HSS-604 Use and Inspection of Rigging and Hoisting Equipment

Overview

Purpose

The purpose of this document is to describe the general usage and inspection requirements for all rigging and hoisting equipment and accessories used at the Marathon Petroleum Company (MPC) Los Angeles Refinery (LAR).

The purpose is to ensure that all hoisting and rigging equipment is maintained in a safe operating condition by bringing together all regulations, requirements, and recommendations into one document.

As such, the intent is to include references that apply to the most common types of hoisting equipment found at the MPC LAR. Regulations concerning other equipment not covered by this document may be found by examining the documents listed in Section 2.0 References.

Note: Regulations concerning Mobile Crane Safety are found in the LAR standing instruction HSS 602 Mobile Crane Safety.

Scope

This standing instruction covers the safe use of common types of manual lifting equipment such as chain hoists (aka chain-falls), lever hoists (aka come-a-longs), slings and other lifting hardware, and other lifting equipment not covered in a separate standing instruction.

The requirements in this standing instruction apply to all MPC employees, contractors, and subcontractors that are involved in the operation of rigging and hoisting equipment at the LAR.

All contract companies must meet or exceed the Marathon LAR inspection and self-assurance program as described in MNT-RIG-023 Inspection and Maintenance Requirements for Rigging and Hoisting Equipment. Contractors and subcontractors must be able to produce evidence of current inspection requirements upon request.

Records Retention

Printed copies of this document should not be retained more than 12 months. Any revision to this document will be retained a maximum of 10 years following the revision.

Supersedes

This document replaces FS-591, SAF-061g1, SAF-061g2, SAF-061g3, SAF-061g5, and SAF-061g6.

Table of Contents

1.0 References

1.1 Refining References

The table below lists the Refining references used within this document.

Number	Description
MNT-RIG-023	Inspections and Maintenance Requirements for Rigging and Hoisting Equipment
HSS-602	Mobile Crane Safety

1.2 Industry References

The table below lists the industry references used within this document.

Number	Description
ASME B30.9	Slings
ASME B30.10	Hooks
ASME B30.16	Overhead Hoists
ASME B30.20	Below the Hook Lifting Devices
ASME B30.21	Manually Operated Lever Hoists
ASME B30.26	Rigging Hardware

1.3 Regulatory References

The table below lists the regulatory references used within this document.

Number	Description
OSHA 1926.1400	Cranes and Derricks in Construction
Cal-OSHA Subchapter 7, Group 13	General Industry Safety Orders - Cranes and Other Hoisting Equipment

1.4 Terms

The following terms are used in this document:

- Basket Hitch
- Bird Caging
- Choker Hitch
- Competent Person
- D/d Ratio
- Designated Person
- Hitch
- Kink
- Lay

- Lifting Technical Authority (LTA)
- Load
- Qualified Person
- Rated Capacity
- Rigger
- Reeving
- Shackle
- Side Loading
- Signal Person(s)
- Sling
- Softener
- Sorting Hook
- Synthetic Sling Shackle
- Total Gross Load
- Wire Rope Clamp
- Wire Rope Sling

Reference: For details, see Appendix A: Terms and Definitions.

2.0 Roles and Responsibilities

2.1 Roles and Responsibilities

The table below describes the roles and responsibilities related to this document.

Roles	Responsibilities
Rigging Site Foreman	• Ensure that the equipment user is trained in the use and inspection of hoisting and rigging equipment. • Ensure all rigging and hoisting equipment is properly maintained, inspected, and tested at the specified time intervals by the Designated Person(s). • Ensure periodic inspection results are documented, maintained, and kept up-to-date. • Perform random inspections to ensure this standing instruction is being adhered to. • Review contractor rigging and hoisting equipment inspection records. • Ensure rated capacity of lifting equipment is not exceeded.
Lifting / Hoisting Equipment Operator	• Ensure all components of the lifting equipment have up-to-date inspections and are in good working order. • Understand the capacity of the crane at all load positions for the lift. • Prior to the lift, know and discuss lifting parameters including gross load weight, equipment rigging and crane capacities and limitations, etc. with the rest of the crew. Ensure rated capacity of lifting equipment/crane is not exceeded throughout the lift. • Do not leave the controls while the load is suspended. • Follow signals from the designated signal person. • When a lifting equipment operator has any doubt as to the safety of the lift or people in the work area, he/she shall not move any equipment or load until safe working conditions have been assured.
Rigger	Riggers shall be qualified to rig the load and meet the following requirements: • Read and understand their responsibility in accordance with this instruction. • When assigned, perform the duties of the Qualified Person in charge of the lift.

	• Inspect all rigging before, during, and after use and remove any defective equipment from service. • Determine the weight of the material, equipment, load being lifted, either by direct measurement with a weight scale, by referring to manufacturer's documentation, by estimating using similar known weights, or by other reliable methods. This includes knowing the weight of equipment and material being lifted, the center of gravity of the load, and the weight of the rigging to be used. • Know and follow the lift/rigging plan (whether written or verbal) including the plan for accessing, connecting, and disconnecting the load. • If there are any proposed changes to the lift/rigging plan during the task, stop the job and have a team meeting to update the plan. • Be able to identify when a lift is Critical and ensure that all Critical Lifts are done in accordance with applicable procedures and lift plans. • Know the rated capacity and limitations of all rigging and do not exceed these limits. • Select the proper connection or hitch (vertical, basket, choke, etc.) for the load to be hoisted and ensure it is properly applied. • Keep the load line plumb above the load and rig above the center of gravity of the load or make appropriate accommodations to maintain a stable load. • Be a qualified signal person. • Always keep the load under control and prevent it from contacting people and/or other equipment and structures. Loads shall not be passed directly over workers, occupied work-spaces or occupied passageways without a written variance to this policy. • Safely land the load and stabilize it with blocks, chocks, or other means before disconnecting the rigging.
Designated Signal Person	• Be a qualified signal person. • Barricade, tag, and clear the lift area of all non-essential personnel. • Know the load path. • Know the limitations of the lifting equipment and work within those limits. • Give the signals in a smooth and logical order to limit impact loads from sudden stops and direction changes.

	• Ensure the load does not swing over any personnel. • Obtain assistance when unable to see both the lifting equipment and the load.
Tag Line Person	• Keep the tag line free of knots, fraying, and prevent it from catching on other objects. • Stay out from underneath the load as well as away from any position that the load could fall.

3.0 Inspection

Guidelines for inspection requirements, inspection intervals and criteria for removal from service can be found in the appropriate OSHA Standards as noted in Section 1.3 above and ASME Standards as noted in Section 1.2 above, in the equipment manufacturers' documentation, and in MPC LAR MNT-RIG-023 Inspection and Maintenance Requirements for Rigging and Hoisting Equipment.

3.1 Initial Inspection

Prior to use, all new, altered, or modified rigging and hoisting equipment must be inspected by the manufacturer or their designee to verify compliance with the required regulations.

3.2 Frequent Inspection

Each day before being used, the sling and all fastenings and attachments shall be inspected for damage or defects by a qualified person. Additional inspections shall be performed during sling use, where service conditions warrant. Damaged or defective slings shall be immediately removed from service. Inspection shall include verifying manufacturer labels are attached and legible.

3.3 Periodic Inspection

A complete inspection by the Designated Person and based on usage/service

a. Normal service: annually

2024	Orange
2025	White
2026	Yellow
2027	Red
2028	Green

Table 1 - MPC LAR Inspection Color Coding - 5 Year Rotation

4.0 General Rigging and Inspection

The rigger shall be trained and qualified to safely perform the rigging operation. All loads are to be rigged by a qualified rigger or a trainee under the direct visual supervision of a qualified rigger.
Prior to performing Rigging and Signal Person tasks at LAR, Qualified contractors will be issued the appropriate decal (sticker) by MPC LAR. The decal(s) are to be placed on the exterior of the hard hat.

4.1 General Usage

a. Determine the weight of the load and the center of gravity before selecting the rigging that will be used to lift the load. Consider whether equipment will contain fluid, sludge, internal equipment, etc. These items can add significantly to the nominal weight, can create dynamic motion, and should be removed if possible.
b. Calculate sling tension to select the proper rigging.
c. The hook shall be placed above the center of gravity of the material or equipment being lifted unless additional load control measures are employed.
d. Attach the rigging to the load at points that will minimize slipping or rotation, and to eliminate jerking or slipping while upending, setting, or laying the material/equipment down.
e. When attaching chain hoists, snatch blocks, or rigging hardware to permanent structures, verify that the structure and anchor points are strong enough to support the load.
f. Do not use equipment that does not have a clearly marked safe working load rating, current inspection tag, or visual color code identifier.
g. Never replace a shackle pin with a bolt; only the proper fitted pin shall be used.

4.2 Rigging, Lifting, and Landing Loads

a. Rig loads to prevent any parts from shifting or dislodging during the lift. Suspended loads shall be securely rigged and properly balanced before they are set in motion.
b. Always keep the load under control. Use one or more taglines, if needed, to prevent uncontrolled motion.
c. Loads shall not be released or detached from a crane or other hoisting apparatus until the qualified Rigger detaching the load has verified the load is secure or supported to prevent inadvertent movement.
d. Never wrap the hoist rope or chain around the load. Attach the load to the hook with slings or other rigging devices.
e. Position the load line over the load's center of gravity before the lift is started.
f. Keep hands away from pinch points as slack is being taken up.
g. Wear impact resistant leather gloves when handling wire rope.
h. Make sure that non-essential personnel stand clear when loads are being lifted, lowered, and the rigging is removed.

i. Before making a lift, check to see that the rigging is properly attached to the load.
j. Never work under a suspended load.
k. Never make temporary repairs to a sling. Follow the manufacturers recommendations and OSHA Regulations when a sling needs to be repaired.
l. Secure or remove unused sling legs of a multi-leg bridle sling before the load is lifted.
m. Avoid impact loading caused by sudden jerking during lifting and lowering. Take up slack on the rigging gradually.
n. Prepare adequate blocking before loads are lowered. Blocking can help prevent damage to slings.

5.0 Rigging Hardware/Equipment Use

5.1 Slings

a. Slings shall have permanently affixed and legible markings as prescribed by the manufacturer that indicate the recommended safe working load for the type of hitch used. The angle upon which it is based, and the number of legs if more than one.
b. Use softeners in areas where the slings are in contact with sharp edges to prevent cuts or bent slings. Examples of sling protection are split sections of large diameter pipe, corner saddles, cut resistant softeners, wood blocking, or manufactured sling protection.
c. Slings shall be attached or connected in a manner providing control of the load. The load should be lifted a few inches off the ground to ensure the slings do not slip or render and the load is stable to be lifted.
d. Slings that are shortened or adjusted only by methods approved by the sling manufacturer or a Qualified Person.
e. During lifting with or without a load, personnel shall be alert for possible slings or rigging getting snagged.
f. Prepare adequate cribbing before loads are lowered to rest on cribbing to help prevent damage to slings and ensure the load is safe and stable.
g. The slings shall not be bunched, constricted, or pinched by the load, hook, or any fitting.
h. Store slings in an area where they will not be subjected to mechanical damage, corrosive action, moisture, extreme temperature, or to kinking. Avoid extended exposure to UV sunlight. If exposed to extreme temperatures, follow the guidance provided by the sling manufacturer or Qualified Person.
i. Retain a certificate of proof test for the service lift of the sling. Make certificate of proof test available for examination upon request.
j. Each day before being used, the sling and all fastenings and attachments shall be inspected for damage or defects by a Qualified Person. Additional inspections shall be performed during sling use, where service conditions warrant. Damaged or defective slings shall be immediately removed from service.

5.2 Synthetic Slings

1. Synthetic web slings of polyester and nylon shall not be used at temperatures in excess of 180°F. Polypropylene web slings shall not be used at temperatures in excess of 150° F.
2. Polyester and polypropylene web slings shall not be used where fumes, vapors, sprays, mists, or liquids of caustics are present.
3. Synthetic web slings which are repaired shall not be used unless repaired by a sling manufacturer or an equivalent entity.
4. Softeners should be cut resistant to withstand the cutting force of a sharp edge and smooth to prevent cutting the sling.
5. Synthetic web slings shall be immediately removed from service if any of the following conditions are present:

- Acid or caustic burns;
- Melting or charring of any part of the sling surface;
- Broken or worn stitches;
- Distortion of fittings;
- Snags, punctures, tears, or cuts;
- Slings with other apparent defects shall be sent to the manufacturer or equivalent entity for determination of rated capacity and safety for continued use.

6. Synthetic web slings shall have markings indicating the type of synthetic web material (Examples are nylon, polyester, and Kevlar), in addition to the marking requirements in Section 5.1.a.
7. Synthetic round slings shall have markings indicating the core and cover (if different than the core material) material, in addition to the marking requirements in Section 5.1.a.

5.3 Wire Rope Slings

1. When using multiple slings to lift a load, the sling angle increases the tension on the sling or attachment. Use the Load Angle Factor (Figure 1) to calculate the tension on the slings. Larger slings or attachments may be required to withstand the increased load.

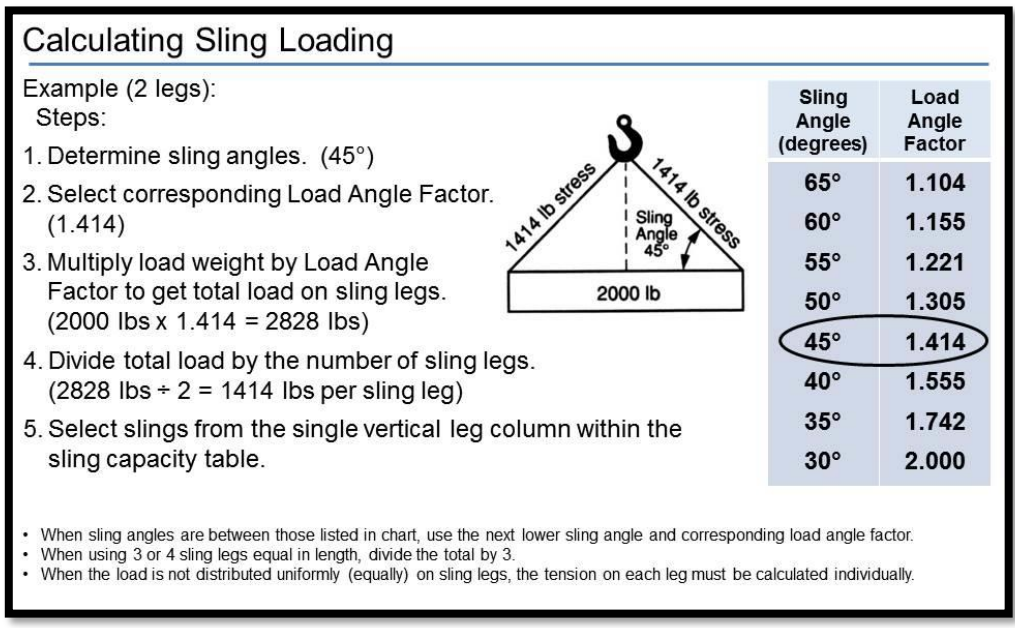
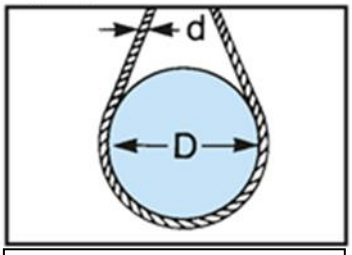


Figure 1 Calculating Sling Loading

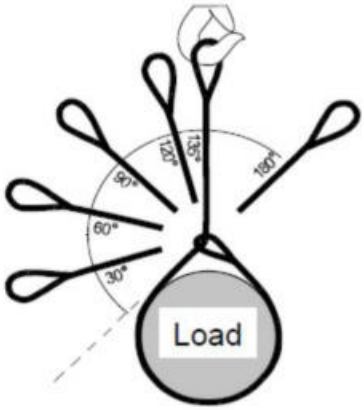
(D/d) Considerations



When wire rope is bent around a load, if the D/d is less than 25:1, the rope strength is decreased. The D/d ratio is diameter of the object around which the rope is bent (D), divided by the diameter (d) of the rope. D/d affects slings used in basket hitches and must be taken into consideration. When the diameter of the load is 4 times the diameter of the wire rope sling the D/d ratio is 4/1 and the sling efficiency is 75% of the Basket WLL.

D/d RATIO	Wire Rope Sling Strength Efficiencies
25/1	100%
20/1	92%
15/1	88%
10/1	86%
8/1	84%
6/1	80%
4/1	75%
2/1	65%
1/1	50%

Figure 2 D/d Considerations



Choker Hitch Angle Reduction Chart	
Choker Hitch Angle (degrees)	Reduction Factor
120 - 180	1.00
105 - 120	.82
90 - 105	.71
60 - 90	.58
0 - 60	.50

2. When using four-legged slings, be aware that normal lifting practices may not distribute the load uniformly on all four legs. Calculate four-legged sling capacities as if they were three-legged.
3. Balance the load in basket hitches. Double wrap the sling, when necessary to prevent slippage.
   - D/d Ratio, as it applies to wire rope, is the Diameter of the Load or Hardware divided by the diameter of the wire rope. A fully rated wire rope Basket Hitch must have 90° sling legs, a D/d Ratio of at least 25:1, an even wrap. When D/d ratios smaller than 25/1 for mechanical spliced and swaged or poured socket-type slings are used in the body of the sling, the rated load of the sling shall be decreased according to the recommendations of the manufacturer, a qualified person, or the Wire Rope Sling User's Manual. For example: If the shackle or object has 2 times the diameter of the wire rope sling (D/d 2:1), the basket sling capacity will be 65% of Working Load Limit (WLL). For other sling types, consult the sling manufacturer for specific data or refer to the Wire Rope Sling User's Manual.

4. Keep hands and fingers from between the sling and the load while the sling is being tightened around the load.
5. Wire rope, and wire rope slings, should not be allowed to lie on the ground for long periods of time, or on damp or wet surfaces, rusty steel, or near corrosive substances.
6. Avoid dragging slings out from underneath loads.
7. Keep wire rope slings away from flame cutting and electric welding.
8. Never make slings from discarded hoist rope.
9. Keep the sling straight by not twisting, knotting, or kinking it during use.
10. The eyes of wire rope slings or wire rope bridles shall not be formed with wire rope clips or knots.
11. Wire rope slings shall have permanently affixed and legible identification markings as prescribed by the manufacturer, and that indicate the recommended safe working load for the type of hitch used, the angle upon which it is based, and the number of legs if more than one.

12. Wire rope slings shall not be used without affixed and legible identification markings as required by subsection (g)(1) of Cal-OSHA Title 8 Section 5045.
13. Wire rope slings shall be immediately removed from service if any of the following conditions are present (see Figure 3):

- 3/6 Rule: three broken wires in one strand in one rope lay, or six randomly distributed broken wires in one rope lay;
- Wear or scraping of one-third the original diameter of outside individual wires;
- Kinking, crushing, bird caging or any other damage resulting in distortion of the wire rope structure;
- Evidence of heat damage;
- End attachments that are cracked, deformed or worn to the point where the rated capacity is reduced;
- Corrosion that is of such severity or extent as to reduce the rated load capacity of the wire rope or end attachment;
- One or more broken wires within one rope lay of the end attachments;
- Overloaded or damaged.

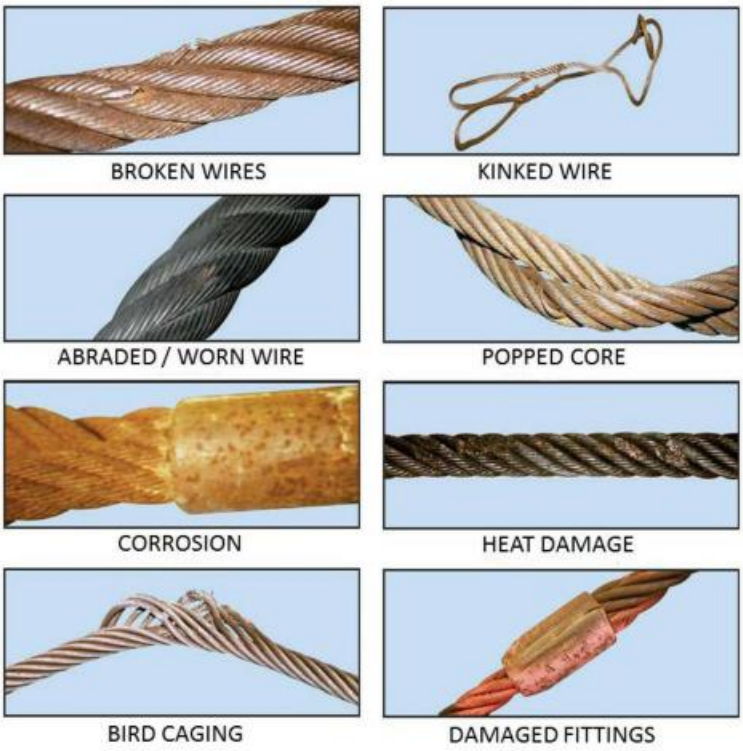


Figure 3 Examples of Wire Rope Slings Requiring Removal from Service

14. Do not use wire rope sling with Independent Wired Rope Core (IWRC) at temperatures above 400° F.
15. Fiber core wire rope slings of all grades shall be permanently removed from service if they are exposed to temperature in excess of 180° F.

16. When non-fiber core wire rope slings of any grade are used at temperatures above 400° F, or below -60° F, do not use sling and follow the sling manufacturers recommendations.

5.4 Alloy Steel Chain Slings

(a) Sling Identification - Alloy steel chain slings shall have permanently affixed and legible markings as prescribed by the manufacturer that indicate the recommended safe working load for the type(s) of hitch(es) used, the angle upon which it is based, and the number of legs if more than one.

(b) Attachments

(1) Hooks, rings, oblong links, pear-shaped links, welded or mechanical coupling links or other attachments shall have a rated capacity at least equal to that of the alloy steel chain with which they are used or the sling shall not be used in excess of the rated capacity of the weakest component.

(2) Makeshift links or fasteners formed from bolts or rods, or other such attachments, shall not be used.

(c) Alloy steel chain slings shall be inspected according to Section 5.0 of this procedure.

(1) A record of the most recent month in which each alloy steel chain sling was thoroughly inspected shall be maintained and available for examination.

(d) Before use of a new, repaired, or reconditioned alloy steel chain sling, including all welded components in the sling assembly, conduct a proof test in accordance with the sling manufacturer's recommendations. Maintain a certificate of the proof test, for the service life of the sling. Minimum proof loads for alloy steel chain shall be equal to twice the working load limit values shown for single slings.

(e) Alloy steel chain slings shall be permanently removed from service if they are heated above 1000º F. When exposed to service temperatures in excess of 600º F, maximum working load limits shall be reduced in accordance with the chain or sling manufacturer's recommendations.

(f) Slings shall be removed from service if hooks are cracked, have been opened more than 5 percent not to exceed 1/4" of the normal throat opening measured at the narrowest point, any visible bend or twist from the plane of the unbent hook, or any wear exceeding 10 percent.

(g) Makeshift links or fasteners formed from bolts or rods, or other such attachments, shall not be used.

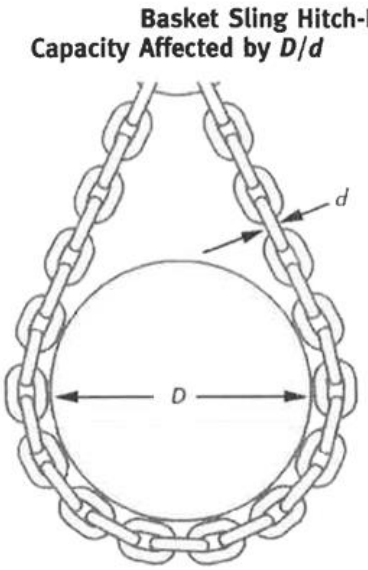
(h) If the chain size at any point of the link is less than that stated in Table 2 (Table N-184-1 from OSHA Standard 1910.184), chain shall be removed from service.

Chain Size, inches	**Minimum Allowable Chain Size, Inches**
1/4	13/64
3/8	19/64
1/2	25/64

5/8	31/64
3/4	19/32
7/8	45/64
1	13/16
1 1/8	29/32
1 1/4	1
1 3/8	1 3/32
1 1/2	1 3/16
1 3/4	1 13/32

Table 2 - Minimum Allowable Chain Size at Any Point of Link

(i) Chain sling D/d ratio must be 6:1 or greater to equal the Working Load Limit (WLL) of a Basket Hitch listed on a sling tag. See Figure 4 below for rated capacity if D/d ratio is less than 6:1.



D/d	Rated Capacity, %
Less than 2	Not recommended
2	60
3	70
4	80
5	90
6 and above	100

Figure 4 - Basket Sling Rated Capacity

5.5 Metal Mesh Slings

a. Each metal mesh sling shall have permanently affixed durable identification stating the following:
   1) Manufacturers name or trademark
   2) Rated capacity in vertical basket hitch and choker hitch.

b. Handles shall have a rated capacity at least equal to the metal fabric or exhibit no deformation after proof load testing.
c. The fabric and handles shall be joined so that:
   1) The rated capacity of the sling is not reduced;
   2) The load is evenly distributed across the width of the fabric;
   3) Sharp edges will not damage the fabric.
d. Safe operating temperatures for metal mesh slings which are not impregnated with elastomers may be used in a temperature range from -20 F to 550 F without decreasing the WLL. Metal mesh slings impregnated with polyvinyl chloride or neoprene may be used only in a temperature range from 0 F to 200 F. For operations outside these temperature ranges or for metal mesh slings impregnated with other materials, the sling manufacturers recommendations shall be followed.
e. Metal mesh slings shall be immediately removed from service if any of the following conditions are present:
   1) A broken weld or broken brazed joint along the sling edge;
   2) Reduction in wire diameter of 25% due to abrasion or 15% due to corrosion;
   3) Lack of flexibility due to distortion of the fabric;
   4) Distortion of the female handle so that the depth of the slot is increased more than 10%;
   5) Distortion of either handle so that the width of the eye is decreased more than 10%;
   6) A 15% reduction of the original cross-sectional area of metal at any point around the handle eye;
   7) Distortion of either handle out of its plane;
   8) Slings in which the spirals are locked or without free articulation;
   9) Fittings that are pitted, corroded, cracked, bent, twisted, gouged, or broken;
   10) Broken wires in any part of the mesh;
   11) Missing or illegible sling identification;
   12) Conditions that cause doubt as to continued use of the sling.
f. Metal mesh slings shall be inspected according to Section 5.0 of this procedure.
g. Chemically active environments can affect the strength of metal mesh slings. Consult that manufacturer before using a sling in such environments.
h. Slings should not be dragged on the floor or over an abrasive surface.
i. Slings should not be constricted, bunched, or pinched by the load, hook, or any fitting.
j. Slings in contact with edges, corners, or protrusions should be protected with a material of enough strength, thickness, construction to prevent damage.
k. Slings used in pairs should be attached to a spreader beam.
l. In a basket hitch, the load should be balanced to prevent slippage.
m. The load should be evenly distributed across the width of the metal mesh.

n. When lifting with a basket hitch, the legs of the sling should contain or support the load from the sides, above the center of gravity, so that the load remains under control.
o. For metal mesh slings in a choker hitch, the load should be balanced to prevent edge overload.
p. For metal mesh slings in a choker hitch, the choke point should only be on the sling body, not on a weld, braze, or end fitting.

5.6 Blocks and Hooks

a. Blocks and sheaves shall be in proportion to the size, strength, and design of cables used, or attachments for the rigging application.
b. Sheave grooves shall be smooth and free from surface defects which could cause rope damage.
c. The bearings shall be kept well lubricated; sheaves with badly corrugated cable grooves or grooves smaller than the cable in use, shall not be used.
d. All blocks shall be designed and maintained to prevent fouling.
e. The bearing and yoke pins of all blocks shall be securely fastened.
f. The wire rope shall be properly seated in the sheaves.
g. All rigging blocks shall be marked by the manufacturer to show the following:
(1) Name or trademark of manufacturer;
(2) Rated load;
(3) Rope size(s).
h. When rigging blocks are to be used at temperature above 150 F or below 0 F, the rigging block manufacturer or a qualified person should be consulted.
i. Rigging blocks shall be inspected according to Section 5.0 of this procedure. Examples of rigging blocks are shown in Figure 5.

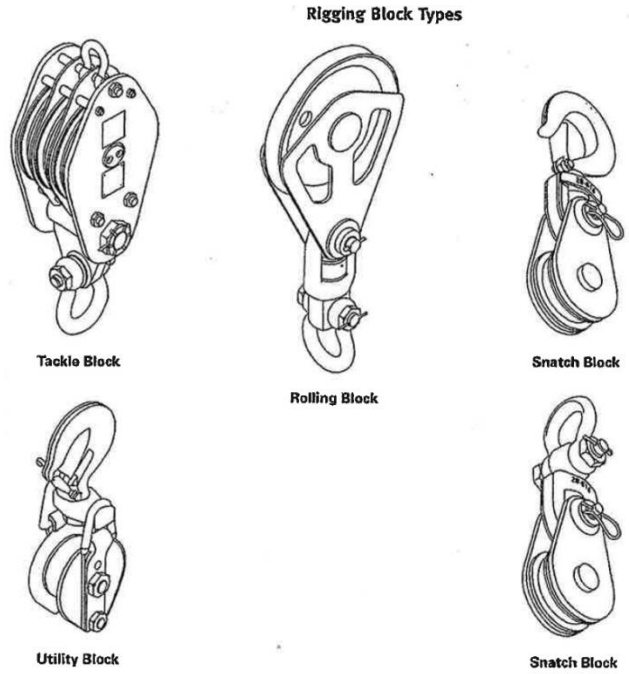
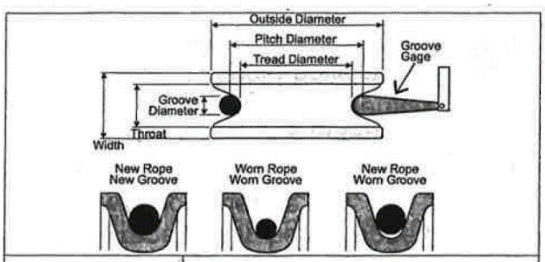


Figure 5 - Rigging Block Types

j. Rigging blocks shall be removed from service if conditions such as the following are present and shall only be returned to service when approved by the manufacturer, or a qualified person:

(1) Missing or illegible identification;
(2) Misalignment or wobble in sheaves;
(3) Excessive sheave groove corrugation or wear (see Figure 6);
(4) Loose or missing nuts, bolts, cotter pins, snap rings, or other fasteners and retaining devices;
(5) Indications of heat damage, including weld splatter or arc strikes;
(6) Excessive pitting or corrosion;
(7) Bent, cracked, twisted, distorted, stretched, elongated, or broken load-bearing components;
(8) Excessive wear, nicks, or gouges
(9) A 10% reduction of the original or catalog dimension at any point;
(10) Excessive damage to load-bearing threads;
(11) Evidence of unauthorized welding or modifications;
(12) Other conditions, including visible damage that cause doubt as to continued use of the rigging block.



Nominal Diameter (inches)	Amount by which the Groove Diameter should exceed the Rope Diameter (In)	
	For Minimum Conditions	For New or Regrooved Sheaves or Drums
5/16 and smaller	1/128	1/64
3/8 - 3/4	1/64	1/32
13/16 - 1 1/8	3/128	3/64
1 3/16 - 1 1/2	1/32	1/16
1 9/16 - 2 1/4	3/64	3/32
2 5/16 and up	1/16	1/8

Sheave Groove Conditions

Figure 6 - Sheave Groove Conditions

k. The minimum D/d ratio between the sheave pitch diameter and wire rope diameter is 6.
l. All portions of the human body shall be kept away from between the rigging block, running lines, load, and any other rigging during lifting or load-handling activities.
m. The load line multiplied by the block load factor shall not exceed the rated load of the rigging block.
n. Block friction ratio shows the number of parts of line and the efficiency of three types of sheaves. It includes ratio charts for fiber rope blocks at a 10% friction load, wire rope bronze bushing sheaves at a 5% friction load, and wire rope roller bearing sheaves at 3% friction load.
o. Hook users shall be trained in the selection, inspection, cautions to personnel, effects of environment, and rigging practices in reference to 29CFR1926.251/CFR1915.113/Cal-OSHA Title 8 Section 3474.
p. The hook material shall have enough ductility to permanently deform before losing the ability to support the load at the temperatures at which the specific hook will be used.
q. When hooks are to be used at temperatures above 400 F or below -40 F, the manufacturer or a qualified person should be consulted.
r. All hooks shall have permanently affixed and legible identification markings of the manufacturer, and the rated load identification shall be forged, cast, or die stamped on a low stress and nonbearing area of the hook.
s. Loads shall be applied to the throat of the hook since loading the point over stresses and bends or springs the hook.
t. Hooks that are cracked, have been opened more than 5 percent not to exceed 1/4” of the normal throat opening measured at the narrowest

point, any visible bend or twist from the plane of the unbent hook, or any wear exceeding 10 percent shall be removed from service (see Figure 7).

Figure 7 - Examples of Hooks to be Removed from Service

u. All hooks shall have functioning safety latches to prevent accidental load disengagement, except for sorting or shack out, and pipe hooks.
v. Hooks shall be inspected according to Section 5.0 of this procedure.
w. If two or more slings are to be connected to a hook, and the angle between the slings will exceed 90 degrees, connect the slings to the hook with slings resting in the bell of a shackle, or use master links or ring assemblies. This will prevent the spread of the sling legs from damaging the safety latch or coming off the hook.
x. Use blocks with a pitch diameter 16 times the diameter of wire rope used for the hoisting lines.
y. Avoid tip-loading, back loading, and side loading hooks, except for sorting/pipe hooks specifically designed for tip loading (See Figure 8).

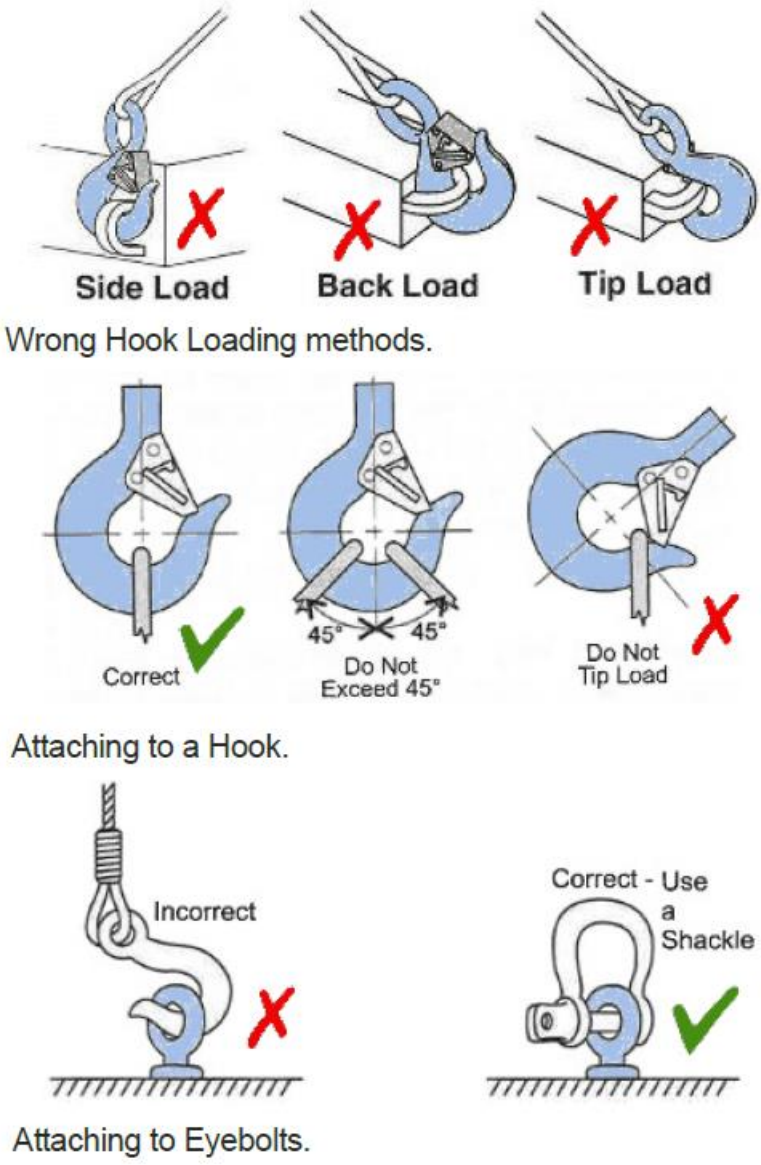


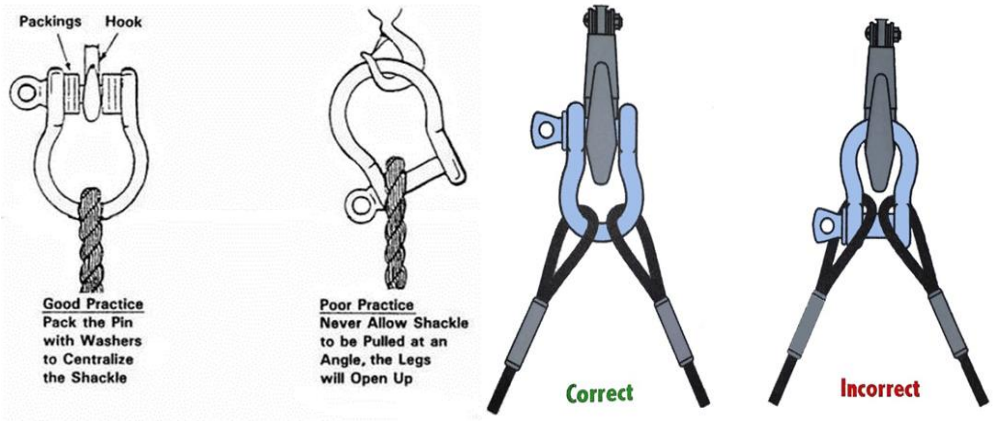
Figure 8 - Rigging Best Practices

z. Sorting hooks shall not be used to place loads at elevation, they are to be used at ground level only.

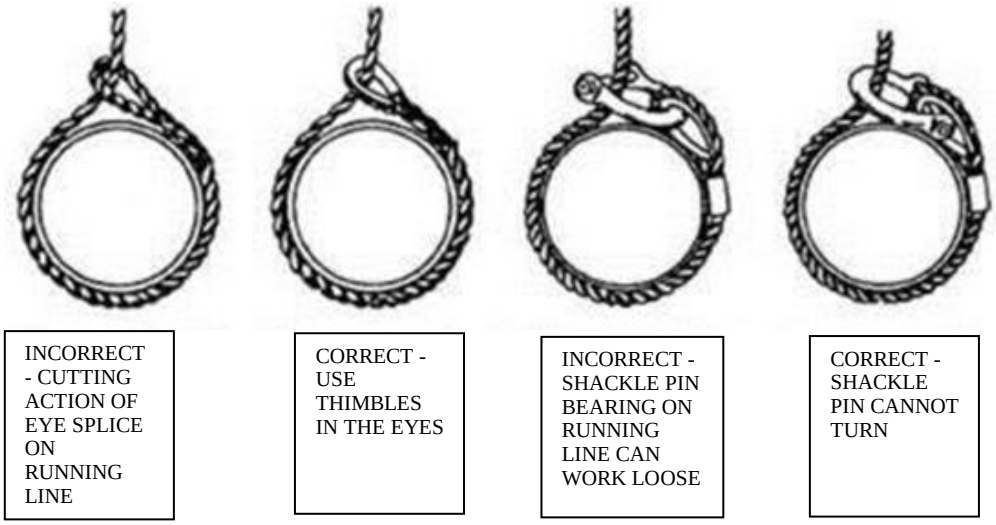
5.7 Shackles

a. Use only shackles that have been inspected prior to use and are in good working order. Shackles shall be inspected according to Section 5.0 of this procedure.
b. Use shackles of the same diameter or larger than that of the sling it is connected to (D/d = 1).

c. When using synthetic slings, use shackles large enough to allow the webbing to lie close to flat in the shackle and not bunch up or over-stress the outer edges or center of the web.
d. Ensure the bolt in a screw pin shackle, or the nut on a bolt/anchor type shackle turns easily. If the pin or nut is difficult to turn the shackle should not be used.
e. Hand tighten the pin to prevent spreading of the bow during lifting. The shoulder of the pin and the nut (bolt-type shackles) shall contact the shackle body or bow.
f. Place the pin of the shackle in the hook of the lifting equipment.



g. Place the pin in the eye of the sling when using a Choker Hitch.



h. Decrease the capacity of the shackle if it is not being pulled perpendicular to the pin of the shackle.
   - Note: De-rate the shackle by 30% capacity if it is being pulled at 45º from perpendicular to the pin, or by 50% of capacity if being pulled at 90º or greater (see Figure 9).

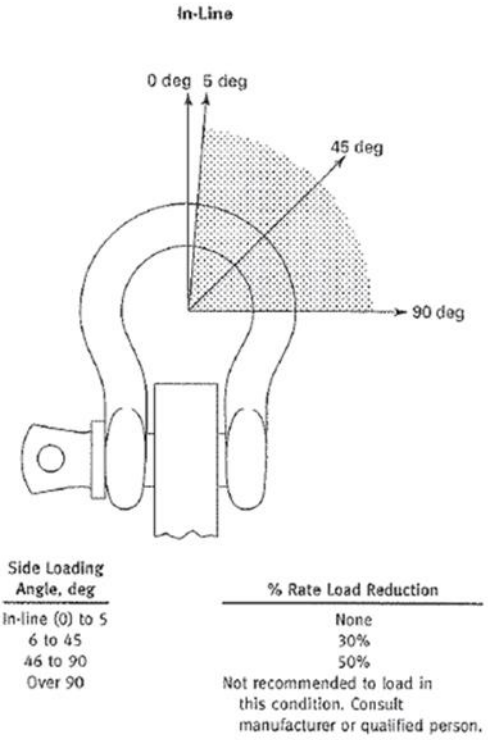
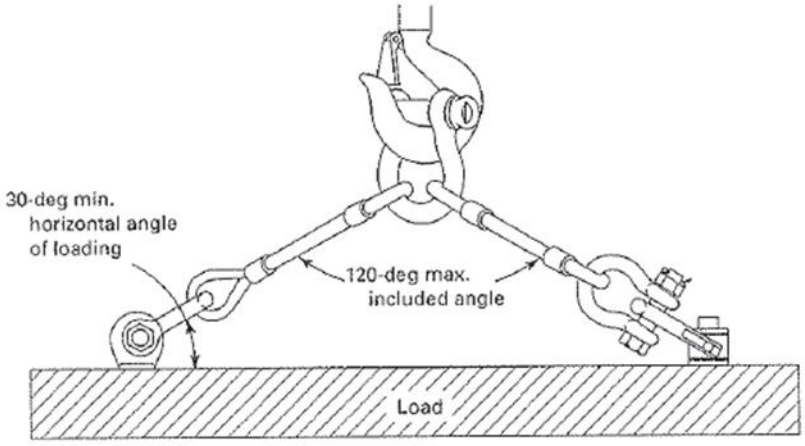


Figure 9 - Percent Rate Load Reduction as a Result of Side Loading

5.8 Using Multiple Slings on a Shackle

1. Ensure multiple sling loads are not applied to the pin or bolt of the shackle.
2. Screw pin shackles shall not be used in a manner that would cause the pin to unscrew during lifting.
3. When using multiple slings, do not exceed 120º included angle loading on shackle body (see Figure 10).



Horizontal Angle, deg	Stress Multiplier
90	1.000
60	1.155
45	1.414
30	2.000

Figure 10 - Increased Stress on the Shackle when using Multiple Slings

5.9 Lever Hoists

Using chain lever hoists allows for a load to be stopped and kept stationary at any point. Because of their slow rate of travel, chain lever hoists also allow precise vertical placement.

- Chain lever hoists are intended for use in a vertical or near vertical position only. They should be rigged so that there is a straight line between the upper and lower hooks. Always make sure that the lever hoist is hanging freely.

Lever hoists are a portable means of lifting or pulling loads short distances. They can be used vertically, horizontally or on an angle.

Lever Hoists shall be inspected according to Section 3 of this document.

5.10 Attaching the Load

1. The supporting structure or anchoring means must have a load rating at least equal to that of the hoist.
2. Hoisting from non-process equipment is preferred. If a process line is to be used as an anchor, refer to Table 5 below to select the appropriate pipe size for an intended load.

Pipe Size	Weight of water per ft	Weight of pipe per ft	Weight of water plus pipe per inch	Stress due to pipe + water, psi	Maximum Allowable Load (lbs.)

2 in Sch 80	1.28	5.02	0.52	21.55	122
3 in std wt.	3.20	7.58	0.9	15.63	287
4 in std wt.	5.51	10.79	1.36	12.69	535
6 in std wt.	12.51	18.97	2.62	9.26	1,416
8 in std wt.	21.70	28.6	4.19	7.48	2,801
10 in std wt.	34.20	40.5	6.23	8.84	3,518
12 in std wt.	49.00	49.6	8.22	5.63	7,298
14 in std wt.	59.70	54.6	9.53	5.37	8,864
16 in std wt.	79.10	62.6	11.81	5.04	11,714
18 in std wt.	101.20	70.6	14.32	4.79	14,946
20 in std wt.	126.00	78.6	17.05	4.59	18,562
22 in std wt.	153.70	86.6	20.03	4.44	22,562
24 in std wt.	183.8	94.6	23.20	4.30	26,978
30 in std wt.	291.20	119	34.18	4.02	42,458

Note: Pipe condition(s) shall be considered when using piping as an anchor. If there are any questions or if parameters may be exceeded, consult the Inspection Department.

Section Modulus is a geometric property for the cross-section of a pipe. A low Section Modulus means pipe has low strength. A high Section Modulus means pipe has high strength.

Assumptions:

- Pipe is assumed to be carbon steel, ASTM A53 or A106 GR B allowable stress = 20,000 psig.
- Pipe is no more than 300°F.
- Load is applied at the middle of a 20 ft span.
- Pipe is not insulated and is full of water/liquid.

- Stress due to internal pressure or thermal loads have not been included.
- Pipe is in good to new condition.

Do not use pipe in highly toxic service or under pressure greater than 500 psig.

Table 5 - Maximum Loads for Rigging Off Pipe (Provided by Engineering)

5.11 Safety Precautions

1. Use proper body mechanics when operating a hoist.
2. Ensure that anchorage and structure will support the load. When using process piping as an anchor point, ensure the Inspection Department has approved the anchor point. Consider the following examples: external corrosion, live process, hot/cold piping, process service, pipe diameter.
3. Do not use cheater on hoist handle.
4. Never exceed the working load limit (WLL) marked on the hoist.
5. Do not use the hoist chain as a sling or choker.
6. Ensure that load chain is properly seated in wheels or sprockets before lifting.
7. Do not leave the suspended load unattended.
8. Keep the hoist chain straight.
9. Stand clear of load and pulling path of hoist chain. Do not stand under the load.
10. Keep upper and lower hooks in a straight line so that the frame is free to swivel.
11. Do not use a hoist with a twisted, kinked, damaged, or worn chain.
12. Ensure the hook is positioned above the center of gravity of the load.
13. Do not carry loads over personnel.
14. Do not support or move the load using the tip of the hook or hook latch
15. Only one operator should pull on a single hand chain at a time.
16. Maintain the chain hoist according to manufacturer's specifications. Ensure chain hoists are inspected according to Section 3 of this document.

5.12 Hydraulic Jacks

Hydraulic jacks are quite compact and can lift very heavy loads. They are readily available in capacities ranging from a few tons to over 1,000 tons, for specialty units.

Hydraulic jacks are also available in low profile models that can be positioned under a load close to the ground. Also known as "button jacks", these are useful for lifting a load high enough to get a regular jack in place.

a. DO NOT use connecting hoses that are unnecessarily long.
b. Jacks should only be used in a true vertical position for lifting.
c. Jacks should never be used for long-term support of a load. Whenever possible, the load should be progressively blocked as jacking proceeds.

5.13 Davits

Davit cranes at LAR shall be load rated, inspected and approved for use by the Inspection Department. Manway davits shall not be used to lift anything other than the equipment for which it was designed. Manway davits are not subject to routine inspection.

5.14 Monorails

a. Monorails at LAR shall be approved for use by the Inspection Department. (Note: If the MPC color code for inspection for the current year is visually present on both sides of the monorail, the Inspection Department does not have to approve the use of the monorail.)
b. A visual inspection shall be conducted of the beam and attachment points for each monorail.
c. Monorails shall be load rated and have end stops on both ends of the beam, of the proper size, to stop the trolley from exiting the beam during use.

6.0 Training

Personnel using rigging or hoisting equipment must be trained and qualified in the pre-use inspection and operation of the equipment by their respective companies.

Specific training to qualify MPC LAR Craftsperson's and Equipment Operators will be provided through the MPC LAR Learning and Development Department.

Appendix A: Terms and Definitions

A.1 Basket Hitch	A method of rigging a sling in which the sling is passed around the load and both eyes of the sling attached to the lifting device. A fully rated basket hitch has an even wrap, 90° legs, and a D/d ratio of at least 25:1.
A.2 Bird Caging	Damage to a wire rope creating a torsional imbalance on the rope such that the strands are separated and distorted such that they will no longer evenly distribute the load to the rope; caused by sudden stops, pulled through too small a sheave, etc.
A.3 Choker Hitch	A method of rigging a sling in which the sling is passed around the load, then though one loop eye, end fitting, or other device, e.g., a shackle, with the other loop eye or end fitting attached to the lifting device.
A.4 Competent Person	One who can identify existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authority to take prompt corrective measures to eliminate them.
A.5 D/d Ratio	The ratio of the diameter (D) of the item being picked or connector to the diameter (d) of the sling or rigging used to pick it.
A.6 Designated Person	A qualified person selected or assigned by a Maintenance Supervisor (aka Maintenance Foreman) as being competent to perform specific duties.
A.7 Hitch	Method of attaching a sling to a load, i.e. choke, basket, double wrap, etc.
A.8 Kink	A deformation of wire rope so severe that the wires or strands are pushed out of their original position permanently deforming the wire rope by locking wires and strands, thereby preventing them from sliding and adjusting to properly take the load. It represents irreparable damage and is cause for replacement of the wire rope.
A.9 Lay	Length along the rope in which one strand makes a complete revolution around the rope.

A.10 Lifting Technical Authority (LTA)	The Maintenance Supervisor (or equivalent), or their designee, who has the responsibility and accountability for overseeing lifting practices on site and providing technical advice and assurance to ensure the site practices are followed.
A.11 Load	Refers to the object(s) being hoisted and/or the weight of the object(s); both uses refer to the object(s) and the load-attaching equipment, such as, the load block, ropes, slings, shackles, and any other ancillary attachment.
A.12 Qualified Person	A person who operates/uses equipment and has possession of a certificate of professional standing, or has knowledge, training, and/or experience in the operation and inspection of equipment.
A.13 Rated Capacity	The maximum allowable working load established by the rigging equipment manufacturer. The terms “rated capacity”, capacity, safe working load (SWL), and “working load limit” are commonly used to describe rated load.
A.14 Rigger	The Qualified Person(s) designated to be responsible for the safe handling of a load.
A.15 Reeving	A rope system in which the rope travels around drums and/or sheaves.
A.16 Shackle	A U-shaped load bearing connector designed to be used with a removable pin.
A.17 Side Loading	A load applied at an angle to the vertical plane of the boom/lift.
A.18 Signal Person(s)	Qualified Person assigned to signal the hoisting equipment during rigging and hoisting operations. Only one signal person at a time will have authority to directly signal the lifting equipment operator.
A.19 Sling	An assembly which connects the load to the material handling equipment.
A.20 Softener	A material of enough strength, thickness, and construction to prevent damage to the load or sling in contact with edges, corners or protrusions.

A.21 Sorting Hook	Hook with a long tip that is designed for sorting material. To be used only at ground level and only for sorting material, since they do not have a latch.
A.22 Synthetic Sling Shackle	A wide body shackle designed to be used with synthetic slings to prevent bunching or pinching of the sling material, which reduces the rated capacity, and which could cause additional stress on the edges or center of the webbing.
A.23 Total Gross Load	The total weight of equipment or material being lifted applied to the crane or hoisting equipment, including the weight of load attaching equipment such as lower load block, spreader bars, shackles, slings, additional parts of load line cable, etc.
A.24 Wire Rope Clamp	Also called a clip, is used to fix the loose end of the loop back to the wire rope. It usually consists of a U-shaped bolt, a forged saddle, and two nuts.
A.25 Wire Rope Sling	An assembly fabricated from WIRE ROPE which connects the load to the lifting device.

Revision History

Document Revision History

Complete the following table for each document revision.

Rev. No.	Description of Change	Author	Approved By	Rev. Date	Effective Date
00	First issue of document.	Alek Hamparian	Safety Manager	06/29/20	06/29/20
01	Updated inspection color sequence	Brian Quinn	Safety Manager	03/27/24	03/27/24