Section 53.0
RIGGING

A. Purpose

The purpose of this procedure is to identify for company personnel the requirements for working safely with cranes, hoists, slings, and related equipment, and aid the company in complying with API and ANSI standards.

B. Scope

This procedure applies to material handling and related equipment on customer and Company premises both on and offshore.

1. This procedure provides information to enable company personnel to work safely while rigging and while in the vicinity of cranes and other lifting equipment.

C. Responsibilities

1. The Safety Coordinator or his/her designee responsible for ensuring that employees have completed the training required by this procedure.
   - (a) Additional responsibilities include:
     - (i) Ensuring that employees have been properly trained.
     - (ii) The implementation of this Policy.
     - (iii) Take corrective actions on all violations or suspected violations of this procedure.
     - (iv) Documentation of completion by each employee.

2. The Safety Director is responsible for aiding in the implementation of this Procedure.

3. The Supervisor is responsible for providing assistance in the implementation of this policy.
   - (a) Additional responsibilities include:
     - (i) Ensuring that proper inspections and maintenance records are completed and maintained for future reference.

4. Company personnel are responsible for acquainting themselves with this procedure and applying it in their day-to-day operations.

D. General Information

1. OSHA and MMS have adopted design specifications and operating procedures for cranes as per:
   (a) Single Girder under hung cranes covered by ANSI B30.11.
   (b) Overhead hoist used on a single girder crane by ANSI B30.16.
   (c) Crawler and wheel mounted by ANSI B30.5.
   (d) Offshore Cranes API RP 2D and 2C.

2. Only personnel with training and experience that have completed a rigger training program will be allowed to attach or detach lifting equipment to loads or lifting.
   (a) This includes crane operators and inspectors.

3. Rigging consists of ropes, cables, chains, slings, pulleys, winches and related materials used stabilize, lift, or move items.
   (a) Safe rigging operations require observance of correct procedures and knowledge of the materials used.
      (i) Always be certain that cables are in a safe condition and heavy enough to carry the load.
      (ii) Be sure that the rigging is safe and the loads are properly balanced.
      (iii) Keep the loads free of all loose objects such as tools.
      (iv) Be sure the load to be lifted is not greater than the capacity of the lifting device.
      (v) Keep yourself and others clear of loads being lifted.
   (b) Great personal harm and extensive property damage can result from failure to observe the design limitations of hoisting equipment or from failure to recognize evidence of wear, weakening or damage.
      (i) Hoisting equipment is made according to rigid standards of manufacture.
      (ii) It is tested and its limits verified by such national societies as American Society for Testing Materials (ASTM).

(i) Thus the user is assured that an individual item is suitable for use within certain load limits.

(iii) These limits are indicated in various tables and are included for study and future reference.

4. Rigging Skills

Estimation of Safe Loads and Rules of Thumb for Safe Working Loads.

(a) Nails - Safe load lateral resistance in pounds equal 8 times the pennyweight.
- (i) 1 - 6d nail = 8 x 6 or 48 lb.
- (ii) 1 - 8d nail = 8 x 80 or 640 lb.
- (iii) 1 - 10d nail = 8 x 10 or 80 lb.

(b) Manila Rope - Safe Load in tons equals diameter in inches squared. Not accurate in sizes larger than 1 inch.
- (i) 1" = 1 x 1 or 1 ton safe load
- (ii) 1/2 = 1/2 x 1/2 or 1/4 ton safe load for sisal rope, decrease loads by one-third.

(c) Plow Steel Cable - Safe load in tons is 8 times the diameter in inches squared.
- (i) 1/2" rope = 1/2 x 1/2 x 8 = 2 tons

(d) Open Eye Hook
- (i) Safe working capacity of a hook can be approximated in tons as the square of the diameter in inches of the hook at the point where the inside curve starts its arc.

(e) Shackle - Safe load in tons is the diameter of the shackle (stock) in inches squared time 6 (do not use pin diameters)

(f) Chains - Safe load in tons is 6 times the diameter of chain stock in inches squared.

5. Estimating Load Weight

(a) Weights of Material sock in inches squared.

Material	Lb. Per Cubic Foot
Wood	27
Water	63
Earth	100

Sand	120
Concrete	144
Aluminum	160
Cast Iron	442
Steel	488
Brass	534
Copper	550
Lead	710

1. Wire Rope

Wire rope is designed to be used in a specific manner and must be maintained properly.

(a) Allowing wire rope to become damaged or worn can result in possible failure.

(b) Avoid wire rope failure by keeping the following practices in mind.

(c) Be careful when installing wire rope on the drum.

(d) If a reel stand is used, take care that the drum is spooled from the top and that the reel feeds from the top.

(e) This avoids causing a reverse bend in the wire.

(f) A reverse bend will cause spooling problems and damage the wire rope.

(g) When spooling from a reel, make sure a tension device is used so the reel will not overrun the rope.

(h) If using a mallet to align rope as it feeds onto the drum, use one with a plastic or rubber coated face.

(i) Do not strike wire rope with a metal-faced hammer or mallet.

(i) Avoid spooling more wire rope onto a drum than is needed.

(j) The last layer must be at least two rope diameters below the drum flange top.

(k) Spooling more wire rope than is necessary will increase crushing and may cause the rope to jump the flange.

(l) Prevent kinks in the wire.

(m) If a loop forms during unreeling, stop immediately.

(n) Pulling on a loop will produce a kink that will not work itself out.

(o) A kink is a permanent defect and will cause increased wear on the drum, sheaves and the wire rope itself.

(p) If kinks must be cut out of the rope, make sure enough rope remains on the drum to provide 2 or 3 wraps (manufacture's recommendation) on the drum when the crane is extended full range.

(q) Keep the wire rope lubricated.

(i) Rust and dirt can deteriorate and weaken a wire rope.

(ii) In addition, rust and dirt acts as an abrasive on the rope as it spools through the sheaves and drums.

(iii) Lubrication of the rope allows individual wires to move and work together, so that all the wires carry the load instead of just a few.

(iv) Weather and other exposures can also remove the lubricant and allow rust to form.

(r) Taking rigging for granted can cause accidents.

(i) Cranes are only as reliable as each of their rigging components.

(ii) The capacity of wire rope is based on new, or well-maintained rope.

(iii) The strength of wire rope can dramatically decrease if it is poorly cared for.

(s) All hoisting ropes will be of a construction recommended for crane or hoist use.

(i) If a change is contemplated, the manufacturer is to be consulted.

(t) The rated load of the crane, divided by the number of parts of rope, should not exceed 20 percent of the normal breaking strength of the rope.

2. Plow steel rope is more flexible than standard wire rope and is made of wire drawn from specially selected high strength and toughness and capable of resisting severe abrasive tendencies.

(a) Plow steel rope is recommended for all of hoisting and for all rough uses requiring maximum strength and toughness.

3. Table of Safe Load in Pounds for Plow Steel Hoisting Rope (Six Strands of Nineteen Wires, Hemp Center)

Diameter	Weight/Foot	Safe Load	Diameter	Weight/Foot	Safe Load
1/4"	.10 lb	1,100 lb	1"	1.60 lb	16,000 lb
5/16"	.16 lb	1,800 lb	1 1/8"	2.03 lb	21,200 lb
3/8"	.23 lb	2,500 lb	1 1/4"	2.50 lb	26,000 lb
7/16"	.31 lb	3,300 lb	1 3/8"	3.03 lb	31,000 lb
1/2"	.40 lb	4,300 lb	1 1/2"	3.60 lb	37,000 lb
9/16"	.51 lb	5,400 lb	1 5/8"	4.23 lb	43,200 lb
5/8"	.63 lb	6,600 lb	1 3/4"	4.90 lb	49,600 lb
3/4"	.90 lb	9,400 lb	1 7/8"	5.63 lb	56,800 lb
7/8"	1.23 lb	12,800 lb	2"	6.40 lb	64,400 lb

1. Table of Safe Loads in Pounds for Plow Steel Wire Rope Stays (Six Strands of Seven Wire, Hemp Center)

Diameter	Weight/Foot	Safe Load	Diameter	Weight/Foot	Safe Load
1/4"	.10 lb	940 lb	3/4"	.84 lb	7,900 lb
5/16"	.15 lb	1,400 lb	7/8"	1.15 lb	10,700 lb
3/8"	.21 lb	2,000 lb	1"	1.50 lb	13,900 lb
7/16"	.29 lb	2,700 lb	1 1/8"	1.90 lb	17,400 lb
1/2"	.38 lb	3,600 lb	1 1/4"	2.34 lb	21,200 lb
9/16"	.48 lb	4,500 lb	1 3/8"	2.84 lb	25,400 lb
5/8"	.59 lb	5,500 lb	1 1/2"	3.38 lb	30,000 lb

1. Inspection
   - (a) Frequency - Wire rope should be inspected at frequent intervals, and bird-caged, frayed, kinked, worn or corroded rope replaced.
   - (b) The frequency of inspection is determined by the amount of use the rope gets.
     - (i) A rope that is used one or two hours a week requires less frequent inspection than a rope which is in use 24 hours a day.
   - (c) Procedure - The weak points in the rope, or the points where the greatest stress occurs, should be inspected with great care.
     - (i) In general, examine the rope for worn spots and broken wires.
     - (ii) Worn spots will show up as shiny flattened spots on the wires.
     - (iii) Measure some of these shiny spots.

(i) If it appears that the outer wires have been reduced in diameter by one-fourth, the worn spot in unsafe.

(iv) There may be several points in the rope where broken wires occur.

(v) Inspect each point to determine whether it is a single broken wire or several.

(i) If several wires are broken next to each other, unequal load distribution at this point will make the rope unsafe.

(vi) When four percent of the total number of wires in the rope are found to have breaks within the length of one rope lay, the rope is unsafe.

(i) Consider the rope unsafe if three broken wires are found in one strand of 6 x 7 rope, six broken wires are found in one strand of 6 x 19 rope, or nine broken wires are found in one strand of 6 x 37 rope.

2. Storage

(a) Wire rope should be coiled on a spool for storage and should be properly tagged as to size and length.

(b) It should be stored in a dry place to reduce corrosion and kept away from chemicals and fumes which might attack the metal.

(c) Prior to storage, wire rope should always be cleaned and lubricated.

(d) If the lubricant film is applied properly and the wire is stored in a place protected from the weather, corrosion will be virtually eliminated.

(e) Rusting, corrosion of the wires and deterioration of the fiber core sharply decrease the strength of the rope.

(i) It is not possible to estimate accurately the loss in strength from these effects.

3. Attaching Clips and Clamping Wire Rope

The clip method of making rope attachments is widely used.

(a) When properly applied as described herein, this method can develop as much as 80 percent of rope strength.

(b) Drop-forged clips are recommended; both the U-bolt and double-saddle clips are acceptable types.

(c) The length of rope to be allowed for the loop, when attaching clips, depends upon the size of the rope, the load to be handled and resulting number of clips required.

(d) The appropriate length is indicated in the fourth column of the table entitled "Number of Clip Recommended."

(i) This length will vary from 15 to 40 times the diameter of the rope, i.e., for all rope at least 24" should be allowed for the short end measuring from the base of the thimble.

4. Number of Clips Recommended

Diameter of Wire Rope	Number of Clips	Space Between Clips	Length of Rope Turned
3/8"	2	2 1/4	5"
1/2"	3	-1873	9"
5/8"	3	3 3/4	11"
3/4"	4	4 1/2	18"
7/8"	4	5 1/2	21"
1"	4	6	24"
1 1/8"	5	7	35"
1 1/4"	5	8	40"
1 3/8"	6	9	54"
1 1/2"	6	10	60"

(a) Wire the thimble to the rope at the desired point, then bend the rope around the thimble and secure temporarily by wiring the rope members together.

(b) Next, apply the clip farthest from the thimble about 4" from the short end of the rope and screw up tight.

(c) Be sure that the base of the saddle of the clip rests upon the long or main rope and the U-bolt upon the short end. This applies to all clips put on.

(d) See that the short end of the rope rests squarely upon the main rope.

(e) The clip nearest the thimble should go on next.

(i) Do not screw up tight when first put on.

(f) If one or more additional clips are to be used, place them equal distances apart between the clips already attached.

(g) Before tightening the clips put on after the first one, it is advisable to place some stress upon the rope to take up the slack and equalize tension on both sides of the rope.

(h) After this has been done, tighten up the clips last applied.

(i) When the clips are attached correctly, the attachment should appear with all saddles on live end of rope.

(j) After the rope has been in use a short time, all clips should be re-tightened, as stress tends to stretch the rope, thereby reducing its diameter.

(k) The clips should be tightened at all subsequent regular inspection periods.

(l) The nuts on each clip should be tightened uniformly, by giving alternately a few turns to one side and then the other.

(m) It will be found that the application of a little oil to the threads will allow the nuts to be drawn tighter.

2. Chains

Chains are made to rigid specifications for use within definite load limitations.

(a) The load limits of chain can be derived from the table below.

(b) This table supposes new or like-new condition and that the chain has not been over stressed.

(c) A chain may also be damaged by abrasion and rust.

(d) Careful inspection of a chain should be made periodically regardless of the frequency of its use.

(i) If it is stretched, worn or rusted, it should not be used.

(ii) Stretching can be detected by small checks or cracks in the links, by linking binding on each other and by elongation.

(iii) Useful chain life can be extended by avoidance of rust and by protecting the chain from sharp corners or abrasive applications.

(iv) Upon occasion, a fatigued chain can be restored to its original condition by annealing. Special heat-treated steel chain proof-tests to approximately double that of standard steel chain.

(v) It is usually furnished bright and is used where size and weight are important factors.

3. Table of Safe Loads for Standard Chain

Diameter	Safe Load	Diameter	Safe Load
1/4"	1,000	5/8	6,600
3/8"	2,300	3/4	9,500
1/2"	4,200		

1. Chain Terminology
   (a) Size of Chain - The diameter of chain link stock.
   (b) Pitch - The distance from the center of one link to the center of the next.
   (c) Proof Test - The load, expressed in pounds, that a chain will carry without deformation.
   (d) Breaking Strain - The load point at which a chain will break. It is approximately four times the safe working load and double the proof test.
   (e) Safe Working Load - One-half of proof test.

2. Manila Rope

Manila rope requires caution in its use because of the difficulty encountered in determining its condition and because of its lower resistance to weathering than other hoisting materials.

   (a) It is subject to abrasion and must be protected from rough surfaces and sharp corners.
   (b) Moisture affects rope adversely and special care must be observed in handling and storage. It should not be stored wet, and even when dry, it should be stored in loose coils with provision for free circulation of dry air.
   (c) Damage by aging or moisture may be detected by twisting a rope against the lay to uncover the center of the rope.
   (d) A dry powdery condition indicates deterioration. A rope in this condition should not be used.
   (e) Rope should also be examined for frayed strands or fibers or variations in color, which indicate that sections have been subjected to unequal weathering.
      (i) Examination of used or aged rope against new rope will reveal its condition.
   (f) Safe loads for the most commonly used manila rope sizes are listed in the following table.

3. Table of Manila Rope Date (Based on US. Spec. T-R-601)

Diameter	Circumference	Feet/Pound	Weight 100 Feet	Breaking Strength	Working Load
3/16"	5/8"	66.6	1.5 lb	450 lb	90 lb
1/4"	3/4"	50	2.0 lb	600 lb	120 lb
5/16"	1"	34.5	2.9 lb	-2011000 lb	200 lb
3/8"	1 1/8"	24.40	4.1 lb	1350 lb	270 lb
7/16"	1 1/4"	19.00	5.3 lb	1750 lb	350 lb

-2011/2"	1 1/2"	13.3	7.5 lb	2650 lb	530 lb
9/16"	1 3/4"	9.61	10.4 lb	3450 lb	690 lb
5/8"	2"	7.5	13.2 lb	4400 lb	880 lb
3/4"	2 1/4"	-2016	16.7 lb	5400 lb	1080 lb
13/16"	2 1/2"	5.13	19.5 lb	6400 lb	1300 lb
7/8"	2 3/4"	4.45	22.5 lb	7700 lb	1540 lb
-2011"	3"	3.71	27.0 lb	9000 lb	1800 lb
1 1/16"	3 1/4"	3.2	31.3 lb	10500 lb	2100 lb
1 1/8"	3 1/2"	2.78	36.0 lb	12000 lb	2400 lb
-2011 1/4"	3 3/4"	2.4	41.8 lb	13500 lb	2700 lb
1 5/16"	4"	2.09	48.0 lb	15000 lb	3000 lb
1 1/2"	4 1/2"	1.67 lb	60.0 lb	18500 lb	3700 lb
1 5/8"	5"	1.34 lb	74.4 lb	22500 lb	4500 lb
1 3/4"	5 1/2"	1.12 lb	89.5 lb	26500 lb	5300 lb
2"	06"	0.93	0108.0 lb	31000 lb	6200 lb

1. Slings
   - (a) There are many types of slings.
     - (i) The choice of sling will depend on the type of materials being handled, some slings being more secure are less apt to damage the load than others.
     - (ii) Slings are made of wire, rope, chain or manila rope.
   - (b) Slings should be inspected before each use.
   - (c) It is the responsibility of the user to be sure he/she is using the correct equipment in the correct manner and that the equipment is in a safe condition.
   - (d) The tension in a sling rope depends on the load and on the angle of the sling.
   - (e) A long, almost vertical, sling is the strongest while a short widely spread sling can develop tensions in excess of the actual load being lifted.
   - (f) Sling angles of less than 45 degrees should be avoided since they result in high sling tensions which can lead to sling failure or crushing of the materials being lifted.

2. Synthetic Web Slings

Each day before being used, all slings, fastenings, and attachments must be inspected for damage or defects.

- (a) Any damaged or defective sling must be immediately removed from service.

(b) General safe operating practices for slings of all types are:

(i) Inspect the outer surface and stitching of the slings for cuts and abrasions.

(ii) Inspect the sling for the sewn in rating tag.

(iii) Do not use slings that have red safety threads showing along the outer flat surface. This indicates that the sling is badly damaged.

(iv) Slings shall not be shortened with knots, bolts, or other makeshift devices.

(v) Sling legs shall not be kinked.

(vi) Slings shall not be loaded in excess of their rated capacities, and must be securely attached to their loads.

(vii) Slings shall be padded or protected from all sharp edges of their loads.

(viii) A sling shall not be pulled from under a load, when the load is resting on the sling.

(ix) Synthetic web slings shall be removed from service, if one or more of the following conditions are present:

(i) Acid or caustic burns.

(ii) Melting or charring of any part of the sling surface.

(iii) Snags.

(iv) Punctures.

(v) Tears.

(vi) Cuts.

(vii) Broken or worn stitches.

(viii) Distortion of fittings

3. Hoisting Hooks

(a) Hooks are designed for operations within established load limits.

(b) These limits can be computed readily by reference to either the formula or the table below.

(c) A hook is designed to fail by straightening before its chain is overloaded.

(i) Because of this design feature, a type of weight of hook other than that originally installed should not be used without full knowledge of the load limits of both hook and chain.

(d) The safe working capacity (SWC) of a hook can be approximated in tons as the square of the diameter in

inches of the hook at the point where the inside curve starts its arc (dimension "A" in the figure at the right).

(i) Thus, when A = 1/4,

(ii) SWC = A2

(iii) SWC = 1 1/4 x 1 1/4 = 19/16 tons

(e) Safe working loads can be computed in this manner or can be determined from the table which follows:

4. Table of Safe Hoisting Hook Loads

Dimensions (Inches)				Safe Load In Pounds
A	B	C	D	
1 1/16	7/8	1 1/16	4 15/16	1,200
3/4	1	1 1/8	5 13/32	1,400
7/8	1 1/8	1 1/4	6 1/4	2,400
1	1 1/4	1 3/8	6 7/8	3,400
1 1/8	1 3/8	1 1/2	7 5/8	4,200
1 1/4	1 1/2	1 11/16	8 19/32	5,000
1 3/8	1 5/8	1 7/8	9 1/2	6,000
1 1/2	1 3/4	2 1/16	10 11/32	8,000
1 5/8	2	2 1/4	11 27/32	9,400
1 7/8	2 3/8	2 1/2	13 9/32	11,000
2 1/4	2 3/4	3 14	13/16	13,600
2 5/8	3 1/8	3 3/8	16 1/2	17,000
3	3 1/2	4 19	3/4	24,000

1. There are two main types of hoisting hooks.

(a) The slip hook allows its chain to move freely through it,

(b) The grab hook opening is small enough that it engages between links of its chain and does not allow slippage.

2. Shackles

There are three types of shackles:

(a) Screw Pin Shackle

(b) Round Pin Shackle

(c) Safety Shackle

3. Safe Load in Pounds - Drop Forged Steel Weldless

Diameter	Max Width	Safe Working Load	Diameter	Max. Width	Safe Working Load
1/2	3/8	560	1 1/4	1 7/8	16,000

3/8	9/16	1,400	1 3/8	2	20,000
1/2	11/16	2,700	1 1/2	2 1/8	24,000
5/8	13/16	3,600	1 5/8	2 1/4	28,000
3/4	1 1/16	5,600	1 3/4	2 3/4	32,000
7/8	1 1/4	7,800	2	2 3/4	36,000
1	1 1/2	10,400	2 1/4	3 1/4	46,000
1 1/8	1 5/8	13,200	2 1/2	4	56,000

1. All shackle pins must be straight and all pins of screw pin type must be screwed in all the way.
   - (a) Make certain that a bolt and screw pin shackle works easily.
   - (b) Never use a substitute bolt for the original unit, the alloys are different.
   - (c) Lightly oil the threads of a screw pin if needed.
   - (d) Do not use screw pin shackles if the pin is difficult to turn.
   - (e) Use safety pin or screw pin shackles whenever possible.
   - (f) Use the largest bearing surface possible on the shackle pin to avoid
   - (g) If width between the eyes is greater that listed in the chart above, THE SHACKLE HAS BEEN OVER STRAINED AND MUST NOT BE USED.

2. Fittings

Check fittings for:
- (a) Cracking.
- (b) Nicks.
- (c) Bending.
- (d) Excessive wear.
- (e) Never use a fitting that shows damage.

3. Personal Protective Equipment
- (a) Hard hats must be worn on all construction sites and in any area where there is a hazard of falling objects.
- (b) Proper eye protection will be used.
- (c) Steel toed shoes are required.
- (d) Hearing protection will be used where necessary.

FOR ADDITIONAL INFORMATION ON PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS SEE THE COMPANY PERSONAL PROTECTIVE EQUIPMENT PROCEDURE.

A. Rigger Training Requirements

1. Riggers will be trained on the following topics:
   (a) Crane Comments.
   (b) All major issues addressed in API RP 2C and D
   (c) Lift planning and working safely around cranes.
   (d) Standard crane operation hand signals.
   (e) Hands-on workshop on the proper inspection, use and maintenance of slings, shackles, hooks, nylon slings, and etc.
   (f) Basic safety requirements for load rigging.
   (g) A written examination.
   (h) Contents of this procedure.

B. Rigger Training Frequency

Operators will be trained according to the following schedule:
   (a) Before being assigned to do any rigging.
   (b) Every 3 Years after initial training.
   (c) They will be retrained if their work shows lack of proficiency.

C. Definitions

1. **Bird Cage** means distortion damage to wire rope that resembles a small bird cage in appearance.

2. **Conventional Rigging (equipment)** means hardware or equipment used to safely attach a load to a lifting device.
   (a) Conventional rigging is commercially available, over-the-counter equipment, used in the manner for which it was designed.

3. **Crane** is a machine used for lifting and lowering a load vertically, and that has a hoisting mechanism as an integral part.
   (a) Moving loads horizontally can be achieved with proper rigging.

4. **Hoist** is a device that applies a force for lifting or lowering.

5. **Tag line** is a line tied to a suspended load that is used to guide and manipulate the load.