travel alarms,
- travel warning lights, and
- bumpers


Horns, Bells, Whistles

Travel Alarms


Travel Warning Lights


Bumpers

NOTES

Crane Components Module Exam

1. **Select the best answer.** Safety devices that affect the safe load lifting and handling capabilities of equipment are considered _____ safety devices.

a. general
b. load bearing
c. operational
d. universal

2. **Select the best answer.** Which of the following does not affect the safe operation of the crane?

a. Load-controlling parts
b. General Safety Devices
c. Load-bearing Parts
d. Operational Safety Devices

3. **Select the best answer.** Travel gears are what type of components?

a. General Safety Devices
b. Load-Bearing Parts
c. Operational Safety Devices
d. Load Controlling Parts

4. **Select the best answer.** Load _____ parts are those that restrain, position, or control the movement of the load.

a. lifting
b. handling
c. bearing
d. controlling
e. operation

5. **Select the best answer.** A horn is what type of component?

a. Operational Safety Device
b. Load-Controlling Part
c. Load-Bearing Part
d. General Safety Device

6. **Select the best answer.** Load - _____ parts are those that support the load.

a. lifting
b. handling
c. operational
d. controlling
e. bearing

7. **Select the best answer.** A travel alarm is what type or group of components?

a. Operational Safety Device
b. General Safety Device
c. Load-Bearing Part
d. Load-Controlling Part

8. **Select the best answer.** Hydraulic foot brakes are what type or group of components?

a. Load-Controlling Parts
b. Operational Safety Device
c. Load-Bearing Part
d. General Safety Device

9. **Select the best answer.** Safety devices that provide protection for personnel and equipment are considered _____ - safety devices.

a. operational
b. universal
c. general
d. load-bearing

10. **Select the best answer.** A hook is what type of component?

a. Operational Safety Device
b. Load-Bearing Part
c. General Safety Device
d. Load-Controlling Part

OPERATOR'S DAILY CHECKLIST (ODCL) MODULE

Introduction

An Operators Daily Checklist or ODCL is a safety checklist specifically developed for each type of crane.

The ODCL aids the operator in doing a complete check and provides a record of daily inspections.

Purpose

The daily inspection conducted by the operator is a general check by:

- sight,
- sound, and
- touch

It helps the operator identify conditions that may render the crane unsafe to operate and enhances crane reliability.

ODCL Frequency

A complete check of the crane is performed by the operator prior to the first use of the crane each day using a Crane Operator's Daily Checklist, referred to as the ODCL.

The operator signs the ODCL at the completion of this initial check.

Subsequent operators:

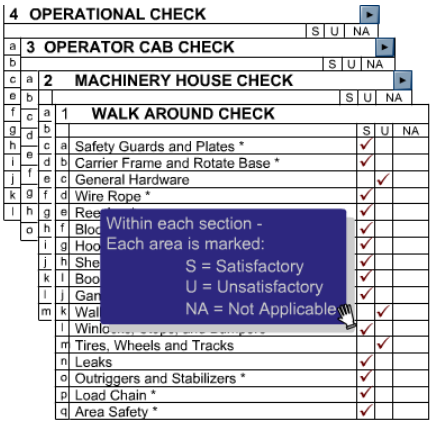
- review
- perform operational checks, except boom limit switches and
- sign the initial ODCL

.....prior to operating the crane.

If a load is suspended from the hook for a period, that spans more than one operator; the appropriate check shall be performed immediately upon completion of the lift, unless the equipment will not be operated again by that operator.

For operations not involving a lift, such as moving the crane to a new location, the operator needs to check only the functions to be used.

ODCL Sections

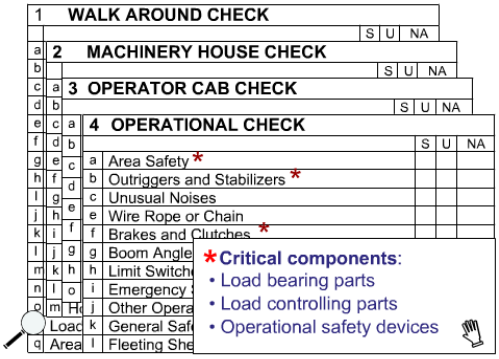


A proper pre-operational check is performed in four sections:

- the walk around check,
- the machinery check,
- the operator's cab check, and
- the no-load operational check

Critical Components

Critical crane components are identified by an asterisk (*)



The ODCL identifies components that are critical to the safe operation of the crane.

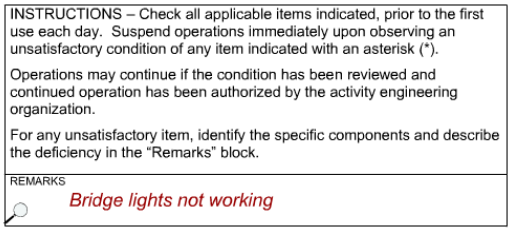
Critical components are

- load-bearing parts,
- load-controlling parts, and
- operational safety devices

These are identified by an asterisk (*) next to the item.

Any deficiency to a critical component or safety hazard must be reported to your supervisor immediately.

Unsatisfactory Conditions



You must give a detailed description of unsatisfactory conditions in the remarks block of the ODCL form.
If you discover a load bearing part, load controlling part or operational safety device that is unsatisfactory, you must

- stop,
- secure the crane and
- notify your supervisor

Recording ODCL Results

Results of the inspection must be noted on the ODCL.

Each item shall be marked:

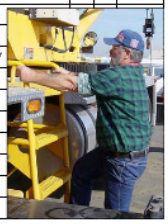
- "S" for satisfactory,
- "U" for unsatisfactory or
- "N/A" for not applicable.

The operator signs the ODCL after performing the pre-operation check.

Walk Around Check

This is a sample walk around check section from an ODCL.

1	WALK AROUND CHECK	S	U	NA
a	Safety Guards and Plates *	✓		
b	Carrier Frame and Rotate Base *	✓		
c	General Hardware		✓	
d	Wire Rope *	✓		
e	Reeving *			
f	Block *			
g	Hook *			
h	Sheaves or Sprockets *			
i	Boom and Jib *			
j	Gantry, Pendants, and Boom Stops *			
k	Walkways, Ladders, and Handrails			
l	Winlocks, Stops, and Bumpers			
m	Tires, Wheels and Tracks			
n	Leaks			
o	Outriggers and Stabilizers *			
p	Load Chain *			
q	Area Safety *			



Begin this check by walking around the crane and the job site, observing anything that is out of order or out of place as well as any potential hazards or interference.

Walkways, Ladders, Handrails

Check the condition of:

- walkways,
- ladders, and
- handrails

for

- loose mountings,
- cracks,
- excessive rust, and
- loose rungs.

Ensure safety chains and gates are functional.

Rail Sweeps and Bumpers

Inspect rail sweeps and bumpers, looking for obvious damage.

Check for damage such as:

- loose or broken bolts,
- cracking,
- bending and
- deformation.

Look carefully for cracking or flaking paint that may indicate a crack or damage in the structure beneath.

Where bolts and rivets are painted, cracked paint may indicate looseness.

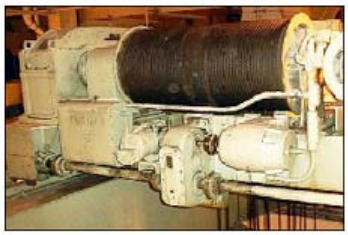
General Hardware

As you walk around the crane look for missing and loose hardware such as:

- nuts,
- bolts,
- brackets and
- fittings

Bridge and Trolley Structure

Visually check bridge girders and the trolley platform for obvious physical damage such as cracked paint, indicating loose or bent structural elements or deflection.



Trolley Rails and Stops

Visually check trolley rails, stops and bumpers for signs of obvious damage, missing fasteners and bent or broken members.

Also check for proper rail alignment and temporary rail stops.

Safety Guards and Plates

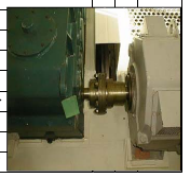
Do a visual check for:

- damage,
- loose or missing safety guards,
- fasteners or
- parts.

Machinery House Check

This graphic represents the machinery check section of a typical ODCL.

2	MACHINERY HOUSE CHECK	S	U	NA
a	Housekeeping	✓		
b	Diesel Engine and Generator *	✓		
c	Leaks			
d	Lubrication			
e	Battery			
f	Lights			
g	Glass			
h	Clutches and Brakes *			
i	Electric Motors			
j	Auxiliary Engine and Compressor			
k	Danger/Caution Tags *			
l	Fire Extinguishers			
m	Hoist Drum Pawls and Ratchets *			



Housekeeping

Good housekeeping is important to the safety of all crane personnel.

- Oil, grease, or mud on floors, ladders, or landings can cause serious falls.
- Check to ensure that the machinery area and accesses are clean and free of materials and trash.
- Ensure tools and authorized materials are properly stored and that waste and rags are removed daily.

Lubrication

Visually check the bearings, bushings and pillow blocks to ensure that the crane has been properly lubricated.

Look for signs of inadequate or excessive lubrication, and heat, often indicated by discoloration.

Leaks

- Inspect for excessive grease on machinery.
- Look for hydraulic brake fluid leaks around brake linings and cylinders.
- Check lubricating oil leaks around gear cases.
- If they appear to be more than normal seepage, report the condition to your supervisor.

Brake Linings

Inspect all brakes for signs of contamination from lubricants, overheating as evidenced by discoloration of the drum and scoring caused by rivet contact.

If a brake is equipped with a manual release, ensure that the mechanism is not in the released position.

Motors

Inspect electric motors for signs of damage including:

- physical damage,
- excessive carbon dust, and
- loose or missing fasteners.

Operator's Cab Check

This is a typical Operator's Cab Check section from an ODCL.

3 OPERATOR CAB CHECK				
		S	U	NA
a	Gauges		✓	
b	Indicator and Warning Lights	✓		
c	Visibility *	✓		
d	Load Rating Charts *	✓		
e	List Trim Indicator (Floating Cranes) *			
f	Boom Angle / Radius Indicator			
g	Fire Extinguisher			
h	Level Indicator (Mobile Cranes) *			
o	Danger / Cautions *			

Posting Requirements

- The crane number, certification expiration date and crane capacity must be posted on the crane.
- There are several ways to post the required information.
- They may be posted as a copy of the certification papers, on signs, stenciled or painted on the crane or on a nearby wall. This information may also be found on a crane test card or on stickers.

Cab Controls

Before energizing the crane:

- ensure that all controls are in neutral position and
- check for proper action of the controllers and brake pedals.

Warning Tags

Before energizing the crane, look for warning tags.

- The red danger tag prohibits operation of equipment when its operation could jeopardize the safety of personnel or endanger equipment.
- The yellow caution tag is often used to provide temporary special instructions, or to indicate a specific caution.

A yellow caution tag could be used to warn the operator of temporary rail stops, for example.

- The striped lockout tag is used to protect the person or persons who hung the tag while they are working on the affected system or component.

It is intended for one shift use and is usually accompanied by a physical locking device to prevent operation.

Remember, only authorized personnel may install or remove warning tags.

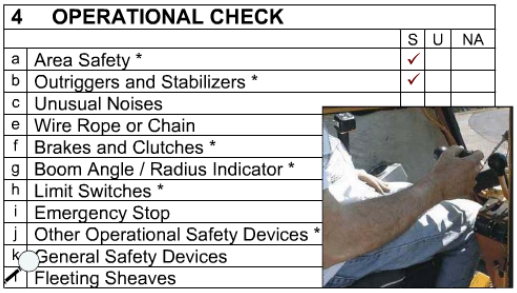
Visibility and Glass

From the operator's cab, check for unrestricted visibility and clean, unbroken windows and mirrors.

Operational Check

The final check before placing the crane in service is the "No Load" operational check.

- When possible, the no load operational check shall be conducted away from personnel and any hazardous surroundings.
- A qualified rigger, if present during the operational check, should control access, observe crane operation, and report any unusual noises, or other indications of unsafe conditions to the crane operator.



4	OPERATIONAL CHECK	S	U	NA
a	Area Safety *	✓		
b	Outriggers and Stabilizers *	✓		
c	Unusual Noises			
e	Wire Rope or Chain			
f	Brakes and Clutches *			
g	Boom Angle / Radius Indicator *			
h	Limit Switches *			
i	Emergency Stop			
j	Other Operational Safety Devices *			
k	General Safety Devices			
l	Fleeting Sheaves			

Wire Rope

Visually inspect wire rope for unusual:

- wear,
- fraying,
- bird-caging,
- corrosion and
- kinking.

During the operational check, where possible, observe sections of wire rope that may not be visible during the walk around check, such as lower layers on the hoist drum that can only be seen when the hook is lowered.

Controls and Brakes

Operate the controls through all speed points. Ensure the controls are functioning properly.

Check for proper operation of dead man controls by removing your hand from the controller handle. The function should stop. Reset the function by returning the control to neutral.

Horns and Alarms

Activate all horns and alarms to test for

- proper operation,
- volume and
- tone.

Knowledge Check

1. **Select the best answer.** When is the ODCL Check performed?

   a. The ODCL is performed prior to the first use each day.
   b. The ODCL is performed only during routine maintenance.

2. **Select the best answer**. On the ODCL, critical components are identified.

   a. In bold lettering.
   b. With an asterisk.

3. **Select all that apply**. Critical components must be carefully examined during the ODCL. Which of the following are considered critical components?

   a. Batteries
   b. Electric motors
   c. Windlocks, Stops and Bumpers
   d. Emergency Stop Button

4. **Select the best answer**. Whether a critical component or not, any unsatisfactory conditions must be:

   a. Described in the “Remarks” block of the ODCL worksheet.
   b. Delivered to maintenance and engineering for action.

5. **Select the best answer**. If you find a critical component, a load bearing component, load controlling component, or operational safety device, unsatisfactory you must take what action?

   a. You must stop, secure the crane and notify your supervisor.
   b. Proceed with the expected action and complete the assigned lift.

NOTES

ODCL Module Exam

1. **Select four sections**. What are the four sections of a properly performed pre-operational check?

a. Electrical function check
b. No-load operational check
c. Operator's cab check
d. Walk around check
e. Machinery house check
f. Stability check

2. **Select the best answer**. If you observe a lock out tag on a piece of equipment, you should:

a. Verify the tag was from previous work
b. Fix the problem and operate the equipment
c. Remove the tag and continue operations
d. Review the special instructions and operate accordingly
e. Under no circumstances attempt to operate the equipment

3. **Select the best answer**. If you observe a red tag on a piece of equipment, you should:

a. Verify the tag was from previous work
b. Fix the problem and operate the equipment
c. Under no circumstances attempt to operate the equipment
d. Review the special instructions and operate accordingly
e. Remove the tag and continue operations

4. **Select the best answer**. The crane number, certification expiration date and certified capacity are found:

a. In the operator's manual
b. In the load lift review
c. Posted in the crane maintenance area
d. In the EOM
e. Posted on the crane

5. **Select the best answer**. If you discover a load bearing part, load controlling part or operational safety device that is unsatisfactory, you should:

a. Resolve the situation before continuing
b. Stop, secure the crane and notify your supervisor
c. Report the situation to crane inspection
d. Report the situation to crane maintenance.

6. **Select the best answer**. During inspection, cracked or flaking paint may indicate:

a. Structural damage or loose bolts
b. Aluminum paint on steel components
c. Latex paint over alkaloid primer
d. Poor quality paint

7. **Select the best answer**. What method of inspection is used in the operator's daily check of the crane?

a. Review of the OEM manual
b. Observing the crane in operation
c. CCI inspection
d. Sight, sound and touch

8. **Select the best answer**. Any deficiency of a critical component or safety hazard must be reported immediately to:

a. Crane maintenance
b. Crane engineering
c. Your supervisor
d. Crane inspector

9. **Select the best answer**. Each item on the ODCL shall be marked:

a. Stable, unstable, or not applicable
b. Correct, incorrect, not applicable
c. Satisfactory, unsatisfactory, or not applicable
d. Serviceable, unserviceable, or not applicable

10. **Select the best answer**. Dead man controls refers to controllers that automatically:

a. Gently pushes your hand away from the handle when the crane stops
b. Compensates for slow operator response
c. Changes operational speeds to suit conditions
d. Stops operations when it is released

11. **Select the best answer**. Discoloration of the brake drum is usually caused by:

a. Overheating
b. Overloading the crane
c. Lubrication
d. Normal operations

12. **Select the best answer**. On the ODCL critical components are identified by:

    a. Ampersand (&)
    b. Asterisks (*)
    c. Bold letters
    d. Letter color: red for critical – yellow for cautionary

13. **Select the best answer**. If you observe a yellow tag on a piece of equipment, you should:

    a. Review the special instructions and operate accordingly
    b. Verify the tag was from previous work
    c. Remove the tag and continue operations
    d. Fix the problem and operate the equipment
    e. Under no circumstances operate this piece of equipment

14. **Select the best answer**. A complete check of the crane is performed by the operator prior to:

    a. Moving the crane to a new location
    b. The first use of the crane each day
    c. Complex lifts only
    d. Securing the crane each day

15. **Select the best answer**. The ODCL is used to identify:

    a. Conditions that may render the crane unsafe
    b. Members of the current crane team
    c. Who is licensed to operate the crane
    d. Necessary and missing paperwork

COMPLEX AND NON-COMPLEX LIFTS

Non-Complex Lifts

Non-complex lifts:

- are ordinary in nature,
- do not require direct supervisory oversight, and
- are made at the discretion of the rigger in charge.

Complex Lifts

Complex lifts have a moderate to high level of risk.

Activities are required to identify complex lifts and prepare detailed written procedures for their execution.

Procedures may be in the form of standard instructions or detailed procedures specific to a lift.

Complex Lift Categories

- Hazardous materials
- Large and complex geometric shapes
- Personnel lifts
- Lifts exceeding 80% of rated capacity of hoist
- 50% hoist capacity for barge-mounted mobile cranes
- Lifts of submerged or partially submerged objects
- Multiple crane or multiple hook lifts
- Other non-routine lifts

Complex Lift Procedures

A supervisor or working leader must review on-site conditions and conduct a pre-job briefing for all complex lifts.

If the lifts are repetitive in nature, supervisors must be present during the first complex lift evolution with each team.

Subsequent identical lifts by the same crew may be done under the guidance of the rigger-in-charge.

Complex Lift Exceptions

Exceptions to the complex lift requirements include lifts over 80% of capacity made with jib cranes, pillar jib cranes, fixed overhead hoists, and monorail cranes.
These cranes are usually smaller capacity cranes used primarily to service only one workstation, machine or area.

Lifts of test weights during maintenance or load test are excluded from the complex lift requirements.

Ordnance lifts covered by NAVSEA OP 5 in lieu of the NAVFAC P307 are also excluded.

Complex Lift Examples

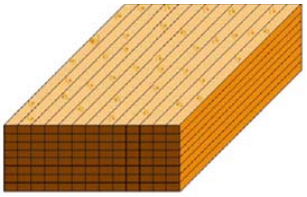
Hazardous Materials

Lifting hazardous materials with a crane is a complex lift.

Materials such as oxygen, acetylene, propane or gasoline in bottles, cans or tanks that are properly secured in racks designed for lifting by a crane are **excluded.**

Large and Complex Shapes

Complex lifts also include large and complex shapes.



For example:

- objects with large sail area that may be affected by winds,
- objects with attachment points at different levels requiring different length slings, and
- odd shaped objects where the center of gravity is difficult to determine.

Personnel Lifts

Use cranes for lifting personnel only when no safer method is available.

Cranes, rigging gear and personnel platforms shall conform to OSHA requirements, Title 29 Code of Federal Regulations, Part 1926.550g.

The total weight of the loaded personnel platform and rigging shall not exceed 50% of the rated capacity of the hoist.

A trial lift with at least the anticipated weight of all personnel and equipment to be lifted shall be performed immediately before placing personnel in the platform.

A proof test of 125% of the rated capacity of the platform must be held for 5 minutes.
This may be done in conjunction with the trial lift.

Lifts over 80% of capacity

Lifts exceeding 80% of the capacity of the hoist are considered complex lifts.

Use a larger capacity hoist if possible to avoid exceeding 80% of capacity.

Multiple Crane or Hook Lifts

Lifts with two or more cranes are complex lifts.

These lifts require special planning, coordination and skill.

The weight carried by each crane must be calculated carefully.

One signal person must be assigned to direct and control the entire operation.

NOTES

Complex and Non-complex Lifts Module Exam

1. **Select the best answer.** Materials such as oxygen, acetylene, propane or gasoline in bottles, cans or tanks, properly secured in racks designed for lifting by a crane are considered:

a. non-complex lifts
b. hazardous lifts
c. explosive lifts
d. complex lifts

2. **Select the best answer.** A crane with a capacity of 100,000 pounds is performing a lift of 90,000 pounds. This is a(n)

a. overload lift
b. hazardous lift
c. complex lift
d. non-complex lift

3. **Select the best answer.** Which of the following identify the two basic categories of crane lifts?

a. Usual and Unusual
b. Complex and Non-complex
c. Critical and Non-critical
d. Common and Non-Common
e. None of these

4. **Select the best answer.** Lifts of test weights during maintenance or load test are

a. Included in the complex lifts requirements.
b. Evaluated according to the complex lift requirements.
c. Routine lifts because they are not complex shapes.
d. Excluded from the complex lift requirements.

5. **Select the best answer.** Personnel in the platform must

a. Wear aircraft reflective tape on their hard hat.
b. Stand with knees bent to absorb motion shock
c. Wear a safety belt with a shock-absorbing lanyard
d. Wear a full body harness with a shock-absorbing lanyard

6. **Select the best answer.** Detailed written procedures are required for:

a. Complex lifts
b. Non-Complex lifts
c. All lifts
d. Some lifts

7. **Select the best answer.** For personnel lifts the total load must be:

a. Less than 80% of the hook capacity
b. Less than 50% of the hook capacity
c. Less than the gross capacity if designated as a complex lift
d. Less than the load chart capacity

8. **Select the best answer.** Personnel lifts are:

a. Always considered complex lifts
b. Considered complex only under special conditions
c. Not considered complex if personnel lifting devices are used
d. Not considered complex if personal protective gear is worn

9. **Select the best answer.** For all complex lifts, a supervisor or working leader must review on-site conditions and

a. Define the crane operating envelope
b. Inspect all rigging gear
c. Select rigging gear
d. Conduct as pre-job briefing

10. **Select the best answer.** A crane with a capacity of 100,000 pounds is performing a lift of 40,000 pounds. This is a(n)

a. Hazardous lift
b. Non-complex lift
c. Overload lift
d. Complex lift

DETERMINING LOAD WEIGHT MODULE

Determining Load Weight

Load weight determines the capacity of the crane and the rigging gear required.

Load weight must be verified or calculated whenever it is estimated to exceed 50% of the crane's hook capacity or 80% of the rigging gear capacity

Acceptable Methods

- Load-indicating devices,
- label plates,
- engineering evaluation and
- calculation

... are all acceptable methods of determining load weight.

Unacceptable Methods

Never take word of mouth to establish load weight!

Guidelines

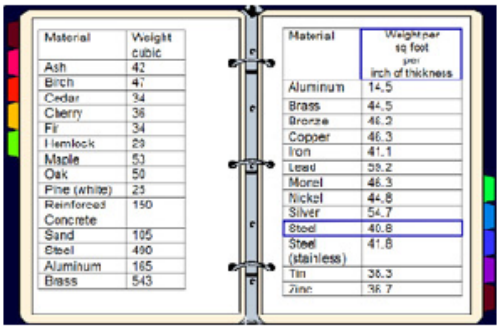
When determining the weight of an object you can

- always round up the dimensions and the weight, but
- never round down.

Never mix feet and inches, and double-check your answers.

Standard Weights of Materials

This is a standard chart showing the weights of various materials per square foot, per inch of thickness and weight per cubic foot of volume.
This chart is used as an aid when calculating load weights.



Material	Weight cubic
Ash	42
Birch	47
Cedar	34
Cherry	36
Fir	34
Hemlock	29
Maple	53
Oak	50
Pine (white)	25
Reinforced Concrete	150
Sand	105
Steel	490
Aluminum	165
Brass	543

Material	Weight per sq foot per inch of thickness
Aluminum	14.5
Brass	44.5
Bronze	46.2
Copper	46.3
Iron	41.1
Lead	58.2
Monel	46.3
Nickel	44.8
Silver	54.7
Steel	40.8
Steel (stainless)	41.8
Tin	38.3
Zinc	36.7

Finding Weight

Weights may be calculated using either area or volume.

Find the weight of two-dimensional objects such as plates by multiplying the area in square feet by the material weight per square foot, for a given thickness.

To find the weight of three-dimensional objects multiply volume in cubic feet by the material weight per cubic foot.

Which calculating method you use, will depend on the item.

You may need to use both methods for complex objects.

Calculating Weight by Area

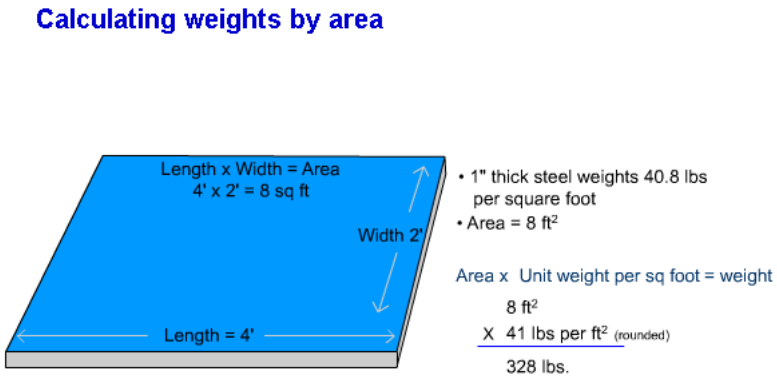
To calculate the weight of this plate, we must find the area and multiply it by the material weight per square foot.

Here, we have a steel plate, 4 feet by 2 feet by 1 inch thick. The area is 8 square feet.

To calculate the weight, we need to find the unit weight, or weight per square foot for the material.

Using the standard material weight chart, we find steel weighs 40.8 pounds per square foot per inch of thickness.

The math can be simplified by rounding to 41 pounds. Multiplying 8 square feet by 41 pounds per square foot gives us 328 pounds.



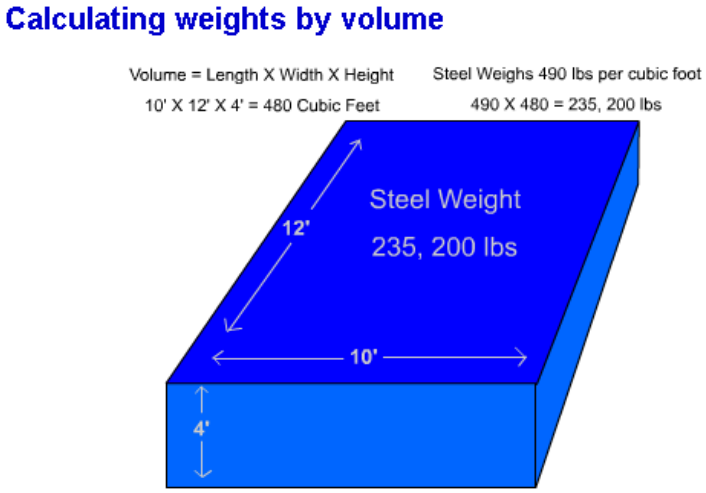
Calculating Weights by Volume

Volume is always expressed in cubic units, such as cubic inches, cubic feet, and cubic yards.

Let's calculate the volume of this box. The formula is length, times width, times height.

The length is 12 feet. The width is 10 feet. The height is 4 feet. When we multiply 12 times 10, times 4, the volume is 480 cubic feet.

Now we can use the standard materials weight chart and multiply the standard weight by the volume.

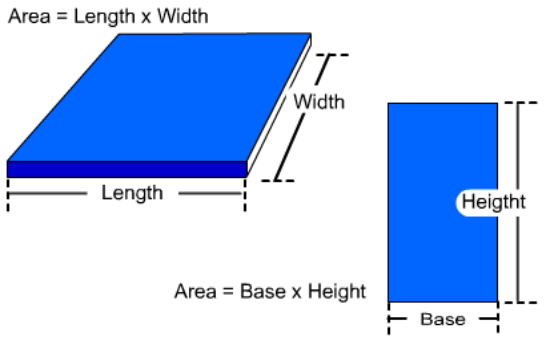


Calculating Area

Square or Rectangular Shaped Area

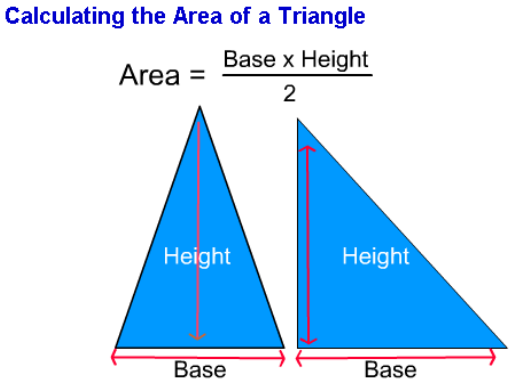
The area of a square or rectangular shaped object is determined by multiplying length times width or base times height.

It is always expressed in square units such as square feet or square inches, even when the object is circular.



Triangle Area

To calculate the area of a triangle multiply the base of the triangle by the height of the triangle and then divide by 2.



Circle Area

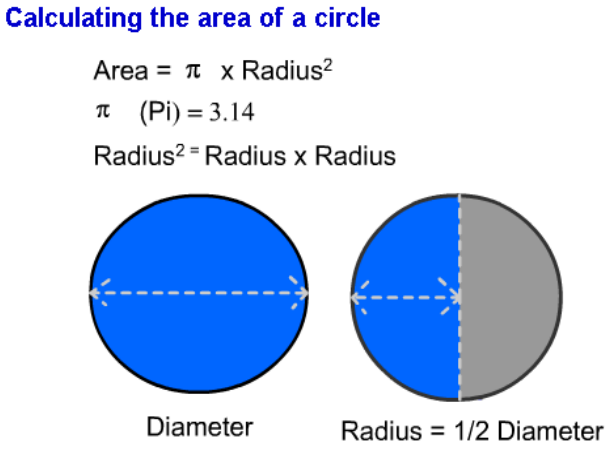
To calculate the area of a circle, multiply Pi, which is 3.14, by the radius squared.

Find the radius of the circle by dividing its diameter in half. To square the radius, multiply the radius by itself.

For example, if a circle has a diameter of 3 feet, the radius will be 1.5 feet.

1.5 feet times 1.5 feet equals 2.25 square feet. Therefore, the radius squared is 2.25 square feet.

Pi times the radius squared would be 3.14 times 2.25 square feet, or 7.065 square feet.



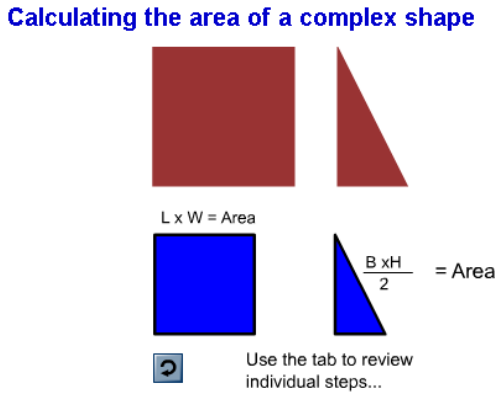
Calculating the Area of a Complex Shape

Most complex shapes can be broken down into a series of simple shapes.

To calculate the area of this complex shape, calculate the area of the square using the formula length times width.

Next, calculate the area of the triangle using the formula base times the height divided by 2.

Then add the areas together to get the total area of the complex shape.



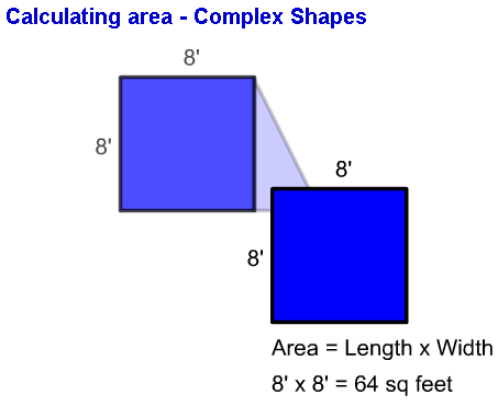
Calculating the Area of the First Part

The first step is to calculate the area of the rectangle, or square, as shown in this example.

The formula for the area of a rectangle is, length times width.

The length is 8 feet and the width is 8 feet.

8 feet, times 8 feet, equals 64 square feet.



Calculating the Area of the Second Part

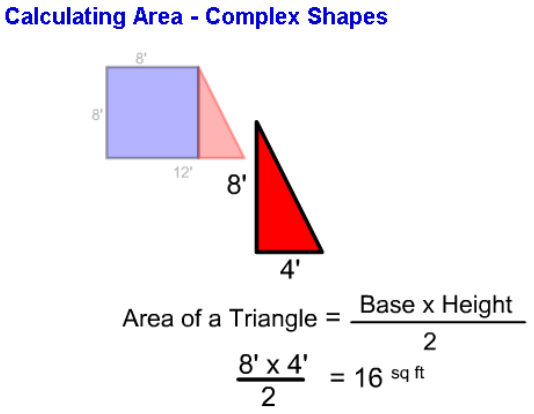
Next, find the area of the triangle.

The formula for the area of a triangle is, base times height divided by 2

The base is 4 feet and the height is 8 feet

4 ft times 8 ft equals 32 ft^2

32 ft^2 divided by 2 equals 16 ft^2

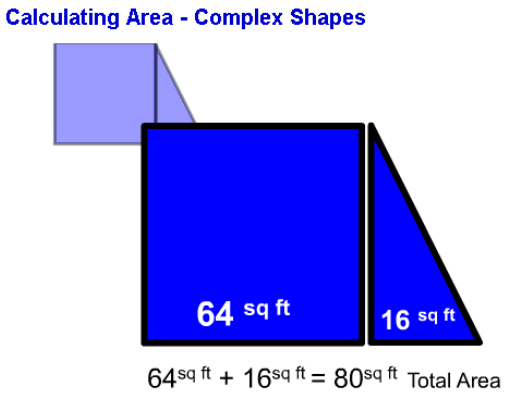


Adding Areas

Now that we have found the area of the two sections, all we have to do is add the area of the square to the area of the triangle to find the total area of the object.

64 square feet, plus 16 square feet, equals 80 square feet.

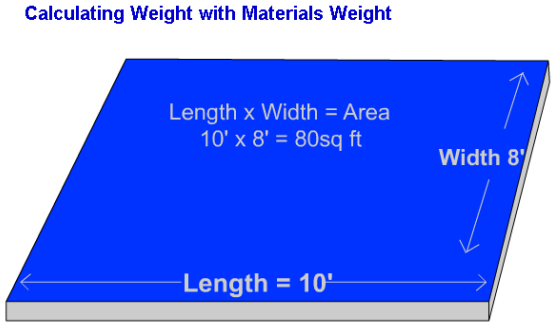
If we know what the material is and how thick it is, we can find its weight with one more calculation.



Calculating Weight Using Area

To calculate the weight using area, we must find the material weight per square foot based on its thickness.

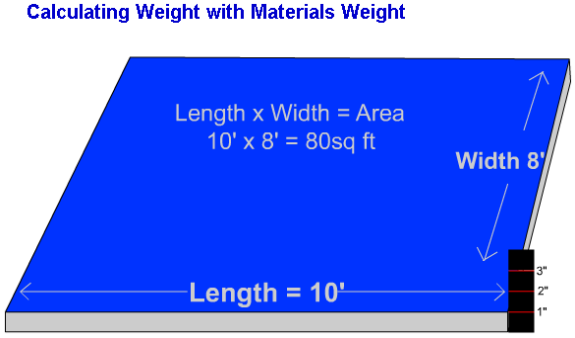
Then, we simply multiply the base weight by the area of material. The area of this steel plate is 80 square feet.



Step 2

Now we need to know the plate's thickness.

According to the ruler, it is 1 inch thick.



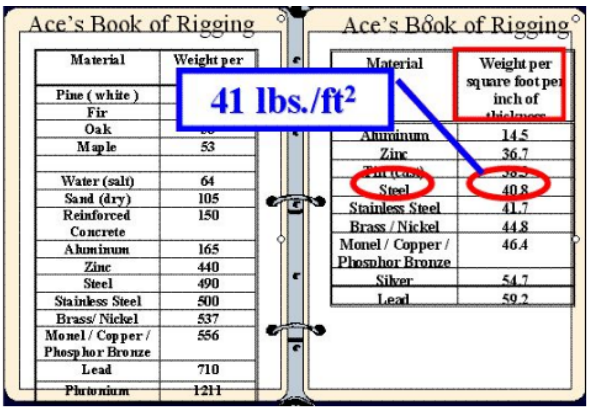
Step 3

We can find the weight of common materials listed in several reference books available from various industry sources.

Here, in “Ace’s Book of Rigging”, we find these tables.

Material weight per cubic foot is in the left table.

In the right table, unit weights are listed by weight per square foot, per inch of material thickness.



We will use the table on the right since the material weights here are based on the thickness of material.

We find steel listed in the “Materials” column.

The unit weight is 40.8 pounds per square foot, per inch thickness of steel plate.

Now let’s apply the rule we learned earlier in the lesson to make the math easier and give us a safety margin in our calculations.

What was the rule on rounding that we should apply to this unit of weight?
Round up!

So, 40.8 pounds per square foot is rounded up to 41 pounds per square foot.

Step 4

To calculate the weight of the plate:
Multiply the area, 80 square feet by the unit weight of 41 pounds per square foot.

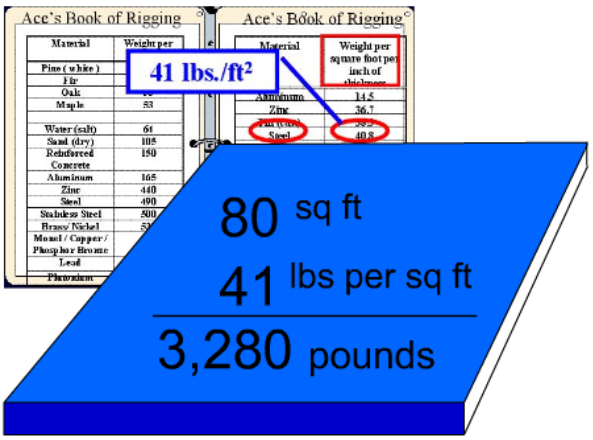
The weight of the plate is 3280 pounds

If 1-inch thick steel plate weighs 41 pounds per square foot, a 2-inch thick steel plate would weigh 82 pounds per square foot.

What would 1/2 inch thick steel plate weigh per square foot?

It would weigh 20.5 pounds.

Calculating Weight with Materials Weight



Calculating the Weight of a Triangular Shape

In this example, we have a triangular shape.

Calculating Weight - Triangle

How do we find the area of this plate?

Multiply the base times the height and divide by 2.

12 times 5, divided by 2

The area of this plate is 30 square feet.

$$\text{Area of a Triangle} = \frac{\text{Base x Height}}{2}$$

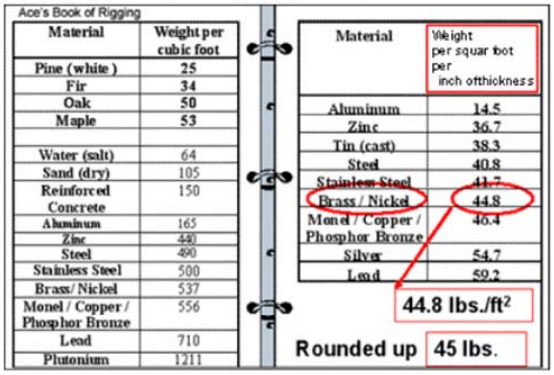
$$\frac{5' \times 12'}{2} = 30 \text{ sq ft}$$

Step 2

To find the weight of this plate, we have to multiply the area (30 square feet) by the unit weight of the material per inch of thickness.

The material is brass, and the thickness is 3 inches.

To find the total weight of the material we need to reference a table or chart to obtain the unit weight.



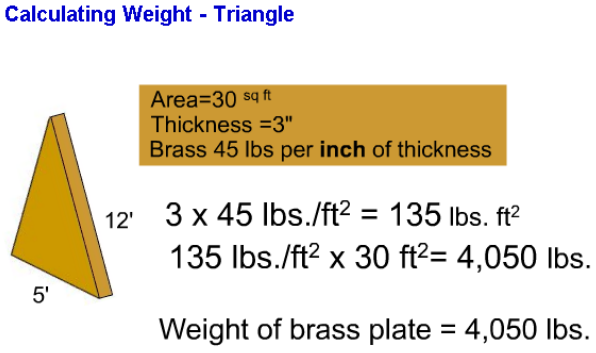
Step 3

We now know that brass weighs 45 pounds per square foot, per inch of thickness.

We multiply the thickness, 3 inches, by the unit weight of 45 pounds. The material weighs 135 pounds per square foot.

Next, we multiply the area, 30 square feet, times the weight per square foot, 135 pounds. We find that this item weighs 4,050 pounds.

Let's try another example...



Calculating the Weight of a Circular Shape

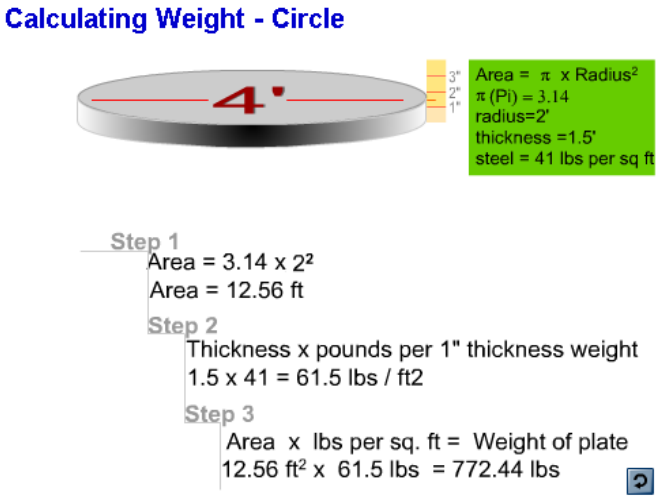
To calculate the area of a circle, multiply Pi, 3.14, by the radius squared.

This steel plate is 4 feet in diameter. Therefore, the radius is 2 feet.

The plate is 1 ½ inches thick.

To find the area: multiply Pi, or 3.14 times the radius squared. 3.14 times 2, times 2 equals 12.56 square feet.

To find the weight per square foot: multiply the plate thickness, 1 ½ inches, times the weight of 1 square foot of 1-inch thick steel. 1.5 times 41 equals 61.5 pounds.



To find the weight: multiply the area, 12.56 times the unit weight of 1 ½ inch thick steel plate which is 61.5 pounds.

The weight of this circular steel plate is 772.44 pounds.

Rounding

Rounding numbers make calculations easier.

Always round up.

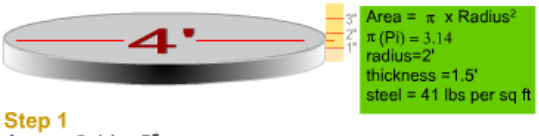
Rounding up gives a larger area and heavier weight, therefore an added safety margin.

Round up the plate area and the weight.

The area, 12.56 square feet, rounded is 13 square feet.

The weight, 61.5 pounds, rounded is 62 pounds.

13 times 62 equals 806 pounds.



Step 1
Area = 3.14 x 2²
Rounded Area = 13 ft²

Step 2
Thickness x pounds per 1" thickness weight
1.5 x 41 = *Rounded* 62 lbs / ft²

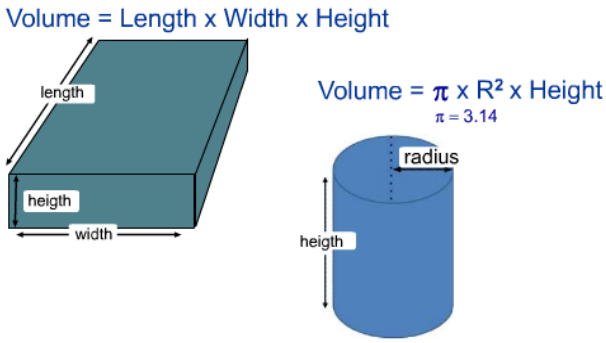
Step 3

Rounded Area	X	*Rounded* lbs/ft² =	Weight of plate
13 ft²		x 62 lbs/ft²	= 806 lbs

Calculating Volume

The volume of a square or rectangular object is figured as length times width multiplied by the height.

The volume of a cylinder is Pi times the radius squared, times the height.



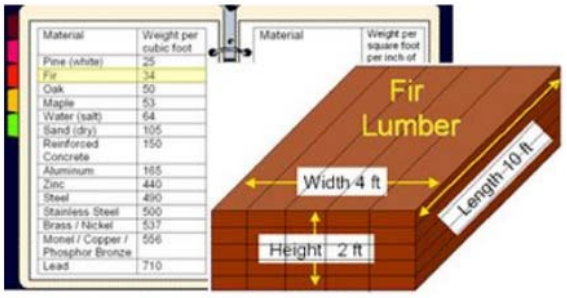
Calculating Load Weight Using Volume

To calculate weight, by volume, we need to find the unit weight, or weight per cubic foot for the material.

We go back to the tables to find the weight for a cubic foot of fir wood. This time we will use the table on the left since the material weights listed here are based on the weight per cubic foot of material.

Using the standard material weight chart, we find that fir weighs 34 pounds per cubic foot.

If the weight were listed in fractions or decimals, such as 33.8 pounds per cubic foot, we would simplify the math by



80 cubic feet of fir lumber
X 34 pounds per cubic foot
2,720 pounds load weight

rounding 33.8 up to 34 pounds. Multiplying 80 cubic feet by 34 pounds equals 2,720 pounds.

This stack of lumber weighs 2,720 pounds.

Calculating the Weight of Cylinders

What is the formula for finding the volume of a cylinder?

To calculate the volume we must first find the area of the circular end. The formula for area is Pi times radius squared.

Once we know the area, we simply multiply it times the height or length.

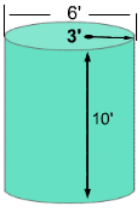
So the formula we use to find the volume of a solid cylinder is, Pi times radius squared times the height.

If the cylinder were lying down you would use its length in place of the height.

Calculating the Area, Volume and Weight of a Cylinder

Area (ft^2) of the circular end (area of a circle) = Pi x $radius^2$

Volume (ft^3) of a solid cylinder = Pi x $radius^2$ x height



Volume of a Cylinder

Volume of a Cylinder = Pi x $Radius^2$ x Height

Calculating the Volume of a Cylinder

Let's calculate the volume of this cylinder.

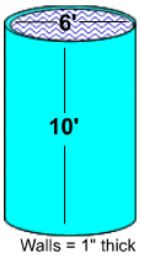
If the diameter of this object is 6 feet, what would the radius be?

The radius would be 3 feet.

The height is 10 feet.

We multiply Pi, which is 3.14 times 3 feet times 3 feet. The result is 28.26 square feet.

Calculating the Volume of a Cylinder



Dimensions:

Height=10'

Diameter = 6' Radius = 3'

Area of a Cylinder = π x $Radius^2$ x Height

3.14 x (3'x3') = 28.26 sq feet

28.26 sq feet X 10' = 282.6 cubic feet

Now, multiply 28.26 square feet, times the height, 10 feet.

The result is the volume of this cylinder, 282.6 cubic feet.

If the cylinder is hollow, we will need to calculate the volume of the cylinder and the volume of the contents separately.

Calculate the volume as if the cylinder is solid. Then calculate the volume of the hollow. Subtract the volume of the hollow section from the volume of the solid cylinder.

Calculating the Weight

One inch steel plate weighs 40.8 pounds per square foot.

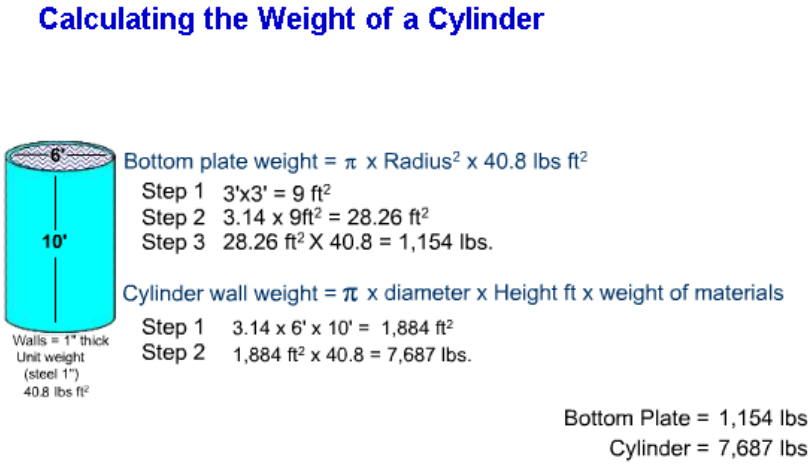
The bottom plate is 6 feet in diameter, so the radius is 3 feet. 3 feet squared equals 9 square feet.

We multiply 9 square feet by 3.14. This gives us the area, 28.26 square feet.

We multiply this by the unit weight for steel plate of 40.8 pounds per square foot. The bottom plate weighs 1,154 pounds.

Calculate the cylinder wall weight as a flat plate. Multiply Pi, (3.14) times the diameter, 6 feet, times the height, 10 feet.

Multiply the area 1,884 square feet by the weight of steel plate, 40.8 pounds per square foot. The resulting weight is 7,687 pounds.



Calculating the Weight of a Cylinder and its Contents

Using the volume calculation, let's find the weight of the water contained in this thin-walled cylindrical tank.

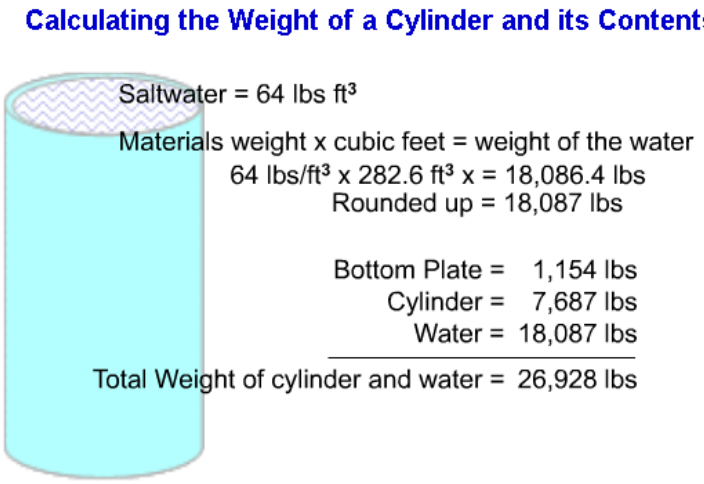
Let's calculate the weight of this cylinder full of salt-water.

We need to know the weight per cubic foot of salt water.

Looking at our material weight chart we see saltwater weighs 64 pounds per cubic foot.

We multiply the material weight times the cubic feet to find the weight of the water in the cylinder.
282.6 cubic feet times 64 pounds per cubic foot equals 18,086.4 pounds.

Now we will add up the weights.



1,154 pounds for the bottom plate, 7,687 pounds for the cylinder wall; and 18,087 pounds of water, for a total load of 26,928 pounds.

Knowledge Check

1. **Select the best answer**. To find the weight of a piece of aluminum plate, you would multiply…

a. cubic feet *times* material weight per cubic foot.
b. Square feet *times* material weight per square foot based on a specified thickness.

2. **Select the best answer**. A box has 27 cubic feet of sand in it. Sand weighs 105 lbs. per cubic foot. The box weighs 1,200 lbs. empty. The correct equation to find the total weight is:

a. 27 x 105 = 2,835 + 1,200 = 4,035 lbs
b. 27 x 1,200 = 32,400 + 105 = 32,505 lbs
c. 27 x 105 = 2,835 lbs

NOTES

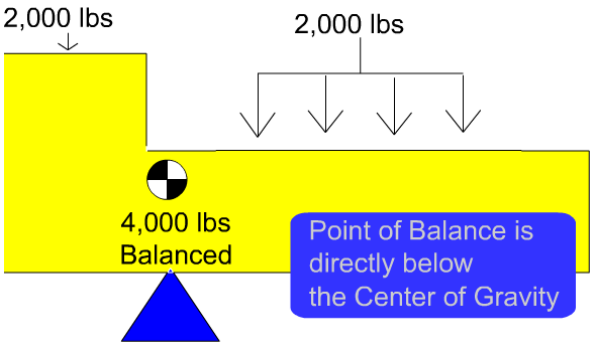
LOAD WEIGHT DISTRIBUTION MODULE

Center of Gravity

Balancing Point

An object will rest in a state of balance when supported at its balance point.

The balance point may not be located at the center of an object, but it is always directly below the center of gravity.



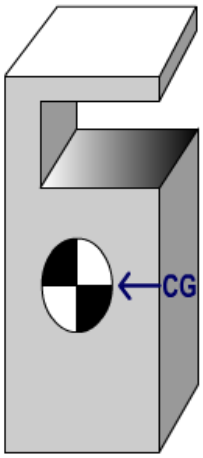
Center of Gravity (CG)

The center of gravity is the point where the entire weight of the object would balance in any direction, as if all the weight were concentrated in that one point.

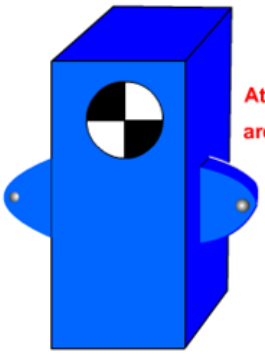
It is a fixed point and does not change unless the shape of the object is altered.

Center of gravity is generally located in the center of symmetrical objects made of like material.

For non-symmetrical objects, it must be calculated and could be located outside the object.



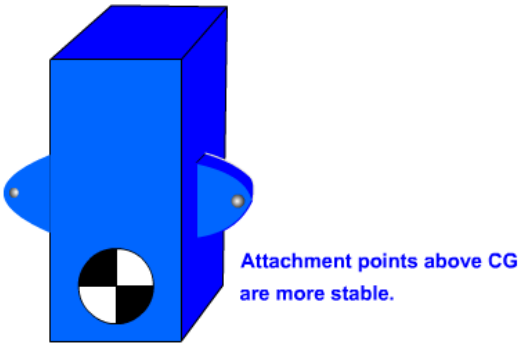
Why find the Center of Gravity



The location of the center of gravity will affect an object's reaction to movement.

If the attachment points are below the center of gravity, the object will tip over more easily when moved.

If the attachment points are above the center of gravity, the object is not likely to tip.



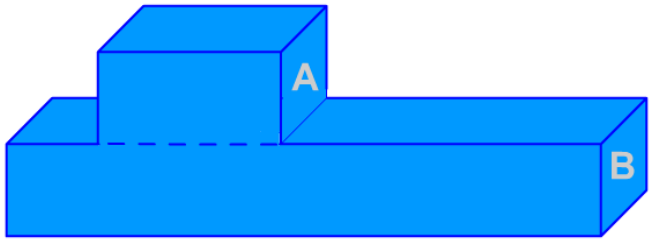
Finding the Center of Balance

Step 1
The balance point of a symmetrical object will be directly under its center.

To find the balance point of a complex shape, we must first break the object into symmetrical sections or components.

Finding the Center of Balance - Step 1

Break the object into sections or components



Step 2
The second step is to determine the weight of each section.

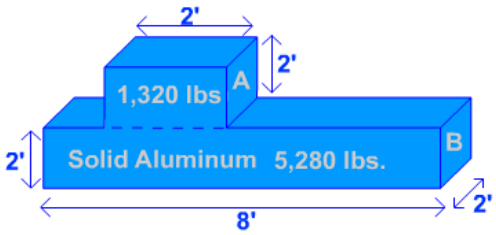
Finding the Center of Balance - Step 2

Determine the weight of each section or component.
Aluminum weighs 165 lbs per cu. ft.

Part A = 2' X 2' X 2' = 8 cu. ft X 165 lbs = 1,320 lbs

Part B = 2' X 8' X 2' = 32 cu. ft X 165 lbs = 5,280 lbs

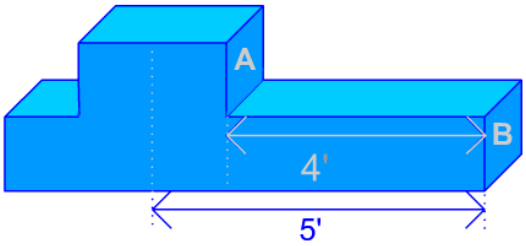
Add the sections: 1,320 + 5,280 = 6,600 lbs



Step 3
The next step is to measure from the reference end to the center of each section of the object.

Finding the Center of Balance - Step 3

Measure from the reference end to the center of each section.



Step 4

Then, multiply the weight of each section, by the distance from the reference end to the center of that section. The result is called moment.

Moment is an effect produced by a force at some distance from a fixed point, such as the center of gravity.

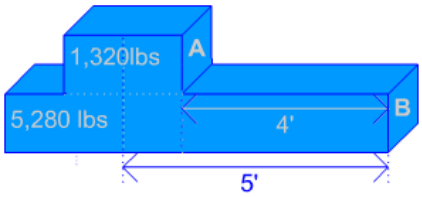
Moment, like torque, is often described in foot-pounds or pound-feet.

Finding the Center of Balance - Step 4

Multiply the weight of each section by the distance from the reference end to the center of each section.

Moment of Section A = 1,320 lbs X 5' = 6,600 ft lbs

Moment of Section B = 5,280 lbs X 4' = 21,120 ft lbs



Step 5

Add the moments together and divide this number by the total weight of the object.

The balance point is where the moments, measured from each end, are equal.

Finding the Center of Balance - Step 5

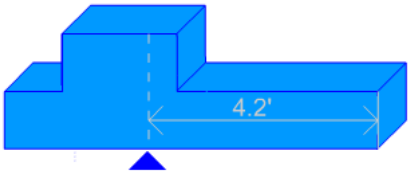
Add the moments of each section (from step 4)

Divide by the total weight (from step 2)

Moment: 6,600 ft lbs + 21,120 ft lbs = 27,720 ft lbs

Weight: 1,320 lbs + 5,280 lbs = 6,600 lbs

27,720 ft lbs / 6,600 lbs = 4.2'



Pinpointing the Center of Gravity

CG Height

In this example the weight of section A is 2,640 pounds.

The weight of section B is 5,280 pounds.

Measure the distance from the reference end to the center of each section.
Multiply the weight of each section by the distance from the reference end to the center of the section to obtain the moment.

Finding the Height of the Center of Gravity (CG)

Multiply:

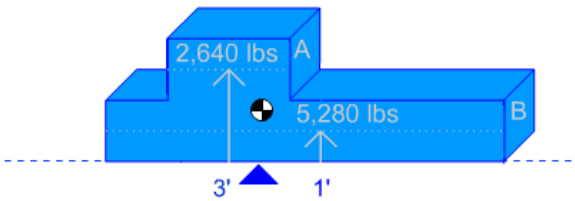
3' X 2,640 lbs = 7,920 lb ft of moment

1' X 5,280 lbs = 5,280 lb ft of moment

Add: 13,200

Divide: 13,200 / 7,920 = 1.666'

CG is located 1.666 feet above the Center of Balance



The distance from the reference line to the center of section A is 3 feet and the distance from the reference line to the center of section B is one foot.
The moment for section A is 7,920 feet. The moment for section B is 5,280 pound feet.

Add the moments together and divide by the total weight to find the height of the center of gravity.

7,920 plus 5,280 equals 13,200 pound-feet.

The weight is 2,640 plus 5,280 or 7,920 pounds.

Now divide 13,200 by 7,920. The center of gravity is 1.666feet up from the reference end.

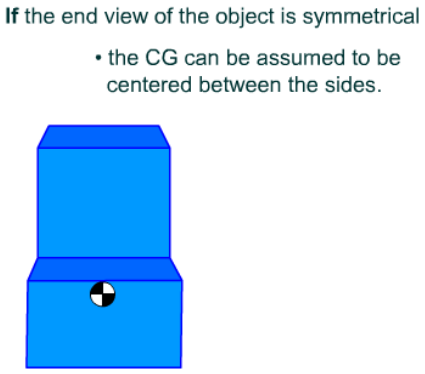
If we convert decimal feet to inches, this equals 1 foot, 8 inches.

CG Depth

To find the depth of the center of gravity, follow the five-step process using the front of the object as the reference end for step 3.

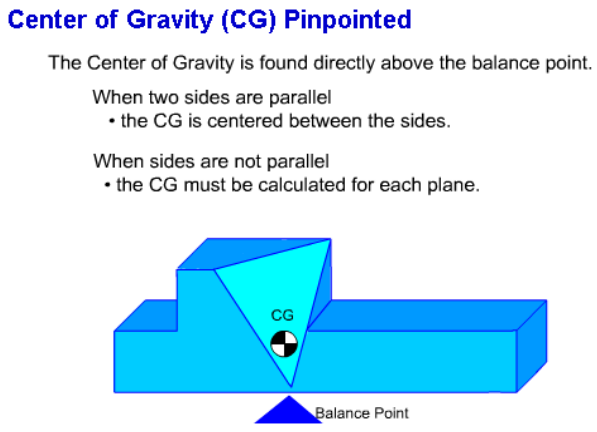
In this example, the end view shows the object is symmetrical.

Therefore, we can assume the center of gravity is in the center of the object –one foot from the front.



CG Pinpointed

The object's center of gravity is always directly above the balance point. It may be helpful to measure and temporarily mark the object's center of balance before rigging.



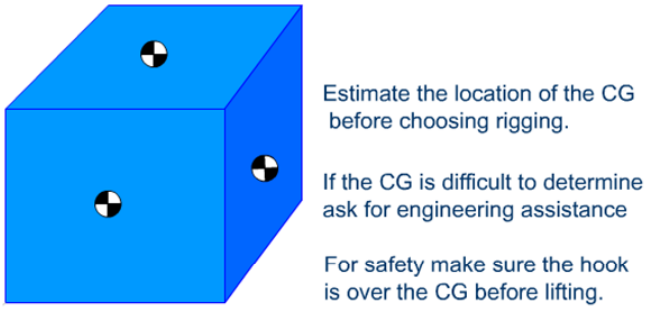
CG Review

Remember to estimate the location of the Center of Gravity in relation to the attachment points before rigging or lifting loads.

If the center of gravity is difficult to estimate, you may need engineering assistance.

Loads hoisted from the bottom without restraint are susceptible to tipping.

Loads should be lifted from their top, or restrained within the slings.



If a load is hoisted without keeping the hook over the center of gravity, the load will shift as it clears the ground.

Sometimes the rigging must be re-adjusted before making the lift.

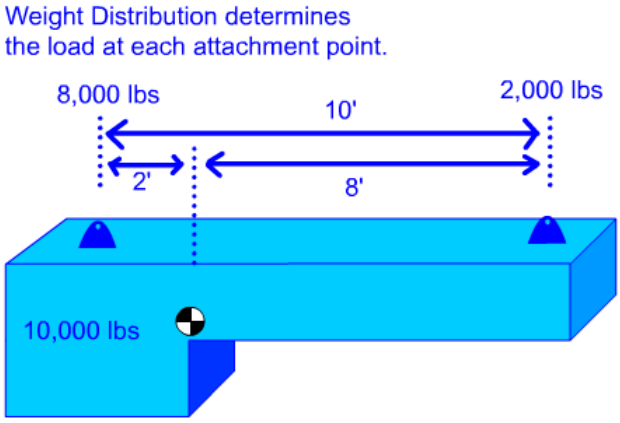
Weight Distribution

The center of gravity provides a quick reference for how the weight is distributed throughout a load.

However, before planning the lift it is necessary to refine how the load weight is distributed.

Weight distribution determines what each attachment point will have to carry.

This information insures the selection of correctly rated rigging gear.



A Wrong Assumption

A common assumption is that 4 legs divide the load weight into 4 equal parts.

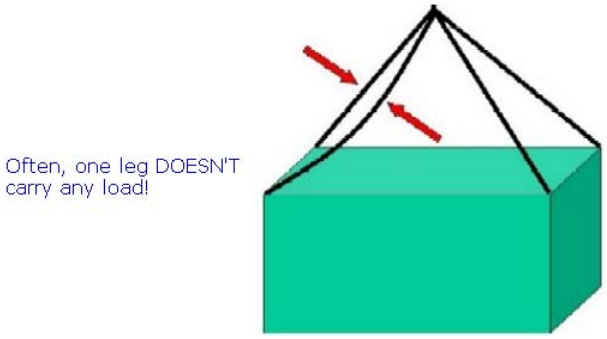
Each leg then carries 25% of the load.

Most often, this is not true.

Number of Legs that Really Carry the Load

We now understand that each leg will not always carry its share of the load.

In this example, one sling is longer than the others. Therefore that attachment point will not carry its share of the load.



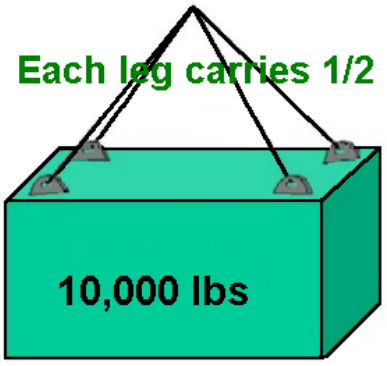
When one sling is longer than the others, the shackles or other hardware are different brands or sizes, or one attachment point is higher than the others, one or more attachments may not carry any load at all.

Never assume that all legs will carry their share of the load.

A Safe Assumption

Here is a safe assumption:

At any given time, any two legs may carry the load, even if three or more legs are used.



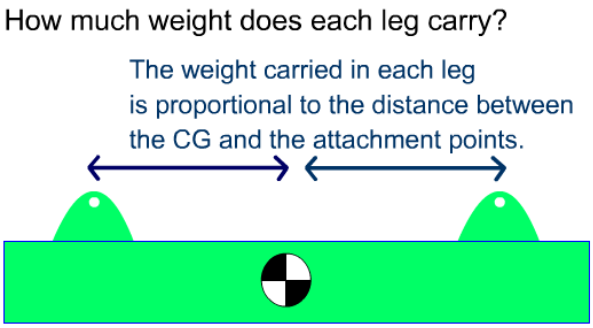
The "two-legs-carry-the-load" rule helps us to compensate for different sling lengths, attachment points at different elevations, and load flex.

Gear selections should be based on two legs being able to carry the load.

For example, if an object weighs 10,000 pounds then each leg would require a rated load of at least 5,000 pounds.

Determining Leg Weight

Gear selection is dependent upon how much weight is carried by each leg - the load's weight distribution.



Weight distribution is proportional to the distance between the object's Center of Gravity and its attachment points

The distances between the Center of Gravity and the attachment points will determine how much of the weight each attachment point will carry.

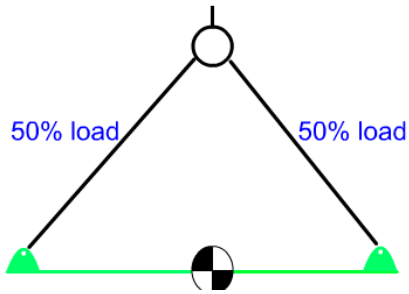
Equal Leg Weight

This drawing represents a load.

Notice the difference in weight distribution as the center of gravity changes distance from each attachment point.

In this first example, each attachment carries equal weight because the center of gravity is equal distance between the attachment points.

Watch the left attachment point as we move the center of gravity.

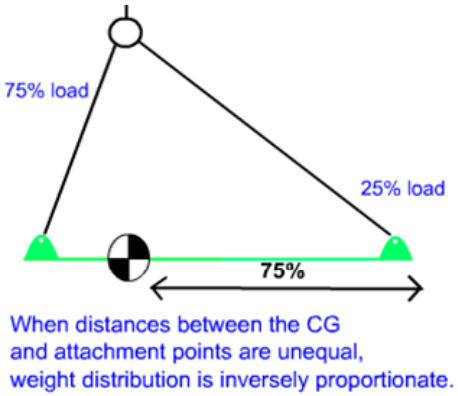


Unequal Leg Weight

In the second example, the weight is greatest in the left attachment point because it's closest to the center of gravity.

When one attachment point is closer to the center of gravity than the other attachment point, it carries more weight.

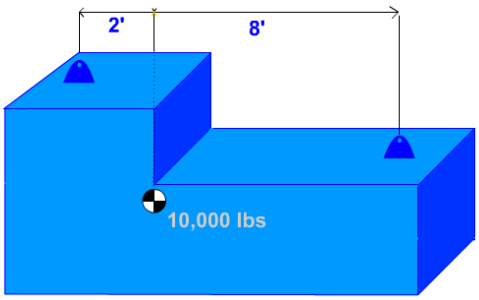
It carries 75% of the weight and the opposite end carries 25%.



Calculating Weight Distribution

Now, let's move beyond estimating and show how to calculate the weight distribution.

In order to calculate weight distribution, you must know the object weight, the location of the center of gravity and the distance of each attachment point from the center of gravity.

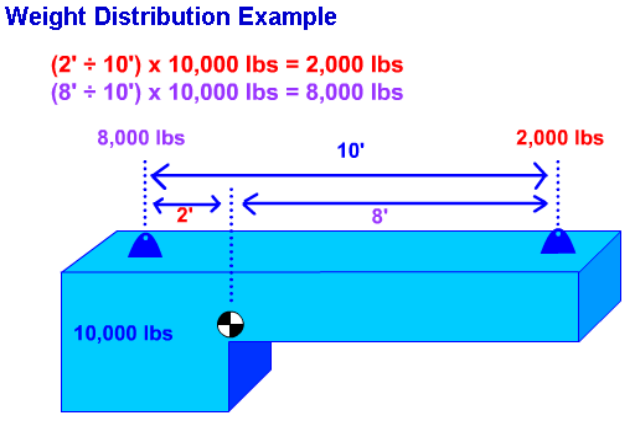


Weight Distribution Example

If we want to find out how much weight is distributed to the attachment closest to the center of gravity, we divide the 8-foot distance by the overall distance between attachment points, which is 10 feet.

Then we multiply this answer by the total weight of the object.

Eight divided by 10, times 10,000 equals 8,000 pounds.



Knowledge Check

1. **Select the best answer**. An attachment point is 2 feet from the center of gravity and the other attachment point is 6 feet from the center of gravity. What is the correct percentage of weight distribution to each attachment point with the attachment point 2 feet from the center of gravity being listed first?

a. 75%, 25%
b. 25%, 75%
c. 50%, 50%
d. 33%, 66%

2. **Select the best answer**. Center of Gravity is best described as:

a. Always in the center of an object
b. Where all the weight is concentrated
c. Where the item balances

3. **Select the best answer**. The center of gravity is located below the center of balance.

a. True
b. False

NOTES

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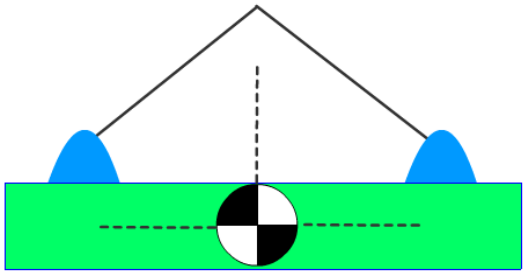
SLING ANGLE STRESS MODULE

Introduction to Sling Angle Stress

Definition

What is sling angle stress?

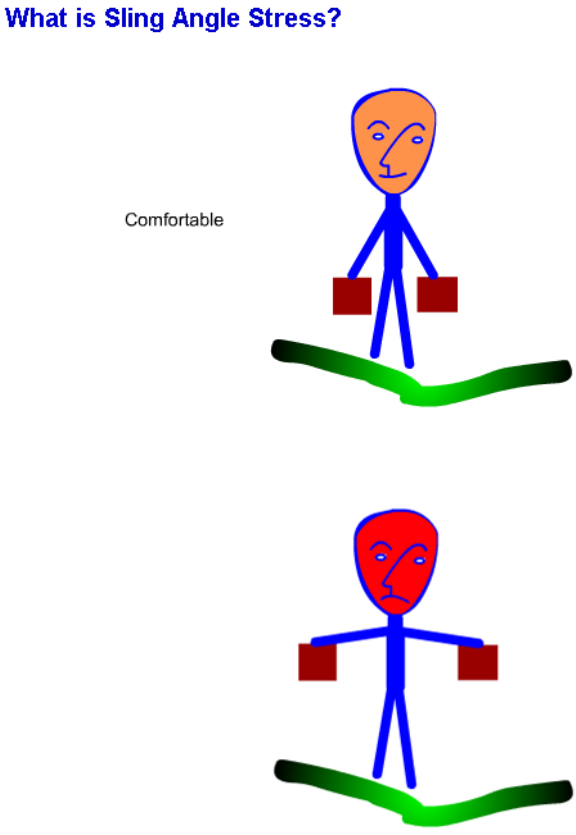
It is the added force created in the rigging when the slings are not perfectly plumb, vertical, and parallel.



Demonstration

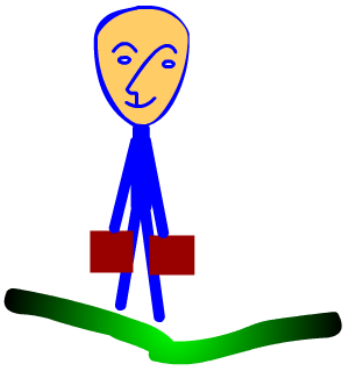
It may be beneficial to use an illustration that we can relate to.

Though this is not exactly sling angle stress, it illustrates the concept very well.



90° illustration

Here's Ace.



He is holding a fifty-pound weight in each hand.

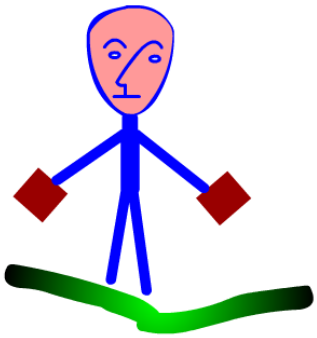
His arms are vertical, similar to a 90° horizontal sling angle.

The amount of stress in Ace's arms is equal to the amount of weight he's holding, fifty pounds.

See what happened as Ace moved his arms increasingly further away from his body.

45° illustration

When Ace has his arms at a 45° angle the stress in his arms increases even more.



The stress increase is 42% of the weight he's holding. It feels like he's holding 71 pounds in each arm.

30° illustration

At a 30° angle, the amount of stress in Ace's arms increases further.

The stress increase at 30° is 100% of the weight he's holding.

Now Ace feels like he's holding 100 pounds in each arm even though the weight is still actually 50 pounds.

This same effect, called sling angle stress, occurs in rigging gear because the legs of a lift are almost always at angles.

This additional stress must be considered when selecting rigging gear.

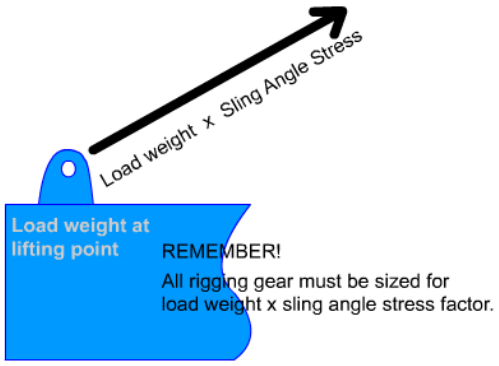
Choosing Your Gear

The two-leg rule is followed when choosing gear capacities for a lift.

Rigging gear must have a capacity greater than the applied load.

The load applied to the rigging gear includes:

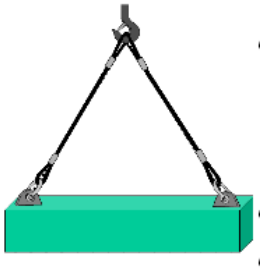
The weight carried by the attachment points multiplied by the sling angle stress factor.



The Effects of Sling Angle

Nearly every lift creates a triangle.

All of the components that make up the sides of a lift triangle are affected by sling angle stress including the attachment points on the load, the crane hook, the rigging gear and the load itself.

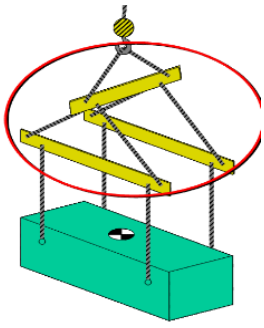


Sling angle stress can cause the load to flex and sag.

Excessive sling angle stress can cause a choker hitch or basket hitch to crush a fragile item.

Remember, sling angle stress does not change the weight of the load being lifted; only the load on the rigging.

Minimizing Sling Angle Stress



Sling angle stress can be minimized by using spreaders or other below the hook lifting devices.

Lifting beams or strong-backs can help ensure each sling is carrying its share of the load and that the load remains level.

Sling angles may still affect the rigging gear between the hook and spreaders, even if the slings between the spreader and the load are vertical!

Sling Angle Stress Summarized

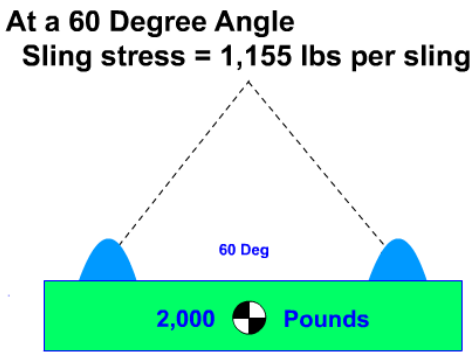
When referring to the effects of sling angle, we refer to horizontal sling angle. In other words, we are measuring the angle created between the sling and a horizontal line through the attachment points.

Sling angle stress is proportional to the degree of the angle from horizontal. The more vertical the angle - the less added force. The more horizontal the angle - the greater the added force. Let's look at this principle on a load.

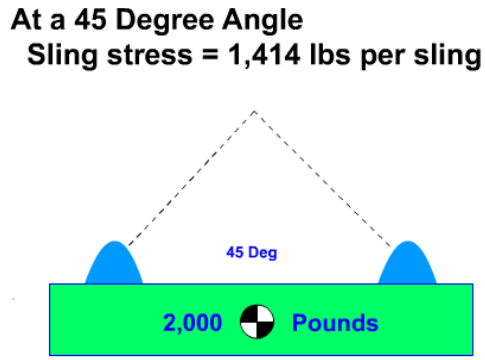
Effects of Sling Angle Stress

At a 60° angle the load on the rigging has increased to 1,155 pounds.
Keep in mind each leg has 1,155 pounds of stress even though only one leg is shown.

60° is the preferred angle!

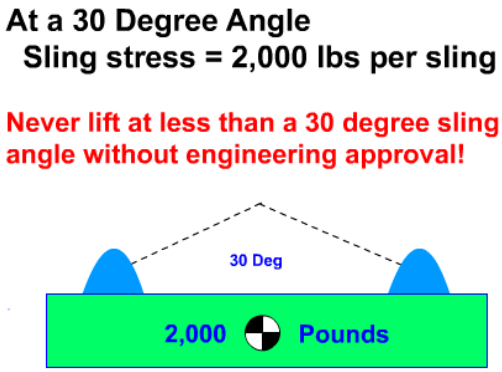


At a 45° angle the load has increased to 1,414 pounds in each sling.
That's nearly a 42% increase!



At a 30° angle the stress has increased to 2,000 pounds
Each sling now has a load equal to the weight of the object!
That is a 100% increase!

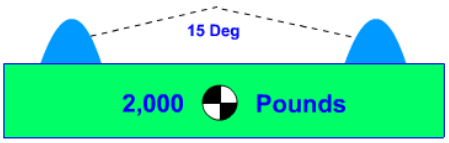
Never lift with less than a 30° angle with out engineering approval!



At a 15° angle the load has increased to 3,860 pounds.
That's a 286% increase in each sling!

At a 15 Degree Angle
Sling stress = 3,860 lbs per sling

Never lift at less than a 30 degree sling angle without engineering approval!



Why Must We Account for Sling Angle Stress?

Not accounting for sling angle stress can lead to overloaded rigging gear and even catastrophic failure.

Minimum Rated Capacity

Remember, two legs must have the capacity to lift the weight of the object, plus the added force from sling angle stress.

After we calculate the sling angle stress, we can determine the minimum requirements for our rigging gear.

Angle Factor

There are several ways to determine sling angle stress. We will use the angle factor chart, as it is readily available and easy to use.

Using an Angle Factor Chart

To use an angle factor chart, you first need to determine the sling angle.

Sling angle can be determined mathematically or measured.

Once you have determined the sling angle, find the corresponding angle factor, and multiply that number by the weight carried in each leg.

When you look at the angle factor column, you will notice a dramatic increase for angles less than 30°.

That's why we do not use sling angles less than 30° unless authorized by an engineering document.

Horizontal Angle	Angle Factor
90	1.000
85	1.004
80	1.015
75	1.035
70	1.064
65	1.104
60	1.155
55	1.221
50	1.305
45	1.414
40	1.555
35	1.742
30	2.000
25	2.364
20	2.924
15	3.861
10	5.747
5	11.490

Angle Factor Chart Example

This shape represents the lift we are about to make.

Let's say that the angle created by the slings we use is 45°.

The angle factor for a 45° angle is 1.414.

We must multiply the angle factor, 1.414 by the weight carried in the leg.

How much weight will the leg carry?

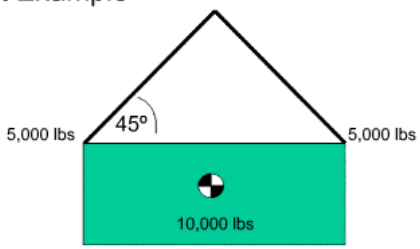
That's right, 5,000 pounds.

1.414 times 5,000 equals 7,070 pounds. This is the total stress in each leg!

This number represents the minimum gear capacity that can be used for the lift.

Angle Factor Chart Example

Horizontal Angle	Angle Factor
90	1.000
85	1.004
80	1.015
75	1.035
70	1.064
65	1.104
60	1.155
55	1.221
50	1.305
45	1.414
40	1.555
35	1.742
30	2.000
25	2.364
20	2.924
15	3.861
10	5.747
5	11.490



1.414 x 5,000 lbs.=7,070 lbs. in each leg.

What is Angle Factor?

Remember the lift triangle?

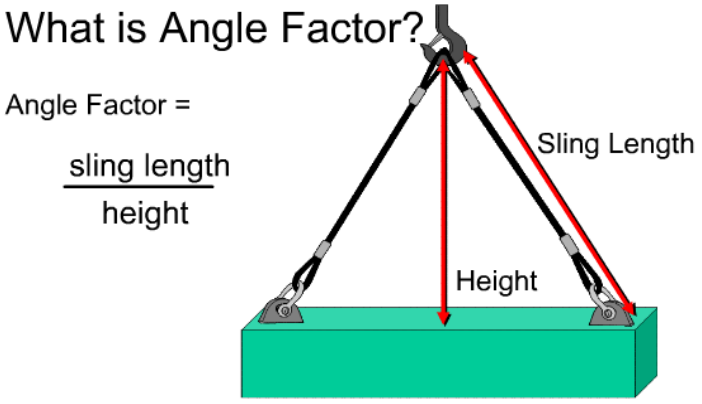
Now the whole triangle idea really comes into play.

The sling angle factor is a ratio of the side of the lift triangle, which in this case is the sling, and the height of the triangle.

To find it, divide the sling length by the height of the lift triangle.

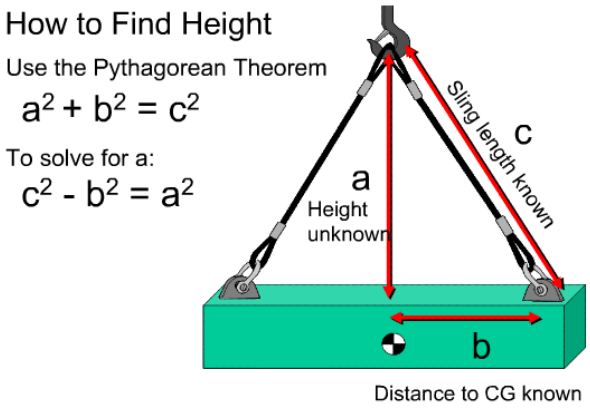
The height is the distance between the bearing area of the hook and an imaginary line running horizontally from the bearing area of the attachment point.

If you cannot measure the height, it can be found mathematically.



How to Find Height

The Pythagorean theorem states that the length of a side of a right triangle squared, equals the length of the base squared plus the height squared.



A squared, plus B squared, equals C squared.

Here the height of the lift triangle is A, the horizontal base is B and length of the sling is C.

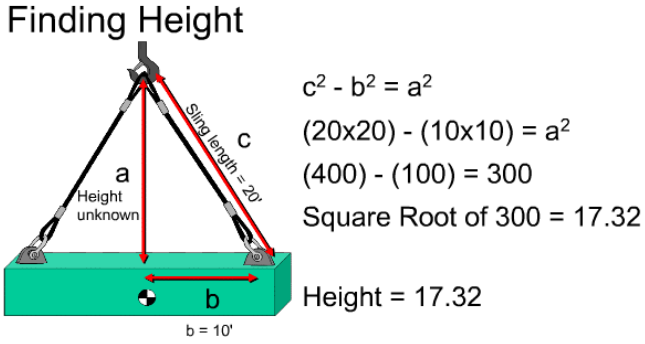
Only A, the height, is unknown.

To find the unknown height, A, use this variation: C squared minus B squared equals A squared.

Use C squared minus B squared equals A squared to solve for height.

The sling, C, is twenty-feet long.

Multiplying the sling length times itself gives us C squared. In this case, that is twenty times twenty or four hundred.



We measure the horizontal distance from the bearing area of the attachment to the top of the load directly above center of gravity.

This dimension, B, is ten feet. We multiply this number by itself.

Ten times 10 equals 100.

Subtract 100, Which is B squared, from 400, which is C squared.
Therefore A squared equals 300.

Now we use the square root function on our calculator to calculate the square root of 300.

The height equals the square root of 300, which is 17.32 feet.

Finding the Angle Factor

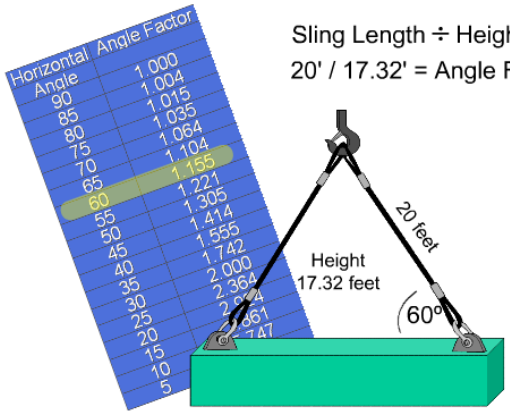
Remember the angle factor equals sling length divided by height.

We just found the height of the lift triangle.

Now, here's how to find the angle factor:

The sling is 20 feet long and we found the height to be 17.32 feet.
20 divided by 17.32 equals 1.155. This is our angle factor.

Finally, we will multiply the angle factor by the amount of weight at the attachment point.



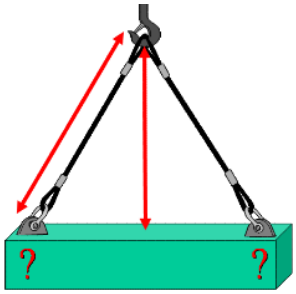
Solving for Sling Angle Stress Mathematically

Now we can use everything we've covered thus far to solve for sling angle stress.

Here's the formula: Sling length divided by height, times the weight distributed to each leg.

Remember, weight distribution is determined by the distance from the center of gravity to the attachment points.

This works for all lifts with level attachment points.



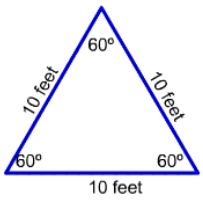
(Sling Length ÷ Height) **X** Weight Distribution = Sling Angle Stress

Sling Angle Methods

60° is the preferred sling angle.

At 60°, the load in the slings increases by 16%.

60° Sling Angle - Preferred Sling Angle



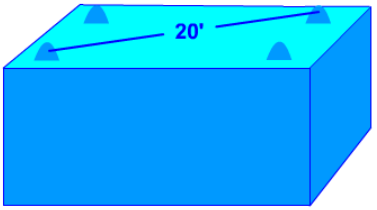
- Only 16% load increase
- Easy to select slings

But...

- Best sling lengths are not always available
- Configuration may restrict
- Overhead clearance

60° Sling Length

To ensure your slings will have at least a 60° sling angle simply measure the distance between attachment points.



Measure diagonally when there are more than two attachment points because it's the longest distance.

Then select a sling that is as long or longer than the distance measured.

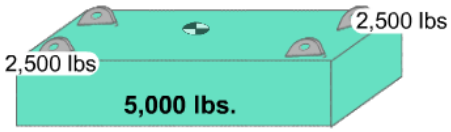
If you use this method to select your slings, you will never have a sling angle less than 60°.

60° Minimum Capacity

Now we can easily determine the stress in the rigging before we and attach the gear.

Let's say the weight of the object is 5,000 pounds.

How much weight would each attachment point carry?



60º angle Factor of **1.155**

1.155 x 2,500 lbs. = 2,888 lbs. Stress

Minimum capacity sling and rigging gear require 2,888 lbs.

Each would carry 2,500 pounds.

What is the angle factor for a 60° sling angle?

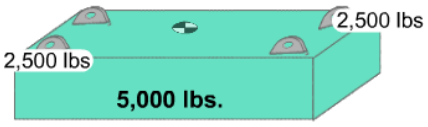
The angle factor is 1.155 .

Multiply the angle factor, 1.155, times the weight distributed to the attachment point, 2,500 pounds.

2,888 pounds is the stress in the rigging gear and attachment points. It is also the minimum capacity for all rigging for this lift!

30° Minimum Capacity

Using the same weight, let's look at the minimum rated capacities for a 30° sling angle.



30º Angle Factor = **2.00**

2.00 x 2,500 lbs. = 5,000 lbs. stress

Minimum capacity sling and rigging gear require 5,000 lbs.

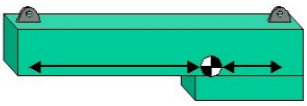
The angle factor for 30° is 2. At a 30° sling angle, the rigging and attachment point stress will double.

Two times 2,500 pounds equals 5,000 pounds of stress.

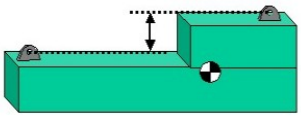
The minimum capacity sling and rigging gear required is five thousand pounds.

Unequal Distances from the Center of Gravity

Where the center of balance is not equally distant between attachment points or when attachment points are on different levels, sling angle stress will not be equal between legs and extra calculations will be required.



Contact your supervisor and consult the activity engineers for guidance when there is a question about sling angle stress for these types of lifts.



Knowledge Check

1. Select the best answer. A 60 degree sling angle will be formed when you match the sling length to the diagonal distance between attachment points.

a. True
b. False

2. Select the best answer. An object has a length of 4 feet, a width of 3 feet, and a distance of 5 feet 6 inches between top right and bottom left attachment points. What length slings would you select to ensure the horizontal sling angle was 60 degrees or greater?

a. 3 feet
b. 5 feet
c. 4 feet
d. 6 feet

3. Select the best answer. To find sling angle stress…

a. Multiply the weight of the item times the rated capacity of the gear
b. Multiply the weight of the item times the distance between attachment points
c. Multiply the weight in the attachment point times the height of the lift triangle
d. Multiply the weight in the attachment point times the angle factor

NOTES

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D/d RATIO MODULE

D/d Ratio

D/d ratio is the relationship between diameter of an object that a sling is bent around to the diameter of the sling.

D/d ratio is generally applied to wire rope slings.

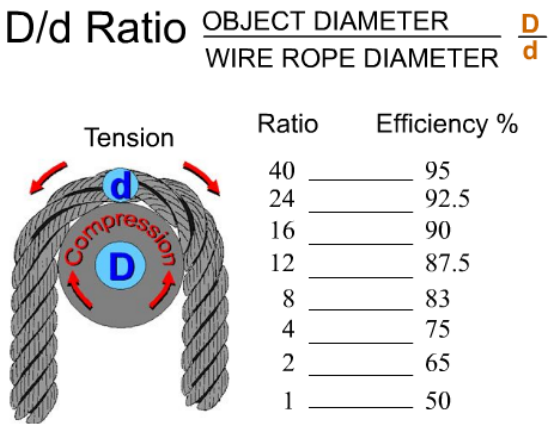
The tighter the bend, the greater the loss of strength.

The sling can be weakened and severely damaged if it's bent around a diameter smaller than its own diameter.

To determine how the bending will affect the sling:

- Divide "D", the object diameter by "d", the sling diameter.
- The result is the D/d ratio.

Use table fourteen-three in the P-307 to determine sling efficiencies at various D/d ratios.



Understanding Efficiency

Here we have a 1/2-inch wire rope sling with a rated load of 4,000 pounds, bent around a 1-inch hook.

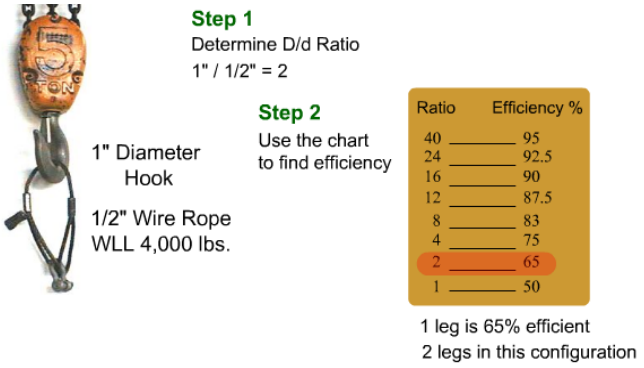
The first thing we must do is determine the D/d ratio.

The hook diameter is 1 inch and the sling diameter is 1/2 inch. 1 divided by 1/2 equals 2.

The D/d ratio is 2.

Looking at the chart, we see that a D/d ratio of 2, provides 65% efficiency.

One leg is 65% efficient. There are two legs in this configuration.



Using Efficiency to Find Rated Load

Now that we know the efficiency, let's figure out the maximum weight that could be lifted in this configuration.

1" Diameter Hook

1/2" Wire Rope WLL 4,000 lbs.

Determine WLL

4,000 x 65% = 2,600

2 legs carry the load

2 x 2,600 = 5,200 lbs.

First, we must determine the rated load of each leg.

We multiply the rated load by the efficiency; 4,000 times .65 or 65%, equals 2,600. 2,600 pounds is the rated load for one leg.

When we double a sling over an object, we effectively create two legs. Since two legs are carrying the load, we multiply the rated load by 2.

2,600 times 2 equals 5,200.

This is the rated load of the doubled sling.

Whenever we bend a wire rope around an object, or double our wire rope slings, this D/d ratio must be calculated.

For D/d ratios that fall between the values shown, use the lower efficiency.

D/d Calculations

The D/d principle also applies to slings bent around corners.

In this case, the diameter of the curvature of the sling as it bends around the corner of the object to be lifted must be determined.

For many applications, special fittings such as pipe sections are placed on the corners of the object to ensure a large enough diameter of curvature for the sling so as not to reduce the sling efficiency too greatly.

NOTES

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RIGGING GEAR SELECTION AND USE - MARKINGS AND RECORD REQUIREMENTS

NAVFAC P-307 Section 14

Let's look at the section of NAVFAC P-307 that deals with rigging; Section 14.

Section 14 provides administrative and technical requirements for inspection, testing, certification, alteration, repair, operation, and use of rigging gear.

These requirements help ensure the rigging gear you use is safe.

When followed, these requirements help ensure optimum service life of the gear.

These requirements apply to Navy owned gear and to contractor owned gear used with Navy owned cranes.

The Test and Inspection Program

P-307 requires each activity to establish a program that includes:

- initial visual inspection and load test of all equipment and marking
- pre-use inspections before equipment is used
- documented periodic inspections of all equipment
- documented periodic load tests of certain equipment

Why Test and Inspection?

Why do we need a test and inspection program?

The primary goal is to prevent personnel injury!

The test and inspection program is designed to identify:

- sub-standard,
- defective,
- damaged, or
- worn equipment

... and remove unsafe equipment from service.

Covered Equipment

Test and inspection requirements apply to the following equipment used in weight handling operations:

- Rigging hardware such as:
    - shackles
    - links and rings
    - swivels
    - eye bolts
    - swivel hoist rings

    - turnbuckles
    - hooks
- Slings including:
    - chain slings,
    - wire rope slings,
    - metal mesh slings,
    - synthetic web slings,
    - synthetic rope slings and
    - synthetic round slings.
- And Crane structures without permanently mounted hoists.

Additional Covered Equipment

Equipment covered includes:

- Manually operated hoists as identified in ASME B30.16 and B30.21 which include chain hoists and lever operated hoists.
- Miscellaneous equipment, including:
    - Below the hook lifting devices as identified in ASME B30.20, such as:
        - spreader beams,
        - plate clamps,
        - magnet lifters,
        - pallet lifters, and tongs.

Equipment Not Covered

Equipment not covered includes:

- Ordnance equipment, which falls under NAVSEA OP-5.
- Original Equipment Manufacturer or OEM installed welded lift lugs, threaded holes and bolt-on pads.
- OEM provided rigging gear used for limited lifts such as off-loading, re-loading, initial storage, and shipment.

Equipment Markings

Markings on each piece of equipment are the most apparent way for you, the user, to know the requirements of NAVFAC P-307 have been met.

Each piece of equipment must be:

- clearly marked,
- tagged or engraved with the:
    - rated load of the equipment and
    - Indication of the re-inspection due date.

Markings must be done in a manner that will not affect the strength of the component.

Vibra-etch methods and low stress dot faced stamps are generally acceptable ways of marking equipment.

Contact the OEM for guidance on where and how to mark.

Special Roundsling Markings

NAVFAC P-307 has additional requirements for alternate yarn roundslings. Alternate yarn roundslings are roundslings made from yarns other than nylon or polyester.

The certificate of proof test must include the diameter of the pin used for the proof test. This will be the minimum diameter over which the sling may be used.

The sling must be marked with the minimum allowable pin diameter.

Specific Use Endless Wire Rope Sling Markings

In specific applications where endless wire rope slings are designed for a particular use, they shall be marked to indicate the pin diameter used to determine the rated load.

Markings on Chain Slings

In accordance with

- CFR 29 1915.112 and
- CFR 29 1917.42

... chain slings used in ship repair or cargo transfer require quarterly periodic inspections and must be marked to show the month they were inspected.

Markings on Lashing

Lashing must be marked to identify it to the spool or reel from which it came.

The rated load must be marked on each piece as well as the re-inspection due date.

Markings on Below the Hook Lifting Devices

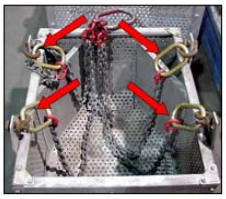
Any below the hook lifting device weighing more than 100 pounds must have the weight clearly marked on it.

Multiple Part Equipment

Some rigging gear has multiple parts that can be disassembled.

To help avoid miss matching parts, all individual components of equipment such as shackles and pins must be identified to each other. Matching ID marks are needed on the primary and subordinate parts.

Markings on Multi-leg Sling Assemblies



Multi-leg slings assemblies shall be marked with

- the rated load of each leg,
- the rated load of the entire assembly, and
- the sling angle upon which the rated load is based.

Markings for Multi-Part Slings

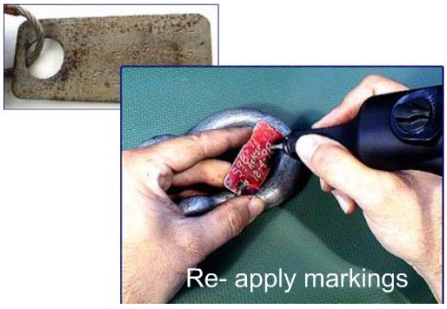
NAVFAC P-307 **requires** that multi-part braided slings must have the OEM's marking re-marked at 70% of the OEM's rated load

- **unless** destructive tests are conducted on sample slings.The documentation is reviewed by the Navy Crane Center.

So, there are many additional markings that may be required for different equipment. Not only do these markings have to be present, they must be legible.

Hard to Read or Missing Markings

Sometimes markings become hard to read due to wear or they may even be removed during a repair process.



Replace markings that are hard to read or have been removed.

Remember, all rigging equipment must be marked.

Required Records

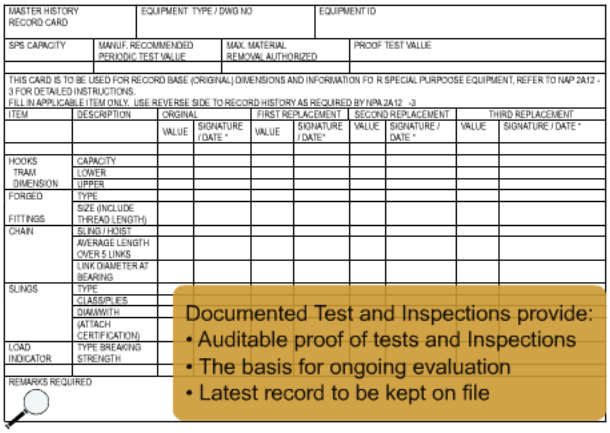
Equipment markings should link the piece of equipment to its test and inspection records.

NAVFAC P-307 requires documentation of tests and inspections.

Records are the auditable proof that equipment has been tested and inspected and provide a basis for ongoing evaluation of the equipment.

The latest test and inspection record will be retained on file at the activity.

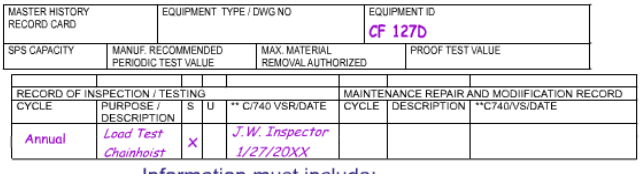
Computer generated files are acceptable if they identify the individual components and inspection results.



Records Must Include

NAVFAC P-307 requires that the records include identification of individual components, latest test and inspection results, and dates of inspections and tests.

There are many ways to identify the equipment to the records.



Identifying Gear to Its Record

A unique identification number may be used to identify the equipment to its record.
The ID number can be as simple or complex as you need it to be.

A simple method might be to use a letter designator that represents a particular type of gear followed by a serialized number.

Unique identification number
Letter designator followed by a number

Example:
S-27
"S" represents *shackles*
27 individually identified shackle

For example, “S” could represent shackles. If you have 50 shackles they could each be individually identified S1, S2, S3, etc.

Mark the equipment ID number on the gear. Write the ID number on the record.

Now the gear has identifiable records!

Identifying Gear to Its Record Example

This is an example of how the gear is marked at one Naval Shipyard. This is just one example of how an activity could choose to identify individual components to their records.

This example reflects a fairly complex system that may be useful for activities who own multiple groups of equipment that need to be segregated.

In this example, the unique identification number is used to identify three different things.

The first number “98” identifies which shop, group, or code owns the equipment.

Secondly, “P28” identifies the specific piece of gear with a serialized number.
This particular number indicates that it was the 28th sling manufactured or certified on a specific day.

The number 94-350 identifies the day it was manufactured or certified:

- 94 being the year 1994
- 350 being the Julian date.

No matter what method you use, there is important information that should be included in the gears records.

Knowledge Check

1. Select the best answer. The reason test and inspection is required is to:

a. Prevent personnel injury
b. Identify sub-standard equipment
c. Remove unsafe equipment
d. All of the above

2. Select the best answer. Rigging gear that has been inspected by a trained inspector does not require inspection before it is used.

a. True
b. False

NOTES

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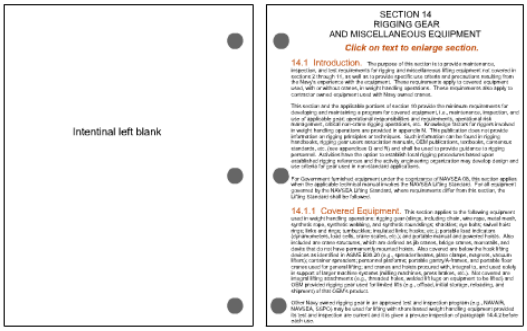
RIGGING GEAR SELECTION AND USE – GENERAL USE

NAVFAC P-307 Section 14

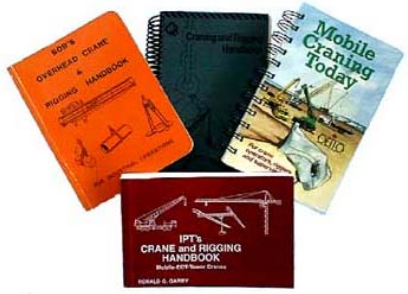
NAVFAC P-307 provides specific rules for using rigging equipment described in section 14.



It does not, however, provide specific direction on rigging practices or techniques.

Rigging Manuals

Information on rigging techniques can be found in rigging handbooks, rigging manuals, OEM publications, textbooks, and consensus standards.



Let's cover some of the safety precautions that apply to all types of rigging equipment or operations.

General Safety Rules

Remain alert when performing crane rigging operations.
Hazards are always present.

Two common danger areas are between the rigging gear and the load; and between the load and other objects.
These areas are sometimes referred to as "the bight".

Be sure to your keep hands, feet, and head, out of the bight!

Never Use Homemade Gear

Never use shop made or homemade equipment unless it has been approved by engineering and certified for use in weight handling operations!

Selecting Rigging Equipment

Use rigging gear only for the purpose it is designed for.

Rigging gear is a tool like a hammer or wrench. We've all heard the phrase…
"use the right tool for the job."

It's the same for rigging gear. If you don't have the right rigging gear to safely do the job, stop and get it!

Never use damaged gear.

Never use gear past its inspection due date!

Your safety and the safety of the rest of the crane team depend on the gear you use, and how you use it.

Take the time to do it right!

Keep the following in mind when selecting rigging equipment:

- Rigging equipment must be selected based on the total force that will be applied to the gear, not just the weight of the load.
- Remember, in some cases, the force in one leg of a multiple sling leg could exceed the weight of the load.
- Keep the overhead height restrictions or clearances in mind when selecting sling lengths.
- Sling lengths that are too long may cause the hook to reach the limit switch before the load reaches the desired height.
- You must also think about the hazards the gear may be subjected to so you can choose the appropriate equipment.

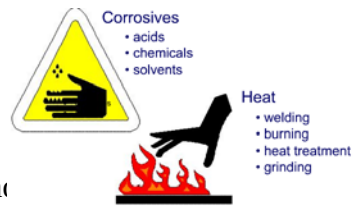
Hazards to Rigging Gear

The first major hazard we must talk about is abuse.

Here the biggest hazard is you, the user!

- Don't drag your slings 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.
- Don't pull slings from under a load while the load is resting on them.
- Set the load down on blocking to keep from crushing the sling.

Keep gear 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 an

For example, acids would quickly destroy a nylon sling but might not harm another synthetic material.

Protect your gear from all heat sources such as welding, burning, grinding, or heat-treating.

Another common hazard is sharp edges.

No matter what type of gear you use, sharp edges will leave their mark if the gear is not protected.

Never use slings against sharp edges without adequate protection.

You must be aware of the danger electricity presents when working around energized components or electrical lines.

Watch out for welding leads, light strings, shore power and other common hazards when looking for lay down areas.

Wire rope, chain, and metal mesh slings should never be used if they could increase the possibility of electrical shock.

Protect yourself and the gear by ensuring all power is secured prior to installing your gear on or around electrical components.

Protective Materials

So how do we protect our gear from being damaged by sharp edges?

It’s necessary to use protective materials, known as “chafing gear,” to prolong the life of our rigging gear and items being lifted.

Chafing gear can be any material used for protecting rigging gear or loads. Chafing gear increases friction thereby reducing the tendency for rigging to slip.

Wood blocks, canvas, cardboard, rubber, leather and old fire hose are great for protecting critical or machined surfaces and increasing friction.

These are just a few examples of chafing gear.

Using Chafing Gear

Chafing gear can be many types of materials and it may be used many different ways. Wood blocks may be used to keep slings away from sharp edges.

Old fire hose can be placed between your gear and sharp edges or a sling can be passed through the hose and used as a protective sleeve.

Remove the hose to inspect for damage before and after each use. Hose can hide sling damage if left on the sling!

Hoist and Crane References

Portable floor cranes, portable a-frames, portable gantries, and cranes integral to larger machine systems must be operated in accordance with applicable ASME B30 criteria and OEM recommendations.

Chain Hoists and portable hoists must be operated in accordance with ASME B30.16 and OEM recommendations.

Lever operated hoists must be operated in accordance with ASME B30.21 and OEM recommendations.

Other applicable equipment must be operated in accordance with ASME B30 and OEM recommendations.

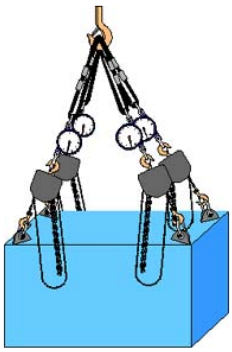
Using Hoists and Cranes

When using chain hoists and portable floor cranes, ensure hoist capacities meet or exceed the expected load.

Load indicating devices may be used to help prevent overload of the hoist and related gear when leveling, rotating, or tilting objects.

Using Hoists to Distribute Sling Loading

When chain hoists are used to equalize a load at four or more points, they must be used in conjunction with load indicating devices.



- Load indicators help keep tension on each leg equal
- 2 and 3 point lifts tend to be self-leveling

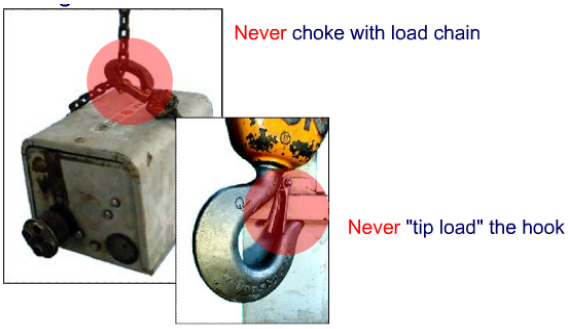
Using Hoists and Cranes

Secure hand chain and excess load chain to prevent tangling and inadvertent operation.

A bag can be attached to the hoist body to hold excess chain.

Do not use excessive force to operate a hoist. And never use extension bars on lever-operated hoists.

- Never use the load chain to choke around an object. And
- Never “tip load” the hook!



Below the Hook Lifting Devices

Below the hook lifting devices and container spreaders must be operated in accordance with ASME B30.20 and OEM recommendations.

Never use below the hook lifting devices if you do not thoroughly understand the operating characteristics and limitations.

Ensure the lifting device has sufficient capacity for the expected load.

Knowledge Check

1. **Select the best answer**. Which section of the NAVFAC P-307 is the rigging gear section?

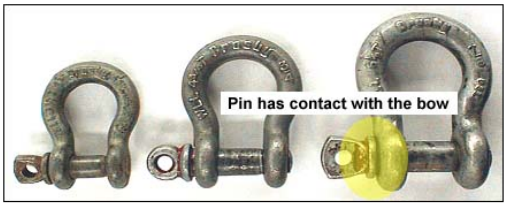
   a. Section 8
   b. Section 12
   c. Section 14
   d. Section 10

NOTES

RIGGING GEAR SELECTION AND USE – HARDWARE

Using Rigging Hardware

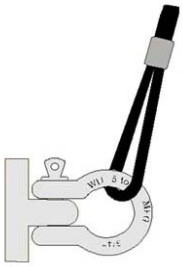
Use the same size and type of shackle on each leg in multiple leg applications.



Different types, sizes, or brands of shackles may vary significantly in physical size. This in turn will affect the overall length of the leg and the tension created in each leg.

When installing the pin into the bail, be sure the pin is fully seated into the bail.

Side Loading Shackles



It may be sometimes necessary to apply a side load to a shackle.

When side loading a screw pin or bolt type shackle reduce the rated load by 50% or as specified by the OEM .

Using Eyebolts, Swivel Hoist & Lifting Rings

When checking the engaging hole in the item you are going to lift:
Make sure the threads are not damaged.
And the hole is free of debris.

Minimum Thread Engagement

The minimum thread engagement depends on the material into which you are installing the piece of rigging equipment.

When installing eyebolts into steel the minimum required thread engagement is one and one half times the diameter.

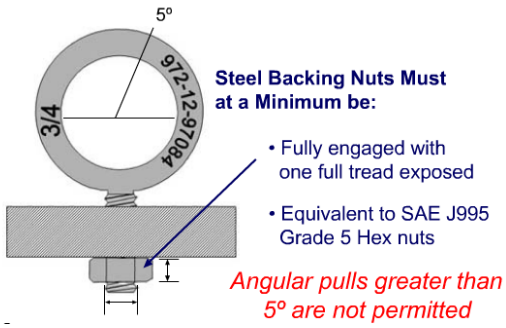
When installing eyebolts into aluminum, the minimum thread engagement is two times the diameter.

For other materials contact your activity's engineering organization or the OEM.

Eyebolts

Backing Nut Use

When eyebolts are used with backing nuts, the backing nut must be at least SAE grade 5 and fully engaged with at least 1 full thread exposed.

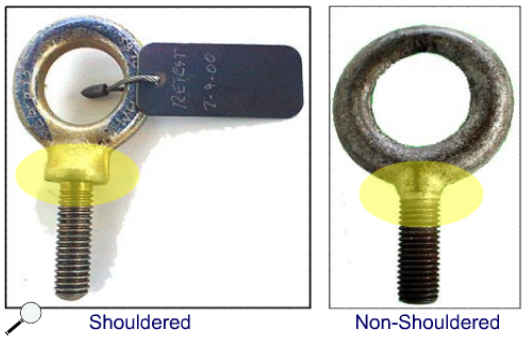


Eyebolt Types

There are two types of eyebolts you may find at your work site, shouldered eyebolts and non-shouldered eyebolts.

Non-shouldered eyebolts are sometimes referred to as plain pattern or regular nut eyebolts.

All eyebolts must be used in accordance with OEM instructions.



Non-shouldered Eyebolts

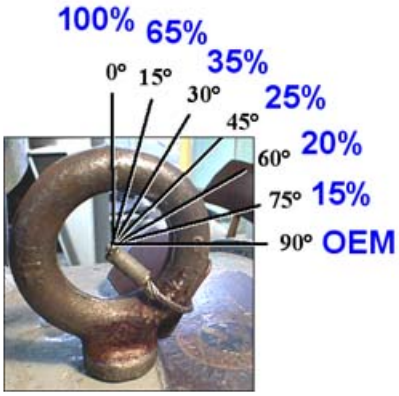
Non-shouldered eyebolts may be used in vertical applications only.

Angled pulls greater than five degrees, even in the plane of the eye are not permitted.

Shouldered Eyebolts

Shouldered or machinery eyebolts may be loaded at an angle as long as it is loaded in the plane of the eye.

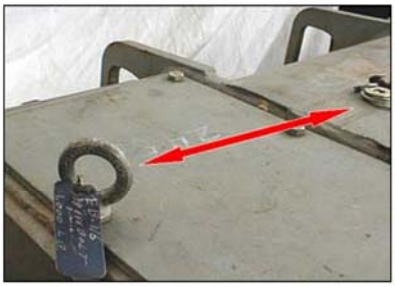
When loading a shouldered eyebolt at an angle the capacity of the eyebolt is reduced.



Installing Shouldered Eyebolts

Shouldered eyebolts must be installed with the shoulder seated flush against the mounting surface.

Shim Usage for Alignment

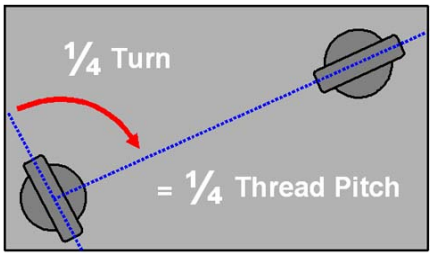


To remedy this, shims may be used to align the eye with the plane of the pull.

When using shims, use the minimum thickness that will orient the eye the plane of the pull. The total thickness of shims must never exceed one thread pitch.

The thread pitch represents one full revolution or rotation of the shank. If there are 16 threads per inch, then the thread pitch is 1/16th inch.

Determining Shim Thickness



In order to determine shim thickness we must determine how much rotation is required.

How far would this eyebolt have to rotate in order to line up in the plane of pull?
It must rotate 1/4 of a turn.

How much shim would that require?
One quarter of the thread pitch would orient the eyebolt in line to the plane of pull.

For the eyebolt noted previously with a thread pitch of 1/16th inch, total shim thickness would be 1/64th inch.

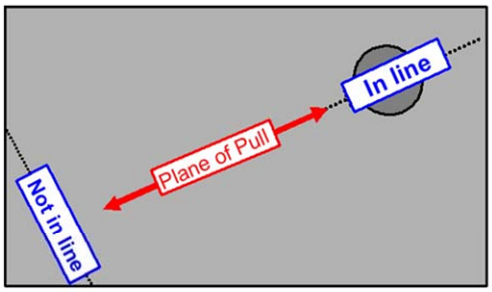
Incorrect Use of Shims to Align Eye

This is an example of shims being used incorrectly.

Do you see the problem with this eyebolt installation?

The total shim thickness is more than the thread pitch.

Aligning the Eye With the Plane of Pull



To use eyebolts with an angular load, the loading must be in line with the plane of the eye.

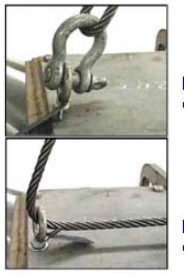
This may not always happen when installing eyebolts.

Look at this shape and imagine two slings connected to each eyebolt shown from the top.

You can see that the top eyebolt would be in line with the plane if two slings were attached.

The bottom eyebolt ended up out of plane when tightened against the seating surface.

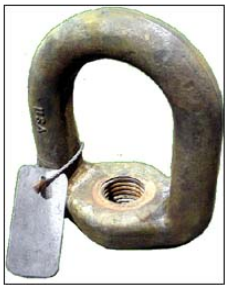
Side Pulls



Side pulls on eyebolts are very dangerous and may cause the eyebolt to fail. Side pulls result from loading out of the plane of the eye.

Never install a sling through two separate eyebolts. The result will be side pulls on both eyebolts and damage to the sling.

Eye-nuts



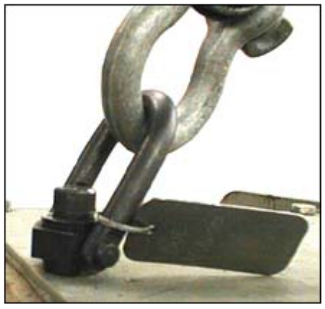
Eye-nuts must be used in accordance with OEM instructions.

They must have full thread engagement.

This means the shank or stud they are attached to must be long enough to allow complete engagement of the eye-nut.

Eye-nuts must be used for vertical applications only.

Swivel Hoist Rings



Angular pulls do not reduce rated load of a swivel hoist ring.

When using swivel hoist rings, they must be installed with the shoulder flush with the mounting surface.

They must be tightened with a calibrated torque wrench in accordance with OEM requirements.

Check the OEM instructions prior to installing any shims. Most manufacturers do not allow the use of shims with swivel hoist rings.

Swivel hoist rings must be used in accordance with OEM specifications.

They must be tightened to the OEM specified torque. And

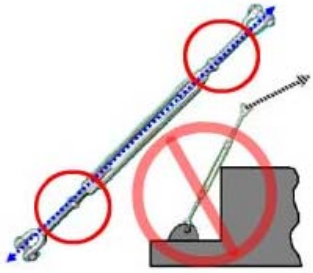
The torque value is usually marked on the hoist ring itself.

Before using backing nuts on hoist rings, check the OEM specification to see if it is allowed.

Selection and Use of Turnbuckles

Turnbuckles are commonly used for tensioning lines and securing loads but may be used for crane rigging if they meet the test, inspection and certification requirements of NAVFAC P-307.

Turnbuckles are used only for in-line pulls.



Jam nuts, when used, must be tightened in accordance with OEM instructions to prevent rotation.

If the possibility of rotation still exists, the turnbuckle must be secured by safety wire or other suitable means in addition to jam nuts.

Items with Threaded Attachment Points

Remember to use extreme caution when using a threaded item such as an eyebolt or a hoist ring as a single attachment point !
Never rotate or spin an object being lifted with a single threaded attachment point.
The lifting attachment may unthread and the object may fall.

Knowledge Check

1. **Select the best answer**. Pulls outside the plane of the eye are allowed on eyebolts as long as the rated load has been decreased.

a. True
b. False

2. **Select the best answer**. The minimum depth of thread engagement for a ¾ inch eyebolt into a steel object is:

a. 1 1/8 inch
b. 1 ½ inch
c. ½ inch
d. 1 inch

3. **Select the best answer**. An angular pull of 45 degrees is allowed on non-shoulder type eyebolts.

a. True
b. False

NOTES

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RIGGING GEAR SELECTION AND USE – SLING USE

Wire Rope Sling Use

A common metal sling is the wire rope sling. Wire rope slings have some limitations even though they are generally strong and durable.

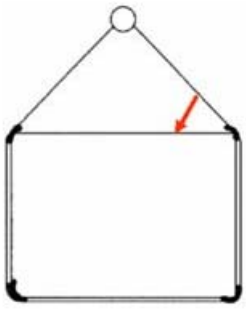
D-to-d is the term for the ratio between the diameter of the object around which the sling is bent and the diameter of the sling body.

The capitol D represents the diameter of the object and the small d represents the diameter of the sling.
When using wire rope slings always maintain a minimum D-to-d ratio of one to one in the body of the sling.

In other words, never bend a wire rope around a diameter smaller than itself!

Bending a wire rope around a diameter smaller than its minimum D-to-d ratio will damage the wires and weaken the sling.

For loads with a non-circular cross section the bend diameter is derived from the minimum bend diameter of the wire rope around the corner of the load.



For slings bent around corners, the corners must be rounded to provide the minimum D/d efficiency.

Chafing protection is used to protect the load and sling from damage.

Wire Rope Temperature Restrictions

Wire rope must also be protected from extreme temperatures, which can seriously affect the wire's strength.

Do not use wire rope slings below minus 40 degrees or above 400° Fahrenheit.

Fiber core rope wire should not be used above 180° Fahrenheit.

Wire Rope Restrictions

Wire rope clips should not be used to fabricate slings.

And wire rope slings should never be knotted.

Chain Sling Use

Chain slings are a good choice when the job demands abrasion and damage resistant slings.

However, if used improperly, they too can be damaged.

Chain slings should not be used on loads that are damaged easily.

Never use knots or bolts to shorten or extend the sling.

Use chafing on sharp corners and edges to prevent damage to slings and load.

Always check OEM instructions for the chain sling you are using.

Chain Sling Temperature Restrictions

NAVFAC P-307 requires that chain slings should not be used when temperatures are below minus 40° Fahrenheit.

When chain slings are used at or above 400° Fahrenheit, follow OEM recommendations.

Metal Mesh Sling Temperature Restrictions

Metal mesh slings are often used in abrasive or high temperature environments that would damage slings.

Do not use metal mesh slings when temperatures are below 0° or above 550° Fahrenheit.

Do not use elastomer coated slings when temperatures are below 0° or above 200° Fahrenheit.

Always follow OEM recommendations.

Types of Synthetic Slings

There are three types of synthetic slings: Web, Rope and Round Slings.

Synthetic slings should be used **only** when they can be protected from damage!

Natural fiber rope slings are **not to be used** for overhead lifting.

Using Synthetic Slings

Synthetic slings cannot be substituted for other slings specified on rigging sketches.

Avoid chemical exposure to synthetic slings and always use chafing gear!

Minimize exposure to sunlight and other sources of ultraviolet light. Store all synthetic slings indoors in a cool dry place.

And
Always follow OEM recommendations when using synthetic slings.

Synthetic Web Sling Use

Web slings must be installed flat around the load without kinks or twists.

Kinks and twists reduce friction on the load and can cause the sling to roll or slide out of position.

These slings are not affected by D-to-d ratio.

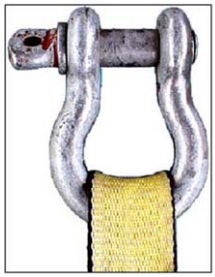
Eye length in relation to the diameter of the hook is critical.

The eyes of webbing slings are stitched and the stitching can be damaged if the eye is spread excessively.

Using Shackles with Web Slings

Shackles used with synthetic web slings must allow the sling to lay relatively flat without excessive curling of the edges.

Curling causes uneven loading of the sling. Slight curling, however, is acceptable.



Web Sling Temperature Restrictions

Do not use synthetic web slings at temperatures above 180° Fahrenheit

Minimum D/d Ratio for Synthetic Rope Sling Use

When making single point lifts with eye and eye synthetic rope slings, use two slings or double up a single sling.

These slings are hand spliced.

If they are allowed to spin, the splice could come undone and drop the load!

The minimum D-to-d ratio is 1 to 1.

This means a one half-inch diameter synthetic rope sling cannot bent around any object that is smaller than one half-inch.

Synthetic Rope Temperature Restrictions

Do not use nylon or polyester synthetic rope slings at temperatures above 180° or under minus 40° Fahrenheit.

Do not use polypropylene slings at temperatures above 150° or under minus 40° Fahrenheit.

Roundsling Use

For roundslings, NAVFAC P-307 recommends that you use the shackle types listed by the OEM.

Alternate yarn synthetic round slings must not be used around items smaller in diameter than the pin used to test the sling.

The minimum D-to-d ratio shall be marked on all alternate yarn round slings.

Roundsling Temperature Restrictions

Follow OEM recommendations when using roundslings in extreme temperatures.

Sling Use Considerations

Slings must not be used at angles less than 30° from horizontal unless specifically authorized by an engineering work document.

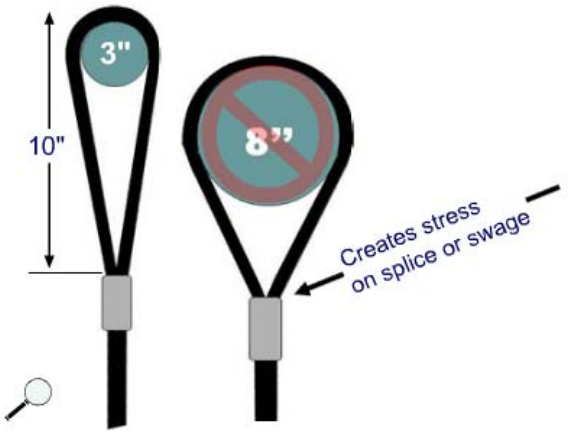
Never use a sling that has been knotted.

Chafing gear should be used where needed.

Rigging gear including slings, shackles, turnbuckles, and eyebolts, must be sized such that two legs can carry the load to allow for variations in sling length and load flex.

Eye Length vs. Hook Diameter

The size of the hook or shackle relative to the size of the sling eye can be critical.



If we place a ten-inch long sling eye on a load which is 3 inches in diameter, the eye opens slightly and causes very little added stress to the eye or the splice.

However, if we place that sling on a hook with a diameter of 8 inches, this can stress the eye and can cause the swage or stitches to fail.

Never place the eye of any sling around an object which has a diameter greater than 1/2 the length of the eye.

If the hook diameter is too large, a shackle can be used to connect the slings to the hook, thereby reducing the diameter over which the sling eyes are placed.

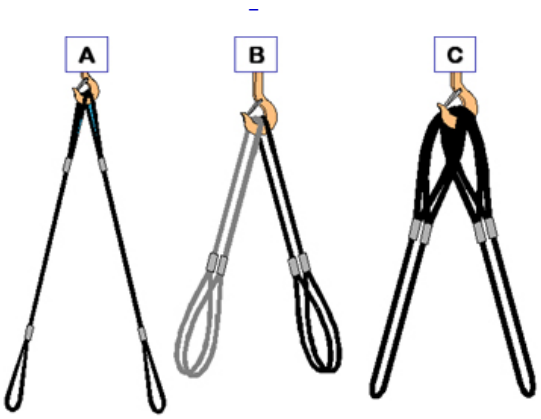
Attaching Gear to Hooks

When attaching rigging gear to hooks be sure the safety latch is working properly and closes the throat opening without obstruction.
Failure to do so can allow the gear to come off the hook.

All gear attached to the hook must seat properly in the bowl. Do not stack slings or allow slings to cross each other in the hook. That can lead to crushing of the slings!

Correct Attachment of Slings to Hooks

These graphics illustrate correct ways to attach slings to a hook.



Graphic “A” shows a vertical application with two sling eyes seated in the bowl of the hook.

Graphic “B” shows two slings doubled over the hook and sling eyes pointing down to attachment points.

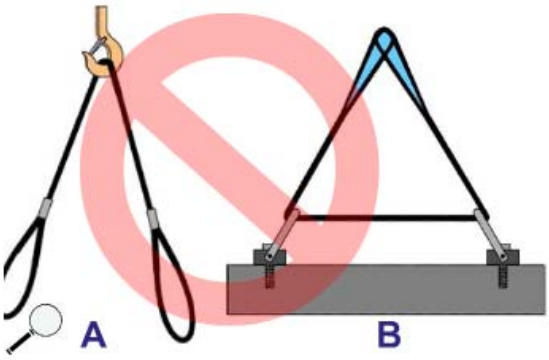
Graphic “C” shows two slings doubled with sling eyes on the hook and the bight pointing down to attachment points.

When wire rope slings are used as in graphics “B” and “C”, and a heavy load is applied, individual wires may become permanently deformed or kinked.

If the slings become kinked, they should not be used again in vertical applications.

Incorrect Use of Slings on Hooks

These graphics illustrate some incorrect ways of attaching slings to a hook.



Incorrect sling applications can be extremely dangerous and can result in loss of load control and personnel injury!

Graphic “A” shows a single sling with the “bight” riding the hook and the eyes attached to two separate attachment points.

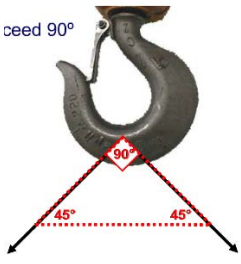
Slings applied in this manner could slip on the hook causing the load to shift.

Graphic “B” shows a sling through two attachment points.

Installing a sling through more than one attachment point will create excess stress on the sling, the attachment points, and the gear.

Included Angle

Included angle is the angle measured between two slings sharing a common attachment point.

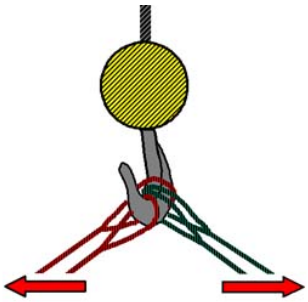


To prevent tip loading when lifting with two slings, the included angle created by slings attached to the hook must not exceed 90°.

If the horizontal angle of the slings is less than 45°, the included angle will exceed 90°.

In this case, you must use a shackle or other collection device to connect the slings to the hook.

Inside and Outside Sling Attachment



When rigging four slings to a hook, separate the slings into two pairs, inside and outside so they do not pull in the plane of the hook.

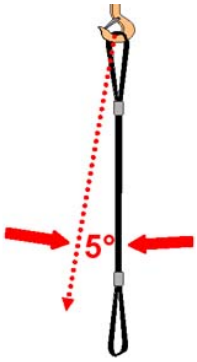
Attach the inside slings to one end of the object and the outside slings to the other end, being careful that they are not crossed.

3 Types of Hitch Configurations

Slings are used in three types of hitches: the vertical hitch, the choker hitch and the basket hitch.

The rated load for the same sling with each hitch will be different.

WLL of Vertical Hitches



The rated load for a vertical hitch is 100% of the sling's capacity.

Sling angle stress is encountered any time the vertical angle exceeds 5° and must be taken into account.

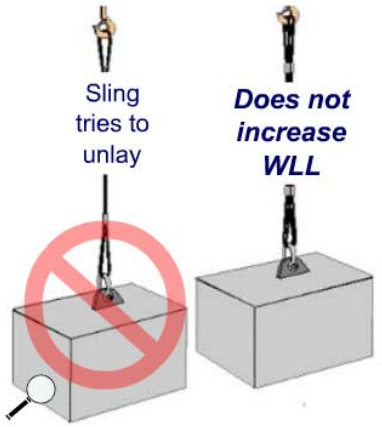
Use of 2 Legs for Vertical Hitches

To prevent unlaying of the wire rope, do not use a single sling leg wire rope sling in a vertical hitch.

Use two legs for single point lifts. The second leg prevents the sling from spinning.

It is important to note that the configuration shown here does not increase the rated load because slings are rarely the exact same length.

The shorter of the two will carry the load.



Choker Hitches

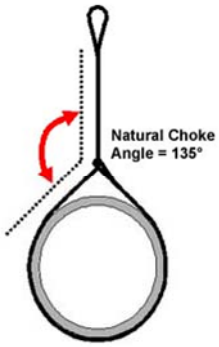
Using a shackle to set a choker hitch will prolong the life of the sling.

Whenever a shackle is used to set a choker hitch set the eye of the sling on the pin of the shackle.

This will prevent the “running” part of sling from rotating the pin of the shackle as it passes over it.

Never set the choker so the running part of the sling passes against the shackle pin.

WLL of Choker Hitches



Whenever a choker hitch is used the sling’s rated load is reduced.

The natural choke angle is 135° if a choker hitch is allowed to tighten itself as the load is lifted.

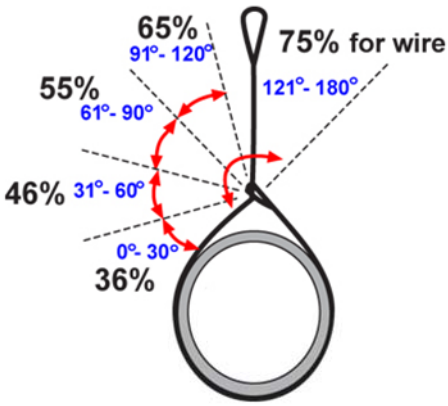
When Choke angles are less than 120° the rated load must be reduced further.

Wire Rope and Synthetic Sling Choker Hitch Capacities

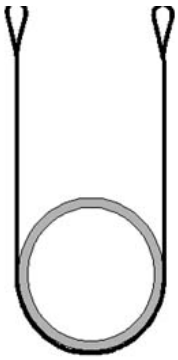
This chart shows the efficiency of the sling’s capacity when choking with a wire rope or synthetic rope sling. Refer to Table 14-4 in NAVFAC P-307 for choker efficiencies for other slings.

For angles 121° to 180° the rated load is reduced to 75% of the vertical capacity.

This does not apply to braided multi-part wire rope slings. Contact the Wire Rope Technical Board for recommended efficiency factors for braided multi-part slings.



WLL of Basket Hitches



Basket hitches are the strongest of the three hitches.

Slings in a basket hitch can carry 200% of the sling's single rated load when the sling angle is less than 5° from vertical, and the required D-to-d ratio is maintained.

Wire rope requires a D-to-d ratio of greater than 40 to 1.

Synthetic rope requires a D-to-d ratio of at least 8 to 1.

NOTES

CRANE COMMUNICATIONS MODULE

Crane Communication Methods

Standard hand signals provide a universal language, understood by everyone involved with weight handling consequently, they are the most common method used in crane operations.

When presented properly, standard hand signals help prevent miscommunication and play a very important part in safe crane operations.

Radio communications are well suited for blind and complex lifts.

As a general rule, direct voice should only be used when the operator and rigger are working in close proximity and ambient noise is not a factor.

Hand Signals

Hand signals are the most widely used method of communication between signalers and crane operators.

Hand signals like those found in the American Society of Mechanical Engineers, A.S.M.E. B30 standards must be posted in the crane in clear view of the operator.

Your activity may approve local signals in addition to these standard signals.

Hand Signaling Rules

- Signalers must remain in clear view of the crane operator.
- If the crane operator can't see you, another method of communication must be used.
- Only one signaler communicates with the crane operator at a time.

Radio Communications

Radios can be used to direct crane lifts while keeping crane team members informed of the lift status.

Follow the guidelines and work practices shown on your screen when using radios.

Radio guidelines

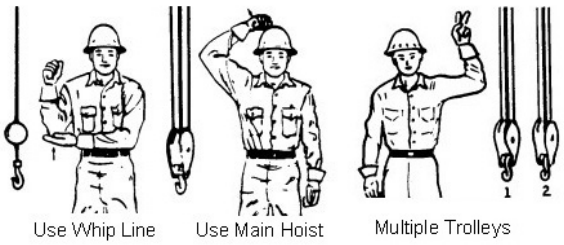
- Use an isolated channel
- Clear the line of other traffic
- Limit background noise

Radio work practices

- Identify the crane and yourself
- Allow time between commands
- Verify the command

Hook and Trolley Signals

These signals indicate which hook or trolley to use and are used in conjunction with operating signals.



Whip Line or Auxiliary Hook

When calling for the whip line or auxiliary hoist:

- the elbow is tapped with the opposite hand and
- followed with the appropriate hook movement signal.

Main Hoist

When calling for the main hoist, the signaler:

- taps a fist on his or her hard hat and
- follows the appropriate hook movement signal.

Multiple Hooks/Trolleys

When working with a multiple trolley crane, these signals indicate which trolley to use.

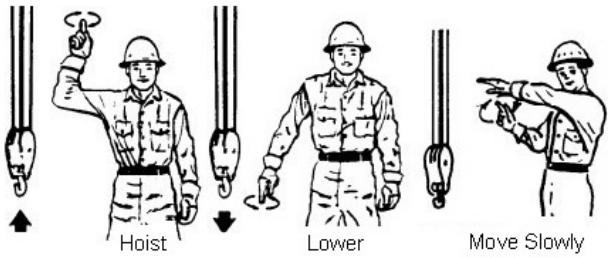
They are always followed by movement signals.

- One finger up for the number "1" hook or trolley
- Two fingers up for the number "2" hook or trolley
- Each followed with standard signals to indicate the desired motion

Hoist Signals

Hoist and lower signals are the same for all cranes.

The distinct circular motion helps the operator see the signal clearly from greater distances and helps distinguish them from other signals.



Hoist Up

The hoist signal is given with:

- the forearm vertical, the index finger pointing up, and
- the hand moving in small horizontal circles.

Lower

The lower signal is given with:

- the arm extended downward,
- the index finger pointed down and
- the hand moving in small horizontal circles.

Hoist/Move Slowly

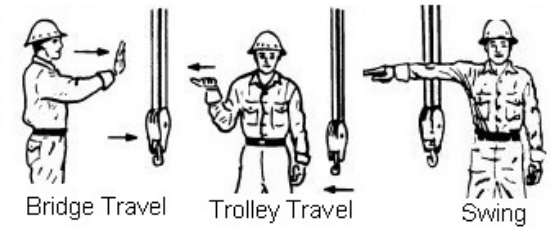
A hand held motionless in front of any signal indicates to move slowly.

In this clip the rigger is signaling to hoist slowly.

- A hand held in front of any signal indicates to "move slowly"
- One hand gives a signal
- The other hand is motionless in front of the signal

Directional Signals

Directional signals are used to guide horizontal crane movements such as bridge, trolley and swing.



Travel

The signal for crane or bridge travel is made with:

- an extended arm,
- hand open with palm facing outward, and
- the hand moving horizontally in the desired direction of travel.

Trolley

The signal for trolley travel is made with:

- a palm up and fingers closed and
- the thumb moving in the desired direction of travel.

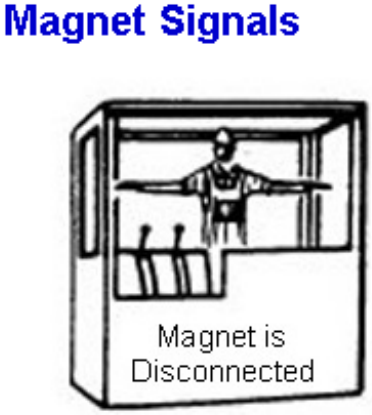
Swing

The signal for swing or rotate is:

- an extended arm
- the index pointed in the desired direction of rotation.

Magnet Signals

Magnet signals are used to communicate the current status of the magnet - whether it is on or off.



Magnet Disconnected

The magnet disconnect signal is used to let the person on the ground know that the electricity has been secured and it is safe to disconnect the magnet from the crane.

The magnet disconnected signal is given with:

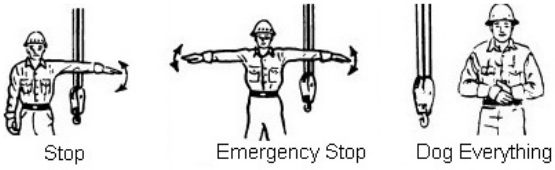
- both extend arms
- palms up and fingers open.

Signals for Stopping Crane Movements

Stop and emergency stop signals can be given by anyone.

When these signals are given, the operator must stop operations as quickly and as safely as possible.

The dog everything signal is used when all operations must be secured.



Stop

The stop signal is:

- an extended arm,
- palm down
- moving back and forth horizontally.

Emergency Stop

The signal for an emergency stop is:

- both arms extended
- with palms down
- moving them back and forth horizontally.

Dog Everything

The signal to dog everything is:

- clasped hands in front of the body.

Knowledge Check

1. Select the best answer. This signal indicates:

a. emergency stop
b. stop
c. travel back
d. swing

NOTES

Crane Communications Exam

1. **Select the best answer**. This signal indicates:

a. Travel
b. Raise hoist
c. Main hoist
d. Auxiliary hoist

2. **Select the best answer**. This signal indicates:

a. Emergency stop
b. Lower load
c. Dog everything

3. **Select the best answer**. In the crane cab the crane operator must have clear view of the:

a. EOM
b. Crane maintenance records
c. ASME Hand Signal Chart
d. Crane lift history

4. **Select the best answer**. This signal indicates:

a. swing
b. travel back
c. stop
d. emergency stop

5. **Select the best answer**. A universal language understood by everyone involved with weight handling is:

a. hand signals
b. direct voice commands
c. spoken word
d. signal flags

6. **Select the best answer**. This signal indicates:

a. Magnet disconnected
b. Emergency stop

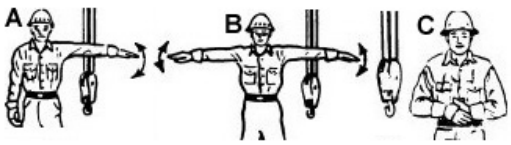
7. **Select the best answer**. Direct voice should only be used when:

a. No other form of communications is available and ambient noise is high
b. The rigger has not learned hand signals
c. The operator and the rigger are working in close proximity and ambient noise is high
d. The operator and rigger are working in close proximity and ambient noise is low

8. **Select the best answer**. Another form of communications, other than hand signals, must be used if:

a. Activities designates alternative methods
b. The signaler is not in clear view of the crane operator
c. The signaler is in clear view of the rigger in charge
d. Ambient noise is greater than the lack of visibility

9. **Select the best answer**. Which signal is used to indicate shutting down everything – commonly known as dog everything?



a. A
b. B
c. C

10. **Select the best answer**. Any additional hand signals must be

a. Approved by NOSH
b. Approved by the ASME
c. Approved by the activity
d. Approved by OSHA

11. **Select the best answer**. For multiple crane lifts, _____ will communicate with the crane operators.

a. Up to three signalers
b. One signaler at a time
c. One signaler for each crane involved
d. No signalers unless directed by the rigger in charge

12. **Select the best answer**. This signal indicates:

a. Emergency stop
b. Magnet disconnect
c. Stop
d. Swing

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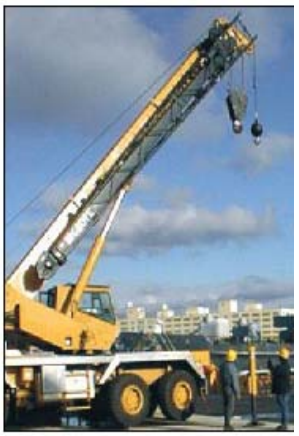
CRANE TEAM CONCEPT MODULE

Crane Team Concept



The crane team concept was developed to help ensure that crane operations are executed:

- without injury to personnel, and
- without damage to property or equipment.

To accomplish this goal, the crane team works together to identify and eliminate obstacles to safety.

Crane Team Members

The basic crane team consists of

- the crane operator and
- the rigger-in-charge.

The supervisor may assign other personnel as required.

Additional members may include:

- crane riggers, and
- a crane walker.

The rigging supervisor assigns the crane team members depending on the complexity and scope of work.

Either the rigging supervisor or rigger-in-charge may conduct team briefings.

Shared Responsibilities

While each member of the crane team has individual responsibilities, all team members share some common responsibility, including:

- participation in pre-job briefings,
- watching for potential problems and
- making other team members aware of them.

All team members are responsible for keeping non-essential personnel away from the crane's operating envelope during lifting evolutions.

Pre-Job Briefing

A pre-job briefing for complex lifts is **conducted by:**

- the rigging supervisor,
- operator supervisor or
- the working leader

and shall be **conducted to ensure** that all crane team personnel understand the requirements of the lift.

Communications

Communications during the lift are just as important as the pre-lift brief.

All team members must be made aware of any problems that are discovered.

Safety

- **Stop crane operations** before personnel board the crane.
- Cranes should be positioned to allow safe boarding.
- **Stop work** if you're unsure about the assigned task or, if you feel safety is in jeopardy.
- Have problems resolved before resuming operations.

Knowledge Check

1. **Select the best answer**. What is the purpose of the crane team concept?
The crane team concept:

a. Helps ensure crane operations without injury to personnel and without damage to property and equipment
b. Ensures members follow all procedures and adhere to all policies

Crane Operator Responsibilities

The crane operator is responsible for performing the pre-use check as well as the safe operation of the crane.

The crane operator must have a full understanding of each lift prior to execution and moves only when directed by the signal person.

ODCL

When performing the pre-use check of the crane, the operator follows and completes the Operator's Daily Checklist, the ODCL.

ODCL Includes:

- walk around check
- machinery check
- operator's cab check
- no load operational check

Full Understanding of the Lift

Before making a lift, the crane operator must have:

- a full understanding of the lift and
- how it is to be executed.

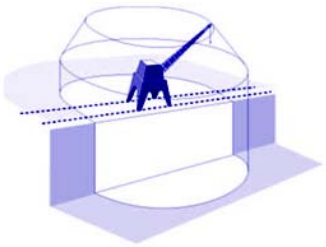
The operator must know:

- the exact or estimated load weight,
- the destination and
- the capacity of the crane as it is configured.

Stopping Operations

The crane operator must immediately stop operations:

- When the operating envelope is penetrated,
- If communications are lost during a blind or complex lift, and
- Anytime a stop signal is given by anyone.



Rigger-In-Charge Responsibility

The rigger-in-charge has overall responsibility for the safety, planning, and control of the lift.

The Rigger-In-Charge ensures that:

- each load is rigged properly and
- the crane envelope is kept clear.

He or she also signals the crane operator or designates other personnel to provide signals and coordinates the activities of the crane team members.

Lift Planning

The rigger-in-charge plans all aspects of each lift. He or she determines the load weight and center of gravity of each load and then selects the proper rigging.

Next, the load path is determined and the method of communication is planned.

Crane Rigger Responsibilities

A crane rigger is responsible for carrying out assignments from the rigger-in-charge or the rigging supervisor.

These duties include:

- assisting the crane operator with the pre-use check,
- selection and inspection of rigging gear,
- safely rigging the loads and
- keeping the rigger-in-charge informed.

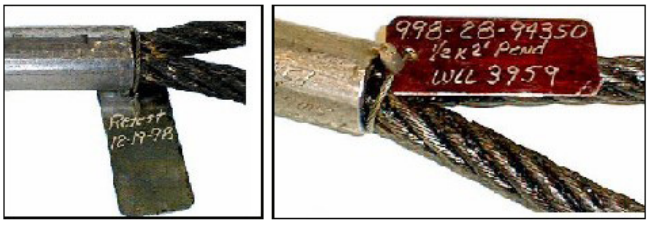
Assisting with the ODCL

The crane rigger assists the operator in performing the pre-use check of the crane and work area.

Selecting and Inspecting Rigging

The crane rigger:

- selects and inspects crane rigging gear, and
- establishes proper attachment points as directed by the rigger-in-charge.



Communicating

A crane rigger keeps the rigger-in-charge informed of:

- questionable or unsafe conditions and
- changes that may affect the operation.

Crane Walker Responsibility

Often a crane supervisor will assign a crane walker to the crane team.

Like the crane rigger, the crane walker is responsible for carrying out the assignments of the rigger-in-charge and the rigging supervisor.

The crane walker is responsible for:

- Assisting with the pre-use check
- Helping ensure safe crane travel
- Aligning crane rails
- Staying in position to communicate stop signals to operator
- Participating in crane team briefings

Assisting with the ODCL

A crane walker assists the crane rigger and crane operator in performing the pre-use check of the crane.

Safe Travel of the Crane

The crane walker ensures the crane's travel path is clear by:

- watching for potential obstructions and
- checking the proper alignment of the crane track switches.

Communicating Stop

Crane walkers stay near the emergency stop button to communicate the stop signals to the crane operator.

Supervisor Responsibility

The supervisor is familiar with NAVFAC P-307 and supports the crane team concept.

The supervisor:

- Designates crane team personnel
- Reviews site conditions for complex lifts
- Reviews procedures for operations near electrical lines
- Investigates and reports crane accidents

Site Conditions

The supervisor reviews onsite conditions for all complex lifts.

Operation near Power Lines

The supervisor

- assesses potential hazards and
- establish procedures for safe operations around overhead electrical power lines.

Lifts exceeding 80% Capacity

A supervisor oversees lifts exceeding 80% of hook capacity, 50% for barge mounted mobile cranes.

If the lifts are repetitive in nature, the supervisor shall be present during the first evolution of the lift for each rigging crew.

Accidents

The supervisor shall:

- inspect suspected accident scene,
- notify appropriate authority and
- ensure that the accident report is filed.

Complex Lifts

A supervisor shall

- review on-site conditions for complex lifts and
- perform a pre-job briefing with all crane team personnel.

A supervisor shall personally oversee all lifts

- exceeding 80% of the certified capacity of the crane's hoist or
- 50% for mobile cranes mounted on barges.

NOTES

Crane Team Module Exam

1. **Select the best answer**. If an accident is reported the preliminary investigation will be performed by the:

a. Crane rigger
b. Supervisor
c. Rigger in charge
d. Crane operator

2. **Select the best answer**. When rigging your own loads, you are responsible for the following:

a. Determining the load weight
b. Selecting and inspecting the rigging gear
c. Calculating the Center of Gravity of the load
d. Hooking up the load
e. All of the above

3. **Select the best answer**. While the members of the crane team have individual responsibilities each have joint responsibilities as well. Each member must:

a. Support the goal of safe crane operation
b. Attend the pre-lift briefing. Any new members who replace another team member, must be briefed as well.
c. Keep the Rigger in Charge well informed of conditions affecting personnel or the equipment during lifts.
d. Keep non-essential personnel out of the operating area
e. Stop operations whenever safety is in question
f. All of the above

4. **Select the best answer**. Additional crane team members may be assigned by

a. The crane rigger as required.
b. The EOM designation.
c. The supervisor as required
d. The crane operator as required

5. **Select the best answer**. Planning the lift route is the responsibility of the:

a. Crane operator
b. Rigger in charge
c. Crane supervisor
d. Crane rigger

6. **Select the best answer**. A _____ may be assigned by the rigger in charge to assist the operator with the pre-use check, select and inspect rigging gear, and rig loads.

a. Crane rigger
b. Crane supervisor
c. Crane operator
d. Crane engineer

7. **Select the best answer**. During the performance of your task if you feel safety is in jeopardy you should:

a. Evaluate the lift plan
b. Use the OEM manual to solve the problem
c. Call your supervisor for clarification
d. Stop work and have the problem resolved

8. **Select the best answer**. Securing the crane envelope is the

a. Combined responsibility of all team members
b. Sole responsibility of the crane operator
c. Sole responsibility of the rigging supervisor
d. Combined responsibility of the crane operator and the crane supervisor

9. **Select the best answer**. The crane operator is responsible for the safe _____ of the crane.

a. Operation
b. Condition
c. Repair
d. Return
e. Inspection

10. **Select the best answer**. Crane operators are responsible for all of the following EXCEPT:

a. Moving the crane only when signaled
b. Maintaining communication with the signaler
c. Doing a thorough ODCL inspection
d. Slowing down when signals are unclear
e. Lifting and landing all loads safely

11. **Select the best answer**. Coordinating the activities of the crane team is the responsibility of the:

a. Crane supervisor
b. Crane rigger
c. Crane operator
d. Rigger in charge
e. Activities

12. **Select the best answer**. The crane operator moves the crane only as directed by the:

a. Signaler
b. Rigger
c. Crane walker

13. **Select all that apply**. The crane operator must immediately stop operations when

a. The weather forecast is not good
b. Communications are lost during a blind or complex lift
c. Any time a stop signal is given
d. Operations have exceeded allowed time
e. The operating envelope is penetrated.

14. **Select the best answer**. The Crane Team Concept was developed to ensure that all operations involving the crane are executed without:

a. Injury to personnel
b. Damage to property
c. Damage to equipment
d. All of the above

15. **Select the best answer**. The minimum Crane Team consists of:

a. The Crane Operator and Rigger in Charge
b. The Crane Operator, Rigger Supervisor, and Crane Rigger
c. The Crane Operator, Crane supervisor, and Crane Rigger
d. The Crane Operator, Crane Walker, and Crane Rigger

SAFE OPERATIONS MODULE

Understanding the Crane

Most crane accidents can be avoided by consistently practicing basic safety procedures.

Team members are often to blame for crane accidents, due to inattention, poor judgment, overconfidence, or haste.

Understanding the crane is the operator's first responsibility.

Crane operators at naval activities must often operate a variety of cranes. They must be familiar with each type of crane they are qualified to operate.

Operation Manual

Operators must read and follow the:

- manufacturer's requirements,
- written procedures,
- safety instructions and
- precautions.

Posted Information

The operator must heed posted warnings and instructions on the crane such as:

- hand signal placards,
- controller function labels, and
- warning labels.

Certification information should be posted in plain sight.

Pre-operational Check

To make sure the crane and work area are safe, the operator performs a mandatory daily crane inspection using the ***Operator's Daily Checklist.***

Operator Awareness

When operating a crane, the operator must be aware of everything in the operating envelope including:

- hazards,
- obstructions, and
- personnel.

At the same time the operator must be aware of the:

- sound,
- feel and
- behavior of the crane.

Unsafe Conditions

Whenever an unsafe condition exists, operators must immediately stop operation and the condition must be resolved before continuing.

If you cannot resolve a safety issue with the team members, contact the supervisor for assistance.

Remember, operators have the **authority and responsibility** to stop and refuse to operate the crane until safety is assured.

Lifts Near Personnel

Loads must never be moved or suspended over personnel.

Choose an alternate load path or evacuate personnel from the area.

Riding Loads

Personnel must never ride loads.

Use only approved personnel-lifting devices if personnel must be lifted.

Operating Practices

The crane operator must operate the crane in a safe manner, moving loads slowly and smoothly.

Avoid rapid starts and sudden stops to help reduce load swing.

Anticipate stopping points, and slow down before bringing loads to a stop.

Never leave a suspended load unattended.

Lifting Loads

When lifting loads, position the freely suspended hook directly over the load for vertical lifting.

This prevents side loads and prevents load shifting at lift-off.

Take the slack out of rigging gradually and watch for hook movement that indicates the need to reposition the crane before lifting.

Stop when the load lifts a few inches off the ground and check the hoist brake.

Accelerate smoothly to reduce dynamic loading.

Landing Loads

When lowering loads, be sure the surface that you plan to land on will support the load.

Slow the load down as you approach the landing surface.

To land heavy loads softly, stop the load a few inches off the ground and allow the load to settle before touching down.

Securing the Crane

When securing cranes remove gear from the hook, place all controls in the neutral position and engage all brakes and locks.

Stow hooks near, but not in, the limit switches.

For cranes located out doors, secure the crane against wind movement and chock the wheels as necessary.

Knowledge Check

1. **Select the best answer**. The first step in the procedure for lifting loads is to:

   a. Hoist slowly and remove slack
   b. Hoist at one speed until the load lifts
   c. Hoist slowly until the load lifts

2**. Select the best answer**. The second step for lifting loads is to:

   a. Lift until completely suspended and stop
   b. Lift until load clears all obstacles and stop
   c. Lift until desired height and stop

Traveling

When traveling cranes with loads, stow unused hooks, follow OEM requirements and keep loads close to the ground while avoiding obstructions.

Use slow speeds for better load control.

Be aware of travel restrictions, and other cranes working in the area.

Remember to check clearances and watch for obstructions.

OET and Gantry Crane Operations

The bridge travel function is used to:

- travel the crane in the selected direction along the length of the runway rails.
- This, allows the operator to move the entire crane along its supporting rail structure, in the selected direction.

The trolley function is used to:

- move the hoisting machinery in the selected direction along the trolley rails.

The hoist function is used to:

- raise and lower the hooks.

OET and Gantry Cranes Operating

Overhead electric traveling cranes are generally operated indoors so congestion is often an issue.

- Watch for changes in the work area that may cause interference.
- Storage racks with material stacked too high are a common problem.

Operators should always check for trolley & bridge drift before operating the crane.

Lift loads vertically.

Side pulls can cause uneven or overlapped spooling of the hoist wire, and may cause the wire rope to be cut or severely damaged.

Avoid sudden starts and stops with the bridge.
This can result in skidding and uneven wear on the wheels.

A sudden start with a heavy load on one end of the bridge may cause a crane to skew.

Skewing means that the bridge and trucks are out of alignment with the rails, often resulting in wheel chatter from flange contact with the sides of the rail head.

Always board cab-operated cranes at designated places.

Access the crane cab or bridge walkway using fixed ladders, stairs, or platforms.

Remain aware of other cranes working on the same rail system.

For gantry cranes, watch travel truck clearances.

For cab-operated gantry cranes, this may require additional personnel to ensure a clear travel path.

Use radio controls according to the manufacturer’s instruction.

Turn off power to the radio controller and properly store when finished operating.

Securing

Move cab-operated cranes to a boarding platform or ladder.

Never attempt to walk the rails to enter or exit an OET crane.

Secure main power switch, usually located on the bridge, for cab-operated cranes only.

When necessary for OET or gantry cranes located out of doors, secure the crane against movement by the wind.

Chock the wheels as necessary for travel trucks.

NOTES

Safe Operations Module Exam

1. **Select the best answer**. In general, which of the following things should an operator do when traveling cranes with loads?

a. Keep loads just high enough to clear obstacles
b. Start slowly and increase speeds gradually
c. Avoid sudden stops
d. Stow or secure unused hooks
e. All of the above

2. **Select the best answer**. What information should be posted, clearly understandable, and readily available to the operator.

a. Labeled controls for each function
b. Operator's name
c. ODCL Checks

3. **Select the best answer**. Side loading a crane by dragging loads or lifting a load with a non-vertical hoist is not permitted due to:

a. Destructive stresses placed on the sheaves
b. Possible overload due to swing-out of the load after liftoff.
c. Uncontrolled movement of the load due to shifting.
d. All of the above

4. **Select the best answer**. Crane operators at naval activities may operate various types, makes, and models of cranes for which they are licensed. How must safety and operator proficiency be assured under these circumstances?

a. Operators must operate at reduced speeds until confident and capable
b. Operators must receive written and performance tests by a crane license examiner as outlined in the NAVFAC P-307 manual
c. Operators must be familiarized (as directed by a supervisor) before operating

5. **Select the best answer**. While operating, the crane operator becomes concerned over the safety of the lift. The Rigger in Charge sees no problem and tells the operator to continue. The operator should:

a. Tell his supervisor at the end of the shift
b. Note the incident on the back of the ODCL card
c. Proceed slowly with caution
d. Refuse to continue until safety is assured

6. **Select the best answer**. When lifting loads with a crane, which of the following is the first thing an operator should do?

a. Lift the load slightly to check the brake
b. Center the hook over the load
c. Change speeds smoothly
d. Take the slack out of the rigging

7. **Select the best answer**. What information should be posted, clearly understandable, and readily available to the operator.

a. Certification information
b. Crane Operator's license number
c. Travel speed through congested areas

8. **Select the best answer**. When operating cranes, the operator's primary responsibility is to:

a. Do pre-use checks
b. Operate safely
c. Keep crane clean

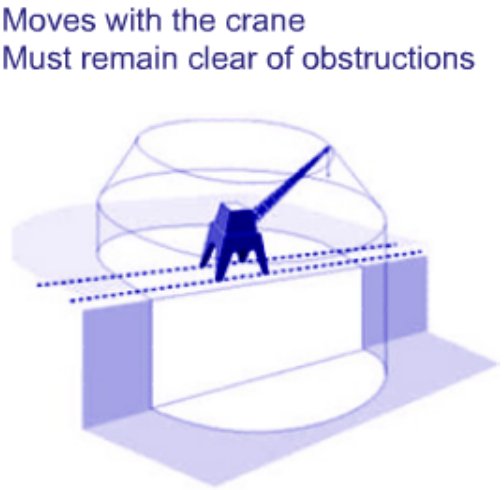
CRANE AND RIGGING GEAR ACCIDENTS MODULE

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,
- the 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 Operating 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 Definition

A crane accident occurs when any of the elements in the operating envelope fails to perform correctly, during operations, including operations during maintenance or testing,
resulting in:

- personnel injury or death,
- material or equipment damage,
- dropped load,
- derailment,
- two-blocking,
- overload or
- collision.

Rigging Gear Accident Definition

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.

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.

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

The majority of crane accidents are caused by personnel error and can be avoided.

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.

Operator Responsibilities

The operator can play a significant role in eliminating human error and accidents.

Drugs and alcohol can affect a person's capability to think, reason, or react in normal situations and can certainly lead to serious accidents.

Operators must always consult their physicians regarding effects of prescription drugs before operating equipment, and recognize that medications often affect people differently.

An operator is responsible for evaluating his or her physical and emotional fitness.

Accident Reporting Procedures

If you have an accident with a crane or you find damage and suspect an accident has happened, you 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.
- Preserve the accident scene to aid the investigation.
- The activity responsible for the weight handling operation at the time of the accident shall initiate and submit the accident report.

The activity shall prepare a crane and rigging gear accident report and forward a copy to the Navy Crane Center within 30 days of the accident. Email is the preferred method of 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

Contractor Accident Reporting Procedures

Take a look at the reporting procedure.

Reporting Procedures - 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 30 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(s), photographs (if available), and corrective actions taken.

Contracting Officer Reporting Procedures

Review the information presented.

Reporting Procedures - Contracting Officer

The contracting officer shall:

- Notify the host activity of any WHE accident upon notification by the contractor
- Provide the Navy Crane Center and the host activity a copy of every accident report, 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

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 promulgated by OPNAVINST 5100.23 and related local instructions.

NOTES

Crane and Rigging Gear Accidents Module Exam

1. **Select the best answer**. To whom or to what are the majority of crane accidents attributed?

    a. Personnel error
    b. Crane operators
    c. Riggers or signalmen
    d. Equipment failure
    e. Weather conditions

2. **Select all that apply**. Team members having too much confidence in their abilities and poor judgment contribute to crane and rigging gear accidents. Select additional factors that contribute to accidents:

    a. Operating the crane too fast
    b. The crane operating envelope
    c. Engineering lift specifications
    d. Inattention to the task

3. **Select all that apply**. When rigging gear covered by P-307 Section 14 fails while suspended from a structure and drops the load it is a:

    a. Rigging error
    b. Crane accident
    c. Load configuration error
    d. Rigging gear accident

4. **Select all that apply**. The rigging gear operating envelope contains the rigging gear and miscellaneous equipment covered by P-307 section 14, the load itself and

    a. Load rigging path
    b. The user of the gear or equipment
    c. The gear or equipment's supporting structure

5. **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(n)

    a. Operator error
    b. Rigger error
    c. Rigging gear deficiency
    d. Crane accident

6. **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. Secure the crane and power as required
b. Stop operations as soon as safely possible
c. Call emergency services if anyone is injured
d. Notify your supervisor immediately

7. **Select the best answer**. If a component failure such as motor burnout occurs and does not result in damage the component failure is considered:

a. Crane maintenance's responsibility
b. A rigging accident
c. A non-accident
d. A crane accident

8. **Select all that apply**. The crane operating envelope includes the crane, the operator, the riggers, the crane walkers, and

a. The load
b. The area where the load will be landed
c. Any supporting structures
d. Rigging gear between the hook and the load

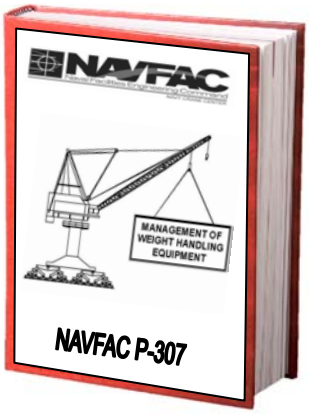
9. **Select the best answer**. During crane operations the load shifts. The operator reacts quickly and saves the load but causes the crane to derail. This is reported as a (an)

a. Crane accident
b. Operator error
c. Load configuration error
d. Crane walker's error

10. **Select the best answer**. Who is primarily responsible for evaluating a crane operator's physical and emotional fitness?

a. The Crane operator
b. The Crane supervisor
c. The activity medical Officer
d. The Dispatcher
e. All of the above

Navy Crane Center



NAVFAC P-307 Training

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