# Part 6 Cranes, Hoists and Lifting Devices

## Highlights

- Section 59 states that this Part does not apply to drawworks on equipment that is subject to Part 37, *Oil and Gas Wells*.
- Section 63 requires employers to ensure that mobile cranes, boom trucks and tower cranes be equipped with load charts.
- Section 64 requires operators to be competent in the use of load charts.
- Section 65 permits the use of electronic log books. Log books are not required for manually operated hoists.
- Section 67 requires employers to develop procedures to prevent collisions during multi-crane lifts. (Section 8 of the *OHS Regulation* requires that procedures be in writing and available to workers.)
- Section 68 requires that employers provide the operator or person in charge of a lift with all the information necessary to determine the weight of the load being lifted.
- Section 68.1 establishes a requirement to conduct load calculations for lifts exceeding 75 percent of a crane's capacity.
- Section 69 describes restrictions on the lifting of loads above workers.
- Section 89 requires employers to have load-bearing components of a mobile crane undergo non-destructive testing at 12-month intervals.
- Section 112 requires employers to ensure that vehicle hoists meet the specified American National Standards Institute (ANSI) standards.

# Requirements

## Section 59 Application

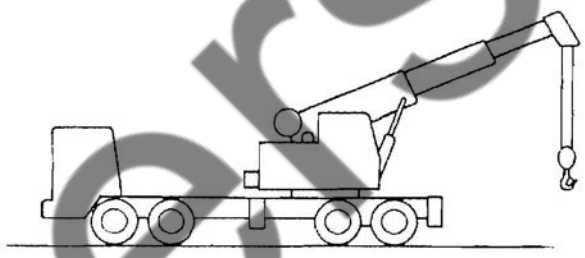
### Subsection 59(1)

Except as described in subsection 59(4), all lifting devices with a rated capacity of 2000 kilograms or more are subject to the requirements of this Part. A lifting device is a device used to raise or lower materials or an object.

A crane is a lifting device that can move a load horizontally. Examples of cranes include the following:

- Boom-type mobile — a self-propelled crane equipped with a boom and mounted on a chassis that is supported on either rubber tires, crawler treads or railway wheels running on railroad tracks. See Figure 6.1.

Figure 6.1 Example of boom-type mobile crane

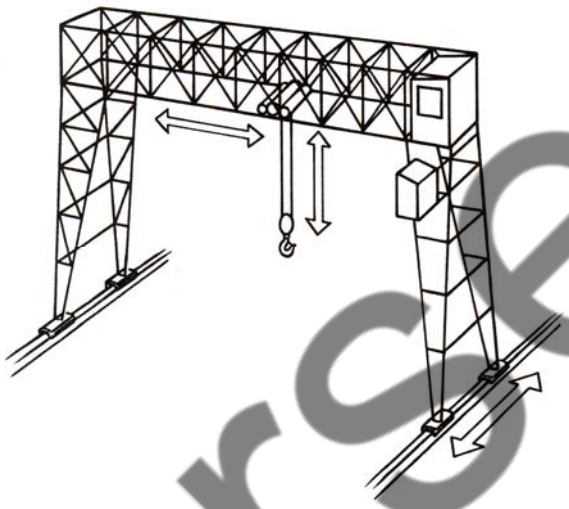


- Floor operated — a crane that is controlled via a pendant or wireless control console by an operator on the floor or a platform independent of the crane.

- Gantry — similar to an overhead travelling crane except that the bridge for carrying the trolley or trolleys is rigidly supported on two or more movable legs running on fixed rails or other runway. See Figure 6.2.
    - Cantilever gantry — a gantry crane in which the bridge structure extends beyond the runway on one or both sides. Its runway may be either on the ground or elevated.
    - Portal (Whirley type) — a crane that has a boom attached to a revolving crane mounted on a gantry, with the boom capable of being raised or lowered at its head i.e. outer end. Portal cranes may be fixed or mobile.

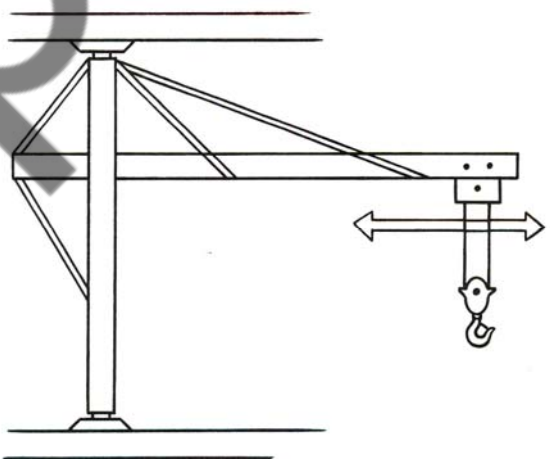
- Semi-portal — a portal crane mounted on a semi-gantry frame instead of a gantry frame.
- Semi-gantry or single leg — a gantry crane with one end of the bridge rigidly supported on one or more moveable legs, running on a fixed rail or runway, the other end of the bridge running on an elevated rail or runway.
- Yard crane — rubber tired gantry crane.

Figure 6.2 Example of a gantry crane



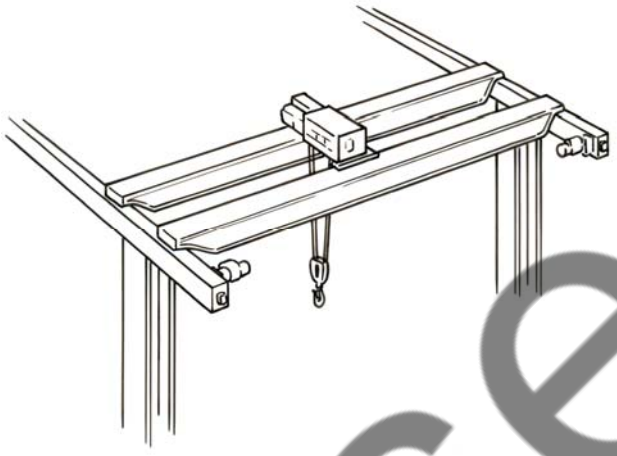
- Jib — a fixed crane consisting of a supported vertical member from which extends a horizontal swinging arm carrying the hoisting mechanism. See Figure 6.3
  - Travelling jib — a jib crane with the vertical member running on a track, its upper end guided by a parallel overhead track.

Figure 6.3 Example of a jib crane



- Overhead travelling (also known as a bridge crane) — a crane on parallel elevated runways and consisting of one or more trolleys operating from a bridge operating on the runways. Operation of the travelling crane is limited to the area between the runways. See Figure 6.4

Figure 6.4 Example of an overhead travelling crane

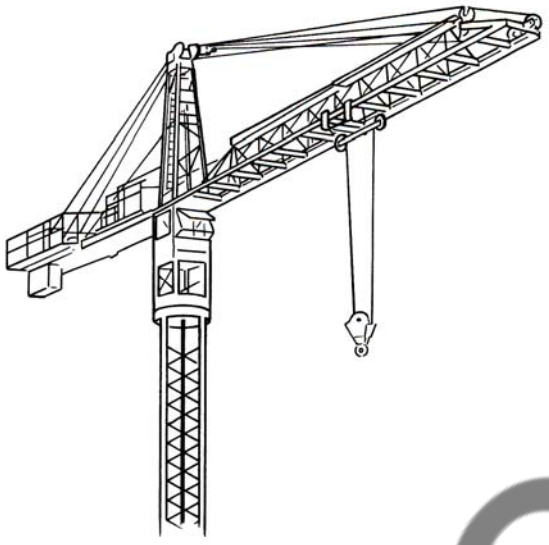


- Pillar — a fixed crane consisting of a vertical member with a revolving boom supported at the outer end by a tension member.
    - Pillar jib — a pillar crane carrying a trolley.

- Polar — a bridge or gantry crane that travels on a circular track.

- Tower — a crane in which a boom, swinging jib or other structural member is mounted on a vertical mast or tower. See Figure 6.5.
    - Climber — a crane erected upon and supported by a building or other structure and that may be raised or lowered to different floors or levels of the building or structure.
    - Free-standing — a crane with a horizontally swinging boom that may be on a fixed base or mounted on rails.
    - Mobile — a crane mounted on a crawler tractor, truck or similar carrier for travel or transit.
    - Self-erecting — truck carrier mounted and capable of self-erection.
    - Hammerhead — a rotating, counterbalanced cantilever, equipped with one or more trolleys and supported by a pivot or turntable on a travelling or fixed tower.

Figure 6.5 Example of a tower crane



- Wall crane — a crane having a jib with or without a trolley and supported from a side wall or line of columns of a building.

A hoist is a lifting device designed to lift and lower loads. Examples include:

- Simple drum hoist — a hoist with one or more drums controlled by manual clutches, brakes or ratchet and pawl on a drum and powered by hand or electricity.
- Electric hoist — an electrically powered, motor-driven hoist, having one or more drums or sheaves for a rope or chain.

## Subsection 59(1.1) Drawworks

This subsection clarifies that drawworks used in activities and auxiliary processes associated with exploring for and drilling, operating or servicing wells for gas, crude oil or geothermal energy are covered by Part 37. Drawworks on equipment used for other purposes continue to be covered by Part 6.

## Subsections 59(2) and 59(3)

All requirements of this Part apply to roofer's hoists, regardless of size, except for the load chart requirements (section 63) and the log book provisions (sections 64(4) and 65).

This subsection prohibits the use, for vertical lifting, of devices not designed or intended for vertical lifting. This includes load binders, ratchet-drive pulleys (commonly known as "come-alongs"), grip-action devices (commonly known as "tirfors"), etc. These units are typically designed for pulling only in a horizontal plane and are not to be used for vertical lifting unless complying with relevant provisions of Part 6 and specifically defined for vertical lifting in a manufacturer's specifications.

### Subsection 59(4)

Subsection 59(1) states that this Part only applies to lifting devices with a rated load capacity of 2000 kilograms or more. Subsection 59(4) overrides this requirement with respect to the marking of rated load capacity. Knowing the load capacity of a lifting device is vital to preventing it from being overloaded. Subsection 59(4) requires all lifting devices with a rated load capacity of less than 2000 kilograms to have their rated load capacity shown on the equipment.

## Section 60 Not commercially manufactured

Any lifting device must be either commercially manufactured or certified by a professional engineer as fit and safe for use. The certification must be in writing and bear the professional seal and signature of the certifying engineer as required by section 14 of the OHS Code.

In general, a commercially manufactured product has the following qualities

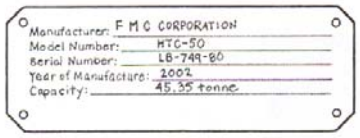
(a) it is designed and built to some standard or generally accepted engineering principles that make it safe for use;
(b) it is designed and built by person(s) with the skill or competence to be able to make the product safe;
(c) it is produced with the intention of being generally available to anyone who wants to buy it — normally there is an exchange of money;
(d) it is normally supported by the manufacturer with a warranty, guarantee, and product support; and
(e) liability and safety issues related to its use have been addressed by the manufacturer.

It is implied by the OHS Code, that a product that is "commercially manufactured" is "safe" because it has been produced by a "manufacturer" that has the skills and competencies to do so.

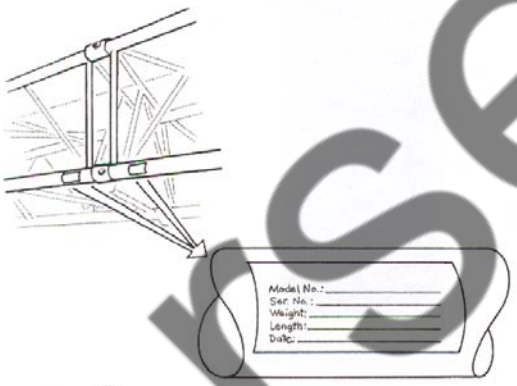
## Section 61 Identification of components

The intent of this section is to ensure that safe operation of a lifting device is not compromised by random selection and installation of components. The identification mark must be referenced to the manufacturer's specifications. Figure 6.6 shows examples of typical component marking tags.

Figure 6.6 Examples of component marking tags




Label showing rated capacity




Typical boom section identification plate

## Section 62 Rated load capacity

### Subsections 62(1) and 62(2)

Rated capacity is the maximum load for which a lifting device is designed and built. Displaying this directly on the lifting device provides an employer with information necessary to comply with section 12 of the OHS Code.

For example, a lifting device with a rated capacity of 45 tonnes means that the device, with standard components and operated in accordance with the manufacturer's specifications, will lift a load of 45 tonnes without over-stressing any of the components and without exceeding safety factors. The 45 tonne rated capacity includes the weight of any auxiliary devices and rigging.

The rated capacity of a crane varies with the angle of the boom and its boom length.

In general, a commercially manufactured product has the following qualities

(a) it is designed and built to some standard or generally accepted engineering principles that make it safe for use;
(b) it is designed and built by person(s) with the skill or competence to be able to make the product safe;
(c) it is produced with the intention of being generally available to anyone who wants to buy it — normally there is an exchange of money;
(d) it is normally supported by the manufacturer with a warranty, guarantee, and product support; and
(e) liability and safety issues related to its use have been addressed by the manufacturer.

It is implied by the OHS Code, that a product that is "commercially manufactured" is "safe" because it has been produced by a "manufacturer" that has the skills and competencies to do so.

### Subsection 62(3)

This labelling requirement does not apply to A-frames and gin poles.

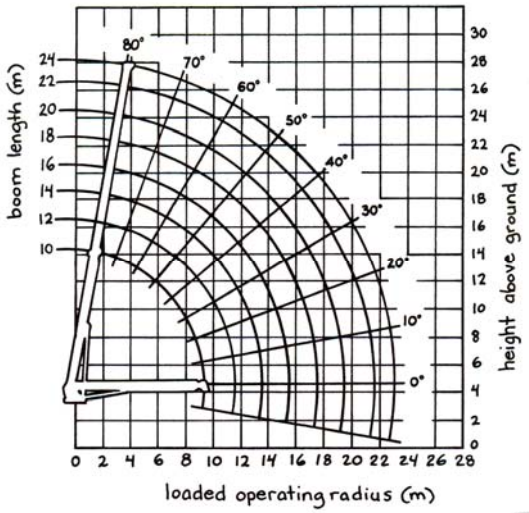
## Section 63 Load charts

### Subsection 63(1)

Load charts list a crane's rated capacity at various boom lengths and incline angles (see Figure 6.7). Since these are the maximum loads that the crane can safely lift, these values must never be exceeded. The values found on crane load charts are referred to as gross capacities, rated capacities or rated loads. These values apply to a crane kept in "as new" condition and set up in accordance with the manufacturer's specifications.

To determine the maximum load a crane can safety lift, i.e. net capacity, the weight of all auxiliary devices such as jibs, rigging (including the hook, slings, shackles, spreader bars, etc.), load blocks and ball must be deducted from the rated capacity.

Figure 6.7 An example of a load chart




| Maximum Rated Load in LBS. With Outriggers Fully Extended | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Loaded Operating Radius | Loaded Boom Angle | Retracted Boom Length | Loaded Boom Angle | Boom Length | Loaded Boom Angle | Boom Length | Loaded Boom Angle | Boom Length | Loaded Boom Angle | Boom Length |
| Feet | <° | 25 Feet | <° | 35 Feet | <° | 45 Feet | <° | 55 Feet | <° | 59 Feet |
| 5 | 80 | 60,000 | | | | | | | | |
| 8 | 73 | 43,000 | 78 | 40,500 | | | | | | |
| 10 | 67 | 36,500 | 74 | 34,500 | 78 | 33,000 | 80 | 32,000 | | |
| 12 | 62 | 31,900 | 71 | 30,100 | 75 | 28,600 | 78 | 27,500 | 79 | 27,000 |
| 14 | 57 | 28,500 | 67 | 26,500 | 73 | 25,400 | 76 | 24,300 | 77 | 24,100 |
| 16 | 50 | 25,500 | 63 | 24,100 | 70 | 22,600 | 74 | 21,600 | 75 | 21,400 |
| 18 | 44 | 23,000 | 59 | 21,800 | 67 | 20,400 | 71 | 19,400 | 73 | 19,200 |
| 20 | 36 | 21,000 | 55 | 19,900 | 64 | 18,600 | 69 | 17,700 | 71 | 17,400 |
| 25 | | | 44 | 16,600 | 57 | 15,500 | 64 | 14,700 | 66 | 14,500 |
| 30 | | | 31 | 13,500 | 49 | 13,100 | 58 | 12,400 | 60 | 12,200 |
| 35 | | | | | 39 | 11,200 | 51 | 10,700 | 55 | 10,500 |
| 40 | | | | | 27 | 9,300 | 44 | 9,300 | 48 | 9,200 |
| 45 | | | | | | | 35 | 8,300 | 41 | 8,300 |
| 50 | | | | | | | 24 | 6,900 | 33 | 7,200 |
| 55 | | | | | | | | | 21 | 6,000 |
| 60 | | | | | | | | | | |

Ratings above the heavy line are based on structural competence and not machine stability.

# Section 64 Operator requirements

## Subsection 64(1)

An employer must ensure that the operator of a lifting device meets two conditions. First, the worker must be competent. Under the *Apprenticeship and Industry Training Act*, no person may work in the occupation of Crane and Hoisting Equipment Operator unless that person

- has a recognized trade certificate:
    - Alberta Journeyman Certificate
    - Alberta Qualification Certificate
    - Alberta Certificate of Completion of Apprenticeship
    - Alberta Certificate of Proficiency
    - Certificates of Completion of Apprenticeship issued by another province prior to May 9, 1996
    - Certificates bearing the Interprovincial Standards Program Red Seal
    - Effective June 26, 1988, certificates for the Trade issued by Saskatchewan Apprenticeship, or
- has applied to go into an apprenticeship program, or
- is in an apprenticeship program, or
- is a student in a work-training program, or
- is otherwise permitted under the *Apprenticeship and Industry Training Act* to work in the trade, or
- has a certificate from another jurisdiction that is not recognized and has applied to have it recognized and is working under apprentice-type supervision, or
- is in a recognized training program from another jurisdiction and working under apprentice-type supervision, or
- has applied for a certificate and is working under apprentice-type supervision.

These provisions under the *Apprenticeship and Industry Training Act* are limited to:

(a) tower cranes;
(b) mobile cranes with a lifting capacity of 15 tons or greater;
(c) stiff boom trucks that have a lifting capacity greater than 5 tons;
(d) articulating boom trucks that have a lifting capacity greater than 5 tons equipped with a winch or 8 tons if not equipped with a winch; and
(e) wellhead boom trucks.

A journeyman's certificate, or an equivalent credential recognized by Alberta Advanced Education and Technology, Apprenticeship and Industry Training, is *not* required under the *OHS Act, Regulation* or Code to prove the competency of a worker performing the work of a particular compulsory trade.

The absence of an Alberta trade certificate alone is insufficient to consider a worker not competent. The employer is ultimately responsible for ensuring that workers are adequately qualified, suitably trained and have sufficient experience to perform their work safely. Employers need to be aware of OHS and other legislation that applies to their workers.

## Subsection 64(2)

An operator must be able to demonstrate competency in operating the device, including, where relevant:

(a) operating the lifting device in a proper, safe, controlled, and smooth manner in accordance with the manufacturer's specifications;
(b) reading and understanding lift plans;
(c) maintaining the equipment log book and the operator's log book;
(d) selecting the appropriate boom, jib and crane configuration to meet lift requirements and determine the net lifting capacity of this configuration;
(e) determining the number of parts of line required;
(f) thoroughly understanding the information in the operating manual and understanding the device's limitations;
(g) knowing, understanding and properly using the load charts;
(h) inspecting the lifting device and performing daily maintenance as required by the manufacturer's specifications or by the employer;
(i) checking that all hazards have been identified;
(j) shutting down and securing the device when it is unattended; and
(k) understanding and using hand signals for hoisting operations.

## Subsection 64(3)

Any worker who does not meet the requirements of subsection (1) is prohibited from operating the lifting device.

## Subsection 64(4)

To ensure the safest possible lifting operation, the operator of a lifting device must be familiar with the device's operating condition. The device's log book is the record of that condition at any given time and the operator is required to review recent entries prior to operating the device.

### For more information

http://employment.alberta.ca/documents/WHS/WHS-PUB_is009.pdf
Guidelines for Safety Training of Overhead Crane Operators and Supervisors

# Section 65 Log books

## Subsection 65(1)

Log books are a crucial source of relevant information about the operational condition of a lifting device. Employers have the option of using a conventional hard copy version that typically stays with the lifting device or an electronic version typically linked to a computer. Figure 6.8 is an example of a daily crane operation log book.

## Subsection 65(1.1)

Manually operated hoists are used widely across many industries. Often these hoists are portable units such as come-alongs transported in vehicles and with equipment. Reflecting the difficulty and impracticality of maintaining log books for these hoists, log books are not required for manually operated hoists.

## Subsection 65(2)

Because the information in the log book can be critical during a lifting operation, it is important that the log book

(a) be readily available to an occupational health and safety officer and ready for inspection in a prompt, timely and cooperative manner,
(b) be up-to-date, accessible and ready for use by an operator in a prompt and timely manner, and
(c) stays with the lifting device if ownership of the device changes.

## Subsection 65(3)

In addition to the listed details, it is good operating practice to record in the log book the results of a pre-use check that includes the following:

(a) structural condition;
(b) time, date, weather condition;
(c) damage;
(d) running repairs;
(e) all accidents and incidents involving the crane; and
(f) "shock loading" incidents.

In the case of tower cranes, CSA Standard Z248-04, *Code for Tower Cranes*, specifically requires that before commencing work each day, the crane must be operated through its full range of movements to ensure that all limit switches, signal lights, brakes, and audio and visual indicators are functioning properly.

Figure 6.8 Example of a operator's daily crane log book

**DAILY CRANE OPERATION LOG BOOK**

**Week Ending**:
Saturday: _____, 20 ___ Operator: _____

Unit Number: _____

Model Number: _____ Hour Meter Reading: _____

| Items Checked | S | M | T | W | T | F | S | Operator Comments |
|---|---|---|---|---|---|---|---|---|
| (1) Oil levels – engine, transmission, hydraulic | | | | | | | | |
| (2) Antifreeze (coolant), fan belts | | | | | | | | |
| (3) Headlights, taillights, clearance/marker lights | | | | | | | | |
| (4) Brake lights, revolving beacon light | | | | | | | | |
| (5) Backup alarm, horn, windshield wipers | | | | | | | | |
| (6) All glass clear/good condition | | | | | | | | |
| (7) Swing brake, house lock | | | | | | | | |
| (8) Boom angle indicator | | | | | | | | |
| (9) Weight load indicator | | | | | | | | |
| (10) Anti two block device | | | | | | | | |
| (11) All instrument gauges | | | | | | | | |
| (12) Air pressure, low air pressure warning device | | | | | | | | |
| (13) Air tanks drained | | | | | | | | |
| (14) Parking brake, foot brakes | | | | | | | | |
| (15) All controls for proper function | | | | | | | | |
| (16) Outrigger pads, latches, outrigger float pads | | | | | | | | |
| (17) Tire condition/pressure, wheel studs (or tracks) | | | | | | | | |
| (18) Hoists (load, whip or boom) | | | | | | | | |
| (19) Boom and attachments | | | | | | | | |
| (20) Hooks, load block, headache ball | | | | | | | | |
| (21) Fuel | | | | | | | | |
| (22) Fire extinguisher | | | | | | | | |
| (23) Operator manual | | | | | | | | |
| (24) Walk around inspection for<br>• Loose/missing bolts<br>• Pins/cotter pins<br>• Leaking fluids<br>• Cracked/damaged hoses<br>• Cracked welds<br>• Dents/damage<br>• Frayed/damaged wire rope<br>• Protective guards/shields in place | | | | | | | | |

Comments:
_____
_____
_____

### Subsections 65(4) and 65(5)

For control and audit purposes, it is important that each entry in the log book is
(a) signed by the person performing the work if it is a paper log book, or
(b) identifies the person doing the work if it is an electronic log book.

### Subsection 65(6)

Having the employer's representative initial entries in the log book ensures that the employer has knowledge of all the crane's activities.

## Section 66 Preventing an unsafe lift

The operator is responsible for being aware of conditions that may affect safety at the lift site. This can include site conditions, equipment conditions, or any other aspect of the lift. If the operator has any doubt as to the safety of the lift, the operator must cease operations until the condition is made safe.

## Section 67 Preventing collisions

Whenever two or more lifting devices are on site and close enough that a collision might happen (see Figure 6.9), the employer must:
(a) prepare procedures to prevent collisions. Section 8 of the *OHS Regulation* requires the procedures to be in writing and available to workers. Such procedures can take into consideration the following:
    - provision of adequate, qualified supervision
    - ground conditions
    - the use of proximity sensing and warning devices
    - exact load weight and configurations
    - the longest expected load radius of each crane
    - boom length and boom angles of each crane
    - line, swing and boom speeds
    - the need to travel with a load; and
(b) ensure that operators are familiar with these procedures as required by section 13 of the *OHS Regulation*.

Unless specifically required elsewhere in this Part, the employer should
(a) ensure that operators are kept aware of operating conditions, including the location and proximity of other lifting devices;

(b) ensure that all workers involved know exactly what they must do and what movements will be made before the lift begins; and
(c) ensure that operators are provided with a visual or auditory means of communicating with each other.

Only one person should direct and control operations involving multiple cranes. That person should be positioned to view the total operation and should maintain contact with the operators.

Figure 6.9 Example of multiple cranes in service

## Section 68 Load weight

The weight of the load being lifted is perhaps the most critical piece of information needed to conduct a lift safely. Everyone involved in the lift must know this in order to carry out their duties. The rigger must be able to apply the appropriate type, number and configuration of slings and other attachments. The operator must be able to place the lifting device and adjust boom lengths and angles to the appropriate configuration. The person in charge of the lift, such as the lift coordinator, has ultimate responsibility at the lift site for the lift's safe execution. Depending on the complexity of the lift, a lift engineer or rigging specialist may be required to design the lift.

The total weight of a load is the sum of the actual load weight, the weight of the hook and block, and the weight of slings and other lifting attachments. These weights can be determined in information provided by manufacturers, engineering specifications, or calculations performed by a competent person.

## Section 68.1 Lift calculation

Performing a lift calculation ensures that relevant and applicable factors for lifting a load have been considered and calculated. These factors include:

(a) load information (total weight of item to be lifted, weight of load block, weight of rigging/attachments, load centre of gravity, if applicable;
(b) crane information:
    (i) mobile cranes i.e. maximum radius, boom length/angle, configuration, relevant deductions, etc.;
    (ii) overhead cranes i.e. capacity;
(c) calculated percentage of crane capacity; and
(d) sketch i.e. crane placement, clearance to surrounding facilities like buildings and power lines.

While this is a good practice regardless of the load weight, it is critical as the load approaches the crane's capacity. This calculation must be performed when the load reaches or exceeds 75 percent of the crane's capacity.

For multiple lifts, the "worst-case" lift can be used to satisfy this requirement. In the case of tower cranes, lifting operations are typically planned or engineered and test weights are lifted daily. This would satisfy this requirement.

Figure 6.9.1 Example of hoisting information and planning sheet

- HOISTING INFORMATION AND PLANNING SHEET -

JOB DESCRIPTION: DATE :
AREA CONTACT: S.W.P. # :
LOCATION: J.T. # :
OPERATOR NAME: CRANE SIZE:
WEIGHT OF LOAD INFORMATION PROVIDED BY:

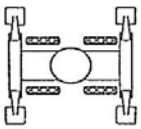
| - LIFT INFORMATION - | - LIFT DIAGRAM - |
|---|---|
| WEIGHT OF LOAD: _____ LBS<br>ALLOWANCE FOR EXTRA WEIGHT: _____ LBS<br>(Scale, Sludge, Internals, Liquid etc.)<br>WEIGHT OF RIGGING: _____ LBS<br>WEIGHT OF BLOCK OR BALL: _____ LBS<br>WEIGHT OF ATTACHMENTS: _____ LBS<br>*TOTAL WEIGHT TO BE LIFTED :* _____ *LBS*<br>MAX. RADIUS TO BE USED: _____<br>BOOM LENGTH: _____<br>BOOM ANGLE: _____<br>CAPACITY FROM CHART: _____ LBS<br>% OF CAPACITY: _____ (See example below)<br>EST. CLEARANCE BETWEEN BOOM AND SURROUNDING FACILITIES: _____ |  |
| EXAMPLE:<br>TOTAL WEIGHT TO BE LIFTED: 8.695 LBS<br>DIVIDED BY<br>CAPACITY FROM CHART: 15.500 LBS<br>X 100 = % OF CAPACITY: 56.1% | |

Figure 6.9.2 Example of lift calculation form (A)

## Overhead Crane Lift Calculation Form

| Crane Unit Number | Capacity of Crane (A) Lbs/mt | Rigging Weight (R) Lbs/mt | Load Weight (L) Lbs/mt | Total Weight (R+L) Lbs/mt | Percentage of Load Capacity (R+L)/(A) | Operator's Name | Date |
|---|---|---|---|---|---|---|---|
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mt = metric tonnes

Figure 6.9.3 Example of lift calculation form (B)

## Mobile Crane Lift Calculation Form

**Name:** _____ **Date:** _____

This form is to be filled out when working beyond 75% of charts.

| **Crane Information** | **Lift/Crane 1** | **Lift/Crane 2** |
|---|---|---|
| Crane Size | | |
| Make/Model No. | | |
| Boom Length (ft/m) | | |
| Jib Length (ft/m) | | |
| Jib Stowed | Yes ☐ No ☐ Removed ☐ | Yes ☐ No ☐ Removed ☐ |
| Counterweight Configuration | | |
| Mast Length (ft/m) | | |
| Superlift (lbs/ton/mt) | | |
| Lift Radius (ft/m) | | |
| **A** Crane Capacity | | |
| **Load Information** | | |
| Load Description | | |
| Load Weight (lbs/mt) | | |
| Verified by | | |
| Load Block Weight (lbs) | | |
| Headache Ball Weight (lbs/mt) | Weight<br>Installed ☐ Removed ☐ | Weight<br>Installed ☐ Removed ☐ |
| Auxiliary Head (lbs/mt) | Weight<br>On ☐ Off ☐ N/A ☐ | Weight<br>On ☐ Off ☐ N/A ☐ |
| Jib Stowed or Erected (lbs/mt) | | |
| Other (lbs/mt) | | |
| Rigging (lbs) | | |
| **B** Total Load Weight (lbs/mt) | | |
| % Capacity = (**B/A)** x 100 | | |

mt = metric tonnes (circle applicable units)

Lifting attachment used: Trunnions ☐ Lift Lugs ☐ Basket ☐ Other _____

| **Lift Plan:** |
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| | | |
|---|---|---|
| Reviewed by: | | |
| Approved by: | | |

## Section 69 Loads over work areas

### Subsection 69(1)

The planning for a lift must ensure that, wherever possible, a load is not moved over workers. The planning process should assess
(a) the type of load and its rigging requirements,
(b) whether the load might drift, fall freely, or be released unintentionally,
(c) whether the lifting device might strike workers, and
(d) whether the lifting device might fail or fall over.

### Subsections 69(2) and 69(3)

Subsection (3) prohibits workers from standing or passing under a suspended load, whether the load is moving or stationary. However, if there is no reasonably practicable alternative, the workers must be warned of the hazard and the lifting device operator must be aware of workers standing under the suspended load.

### Subsection 69(4)

The load must be carried as close to the ground or grade as possible (and should be close to the lifting device) to reduce the possibility of injury or equipment damage in the event that the load is dropped. Other precautions that should be followed when moving a lifting device that is carrying a load include:
(a) if the device has a boom, the boom should be as high as possible while still ensuring that the load does not swing;
(b) the load should be carried in line with the device; and
(c) the bottom edge of the suspended load should be carried at a height no greater than the shoulder height of workers attending to the load.

## Section 70 Tag and hoisting lines

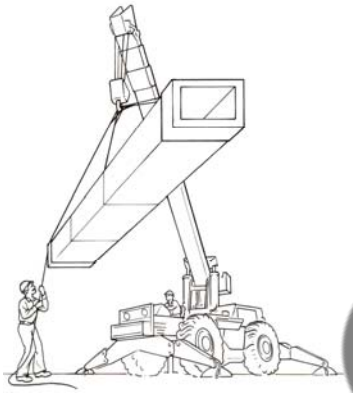
### Subsections 70(1) and 70(2)

Tag lines (see Figure 6.10), which are usually made of nylon rope or other non-conductive material, are used to:
(a) help riggers control the motion of a suspended load. A load can move or swing dangerously if the crane boom moves rapidly or a gust of wind catches the load. To do so, they must be of sufficient length to allow control of he load and must be used in a manner that ensures the rigger holding the line will not be struck by the load;
(b) allow riggers to stand a safe distance away from the load; and

(c) provide some protection from electrocution as nylon rope is a poor conductor of electricity.

As an alternative to tag lines, an employer may consider options for securing the load to the crane or controlling equipment.

Figure 6.10 Example of tag line in use



To reduce the likelihood of a suspended load swinging or moving uncontrollably, the hoisting line must be positioned over the load's centre of gravity. The load's "centre of gravity" is the load's balance point or centre of weight. The location of a load's centre of gravity depends on the load's shape and how its weight if distributed i.e. heavier at one end and than the other, or distributed evenly.

### Subsection 70(3)

Usually, tag lines improve the level of safety for riggers. They should not be used if there is a chance that the danger to workers would be increased. This could include:

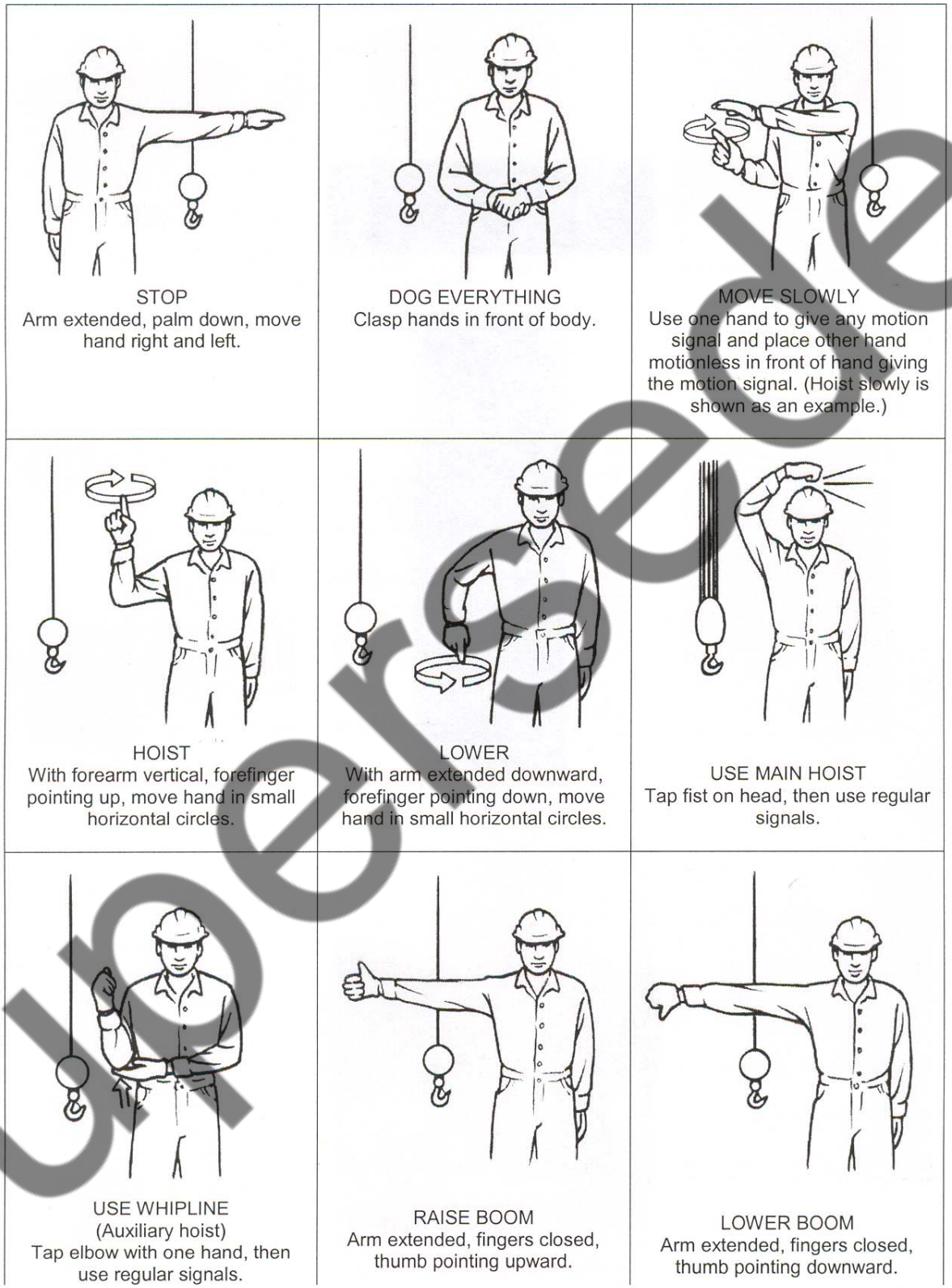
- chance of contact wit live electrical conductors;
- chance of entanglement in moving machinery;
- chance of getting caught on moving mobile equipment.

As an alternative to tag lines, an employer may consider options for securing the load to the crane or controlling equipment.

## Section 71 Hand signals

It is common in many hoisting operations to use portable two-way radios when directing the motion of a suspended load. Where this is not possible, hand signals by a designated signaller may be required. Figures 6.12 and 6.13 are examples of standard hand signals for crane operations. The employer must designate signallers in accordance with section 191 of the OHS Code. All signals should be continuous and there should be no response to unclear signals.

Figure 6.12 Mobile crane signals



STOP
Arm extended, palm down, move hand right and left.

DOG EVERYTHING
Clasp hands in front of body.

MOVE SLOWLY
Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal. (Hoist slowly is shown as an example.)

HOIST
With forearm vertical, forefinger pointing up, move hand in small horizontal circles.

LOWER
With arm extended downward, forefinger pointing down, move hand in small horizontal circles.

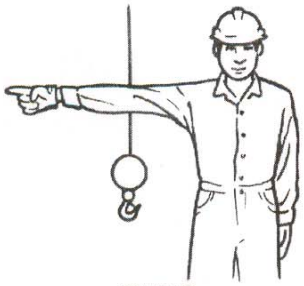
USE MAIN HOIST
Tap fist on head, then use regular signals.

USE WHIPLINE
(Auxiliary hoist)
Tap elbow with one hand, then use regular signals.

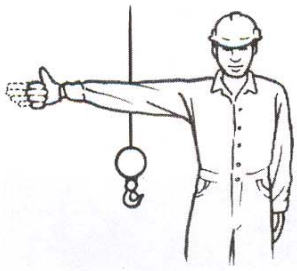
RAISE BOOM
Arm extended, fingers closed, thumb pointing upward.

LOWER BOOM
Arm extended, fingers closed, thumb pointing downward.

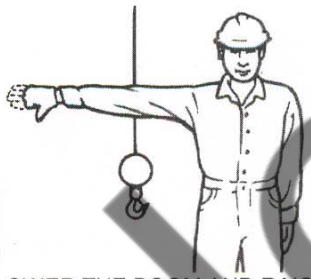
Figure 6.12 continued



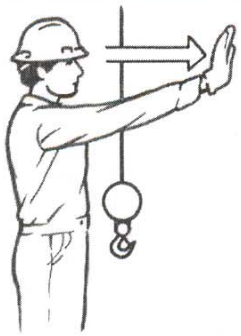
SWING
Arm extended, point with finger in direction of swing of boom.



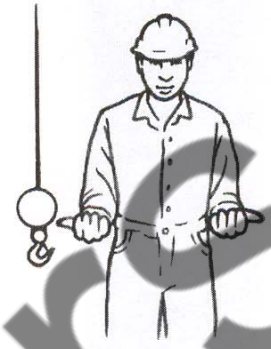
RAISE THE BOOM AND LOWER THE LOAD
With arm extended, thumb pointing up, flex fingers in and out as long as load movement is desired.



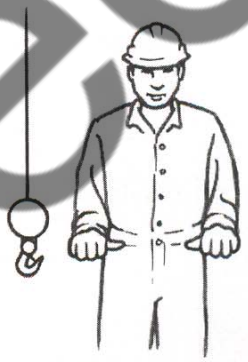
LOWER THE BOOM AND RAISE THE LOAD
With arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired.



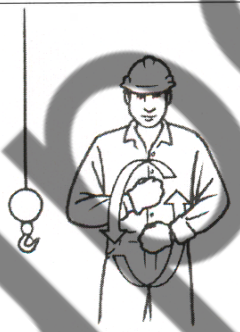
TRAVEL
(Rail mount or trolley)
Arm extended forward, hand open and slightly raised, making pushing motion in direction of travel.



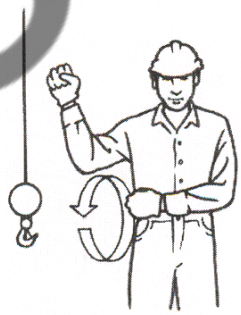
EXTEND BOOM
(Telescoping booms)
Both fists in front of body with thumbs pointing outward.



RETRACT BOOM
(Telescoping booms)
Both fists in front of body with thumbs pointing towards each other.

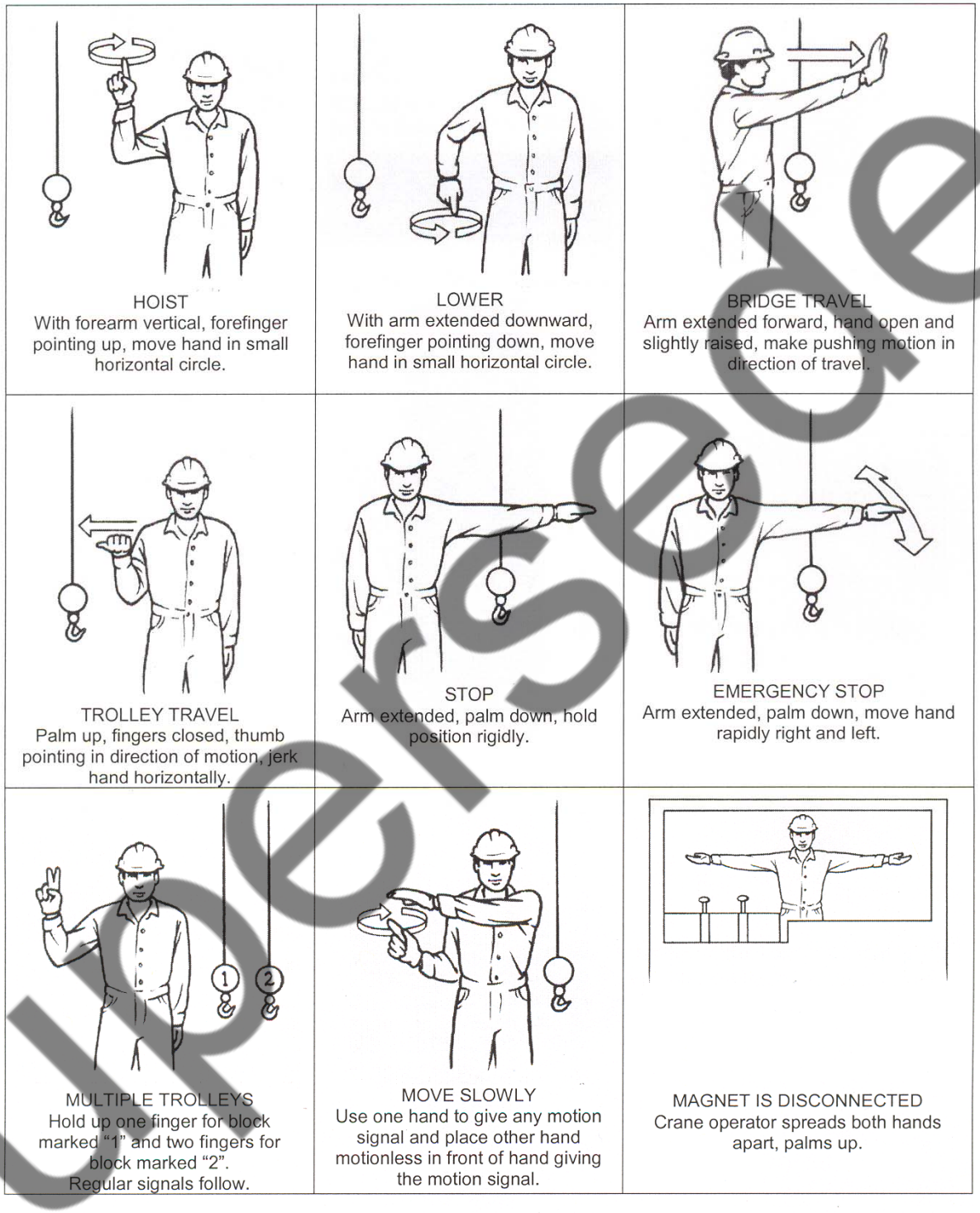


TRAVEL (Both tracks)
Use both fists in front of body making a circular motion about each other, indicating direction of travel, forward or backward.
(For crawler cranes only)



TRAVEL (One track)
Lock the track on side indicated by raised fist. Travel opposite track in direction indicated by circular motion of other fist, rotated vertically in front of body.
(For crawler cranes only)

Figure 6.13 Overhead crane signals



## Section 72 Controls

### Subsection 72(1)

"Constant manual pressure" is the deliberate, sustained application of force in order to operate the device. Typically, this force is applied by the operator's hand or foot. Removal of this force is intended to immediately stop the operation. Any form of locking mechanism that keeps the control active without use of the operator's hand or foot is not permitted.

### Subsection 72(2)

A drilling rig is typically equipped with a control that maintains a pre-determined weight on the drill bit. This control can be hydraulically or air-operated and adjusts automatically as drilling conditions change.

### Subsection 72(3)

"Visually distinguishable" means that the operator is visible at a distance and can be identified as the operator. This can be accomplished by the wearing of high-visibility clothing or markings of a distinctive colour.

## Section 73 Repairs and modifications

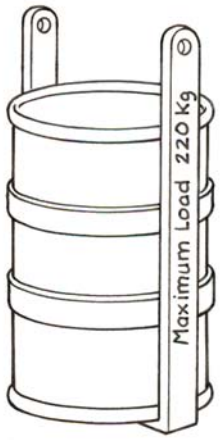
For the purpose of this section,
(a) "repairs" are actions that restore, renew or mend to sound condition after damage or excessive wear, and
(b) "modifications" are changes or alterations unrelated to any damage.

It is good practice to contact the manufacturer before repairs or modifications are undertaken. Any thin-walled structural sections that have buckled, been dented or deformed should be cut out and replaced with new components that are, at a minimum, equivalent in strength and capacity to the original. Any modifications must not by-pass or decrease any function or capability of the lifting device.

## Section 74 Containers for hoisting

Containers must be strong enough to withstand hoisting forces and forces exerted by the load. See Figure 6.14.

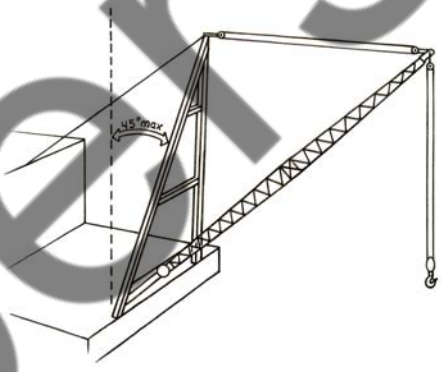
Figure 6.14 Example of an acceptable container for hoisting




## Section 75 A-Frames and gin poles

Inclining an A-frame or gin pole at an angle greater than 45 degrees from the vertical can impose unusual forces on components leading to hoist failure.

Figure 6.15(a) Example of A-frame with boom




An A-frame is not typically built with a boom. However, where it is, adequate "boom stops" can be provided by using chains or guy lines.

# Section 75.1 Suspended personnel baskets

## Section 75.1(1)

Because its failure can have catastrophic consequences, a suspended personnel basket that has not been commercially manufactured must be designed and certified by a professional engineer as safe for use. Readers are referred to section 88.1 of this Explanation Guide for technical design requirements applicable to personnel baskets used with a mobile crane.

Figure 6.15.1 shows a commercially manufactured suspended personnel basket. This type of personnel basket may be manually operated or power driven, is generally suspended from a thrustout, and is equipped with a separate vertical lifeline i.e. life safety rope. Figure 6.15.2 shows a typical personnel basket designed and certified by a professional engineer. It is generally suspended from a crane and is not equipped with a separate vertical lifeline i.e. life safety rope, for each worker in the basket. This type of personnel basket requires a separate safety line as described below.

Figure 6.15.1
Example of a commercially manufactured suspended personnel basket

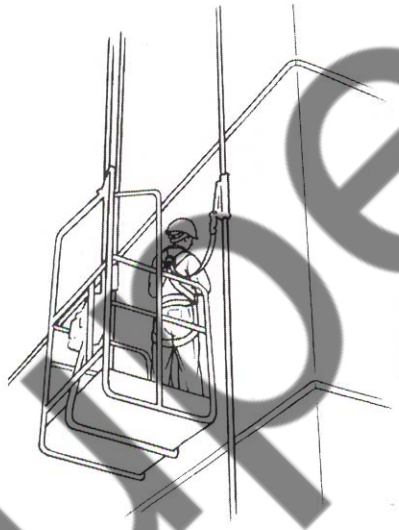
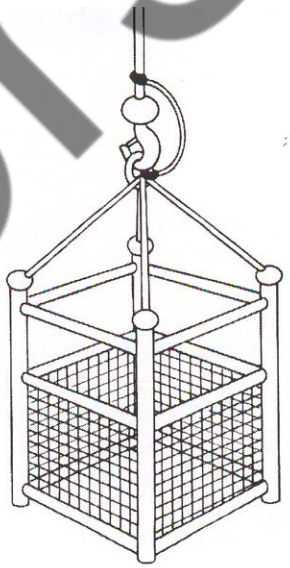


Figure 6.15.2
Example of a suspended personnel basket designed and certified by a professional engineer



### Commentary about "commercially manufactured"

In general, a commercially manufactured product has the following qualities
(f) it is designed and built to some standard or generally accepted engineering principles that make it safe for use;
(g) it is designed and built by person(s) with the skill or competence to be able to make the product safe;
(h) it is produced with the intention of being generally available to anyone who wants to buy it — normally there is an exchange of money;
(i) it is normally supported by the manufacturer with a warranty, guarantee, and product support; and
(j) liability and safety issues related to its use have been addressed by the manufacturer.

It is implied by the OHS Code, that a product that is "commercially manufactured" is "safe" because it has been produced by a "manufacturer" that has the skills and competencies to do so.

Criterion (a) refers to the product being designed and built to some "generally accepted engineering principles". It is expected that a "manufacturer" is able to provide drawings or sketches of the product that include an assessment of the product's strength, load-bearing capacity, etc. Further, criterion (d) mentions "product support". This may include, among other elements, the availability of written manufacturer specifications.

### Section 75.1(2)

Under normal circumstances, a worker working from a suspended personnel basket is protected from falling by using a personal fall arrest system such as a vertical lifeline (life safety rope)/rope grab combination or a self-retracting lifeline. The lifeline is often secured to an anchor point on the boom of the crane from which the personnel basket is suspended. In the event that it is impracticable to provide a personal fall arrest system for one or more workers in the personnel basket,
(a) a separate personnel basket support must be attached between the suspended personnel basket and the hoisting line above the hook assembly, and
(b) each worker within the personnel basket must wear a full body harness with lanyard securely attached to fall protection anchorage points located in or on the personnel basket.

The separate or secondary personnel basket support, in combination with the worker being attached to the personnel basket, functions as a fall arrest system. To limit fall distance and the arresting force experienced by workers inside the basket, the secondary personnel basket support must be kept as short as possible.

# Cantilever hoists

## Section 76 Installation and use

### Sections 76(a) and 76(b)

No explanation required.

### Section 76(c)

This requirement is intended to protect workers from the possibility of falling materials. Where the nature of the materials is such that the load must project beyond the edges of the platform or skip, the employer must provide an effective means of protection for workers against falling materials.

# Chimney hoists

## Section 77 Equipment requirements

A chimney hoist is used in the construction of chimneys, stacks, silos and similar structures. Chimney hoists are typically a freely suspended bucket, platform or cage. They are constructed progressively upwards.

### Section 77(a)

"Positive drives" means that the load-carrying unit is driven in both up and down directions. "Non-positive" (free-wheeling) means that the load-carrying unit is driven in the up direction and may be permitted to descend freely.

### Section 77(b)

Installation of a clutch is prohibited to prevent disengagement of the positive drive mechanism either through mechanical failure or accidental activation of the clutch control.

### Section 77(c)

The hoist operator must be aware of the hoist's speed if the hoist is capable of operating at speeds in excess of 0.6 metres per second. Section 78 prohibits lifting a worker at a speed greater than 0.6 metres per second.

### Section 77(d)

This requirement is intended to ensure that the hoist platform or bucket is prevented from falling in the event of a hoisting cable failure or other mechanical malfunction. More than one braking system is required and each must be capable of stopping one and one-half times the maximum load rated capacity travelling at the maximum rated speed.

### Section 77(e)

Requiring a swivel recognizes that wire ropes have a tendency to rotate. A swivel keeps the platform or bucket from rotating.

### Sections 77(f) and 77(g)

No explanation required.

## Section 78 Operator responsibilities

### Subsection 78(1)(a)

Since a chimney hoist is typically freely suspended, a maximum speed limit is required.

### Subsection 78(1)(b)

Proper use of the positive drive mechanism is required to control speed.

### Subsection 78(1)(c)

No explanation is required.

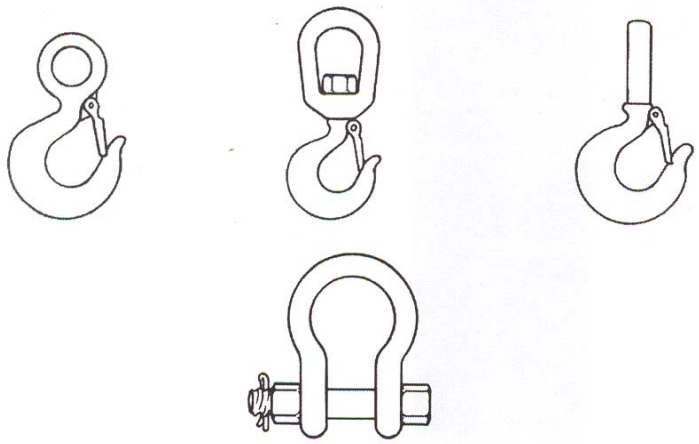
### Subsection 78(1)(d)

This requirement is intended to prevent materials and equipment from striking and injuring the worker in the event that the hoist moves abruptly. The worker is permitted to hold hand held equipment while being raised or lowered.

### Subsection 78(2)

Figure 6.16 provides examples of acceptable hooks and a shackle.

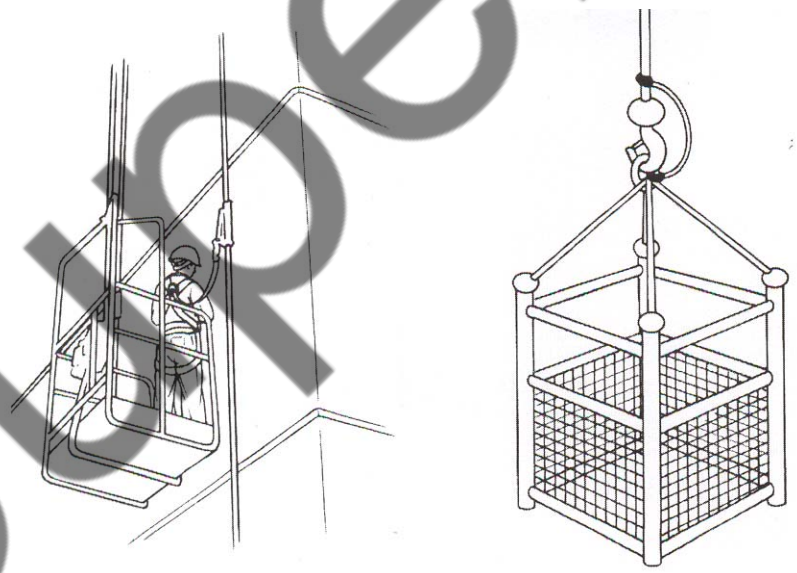
Figure 6.16 Examples of hooks with safety latches and a shackle equipped with a safety pin



## Section 79 Worker in lifting device

To ensure the worker's safety, he or she must be in a personnel basket while being lifted or lowered by a chimney hoist. The requirements of section 75.1 of the OHS Code must be met.

Figure 6.17 Examples of personnel baskets

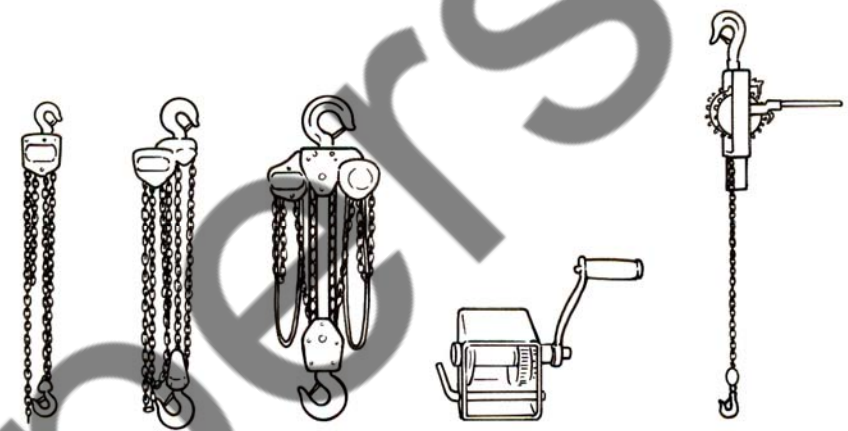


# Hand-operated hoists

## Section 80 Holding suspended load

"Hand-operated hoists" includes chain hoists, winches and "come-alongs". See Figure 6.18

Figure 6.18 Examples of hand-operated hoists

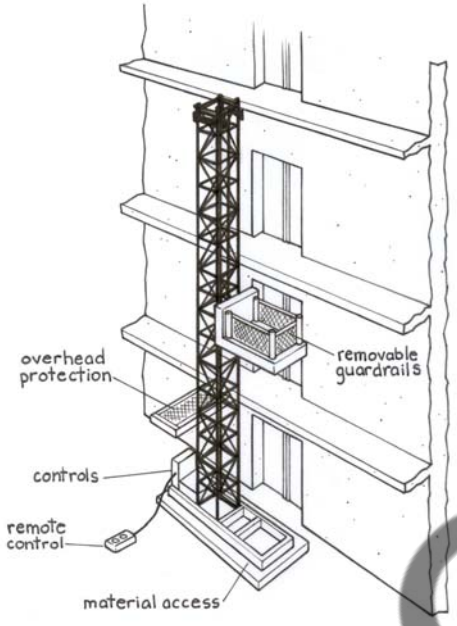


# Material hoists

## Section 81 Safety code for material hoists

CSA Standard CAN/CSA-Z256-M87 (R2006), *Safety Code for Material Hoists*, applies to hoists that are not a permanent part of structures and that are used to raise and lower material connected with or related to a building project. See Figure 6.19.

Figure 6.19 Example of a material hoist




The standard does not apply to
(a) hoists for moving people,
(b) temporary elevators installed in hoistways during the construction of buildings and incorporating a part of the permanent elevator to be installed later,
(c) manlifts, counterbalanced or endless-belt type,
(d) mine elevators,
(e) cranes and derricks,
(f) window cleaners and swingstages,
(g) mobile forklift trucks and similar equipment, and
(h) rope-guided and non-guided construction hoists for moving people.

The standard covers the design, construction, installation, operation, inspection and testing of material hoists. The following is a list of some of the standard's more critical requirements:

- *Part 6 Hoistway Enclosure* — this describes spacing and material requirements for a structure that isolates the hoistway, i.e. the space travelled by the car or counterweight, from all other parts of the building.

- *Part 7 Hoistway Landings and Doors* — this describes requirements for that portion of a floor, balcony, or platform used to receive the hoisted materials.

- *Part 8 Cars* — this describes requirements for the load-carrying units.

- *Part 15 Operation and Operating Devices* — this describes requirements for the hoist's actuating controls.

- *Part 20 Safeties and Governors* — this describes requirements for devices to stop and hold the car or counterweight in case of overspeed or free fall or if the hoisting ropes slacken.

- *Part 25 Communication* — this describes the requirements for communication and signal systems.

- *Part 26 Inspections and Tests* — this describes the requirements for when inspections should take place, what should be included in the inspection and the tests to be carried out.

## Section 82 Rider restriction

Part 10 of CSA Standard Z256-M87 (R2001), *Safety Code for Material Hoists*, requires that a sign be posted on each landing door and inside the car that reads "No Person Shall Ride On This Hoist". The only exception is for the purposes of inspection and maintenance of the hoist by a competent worker.

## Section 83 Gate interlocks

No explanation required.

## Section 84 Operator responsibilities

No explanation required.

## Section 85 Signal systems

Part 25 of CSA Standard Z256-M87 (R2001), *Safety Code for Material Hoists,* requires the use of either
(a) a two-way voice communication system, or
(b) a system, or combination of systems, of hand, audible or electric signals.

If a signal system is used, visual contact with the hoist operator must be maintained. When hand signals are used, the signaller must wear clearly distinguishable clothing such as a vest or armlets.

A signal system that incorporates voice communications must be used if a material hoist erected at a building is more than 20 metres in height.

## Section 86 Hoist brakes

Clauses 21.8 and 21.9 of CSA Standard Z256-M87 (R2001), *Safety Code for Material Hoists,* describe detailed requirements for brakes. Most material hoists are fitted with an auxiliary braking mechanism sometimes referred to as a "broken rope device". Activated in the event of a hoisting rope failure, brake cams clamp the frame of the hoist mast and stop the car from descending.

## Section 87 Location protected

### Sections 87(a) and 87(b)

Clause 6.1 of the CSA standard requires that the hoistway at grade level be enclosed up to a height of at least 3.5 metres from grade level. See Figures 6.20 and 6.21.

Clause 7.4.1 of the CSA standard requires that hoistway landings be protected by substantial door and gates/guardrails as shown in Figures 6.20 and 6.21.

Guardrails must meet the requirements of section 315 of the OHS Code.

Figure 6.20 Example of hoistway enclosure and guarding at a landing (plan view)

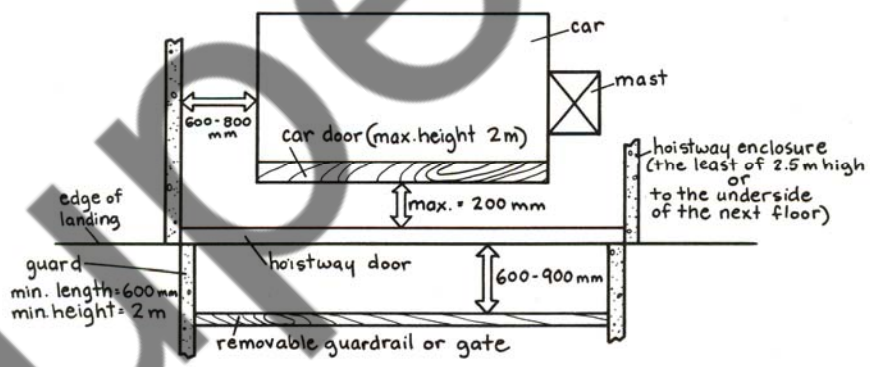
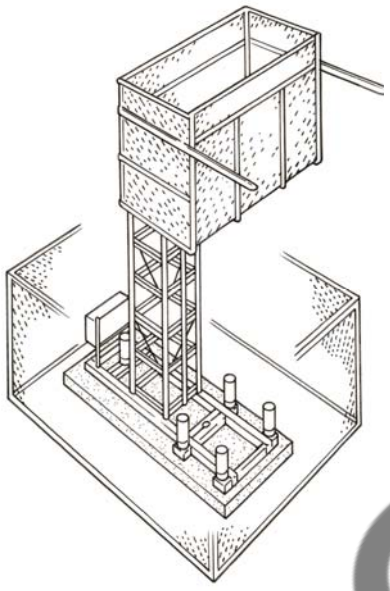


Figure 6.21 Example of typical enclosure at hoist base



Section 87(c)

An overhead protective covering must meet the requirements of section 318 of the OHS Code.

# Mobile Cranes and Boom Trucks

## Section 88 Safety code for mobile cranes

CSA Standard CAN/CSA-Z150-98 (R2004), *Safety Code on Mobile Cranes*, describes the design, construction, load rating, installation, erection, inspection, maintenance, repair, modification, test and operation of lattice and telescopic boom mobile cranes.

The Standard applies only to machines that have all of the following fundamental characteristics:

(a) the crane comprises, or is mounted on, a non or self-propelled, crawler or wheel-mounted mobile base;
(b) the crane is designed and manufactured for the primary purpose of hoisting and lowering loads by means of tackle suspended from a boom;
(c) the boom is lattice or telescopic and capable of being elevated and lowered in the vertical plane and of being rotated from side to side in the horizontal plane;
(d) the tackle is suspended from the boom and is capable of being increased and diminished in length;

(e) the crane uses an engine(s) or motor(s) of sufficient power to
  (i) elevate and lower the boom in the vertical plane with the load suspended from the tackle;
  (ii) rotate the boom in the horizontal plane with the load suspended from the tackle;
  (iii) increase and diminish the length of the tackle with the load suspended from the tackle; and
  (iv) in the case of a self-propelled crane, propel the vehicle, carrier, or base on which or to which the boom and hoist mechanism is attached.

The Standard applies to crawler-mounted cranes, commercial truck-mounted cranes and boom trucks, and wheel-carrier-mounted cranes, as well as any variations thereof that retain the fundamental characteristics of these cranes.

The requirements of CSA Standard Z150-98 (R2004) apply to
(a) articulating booms such as knuckle boom cranes;
(b) railway cranes, locomotive-mounted cranes and rail-mounted cranes;
(c) side boom tractors as used in pipeline work (to which ASME Standard B30.14 applies);

(d) mobile lifting devices designed specifically for use in powerline and electric utility services such as digger derricks, radial boom derricks intended to auger holes for and to set power and telephone poles;
(e) lift trucks such as forklifts, equipped with booms; and
(f) portable, truck mounted tower cranes.

The following are some critical requirements of the Standard.

- *Part 4 Inspection, Testing and Maintenance*

  (1) *Prior to initial use*
  No crane is to be put into operation until it has been thoroughly inspected and any defects and hazards eliminated.

  (2) *Cranes in regular use*
  Inspections must be conducted at the intervals shown in Table 6.1.

Table 6.1 Inspection interval based on type of inspection

| Type of Inspection | Inspection interval |
|---|---|
| Daily | To be performed daily. |
| Periodic | Every 3 months or every 350 hours of machine time or as specified by the original equipment manufacturer. |
| Annual | To be performed annually. |
| Complete structural inspection of telescopic boom | Any time the boom is disassembled or at a minimum once every 10 years or 10,000 hours of service or as specified by the manufacturer. |
| Special | Carried out as required after any form of actual, suspected, or potential damage is sustained. |

### Daily inspections

Daily inspections must include, but not be limited to, the following:

(a) all rope reeving, including load lines, jib suspension, boom hoist and mid-point suspension;

(b) all control mechanisms for incorrect and/or malfunctions interfering with proper operation;
(c) all control mechanisms for excessive wear of components and contamination by lubricants or other foreign matter;
(d) all safety devices;
(e) all air, hydraulic, lubricating and cooling systems for deterioration or leakage;
(f) electrical apparatus for malfunction, signs of excessive deterioration, dirt, icing and moisture accumulation;
(g) all hydraulic hoses;
(h) hooks and latches for deformation, chemical and heat damage, cracks and wear;
(i) hydraulic system for proper oil level;
(j) swivels for freedom of rotation;
(k) clutches, brakes and attachments for malfunction;
(l) outriggers and outrigger boxes;
(m) tires.

## Periodic inspections

Periodic inspections must include, but not be limited to, the following

(a) all daily inspection items;
(b) deformed or corroded and cracked members or welds in the crane structure or boom;
(c) loose bolts, nuts, pins;
(d) cracked, worn or distorted parts such as pins, gears, rollers, and locking devices;
(e) wear on brake and clutch system parts such as linings;
(f) pawls and ratchets;
(g) load, boom angle and other indicators;
(h) all power plants;
(i) hooks;
(j) all control mechanisms for excessive wear and contamination;
(k) travel steering and braking systems for malfunction;
(l) worn or damaged tires and crawler undercarriage;
(m) hoses, fittings and tubing for leakage, blistering, deformation, tight joints, excessive abrasion or scrubbing;
(n) hydraulic and pneumatic pumps and motors for loose bolts, fasteners, leaks, shaft seal leaks, unusual noises or vibration, loss of operating speed, excessive heating, loss of pressure;
(o) valves for cracks, leaks, sticking, failure;
(p) cylinders for leaking, seals, welded joints, scored, nicked, dented rods, dented case, loose, deformed rod eyes and joints;
(q) filters;
(r) windows, horn, wipers, heater, defroster, lights, gauges, transmissions, differential, cooling, fuel, electrical system, drive belts, suspension, steering, brake systems, crawler chain, tracks, sprockets, rollers.

## Annual inspection

An annual inspection must be performed by a qualified person and supervised by a professional engineer. Annual inspections must include, but not be limited to, the following:

(a) all daily and periodic inspection items including test load, if specified by the manufacturer;
(b) outrigger and outrigger boxes;
(c) rotating frame and bearing including main baseplate welds;
(d) steering knuckles;
(e) boom foot section, lattice boom;
(f) boom head;

(g) boom hoist;
(h) boom sections including sheaves, hooks, blocks, wedge sockets;
(i) teardown inspection and lubrication of the swivel hook, and block assembly at least every five years and the hooknut disassembled and inspected for corrosion and wear.

Inspection of welds must be in accordance with CSA Standard W59-M1989 (R2001), *Welded Steel Construction (Metal Arc Welding)*. Critical areas identified by the manufacturer, the supervising professional engineer or the qualified inspector must be further examined by an appropriate non-destructive test.

Structural inspection of telescopic boom

In addition to daily, periodic and annual inspections, non-destructive testing and inspection of interior welds within 1.8 metres of the base or tip of each section of the telescoping boom must be performed every 10 years or 10,000 hours of service, whichever comes first, or as specified by the manufacturer.

(3) *Cranes not in regular use*
A crane that has been idle for more than one month but less than six months must be given a daily inspection before being placed into operation. A crane that has been idle for more than six months must be given a periodic inspection before being placed into operation.

(4) *Testing*
Prior to initial use, all load-bearing parts that have been altered, replaced or repaired must be load tested to 100 percent of rated capacity by a professional engineer and re-rated by the original manufacturer or a professional engineer.

(5) *Maintenance*
A preventive maintenance program based on the manufacturer's specifications is required. Any adjustments must be in accordance with the manufacturer's specifications or a professional engineer.

# Section 88.1 Personnel baskets

## Section 88.1(a)

Clause 5.4.7 of CSA Standard CAN/CSA Z150-98 (R2004) states:

5.4.7.1 Personnel Lifting for Suspended Baskets

5.4.7.1.1 General
The person specifically responsible for the overall work function to be performed shall determine that there is no practical alternative way to perform the needed work or gain access to the area, and shall authorize its usage.

5.4.7.2.1 Platform Requirements
The platform that the worker is on shall

(a) be capable of supporting, without failure, its own weight and at least five times the rated load of the platform;
(b) have a minimum carrying capacity of 136 kg (300 lb);
(c) be designed and approved by a professional engineer, and in accordance with good engineering practice;
(d) have design drawings that set out the size and specifications of all components of the platform, including the type and grade of materials used for it, the rated load of the platform, and instruction for the proper maintenance and inspection of the platform;
(e) be equipped with a second means of suspension or support, where the second means of support is secured above the hook. The secondary support shall, at all times, be connected to the travelling block, and neither impede the operation of the hoist line and travelling block nor compromise the structural integrity of the travelling block or the hoist line;
(f) be constructed and maintained in accordance with the design drawings;
(g) have all weldments conforming to CSA Standard W59 or ANSI/AWS D14.3. Similar standards or procedures are acceptable, providing the welding process meets or exceeds the criteria of CSA Standard W59 or ANSI/AWS D14.3;
(h) not have synthetic slings and slings utilizing wire rope clips used as part of the main suspension system;
(i) be modified or repaired in accordance with the manufacturer's specifications or as directed by a professional engineer;
(j) be designed, constructed and maintained so that the failure of one means of support or suspension will not cause the collapse of all or part of the platform;
(k) have the primary and secondary suspension designed with a factor of safety of 10 to 1;

(l) have bridles and associated rigging for attachment to the hoist line that are identified and used only for the purpose of lifting or lowering workers;
(m) be equipped with sufficient numbers of fixed supports for lanyards. Fixed supports for lanyards are clearly identified. Each support shall be free of sharp edges that might cut or chafe the connection and each shall have the ability to resist the arrest forces in case of a fall;
(n) have all eyes in wire-rope slings fabricated with a Flemish eye, with mechanical splice;
(o) have all wire rope, shackles, rings, master links, and other rigging hardware capable of supporting, without failure, at least ten time the maximum intended load applied or transmitted to that component;
(p) have guardrail protection, consisting of a top rail, intermediate rail, toe board, and lower barrier. The top rail shall be no less than 900 mm (39 in) nor more than 1140 mm (45 in) in height with respect to the platform floor. The intermediate rail shall be positioned at an equal distance between the toe board and the top rail. The toe board shall be around the periphery of the platform and shall be a minimum of 90 mm (3.5 in) in height. The lower barrier shall span the distance between the toe board and intermediate rail and be of solid construction or expanded metal.
(q) have continuous hand or grab rail inside the perimeter of the suspended platform;
(r) have flooring with a slip-resistant surface, with provision to allow free drainage of liquids;
(s) have means of securing loose items within the platform; and
(t) if built with an access gate, be equipped with an acting device to restrain the gate from accidental opening. When provided, access gates shall swing into the platform.

## Section 88.1(b)

See section 75.1

### Commentary about “commercially manufactured”

In general, a commercially manufactured product has the following qualities
(a) it is designed and built to some standard or generally accepted engineering principles that make it safe for use;
(b) it is designed and built by person(s) with the skill or competence to be able to make the product safe;
(c) it is produced with the intention of being generally available to anyone who wants to buy it — normally there is an exchange of money;
(d) it is normally supported by the manufacturer with a warranty, guarantee, and product support; and

(e) liability and safety issues related to its use have been addressed by the manufacturer.

It is implied by the OHS Code, that a product that is "commercially manufactured" is "safe" because it has been produced by a "manufacturer" that has the skills and competencies to do so.

Criterion (a) refers to the product being designed and built to some "generally accepted engineering principles". It is expected that a "manufacturer" is able to provide drawings or sketches of the product that include an assessment of the product's strength, load-bearing capacity, etc. Further, criterion (d) mentions "product support". This may include, among other elements, the availability of written manufacturer specifications.

## Section 89 Non-destructive testing

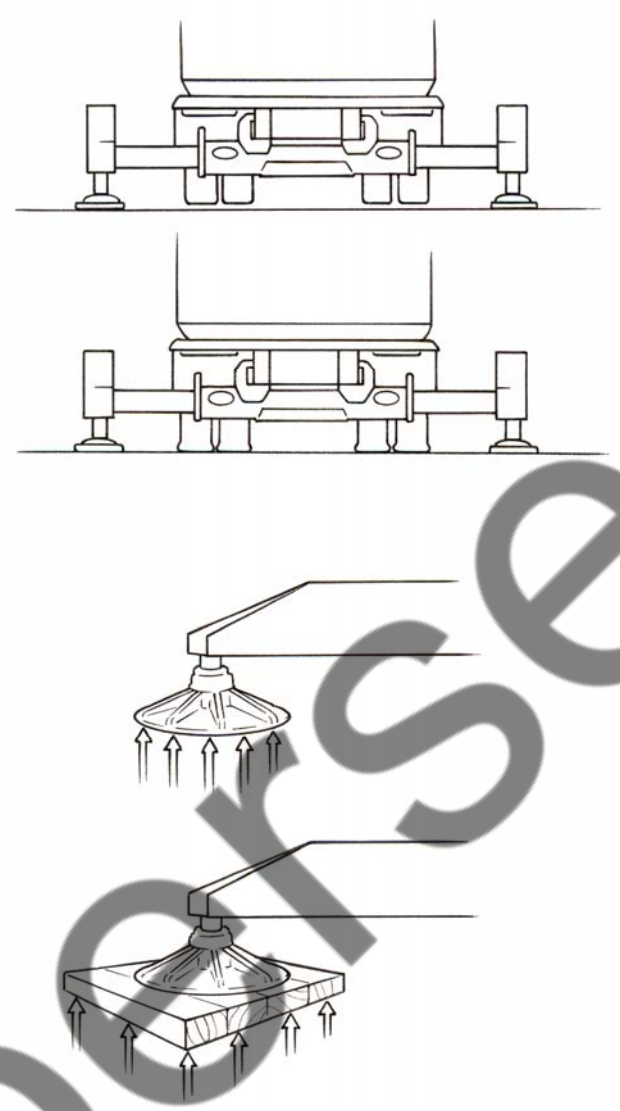
Non-destructive testing (NDT) is a method of testing materials and components that does not damage or destroy the test sample. NDT tests include measuring for flaws, thickness, material condition, corrosion, bulk conductivity, residual stress, alloy type, hardness, microstructure heat treatment verification and modulus.

NDT methods include the use of :
(a) eddy currents;
(b) ultrasound transducers;
(c) acoustic emission;
(d) magnetism, including induction or Barkhausen;
(e) a beta gauge;
(f) optical techniques such as a shearograph or holograph;
(g) radiography e.g. x-ray imaging.

## Section 90 Counterweights and outriggers

Figure 6.22 shows examples of outriggers fully extended and supported on solid footings.

Figure 6.22 Examples of outriggers fully extended and how loads can be distributed over large, solid footings



## Section 91 Warning device

This section requires a means of warning workers in the vicinity of a mobile crane. The warning must be sounded when hoisting is about to commence or the entire crane is about to be set in motion. Section 267 describes requirements for warning signals if the operator's view of the crane's path of travel is obstructed. See Figure 6.23.

Figure 6.23 Example of warning device


## Section 92 Preventing damage

"Positive boom stops" are devices that prevent the boom from toppling or being pulled backwards over the top of the cab. Boom stops physically stop further motion of the boom at a predetermined safe angle.

"Boom stop limit devices" are limit switches that disconnect the drive or stop the engine when the boom reaches a predetermined angle. See Figures 6.24 and 6.25.

Figure 6.24 Example of boom stop

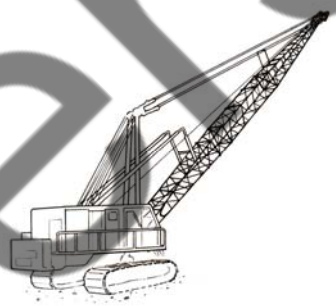
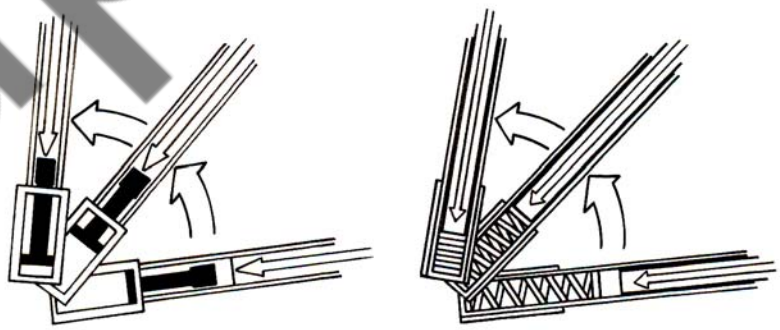


Figure 6.25 Examples of boom stop limit devices



## Section 92.1 Load blocks

Load blocks are assemblies that consist of a hook or shackle, swivel, bearing, sheaves, sprockets, pins and frame. They are suspended by a hoisting rope or load chain and are designed for a variety of lifting applications.

Inspection, maintenance and repair requirements are typically specified by the manufacturer. Where such specifications exist, an employer is obliged, under this section, to follow them. If there are no manufacturer's specifications, an employer must follow the requirements of CSA Standard CAN/CSA Z150-98 (R2004) which states in Clause 4.3.5.2:

> *"Teardown inspection and relubrication of the swivel, hook, and block assembly shall be performed at least every five years and the hooknut shall be disassembled and inspected for corrosion and wear. The hooknut shall be relubricated with a high-pressure grease of medium consistency, to seal the assembly from moisture, or with molybdenum disulphide grease or another sacrificial lubricant possessing the same physical characteristics. The hooknut assembly shall be durably marked to indicate the date of inspection."*

In a recent British Columbia incident, a tower crane was hoisting a load weighing approximately 4000 kgs. The hook assembly on the load block failed, causing the load to fall. In the investigation, the threads on the hook and nut were found to be corroded and excessively worn. The damage was not visible when the load block was assembled. This type of wear and corrosion could be found on any crane hook with a threaded shank.

## Section 92.2 Outriggers

Proper outrigger support is an important part of crane setup. Crane collapse can result from

(a) failure to fully extend the outriggers,
(b) not extending all outriggers,
(c) failure to get completely "off rubber",
(d) not accounting for poor ground conditions, or
(e) failure to level the crane.

Outriggers improve crane stability. Accurate use of the "on-outriggers fully extended" load chart requires that outriggers be fully extended and raise the crane completely off the tires. If the tires are touching the ground, then the "on rubber" load chart is used. Manufacturers do not recommend extending only one or two outriggers. The load charts of some manufacturers now permit partially-extended outriggers, so use of the correct load chart is critical.

All crane outriggers are designed for good ground conditions. Poor ground conditions reduce the amount of load a crane can safely place on an outrigger. Because of this, many crane operations require additional supports or "floats". These floats may be of wood, steel or synthetic material but must be of sufficient size, strength and rigidity to transfer the outrigger load to the full area of the float. A float that is smaller than the outrigger pad will increase the pressure on the ground and will cause an outrigger to "punch through". If the outrigger is set on an unlevel float, the pad may slide causing the crane to tip. Many manufacturers stipulate that the crane must be within 1 percent of level before their load chart applies. In a 20-foot span this is only 2 inches off-level. Past that, the crane can lose 15 to 20 percent or more of its capacity.

When sizing outrigger floats, it is important to know the maximum pressure applied by the outrigger as well as the required float area. The area (square feet) of float can be estimated by dividing the maximum capacity of the crane by five (5).
[Construction Safety Association of Ontario]

A reasonable approximation for maximum ground pressure (worst case) applied by the outrigger is:

Pressure (tons per $ft^2$) applied by outrigger =

$$0.85 \times \frac{\text{total crane mass} + \text{maximum crane capacity}}{\text{individual outrigger area}}$$

[Construction Safety Association of Ontario]

This can be then be used to calculate the required thickness of float.

# Overhead Cranes

## Section 93 Electrical components and functions

### Section 93(a)

Section 40 of the *Canadian Electrical Code*, Part 1, covers certain design features of electrical equipment and circuits for cranes. These are in addition to the general requirements of the *Canadian Electrical Code*. Section 40 does not cover equipment and wiring of cranes that are assembled and erected in the field, which must comply with CSA Standard C22.2 No. 33-M1984 (R2004), *Construction and Test of Electric Cranes and Hoists*. It is good practice to obtain a manufacturer's certification of compliance with this requirement.

### Section 93(b)

CSA Standard C22.2 No. 33-M1984 (R2004), *Construction and Test of Electric Cranes and Hoists,* is a manufacturing standard that applies to all types of electrical cranes for voltages of 750 volts and less between conductors, designed, installed and used in accordance with the rules of the *Canadian Electrical Code, Part 1*. It includes the design of the collector arrangements for the contact conductors along the main runway and applies to equipment for general industrial and commercial application, in non-hazardous locations, both indoors and outdoors, and covers installation in a normal ambient temperature not exceeding 40$^{O}$ Celsius. It is good practice to obtain a manufacturer's certification of compliance with this requirement.

## Section 94 Maintenance and inspection

CSA Standard CAN/CSA-B167-96 (R2007), *Safety Standard for Maintenance and Inspection of Overhead Cranes, Gantry Cranes, Monorails, Hoists and Trolleys*, specifies the minimum requirements for inspection, testing and maintenance of overhead cranes, monorails, hoists, trolleys, jib cranes, gantry and wall cranes, and other equipment having the same fundamental characteristics. All maintenance, inspections, repairs and modifications must be recorded in the equipment's log book. As well, the log book should contain

verification that the supporting structure has been designed and approved by a professional engineer to carry the maximum load as rated.

The following is a list of the more critical requirements of the Standard:

(f) *Section 4.1* — A crane inspector must have at least 10,000 hours of relevant experience including knowledge of legislation, safety practices and standards.

(g) *Section 4.2* — Critical components and inspection criteria must be identified by the manufacturer or a professional engineer.

(h) *Section 4.4* — Describes the type and frequency of required inspections based on type of service.

(1) Initial inspection
- prior to initial use, all new, re-installed, modified, or rebuilt equipment must be inspected by a crane inspector.

(2) Cranes in regular use
- An operational inspection is a visual examination done by the operator or a qualified person in accordance with Table 6.2.

Table 6.2 Frequency of operational inspections based on service class

| Service class | Frequency |
|---|---|
| A + B | At least monthly |
| C + D | At least weekly to monthly |
| E + F | Daily to weekly |
| Special | As recommended by a qualified person |

The CSA standard defines the service classes as follows:

*Class A (standby or infrequent service)*
This covers cranes that may be used in installations such as powerhouses, public utilities, turbine rooms, motor rooms and transformer stations where precise handling of equipment at slow speeds with long idle periods between lifts is required. Rated capacity loads may be handled for initial installation of equipment and for infrequent maintenance.

*Class B (light service)*
This covers cranes that may be used in repair shops, light assembly operations, service buildings, light warehousing, etc. where service requirements are light and the speed is slow. Loads may vary from no load to occasional rated-capacity loads, with 2.5 lifts per hour, averaging 2.6 metres per lift.

*Class C (moderate service)*

This covers cranes that may be used in operations such as machine shops, papermill machine rooms, etc., where requirements are moderate. In this type of service, the crane handles loads that average 50 percent of the rated capacity, with 5 to 10 lifts per hour, averaging 3 metres per lift, with no more than 50 percent of the lifts at rated capacity.

*Class D (heavy service)*
This covers cranes that may be used in heavy machine shops, foundries, fabricating plants, steel warehouses, container yards, lumber mills, etc., and standard duty bucket and magnet operations where heavy-duty production is required. In this type of service, loads approaching 50 percent of the rated capacity will be handled constantly during the working period. High speeds are desirable for this type of service, with 10 to 20 lifts per hour, averaging 3 metres per lift, with no more than 65 percent of the lifts at rated capacity.

*Class E (severe service)*
This covers a crane capable of handling loads approaching its rated capacity throughout its life. Applications may include scrap yards, cement mills, lumber mills, fertilizer plants, container handling, etc., with 20 or more lifts per hour at or near the rated capacity.

*Class F (continuous severe service)*
This covers a crane capable of handling loads approaching rated capacity continuously under severe service conditions throughout its life. Applications may include custom designed specialty cranes essential to performing critical work tasks affecting the total production facility. These cranes must provide the highest reliability.

*Special service*
This covers equipment that is not being used in the service classification for which it was designed or is subject to adverse conditions or environment.

## Operational inspection

The operational inspection must include, but not be limited to, the following:
(a) all operational functions;
(b) leakage in line, tanks, valves, pumps and air or hydraulic systems;
(c) deformed, worn or cracked hooks;
(d) hook latches;
(e) hoist ropes;
(f) limit device(s) for function;

(g) function labels for operator control;
(h) all brakes.

Any defects found in this inspection must be corrected by a qualified person.

### Periodic inspection

This is a visual examination done by a crane inspector in accordance with Table 6.3.

Table 6.3 Frequency of periodic inspections based on service class

| Service class | Frequency |
|---|---|
| A + B | At least annually |
| C + D | At least semi-annually |
| E + F | At least quarterly |
| Special | As recommended by a professional engineer or the manufacturer |
| Out of service | Prior to being returned to service |

The periodic inspection must include, but not be limited to, the following:
(a) all elements of the operational inspection;
(b) deformed, cracked or corroded members;
(c) loose bolts or cracked welds;
(d) sheaves and drum cracks, distortion and wear;
(e) worn, corroded, cracked or distorted pins, bearings, bushings, shafts, couplings, gears, bumpers and trolley stops;
(f) glazing, scoring, warpage, contamination or wear of electrical and mechanical brakes;
(g) visible damage to hook, retaining nut and safety latch;
(h) deformed hook or worn hooks for compliance with manufacturer's recommendations;
(i) evidence of pitting or deterioration of electrical contacts;
(j) electrical wire, cables and controls;
(k) performance of limited switches;
(l) worn and or damaged trolley and bridge wheel assemblies;
(m) load brake or controlled lowering device;
(n) wear, cracks, or corrosion of wire rope, load chain, end clamps or rope clips;
(o) missing or loose bolts in the supporting structure.

If the crane has, at any time, been accidentally overloaded, it must be removed from service, a periodic inspection carried out, and the load rating certified by a professional engineer before returning the crane to service.

(3) Cranes not in regular use

- Before being placed in service, an operational inspection must be completed on a crane that has been in infrequent service or out of service for more than one month but less than a year.

- Before being placed in service, a periodic inspection must be completed on a crane that has been out of service for more than one year.

(i) *Section 5.1 Tests*

Before initial use, for all new, re-installed, modified or rebuilt equipment, the following functions and components must be tested:

(a) all motions;
(b) limit switches at full speed;
(c) limiting and indicating devices;
(d) all circuits, controls, interlocks and sequence of operation;
(e) each crane motion, holding brakes and travel brakes with the hook carrying
   - rated capacity – during these tests the specified speeds are to be attained, provided the power supply to the crane is as specified, and
   - 125 percent of the rated capacity – during this test the specified speed need not be attained but the crane must show itself capable of dealing with the load without difficulty.

The rated capacity and 125 percent of rated capacity tests must be performed with the crane or hoist installed on its supporting members.

Prior to initial use, the vertical deflection of all new, reinstalled, modified or rebuilt equipment must be measured. The vertical deflection of the girder, produced by the weight of the trolley and the rated load, must not exceed the maximum allowed by the design specification.

A test report must be prepared and entered into the log book.

(j) *Part 6 Maintenance* — Describes the requirements for preventive maintenance and specific maintenance procedures. Repairs must only be performed by, or under the direct supervision of, a person having at least 8000 hours of relevant experience.

# Section 95 Safe movement

## Section 95(a)

The purpose of this requirement is to prevent a crane from over running its movement limits or making "uncontrolled, unintended contact" with other equipment that may be on the same rail, track or trolley. It does not restrict a competent operator from performing a controlled low-speed contact as may be required during a multiple crane lift. The requirement can be achieved through the use of (see Figure 6.26)

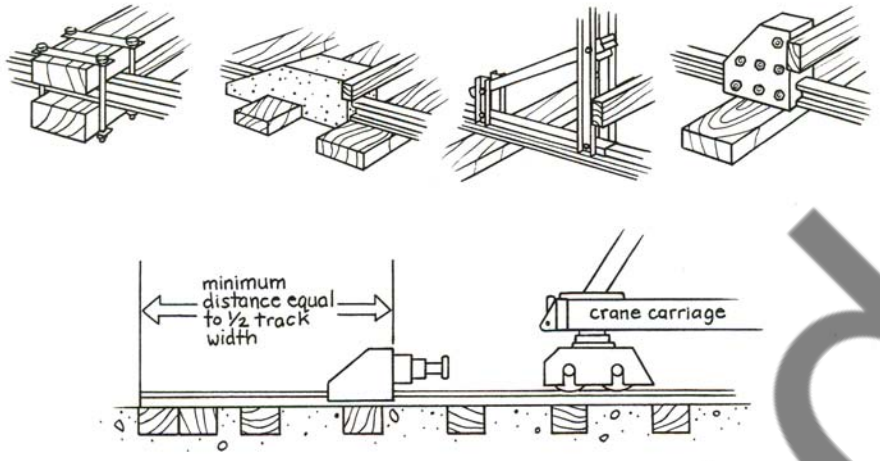
(a) shock-absorbing rail stops,
(b) rail-mounted rubber bumpers. When mounted on a crane, a rubber bumper is considered to be part of the crane and not a positive stop or limiting device capable of preventing contact,
(c) limit switches,
(d) speed-limiting motion or proximity sensors mounted on the crane,
(e) other equally effective means.

If the limiting device is disabled to permit the crane to make a controlled contact, the lifting pendant or control panel should be tagged to show that normal functioning of the limiting device has been disabled. Once the lifting operation is complete, the limiting device should be restored to normal function and the tag removed by the operator.

### For more information

http://employment.alberta.ca/documents/WHS/WHS-PUB_cra001.pdf
Preventing Overhead Crane and Hoist Collisions: Use of Rubber Bumpers

Figure 6.26 Examples of positive stops installed to protect a rail-mounted crane



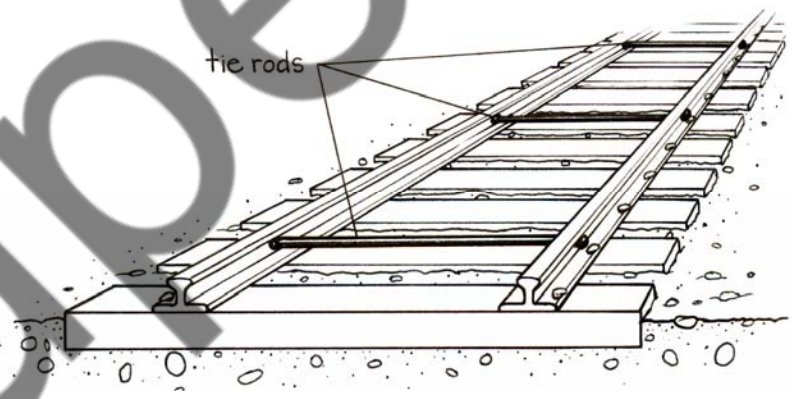

## Section 95(b)

The crane must be fitted with a device that prevents an overspeed descent of the load in excess of manufacturer's specifications.

## Section 95(c)

Figure 6.27 is an example of an acceptable means of ensuring that rails do not spread.

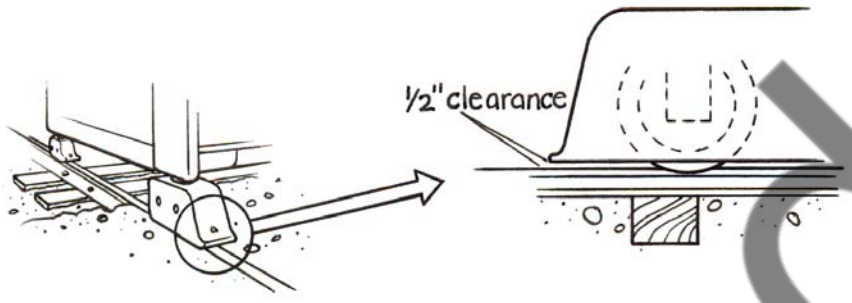
Figure 6.27 Tie rods that limit the spreading of rails



### Section 95(d)

Figure 6.28 shows an example of acceptable sweepguards.

Figure 6.28 Example of trolley-mounted sweepguards




### Section 95(e)

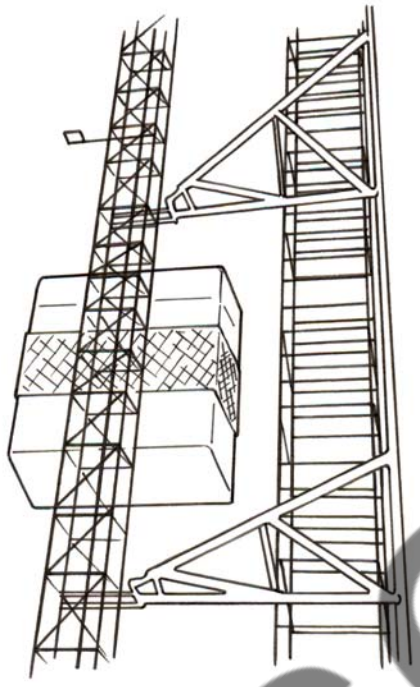
No explanation required.

## Personnel hoists

### Section 96 Safety code for personnel hoists

CSA Standard CAN/CSA-Z185-M87 (R2006), *Safety Code for Personnel Hoists,* applies to structures and hoists that are not a permanent part of buildings, structures, or other work and that are used during construction, alteration, or demolition to raise and lower persons and/or materials connected with or related to a building project. The Standard covers the design, construction, installation, operation and acceptance inspection and testing of personnel hoists. See Figure 6.29.

Figure 6.29 Example of a personnel hoist



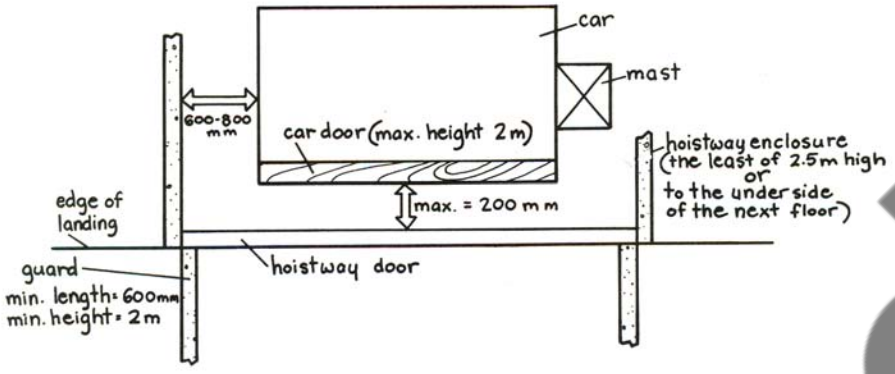
The Standard does not apply to:

(a) hoists for raising and lowering materials and that are not intended to carry personnel;
(b) temporary elevators installed in their hoistways during the construction of buildings and incorporating a part of the permanent elevator to be installed later;
(c) manlifts, counterbalanced or endless-belt type;
(d) mine elevators;
(e) cranes and derricks;
(f) window cleaners and swingstages;
(g) mobile forklift trucks and similar equipment;
(h) rope-guided and non-guided personnel construction hoists.

The following are some critical requirements of the Standard:

- *Part 6 Hoistway Enclosure*
  The "hoistway" is the shaftway space travelled by the car or counterweight extending from the pit floor to the overhead structure. A "hoistway enclosure" is a structure that isolates the hoistway and on which hoistway doors are installed. Figure 6.30 shows the design requirements that a hoistway enclosure must meet.

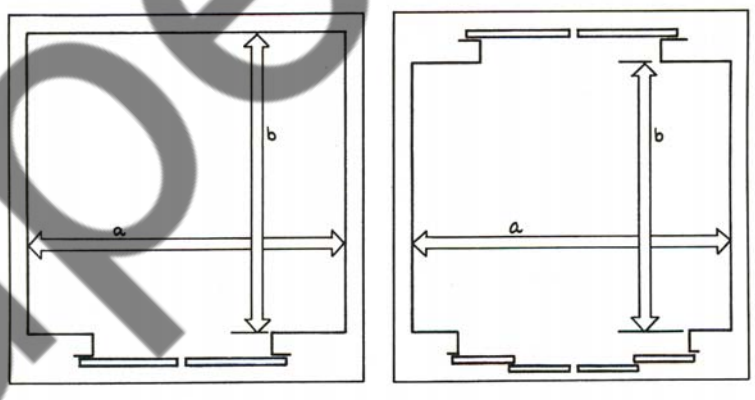
Figure 6.30 Example of a hoistway enclosure (plan view)




- *Part 7 Hoistway landings and doors*
  This part describes requirements for that portion of a floor, a balcony or platform used to receive and discharge passengers.

- *Part 8 Cars*
  This part describes requirements for the load-carrying unit. The car's rated load capacity is based on its inside net platform area, determined using the "a" and "b" measurements shown in Figure 6.31. The maximum allowable number of passengers is determined by:
  (a) multiplying the net inside area of the car, in square metres, by five, or
  (b) dividing the net inside area of the car, in square feet, by two.

Figure 6.31 Net inside area of the car (plan view)




- *Part 11 Counterweights*
  This part describes the design and guiding requirements for counterweights.

- *Part 14 Operation and control devices*
  This part describes requirements for the actuating controls.

- *Part 19 Safeties and governors*
  This part describes requirements for devices to stop and hold the car in case of overspeed or free fall or if the hoisting rope slackens.

- *Part 20 Drive, machines, sheaves, drums*
  This part describes requirements for the hoist's drive mechanism. Maximum car speeds are:
  (a) 1.75 metres per second for traction machines and winding drums machines;
  (b) 0.75 metres per second for single-speed operation;
  (c) 1.60 metres per second for rack and pinion machines;
  (d) 0.75 metres per second for inspection purposes.

- *Part 23 Communication*
  A two-way voice communication system between all landing entrances is required.

- *Part 24 Required inspections and tests*

  (1) Before being placed into service, a hoist must be inspected and tested after it has been installed or when:
  (a) the mast is extended,
  (b) entrances are added,
  (c) hoisting ropes are changed, and
  (d) a rack section is added or changed.

  The tests must include:
  (a) operation of drive machine brakes;
  (b) plunger-return and load/speed of buffers, except bumpers or spring buffers;
  (c) operation of car safeties and governors;
  (d) operation of ground fault circuit interrupter.

  The inspections are to include:
  (a) electrical grounding;
  (b) wire rope; and
  (c) teeth wear and clearances on rack and pinion devices.

(2) All parts of the machine and mast should be inspected daily before operations begin to ensure the hoist is in safe condition. The inspection must be conducted by a competent person and the tests must be conducted in the presence of a competent person.

# Roofer's hoists

## Section 97 Safe use and design

### Subsection 97(1)

The counterweights used with a roofer's hoist (see Figure 6.32 and 6.33) must
(a) be clearly designed to work as part of the hoist,
(b) stay in place and remain firmly attached until the lifting operation is complete, and
(c) provide a factor of safety against overturning of not less than 4.

Figure 6.32 Properly designed counterweights for a roofer's hoist

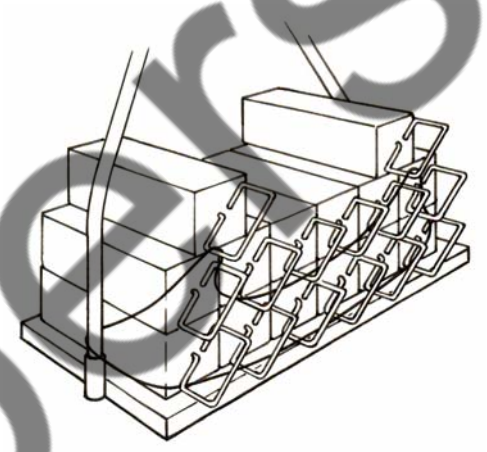
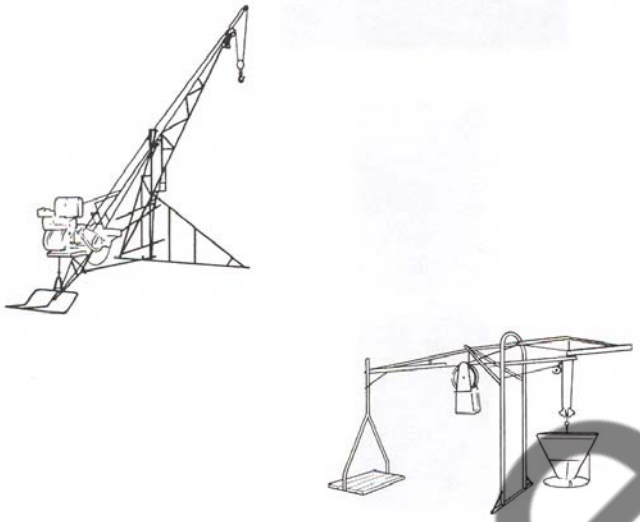


Figure 6.33 Examples of roofer's hoists

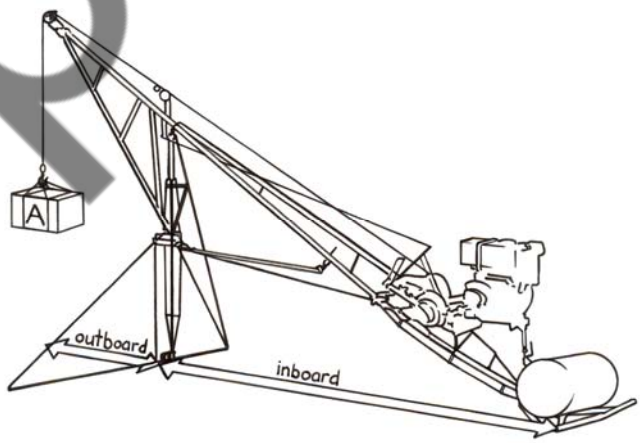


The weight of the counterweight can be calculated using the following formula:

$$\text{Weight of counterweight} = 4 \times \text{maximum weight of load being lifted} \times \left(\frac{\text{length of the outboard arm}}{\text{length of the inboard arm}}\right)$$

The length of the outboard arm is the horizontal distance measured between the hoist's fulcrum point and the hoisting line. The length of the inboard arm is the horizontal distance measured between the hoist's fulcrum point and the counterweight's centre of gravity (see Figure 6.34).

Figure 6.34 Illustration of "inboard" and "outboard" arms



## Subsection 97(2)

Roofing materials cannot be used as counterweights. Counterweights must work as part of the hoist and remain secured in place while lifting. Bundles of roofing material can be unstable and are intended to be removed as work progresses, gradually reducing the weight and effectiveness of the counterweight.

## Subsection 97(3)

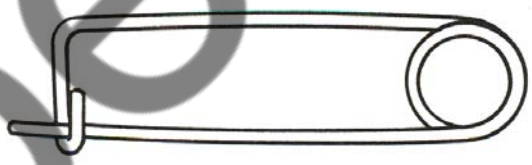
Before use each day, the hoist must be inspected by a competent person designated by the employer. The inspection must be in accordance with the manufacturer's specifications and should include, but not be limited to, the following:

(a) members and welds in the hoist structure;
(b) bolts, nuts, pins;
(c) sheaves, ropes;
(d) brake and clutch systems, pawls, ratchets;
(e) control devices.

## Subsection 97(4)

Figure 6.35 shows an example of a safety pin that is used on the bolts and pins of a roofer's hoist. The bolts and pins hold the hoist's components together — the safety pin prevents the bolts and pins form dislodging.

Figure 6.35 Example of a standard safety pin



## Subsection 97(5)

Roofer's hoists are not typically designed to create or withstand horizontal forces that occur when swinging a load or pulling a load across a surface. Such horizontal movements could lead to overturning or component failure.

### Subsection 97(6) and 97(7)

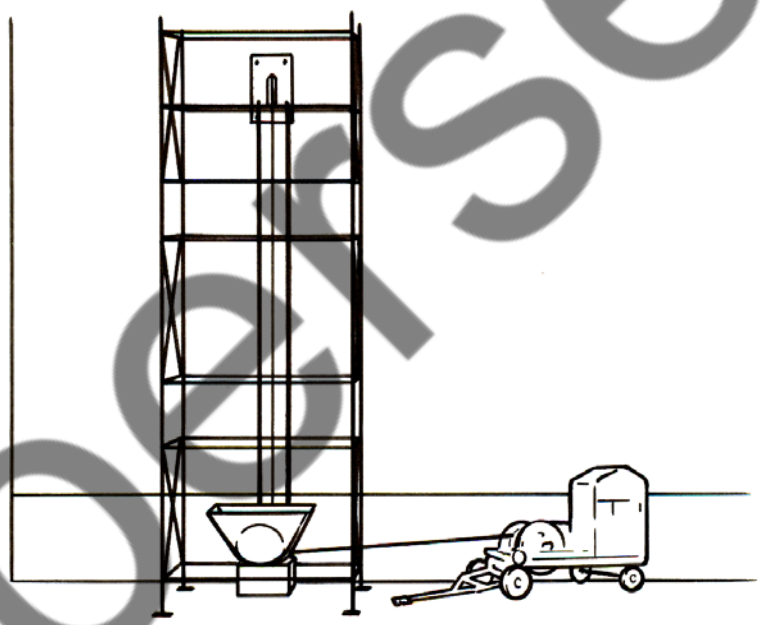
Gallows frame hoists are rarely used today, but may be found on relatively minor repair jobs. Where such a hoist is used, its construction must comply with the design limits specified in this subsection.

## Tower and Building Shaft Hoists

### Section 98 Protective enclosure

A tower hoist is a materials-only hoist in which the platform on which loads are placed runs inside a framed tower. The platform is raised and lowered by a cable, drum or a rack and pinion drive system (see Figure 6.36).

Figure 6.36 Example of a tower hoist



### Section 98(a)

The walls must be sufficient height and strength to prevent accidental contact with the tower or the hoist machinery. The fencing should be at least 600 millimetres from the sides of the tower.

### Section 98(b)

The enclosure should be at least 600 millimetres from the sides of the shaft.

### Section 98(c)

The use of an interlock system with each landing gate is required to ensure that workers are protected against falling into the open shaft.

### Sections 98(d) to (f)

No explanation required.

## Section 99 Design

No explanation required.

# Tower Cranes

## Section 100 Safety code for tower cranes

CSA Standard Z248-04, *Code for Tower Cranes*, applies to the design, characteristics, construction, installation, dismantling, operation, testing, maintenance and inspection. of tower cranes.

The following are some critical requirements of the standard:

- *Section 6.4.3 Manuals*
  A manual for the specific model of crane, containing all pertinent manufacturer's specifications and instructions relating to its operation and maintenance. This must be provided by the crane supplier.

- *Part 5 Erection, Dismantling and Climbing*
  This part describes requirements for erecting, dismantling, and transporting the crane, including foundation design.

- *Part 6 Inspection, Testing and Repairs*
  This part describes requirements for inspection, testing, maintenance and repairs. These must be performed by the crane operator or qualified personnel on a scheduled basis.

### Before being placed into service

Once erected and before being placed into service, the crane must be inspected by the erector's personnel and the crane's operator. Operating tests must be conducted to ensure that:

(a) clearances and alignments are in order and all moving parts are engaged properly;
(b) all controls and limit switches are set and operating correctly in accordance with the manufacturer's specifications;
(c) all circuits and interlocks operate in accordance with the manufacturer's specifications;
(d) all protective devices operate satisfactorily; and
(e) each motion of the crane operates in accordance with the manufacturer specifications.

A load test must be performed as specified by the manufacturer. In the absence of such specifications, a load test must be performed with a load equal to 105 percent of the rated load.

### Daily inspections

The operator must carry out the following daily inspection activities:

(a) ensure that all wedges in slab openings are in place and are tight;
(b) ensure that all guy lines and all guy line connections, if used, are acceptable;
(c) inspect mast bolts and anchor bolts;
(d) ensure that all limit switches (except line pull limit switches), signal lights, audio and visual indicators, and brakes are functioning properly;
(e) inspect load hoist and boom hoist ropes according to Clause 6.5 of the CSA Standard;
(f) inspect grounding connections;
(g) inspect the tracks for loose connections, proper drainage, subsidence, and bogie wear on travelling cranes; and
(h) inspect rail clamps, if used, daily or each time their application is made.

The rigger must:

(a) check all slings and rigging used with the crane prior to use;
(b) inspect the test block-lifting hardware prior to lifting the test block; and
(c) inspect the load block and hook.

### Weekly inspections

The following must be inspected weekly:
(a) structural pins and keepers;
(b) trolley rollers, tracks, slewing rings, and rollers;
(c) gear shaft and belt drives;
(d) sheaves, bushings, and pins;
(e) guy ropes, pendant lines, cable clips, thimbles, and ferrules;
(f) jib backstops (boom stops);
(g) all rope attachments;
(h) walkways, handrails, and ladders;
(i) the location in the structure where accumulation of water could result in damage to ensure that such water is drained;
(j) tie-ins to slabs or other bracing systems where used.

### Monthly inspections

The following must be inspected monthly:
(a) all running ropes, in accordance with Clause 6.5.1.3 of the CSA Standard to check for all types of deterioration;
(b) mast and boom structure for cracks or buckling;
(c) bogie wear on travelling cranes;
(d) counterweight supports;
(e) brake adjustment (wear); and
(f) drums, sheaves, bearings and mounts.

### Annual inspections

After a crane has been in service for 12 months, it must undergo
(a) visual inspection of the structure with nondestructive inspection according to Clause 6.3.1 of the CSA Standard on suspect areas;
(b) inspection of all load-carrying equipment, including sheaves, blocks, rings, shackles, hooks, chains, and slings
(c) inspection of all fixed ropes according to Clause 6.5.1.3 for all types of deterioration;
(d) inspection of all running ropes according to Clause 6.5.1.3 for all types of deterioration;
(e) operational tests according to Clause 6.3.2; and
(f) a load test in accordance with Clause 6.3.3.

### Special inspections

Special inspections are inspections conducted following shock loading, electrical contact, other misadventures, repairs, alterations, or prolonged shutdown.

A crane that requires structural alterations, repairs, or replacement of parts related to hoisting or safety of operation must be tested and approved by a professional engineer or the engineer's designate. Repairs or alterations to structural parts must be carried out in accordance with the manufacturer's specifications and instructions or the specifications of a professional engineer. All welding must be done in accordance with CSA Standard W59-03 (R2008), *Welded Steel Construction (Metal Arc Welding)*.

A load test must be carried out after any alteration or repairs have been made to the load-carrying ability of the crane. This test must be performed as described in Clause 6.3.3. of CSA Standard Z248-04.

Prior to commencing work after a prolonged shutdown, a full soil inspection by a professional engineer competent in soil inspection and a structural inspection according to Clause 6.4.7 of the Standard must be carried out by a professional engineer competent in the inspection of tower cranes.

Clause 6.5 of the Standard describes inspection and replacement requirements for wire rope.

- *Part 7 Maintenance and Repairs*
  This part describes proactive maintenance, lubrication, adjustment and repair requirements.

- *Part 8 Safe Operation*
  This part describes operating responsibilities and requirements.

## Section 101 Limit devices

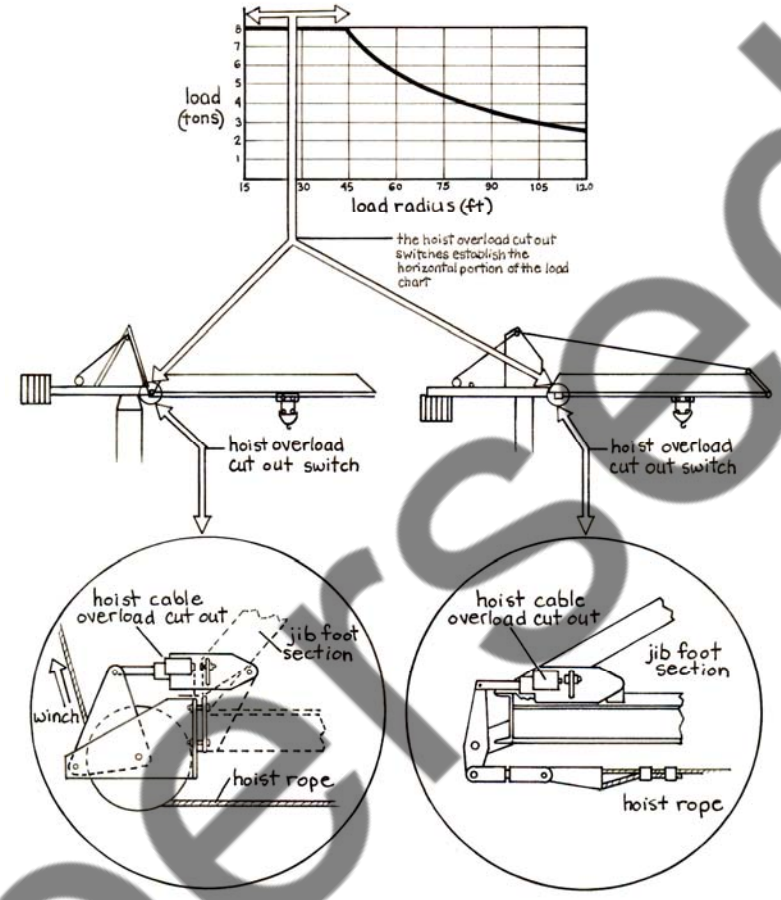
### Subsection 101(1)

Limit devices are not to be used as operating "stops". An operator must not operate a crane in which jumpers or by-passes have been installed in any limiting device, except under the supervision of a competent person and with the express authorization of the crane supplier.

## Subsection 101(1)(a)

The overload device should be a hoist cable overload "cutout" that is set to cut out at no more than 5 percent suspended load. See Figure 6.37.

Figure 6.37 Examples of hoist cable overload cutouts




## Subsection 101(1)(b)

"Movement " means a tendency to produce motion about a point of axis. The movement overload limit device senses the tension in the jib pendants, support cables, etc. This tension increases as the load moves out on a jib or as heavier loads are lifted. It must be set to "cutout" at no more than 5 percent overload. This device must also "cutout" the trolley as it is possible to overload the crane within the rated capacity at close radius simply by moving the trolley out along the boom. See Figures 6.38 and 6.39.

Figure 6.38 Examples of location of moment overload cutout switch and switch performance

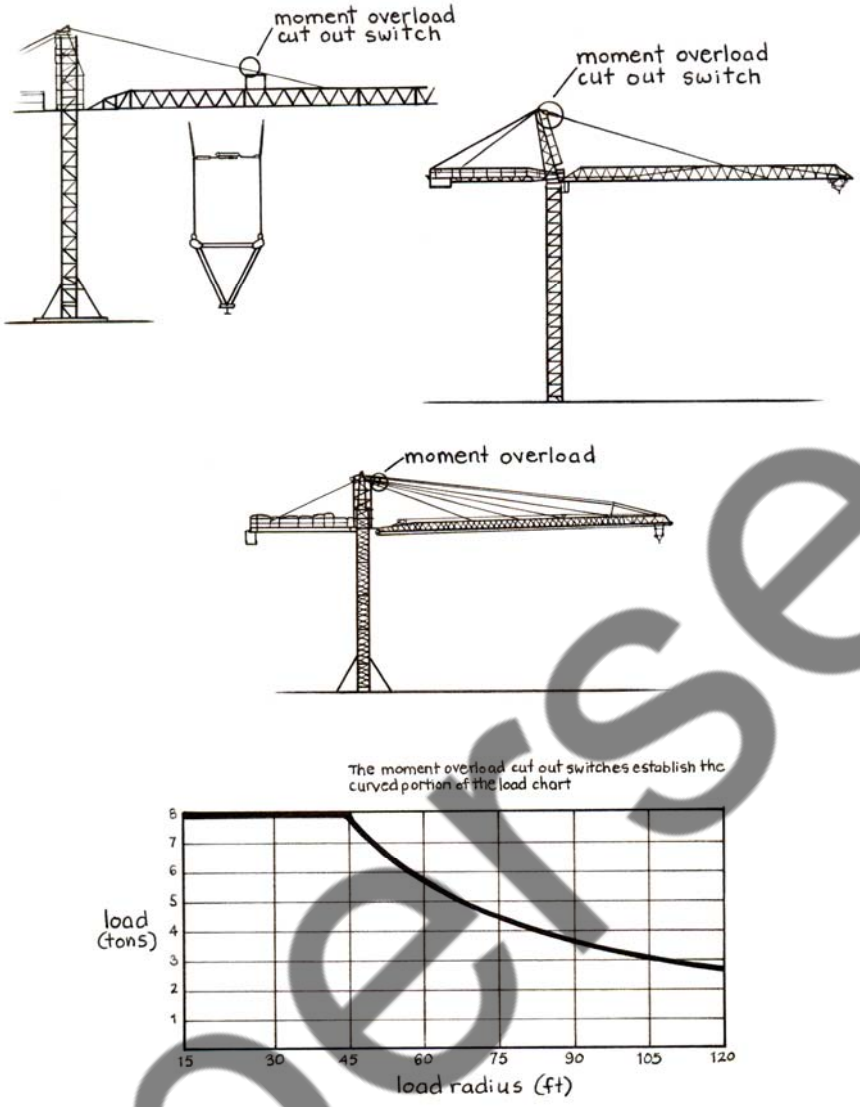
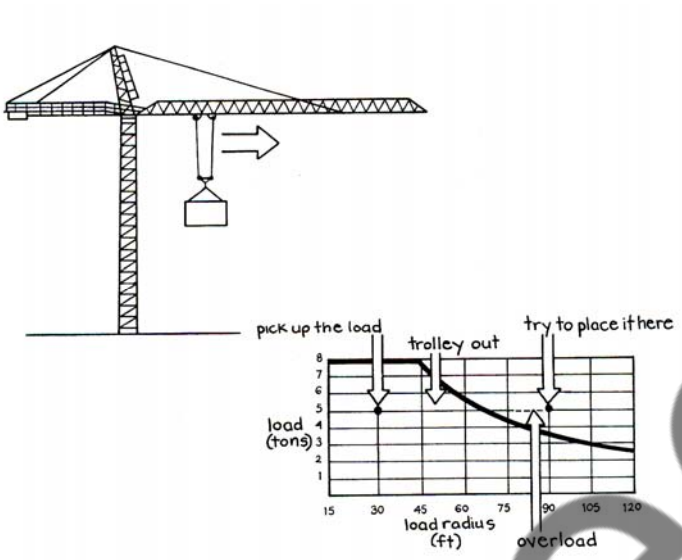


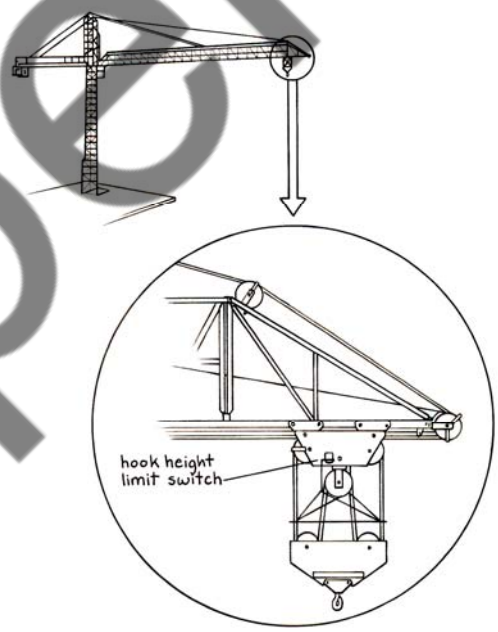
Figure 6.39 Example of travel limit switch performance




## Subsection 101(1)(c)

A height limit switch causes the hoist drum to stop whenever the load hook reaches a predetermined maximum height position. See Figure 6.40.

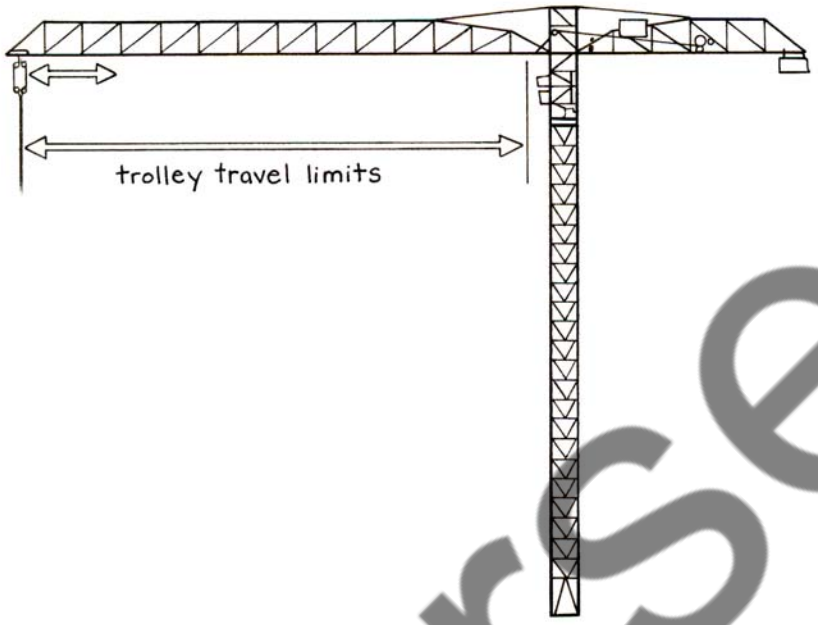
Figure 6.40 Example of height limit switch



### Subsection 101(1)(d)

Trolley travel limit devices automatically prevent the trolley from running into either end of the track (see Figure 6.41).

Figure 6.41 Trolley travel limits




### Subsection 101(2)

"Sealing" limit switches means to ensure that only authorized workers can adjust them. The employer can choose the most effective method as long as it does not conflict with the manufacturer's specifications.

## Section 102 Operation

No explanation required.

## Section 103 Changing components

### Subsection 103(1)

The major components of a tower crane are designed to perform in a specific manner. Using parts from another crane could adversely affect the crane's safe performance.

### Subsection 103(2)

The operator's cab, when attached to the crane boom, imposes forces on the boom that are similar to the forces imposed by a load. If a cab is attached to the boom, all aspects related to its design, securement and use must be in accordance with the manufacturer's specifications or the specifications of a professional engineer.

## Section 104 Test weights

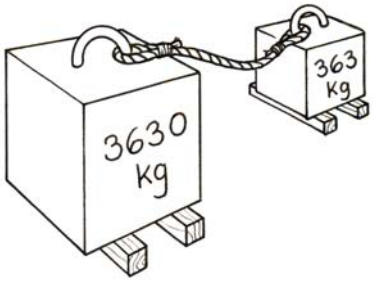
### Subsection 104(1)(a)

Marking the test weights with their true weight must be done in a way that is legible, easily read and able to withstand the effects of the weather.

### Subsection 104(1)(b)

To get an accurate indication of the weight being lifted, the test weight must not be prevented from being lifted. To avoid freezing to the ground or creating a vacuum, the weights can be placed on blocking when not in use. See Figure 6.42.

Figure 6.42 Accurate test weights placed on blocking



### Subsection 104(2)

The lifting attachment of a test weight cannot be made of reinforcing bar (rebar) steel. This steel is of low ductility and low impact strength.

## Section 105 Structural testing and examination

### Subsection 105(1)

When a tower crane arrives in Alberta for the first time and before it is used at a worksite, all structural and rigging elements and components must be inspected for soundness using accepted methods of non-destructive testing (NDT). Several methods are available including:

(a) eddy currents;
(b) ultrasound;
(c) acoustic emission;
(d) magnetism, including induction and Barkhausen;
(e) beta gauge;
(f) optical techniques such as shearography, holography, etc.;
(g) radiography e.g. X-ray imaging.

Since transporting equipment and time out of service may impact the integrity of crane components, this testing must be carried out even if similar testing was conducted before the crane arrived in Alberta.

### Subsection 105(2)

A tower crane in continuous service at a project must undergo a structural examination every 2000 operating hours or 12 months, whichever happens first.

### Subsection 105(3)

The tests required by subsections (1) and (2) must be under the direction and control of a professional engineer and the results certified by the engineer.

## Section 106 Wind and temperature limitations

Wind velocity limits for tower crane operation are set to prevent loads from shifting, the uncontrolled movement of loads, and prevent a load radius from increasing. Setting these operational limits prevents structural failure or the tower crane from overturning.

Temperature limits for tower cranes are set to avoid excessive stress on components due to cold temperatures.

## Section 107 Multiple cranes

### Sections 107(a) and 107(b)

When the radii of multiple cranes overlap, collisions must be prevented. Operators of the cranes must be provided with a means of communication and the operators must use it. Portable two-way radios are often used in such situations.

### Section 107(c)

Several options are available to prevent collisions between multiple cranes and their loads:

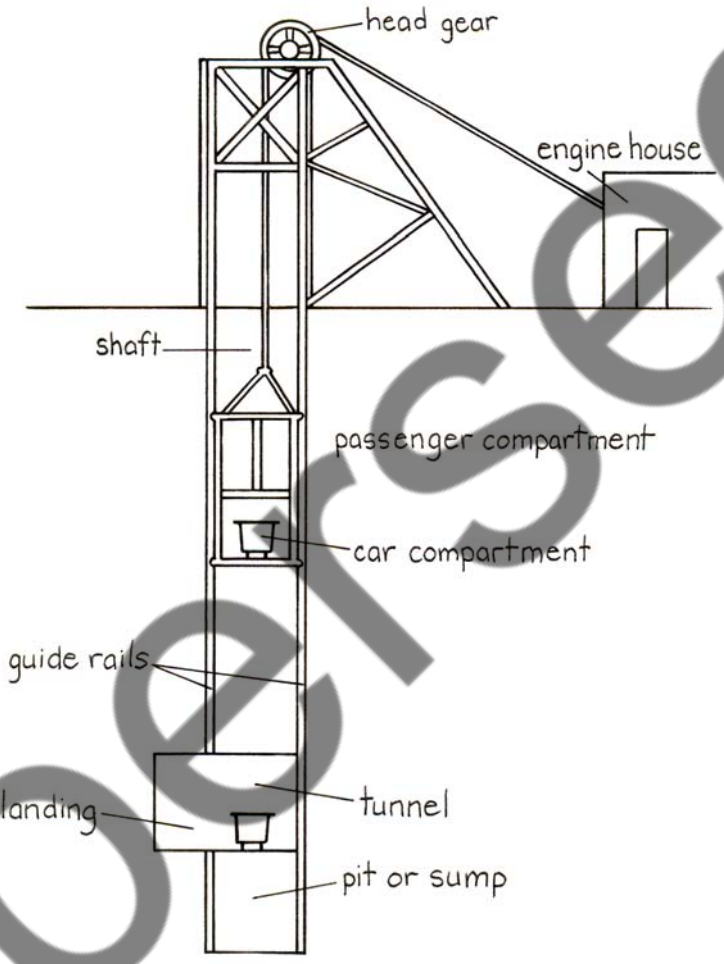
(a) erecting the cranes at staggered heights, maintaining at least one metre clearance distance between all crane components under all conditions of loading;
(b) installing "slewing" limit switches set to activate and stop the jib before it gets into the overlap zone;
(c) developing written operating procedures in accordance with section 67; and
(d) securing the jib of an unattended crane in a position facing downwind in line with any anticipated prevailing winds.

# Underground Shaft Hoists

## Section 108 Safety requirements

Figure 6.43 shows an example of an underground shaft hoist.

Figure 6.43 Example of an underground shaft hoist and its parts




### Section 108(1)(a)

The base of an underground shaft hoist will typically be a rigid concrete foundation that should be designed by a professional engineer.

## Section 108(1)(b)

"Positive drives" means that the load-carrying unit is driven in both up and down directions. "Non-positive" (free-wheeling) means that that load-carrying unit is driven in the up direction and may be permitted to descend freely.

## Section 108(1)(c)

Installation of a clutch is prohibited to prevent disengagement of the positive drive mechanism either through mechanical failure or accidental activation of the clutch control.

## Section 108(1)(d)

The braking system should be able to:

(a) stop the cage within the deceleration parameters specified by the manufacturer or a professional engineer, for both the descending and ascending modes;
(b) apply automatically in the event of a power failure, whenever the safety circuit of the hoist is interrupted and whenever the pressure in the hydraulic or pneumatic brake actuating system drops below normal; and
(c) be applied by the hoist operator in the event of an emergency.

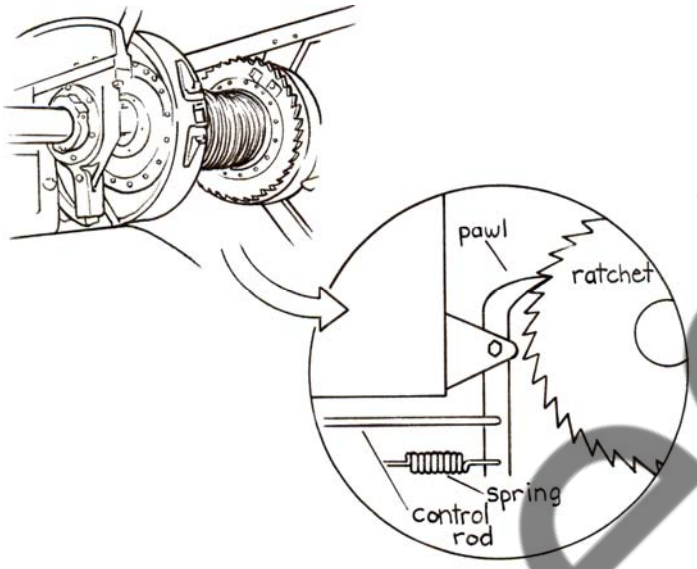
No hoist should be used for the transport of workers unless it has at least two sets of mechanical brakes each of which should:

(a) be capable of safely stopping and holding the drum when carrying its maximum rated load;
(b) be arranged so that it can be independently tested;
(c) be arranged to apply normal braking effort before any linkage or brake piston reaches a limit of travel; and
(d) if of a drum type, be equipped with a device to give positive indication of tread wear or slack linkage and prevent any movement of the hoist if predetermined limits are exceeded.

## Section 108(1)(e)

A positive spring-actuated pawl remains engaged until manually released and then returns to the engaged position when the manual control is released. See Figure 6.44.

Figure 6.44 Example of a spring-actuated pawl mechanism




### Subsections 108(2) to 108(4)

The required communication system should
(a) enable clear, audible signals to be given that are separate and distinct for each shaft compartment,
(b) be arranged so that the hoist operator can return a signal to the person giving the signal, and
(c) be installed throughout the shaft and at every working level, landing deck and other necessary location.

A hoist should not be moved on manual control unless the prescribed signal has been given and returned by the hoist operator. Signaling systems should be tested daily. Optional systems include voice, telephone and speaking tube.

## Section 109 Operator responsibilities

This section describes two of the more critical operator responsibilities when operating the shaft hoist. These are braking control and speed control.

### Subsections 109(1)

The brake control may be hand or foot operated but must be of the positive pressure or "deadman" type where physical force or pressure is required to keep the brake in the "off" position. Release of this force automatically engages the brake.

### Subsection 109(2)

Because the cage typically is guided, it is acceptable to operate the hoist at a rate of speed greater than that acceptable for a chimney hoist. However, the maximum speed at which the cage can be raised or lowered while transporting a worker must not exceed 1.2 metres per second.

## Section 110 Hoist cage

### Subsection 110(1)

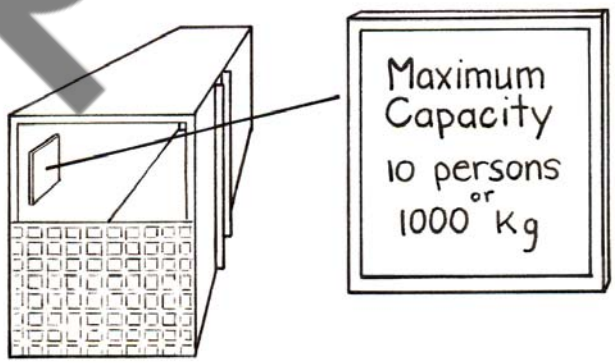
A car locking device is a method of securing the cage when it is at the landing. The device stabilizes the cage and prevents it from slipping. Where such a device is part of a friction hoist, it must be operated in accordance with the manufacturer's specifications to ensure that the hoisting rope does not slacken.

In addition to guiding the movement of the cage, guide rails are part of an emergency braking system. Should the cage descent speed exceed the specified limit, the overspeed limit device actuates roller arms extending outward to engage rollers against the guide rail and prevent or stop the hoist from falling.

### Subsection 110(2)

The hoist cage must have a capacity plate similar to that shown in Figure 6.45.

Figure 6.45 Example of hoist cage capacity plate



### Subsection 110(3)

An open hook cannot be used to attach the hoist cage to the hoist rope since any slack in the hoisting line might cause the line to come off the hook.

## Section 111 Unguided suspended cage

No explanation required.

# Vehicle Hoists

## Section 112 Safety standards

### Section 112(a)

ANSI Standard ANSI/ALI ALCTV-2006, *American National Standard for Automotive Lifts — Safety Requirements for Construction, Testing and Validation*, lists requirements for the construction, testing and validation of automotive lifts that are
(a) manually driven,
(b) power driven,
(c) stationary, or
(d) mobile.

The lifts can be installed "in-ground" or at the surface (see Figures 6.46 through 6.50 for examples). The Standard does not cover lifts that are moveable, designed to tilt the superstructure, or are not "automotive vehicle service lifts".

Figure 6.46 Two post, wheel or axle engaging, moveable piston, in-ground lift

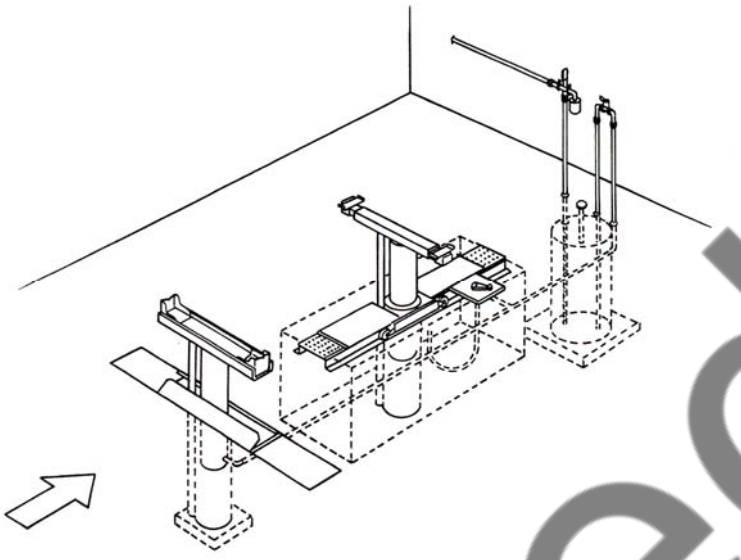


Figure 6.47 Single post, frame engaging, in-ground lift

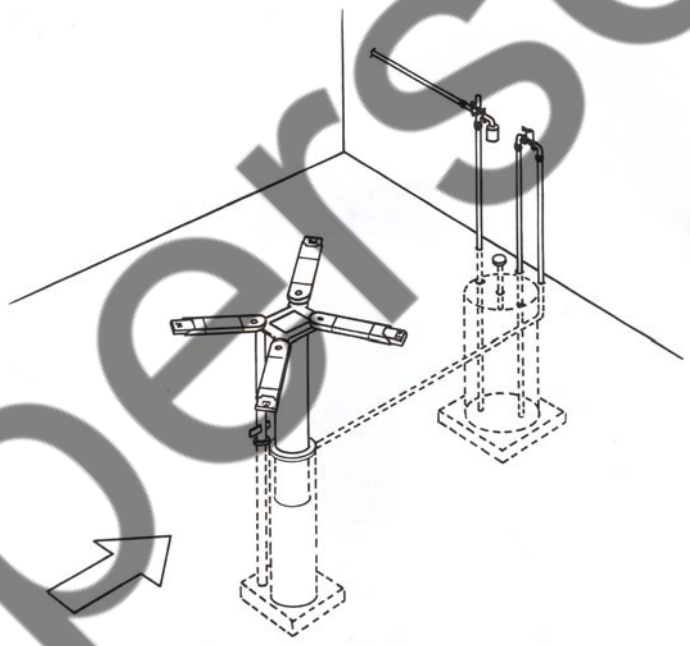


Figure 6.48 Two post, frame engaging, clear floor, surface mounted lift

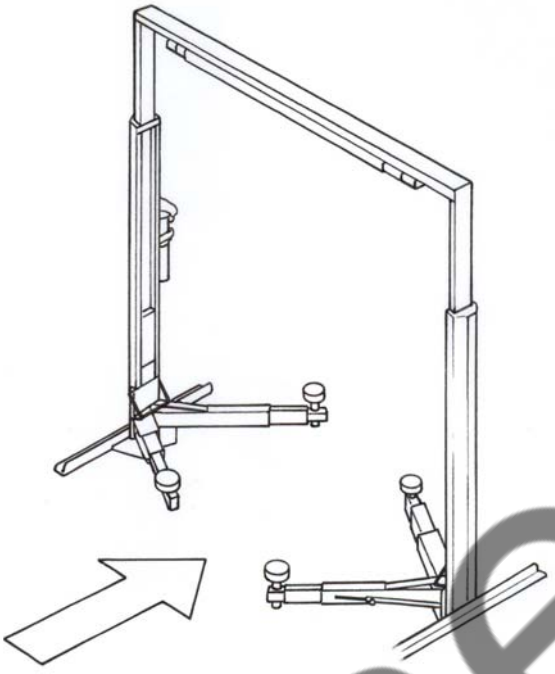


Figure 6.49 Roll-on, scissors, surface mounted, hinged lift

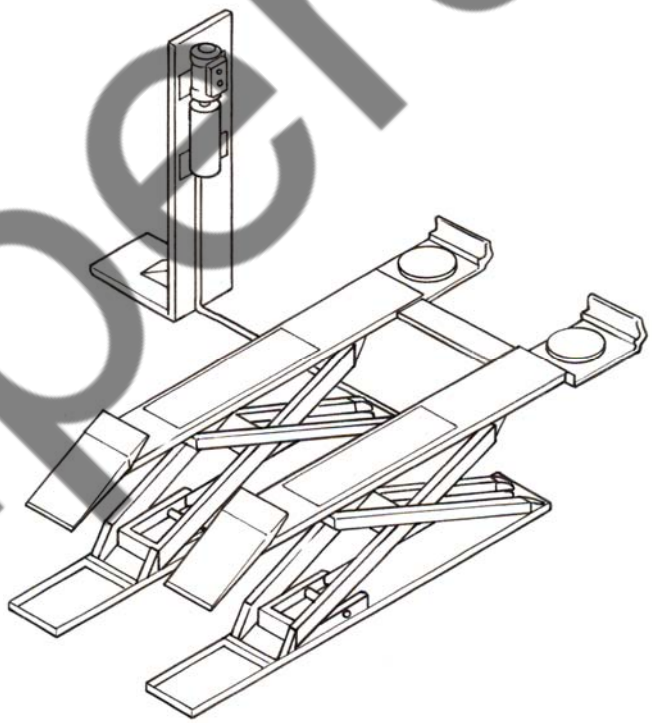
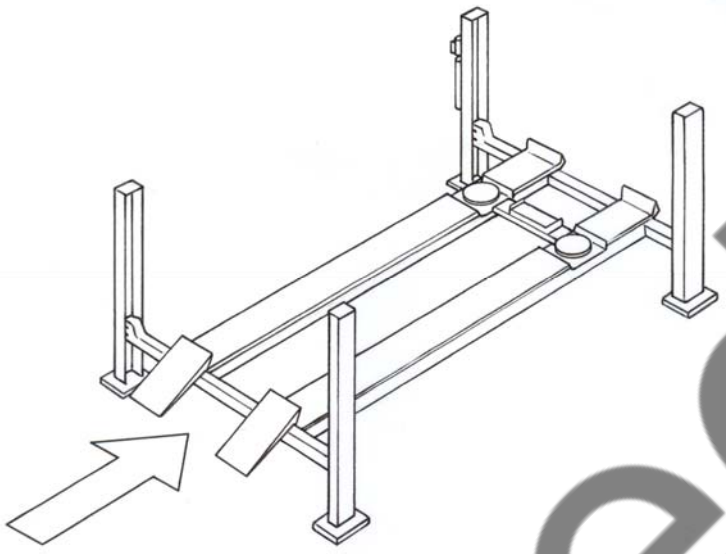


Figure 6.50 Four post, surface mounted lift



The Standard describes the installation, operation, inspection and maintenance instructions that must accompany each hoist. These include:

(a) design specifications;
(b) installation instructions;
(c) safety instructions;
(d) operating instructions;
(e) inspection and maintenance instructions; and
(f) identification of vehicle lifting points.

The Standard describes labelling requirements for

(a) safety warnings and instructions,
(b) components,
(c) electrical safety,
(d) product identification, and
(e) third-party certification.

The third-party testing, evaluation and certification of these vehicle lifts must be conducted by a laboratory that is accredited by the U.S. Occupational Safety and Health Administration.

## Section 112(b)

ANSI Standard ANSI/ALI ALOIM-2000, *Automotive Lifts — Safety Requirements for Operation, Inspection and Maintenance*, lists requirements for the operation, inspection and maintenance of installed automotive lifts.

Section 4.1 of the Standard describes operator qualifications which include
(a) a demonstrated ability in written or oral communication,
(b) a demonstrated ability to understand the mathematical, mechanical and electrical principles of automotive lifts, and
(c) a demonstrated physical ability to carry out operator responsibilities in a safe manner.

Section 4.4 of the Standard describes operator responsibilities which include:
(a) using all safety features and operating the lift in accordance with the manufacturer's instructions;
(b) maintaining the lift in a clean and orderly manner;
(c) conducting a daily inspection for and of:
    (i) operational controls;
    (ii) deformation and excessive wear of structural components, hoses, wires, drive chains, cables, screws, lift contact points; and
    (iii) evidence of hydraulic and pneumatic leaks, unusual noises or movements, cracked or loose concrete around anchor bolts.

Part 5 of the Standard describes the requirements for periodic, documented inspections that must be carried out in accordance with the manufacturer's instructions and in no case less than annually. Periodic inspections must be carried out by an inspector with:
(a) knowledge of personal safety practices;
(b) the ability read and understand manuals, drawings, parts lists;
(c) knowledge of the function of all components, devices, accessories;
(d) a working knowledge of the principles of the following as applied to the operation and components of the lift:
    (a) electrical and electronic control circuits,
    (ii) mechanics,
    (iii) hydraulics,
    (iv) pneumatics, and
(e) knowledge of the types, styles, uses and limitations of lifts.

Periodic inspections must include, but not be limited to, the following:
(a) presence of required labelling;
(b) confirmation of adequate clearances;
(c) examination of structural components such as electrical components, lift controls, runways including runway stops, swing arms including swing arm restraints, fastening devices, exposed surfaces and edges, lift adaptors;
(d) operation of the lift through its full cycle;
(e) lowering speed when carrying a representative vehicle;
(f) operations of synchronization or equalization systems;
(g) working platforms, railings, stairways;
(h) operation of up over-travel shutoff switch;
(i) all chains and cables including checking for tracking and level winding;
(j) potential pinch points;
(k) presence of water in pits or enclosures; and
(l) lift system checks for hydraulic lifts, mechanical lifts, hydraulically-driven mechanical lifts and pneumatic lifts.

Part 6 of the Standard describes requirements for preventive maintenance and repair maintenance.

## Section 113 Safe use

### Subsections 113(1) and 113(2)

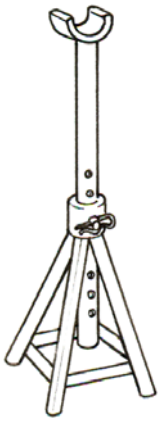
"Constant manual pressure" is the deliberate, sustained application of force in order to operate the device. Typically, this force is applied by the operator's hand or foot. Removal of this force is intended to immediately stop the operation. Any form of locking mechanism that keeps the control active without use of the operator's hand or foot is not allowed.

The vehicle hoist operator must not approach the vehicle while it is being raised or lowered. The operator controls the motion of the lift and must do so responsibly.

### Subsection 113(3)

A worker is responsible for ensuring that work is not done under a suspended vehicle unless it is on
(a) a vehicle hoist designed for that purpose, or
(b) substantial stands that are placed on a solid, level foundation and under the axles or frame are in place (see Figure 6.51). The use of the lifting device called a jack, supplied with the vehicle by its manufacturer, or similar device, is not permitted.

Figure 6.51 Example of substantial stand designed to support a vehicle load



# Winching Operations

## Section 114 Safe practices

To avoid unexpected movement when hooking or unhooking a vehicle-mounted winch line, the vehicle is typically restrained by placing blocks against the face of its tires. Figure 6.52 shows how such blocking can be used.

Figure 6.52 Blocking tires when using vehicle-mounted winch