CRANE AND RIGGING PROGRAM

FOR:

R.W. LaPine Inc.
Mechanical Contractors

Date: 11-05-2005
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INDEX

PURPOSE

R.W. LaPine, Inc. recognizes that crane and rigging operations require special consideration in order to protect against death and injuries. R.W. LaPine, Inc.'s policy is to maintain a safe workplace for its employees; therefore, only qualified individuals will be involved in crane and rigging operations. MIOSHA standards shall be strictly adhered too. The safety rules listed in this program shall apply to all R.W. LaPine, Inc. employees, supplemental labor, and subcontractor personnel.

RESPONSIBILITIES

Management:

- Identify areas where hoisting and rigging techniques are used.
- Obtain necessary equipment.
- Establish procedures for inspection, care and maintenance of equipment.
- Ensure workers are trained.

Job-Site Foreman:

- Know when hoisting and rigging techniques are necessary.
- Ensure equipment is properly maintained.
- Ensure workers use safe lifting and rigging techniques.

Safety Manager:

- Assist in identifying areas where hoisting and rigging techniques are used.
- Provide worker training.

Employees:

- Attend training.
- Know how to perform necessary equipment inspections.
- Know how to maintain equipment.
- Use appropriate safe lifting and rigging techniques.

CRANE SETUP

Swing Radius:

Accessible areas within the swing radius of the rear of the rotating superstructure of the crane, either permanently or temporarily mounted, shall be barricaded in a manner that prevents any employee from being struck or crushed by the crane.

Ground Stability:

Soil type must be determined to be acceptable for the imposed load, and underground utilities and structures are not at risk for damage. Cranes must not be used unless ground conditions are able to support the equipment and any supporting materials per the manufacturer's specifications.

Assembly/Disassembly:

All manufacturer instructions and prohibitions shall be followed when assembling and/or disassembling equipment. Only a competent and qualified person may direct the assembly and disassembly of the equipment.

Overhead Clearances:

A per-operation hazard assessment will be performed to identify the work zone and determine if any part of the equipment could reach closer than 20 feet to a power line. In the event this could occur the following actions will be taken:

Contact utility to de-energize the overhead hazard. If this is not practical then the following policy shall be enforced.

Equipment shall not be operated closer to an exposed energized part than the clearances prescribed in table 1. If adequate clearance cannot be maintained then R.W. LaPine, Inc. shall notify the owner of the energized part and shall comply with either of the following;

(a) An insulated barrier shall be installed on the exposed energized part.
(b) The energized part shall be de-energized and grounded.

TABLE 1

Voltage	Boom Raised	Clearance Boom Lowered and No Load
to 50 kV	10 feet	4 feet
50 to 345 kV	10 feet + 0.4 inch per kV over 50 kV	10 feet
346 to 750 kV	10 feet + 0.4 inch per kV over 50 kV	16 feet

CRANE INSPECTION

A visual inspection of the equipment shall be made by a competent person prior to each shift of use. In addition to regular inspections, monthly inspections shall be made by a competent person and the inspections shall be documented.

During inspection all safety devices shall be determined to be in proper working order before any operation begins. All manufacturers procedures applicable to the operational function of the equipment must be complied with.

All operating procedures including the operation manual shall be readily available in the cab at all times.

SELECTION, USE and INSPECTION of SLINGS

Employees involved in hoisting and rigging must exercise care when selecting and using slings. The selection of slings should be based upon the size and type of the load, and the environmental conditions of the workplace. Slings shall be inspected visually before each use, to ensure their effectiveness.

Slings and rigging equipment shall not be loaded in excess of its recommended safe working load. All slings and rigging equipment when not in use shall be removed from the work immediate work area.

There are three groups of slings, chain, wire rope and mesh, and fiber rope web. Each type has its own particular advantages and disadvantages. Factors to consider when choosing the best sling for the job include;

- size
- weight
- shape
- temperature
- sensitivity of the material being moved
- environmental conditions under which the sling will be used

Tag lines:

Tag lines shall be used to maintain the stability of the lifting load.

Location of personnel:

Barricades and/or identified safety monitors shall stop anyone from entering the lift zone area. No employee will be allowed under any suspended load.

Chains:

Alloy steel chains are strong and able to adapt to the shape of the load. Care should be taken when using chain slings because sudden shocks will damage them. This may result in sling failure and possible injury to employees or damage to the load.

Chain slings shall be visually inspected prior to use. Attention should be paid to the following;

- stretching
- nicks
- gouges
- wear in excess of the allowances made by manufacturer

These signs indicate that the sling may be unsafe and must be removed from service immediately.

Wire Rope:

When selecting a wire rope sling to give the best service there are four characteristics to consider;

- Strength – Strength of wire rope is a function of its size (i.e. diameter of the rope), grade, and construction, and must be sufficient to accommodate the maximum applied load.
- Fatigue (Bending without failure) – Fatigue failure of wire rope is caused by the development of small cracks during small radius bends. The best means for preventing fatigue failure of wire rope slings is to use blocking or padding to increase the bend radius.
- Abrasive Wear – The ability of wire rope to withstand abrasion is determined by the size and number of the individual wires used to make up the rope. Smaller wires bend more readily and offer greater flexibility, but are less able to withstand abrasion. Larger wires are less flexible, but withstand abrasion better.
- Abuse – Misuse or abuse of wire rope slings will result in their failure long before any other factor. Abuse can lead to serious structural damage, resulting in kinks or bird caging. (Bird caging, the wire rope strands are forcibly untwisted and become spread outwards.)

Wire rope slings shall be visually inspected before use. Slings with excessive broken wires, severe corrosion, localized wear, damage to end-fittings (i.e. hooks, rings, links, or collars), or damaged to the rope structure (i.e. kinks, bird caging, distortion) must be removed from service and discarded.

Fiber Rope and Synthetic Web:

Fiber Rope and Synthetic Web slings are the best choice for use on expensive loads, highly finished or fragile parts, and delicate equipment.

Fiber Rope Slings – can deteriorate on contact with acids and caustics and, therefore, must not be used around these substances. Fiber slings that exhibit the following shall be taken out of service and discarded.

- cuts
- gouges
- worn surface areas
- brittle or discolored fibers
- melting or charring

A buildup of powder like sawdust on the inside of a fiber rope indicates excessive internal wear and that the sling is unsafe. If rope fibers separate easily when scratched with a fingernail, it indicates that the sling has suffered some kind of chemical damage and should be discarded.

Synthetic Web Slings – are commonly made of nylon, polypropylene or polyester. Synthetic web slings shall be inspected before use and should be removed from service if found to have any of the following;

- acid or caustic burns
- melting or charring of any part of the surface
- snags
- tears
- cuts
- broken stitches
- distorted fittings
- wear
- elongation beyond the manufacturer's specifications

SAFE LIFTING PRACTICES

Modifications:

Any additions that may affect the capacity or safe operation of the equipment must not be made without written approval from the manufacturer or approval from a registered professional engineer.

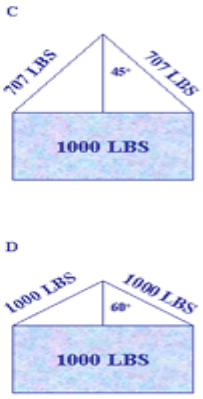
Load Size, Weight, and Center of Gravity:

The center of gravity of an object is that point at which the entire weight may be considered to be concentrated. To make a level lift, the hoist hook must be located directly above this point. If the hook is too far to either side of the center of gravity, dangerous tilting will result, causing unequal stress in the sling legs. Load imbalances must be corrected immediately.

Number of Legs and Angle with the Horizontal:

The smaller the angle between the sling legs and the horizontal, the greater the stress on the individual sling legs. This increased stress effectively decreases the weight that can be safely lifted with any given sling size. The rated capacity as marked on the sling shall never be exceeded.

Sling Angle with Vertical	Stresses per Sling Leg Per 1000 Lbs. Total Load
0	500
5	502
10	508
15	518
20	532
25	552
30	577
35	610
40	653
45	707
50	778
55	872
60	1000
80	2880



RIGGING

The most important job of any crane operation is rigging of the load. Poor rigging may result in personnel injury, property damage, or other serious hazards. R.W. LaPine, Inc. believes that it is essential for employees to take the necessary time to rigging the load. Rigging represents the single most hazardous potential of crane operation.

Rigging equipment for material handling shall be inspected prior to use and on each shift and as necessary during its use to ensure that it remains safe.

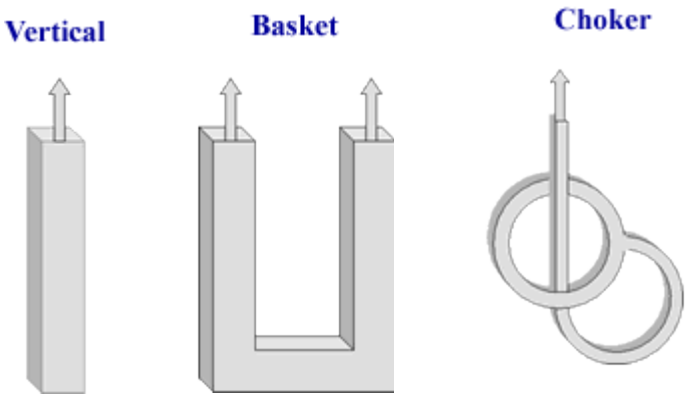
Latches will be in place on all hooks, eliminating the hook throat opening. Hooks on overhaul ball assemblies, lower load blocks, or other attachment assemblies shall be of a type that can be closed and locked, eliminating the hook throat opening.

Any defective rigging shall be removed from service, and taken off site.

In multi-sling operation, each leg must be of the same length and must contribute equally to load distribution.

Rigging shall be checked by lifting the load a few inches off the ground to ensure that no swing develops and that the load is completely secured. Before lifting the load make sure there are no loose items, such as screws or tools that may become projectiles during a lift.

SLING POSITION



Rigging slings may be utilized in three basic manners

Each sling carries with it a label with rated weight limit capacities for vertical, basket, and chocker configurations. The basket configuration, which is similar to using a spreader bar to distribute the weight on two legs instead of a single vertical sling, represents the highest rated capacity. The basket configuration is roughly twice as strong as the vertical configuration.

Example: A basket configuration with a 7200 lbs capacity would have a vertical capacity limit of only 3600 lbs. Taking a single sling and using it in the chocker configuration would further degrade the capacity of the sling, dropping the rate of capacity of 3600 lbs in the vertical position to 2900 lbs in the chocker position.

Therefore, in addition to the sling angle, sling position must be considered for all crane lifts.

CRANE and RIGGING SAFETY RULES

The crane operator has the authority to **STOP** and to refuse to handle loads whenever he or she believes there is a safety concern.

The following safety rules shall be enforced:

- Check limit switches before rigging the load
- Make sure the load does not exceed rated capacity
- Know the center of gravity of the load
- Attach load above the center of gravity for stability
- Select hitch that will control the load
- Know the rated capacities of rigging and slinging
- Inspect all rigging before use
- Protect the sling from sharp corners
- Allow for increased tension due to sling angle
- Equalize loading on multiple leg slings
- Allow for load reductions when using chocker hitches
- Attach tag line prior to lift
- Keep personnel clear of lift area
- Wear hard hats when making overhead lifts
- Lift load a few inches to verify rigging
- Check for any loose items
- Know limitations of hoisting device
- Start and Stop slowly, watch for obstructions
- Check pathway is clear before making a lift (use a spotter for blind spots)
- Verify hook completely closes
- Use appropriate hand signals
- Maintain load control at all times
- Report suspected drum wrappings immediately
- Never leave load unattended.

TRAINING

Crane operators shall be trained and qualified prior to being permitted to operate any crane. Before any employee is assigned the responsibility of rigging or directing a crane lift they shall receive training in the following areas.

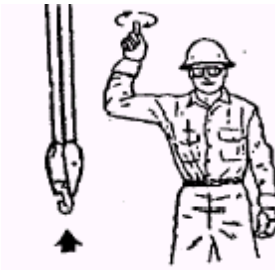
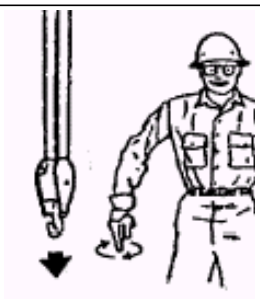
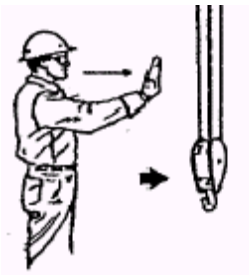
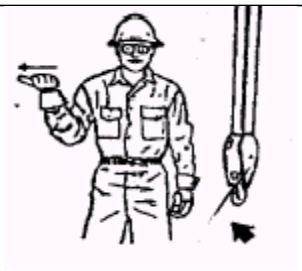
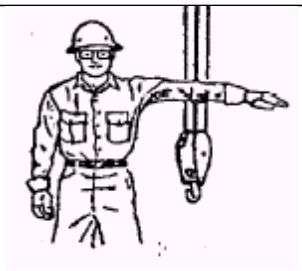
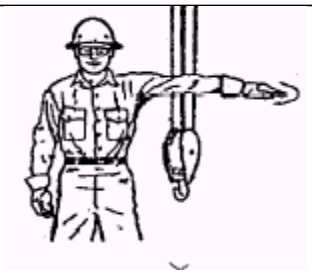
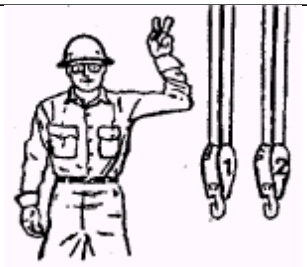
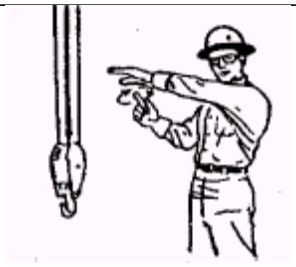
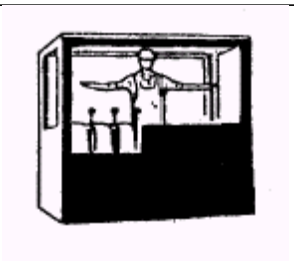
- Sling and hitch types
- Sling capacity determination
- Equipment inspection, care, and maintenance
- Load weight and center of gravity determination
- Safety lifting techniques
- Rigging safety requirements
- Proper hand signals

HAND SIGNALS

A signal person shall be provided when the crane operators view is obstructed. Or if site specific safety concerns require it, or the crane operator determines it is necessary.

Only one person shall direct a crane lift, and should be readily identifiable. The crane operator shall only take direction from this designated person, unless it is an emergency stop, which can be called out by anyone working with the lift.

Standard Hand Signals

 HOIST. With forearm vertical, forefinger pointing up, move hand in small horizontal circle	 LOWER. With arm extended downward, forefinger pointing down, move hand in small horizontal circle.	 BRIDGE TRAVEL. Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel.
 TROLLEY TRAVEL. Palm up, fingers closed, thumb pointing in direction of motion, jerk hand horizontally.	 STOP. Arm extended, palm down, hold position rigidly.	 EMERGENCY STOP. Arm extended, palm down, move hand rapidly right and left.
 MULTIPLE TROLLEYS. Hold up one finger for block marked “1” and two fingers for block marked “2”. Regular signals follow.	 MOVE SLOWLY. Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal. (Hoist Slowly shown as an example.)	 MAGNET IS DISCONNECTED. Crane operator spreads both hands apart – palms up.

ATTACHMENT A:

Critical Lift Plan & Crane Permit

CRITICAL LIFT PLAN & CRANE PERMIT

Permits must be posted at the lift site until lift is complete. Permits must be reissued if conditions (equipment, weather, and/or ground) or scope of work has changed. Critical lifts are considered any of the following types of lifts.

__ Two or more cranes are used to lift
__ Lifts =/> 24,000 pounds
__ Crane will lift personnel
__ Crane will "Walk" with load
__ Load will be upended and weighs > 10,000 lbs
__ Loads =/> 75% of Rated Load Capacity

GENERAL		
Contractor:	**Start Date/Time:**	**Finish Date/Time:**
_____	___/___/___ _____	___/___/___ _____
Crane Owner:	**Emergency Phone #**	**Crane lift location (area/building)**
_____	____ ____ _____	_____
Competent Person:	**Phone:**	
_____	____ ____ _____	

LIFT DATA	
1. Load Weight:	1. Describe Load and Enter Total Weight _____ Estimated Weight: _____ lbs. Actual Weight: _____lbs.
2. Rigging Weight (net load)	2a. Main Hoist Block, Auxiliary Boom Head / Headache Ball: _____ Total Block Weight: _____lbs. 2b. Slings, Shackles, Hardware (list all used): _____ Total Rigging Weight: _____lbs. 2c. Jib weight Allowance: _____ lbs. Check One: Erected (not used) __ Erected (in use) __ Jib Stowed (on boom) __

3. Total Lift Weight	3a. On Sling: 1 + 2b = _____ 3b. On Crane: 1 + 2a + 2b + 2c = _____
4. Lifting Height:	Height of Load to be not greater than _____ Feet __ Elevation drawing showing load height relation to crane and any obstructions is attached __ Maximum height of Crane Boom tip is within Permit Limits Granted by Airport
5. Operating Radius:	Maximum Radius of load to be not greater than _____ Feet __ Plan view of load location and crane orientation attached
CRANE DATA	
1. Crane Manufacturer:	Crane Manufacturer: _____ Size: _____ Model #: _____
__ Verify manufacturer's load chart indicates lifting capacity at stipulated load radius and boom lengths. Note: If boom length and/or radius is between the stipulated or posted value on the load chart select the **next lesser rating capacity. The next lesser rating capacity ay be the next longer or shorter boom length.**	
2. Attachments:	**__ Confirm Crane has an anti Two Blocking Device installed and is operational**
3. Counterweight:	__ Yes Total Weight _____lbs.
4. Boom Length:	Not greater than: _____ Feet Maximum height of Crane Boom/Extension: _____ Feet
5. Jib/Extension:	Jib Length (as extension): _____ Jib Offset: _____
6. Main Load Block:	Capacity Size: _____ ton # Sheaves: _____
7. Auxiliary Boom Head/Ball:	Capacity Size: _____ ton # Sheaves: _____
8. Outriggers, Pads, and Tires:	__ Outriggers Fully Extended and Set Ck One: __ Track __ Tires __ Soil Type is determined to be acceptable for imposed load __ It has been determined underground utilities and structures are not at risk for damage

RIGGING DATA	
1. Sling(s) and/or Shackles:	Diameter: _____ Length: _____ Capacity (per leg): ____ Indicate how slings are to be used: Basket: __ Vertical: __ Chocker: __ Size: _____ Capacity (ea.) _____
2. Provide brief description and sketch of load rigging:	

LIFT COMPUTATION		
Maximum Boom Angle:	**Maximum Boom Length:**	**Maximum Lift Radius:**

Note: Cranes equipped with computers indicating boom length, angle, and radius are *safety devices only* and should not be used in place of the operator's responsibility to actually determine the measurements required to calculate a safe lift.

Note: Accessories, Crane Capacity, Parts of Line and Rope Capacity, and the working quadrant of the crane should be considered when calculating Net Crane Capacities.

1. Net Crane Capacity:
(Rated Lift Capacity – Block, Rigging, and Accessory Weights) = _____ Tons

2. Load Orientation Prior to Lift: __ Front __ Side __ Rear

3. Swing Orientation Relative to Crane: __ Front __ Side __ Rear

4. Total Lift Weight: Item 3b of LIFT DATA: _____ lbs.

5. Total Weight on Slings & Shackles: Item 3a of LIFT DATA: _____ lbs.

6. Wind Speed: Lifts are not allowed with wind speed in excess of: ____ MPH
Wind Speed at time of lift: _____ MPH

The Contractor, Rigger, and Crane Operator are the competent persons solely responsible for the safe execution of the lift(s). Execution of the lift will be in complete accordance with MIOSHA regulations.

COMPLETE CHECKLIST BELOW TO ENSURE A SAFE LIFT IS PLANNED

__ The load weight is confirmed known
__ The load hook is directly over the load center of gravity
__ Boom angle, boom length, lift radius, and crane capacity are known
__ Outrigger pads are fully extended and blocking is sufficient for the load
__ Tires are clear of the ground and the crane is level
__ Ground, soil, and/or pavement is confirmed to have capacity for the imposed load
__ Rigging equipment has been inspected and in safe working condition
__ All obstacles and obstructions have been identified
__ Lifts in close proximity to power transmission lines meet minimum safety distances
__ A final check will determine the wind speed is within approved limits for this lift
__ A signal method has been determined between the crane operator and the signal person
__ An individual has been designated to observe for obstructions and unauthorized personnel
__ The crane operator meets MIOSHA qualifications requirements to operate the crane

__ Verify a "competent person" is to inspect prior to use and during use, all slings, fastenings, and attachments for damage or defects. Damaged or defective equipment shall be immediately removed from service.

__ Verify a "competent person" is to inspect all crane equipment and machinery prior to use during use to ensure it is in safe operating condition. Any deficiencies shall be repaired prior to continued use.

__ Verify the crane is in compliance with Federal and State regulations requiring frequent, periodic, and annual inspections. A thorough annual inspection has been made by a competent person, government, or private party recognized by the U.S. Department of Labor.

Date of Last Annual Inspection: _____ Inspected By: _____

APPROVALS

Construction Manager:

Name: _____ Signature: _____ Date: ___/___/___

Contractor Representative:

Name: _____ Signature: _____ Date: ___/___/___

Crane Operator:

Name: _____ Signature: _____ Date: ___/___/___

Crane Load Rigger:

Name: _____ Signature: _____ Date: ___/___/___

ATTACHMENT B:

CRANE SAFETY CHECKLIST

CRANE SAFETY CHECKLIST

BOOM:	YES	NO
Are Main Chords damaged?		
Are lattice members bent or cracked?		
Are point sheaves and bearings in a good repair?		
Are cable guides on point?		
Are pins of proper size and all in place?		
Is manufacturer's recommended boom length exceeded?		
Are boom backstops in place?		
Is there a boom limiting device?		
Are mid-point suspension cables in place?		
Is high gantry raised?		
Are boom foot bushings tight?		
CABLES:	**YES**	**NO**
Are there any frayed or flat spots?		
Are there any raveled places?		
Is the cable rusty?		
Are the proper parts of line for load handled used?		
Is there any rubbing on boom machine?		
Are there any kinks?		
Are cables wrapped on drum correctly?		
Are extender cables in good condition?		
Are there swaged ends? Woven? (Instead of clamped ends)		
Is cable size large enough?		
Are boom hoist cable and sheaves in good shape?		
Jib backstop cables in place?		
Extender cable pins locked in with keys?		
Cable dead-ended properly?		
Correct size sockets and wedges?		
Sufficient cable lengths?		

MACHINE	YES	NO
Clean operator's compartment?		
Cab glass in good shape?		

Can operator see complete job? Or see signal-man?		
Does operator understand who is to give signals?		
Is machine setting level?		
On firm ground? Or mats?		
Is cab in good repair?		
Are brakes and clutches in good working order?		
Operator controls in good adjustment? No slack? Broken?		
Does engine need adjustment?		
Do clutches grab or slip dangerously?		
All bolts and pins in place and tight?		
Machinery shields in place?		
Main frame cracked, welded or rusty?		
Brakes and steering mechanism working safely?		
Swing lock in working order?		
Swing brake in working order?		
Electrical equipment and power lines at required distance?		
Is boom hoist independent or not free-fall?		
Do swingers grab and jerk?		
Are operator's controls convenient? Easy to reach?		
Power controls?		
Is capacity chart in machine and visible?		
Does operator stay within capacity chart range?		
Does crane have independent travel?		
Does crane have power load lowering on hoist drums?		
Is counterweight tight on machine?		
Have any additions or alterations been made to counterweight?		
Is lower frame cracked or welded?		
Is machine tied down to other machines or anchors while lifting?		
Does operator have sufficient space to swing machine?		
Are outriggers locked? Are locks automatic?		
Are pontoons located on pads in soft ground?		
ADDITIONAL ITEMS:	**YES**	**NO**
Crane operator meets company qualification requirements?		
Lift calculations and rigging plan completed?		
Weather conditions and wind speed acceptable?		
Has the stability of the ground been checked?		
Are all underground facilities known? Size and Location?		
All rigging inspected for defects?		
Hoist area and load path cleared of non-essential personnel?		
Are tag lines being used?		

Completed By: _____ Dated: ___/___/___

REFERENCES

The following references were utilized in developing this program.

LSU: Crane Training, obtained over the world-wide-web, http://www.camd.lsu.edu/msds/trainingtest/crane/slide13.htm

MIOSHA Construction Standard, Part 10. Lifting and Digging Equipment

Pfizer PGM Kalamazoo, Critical Lift Plan & Crane Permit

Princeton University: Hoisting and Rigging Safety obtained over the world wide web, http://web.princeton.edu/sites/ehs/healthsafetyguide/B15.htm

U.S. Department of Labor, Guidance on Safe Sling Use, obtained over the world-wide-web, http://www.osha.gov/dsg/guidance/slings/synth-round.html