



SAFE OPERATING & PRACTICES MAINTENANCE MANUAL

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A. GENERAL

Most accidents involving cranes are the result of violating a safety rule in operation and/or lack of proper maintenance.

The purpose of this section is to assist users of crane and monorail equipment to establish safety rules for operators, and to set up a proper preventive maintenance program.

NOTE: Most companies who use hoists have a safety program in force in their plants. In the event that some conflict exists between a rule set forth in this publication and a similar rule already set by an individual company, the more stringent of the two should take precedence.

Reference should also be made to ASME/ANSI B30.11, by the American Society of Mechanical Engineers, or equivalent local standards. This document contains additional information on safety.

B. OPERATOR QUALIFICATIONS

General

Only the following personnel should be permitted to operate a crane:

1. Appointed operators.
2. Maintenance and test personnel, when required to do so in the performance of their duties.
3. Inspectors.

Operator Testing

Every employer should require that all persons who will be authorized to operate a crane first pass an examination which accurately measures practical knowledge of electrical wire rope hoists and cranes, and proper methods to be used in attaching loads.

Physical and Mental Condition

An operator must meet the following physical and mental qualifications:

1. An operator must possess good hearing ability and vision (corrected or uncorrected). Good depth perception is also required where load spotting must be accomplished at some distance from the operator.
2. An operator must not be afflicted with any known health condition which could cause a sudden inability to react quickly.

3. An operator who is taking medication prescribed by a doctor must present written assurance from his doctor that the medication will not affect the operator's ability to operate the crane in a safe manner.
4. An operator who is known, or suspected, to be under the influence of alcohol or drugs must not be allowed to operate a crane under any circumstances.
5. The operator must have a good attitude towards safety at all times.

C. SAFE OPERATION

General

The following are general requirements for safe crane operation:

1. It is the operator's responsibility to be fully acquainted with the crane before attempting to operate it. Know the crane's rated capacity, its type of control system, and the function of all operating controls.
2. Verify that all required periodic lubrication and other periodic maintenance have been accomplished before beginning operating at the start of a shift.
3. If any adjustments or repairs are necessary or if any damage is known, or suspected, the operator must report this to their supervisor or other duly appointed person. The next operator must also be informed upon changing shifts if the know deficiency has not been corrected. **DO NOT OPERATE** until the equipment has been repaired.
4. A crane must not be operated if there is a "Lock-out/Tag-out" sign, or similar warning sign, hung on the control pendant or main disconnect switch. A sign of this type should be removed only by the person who originally placed the sign, or some other designated person.
5. All operating controls shall be tested at the beginning of each shift. If any malfunction appears, it shall be corrected before actual operations are begun.
6. Before operating the crane, make certain that all personnel are clear of the area.
7. Keep your hands clear of the bottom block and other moving parts when operating the crane.

Safe Load Handling

Observe the following while actually handling loads:

1. No crane shall be loaded beyond its rated capacity, except when conducting properly authorized and supervised load tests.
2. The load shall be attached to the bottom block by means of a sling or other approved device. Under no circumstances shall the hoist rope be wrapped around the load.
3. The sling, or other approved lifting device, must be fully seated in the saddle of the hook before beginning a lift.
4. Check the hoist rope to make sure that it is not kinked, twisted, or damaged in any way. Also check to ensure that the hoist rope is properly seated on the drum and in the sheaves.
5. With the load lifted only a few inches, check to make sure that the load is properly balanced. If an unbalance exists, lower the load and reconnect the sling to achieve the proper balance.
6. Always inch the hoist into engagement with the load and, after checking for proper load balance, raise the load steadily to the desired height. Avoid unnecessary or sudden stops and starts when raising a load.
7. The bottom block must be centered over the load (hoist rope vertical) when the lift begins.
8. At all times, avoid carrying loads over people.
9. Use extreme care to avoid contacting any obstruction with a moving load.
10. Never leave a load suspended in the air unattended or for extended periods of time. The operator must remain at the controls ready to take action in the event of a holding brake failure.
11. The upper hoist limit switch is intended solely as a safety device. It must not be used as a normal operating control. Unnecessary actuation of the upper limit switch shall be avoided.
12. A load or the bottom block shall not be lowered below the point where less than two full wraps of wire rope remain on the drum.

Motor Brake Test for Near Capacity Loads

Each time that a rated or near rated load is to be lifted, the motor brake must be tested for its ability to hold the load suspended. Make this test with the load lifted just a few inches off the floor, or other support. If the motor brake fails to hold, do not attempt to handle the load until the brake has been adjusted or repaired, as applicable.

Handling Personnel

Personnel must not be allowed to ride the hook or the load under any circumstances. Nor shall a hoist be applied to a man lift cage or platform without consent from the hoist manufacturer and TC/American Monorail, Inc.

D. INSPECTION and MAINTENANCE SCHEDULE

General

Regular, periodic inspection is essential to continued safe performance of a crane. Careful inspection on a regular basis will reveal potentially dangerous conditions while still in the early stages, allowing corrective action to be taken before the condition becomes dangerous.

Any deficiency revealed through inspection shall be reported to an appointed person. A determination must be made as to whether a deficiency constitutes a safety hazard before resuming operation of the crane.

Records and Reports

Inspection records shall be maintained for each crane, listing all points requiring periodic inspection. A written report shall be dated, signed by the person who performed the inspection, and kept on file where they are readily available to authorized personnel.

Daily Inspection by Operators

Cranes in regular service shall be inspected daily, or at the start of each shift, for damage, wear, operating malfunctions, and other defects. This inspection shall include, but not be necessarily limited to, the following items:

1. Make a thorough visual inspection of the entire crane and monorail system for damage. Do not operate if damage is found.
2. Test all controls for proper function.
3. Check upper and lower hoist limit switches (as applicable) for proper operation.
4. Test all brakes for proper operation.
5. Make visual inspection of electrical collectors for proper contact and any broken parts.

6. Examine all hoist wire ropes for excessive wear, frayed ends, broken strands, twists, bends and kinks.

NOTE: A more thorough inspection procedure for wire ropes is usually described in the hoist manual.

7. Examine hoist bottom block for loose or frozen bearings.
8. Examine the hoist hook for the following:
 - a. Free rotation.
 - b. Deformation.
 - c. Chemical damage (if hook is exposed to corrosive chemicals or atmosphere).
 - d. Throat opening in excess of 15% of normal.
 - e. A twist of more than 10% from the plane of an unbent hook.
 - f. Proper fit of the hook latch. If the latch snaps past the tip of the hook, the hook is sprung.
 - g. Wear in excess of 10% of the original dimension at the load carrying point.

!WARNING!

Without exception, an excessively bent, twisted, worn, or sprung hook must be replaced immediately. An excessive throat opening and/or a severely bent hook indicates that the hoist has been abused or overloaded. In addition to replacing the hook, all other load bearing components of the hoist must be carefully examined on a daily basis until there is assurance that no damage has occurred to those components.

Monthly by Maintenance Personnel

NOTE: Reports of all inspections should be kept in a secure location.

Gear Reducers: Check the oil in the gear cases and add oil as required (see Lubrication Information).

Brakes: Remove and inspect the brake friction disks and stationary plates. Clean or replace parts as required and, if necessary, adjust the brake for proper operating clearances.

Wire Rope: Inspect the wire rope for excessive wear, frayed ends, broken strands, bends and kinks.

Bottom Block: Inspect the load hook for free rotation, deformation and hook latch operation.

Wheels: Inspect all trolley and bridge wheels for wear.

Electrical Collectors: Inspect for wear and replace if necessary. Check for proper alignment and pressure. Adjust as required. Lubricate hinges with a couple of drops of oil. Inspect the electrical connections.

Grease Fittings: Inspect all grease fittings for damage or clogs and replace as required. Add lubrication as necessary.

Drive Tires: Test operate the drive tires in starting and stopping while looking for slippage. If slippage is noted, see the section “Drive Tire Adjustment” in the General Installation Information.

Every 3 Months, in Addition to Previous Schedule

Roller Chains: Inspect for alignment and proper tension. Adjust and lubricate as required.

Running Gear: Inspect all shafts, couplings, etc. for loose bolts and set screws. Tighten as necessary.

Trolley and Bridge Wheels: Lubricate all open gearing with a moly base lubricant.

Crane Structure: Inspect for loose bolts and tighten as required.

Runways: Inspect for loose or missing bolts on hangers, splice plates and end stops. Replace or tighten as required.

Electrification: Inspect conductor bars for loose joints, bends, alignment and proper end clearances.

Control Panels: Check all wiring for any evidence of damage and check all electrical connections to be sure that they are secure. Check the contactors in all control panels for excessively pitted or worn contacts, loose electrical connections, weak springs and defective wiring.

Controls: Test all control functions for proper operation, including limit switches and pendant pushbuttons.

Every 6 Months, in Addition to Previous Schedule

Control Stations: Inspect for damage. Replace or repair as necessary.

Runways: Inspect track for wear.

Gear Cases: Drain oil and refill per manufacturer’s specifications.

General Cleanup: The entire equipment should be thoroughly cleaned to remove any accumulated dirt. Any rusty spots should be cleaned and touched up with paint.

Annually, in Addition to Previous Schedule

Load Hook: Inspect the hook using magnetic particle, penetrants or other approved method capable of detecting cracks. Inspect the hook retaining nut, thrust bearing races, thrust bearing and locking members for damage and wear.

Running Gear: Inspect the gearing, shafts and bearings for damage and wear.

Load Supporting Members: Inspect all of the load supporting members, including the wire rope, hoist drum, sheaves, trolley and bridge wheels and shafts, etc. for wear and damage.

Load Carrying Swivels: Remove and Magnaflux all load carrying swivels subject to crystallization through vibration or bending. Replace if required. Examine swivel seat or bearing for excessive wear. Clean and lubricate. Replace parts as required.

Cranes Not In Regular Use

A crane that has been idle for a period of time must be checked as follows before being returned to service:

1. A crane which has been idle for at least one month, but less than six months, shall be inspected in the manner described under the topic "Daily Inspection" and "Monthly Inspection" above, by or under the direction of a designated person. Also refer to item #3 below.
2. A crane which has been idle for a period of six months or longer shall be given a complete inspection in the manner described under "Daily Inspection" and "6 Months Inspection" above. Also refer to item #3 below.
3. All wire rope that remained on the hoist during an idle period of one month or more shall be given a thorough inspection before placing the rope in service. A written, dated and signed report on the condition of the rope shall be filed in maintenance records.

E. PREVENTIVE MAINTENANCE

General

A good preventive maintenance program includes regular lubrication, periodic adjustments and the immediate correction of defects revealed through daily and periodic inspection. Preventive maintenance combined with careful inspection at regular intervals not only contributes greatly to safe crane operation, but also will extend the useful service life of the crane and assures continuation of the standard warranty.

The preventive maintenance program set up by the crane user should be based upon the recommendations made in this manual. Detailed records of maintenance performed should be kept for each crane.

Safety Precautions

Observe the following safety precautions when performing maintenance of any type:

1. Open and lock the main disconnect switch in the electrical line feeding the crane.
2. Install "Lock-out/Tag-out" signs or similar warning signs on both the main disconnect switch on the pendant pushbutton station.
3. The warning signs shall be removed only by the person who installed them, or by some other designated person.
4. Upon completion of the required maintenance, the hoist shall not be operated until all guards have been reinstalled and until limit switches and load limit devices have been reactivated.

Caution: The crane must not be running while lubricants are being applied.

Adjustments

Observe the following in making adjustments.

1. Replace all critical parts that are cracked, broken, bent or distorted, or which in any way could result in an unsafe condition, as revealed through daily and periodic inspection.
2. Replacement parts for TC/American Monorail equipment should be obtained from TC/American Monorail.
3. Defective electrical contacts should be replaced only in complete sets.
4. Keep pendant control stations clean and the function labels legible.
5. Damaged or missing warning labels shall be immediately replaced.

F. DO's & DON'T's

General

The following warnings and operating practices are intended to avoid unsafe practices which might lead to personal injury or property damage.

These recommendations apply to all cranes used for vertical lifting service involving material handling of freely suspended, unguided loads.

DO	DO NOT
Become familiar with crane operating controls, procedures, warnings, and hand signals.	Lift more than the rated load.
Make sure that the hook, trolley, and bridge travel is in the same direction as shown on the controls.	Lift people or loads over people.
Make sure that the hoist limit switches function properly.	Use a damaged crane or a crane that is not working correctly.
Maintain firm footing when operating the crane.	Use a crane with twisted, kinked, damaged, or worn wire rope.
Make sure that the load slings or approved attachments are properly sized and seated in the hook saddle.	Lift a load unless the wire rope is properly seated in its sheaves.
Make sure that the hook safety latch is closed and not supported by any part of the load.	Use the wire rope as a sling or wrap the wire rope around the load.
Make sure that the load is free to move and will clear all obstructions.	Lift a load if any binding prevents equal loading on all load supporting ropes.
Take up all slack carefully, check the balance of the load, lift a few inches and check the load holding action before continuing.	Apply the load to the tip of the hook.
Make sure that all persons stay clear of the suspended load.	Operate the crane unless the load is centered under the hoist.
Avoid swinging of the load or load hook.	Allow your attention to be diverted from operating the crane.

DO	DO NOT
Warn personnel of an approaching load.	Operate the hoist beyond the limits of the wire rope travel.
Protect the wire rope from weld splatter or other damaging contaminants.	Use limit switches as routine operating devices. They are emergency devices only.
Make sure that the wire rope is in the sheave and drum grooves.	Use the crane to lift, support, or transport people.
Promptly report any malfunction, unusual performance, or damage regarding the crane.	Leave a suspended load unattended.
Inspect the crane on a regular basis, replace damaged or worn parts, and keep appropriate maintenance records.	Allow sharp contact between two cranes or between a crane and any obstruction.
Use the manufacturer's recommended spare parts when repairing the crane.	Allow the wire rope or hook to be used as a grounding for welding.
Use hook latches.	Remove or obscure the warning or safety labels, plates or tags on the crane.
Apply lubricant to the wire rope as recommended by the hoist manufacturer.	Adjust or repair the crane unless qualified to perform such maintenance.
Make sure that the hoist, bottom block and the hook are directly in line with the direction of loading before making a lift.	Attempt to lengthen the wire rope or repair a damaged wire rope.
	Drag the wire rope or hook on the floor or across objects.
	Apply a sudden load to the crane such as pushing a load off a ledge and allowing the crane to "catch" it.
	Use the hoist load limiting device or warning device to measure the load.

G. TROUBLESHOOTING

This chart provides a general outline of problems that could be experienced with normal use of a crane or monorail system. The schedule lists the problem, the cause, and the possible remedy for the trouble being experienced. For the hoist(s), see hoist manual.

PROBLEM	CAUSE	REMEDY
Motor brake overheats.	Brake does not release or partially releases.	Check the brake adjustment. Check the brake control circuit and the brake coil and solenoid.
Crane operates in one direction or intermittently.	Open limit switch or switches.	Adjust, repair, or replace the limit switches as necessary.
	Loose connections or broken wire.	Check all electrical connections and wires.
	Worn pushbutton.	Replace pushbutton.
	Contactors, timers, and/or relays do not function properly.	Repair or replace the contactor, timer, or relay.
	Motor operation.	Check the motor windings for continuity. Check for proper motor connections.
	Collectors make poor contact.	Check the collectors for free movement of the spring loaded arm, a weak spring, or poor connections.
	Broken wire in pendant cable.	Replace cable.

No bridge or trolley motion (other motions are functioning properly).	Drive motor branch circuit fuses blown.	Check and replace fuses as necessary.
	Drive motor thermal overload tripped.	Proceed to motor overheats section.
	Loose connections or broken wire.	Check all electrical connections and wires.
	Contactors, timers, and/or relays do not function properly.	Repair or replace the contactor, timer, or relay.
	Motor operation.	Check the motor windings for continuity. Check for proper motor connections.
Oil leaks from the gear case.	Oil seals are worn or damaged.	Replace seals.
	Gaskets are damaged.	Replace gaskets.
Crane will not move only under load.	Ballast resistor, soft start, or inverter setting is incorrect.	Adjust as necessary.
Crane will not respond to operator's commands.	Crane electrification power is "OFF."	Turn main and/or crane disconnect to "ON" position.
	Main and/or crane disconnection fuses blown.	Check fuses and replace as necessary.
	Loose connections.	Check all electrical connections.
	Selector switch (ON/OFF) on pushbutton station not functioning properly.	Replace selector switch.
	Contactors and/or relays do not function properly.	Repair or replace the contactor or relay.
	Control power transformer voltage output not correct.	Replace transformer.
	Control power transformer secondary fuse is blown.	Check fuse and replace as necessary.
	Broken pendent cable.	Replace cable.

Motor overheats.	Excessive duty cycle.	Check the weight of the loads being handled and the number of motor starts per hour. Do not exceed the crane duty cycle or rated load.
	Incorrect voltage or frequency.	Check the data stamped on the motor nameplate for the correct power supply. Voltage should be $\pm 10\%$ of that which is stamped on the motor nameplate.
	Three-phase power supply has had a phase loss and/or unbalanced current.	Check the motor windings for open or short circuits. Check the supply lines for balanced currents.
	Motor brake does not release or partially releases.	Check the brake adjustment. Check the brake control circuit and the brake coils and solenoid.
	Mechanical problem.	Check wheel bearings for binding. Check gear reducer for binding. Repair as required.
	Blown fuses.	Check fuses and replace as necessary.

H. DRIVE TIRE ADJUSTMENT

Caution: Correct tire pressure (pressure of the wheel against the underside of the runway or monorail beam) is of the utmost importance because: (1) excessive tire pressure by over-tightening the spring and/or bearing adjustments will cause premature tire failure and put undue stress on the other components; and (2) inadequate tire pressure will cause the tire to slip, making starts and stops impossible to control. We do not recommend “short cuts” in the tire pressure adjustments.

To achieve optimum tire life we recommend the following tire adjustments **when the unit is fully loaded:**

Drivetractors:

Adjustments are accomplished by both the forward and aft trolleys being tightened simultaneously. Keep in mind that the frame of the drivetractor must be level in relationship to the rail. What is to be achieved is minimal slip. To obtain this, several repeated adjustments are in order. Start with the drive wheel just touching the rail and turn the pressure nuts one full turn. Start and stop the drivetractor. If the tire slips in either motion, adjust both pressure nuts **one half** turn and again start and stop the drivetractor. If the tire slips in either direction again, adjust both pressure nuts another **one half** turn. Continue until the tire does not slip at initial start or stop. When this is achieved, tighten the pressure nuts one more **half** turn and tighten all remaining hardware. Adjustments are now complete.

Cranes:

Adjustments are accomplished by both the inboard and outboard adjustments on both (all) end trucks. Keep in mind that the tires are to be vertical in relationship to the runway rail tread. What is to be achieved is minimal slip. To obtain this, several repeated adjustments are in order. Start with the drive wheel just touching the rail and turn the four pressure nuts (on each drive wheel) one full turn.

Note: All drive wheels must be adjusted at the same time.

Start and stop the crane. If the tires slip in either motion, adjust the four pressure nuts **one half** turn, and again start and stop the crane. If the tires slip in either motion again, adjust the four pressure nuts an additional **one half** turn. Continue until the tire does not slip at initial start or stop. When this is achieved, tighten the pressure nuts one more **half** turn and tighten all remaining hardware. Adjustments are now complete.