

Bowling Green State University
Crane, Hoist and Sling Program

PURPOSE

These procedures have been developed to comply with Ohio's Public Employee Risk Reduction Act, the Occupational Safety and Health Administration (OSHA) 29 CFR 1910 Subpart N 1910.178 Overhead and Gantry Cranes, 1910.184 Slings, and 1926 Subpart CC Cranes and Derricks in Construction, as well as the American National Standards Institute (ANSI) B30.2 and B30.9. The purpose of this program is to establish requirements for working with cranes, hoists, and slings to minimize the probability of personal injury and property loss.

DEFINITIONS

Bridge – The part of the crane consisting of girders, trucks, end ties, footwalks, and drive mechanism which carries the trolley.

Bridge Travel – The direction of crane movement parallel to the crane runway.

Cab-operated Crane – A crane controlled by an operator in a cab located on the bridge or trolley.

Competent Person – One who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

Crane – A machine for lifting and lowering a load and moving it horizontally, with the hoisting mechanism an integral part of the machine. Cranes whether fixed or mobile are driven manually or by power.

Floor-operated Crane – A crane which is pendant or nonconductive rope controlled by an operator on the floor or an independent platform.

Gantry Crane – A crane similar to an overhead crane except that the bridge for carrying the trolley or trolleys is rigidly supported on two or more legs running on fixed rails or other runway.

Hoist – An apparatus which may be part of a crane, exerting a force for lifting and lowering.

Overhead Crane – A crane with a movable bridge carrying a movable or fixed hoisting mechanism and traveling on an overhead fixed runway structure.

Pendant – A suspended handheld controller used for operating a crane.

Power-operated Crane – A crane whose mechanism is driven by electric, hydraulic, air, or internal combustion means.

Proof Test – A nondestructive tension test performed by the sling manufacturer or an equivalent entity to verify construction and workmanship of a sling.

Qualified Person – A person who, by possession of a recognized degree, certificate, or professional standing, or by extensive knowledge, training, and experience has successfully demonstrated the ability to solve or resolve problems related to the subject matter, work, or project.

Rated Capacity – The maximum working load of a sling.

Rated Load – The maximum load for which a crane or individual hoist is designed and built by the manufacturer and shown on the equipment nameplate(s).

Reeving – The wire rope system including the block, drum, and sheaves.

Rope – Wire rope unless otherwise specified.

Semi-gantry Crane – A gantry crane with one end of the bridge rigidly supported on one or more legs that run on a fixed rail or runway, the other end of the bridge being supported by a truck running on an elevated rail or runway.

Sheave – A pulley or grooved wheel used to hold and guide wire rope.

Sling – An assembly which connects the load to the material handling equipment.

Stop – A device to limit travel of a trolley or crane bridge. This device normally is attached to a fixed structure and normally does not have energy absorbing ability.

Trolley – The unit which travels on the bridge rails and carries the hoisting mechanism.

RESPONSIBILITY

All individuals working with cranes, hoists, and slings are responsible for following approved procedures as defined by this program. Department supervisors are responsible for ensuring employees are properly trained and equipment is inspected and serviced when required. Contractors are required to follow Bowling Green State University's Crane, Hoist and Sling program. Before any cranes, hoists and slings are placed into operation, a Campus Operations Supervisor or competent person knowledgeable of the worksite must advise contractors of hazardous conditions of which they may not be aware.

CRANE AND HOIST REQUIREMENTS

The general requirements for operating a crane and hoist on campus are as follows:

- Only designated personnel with proper training shall be permitted to operate a crane or hoist.
- The operator shall not carry loads over people.
- The operator shall not leave the controls while a load is suspended.
- All new overhead and gantry cranes constructed and installed on or after August 31, 1971, shall meet the design specifications of ANSI B30.2.0-1967 for Overhead and Gantry Cranes.
- The rated load of the crane shall be plainly marked on each side of the crane and shall be clearly legible from the ground or floor. If a crane has multiple hoisting units, each hoist or load block shall be clearly marked.
- The rated load of a crane, hoist and associated components must not be exceeded.
- Cranes may be modified and rerated provided such modifications and the supporting structure are checked thoroughly for the new rated load by the manufacturer or a qualified engineer.
- There shall be a minimum clearance of 3 inches overhead and 2 inches laterally between a crane and obstructions.
- Where passageways or walkways are provided, obstructions shall not be placed so that movement of the crane will jeopardize the safety of personnel.
- Exposed moving parts such as chains, chain sprockets, gears, set screws, projecting keys, and reciprocating components which might constitute a hazard under normal operating conditions shall be guarded.
- Guards shall be securely fastened and capable of supporting the weight of a 200lb person without distortion unless located where it is impossible to step on.
- Stops shall be provided at the limits of trolley travel and installed to resist the force of impact when contacted.
- All crane and hoist braking systems shall be properly maintained and fully operational.
- All electrical equipment shall be protected from dirt, grease, oil, and moisture.
- Pendant control boxes shall be constructed to prevent electric shock and shall be clearly marked for identification of functions.
- Hooks with cracks or having more than 15% in excess of normal throat opening or more than 10° twist from the plane of the unbent hook shall be discarded.
- Cranes and hoists that have been removed from service shall not be placed back into operation until fully inspected, tested, and repaired by qualified personnel.

Examples of common crane, hoist, and sling types are shown in appendix A. The locations of cranes, hoists and slings on campus are available on the EHS website.

Crane and Hoist Inspections

Prior to initial use, all new and altered cranes and hoists shall be tested to ensure compliance with applicable regulations and manufacturer recommendations, including the following functions:

- Hoisting and lowering;
- Trolley travel;
- Bridge travel;
- Limit switches, locking and safety devices.

The trip setting of hoist limit switches shall be determined by tests with an empty hook traveling in increasing speeds up to the maximum speed. The actuating mechanism of the limit switch shall be located so that it will trip the switch, under all conditions, in sufficient time to prevent contact of the hook or hook block with any part of the trolley.

The routine inspection procedure for cranes and hoists in regular service is divided into two general classifications based upon the intervals at which the inspection should be performed -- frequent and periodic. The intervals are dependent upon the nature of the critical components and the degree of their exposure to wear, deterioration, or malfunction. Frequent inspections are conducted daily to monthly, while periodic inspections are completed on a monthly to annual basis. The inspection frequency of cranes, hoists, and associated components is summarized in the inspection reference guide in appendix B. The BGSU Crane and Hoist Inspection Checklist is in appendix C.

Crane and Hoist Maintenance and Repairs

A preventative maintenance program based on the crane manufacturer's recommendations shall be established. Adjustments and repairs shall be done only by qualified personnel to assure components are correctly functioning. All repairs or replacement components shall be provided promptly as needed for safe operation. Before adjustments and repairs are started, the following precautions shall be taken:

- The crane to be repaired shall be moved to a location where it will cause the least interference with other cranes and operations in the area.
- All controllers shall be at the off position.
- The main or emergency switch shall be open and locked in the open position.
- Warning or "Out of Order" signs shall be placed on the crane, also on the floor beneath or on the hook where visible from the floor.
- Where other cranes are in operation on the same runway, rail stops, or other suitable means shall be provided to prevent interference with the idle crane.

After adjustments and repairs have been made, the crane shall not be operated until all guards have been reinstalled, safety devices reactivated, maintenance equipment removed, and required inspections are completed.

Crane and Hoist Communication

A signal person must be provided if the load travel or placement area is obstructed or the operator determines that it is necessary due to site specific safety concerns. Standard hand signals must be used unless infeasible or where an operation or use of an attachment is not covered by standard hand signals. When using non-standard hand signals, the signal person and operator must agree upon the new hand signals beforehand. Examples of the OSHA standard hand signals are pictured in appendix D.

Non-Standard Hoisting Equipment

All non-standard crane and hoist devices intended for raising and lowering equipment and people shall be used in a manner as originally designed and maintained per manufacturer recommendations. Any modifications made to this equipment must be certified and approved by the manufacturer or a qualified engineer. All records of inspection, maintenance, testing, and design modifications shall be kept on file and available for review.

SLING REQUIREMENTS

Slings used on campus must meet the following requirements:

- Slings that are damaged or defective shall not be used.
- Slings shall not be shortened with knots, bolts, or other makeshift devices.
- Sling legs shall not be kinked.

- Slings shall not be loaded in excess of their rated capacities, or the recommended safe working load as prescribed by the manufacturer on the identification markings permanently affixed to the sling.
- Slings without affixed and legible identification markings shall not be used.
- Slings shall be securely attached to their loads.
- Slings used in a basket hitch shall have the loads balanced to prevent slippage.
- Slings shall be padded or protected from sharp edges of their loads.
- Suspended loads shall be kept clear of all obstructions.
- All employees shall be kept clear of loads about to be lifted and of suspended loads.
- Hands and fingers shall not be placed between the sling and its load while the sling is being tightened around the load.
- Shock loading is prohibited.
- A sling shall not be pulled from under a load while the load is resting on the sling.
- Makeshift links or fasteners formed from bolts, rods or other attachments shall not be used.
- Alloy steel chain slings shall have permanently affixed identification stating size, grade, rated capacity, and reach.
- Metal mesh slings must have a durable marking permanently affixed stating the rated capacity for vertical basket hitch and choker hitch loadings.

Sling Inspections

Each day before use, slings and all fastenings and attachments shall be visually inspected for damage or defects by a competent person designated by the employer. Written documentation of pre-use/frequent inspections is not required; however, additional inspections shall be performed during sling use where service conditions warrant. Slings that are found to be damaged or defective shall be immediately removed from service until repaired and proof tested by the sling manufacturer or equivalent entity with the certification of proof test maintained on file.

All active slings shall receive periodic inspections at regular intervals not to exceed 12 months. These inspections must be documented using the BGSU Sling Inspection Checklist in appendix E and maintained on file for review. Periodic inspections are not required for slings in storage or idle, but they must be thoroughly inspected before being placed back in service. The periodic inspection frequency is determined by:

- Frequency of use;
- Severity of service conditions;
- Nature of lifts being made;
- Experience gained on the service life of slings used in similar circumstances.

Alloy steel chain slings shall be inspected by a competent person and shall include a thorough inspection for wear, defective welds, deformation, and increase in length. A record of the most recent month in which the alloy steel chain was thoroughly inspected shall be maintained on file. All new, repaired, or reconditioned alloy steel chain slings, including all welded components in a sling assembly, shall be proof tested by the manufacturer or equivalent entity with the certification of proof test maintained on file for review.

Sling Maintenance and Corrective Actions

Worn or damaged alloy steel chain slings or attachments shall not be used until repaired. When welding or heat testing is performed, slings shall not be used unless repaired, reconditioned and proof tested by the sling manufacturer or an equivalent entity. Mechanical coupling links or low carbon steel links shall not be used to repair broken length of chain. If an alloy steel chain is exposed to surface temperatures in excess of 600°F, employers must reduce the maximum working-load limits permitted in accordance with the chain or sling manufacturer's recommendations.

Alloys steel chains must be removed from service if any of the following conditions are present:

- The chain size at any point of the link is less than what is stated in Table N-184-1 (appendix F);
- Cracked or deformed mater links, coupling links or other components;
- Heated above 1000°F.

When synthetic web slings are used, the following precautions shall be taken:

- Nylon web slings shall not be used where fumes, vapors, sprays, mists or liquids of acids or phenolics are present.
- Polyester and polypropylene web slings shall not be used where fumes, vapors, sprays, mists or liquids of caustics are present.
- Synthetic web slings made 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 200°F.

Synthetic web slings which are repaired shall not be used unless repaired by a sling manufacturer or an equivalent entity. Slings which have been repaired in a temporary manner shall not be used. Synthetic web slings shall be removed from service if any of the following conditions are present:

- Acid and caustic burns;
- Melting or charring of any part of the sling surface;
- Snags, punctures, tears or cuts;
- Broken or worn stitches;
- Distortion of fitting.

Fiber core wire rope slings of all grades shall be removed from service if they are exposed to temperatures in excess of 200°F. When nonfiber core wire rope slings of any grade are used at temperatures above 400°F or below minus 60°F, you must follow the sling manufacturer use recommendations. Wire rope slings shall be immediately removed from service if any of the following conditions are present:

- Ten randomly distributed broken wires in one rope lay or five broken wires in one strand 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 or the wire rope structure.
- Evidence of heat damage.
- End attachments that are cracked, deformed or worn.
- Hooks that have been opened more than 15 percent of the normal throat opening measured at the narrowest point or twisted more than 10 degrees from the plane of the unbent hook.
- Corrosion of the rope or end attachments.

Natural and synthetic fiber rope slings shall be immediately removed from service if any of the following conditions are present:

- Abnormal wear;
- Powdered fiber between strands;
- Broken or cut fibers;
- Variations in the size or roundness of strands;
- Discoloration or rotting;
- Distortion of hardware in the sling.

Metal mesh slings shall not have coatings applied which diminish the rated capacity of the sling. Handles shall have a rated capacity at least equal to the metal fabric or exhibit no deformation after proof testing. The fabric handles shall be joined so that:

- The rated capacity of the sling is not reduced;
- The load is evenly distributed across the width of the fabric;
- Sharp edges will not damage the fabric.

TRAINING

Supervisors must ensure that all crane and hoist operators have been properly trained on the equipment being operated and that slings are used in a manner as intended and designed. Training must be provided to all responsible parties on:

- The inherent risks involved;

- The emergency procedures in the event of a fire;
- Proper inspection procedures to identify potential hazards and/or defects;
- General operating guidelines;
- Applicable OSHA crane, hoist, and sling regulations;
- The provisions of this program.

Refresher training for operators may be required under the following circumstances:

- Deterioration of the operator's performance;
- The operator has been involved in an accident or near miss;
- The operator has not operated a crane or hoist for an extended period of time;
- The operator is assigned to new technology or a significantly different crane or hoist.

RECORDKEEPING

All cranes, hoists, and slings available for use or placed into operation on campus must have the following documentation maintained on file for review (when applicable):

- Operator manual;
- Employee training records;
- Equipment inspection records;
- Maintenance and repair records;
- Testing and certification records.

Appendix A: Common Crane, Hoist and Sling Types

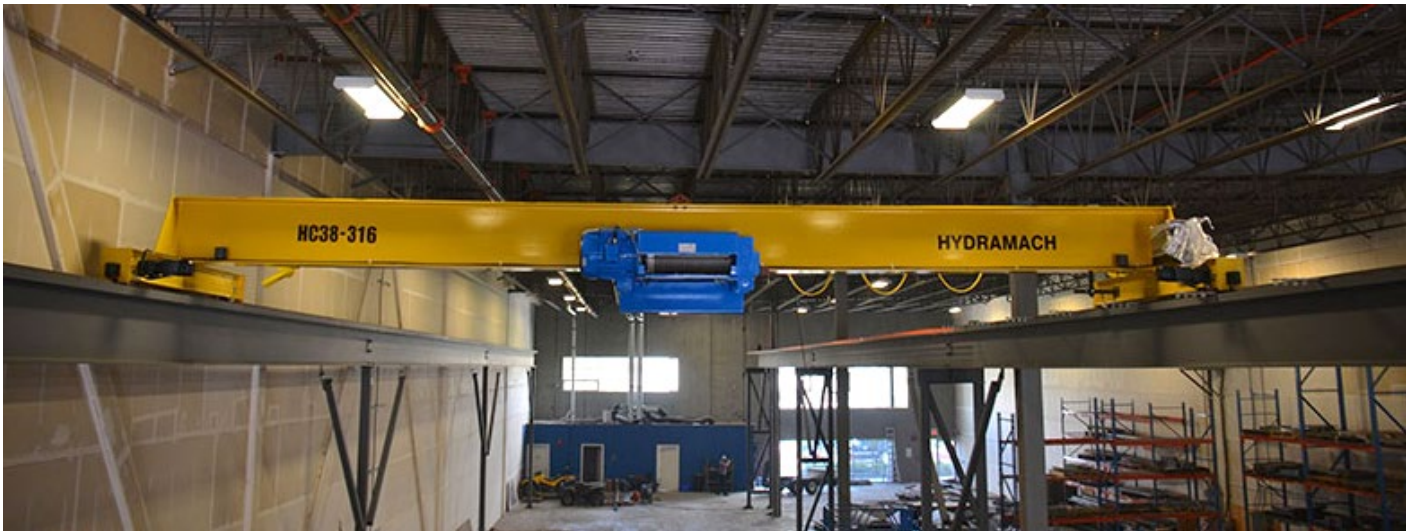
Gantry Crane



Semi-Gantry Crane



Bridge Crane



Jib Crane



Davit Crane



Hydraulic Floor Crane



Appendix A: Common Crane, Hoist and Sling Types

Electric Hoist



Pneumatic Hoist



Manual Hoist



Lever/Ratchet Hoist



Appendix A: Common Crane, Hoist and Sling Types

Chain Sling



Synthetic Web Sling



Wire Rope Sling



Fiber Rope Sling



Wire Mesh Sling



Appendix B: Crane, Hoist, and Sling Inspection Reference Guide

Component	Equipment Type	Inspection Frequency*
All functional operating mechanisms which maladjustment could interfere with proper operation	Crane/Hoist	Daily/pre-use
Deterioration or leakage in lines, tanks, valves, drain pumps, and other parts of air or hydraulic systems	Crane/Hoist	Daily/pre-use
Hooks with deformation or cracks	Crane/Hoist	Daily/pre-use
		Monthly w/ certification record
Hoist chains, including end connections, for excessive wear, twist, distorted links interfering with proper function, or stretch beyond manufacturer's recommendations.	Crane/Hoist	Daily/pre-use
		Monthly w/ certification record
All functional operating mechanisms for excessive wear of components	Crane/Hoist	Frequent
Rope reeving for noncompliance with manufacturer's recommendations	Crane/Hoist	Frequent
Running ropes	Crane/Hoist	Monthly w/ certification record
Deformed, cracked, or corroded members	Crane/Hoist	Periodic
Loose bolts or rivets	Crane/Hoist	Periodic
Cracked or worn sheaves and drums	Crane/Hoist	Periodic
Worn, cracked or distorted parts such as pins, bearings, shafts, gears, rollers, locking and clamping devices	Crane/Hoist	Periodic
Excessive wear on brake system parts, linings, pawls, and ratchets	Crane/Hoist	Periodic
Load, wind, and other indicators over their full range for any significant inaccuracies	Crane/Hoist	Periodic
Gasoline, diesel, electric, or other powerplants for improper performance or noncompliance with applicable safety requirements	Crane/Hoist	Periodic
Excessive wear of chain drive sprockets and excessive chain stretch	Crane/Hoist	Periodic
Electrical apparatus, for signs of pitting or any deterioration of controller contactors, limit switches and pushbutton stations	Crane/Hoist	Periodic
A crane which has been idle for a period of 1 month or more, but less than 6 months	Crane/Hoist	Frequent inspection before placing in service
A crane which has been idle for a period over 6 months	Crane/Hoist	Periodic inspection before placing in service.
All rope which has been idle for a month or more due to shut down or storage	Crane/Hoist	Deterioration inspection w/ certification record
Standby cranes	Crane/Hoist	Periodic – Semi-annually
All slings, including fastenings and attachments	Sling	Daily/pre-use**
		Periodic w/ inspection record
Proof testing of new, repaired, reconditioned alloy steel chain slings	Sling	As required by OSHA 1910.184(e)(4) w/ certificate

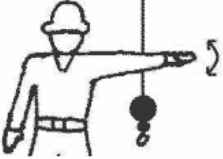
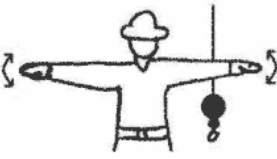
















*Inspection Frequency is based on the nature of the critical component and the degree of exposure to wear. The frequency of inspection is defined as follows: Frequent – daily to monthly; Periodic – monthly to annual.

**Written records are not required for frequent inspections of slings.

Appendix C: BGSU Crane and Hoist Inspection Checklist

BGSU Crane and Hoist Inspection Checklist							
Make and Model:		Rated Capacity:		Crane/Hoist Type:		Date of Inspection:	
Operator Name:				Location:			
Inspection Type: <input type="checkbox"/> Pre-use <input type="checkbox"/> Frequent <input type="checkbox"/> Periodic							
INSTRUCTIONS: Check all items indicated. Inspect and indicate as satisfactory = S, unsatisfactory = U, or not applicable = N/A							
Exterior inspection	S	U	N/A	Operator Cab Inspection	S	U	N/A
Safety guards and covers				Gauges			
Frame/welds				Warning & indicator lights			
Hardware				Control/brakes			
Wire rope				Visibility			
Chain				Load rating charts			
Reeving				Safety devices			
Block				Emergency Stops			
Hook				List/trim indicators			
Sheaves				Boom angle/radius indicator			
Boom/jib				Machinery House Inspection	S	U	N/A
Gantry, pendants, boom stops				Housekeeping			
Walks, ladders, handrails				Engine/Compressor			
Wind locks, chocks, stops				Leaks - fuel, oil, water, lube			
Tires, wheels, tracks				Lubrication			
Leaks - fuel, oil, water, lube				Battery			
Radius indicator				Lights			
Outrigger/locking device				Glass			
Safety labels and data plates				Clutch/brake linings			
General Condition				Electric motors			
Operation Inspection	S	U	N/A	Warning tags			
Area safety				Fire extinguisher			
Unusual noises				Preventative Maintenance	S	U	N/A
Controls				Recommended service up to date			
Brakes/boom/load/rotate				Annual inspection completed			
Crane stability				Date of last annual inspection:			
No load test				Name of company performed:			
Fleeting sheave							
Limit switches							
Notes:							
Operator Signature:				Department:			

Appendix D: OSHA 1926 Subpart CC App A – Standard Hand Signals

 <p>STOP – With arm extended horizontally to the side, palm down, arm is swung back and forth.</p>	 <p>EMERGENCY STOP – With both arms extended horizontally to the side, palms down, arms are swung back and forth.</p>	 <p>HOIST – With upper arm extended to the side, forearm and index finger pointing straight up, hand and finger make small circles.</p>	 <p>RAISE BOOM – With arm extended horizontally to the side, thumb points up with other fingers closed.</p>	 <p>SWING – With arm extended horizontally, index finger points in direction that boom is to swing.</p>
 <p>RETRACT TELESCOPING BOOM – With hands to the front at waist level, thumbs point at each other with other fingers closed.</p>	 <p>RAISE THE BOOM AND LOWER THE LOAD – With arm extended horizontally to the side and thumb pointing up, fingers open and close while load movement is desired.</p>	 <p>DOG EVERYTHING – Hands held together at waist level.</p>	 <p>LOWER – With arm and index finger pointing down, hand and finger make small circles.</p>	 <p>LOWER BOOM – With arm extended horizontally to the side, thumb points down with other fingers closed.</p>
 <p>EXTEND TELESCOPING BOOM – With hands to the front at waist level, thumbs point outward with other fingers closed.</p>	 <p>TRAVEL/TOWER TRAVEL – With all fingers pointing up, arm is extended horizontally out and back to make a pushing motion in the direction of travel.</p>	 <p>LOWER THE BOOM AND RAISE THE LOAD – With arm extended horizontally to the side and thumb pointing down, fingers open and close while load movement is desired.</p>	 <p>MOVE SLOWLY – A hand is placed in front of the hand that is giving the action signal.</p>	 <p>USE AUXILIARY HOIST (whipline) – With arm bent at elbow and forearm vertical, elbow is tapped with other hand. Then regular signal is used to indicate desired action.</p>
 <p>CRAWLER CRANE TRAVEL, BOTH TRACKS – Rotate fists around each other in front of body; direction of rotation away from body indicates travel forward; rotation towards body indicates travel backward.</p>	 <p>USE MAIN HOIST – A hand taps on top of the head. Then regular signal is given to indicate desired action.</p>	 <p>CRAWLER CRANE TRAVEL, ONE TRACK – Indicate track to be locked by raising fist on that side. Rotate other fist in front of body in direction that other track is to travel.</p>		

Appendix E: BGSU Sling Inspection Checklist

BGSU Sling Inspection Checklist			
Sling Type:		Serial #:	Rated Capacity:
Competent Person:		Location:	Date:
<p>INSTRUCTIONS: Check all items listed and indicate yes, no, or not applicable. If any items are marked "Yes" for deficient, the sling must be removed from service until repaired and proof tested by the sling manufacturer or equivalent entity.</p>			
Deficiency	Yes	No	N/A
Missing/illegible identification or markings			
Cracks or breaks			
Broken wires, fibers, or welds			
Excessive wear, nicks, gouges, holes or tears			
Stretched, bent, twisted, knots, deformed chain links or fittings			
Chain link size below minimum diameter (appendix G)			
Kinking, crushing, birdcageing			
Evidence of heat, chemical or UV damage			
Excessive pitting or corrosion			
Chain or fittings unable to hinge freely			
Wire mesh lack of flexibility/distorted			
Weld splatter present			
Other conditions, including visible damage			
Description of defects found:			
Signature:		Department:	

Appendix F: OSHA 1910.184(e)(9)(i) – Table N-184-1 Minimum Allowable Chain Size at Any Point of Link

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