

A Review Paper of Safety & Testing of Over Head Crane

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Abstract- The main aim of this paper is to study various components of electric overhead crane, and Study various loads and various Testing Technique. Load testing and inspection of overhead cranes is required by many safety regulations, national consensus standards and manufacturers. It is the purpose of the annual condition inspection to ensure that the overall structural mechanical and electric components of the equipment have been maintained in a safe and serviceable condition and are functioning properly according to the original equipment manufacturers specifications. It is the purpose of the load test to ensure by actual overloading that the equipment is capable of safely lifting and moving the rated load through all designed motions. The inspection and load test do not take into account the duty factor of the equipment.

INTRODUCTION

For the safety and productivity of your employees and workplace, it's of critical importance to know that new or newly repaired or modernized lifting equipment is in proper working order—before you put it into service. This section defines required pre-service operational testing and load testing. How to load test your overhead crane? Generally, load testing of overhead cranes is required by safety regulation and standards to make sure the overhead crane is installed right according the designing specifications. The owners and operators of overhead cranes should be pay attention to the following: All overhead cranes, gantry cranes, suspension cranes, and jib cranes should be installed on designing specifications.

All overhead cranes, gantry cranes, Suspension cranes and jib cranes should be proof tested once every four years after original proof testing. All overhead cranes, gantry cranes, suspension cranes and jib cranes should be proof tested and operationally

tested after modifications and repairs. The inspection and load test do not take into account the duty factor of the equipment. The frequency of performing a load test can vary depending on regulatory jurisdiction. The CCAA recommends that Load testing be performed at least once every four years. Please keep in mind that the original equipment manufacturer may have more stringent Requirements and these requirements must take precedence. A certification issued is not a license to use a crane beyond the original designed duty factor. Owners and operators should always be aware of the equipment's duty factor.

OBJECTIVE

The main goal here is

- 1) To study various types of cranes
- 2) To study various testing technique

TYPES OF OVERHEAD CRANES

Various types of overhead cranes are used in industries with many being highly specialized. Various types of overhead cranes are single girder cranes, double girder cranes, gantry cranes and monorails.

• SINGLE GIRDER CRANES

The crane consists of a single bridge girder supported on two end trucks. It has a trolley hoist mechanism that runs on the bottom flange of the bridge girder.

• DOUBLE GIRDER CRANES

The crane consists of two bridge girders supported on two end trucks (end carriages). The trolley runs on rails on the top of the bridge girders. Double girder electric overhead cranes are widely used in the industries because they can carry more loads with more span than

any other type of crane. In this project we are concentrating mainly on double girder electric overhead cranes.

• GANTRY CRANES

These cranes are essentially the same as the regular overhead cranes 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. These “legs” eliminate the supporting runway and column system and connect to end trucks which run on a rail either embedded in, or laid on top of, the floor.

• MONORAIL

For some applications such as production assembly line or service line, only a trolley hoist is required. The hoisting mechanism is similar to a single girder crane with a difference that the crane doesn't have a movable bridge and the hoisting trolley runs on a fixed girder. Monorail beams are usually I beams (tapered beam flanges). Monorail or repair trolley cranes are used for maintenance purpose. For maintenance of any single or double girder crane, the crane which is to be taken for maintenance is brought under the repair trolley (monorail) crane so that it can lift the components of the crane

TYPES OF VARIOUS TESTING TECHNIQUE

1. PRE-TEST PROCEDURES

- [1-1] Check that an operator's manual is available for the crane and review same for operational limitations.
- [1-2] Determine that lifting gear to be used with the crane in normal duties or for the purpose of testing the crane has already been tested independently. Check that all lifting attachments are clearly marked with their safe working load.
- [1-3] Review previous test and inspection certificates, wire rope inspections, and deficiency reports and determine that any necessary corrections have been made.
- [1-4] Review periodic inspection reports, maintenance records and documentation of repairs to determine that all work was in order.
- [1-5] Determine that the safe working load for the crane is known and clearly marked on the crane or on charts affixed to it. If the crane way supports more than one crane, verify that the crane way and its supporting structure were designed to support the cranes and loads in all authorized operational configurations.

- [1-6] Choose appropriate loads for the test based on the manufacturer's load ratings for the condition of use. A 25% minimum partial load, the rated load, and a proof load as close as possible but not exceeding 125% of rated load shall be used. Check manufacturer's limitations and or specific instructions on testing. Reeving configuration must be recorded.
- [1-7] rigging should be arranged for the test loads which conforms to good rigging practice for a safe lift.
- [1-8] Barriers should be set up around the operating perimeter if there is any possibility that personnel or vehicles will intrude into the operating region.
- [1-9] A pre—test conference should be arranged with the operator, the riggers, and the signalman to establish how the test will be conducted and to review the signals to be used.
- [1-10] Inspect the crane in its entirety according to the checklist normally used for that type of crane. Particular attention should be given to the structural elements of the crane which will be subjected to stress during the load testing procedure. Any evidence of degradation among the Structural elements should be evaluated and a determination made as to the suitability of the crane's condition for load testing and the need for non-destructive testing or dismantling for detailed examination.
- [1-11] Conduct a visual examination of the crane runway, track, power conductors, collectors and switch gear prior to commencing the test.
- [1-12] The crane should be operated without a load through its full range of operation and all safety devices and limit switches should be checked. The 25% partial load should then be applied and required adjustments made for appropriate function. (i.e., limit switches, variable frequency drives, soft starts, etc.)

2. LOAD TEST

- [2.1] At the start of the rated load test the crane should be positioned over a supporting stanchion or column of the runway with the trolley positioned adjacent to the end truck. With the crane in this position, measure the deflection of the crane main girders and the runway girders at centre span.
- [2-2] Lift the rated load a sufficient height to ensure that each tooth of the lifting gear train is subjected to the rated load. Lower the load to a height of 4-8 inches above the ground.

- [2-3] Traverse the bridge to mid span of each runway girder and measure the deflection. Traverse the trolley with rated load to mid span of the bridge and measure the deflection. Compare these values with appropriate specifications for the crane.
- [2-5] With the holding brake in the released position, start the load down slowly and then return the controller to the off position as the test load is lowering. The load controlling device should prevent the load from accelerating.
- [2-6] For cranes with primary and secondary holding brakes and/or eddy current or hoist dynamic load brakes visually observe that correct operation ensures control of the rated load.
- [2-7] For cranes equipped with a hoist dynamic brake, eddy current brake, or regenerative brake, check lowering speeds against manufacturer's specifications to ensure correct brake operation.
- [2-8] In order to test the reaction of the hoist unit in the event of power failure during a lift, hoist the rated load to a convenient distance above the surface. Lower the load at high speed and, with the controller in the lowering position, disconnect the main power source. The test load should stop lowering when the power is disconnected.
- [2-9] Increase the test load to 125% of rated load to achieve the proof load. Repeat items 2-1 through 2-7 and determine that during these operations all crane functions operate effectively.
- [2-10] While handling the proof load, operate the crane at speeds appropriate to the safe operation and control of the load.
- [2-11] For cranes with two or more hoists, separate tests must be carried out for each hoist.
- [2-12] Operate the trolley with the proof load suspended from the hook through the maximum operational range on the bridge. Use extreme caution and observe that the trolley brakes are operating properly if appropriate and allow for load swing and coasting.
- [2-13] operate the bridge with the proof load suspended from the hook as near as possible to the runway rail on each side through the maximum operational range on the runway system. Use extreme caution and observe for any binding of bridge trucks and proper brake operation etc.
- [2-14] Test bridge and trolley brakes to determine that they stop their respective functions in a distance equal to 10% of full load speed in feet per minute when travelling at full speed with full rated load.

INDUSTRIAL CRANE SAFETY

This easy-to-use Leader's Guide is provided to assist in conducting a successful presentation. Featured are:

PREPARING FOR AND CONDUCTING THE PRESENTATION:

These sections will help you set up the training environment, help you relate the program to site-specific incidents, and provide program objectives for focusing your presentation.

PERIODIC & FREQUENT INSPECTIONS

All cranes must receive a detailed annual or "periodic" inspection from a qualified person or organization. This inspection examines the many parts of the crane that are "off limits" and out of view of most operators. This annual inspection must be documented, signed and dated. In addition, "frequent" inspections of the crane must be done by a qualified person designated by the employer. This frequent inspection, which should be done monthly, should inspect the crane hook, the hoist rope, all limit switches and safety stops. It should also verify the proper operation of the crane's controls. This monthly inspection should also be documented, signed and dated.

PRE-OPERATIONAL INSPECTION

The crane operator should perform a pre-operational inspection before use. The operator should test each crane control to make sure it works properly and causes the crane to react as expected. This includes all directional controls, such as up and down as well as side to side movement. Limit switches and emergency stop controls should also be tested. For example, the upper limit switch should prevent the hook from being raised too high; test this without a load. When using a mobile crane, check fluid levels and tire pressures as well as the proper operation of all driving controls in addition to the crane controls. Inspect the wire rope of the hoist to ensure it is free of defects. Watch the rope as the hook is raised and lowered, looking for breaks, kinks or other damage. All rigging components should also be inspected for good condition.

INSPECTING HOOKS

A hook should have a properly operating safety latch and it should not be stretched or bent. If you discover a hook to be stretched more than 15 percent of its original size

or has been twisted more than 10 percent off the vertical, you must replace it.

INSPECTION & USE OF WIRE ROPE

Wire rope is another common lifting device that must be inspected before use. Wire rope is made of small wires twisted together to form strands. Several strands are then twisted around core material to form a wire rope. When a particular strand makes a complete turn about the core, it is referred to as one "lay." The capacity of a wire rope depends on several factors, including the size and number of wires per strand, the number of strands and the type of core material. Wire rope is not required to have a capacity label affixed to it. Its capacity can be determined by looking it up in a chart or rigging book provided by the wire rope manufacturer or supplier. Make sure you fully understand how to determine the capacity of any wire rope you work with before using it to lift a load; ask your supervisor if you have any questions. Wire rope must be inspected for an excessive number of broken wires, which will reduce its capacity. When wire rope is used as a sling, it must be removed from service if any particular strand contains five or more broken wires within one lay or if there are 10 or more randomly-distributed broken wires within one lay. When wire rope becomes kinked, the core and strands may be damaged, reducing its capacity. When a wire rope has been overloaded, shock-loaded or side-loaded, the strands can separate or even push a part and a "bird cage" is formed. Excessive numbers of broken wires, kinks, separated strands and bird cages all require a wire rope to be removed from service. Always wear heavy leather gloves when handling wire rope. Broken wires can easily cut or puncture unprotected hands.

INSPECTING SLINGS

Perhaps the most common lifting devices are the various types of nylon and webbed slings. These types of slings are strong and lightweight, but are susceptible to damage. When inspecting this type of sling, look for cuts in the sling, frayed webbing or excessive wear and broken stitches. Nylon slings must have a capacity tag attached. If the capacity tag is missing, the sling must be removed from service. If the pre-operational inspection turns up any problems with the crane operation or rigging, do not use the crane and/or rigging. Remove it from service until the problem is corrected by a qualified person. Before working with any crane or rigging any load, make sure you use the necessary protective equipment required by your employer. Safety glasses,

steel-toed boots and a hard hat are usually required; leather gloves may be necessary when handling wire rope or material with sharp edges.

LIFTING DEVICES

Because loads come in many shapes and sizes, the various devices designed to lift them also come in many shapes and sizes. Some lifting devices are fixed in size and shape, while others may be adjustable. Some devices rely on pressure to clamp the load to the lifting device, while others rely on chains, hooks, slings or wire rope to do the job. The weight of any device attached to the crane hook must be considered part of the load. This is critical when determining if a load exceeds a crane's capacity. All components of the lifting device and rigging must be properly rated and certified load-tested to handle the load. This is why you should never use homemade lifting devices or attempt to repair any lifting device unless you are trained and authorized to do so. For example, never replace a missing shackle pin with a standard bolt or add a replacement link to a chain; these types of unapproved modifications can lead to disaster. The various types of fixed lifting devices will have a capacity tag or label displaying its load-tested capacity. If no capacity can be found, do not use the device.

THREE COMMON HITCHES

Chains, slings and wire ropes can be connected to a load in various configurations that greatly affect their lifting capacity. This is why only trained and authorized employees are allowed to rig a load to a crane. The tag on most slings will list three different capacities for the three most common ways the sling is attached to the load; these different connections are commonly called "hitches." A vertical hitch is formed by simply attaching the rope, sling or chain directly from the hook to the load. A basket hitch is formed when a sling is passed under a load with both ends placed in the crane hook. Typically, two slings are used and adjusted to balance the load. A choker hitch may be used to attach a sling to a load. A choker hitch is formed by passing one end of the sling through another, then attaching that end to the crane hook. Be aware that using a choker hitch on a small diameter load while using a wire rope can kink and damage the rope. It's important to check the capacity of any sling you use and understand how that capacity changes based on the type of hitch you plan to use.

EFFECT OF SLING ANGLES ON LOAD FORCE

The number of slings used and the sling angle has a tremendous effect on the amount of force placed on the sling and must be considered when selecting the proper sling for the job. A sling angle is the angle formed between the crane hook and the sling. A single sling with a vertical hitch is holding a 1,000 pound load. There is no sling angle; the amount of force placed on the sling is 1,000 pounds. When two slings are used and attached on the outside edge of the load, a sling angle is created. For example, a sling angle of 30 degrees is created. The force placed on each leg is 578 pounds. If the angle is further increased to 45 degrees, the force placed on each leg increases to 707 pounds. If the angle is further increased to 60 degrees, the force placed on each leg increases to 1,000 pounds. This is equal to the full weight of the load. As this angle continues to increase, the force on each sling continues to increase and can reach levels far exceeding the weight of the load and can easily overload the sling. A good rule of thumb to avoid overloading a sling is to use a sling rated for the full weight of the load and avoid sling angles greater than 45 degrees. Another common application is to use a spreader bar. Using the spreader bar can eliminate sling angles, allows the use of shorter slings and can reduce the force placed on the slings. For the same 1,000 pound load using a spreader bar, the load is divided equally between the slings; the force on each sling is 500 pounds.

PREPARING FOR THE LIFT

Before using a crane, look around for hazards and always make sure to look up as well. Look for any overhead hazards or other cranes that may be in your path of travel or in your swing radius. Keep a sharp lookout for power lines and other electrical hazards. Never use a crane within 10 feet of electrical power lines or live electrical parts. Make sure there are no co-workers or pedestrians in the immediate area before you begin your lift. Workers in the surrounding area should be informed that a crane is being placed in operation. Mobile crane operators must ensure that no one is within the swing radius of the crane. Barricades and/or spotters may be used for this function.

ATTACHING THE LOAD

No matter what type of hitch you are using, place it near the center of the load so it will be balanced when lifted by the crane.

When connecting the load to the hook, always place the sling or connecting device into the deepest part or "throat" of the hook. This is the strongest part of the hook and the only part designed to hold loads at its rated capacity. Lip hooking or connecting the load too close to the lip of the hook can bend and damage the hook. Be aware that odd-shaped loads may have a load center that is not in the visual center of the load.

TESTING THE RIG & BRAKES

Test your rig by slowly lifting the load a few inches off the ground to ensure it stays in balance and doesn't begin to swing. If the load is not balanced, lower it back to the ground, adjust the position of the rig and try again. If this is the first lift of the day, take a moment to test the crane's brakes by lifting the load a few inches and letting it hang about 30 seconds. If the brakes are functioning properly, the load should not slip. It's also a good idea to test the brakes when changing from a lighter load to a heavier load.

LIFTING THE LOAD

Remember that cranes are only designed to hoist loads straight up. Make sure the crane is directly over the load before you lift. When a crane is not placed directly over a load to be lifted, known as "side loading," it can damage parts of the crane and rigging as well as cause the load to swing out of control. Lift the load slowly and avoid sudden jerks and quick stops. Lifting and stopping loads too quickly, also known as "jerking a load," can damage the crane and the lifting devices. This is especially damaging to wire rope, leading to strand separation and bird caging.

MOVING THE LOAD SAFELY

When moving the load, carry it just high enough to clear obstacles in your path. Move the crane at very slow speeds so you can pay attention to the load and its path of travel at the same time. Always keep the load's stability as top priority when you are moving the load. Often, ropes or lines called "taglines" are connected to a load to help control its orientation while being moved. With the crane holding the weight of the load, it doesn't take much tension on the tagline to prevent swinging or to move the load into proper position for landing. Operators and riggers must understand that there is never any reason to ride a load. This dangerous practice is strictly prohibited.

No matter how much control you think you have, never pass the load over co-workers or pedestrians and never allow them to pass under the load. Always be aware that moving a load can easily crush you or a co-worker against a solid object. Operator switch handheld remote controls are especially vulnerable and must keep a safe distance, especially when lifting and landing loads. Riggers and operators should be aware of pinch points created by slings and attachments as the load is raised and be aware of the location of feet and hands when landing a load.

USE OF SIGNALS

In tight spots or when operating a crane with limited visibility, have a properly trained co-worker assist you in lifting or placing a load. This co-worker must be trained to use the proper signals to direct the crane operator. A placard of these signals must be posted on the job site and the operator and signal person must have a clear understanding of the signals to be used and their meaning. To avoid confusion, there should be only one signaler during any lifting operation; however, the crane operator should always obey a stop signal no matter who gives it.

CONCLUSION

Cranes are powerful tools, critically important to moving materials around the workplace. In order to harness their power in a safe manner, crane operators must be committed to safe, proper operation. Inspect the crane and lifting equipment before use. Make sure you know the capacity of the crane and the capacity of any lifting devices or slings you use. Be sure you understand how the various hitches and rigging configurations affect the capacity of the slings. Always be aware that you, the operator, are the most important part of any crane operation. Being a crane operator carries a heavy responsibility.

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