

Student Manual

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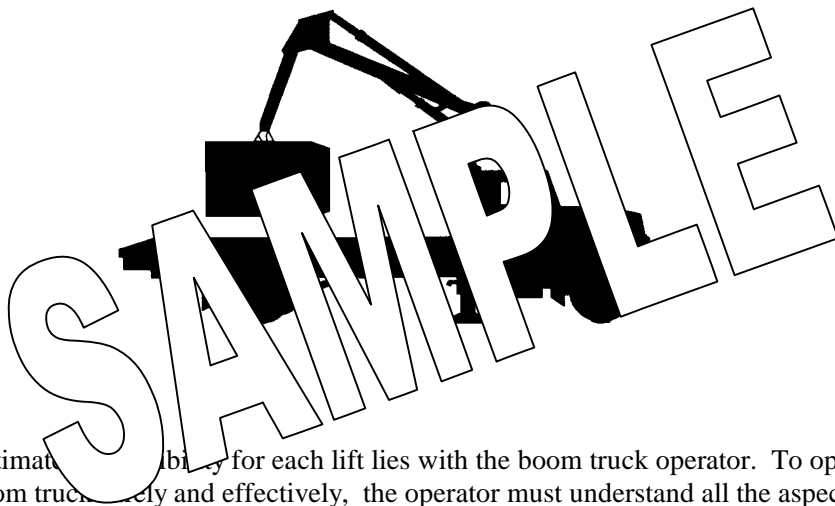


SAMPLE

Articulating Boom Truck Operator Safety Training

INTRODUCTION

Boom trucks are versatile machines, which can be used for many job applications from loading and unloading materials to placing those materials or personnel up to heights of 170 feet. Mounted on a truck bed these cranes can move between job sites at highway speeds carrying payloads in excess of 15,000 lbs. As with all cranes, significant training is needed to ensure safe operation and productivity.

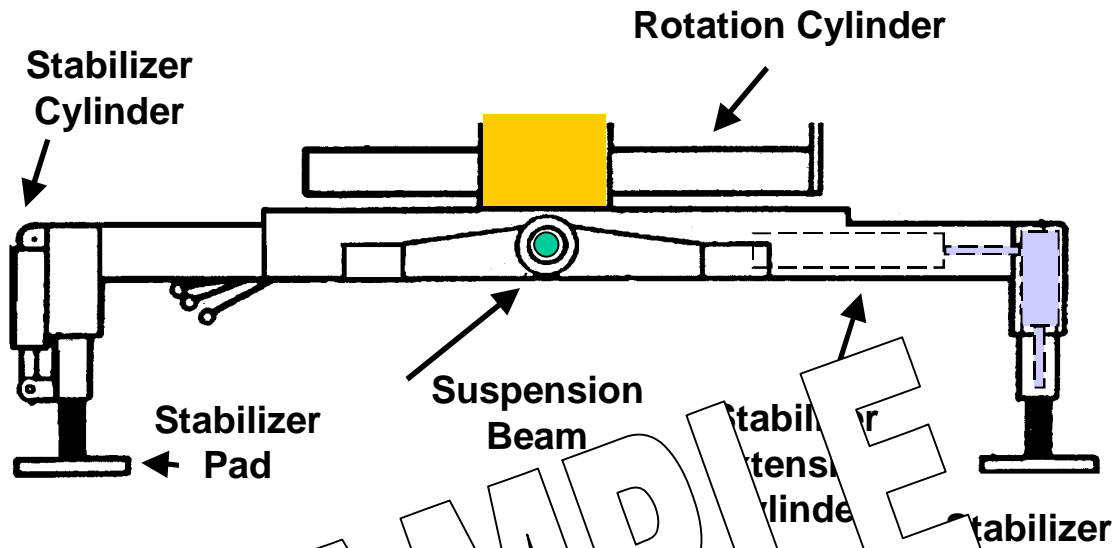


The ultimate responsibility for each lift lies with the boom truck operator. To operate the boom truck safely and effectively, the operator must understand all the aspects of the machine, including: control locations and functions; crane movements; capacities, load charts and related data; operation speeds; signals, both visual and audible. He is also responsible for the inspection of all components and hardware on the truck and crane and have a practical knowledge of rigging and rigging hardware and be able to assess loads and situations that might present a hazard.

- 1. Training can reduce the risk of accidents to you and those you work with.**
- 2. Training can also reduce the operating costs of your company by avoiding damage to the truck, property and product.**

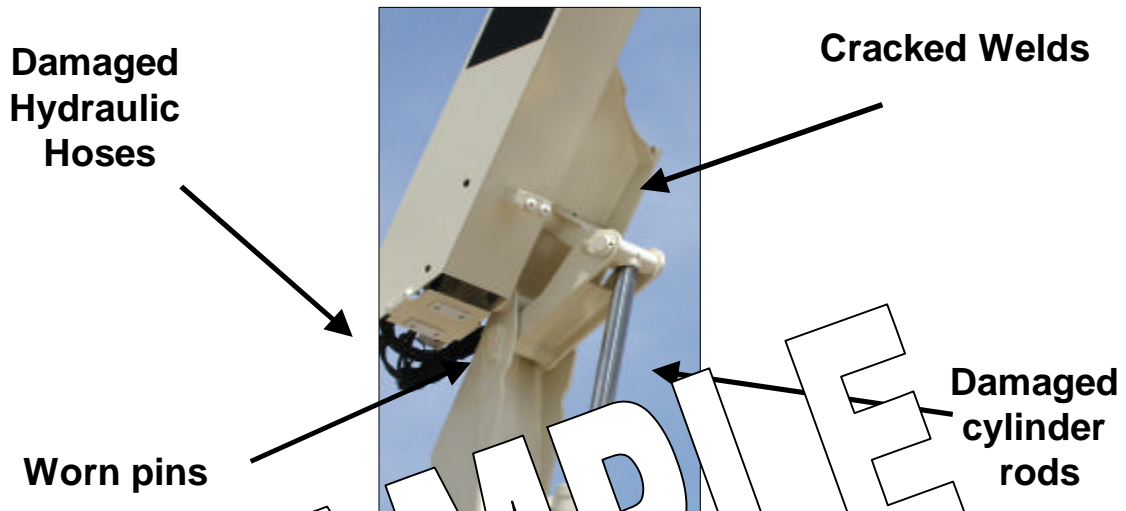
Training makes sense.

BOOM TRUCK INSPECTION



- ✍ Stabilizers should be checked for wear and tear.
- ✍ Check for deformation or cracks in the box ends.
- ✍ The pads should be checked at the corners and should move freely. Check to see that the pin keepers are present and that there is no excessive play in that area.
- ✍ Check the upper hinge pin and bushing by lowering the stabilizer within a few inches of the ground and moving it back and forth. Some movement is normal, but excessive play will allow the crane to move back and forth causing further damage.
- ✍ All welds need to be checked for cracks.
- ✍ Check attachment of crane to truck chassis. If bolted, check around the bolt heads and washer area to see if there is cracked paint or dirt which could indicate movement.

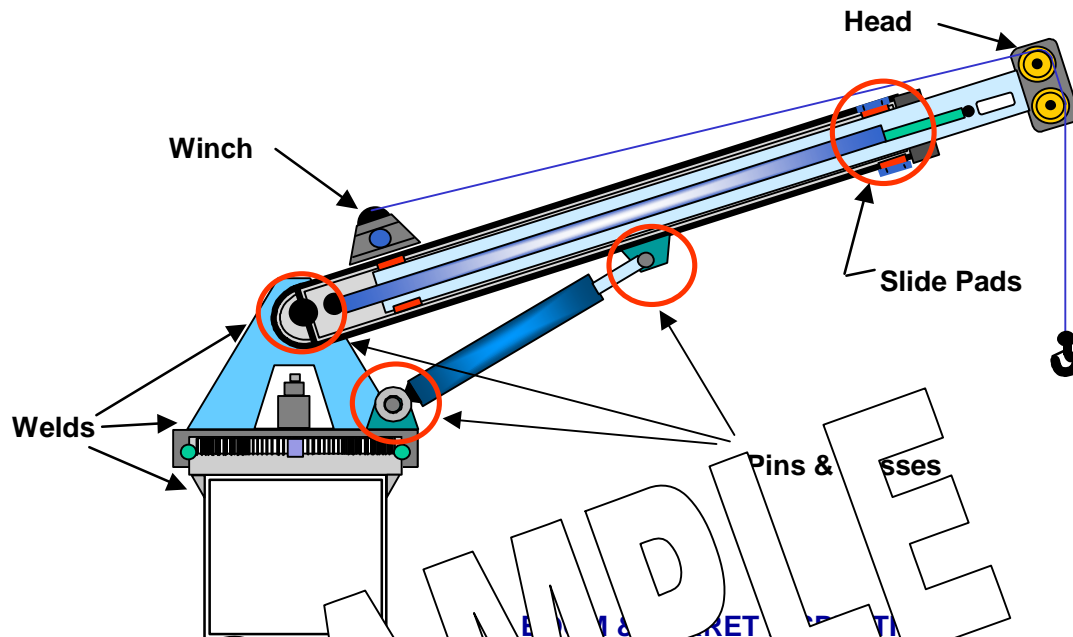
BOOM TRUCK INSPECTION



The following test should be performed by performing the following test:

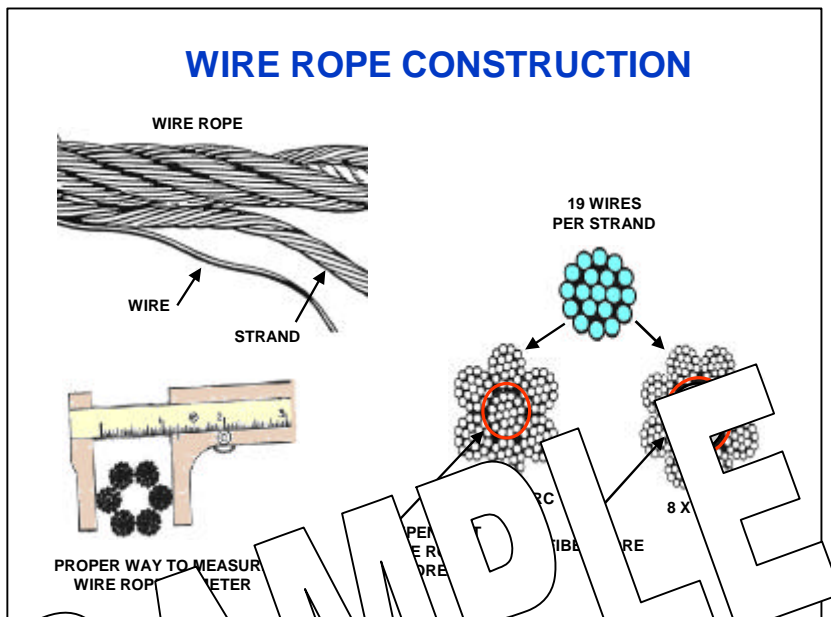
- Set up the crane on level ground with the stabilizers fully extended.
- Retract the boom fully and raise it to its most vertical position and extend the hoist wire about 10 feet.
- Abruptly lower the boom momentarily which will result in the turret and boom component rocking. Observe the movements in the rotation bearing, boom hinge pin and bushing, and the lift cylinder pins and bushings. **CAUTION: WHEN SHAKING THE CRANE, OBSERVE THE HOOK AND STOP ANY BOOM MOVEMENT IF IT CAN SWING INTO THE BOOM.**
- Any excessive movement must be noted and evaluated per the manufacturer's specifications.
- Check the turret area for cracked welds and any deformed components.

BOOM TRUCK INSPECTION



- The boom sections need to be checked for smoothness of operation. Any difficulty in extending could be the result of damaged boom sections.
- All welds need to be checked for cracks.
- Any hydraulic leaks need to be investigated and repaired. Check the hoses for chaffing and wear.
- The slide pads can be checked for proper alignment by extending the boom completely and lowering the tip toward the ground. Move the boom tip back and forth by pushing on it and observe how much the boom sections move inside each other. Excessive movement will require the slide pads to be adjusted or replaced.
- The boom tip needs to be checked for deformation and twisting.
- The winch should be checked for proper reeving. The most common cause of damage to wire rope is crushing due to crossed wraps on the winch drum.

WIRE ROPE



Wire rope is made of several wires laid together to form a **strand**. These strands are laid together to form a rope around a central core of either fiber or wire, as shown at the top. **IPC** is the abbreviation for **independent wire rope core**. The **wire core**, which is actually another strand, has several advantages over a fiber core. It adds about 7 1/2% in strength and helps to resist rope crushing. **Fiber core is impregnated with lubricant** which is released during use. Fiber core also helps to cushion the strands during use. **Fiber core wire rope should not be used for hoisting or rigging.**

Most wire rope is made from preformed strands. The preforming gives the strands a better load distribution, and it prevents unraveling when the rope is cut. The number of strands, number of wires per strand, type of material and nature of the core will depend on the intended purpose of the wire rope.

Wire Rope Lays:

The lay refers to the direction of the winding of the wires in the strands and to the strands in the rope. This term refers to two basic lays. **Regular Lay** and **Lang Lay**.

Regular Lay: The wires in the strands are laid in one direction while the strands in the rope are laid in the opposite direction. The wires are able to withstand considerable crushing and distortion due to the short length of the exposed wires.

Lang Lay: The wires in the strands and the strands in the rope are laid in the same direction. Lang Lay rope should not be used for single part hoisting due to its tendency to untwist. Its biggest advantage is its resistance to abrasion.

WIRE ROPE INSPECTION

Kinks are a permanent distortion. After a wire rope is kinked it is impossible to straighten the rope enough to return it to its original strength. The rope must be replaced. Causes: crossed lines on drum, improper handling and installation, and uncoiling.

KINKED WIRE ROPE



Strand Nicking is due to continued operation under a high load which results in core failure.

STRAND NICKING



Metal Fatigue is usually caused by bending stress from repeated passes over sheaves, from vibration such as the one shown.

FATIGUE FAILURE



Fatigue Breaks can be either external or internal. They can be caused by wobbly sheaves, tight sheaves, poor end terminations. In the absence of all these causes, remember that all wire rope will eventually fail from fatigue.

FATIGUE BREAKS



Bird Caging is a result of mistreatment such as sudden stops, wound on too tight of drum, or pulling through tight sheaves. The strands will not return to their original position.

BIRDCAGE



High Stranding is a condition caused when overloading and crushing take place and the other strands become overloaded.

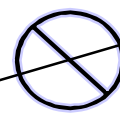
HIGH STRAND



STABILIZER SET UP

- Always extend all stabilizers.
- Avoid setting up on a slope.
- Soils along foundations may be poorly compacted or conceal objects that could collapse.
- Floats of at least 24" x 24" should be used under each stabilizer. The floats should be placed under the stabilizer to reduce the lbs. per sq. inch on the contact surface and help the stabilizer from sinking into the ground.
- Blocking under the stabilizer will prevent the stabilizer from rotating. This will shorten the stabilizer's radius to the center of rotation which reduces the leverage of the boom and increases the chances of a tip over.

Avoid slopes



Avoid recent fill areas

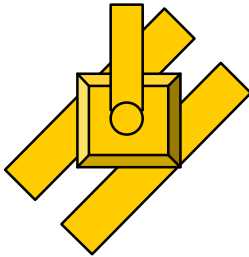
Do not set up on buried objects that could collapse

Shortened Radius

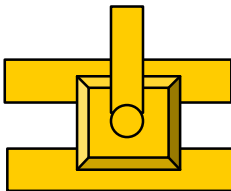
NEVER block under stabilizer

FLOATS UNDER PADS

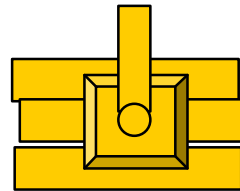
WRONG



WRONG



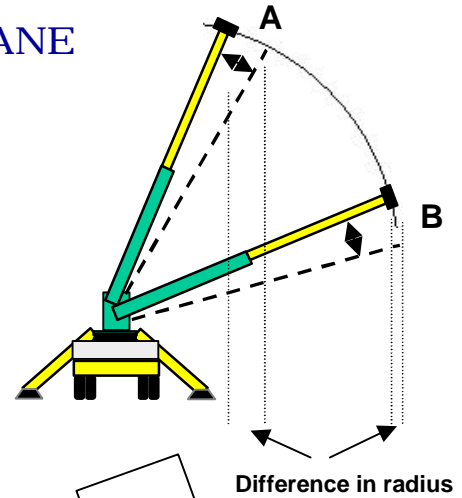
RIGHT



LEVELING THE CRANE

ESTIMATED OUT OF LEVEL

CAPACITY REDUCTIONS



BOOM LENGTH AND RADIUS	HEIGHT OF LEVEL (Deg)	CAPACITY REDUCTION	REDUCTION
	3		
Short Boom, Minimum Radius	10	20%	30%
Short Boom, Maximum Radius	8%	15%	20%
Long Boom, Minimum Radius	30%	41%	50%
Long Boom, Maximum Radius	5%	10%	15%

MAXIMUM RADIUS CHANGES LESS PER DEGREE THAN MINIMUM RADIUS

Note that the percentage of reduction is less when the boom is at maximum radius than when the boom is at minimum radius. Even though the change in the angle for both A and B is the same, the resulting change is much greater when the boom is raised high than when it is low.

BOOM TRUCK STABILITY

When the boom is located directly over the stabilizer, the pressure applied to the ground is the greatest because the stabilizer is supporting most of the load.

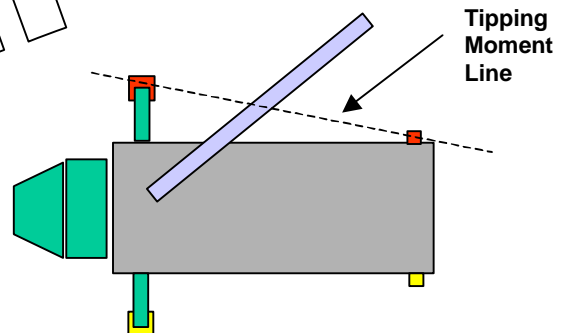
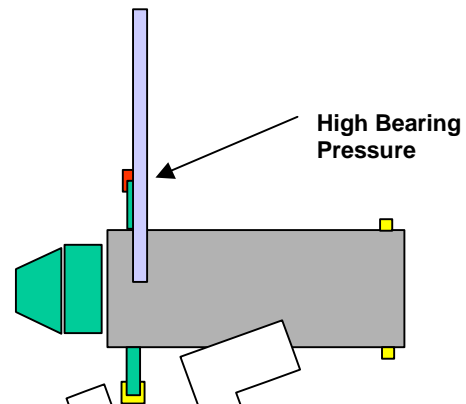
Most boom pads are 12" x 16" which equals 192 sq. in. of surface pressing on the ground. The load placed on this pad can be upwards of 20,000 lbs. This would result in a ground bearing pressure of 100 lbs. per sq. inch.

For this pressure, the ground would need to be hard pan or compacted gravel soil. For sites where the soil conditions are poor and may be only able to support 40 lbs. per sq. inch, a 24" x 24" floor plate is placed under the stabilizer to increase the surface area to 576 sq. inches. This would reduce the ground bearing pressure for a 20,000 lb. load to 34.7 lbs. per sq. inch. This is a significant improvement.

As the boom moves from the forward stabilizer toward the back of the truck, the pressure on the ground is shared by the two stabilizers.

The distance from the crane's center to the tipping moment line has increased so the leverage for the truck has increased making the boom truck more stable.

The danger here is doing the opposite. When a load is picked up from the rear of the truck and brought over the side, the boom truck may initially be very stable, but as the load is swung over the side, the boom truck's leverage decreases, making it less stable. Many operators are deceived by this condition and it results in a tip over. That's why it is important for the operator to take the time to plan every lift.

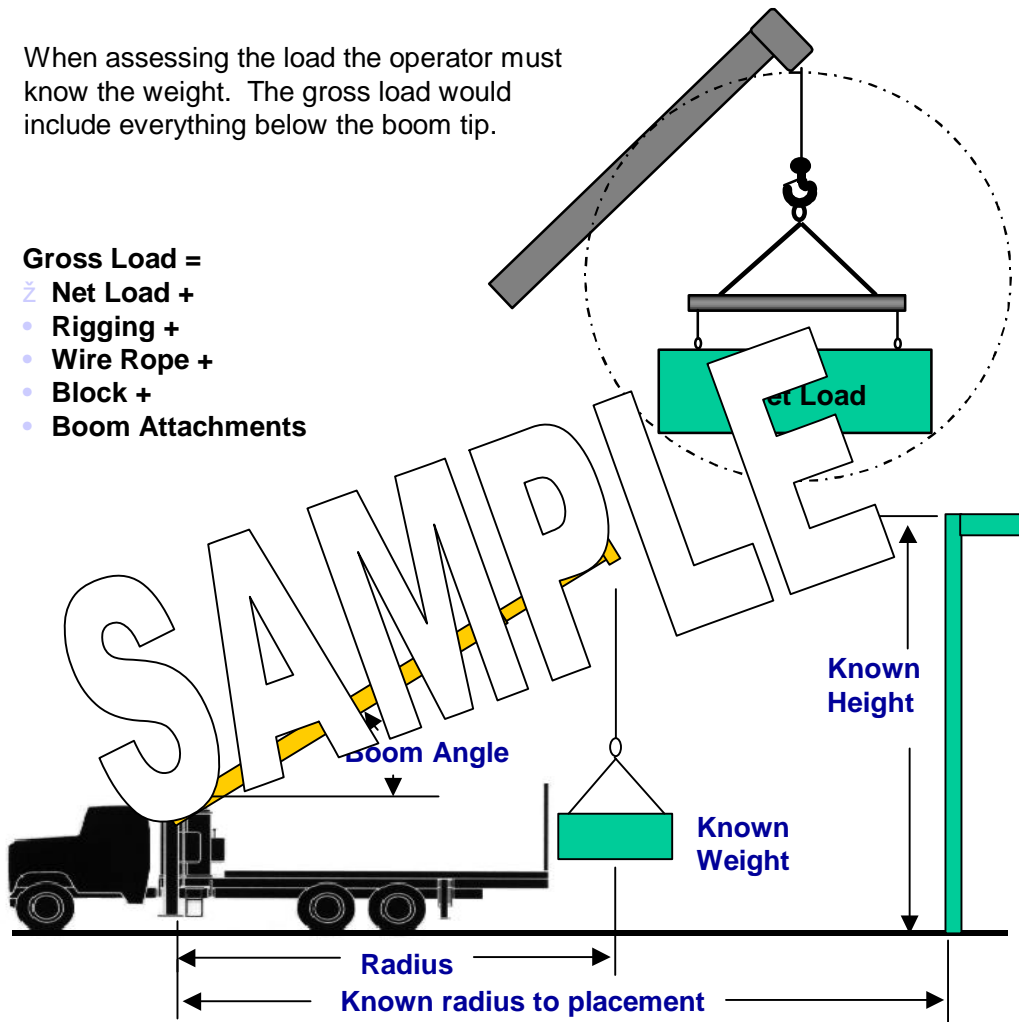


LIFT REQUIREMENTS

GROSS LOAD

When assessing the load the operator must know the weight. The gross load would include everything below the boom tip.

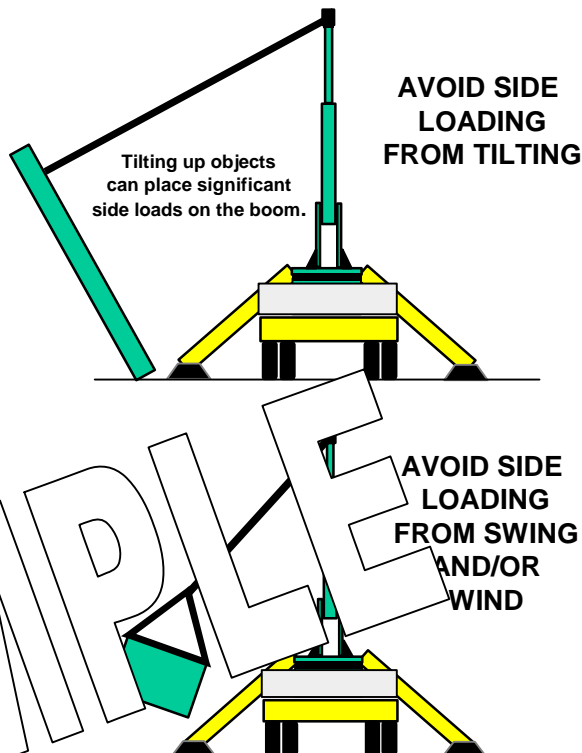
- Gross Load =
- Net Load +
 - Rigging +
 - Wire Rope +
 - Block +
 - Boom Attachments



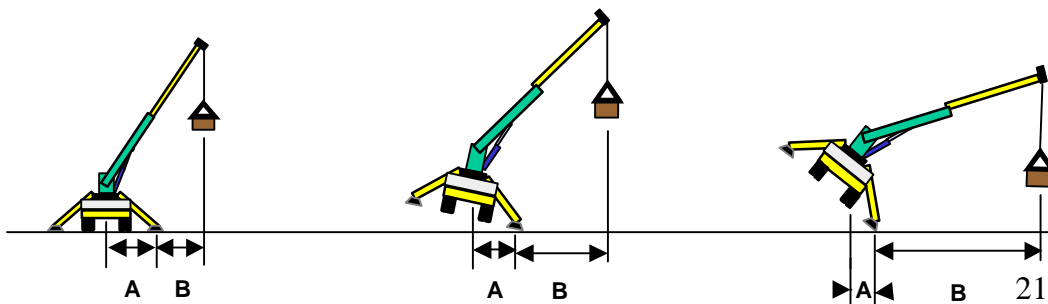
The load radius is the horizontal distance measured from the center of rotation of the crane to the load hook while the boom is under load. The operator may need to make a few measurements if the lifting requirements are close to the maximum capacity for a certain configuration. When placing loads at elevated heights, the operator must know these heights to determine if his boom truck is capable of making the pick. Guessing at the height or the radius may result in a tip over if wrong. Once those distances are known, then the operator can refer to the load chart.

BOOM TRUCK STABILITY

The boom is very susceptible to side loading damage and needs to be above the load at all times. Tilting up panels are a common cause of side loading. When tilting up a panel, the hoist line must remain vertical at all times. Although it is not very apparent, wind can cause excessive stresses on the crane. Wind on the boom itself, especially when fully extended, can contribute to a tip over. The operator must stop operations when the wind becomes a significant factor. When to stop is left to the judgment of the operator. According to OSHA, tilting of panels should not be done in wind speeds less than 10 mph. The pressure on the boom can also be a factor. The boom as well as the hoist line can be damaged. Tagging is necessary to help control the load, but should never be used to pull the load around.



Rate of tipping: In a stable situation, the boom truck leverage is greater than the load leverage. As the boom truck begins to tip, distance A becomes shorter and distance B increases. This results in a decrease in leverage for the truck and increase in leverage for the load. If the truck continues to tip, the rate increases and unless the operator is able to land the load immediately, it may be impossible to stop.



SIGNALS



DOG EVERYTHING



EXTEND BOOM



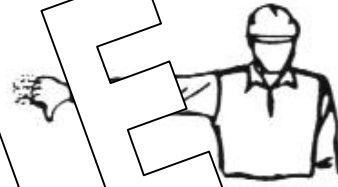
EMERGENCY STOP



LOWER THE LOAD



RAISE THE BOOM



LOWER THE BOOM



RAISE THE LOAD



RAISE THE BOOM



SWING



LOWER THE LOAD



LOWER THE BOOM



STOP

SHACKLE INSPECTION

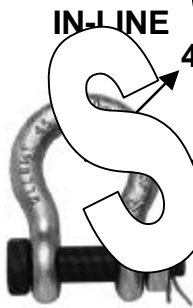


The working load limit (WLL) must be printed on the shackle or it must be taken out of service. This WLL is for vertical lifts only.

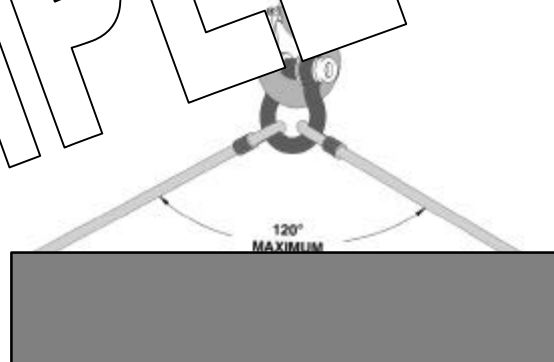
Only two types of shackles are to be used in rigging for lifts. The screw pin type and the bolt type shackle.



Shackles that are deformed or damaged may be removed from service.



SAMPLE

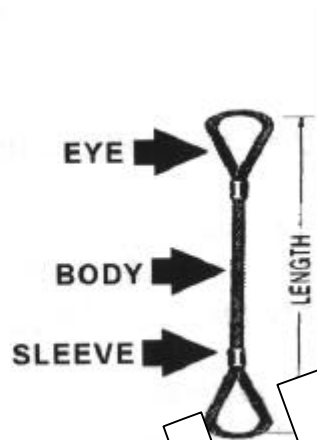


Side Loading Reduction Chart For Screw Pin & Bolt Type Shackles Only†	
<i>Angle of Side Load</i>	<i>Adjusted Working Load Limit</i>
0° In-Line	100% of Rated Working Load Limit
45° from In-Line	70% of Rated Working Load Limit
90° from In-Line	50% of Rated Working Load Limit

† DO NOT SIDE LOAD ROUND PIN SHACKLES

WIRE ROPE SLING INSPECTION

- KINKING**
- CRUSHING**
- UNSTRANDING**
- BIRDCAGING**
- STRAND DISPLACEMENT**
- CORE PROTRUSION**
- CORROSION**
- BROKEN OR CUT STRANDS**
- BROKEN WIRES**



Wire rope slings need to be inspected and recorded. A record kept of those inspections must have a tag indicating the capacity or the weight of the load.

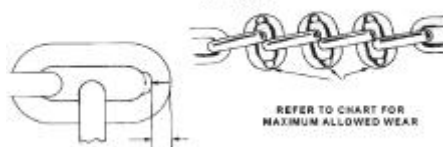
Chain slings are to be inspected regularly. If any of these inspections show there is no capacity, it must be taken out of service.

Chain slings are often used to hold steel while it is being welded. Always check to make sure heat damage has not occurred. Heat damage can be detected by discolored metal.

CHAIN SLINGS CAUSE FOR REMOVAL DEFORMATION AND STRETCH



CHAIN SLINGS CAUSE FOR REMOVAL WEAR



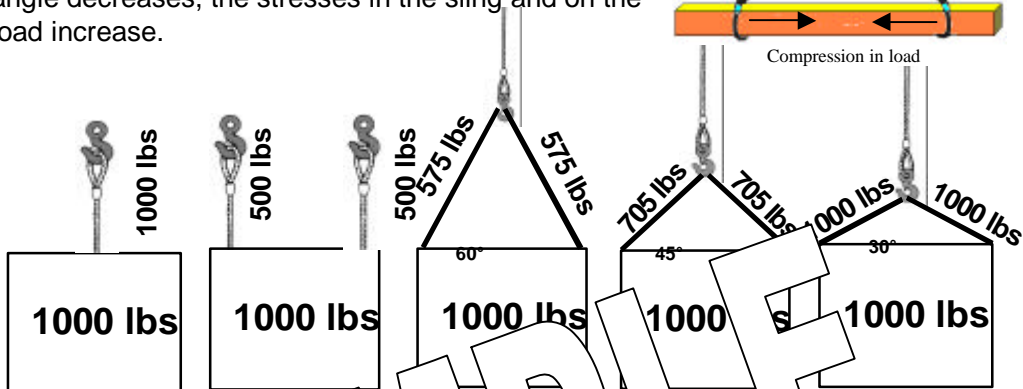
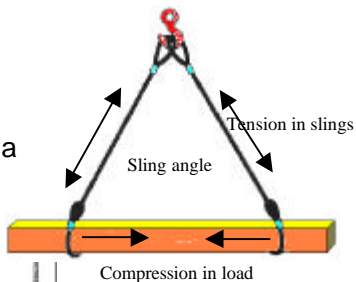
CHAIN SLINGS CAUSE FOR REMOVAL CRACKS, NICKS AND GOUGES



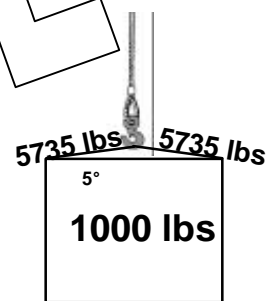
SHARP TRANSVERSE NICKS AND GOUGES SHOULD BE ROUNDED OUT BY GRINDING, DO NOT EXCEED WEAR ALLOWANCE.

SLING ANGLES

When slings are brought together and form a hitch, as shown at right, the stresses in the slings increase and a compression force on the load is created. As the sling angle decreases, the stresses in the sling and on the load increase.



Sling angles of 60 degrees or less are not to be used because the stresses increase. When required, use smaller sling angles. The stresses are based on the internal strength of the sling. The compression force should be considered. When the sling angle is 30 degrees for a 1000 lb load, the compression which is applied to the load will be 866 lbs. Depending on the structural strength of the load, it may be damaged.



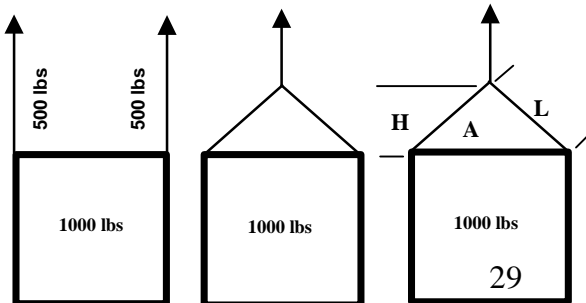
All that is needed to calculate the stress in a sling is the weight of the object and a measuring tape.

Example:

If the sling was 8' long and the height (H) was 4', then 8 divided by 4 equals 2 which equals the **Load Angle Factor**. So, if the load is 1000lbs, each sling is required to support 500lbs. The stress in the sling is equal to 500lbs x the load angle factor of 2 or 1000lbs.

Slings Angle Degree (A)	Load Angle Factor = L/H
90	1.000
60	1.155
50	1.305
45	1.414
30	2.000

Load On Each Leg Of Sling = (Load/2 x Load Angle Factor)



CALCULATING LOAD WEIGHT

To find the weight of any item you need to know its volume and unit weight.

- Volume x Unit weight = Load weight
- Unit weight is the density of the material

Here are some examples of common materials and their unit weight:

WEIGHTS OF MATERIALS BASED ON VOLUME (lbs. Per cu. ft.)

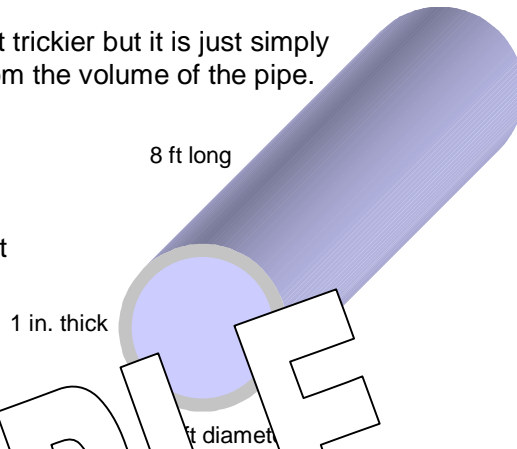
MATERIAL	UNIT WEIGHT	MATERIAL	UNIT WEIGHT
METALS			
Aluminum	168	Redwood	35
Brass	520	Chestnut	36
Brick, soft	120	Fir, seasoned	34
Copper	550	Pine, wet	50
Iron	490	Hemlock	30
Lead	710	Maple	53
Steel	490	Oak	62
Tin	460	Pine	30
MASONARY			
Ashlar masonry	160	Poplar	30
Brick, soft	110	Spruce	28
Brick, pressed	140	White pine	25
Clay tile	60	Railroad ties	50
Rubble masonry	155	LIQUIDS	
Concrete, cinder	110	Diesel	52
Concrete, slag	130	Gasoline	45
Concrete, stone	144	Water	64
Concrete, reinforced	150	EARTH	
MISC.			
Asphalt	80	Earth, wet	100
Glass	160	Earth, dry	75
		Sand and gravel, wet	120
		Sand and gravel, dry	105

CALCULATING LOAD WEIGHT

Volume of pipe

Calculating the volume of pipe is a bit trickier but it is just simply subtracting the volume of the hole from the volume of the pipe.

If the pipe were one inch thick, three feet in diameter and 8 feet long, then we would figure the volume of the entire pipe and subtract the volume of the hole to get the the volume of the material.



$$3.14 \times (1 \frac{1}{2} \text{ ft.})^2 \times 8 \text{ feet} = \text{Volume of pipe (6.3 ft}^3\text{)}$$

$$3.14 \times (1 \text{ in.})^2 \times 8 \text{ feet} = \text{Volume of hole (0.41 ft}^3\text{)}$$

$$6.3 - 0.41 = 5.89 \text{ ft}^3$$

Volume of material left = total weight

If this pipe is **steel** then the unit weight would be 490 lbs.

$$5.89 \times 490 \text{ lbs} = 2,886 \text{ lbs.}$$

For thin pipe a quick way to ***ESTIMATE** the volume is to split the pipe open and calculate the volume like a cube. The formula would be:

$\pi \times \text{diameter} = \text{width}$, so:

$\pi \times \text{diameter} \times \text{length} \times \text{thickness} \times \text{unit weight} = \text{weight of object}$

$$3.14 \times 3 \text{ ft} \times 8 \text{ ft} \times 1/12 \text{ ft (or .008 ft)} \times 490 \text{ lbs} = \text{*3,077.2 lbs}$$