

<b>Lifting Devices Rigging and Signaling</b>	S.O.P. 3P		Page 1 of 10
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STANDARD OPERATING PROCEDURE			

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### I. SCOPE AND PURPOSE

- A. To establish guidelines for the safe use and care of lifting devices. In most cases a third party contractor will provide mechanical lifting equipment and certified operators for the Company's use. This procedure provides general information for supervisors and employees so that they may provide additional safety and quality assurance on those jobsites utilizing mechanical lifting devices.
- B. To establish a standardized visual method for communication of information to Motorized Crane Operators and Motorized Materials Movement Equipment Operators.

### II. RELATED PROCEDURES AND RESOURCES

- A. S.O.P. 3J, Signs, Tags and Barricades
- B. S.O.P. 3M, Manual Materials Handling
- C. Attachment Form 3P.1a, Hand Signals for Hoisting Operations
- D. 29 CFR 1926, Subpart N, Cranes, Derricks, Hoist, Elevators and Conveyors
- E. 29 CFR 1926.251, Rigging Equipment for Material Handling

### III. PERSONNEL RESPONSIBILITY

- A. Supervisor:
  - 1. The supervisor is to ensure that lifting equipment on their project is maintained and used in the manner intended by the manufacturer.
  - 2. The supervisor shall ensure all personnel have received the necessary training and comply with all aspects of this procedure.
- B. Employee:
  - 1. The employee is to comply with these procedures and routinely inspect

and report as soon as possible, any damaged lifting equipment to their supervisor.

#### **IV. WIRE ROPE MAINTENANCE**

- A. Rope shall be stored in such a manner as to prevent damage or deterioration.
- B. Unreeling or uncoiling of rope shall be done as recommended by the rope manufacturer or a qualified person and with care to avoid kinking or inducing a twist.
- C. Means shall used to prevent un-laying of the strands of the rope prior to cutting. Flame cutting of rope is strictly prohibited.
- D. During installation, care should be observed to avoid dragging the rope in the dirt or around objects; which could scrape, nick, crush or induce sharp bends.
- E. Unless prohibited by other considerations, rope should be well maintained in a well-lubricated condition.
  - 1. Lubricant applied, as part of a maintenance program, shall be compatible with the original lubricant. The rope manufacturer should be consulted to ensure compatibility.
  - 2. Those sections of rope, which are located over sheaves or otherwise hidden during inspection and maintenance procedures, require special attention when lubricating rope.
  - 3. The primary reason to lubricate the rope is to reduce internal friction and to prevent corrosion.

#### **V. SLINGS**

- A. General
  - 1. Slings shall have a minimum safety factor of 5, based on breaking strength. Features, which affect the rated capacity of the sling and shall be considered in calculating the factor of safety, are:
    - a. Nominal breaking strength of material from which it is constructed.
    - b. Splicing or end-attachment efficiency.
    - c. Number of parts in the sling.
    - d. Type of hitch, e.g., straight pull, choker hitch, or basket hitches.
    - e. Angle of loading and load center-of-gravity.
    - f. Diameter of curvature around which the sling is bent.
  - 2. Published working loads for chain slings are usually based on 25-33% of their failure or breaking point.
  - 3. The center of gravity of an object is a point around which the entire weight may be concentrated. In order to make a level lift, the crane hook or point of suspension must be directly above this point. While slight variations are usually permissible, if the crane hook is too far to one side of the center of gravity, dangerous tilting will result and should be corrected at once. For this reason, when the center of gravity is closer to one point of the sling

attachment than to the other, the slings must be of unequal length. Sling stresses and sling angles will also be unequal.

4. Slings shall be secured or terminated at the crane hook so that the sling does not slip through the hook. To attach the load, locate the center of gravity (CG), position the crane hook directly above the CG, and then rig the load so that it will lift level and true.
5. The following is an example of selecting a sling using the load angle factor.
  - a. Load = 1000 lb.
  - b. Sling is a 2-legged bridle
  - c. Angle with horizontal =  $45^\circ$
  - d. Load angle factor  $8-7 = 1.414$
  - e. Each of the two legs would lift 500 lbs. if a vertical lift were made. However, there is a 45-degree sling angle involved. Therefore, the 500 lb. load would be multiplied by the load-angle factor giving a total of 707 lb. ( $500 \text{ lb.} \times 1.414 = 707 \text{ lb.}$ ) tension in each sling leg. Each sling leg therefore, must have a rated capacity of at least 707 lbs.

#### B. Safe Load

1. The safe working load or rated capacity of a sling varies depending upon the type of hitch.
2. In cases where bridle slings or multi-leg lift assemblies with three or more legs are used to lift a rigged load, it should be assumed that the load will be carried by only two legs.

#### C. Factor of Safety

1. In general, a safety factor of 5 is maintained throughout this section. However, certain sling fittings, such as hooks, which will straighten without breaking or links, which will deform beyond usefulness before breaking, cannot be assigned a definite numerical safety factor. In such cases, suitable safe loads are listed, based upon wide experience and sound engineering practice.

#### D. Sling Care

1. Proper care and usage are essential for maximum service and safety. Wire-rope slings should be protected from sharp bends and cutting edges by means of corner saddles, burlap padding, or wood blocking. Heavy or continuous overloading should be avoided, as well as sudden jerks, which can build up a momentary overload sufficient to break the sling. Slings should be lubricated to prevent rust and hung up when not in use.

#### E. Sling Storage

1. Wire Rope Chain Slings
  - a. Slings shall be sorted in racks, preferable vertical and in designated locations when not in use.
  - b. Slings should be wiped clean periodically to remove as much dirt and abrasive grit as possible and be re-lubricated to extend their

- useful life. Chains should not be lubricated when in use.
      - c. Slings should be stored in a location where they will not be subjected to mechanical damage, corrosive action, moisture, extreme heat, or kinking.
      - d. Slings may require segregated storage, as determined on a case-by-case basis.
    - 2. Metal-Mesh and Synthetic-Web Slings
      - a. Slings shall be stored in racks, preferably vertical and in designated locations.
      - b. Slings shall be wiped down periodically to remove as much dirt and abrasive grit as possible.
      - c. Metal-mesh slings shall not be stored in areas where the temperature exceeds 550° F (288° C).
      - d. Synthetic- web slings shall not be stored where the temperature exceeds 200° F (93° C).
      - e. Slings may require segregated storage, as determined on a case-by-case basis.
- F. Wire Rope Slings
  - 1. In general, wire rope slings are made up of 6 x 19 or 6 x 37 classification wire rope. Rotation resistant wire rope shall not be used for wire-rope slings. Different kinds of slings have been developed for specific purposes. These are divided into different groups or types as follows:
    - a. Endless-loop slings (grommet construction) and single-part with single-rope legs, double-rope legs, or multiple-part-rope legs.
    - b. Two-leg bridle slings with single-rope legs, equalizing double-rope legs, or multi-part-rope legs.
    - c. Three-leg bridle slings.
    - d. Four-leg bridle slings.
    - e. Special slings and combinations.
  - 2. The total load, which can be safely lifted with slings, depends upon the rating of the slings and the manner in which the slings are attached to the load.
    - a. Fiber core wire rope slings of all grades shall not be exposed to temperatures in excess of 200° F (93° C).
    - b. When wire rope slings of any grade are to be used at temperatures above 400° F (204° C), or below minus 60° F (-51° C), the sling manufacturer should be consulted.
    - c. Extremely low temperatures (<0° F) may cause brittle fractures. Under these conditions, sudden loading should be avoided and the rope should be carefully observed while the load is being applied.
- G. Braided slings are made by braiding ordinary wire ropes together, thus making them more flexible than wire-rope slings. The size of a braided sling is determined by the diameter of one wire rope and the number of ropes in the cross section of the sling.

## H. Inspections

**NOTE:** Supervisors should note that inspection records should be readily available for their review.

1. All slings shall be visually inspected (records are not required) each day they are used or prior to use if the sling is not in regular service. In addition, a periodic inspection (with records) shall be made at least annually by a qualified inspector. More frequent intervals should be established if necessary as determined by a qualified person based on:
  - a. Frequency of use.
  - b. Severity of service conditions.
  - c. Nature of lifts being made.
  - d. Experience gained on the service life of slings used in similar circumstances.
2. Any deterioration, which could result in an appreciable loss of original strength shall be carefully noted and determination made whether further use of the sling would constitute a safety hazard.
3. Slings shall be immediately removed from service if any of the following conditions are present:
  - a. Ten randomly distributed broken wires in one rope lay, or five broken wires in one strand in one rope lay.
  - b. Wear or scraping of one-third the original diameter of outside individual wires.
  - c. Kinking, crushing, bird caging, or any other damage resulting in distortion of the rope structure.
  - d. Evidence of heat damage.
  - e. End attachments that are cracked, deformed, or worn.
  - f. Corrosion of the rope or end attachments.
4. Proof Testing
  - a. Mechanically spliced, single leg and endless slings shall be certified as having been proof tested to 200% of the rated capacity prior to initial use.
  - b. The proof load for single leg, hand tucked slings shall, as a minimum, be equal to the rated capacity but shall not exceed 125% of the rated capacity.
  - c. The proof load for multiple leg bridle slings shall be applied to the individual legs and shall be either 200%, for mechanical splice, or 125%, for a hand tucked splice, of the vertical rated capacity of a single leg sling. Master links to which multiple leg slings are connected shall be proof loaded to 200% of the force applied by the combined legs.
  - d. Welded end attachments shall not be used unless proof tested at 2 times rated capacity prior to initial use.

- e. Test loads stipulated in (1), (2), (3), and (4) above shall be accurate to within -5%, +0% of stipulated values. Certification by the manufacturer or a pull test certified by a qualified person is acceptable.

I. Operating Practices

1. Ordinary lifts

- a. Ensure that materials handling area and lift area are properly barricaded with appropriate barricade tape and tags.
- b. Start and stop slowly; sudden starts and stops increase the stresses in the crane hoist ropes and the slings.
- c. Loads shall be set on blocks. Pulling a sling from under a load, which is resting on the sling, shall not be permitted.
- d. Wire-rope slings shall be protected against weather, chemicals, solvents, and high temperatures.
- e. Fiber core rope slings exposed to temperatures in excess 200° F (93° C) shall be permanently removed from service.
- f. The manufacturer's recommendation shall be followed for use of non-fiber core rope slings at temperatures above 400° F (204° C) or below 0° F (-51 °C).
- g. Knotted slings shall not be used.
- h. Single-leg wire rope slings shall not be secured at the hook to prevent suspended loads from rotating.
- i. Each leg of a wire rope sling should be secured at the hook to prevent slippage of the sling through the hook.
- j. A complete turn of wire rope around the crane hook shall not be made.
- k. Protector pads or blocking shall be used at sharp corners.
- l. Shackles or adjustable choker hooks should be used when making choker hitches.
- m. Slings should be stored on racks away from moisture and acids when not in use.
- n. Damaged wire rope slings shall be removed from service, discarded, and replaced with new slings.
- o. Both prior to use and before storage, wire rope slings shall be checked for:
  - i. Broken or cut wires or strands.
  - ii. Rust or corrosion
  - iii. Kinks
  - iv. Broken seizing wire
  - v. Damage to swaged fittings
  - vi. Other signs of damage or abuse
- p. Wire rope clips shall not be used to fabricate wire rope slings except where the application of slings prevents the use of prefabricated slings or where the specific application is designed

by a qualified person.

- p. When using wire rope clips, the rating of the sling must be de-rated to 80% of the wire rope rating to allow for the inefficiency of the clips.

J. Proof Testing

1. Single leg and endless alloy steel chain slings shall be certified as having been proof tested to 200% of the rated capacity, prior to initial use.
2. The proof load for multiple leg bridle slings shall be applied to the individual legs and shall be 200% of the vertical rated capacity of a single leg sling. Master links to which multiple leg slings are connected shall be proof loaded to 200% of the force applied by the combined legs.
3. Test loads stipulated in (1) and (2) above shall be accurate to within -5%, +0% of stipulated values.
4. Certification by the manufacturer or a pull test certified by a qualified person is acceptable.

K. Operating Practices

1. Loads shall be set on blocks. Setting a load on a sling or pulling a sling from under a load is not permitted. Place wooden blocks under the load high enough to clear the chain.
2. Shortening of chain slings shall be accomplished by hooking back into the chain, into the master link, or with grab hooks. Shortening by knotting, twisting, bolting, or inserting the tip of the hook into a link shall not be permitted.
3. A chain shall not be hammered to force it into position.
4. Chain slings shall be protected from sharp corners, which might bend the links. A suitable pad shall be used to prevent gouging or bending of the chain links, as well as possible scarring of the load.
5. When making choker hitches with chain slings, always face the hook opening out and away from the pull of the sling, so that the hooks will not slip out when slack is taken out of the sling.
6. Steel chain slings shall be checked for
  - a. Nicks, cracks, gouges, and wear.
  - b. Banding, stretching, or shearing of links.
  - c. Bent or distorted hooks.
  - d. Rust and corrosion.
  - e. Uneven lengths when sling legs are hanging free.
  - f. Evidence of heat damage.
7. Welding and local repairs of chain slings shall not be made. All defective chain slings should be returned, through formal procedure, to the vendor for examination, repair, and re-certification.
8. Sudden loading of chain slings shall be avoided.
9. Latches on hooks shall be maintained in good condition.
10. If a chain sling does not look safe, it must not be used. Do not assume that a chain sling is safe because it looks new; look for stretched links. If in

doubt, check with the supervisor.

11. Loads shall not be carried on the point or tip of a hook.
12. Avoid unbalanced loads.
13. Homemade links, makeshift fasteners formed from bolts, rods, etc., or other such attachments shall not be used.
14. The ends of all empty chains shall be hooked onto the hoist hook or bull ring.
15. Makeshift or field-fabricated hooks shall not be used on steel chain slings.
16. Steel chain slings used in DOE-controlled areas shall be marked, as a minimum with
  - a. Size.
  - b. Manufacturer's grade.
  - c. Related load and angle upon which the rating is based.
  - d. Reach.
  - e. Number of legs.
  - f. Sling manufacturer.
  - g. Inspection due date.
  - h. This information may be stenciled or stamped on a metal tag(s) affixed to the sling.
17. Where slings have more than one leg, the tag shall be affixed to the master link.
18. The working load shall not exceed the rated capacity of the sling.

## **VI. CRITICAL LIFTS**

- A. General
  1. This section specifies the guidelines for critical lift determination and delineates the requirements applicable to planning and performing a critical lift in a safe and well thought-out manner.
- B. Critical Lift Determination
  1. An appointed person shall classify each lift into one of the DOE categories (ordinary and critical) prior to planning the lift.
  2. A lift shall be designated as a critical lift if collision, upset, or dripping could result in any one of the following.
    - a. Damage that would result in, unacceptable delay to schedule or other significant program impact, i.e., loss of vital data.
    - b. Significant release of radioactive/other hazardous material or other undesirable conditions.
    - c. Unacceptable risk of personnel injury or significant adverse health impact (on-site or off-site).
    - d. Undetectable damage that would jeopardize future operations or the safety of a facility.

**NOTE:** A lift should also be designated as critical if the load requires exceptional care in handling because of size, weight, close-tolerance installation, high susceptibility to damage, or other unusual factors.














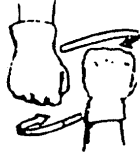









- C. Critical Lift Requirements
  - 1. The applicable provisions for ordinary lifts specified in each section of this manual for a particular equipment category shall be met.
  - 2. The operating organization shall appoint a person-in-charge (PIC) of the entire lifting operations. This person shall meet the definitions of “appointed”, “designated”, and “qualified” person and shall be present at the lift site during the entire lifting operation.
  - 3. The PIC shall ensure that a pre-job plan or procedure is prepared, which defines the operation and shall include the following:
    - a. Identification of the items to be move, the weight, dimensions, center of gravity, and the presence of hazardous or toxic materials.
    - b. Identification of operating equipment crane or cranes, to be used by type and rated capacity.
    - c. Rigging sketches which shall include as applicable:
      - i. Identification and rated capacity of slings, lifting bars, rigging accessories, and below-the-hook lifting devices.
      - ii. Load-indicating devices.
      - iii. Load vectors.
      - iv. Lifting points.
      - v. Slings angles.
      - vi. Boom and swing angles.
      - vii. Method of attachment.
      - viii. Crane orientations.
      - ix. Other factors affecting equipment capacity.
    - d. Operating procedures including special instructions to operators including rigging precautions and safety measures to be followed as applicable.
- D. Experienced operators who have been trained and qualified to operate the specific equipment to be used shall be assigned to make the lift.
- E. Only designated, qualified signalers shall give signals to the operator. **However, the operator shall obey a STOP signal at all times, no who matter who gives the signal.**
- F. A pre-lift meeting involving participating personnel shall be conducted prior to making a critical lift. The critical lift plan/procedure shall be reviewed and questions shall be resolved.

## **VII. SIGNALING**

- A. Signaling is an important factor in the success of any lift.
- B. Universal hand signals have been created to provide a consistent form of

communication.

- C. Attachment 3P.1a provides a guide to the Universal Hand signals adopted by the Company.
- D. Personnel involved in lifting activities shall utilize these hand signals where natural voice or radio communication is not feasible.
- E. Situations where voice communication may not be feasible are:
  - 1. High noise areas.
  - 2. Lifting to heights at twenty feet above grade.
  - 3. Or any other situation where the supervisor deems hand signaling to be a safer and more appropriate means of communication.

<b>HAND SIGNALS FOR HOISTING OPERATIONS</b>		
 <b>Load Up</b> 1	 <b>Load Down</b> 2	 <b>Load Up Slowly</b> 3
 <b>Load Down Slowly</b> 4	 <b>Boom Up</b> 5	 <b>Boom Down</b> 6
 <b>Boom Up Slowly</b> 7	 <b>Boom Down Slowly</b> 8	 <b>Boom Up Load Down</b> 9
 <b>Boom Down Load Up</b> 10	 <b>Everything Slowly</b> 11	 <b>Use Whip</b> 12
 <b>Use Main Line</b> 13	 <b>Travel Forward</b> 14	 <b>Turn Right</b> 15
 <b>Turn Left</b> 16	 <b>Shorten Hydraulic Boom</b> 17	 <b>Extend Hydraulic Boom</b> 18
 <b>Swing Load</b> 19	 <b>Stop</b> 20	 <b>Close Clam</b> 21
 <b>Open Clam</b> 22	 <b>Dog Everything</b> 23	

**No response should be made to unclear signals!**