

- e) Subject to more specific local instructions, the main power switch in the crane is locked with OFF position;
- f) Where the crane is exposed to wind, the travel brakes are locked ON and the hook secured to avoid damage by free swinging. If in his opinion, a crane is not in satisfactory operating condition, the driver shall not leave the premises until he has reported the matter to a responsible authority. If the defect makes the crane unsafe to operate, the driver shall affix danger flags or notices in a prominent and clearly visible position on the crane before leaving it.

CHAPTER 1 MECHANICAL MATERIAL HANDLING

Probably no phase of modern production has undergone more radical changes than material handling. In fact, mass production would be impossible without the highly mechanised material handling equipment now in use. Material handling systems harmonize and optimize the flow of materials from manufacture to distribution. Material handling installations mechanise internal handling processes and at the same time increase their efficiency.

Every type of material and article handled in a factory must be studied in details and consideration given to factors such as weights handled, distance moved, the purpose of handling etc. and suitable methods of handling as decided upon. There are many types of equipment and it would not be possible to deal with all.

Therefore this task will be confined to the following :

- 1) Electric Overhead Travelling Crane (E. O. T. Crane)
- 2) Jib Cranes
- 3) Mobile Crane - Tyre Mounted
- 4) Mobile Crane - Crawler Mounted
- 5) Gantry Crane - Stationery
- 6) Gantry Crane - Mobile
- 7) Power Truck Cranes
- 8) Conveyors
- 9) Lifting Tackles
- 10) Forklift Trucks
- 11) Pay loaders
- 12) Power Shovels

- 13) Winch Cranes
- 14) Hoists and Lifts
- 15) Bucket Elevators
- 16) Pullers



Electric Overhead Travelling Crane



Jib Cranes



Mobile Crane - Tyre Mounted



Mobile Crane - Crawler Mounted



Gantry Crane - Stationery



Gantry Crane - Mobile



Power Trucks Cranes



Conveyors



Lifting Tackles



Forklift Trucks



Pay loaders



Power Shovels



Winch Cranes



Hoists



Lifts



Bucket Elevators

- hands on the controllers at all times.
16. Crane drivers must remember that where any load is being carried on a magnetic block, any form of electrical power supply failure will cause such load to immediately drop unless a safety device is incorporated usually in the lifting mechanism.
17. Where floor personnel are unaware of the approach of the crane and/or crane load, crane drivers shall give adequate warning to such personnel.
18. The crane drivers shall avoid carrying of suspending a load at eye level distance above the floor.
19. Exept where (under close supervision and with appropriate safety precautions having been taken) a particular degree of accuracy is required with regard to special loads, a crane attendant shall not reach for or attempt to handle any load suspended from a crane until all crane movement of such load has completely ceased.
20. After the load has been landed, crane drivers shall not move the crane until the hook has been lowered and the crane attendant has either hooked up or removed the lifting equipment used.
21. Crane loads, cables and lifting equipment shall at no time be dragged along the floor or over any obstructions.
22. When long hitches are made, drivers shall pay special attention to the crane block, to avoid tripping the limit switch or running the block against the drum.

Crane Parking :

1. Before leaving his control position, the crane driver shall at all times ensure that
 - a) The crane is spotted at the location designated for leaving the crane.
 - b) There is no load suspended from the hook;
 - c) The hook is raised clear of all obstructions;
 - d) All controllers are placed in the OFF position;



over workmen or other persons, and the crane driver shall at all time check, to be sure that the crane hook, block, lifting equipment and load will safely clear all apparatus, materials and floor personnel when moving the crane and/or the load.

7. All load movements shall be done smoothly without jerking or sudden stops.
8. The load shall not be moved in any direction whatever with loose or displaced lifting equipment attached to the crane or load, and the crane driver shall immediately warn the crane attendant of such condition.
9. Under no circumstances the crane driver attempt to travel any load, until that load has been hoisted clear of all instructions.
10. Before starting to hoist a free load, the crane driver and crane attendant shall ensure that the hoist rope hangs vertically over the load, and the crane driver shall avoid oscillating (swinging) the load when the lift is taken.
11. When handling loads approaching maximum rated capacity the crane driver shall test the hoist brakes after the first load has been lifted a few inches clear of the floor, by placing the controller in the OFF position. If the brakes do not hold the load then the load shall be lowered at once, and the brake is adjusted.
12. When lifting or lowering a load, the crane driver shall be assured that the crane crab is centered over the load, then proceed carefully, keeping the load under constant control.
13. When lowering from a considerable height, the crane driver should keep the controller at full lowering position to obtain the regenerative braking effect on A. C. supply cranes.
14. Workmen and other floor personnel shall at all times stay clear of crane load immediately prior to and during its movement.
15. While the crane is in motion, crane drivers shall keep their

Safety in Mechanical Material Handling

The basic fact that the unsafe acts of individual are a causative factor in the majority of accidents justifies itself the substitution of Mechanical for Manual operations wherever practicable. In fact the latest technology introduced in material handling is completely Computerised Numeric Controlled (CNC) system for E.O.T. Cranes. The mechanical system must be safe by design, construction, and suited to the purpose, thoroughly guarded, properly maintained and personnel selected to operate them be properly qualified, trained and adequately supervised.

Section 29 of Indian Factories Act, 1948 Lifting machines, Chains, Ropes and Lifting Tackles.

- (1) In any factory the following provisions shall be complied with respect to every lifting machine other than a hoist, lift, chain, rope and lifting tackle for the purpose of raising or lowering persons, goods or material :-
 - a) All parts including the working gear, whether fixed or movable, shall be
 - i) Of good construction, sound material and adequate strength and free from defects;
 - ii) Properly maintained; and
 - iii) Thoroughly examined by a competent person at least once in every period of twelve months or at intervals as the Chief Inspector may specify in writing and a register shall be kept containing the prescribed particulars of every such examination.
 - b) No lifting machine, chain, rope or lifting tackle shall except for the purpose of test, be loaded beyond the safe working load which shall be plainly marked thereon together with an identification mark and duly entered in the prescribed register; and where this is not practicable, a table showing the safe working loads

- or every lifting machine, chain, rope or lifting tackle in use shall be displayed in prominent positions in the premises;
- c) While any person is employed or working on or near the wheel track of a travelling crane in any place where he would liable to be taken to ensure that the crane does not approach within twenty feet of that place.
- 2) The State Government may make rules in respect of any Lift Machine or any Chain, rope, or lifting tackle used in factories:
 - (a) Prescribing further requirements to comply with in addition to those set out in this section;
 - (b) Providing for exemption from compliance with all or any of compliance is unnecessary or impracticable.
 - (3) For the purpose of this section a lifting machine or a chain rope or lifting tackle shall be deemed to have been thoroughly examined if a visual examination supplemented; if necessary, by other means and by dismantling or parts of the gear has been carried out as carefully as the conditions permit in order to arrive at a reliable conclusion as to the safety of the parts examined.

Explanation - in this section :

- (a) "Lifting machine" means a Crab, Crab Winch, Toggle, Chain Pulley Block, Gin Wheel, Transporter or run way;
- (b) "Lifting tackle" means chain slings, rope slings, rings, hooks, shackles and swivels.

Rule prescribed under sub-section (2) of section 64 of Maharashtra Factories Rules of 1963

64. Lifting machines, Chains, Ropes and Lifting tackles

- (1) No lifting machines and on chain, rope or lifting tackle, except a fibre rope or fibre rope sling, shall be taken into

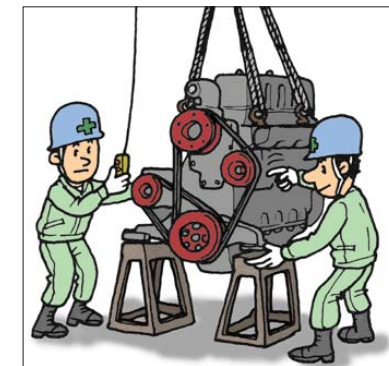
whole hand to be rotated from wrist.

Down. Arm and hand fully extended in front of body, palm of hand down. Whole hand to move in downward motion from wrist, sideways. Arm fully extended sidewise in direction wanted first finger pointing in that direction, rest of fingers closed with palm down. Whole hand to move slight up and down motion from wrist.

To stop, BOTH hands fully open and held at least head high, preferably higher, palms toward crane driver's control position.

Load Movement :

1. All crane movements while loads are being handled, or maintenance or repair work done, shall be governed absolutely by the standard operating signals as given above transmitted to the cranes driver by the person authorised to direct such movements.
2. The crane driver shall obey a STOP signal, regardless of who gives it.
3. Under no condition shall any crane driver move a load unless he has clearly seen and understood the given signal.
4. Where two cranes are operating in tandem (e.g.. together moving a load suspended from an equalising or "spreader" bar), the driver of each crane shall take movement signal ONLY from one (same) person. Before such tandem operation, however, special instructions will have to be issued by the engineer.
5. Bumping into runway stoppers shall be avoided.
6. Load shall not be moved

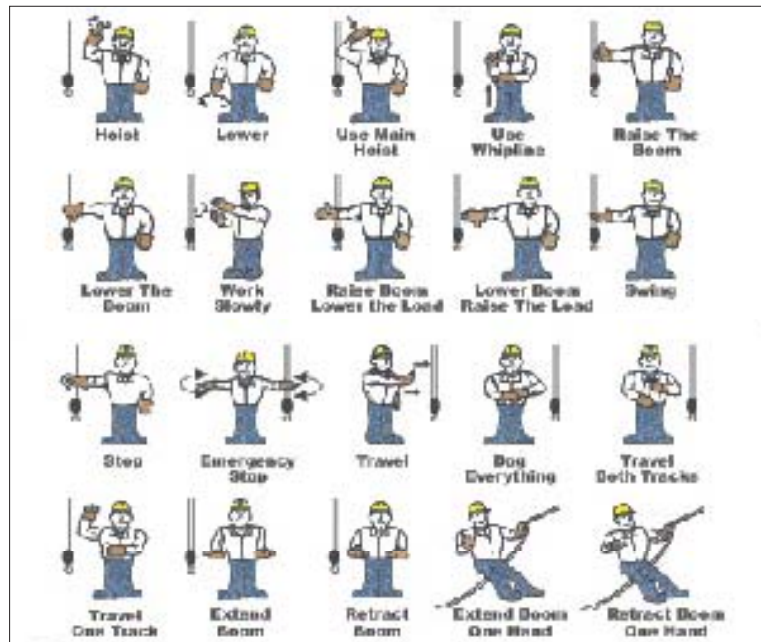


- i) Surface cracks in hooks and chains;
 - j) Distorted links in chains,
 - k) Loose cable clamps, clips or damaged lagging.
10. The crane attendant shall direct the movement of the crane with or without load, in accordance with the Operating signals given below :

Operating Signals :

The signals given here are intended to be BASIC :

1. VERBAL. When giving signals in this manner, the crane attendant shall at all times face the crane driver's position.
2. To move. FOR ALL movement signals, ONE hand and arm ONLY shall be used, the other arm being held down ward and close in the side of the body.
Up. Arm fully first (index) finger pointing upward, rest of fingers closed, palm inclined toward driver's control position,



Crane Operational - Manual Signals

use in any factor for the first time in that factory unless it has been tested and all parts have been thoroughly examined by a competent person and a certificate of such a test and examination specifying the safe working load or loads and signed by the person making the test and the examination, has been obtained and is kept available for inspection.

- (2) Every Jib-crane so constructed that the safe working load may be varied by the raising or lowering of the jib, shall have attached there to either in automatic indicator of safe working loads or an automatic Jib angle indicator and a table indicating the safe working loads at corresponding indications of the jib or corresponding radii of the load.
- (3) A table showing the safe working loads of every kind and size of chain rope or lifting tackle in use, and in the case of a multiple sling the safe working loads at different angles of the legs, shall be posted in the store in which the chains, ropes or lifting tackles are kept and in prominent positions on the premises, and no chain, rope or lifting tackle not shown in the table shall be used.
Provided that this subrule shall not apply in respect of such lifting tackle if the safe working load there of, or in the case of a multiple sling, the safe working load at different angles of the legs, is plainly marked upon it.
- (4) The register to be maintained under clause (a) (iii) of subsection (1) of section 29 of the Asst. shall contain the following particulars and shall be kept readily available for inspection :
 - a) Name of occupier of factory:
 - b) Address of factory
 - c) Distinguishing number or mark, if any, and description sufficient to identify the lifting machine, chain, rope or the lifting tackle.
 - d) Date when the lifting machine, chain, rope or lifting

- tackle was first taken into use in the factory.
- e) Date and number of the certificate relating to any test and examination made under sub rules (1) and (9) together with the name and address of the person who issued the certificate.
 - f) Date of each periodical thorough examination made Under clause (a) (iii) of subsection (1) of section 29 of the Act and subrule (8) and by whom it was carried out.
 - g) Date of annealing or other heat treatment of the chain and other lifting tackle made under subrule (7) and by whom it was carried out.
 - h) Particulars of any defects affecting the safe working load found at any such thorough examination or after inhaling and of the steps taken to remedy such defects.
- (5) All rails on which a travelling crane moves and every track on which the carriage of a transporter or runway moves shall be of proper size and adequate strength and have an even running surface; and every such rail or track shall be properly laid, adequately supported and properly maintained.
 - (6) To provide access to rail tracks of overhead travelling cranes suitable passageways of at least 50 cm. width with two boards and double hand rails 90 cm. high shall be provided alongside, and clear of, the rail tracks of overhead travelling cranes, such that no moving part of the crane can strike persons on the ways and the passageway shall be at a lower level than the crane track itself. Safe access ladders shall be provided suitable intervals to afford access to these passage ways, and from passageways to the rail tracks provided that the chief Inspector may, for reasons to be specified in writing, exempt any factory in respect of any overhead travelling crane from the operation of any provision of this subrule subject such conditions as he may specify.

- i) Unless there is absolutely no other safe way, a load shall not be lifted by means of eyebolts. When using plain eyebolts for a lift, the pull shall always be in line with the shank.
 - k) All lifting equipment is properly marked to indicate the safe working load permissible.
 - l) Accurate records are maintained of all lifting equipment in the section.
 - m) Hooks, ropes, slings and other lifting equipment are inspected before each lift. (See paragraph 9 following).
 - n) Any damaged, defective or unserviceable lifting equipment is immediately withdrawn for repairs or replacement. Care should be taken to ensure that such equipment is immediately tagged.
 - o) The periodic inspection and, where necessary, heat treatment of lifting equipment is carried out. (Subject to more specific local instructions in this regards).
 - p) When chain or rope slings are used for slinging loads of hard material, suitable packing is provided to prevent the links or ropes coming into contact with the sharp edges of such loads.
9. When carrying out an inspections of lifting equipment, crane attendants should look for :
 - a) Broken wires or damaged strands or wire rope;
 - b) Broken strands of manila or sisal rope;
 - c) Burns on rope;
 - d) Deterioration of rope (check by opening up strands of rope)
 - e) Indications of damage due to rough treatment or accident;
 - f) Damage to special lifting devices;
 - g) Straightened hooks or damaged hooks, indicating overloading.
 - h) Kinks in cable due to contact with sharp corners;

- strength of ropes, chains, cables and slings.
3. All crane attendants shall be aware of and follow these instructions, without exception.
 4. The crane attendant is at all times responsible for the safe slinging and handling of the load.
 5. He shares joint responsibility with the crane driver to ensure that all lifting equipment is at all times secure and that all loose materials, chips and / or tools have been removed from the load before its movement.
 6. He shall know the location and proper operation of the main electrical power feeder switch and emergency stop buttons, where exists, for all the cranes in the section in which he is working.
 7. He shall notify his supervisor whenever, and prior to, any unusual or special lifts are to be made.
 8. The crane attendant is responsible for ensuring that :
 - a) Any lifting equipment is not overloaded, if there is any doubt about the capacity of the equipment or the weight of the load, this should be immediately ascertained.
 - b) All loads are securely slung, and used are of the correct size and good quality.
 - c) All loads are moved in such a manner as to clear all obstructions and are not carried over personnel.
 - d) Slings are so arranged that they cannot slip, catch on, or it strike any object.
 - e) All piling and stacking is done in a safe and and orderly manner.
 - f) The slack is carefully removed from all slings prior to the load being lifted and during such process special care is taken when it is necessary to steady the slings by hand.
 - g) Chains, cables and ropes shall be kept free from knots, twists and bends.
 - h) When a sling has to be pulled from under a load, the load shall be landed so that the sling will be free.

- (7) All chains and lifting tackles except a rope sling shall unless they have been subjected to such other treatment as may be approved by the Chief Inspector of Factories be effectively annealed under the supervision of a competent person at the following intervals:
 - a) All chains, slings, rings, hooks, shackles and swivels used in connection with molten metal or molten slag or when they are made of 12.5 mm bar or smaller once atleast in every six months;
 - b) All other chains, rings, hooks, shackles and swivels in general use, once at least in every twelve months. Provided that chains and lifting tackle not in frequent use shall, subject to the Chief Inspector's approval, be annealed only when necessary, Particulars of such annealing shall be entered in a register prescribed under sub rules (4).
- (8) Nothing in the foregoing subrule (7) shall apply to the following classes of chains and lifting tackles:
 - (a) Chains made of malleable cast iron;
 - (b) Plate link chains;
 - (c) Chains, rings, hooks, shackles and swivels made of steel or of any nonferrous metal;
 - (d) Pitched chains, working on sprocket or pocketed wheels;
 - (e) Rings, hooks, shackles and swivels permanently attached to pitched chains, pulley blocks or pocketed wheels;
 - (f) Hooks and swivels having screw threaded parts of ball bearing or other case hardened parts;
 - (g) Socket shackles secured to wire ropes by white metal capping; and
 - (h) Bordeaux connections.

Provided that the such chains and lifting tackles shall be thoroughly examined by a competent person once atleast in every twelve months, and particulars entered in the



- register kept in accordance with sub rules (4).
- (9) All lifting machines, ropes, chains and lifting tackles, except a fibre rope or fibre sling, which have been lengthened altered or repaired by welding or otherwise, adequately retested and examined by a competent person and certificate of such test and examination be obtained, and particulars entered in the register kept in accordance with subrule (4).
- (10) No person under 18 years age and no person who is not sufficiently competent and reliable shall be employed as driver of a lifting machine whether driven by mechanical power or otherwise, or to give signals to a driver.
- (11) Where the Chief Inspector of Factories is satisfied that in a factory due to shutdown or for any other reasons it is not practicable to maintain a minimum distance of 6 meters between the person employed or working on or near the wheel track of a travelling crane and, he may on the request of the manager can reduce the distance to such extent as he may consider necessary and also prescribe further precautions indicating appointment of suitable number of supervisors to ensure the safety of the persons while they are employed or working on or near the track.

I. Electric Overhead Travelling Cranes / Gantry Cranes :

Section 29 of the Indian Factories Act 1948 and Rule 64 of Maharashtra Factories Rules of 1963, deal with the safety requirements of the cranes. All cranes are required to be of good construction, sound material, adequate strength, free from patent defects and properly maintained. They are required to be thoroughly examined by a competent person (a person who is in the opinion of the chief Inspector of Factories competent by virtue of qualification and experience) to examine at least once in a period of 12 months and certify in FORM12 prescribed by the

- operating feature, noise or undue wear that may be noted, and the crane shall not be used (operated) until such condition or defects are examined and rectified by maintenance personnel.
8. In the case of power, failure, the crane driver shall move all controllers to the OFF position, report the matter, and await instructions.
9. He shall not rely on LIMIT SWITCHES in ordinary working they are for emergency only.
10. Except to avoid accident, the crane driver shall not reverse a motor until the Crane completely stops.
11. The crane driver shall not tamper with circuit breakers, limit switches, and / or other safety devices.
12. He shall be constantly alert for any unusual sounds or warnings, since dangers may suddenly become present which cannot be seen.
13. Prior to commencing normal Crane Operations for each shift, the crane driver shall
- a) Inspect the crane, test all limit switches, brakes and all other safety devices; any defects to be reported immediately in locations such as power stations, this requirement may be varied by the issue of specific local instructions to provide for less frequent inspections when appropriate.
 - b) Never touch a switch that has a warning notice on it.
 - c) Before closing main switches, make sure that all controllers are in the "off" position.
 - d) Be sure everyone is clear before commencing to move any load.

Crane Attendants :

1. The crane attendants shall have a adequate knowledge of SAFE handling methods.
2. He shall have a sound knowledge of knotting, slinging, the

cigarette butts, or spitting from the control cabin or bridge structure, are not permitted under any circumstances.

5. They shall keep their hand free when going up or down access ladders.
6. Their spare clothing and other personnel belongings shall not be kept in the vicinity of the control position.
7. They shall familiarise themselves fully with all crane safety operating instructions, the crane mechanism and its proper care.



Crane Operator (Remote Control)

Operations :

1. The Crane driver is at all times responsible for the safe operation of his crane.
2. He shall not operate any crane which, in his opinion, is unsafe.
3. He shall at all times ensure that the crane is properly lubricated in accordance with instructions issued.
4. He shall not leave his control position while a load is suspended from the crane.
5. He shall not permit anyone to be in any position on the crane while the crane is performing normal working operations.
6. Where and when any crane fails to correctly respond to control, the crane driver shall immediately stop operation and open the power switch, then notify his supervisor. No attempt shall be made to get out of the difficulty by repeated operation of the control.
7. He shall immediately report to his supervisor any unusual

State Government. Under section 21 of the factories Act 1948, it is required that all dangerous parts such as gears, revolving shafts, couplings etc., which are not completely inaccessible by virtue of their position, should be securely guarded. The longitudinal travelling shaft of an Electric Overhead Travelling Crane or Gantry crane, has been the cause of several serious accidents and therefore it should be securely fenced throughout its entire length. Great care should be taken to the provision of adequate means of access to overhead cranes.

Crane General :



Electric Overhead Travelling Crane

1. All cranes shall carry in a conspicuous position a statement indicating the load (in tonnes) which the crane is authorised to move.
2. No crane shall be used to move a load greater than that for which it was designed, unless, in extraordinary circumstances, a special written authorisation, signed for specified load, is given to the driver of the crane concerned.
3. No crane shall be used to move a load in any manner other



- than that provided for in its design, i.e. no crane shall be used for dragging or pulling a load.
4. Where more than one crane is erected on the same premises, each shall be clearly marked, for ready identification from floor level, with a distinguishing number.
 5. During normal operations no crane shall be used for the purpose of transporting passengers, or crane attendants or other personnel shall not ride on the lifting equipment or the load.
 6. Where and when crane are required to move loads where workmen and other persons may cross the line of crane movement, an effective warning device shall be provided and securely fastened in a location convenient at all times to the crane driver's control position.
 7. Every crane so situated or used, that its control position is subjected to heat from below or any side shall have suitable heatresisting shields securely affixed.
 8. Crane shall at all times be kept clean.
 9. All operating signals given shall be in accordance with the requirements set out under operating signal system.
 10. Where two cranes operate on the same runway, they shall not approach closer to each other than the distance indicated in the crane cabin or elsewhere on the crane. This limiting distance can only be reduced after the engineer has issued instruction accordingly.
 11. Special care shall be observed at all times to prevent the collision of two or more cranes operating on the same runway. No crane be moved by another crane without driver.
 12. When two cranes operate in tandem (on the same runway); to move a heavy load and the end carriages of each are rigidly connected to each other, a suitable connecting member shall be designed and approved for the purpose by the engineer. Close supervision shall be arranged for special cases where independent motion of cranes is

- considered necessary.
13. When two cranes operate in tandem as in (12) above, the limiting combined capacity of such cranes shall not exceed that is defined by the engineer.
 14. No person is permitted to walk along runways from the cranes to another, or to climb over the end carriage or one onto the end carriage of another crane.
 15. Extreme care shall at all times exercised by crane drivers and attendants, and all other personnel marking or present on premises where cranes are located, to avoid contact with the crane collector wires and / or any other power cables, whether covered or bare.
 16. Rail trucks, or cars, or other transport vehicles, shall not be towed by any crane.
 17. An approved type of fire extinguisher shall be carried in, or conveniently situated to the control position, for use in case of fire. The crane driver must ensure this is checked regularly and kept in fully serviceable condition.
 18. All reports required of crane drivers and attendants, also of inspection, maintenance and repair personnel, shall at all times be properly completed and promptly handed in to the authority designated to receive such reports.

Crane Drivers Conduct :

1. Only trained, competent and properly authorised crane drivers are permitted to operate overhead travelling cranes.
2. Crane drivers must be physically fit, and have good hearing and eyesight. A crane driver shall not operate his crane if not physically fit, but shall report any disability to the medical officer or other appropriate person at once.
3. In the event of a crane driver becoming ill while on duty, he shall follow, so far as it is possible, the regular procedure for leaving the crane.
4. Crane drivers shall be alert at all times. Sleeping or, throwing