Part 22 Safeguards

Highlights

- Section 310 states general conditions that apply to safeguards.
- Section 321 limits to no more than 6 millimetres the height of the gap between a walking or working surface and the bottom of the toe board.

Requirements

Section 310 Safeguards

Subsection 310(1)

Repealed.

Subsection 310(2)

Employers provide safeguards that eliminate contact by workers with the categories of hazard listed in the section. Written as a performance standard, the section requires that some type of safeguard be provided but does not specify its design or how it should be implemented.

In meeting the requirement, employers must recognize the hazards to workers resulting from the design, location and nature of powered machinery or energy sources. Employers must also understand how close workers get to the hazards and what they are doing while there.

Crushed hands and arms, severed fingers, irreversible eye injuries – these are injuries preventable through appropriate safeguarding of machines and equipment. Any machine part, function or process that may cause injury must be safeguarded. When the operation of a machine or accidental contact with it can injure the operator or other workers in the vicinity, the hazards must be eliminated or controlled.

Where mechanical hazards occur

Dangerous moving parts in three basic areas require safeguarding:

(1) *the point of operation* – that point where work such as cutting, shaping, boring, etc. is done on the material;

(2) *power transmission apparatus* – all components of the mechanical system that transmit energy to the part of the machine performing the work. These components include flywheels, bullwheels, pulleys, belts, connecting rods, couplings, cams, spindles, chains, cranks and gears; and

(3) *other moving parts* – all parts of the machine that move while the machine is working. These can include reciprocating, rotating, and transverse moving parts, as well as feed mechanisms and auxiliary parts of the machine.

Hazardous mechanical motions and actions

A variety of mechanical motions and actions can present hazards to workers. These can include the movement of rotating members, reciprocating arms, moving belts, meshing gears, cutting teeth, and any parts that impact or shear. The basic types of hazardous mechanical motions and actions that must be recognized are:

Motions

(a) *rotating, including in-running nip points* – even smooth, slowly rotating shafts can grip clothing, and through mere skin contact, force an arm or hand into a dangerous position. Injuries due to contact with rotating parts can be severe (see Figures 22.1 through Figure 22.4)

Figure 22.1 Examples of hazardous projections on rotating parts

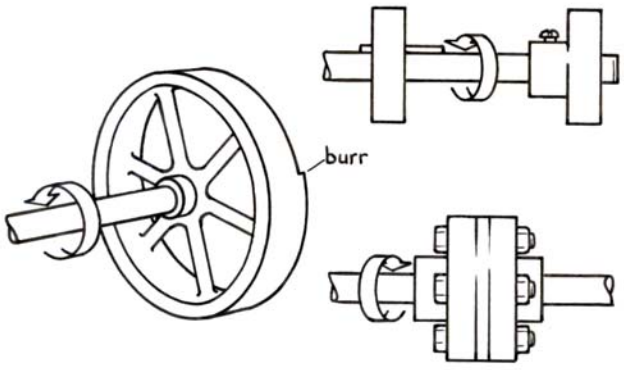


Figure 22.2 Common nip points on rotating machinery

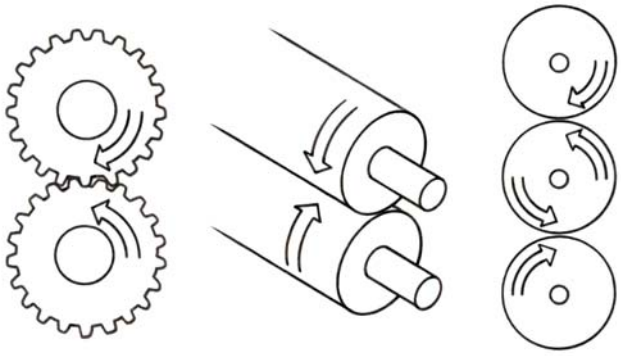


Figure 22.3 Nip points between rotating parts and parts with linear motion

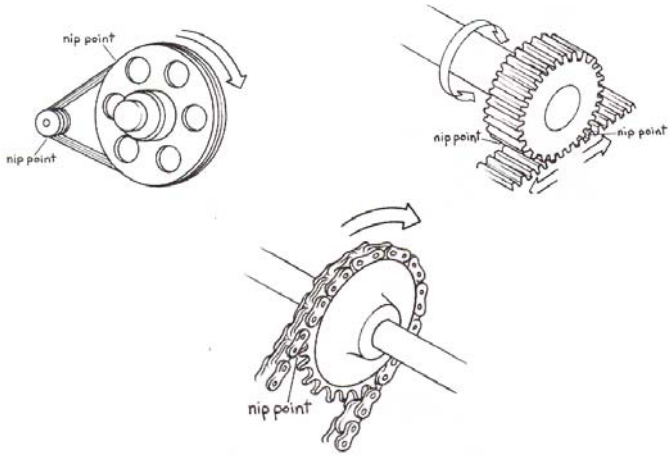
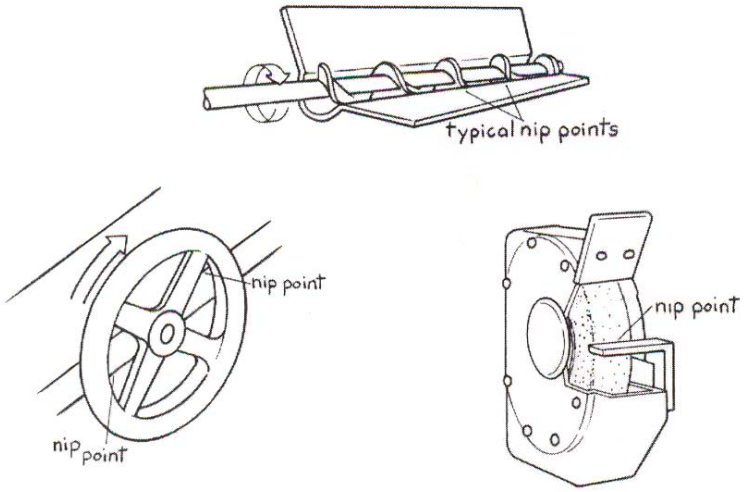
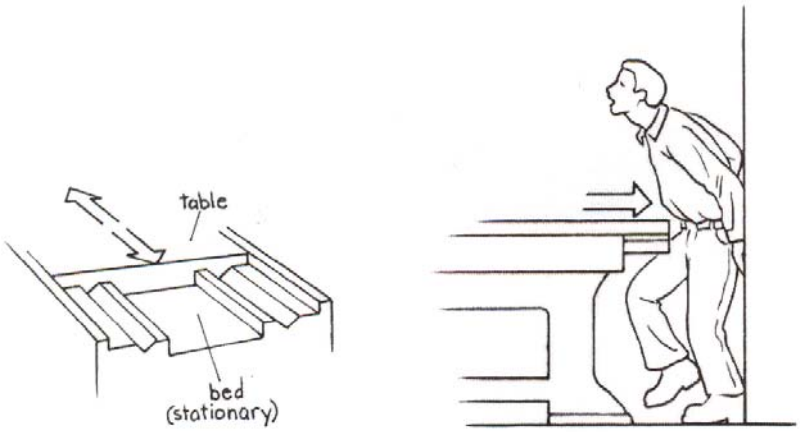


Figure 22.4 Nip points between rotating machine components



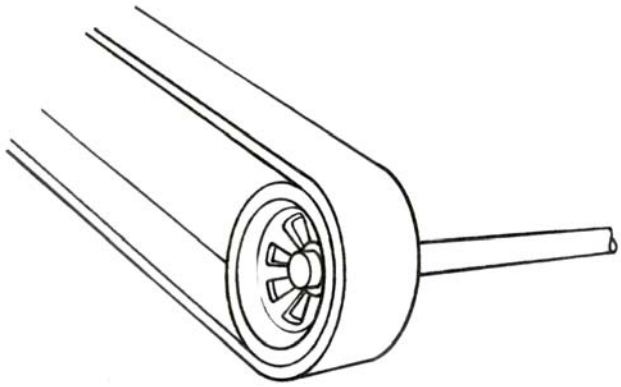
(b) *reciprocating* – during back-and-forth or up-and-down motion, a worker may be struck or caught between moving and stationary parts (see Figure 22.5)

Figure 22.5 Hazardous reciprocating motion



(c) *transverse* – movement in a straight, continuous line creates a hazard because a worker may be struck or caught in a pinch or shear point by the moving part (see Figure 22.6)

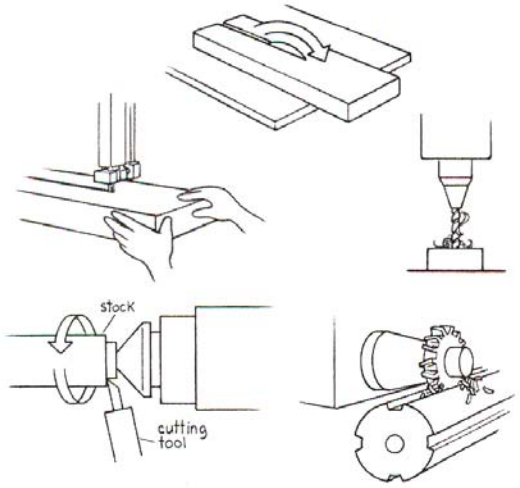
Figure 22.6 Example of transverse motion



Actions

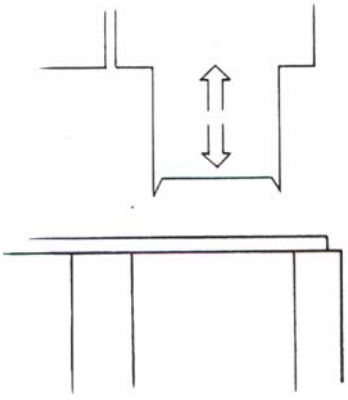
(a) *cutting* – may involve rotating, reciprocating or transverse motion. The danger of this action is at the point of operation where finger, arm and body injuries can occur and where flying chips or scrap material can strike the head, particularly in the eyes or face. Such hazards are present at the point of operation in cutting wood, metal, or other materials. Examples of machinery involving cutting hazards include bandsaws, circular saws, boring or drilling machines, lathes and milling machines (see Figure 22.7)

Figure 22.7 Examples of cutting hazards



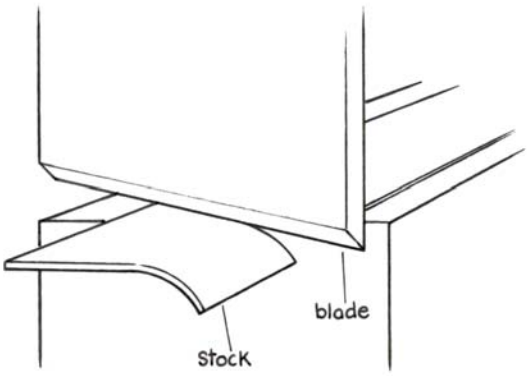
(b) *punching* – occurs when power is applied to a ram for the purpose of blanking, drawing, or stamping metal or other materials. The danger of this type of action occurs at the point of operation where material is inserted, held, and withdrawn by hand, as may be the case with power or punch presses (see Figure 22.8)

Figure 22.8 Typical punching operation



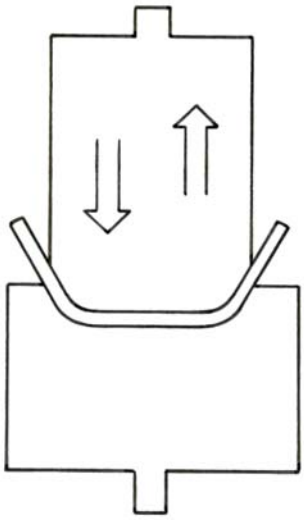
(c) *shearing* – involves applying power to a ram or knife to trim or shear metal or other materials. A hazard is present at the point of operation where stock is inserted, held and withdrawn. Examples of machines used for shearing operations are mechanically, hydraulically or pneumatically powered shears (see Figure 22.9)

Figure 22.9 Example of shearing operation



(d) *bending* – occurs when power is applied to a ram to draw or stamp metal or other materials. A hazard is present at the point of operation where material is inserted, held and withdrawn. Equipment that uses bending action includes power presses, press brakes and tubing benders (see Figure 22.10)

Figure 22.10 Example of bending operation



General requirements for all safeguards

All safeguards should do the following:

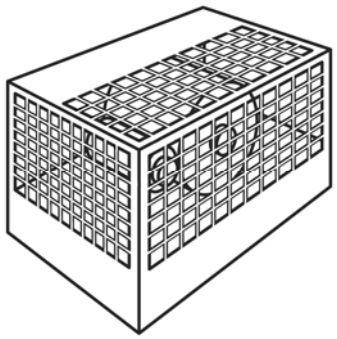
(a) *prevent contact* – the safeguard must prevent the worker's hands, arms and any other part of the body from making contact with dangerous moving parts. A good safeguarding system eliminates the possibility of the operator or another worker placing parts of their bodies near hazardous moving parts;
(b) *be secure* – workers should not be able to easily remove or tamper with the safeguard. Guards and safety devices must be able to withstand conditions of normal use;
(c) *protect moving parts from the entry of falling objects* – the safeguard should ensure that objects such as tools and materials cannot fall into moving parts;
(d) *create no new hazards* – a safeguard must not create a hazard of its own such as a shear point, a jagged edge, or an unfinished surface that can cause a cut. The edges of guards for example, should be rolled or bolted in such a way as to eliminate sharp edges;
(e) *create no interference* – any safeguard that prevents workers from doing their work quickly and comfortably may soon be overridden, ignored or disabled; and
(f) *permit safe lubrication* – if possible, workers should be able to lubricate the machine without having to remove safeguards. Locate oil reservoirs outside the guard, with a line leading to the lubrication point.

Methods of guarding equipment and machinery

The following are examples of six commonly used methods of guarding equipment and machinery:

(1) Fixed or barrier guard that encloses hazardous parts
- can be used in cases where access to the hazardous parts is not required
- the enclosure permanently guards the hazardous part(s)

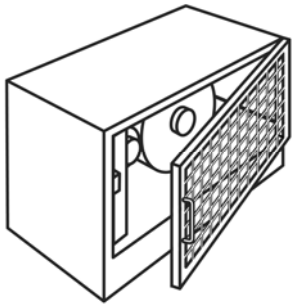
Figure 22.10.1 Fixed or barrier guard



(2) Moveable guard with interlock switch

- can be used where access to moving parts is required
- the moveable guard is interlocked, often mechanically or electrically, to the machine's power source. When the guard door is opened, the machine loses power – hazardous parts stop moving or the entire machine stops

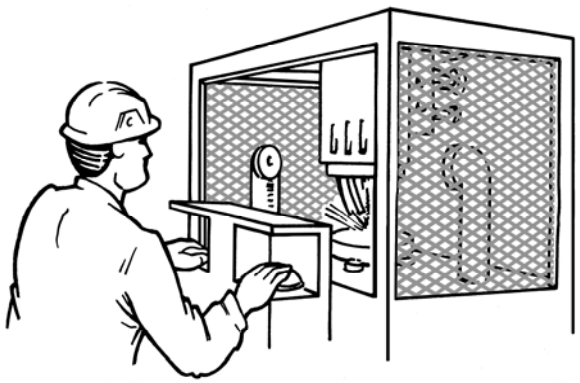
Figure 22.10.2 Moveable guard with interlock switch



(3) Two-hand control

- to prevent a hand from being caught in the machine, two start or process control buttons have to be operated at the same time to allow the machine to run
- the operator's hands cannot be in the machine and at the control at the same time

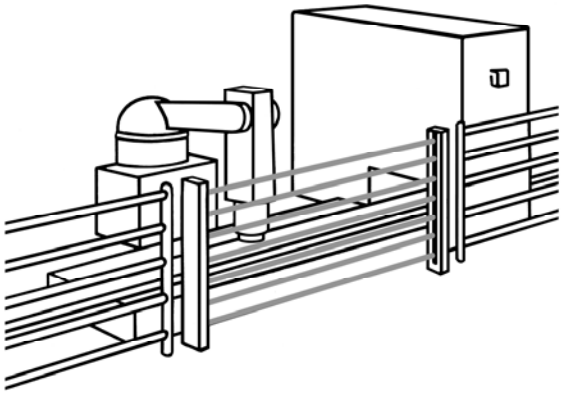
Figure 22.10.3 Two hand controls



(4) Infrared light curtains

- a "curtain" of harmless light beams run in front of the hazardous area
- if a beam is blocked or interrupted, a control circuit senses this and shuts off power to the moving parts or the entire machine

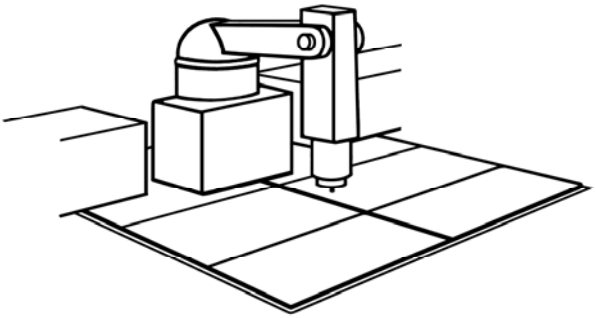
Figure 22.10.4 Infrared light curtains



(5) Pressure sensitive safety mats

- these mats are used to guard a machine by controlling access to the machine while it is running
- mats are placed around the hazardous area and are electrically connected to the machine's control circuits
- an operator's footstep on a mat triggers a pressure-sensing circuit to cut power to the machine

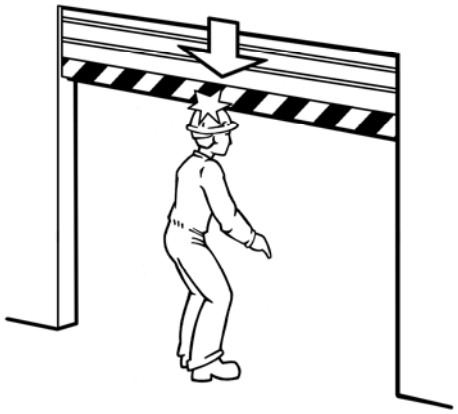
Figure 22.10.5 Pressure sensitive safety mats



(6) Pressure sensitive edges

- flexible edging strips, electrically connected to the guarded device's control circuits, can be added to a moving part such as a powered door or moving machine table
- if the moving part hits the operator, or the operator hits the edge, the edging strip deforms and a stop signal is sent to the power source

Figure 22.10.6 Pressure-sensitive edges



For more information

http://employment.alberta.ca/documents/WHS/WHS-PUB_bp008.pdf
Best Practice on Conveyor Safety

www.osha.gov/Publications/Mach_SafeGuard/toc.html
Concepts and Techniques of Machine Safeguarding

www.msha.gov/s&hinfo/equipguarding2004.pdf
MSHA's Guide to Equipment Guarding
U.S. Department of Labor, Mine Safety and Health Administration

Subsection 310(2.1)

Repealed.

Subsection 310(3)

This subsection permits the use of alternate measures where enclosing or barricading a hazard is inappropriate or undesirable. The measures listed are intended to interrupt the process when the worker approaches the hazard, or to restrain or prevent the worker from coming into contact with the hazards listed.

Subsections 310(4) and 310(5)

Situations arise in which equipment is used in a manner never envisioned at the time that it and its safeguards were originally designed. Situations also arise in which, because of the nature of the work, the work cannot be performed with the guard in place e.g. performing particular types of cuts with a table saw, using an angle grinder in a very tight space.

Removing a guard in order to perform work is always the least desirable option. Consider the following angle grinder example. Its principle can be generalized to all situations in which an employer wishes to remove a guard:

Before removing the angle grinder's guard, the employer should first try
(a) using a grinder with a smaller diameter grinding wheel – Are we using the correct size of tool?,
(b) using a die or pencil grinder that fits into a tighter space – Are we using the correct tool for the task?, and
(c) using some other type of work method – Can we alter the fabrication or finishing process so that we can still use the original tool or make its use unnecessary? Can we redesign the workpiece so that we can still use the original tool or make its use unnecessary?

If the employer determines that an effective safeguard cannot be provided, then the employer may use an alternative mechanism, system, or change in work procedure in place of the safeguard. If an employer uses this option, the alternative approach must offer workers a level of protection that is *equal to or greater than* the protection required by subsection 310(3). An employer should be able to explain why an effective safeguard could not be provided and justify how the alternative approach provides an *"equal to or greater than"* level of worker protection.

Alternative approaches to having a safeguard in place may involve combinations of the following:

- ensuring that a machine's dangerous moving parts are out of the reach of workers i.e. safe by location or distance. For example, the machine can be located on the other side of a wall, or dangerous parts can be located high enough to be out of the normal reach of a worker. The main disadvantage of this approach is that if the equipment jams or becomes blocked, an operator might try to correct the problem with the machine turned on – and no safeguards in place. A worker can relatively easily gain access to the machine by using a ladder or stand on an object at hand to gain access to elevated dangerous parts. Safe by location or distance is an approach that is only suitable when policies and procedures are in place that ensure that the safety provided by this method is not compromised.
- marking danger zones that need to be kept clear of and ensuring that the zones are respected.
- restricting the number of machines that use an alternate guarding arrangement.
- "inching" or "inch-safe-service" procedures. These procedures involve limited motion of machinery where dangerous parts are exposed during cleaning, setting, adjustment or feeding material. The terms "jog", "crawl" and "pulse" may also be used depending on the machine and industry. Machinery operated in this way normally has a "safe" or "hold-to-run" control, with the machine running at the slowest practical operating speed for the purposes of cleaning,

loading and setting up. The inching control should be of a hold-to-run type so that on release of hand pressure the machine's dangerous motion stops immediately.
- using procedures that are confirmed as offering an appropriate level of worker protection.

Subsection 310(6)

The employer is required to place signs in a clearly visible location(s) warning workers of automatically or remotely starting machinery. The signs may bear a message such as "WARNING – This Equipment May Start Without Warning"

Section 311 Tampering with safeguards

This section places responsibilities on a worker who removes a safeguard or makes it ineffective. Safeguards can only be removed or made ineffective under the circumstances listed, and must be immediately replaced or reactivated once the purpose of the interruption is completed. After replacement, the safeguard must be tested to confirm that it is still effective.

A worker may need to remove or make a safeguard ineffective on equipment that is not under the worker's direct control. When this is the case, the worker must control hazardous energy e.g. lockout, as required by Part 15. This ensures that the equipment cannot be activated through the actions of another worker.

Section 312 No safeguards

Circumstances may arise during which machinery cannot accommodate or operate with its safeguards in place. Such machinery would, under normal circumstances, require the use of limited or no personal protective equipment. If the safeguards must be removed, then their absence must be compensated for by the use of personal protective equipment.

In such cases, the personal protective equipment used must offer protection that is *equal or greater* than that provided by the original safeguard. For example, if a guard must be removed to allow a dimensionally larger piece of material to be fed through the equipment, the personal protective equipment used must offer protection against whatever hazards are now exposed by removal of the safeguard. The hazards might require eye protection, hearing protection, limb and body protection, hand protection against cuts and abrasions, etc.

This personal protective equipment alternative is unacceptable if it is used to bypass the employer's responsibility to provide safeguards as required by the OHS Code. The use of personal protective equipment should always be thought of as the "last resort". Personal protective equipment should *not* be used as a substitute for engineering controls such as safeguards.

Section 313 Building shafts

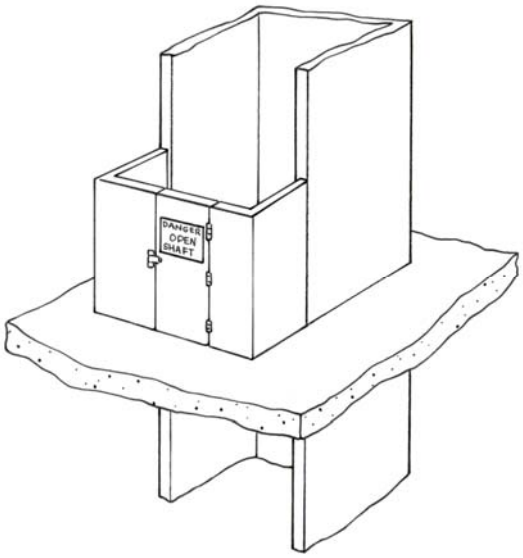
This section is intended to prevent or limit worker and equipment falls into, or in the vicinity of, openings to a building shaft. The work in building shafts referred to in this section usually involves the forming and stripping of forms during the construction of the shaft. However, the requirements apply to other types of work done in building shafts.

The platform from which work is being performed must be covered to prevent any worker, and all larger tools and equipment, from falling to a lower level. The decking itself can be solid material such as plywood, sectional material such as planking, or see-through material such as catwalk grating. Regardless of the material selected, the working platform must be strong enough to withstand the maximum load expected at any given time due to workers, tools and materials.

Because of the potential for any system to fail, and the potential for a significant fall distance, a second platform must be provided below the first. Located not more than 4 metres below the first or working platform, this second platform is intended to limit the fall of any worker, tools or materials. As a result, this second platform must be as strong or stronger than the working platform.

Where there is no work platform at a doorway or opening to a building shaft, workers must be protected from falling into the shaft. The doorway or opening must be enclosed and signed as shown in Figure 22.11

Figure 22.11 Enclosure of open building shaft



Section 314 Covering openings

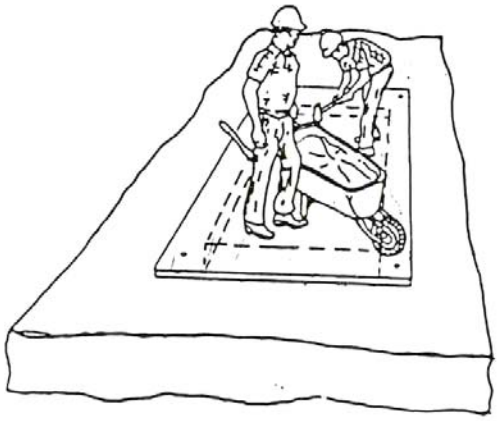
This section protects workers against the hazard of falling into openings and holes. The section does not specify a minimum or maximum dimension on the opening or hole – if a worker's foot could fall through, then the opening or hole is large enough to present a hazard requiring protection.

Also, this section does not specify a minimum height of fall. If a worker can get injured in the fall, regardless of the height, the provisions of this section apply.

The employer has two options:

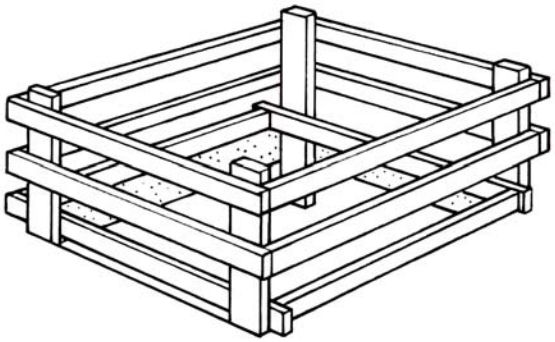
(1) cover the opening or hole (see Figure 22.12):
   (a) the cover must be securely attached over the opening or hole, and
   (b) the cover must be designed to support any anticipated load — this includes workers, tools and materials; or

Figure 22.12 Securely attached covering



(2) install a guardrail and toe boards (see Figure 22.13):
   (a) the guardrail must comply with section 313, and
   (b) the toe boards must comply with section 321.

Figure 22.13 Guardrails and toe boards



The removal of a covering, guardrail, toe board, or any part of one of these safeguards can expose workers to a hazard. The employer is responsible for ensuring that when such a safeguard is removed, an effective alternate means of protection is provided immediately. The removal of guardrails from around an opening may, for example, require the placement of barriers and flagging around the perimeter of the opening (but at a further distance) to prevent workers from getting near the opening.

As required by subsection 311(3), the worker who removes a safeguard or makes it ineffective also has responsibilities. The worker must ensure that alternate measures are in place to protect workers and the original safeguard(s) is replaced immediately

upon the work being completed. The worker is responsible for making sure the safeguard functions properly once it is replaced.

As shown in Figure 22.14, where a temporary covering is used, a warning sign or markings clearly indicating the nature of the hazard must be provided. Workers could remove an unmarked cover, thinking it to be a piece of material left lying on a secure floor surface. Workers removing such a covering could be at risk of falling into the opening. A temporary covering must not be removed unless an effective means of protection is immediately provided.

Figure 22.14 Example of a warning sign for a temporary covering

Section 315 Guardrails

Figures 22.15 and 22.16 show guardrails that meet the requirements of this section. Wire rope or other similar material can be used for the horizontal top or intermediate member as long as it

(a) has a nominal diameter or thickness of at least 6 millimetres (1/4 inch) to prevent cuts and lacerations, and

(b) is under tension to minimize sag – unloaded sag should be no more than approximately the span length between tensioning devices divided by 60, and the lowest portion of the wire rope must not be less than the required minimum heights above the working or walking surface.

If wire rope or a similar material is used as the horizontal top member, it must be flagged at intervals of at least 1.8 metres (6 feet) with highly visible material so that the wire rope or similar material can be seen.

Figure 22.15 Guardrail specifications

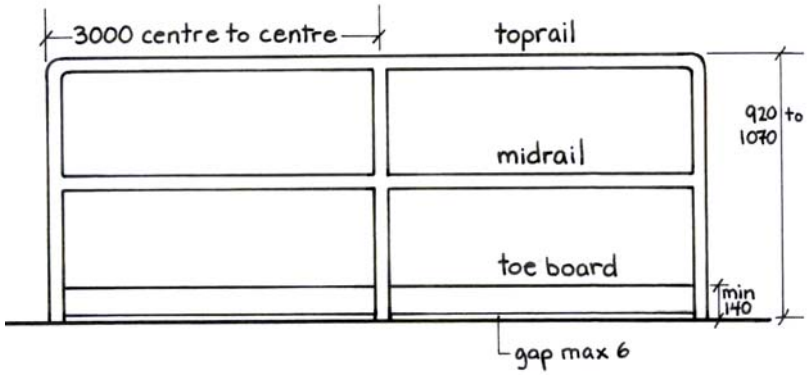
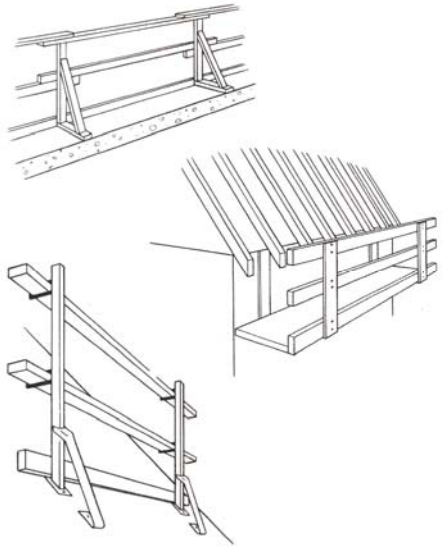
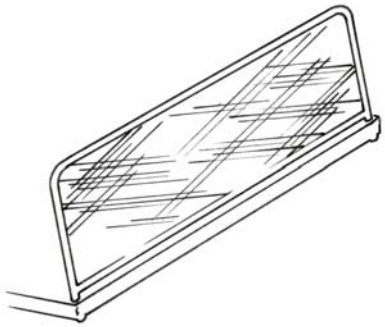


Figure 22.16 Examples of acceptable guardrails



With temporary guardrails, the intermediate horizontal member can be replaced with a substantial barrier such as a wire mesh or solid panel (see Figure 22.17). The alternative must be a substantial barrier that, when positioned and secured between the top member, toe board, and vertical members, will prevent a worker from falling through the space.

Figure 22.17 Wire mesh used as midrail



An often asked question is "How strong should a guardrail be?" As a general guide, a guardrail should be capable of withstanding a force of at least 890 newtons (200 pounds-force) applied within 5 centimetres (2 inches) of the top edge in any outward or downward direction. The guardrail can bend but must not break or separate (dislodge) from the structure to which it is attached.

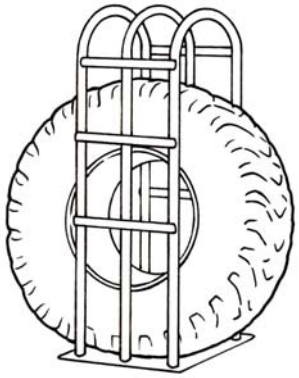
Section 316 Hoppers, bins and chutes

This section is intended to protect workers from falling into hoppers, bins or chutes used for dumping or directing the flow of materials. Alternate means that may provide equally effective protection include guardrails that enclose all open sides or safely capping or blocking off openings that will no longer be used.

Section 317 Machine failure

Where an employer has identified a hazard of machine failure that could result in the machine breaking apart and throwing out debris that might injure a worker, some form of adequate restraining or containing safeguard is required. For example, Figure 22.18 shows a cage used to restrain split rim wheel assemblies while being serviced.

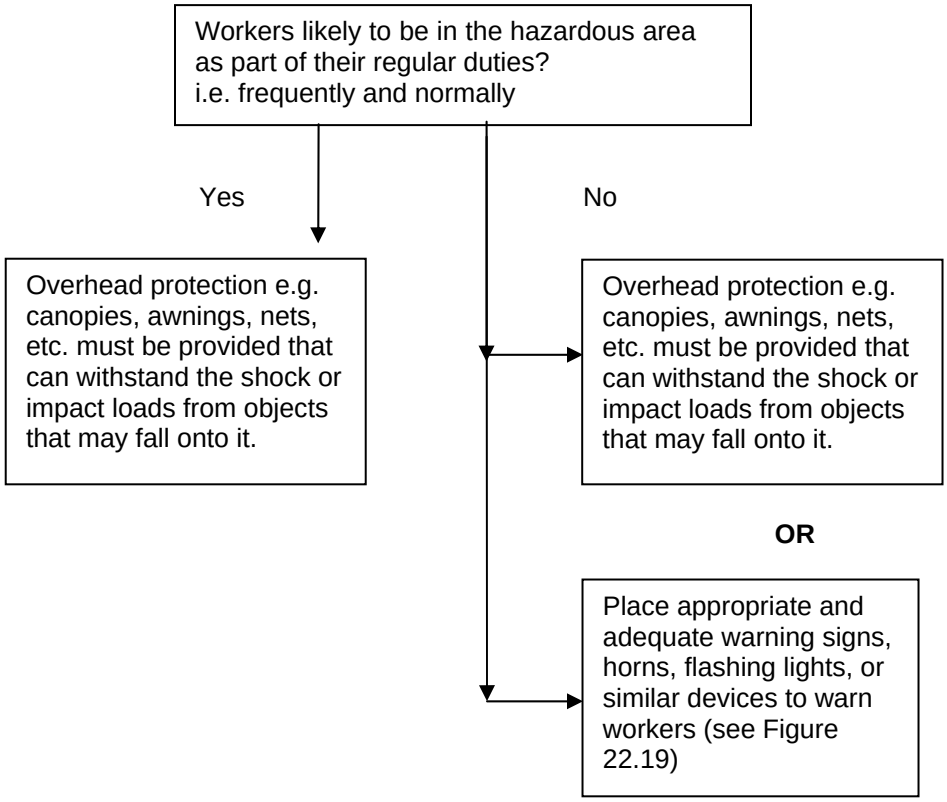
Figure 22.18 Cage to restrain split rim wheel assemblies



Section 318 Protection from falling objects

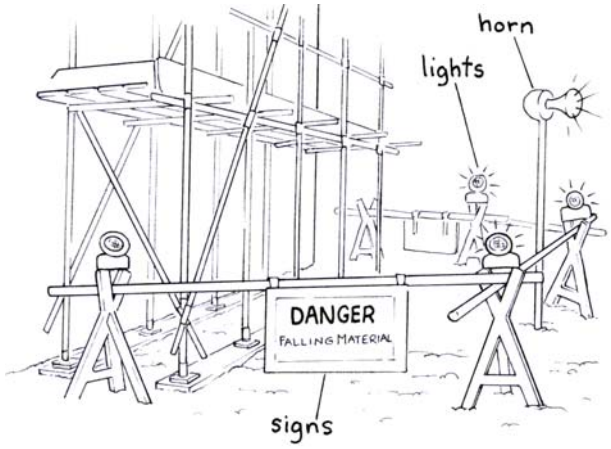
This section permits an employer to use an alternate type of falling object overhead protection based on the extent to which workers are in the hazardous area. Table 22.1 shows the options available to an employer.

Table 22.1 Options for falling object protection



When used as protection from falling objects, structures such as canopies must be strong enough to prevent collapse and to prevent penetration by any objects that may fall onto them.

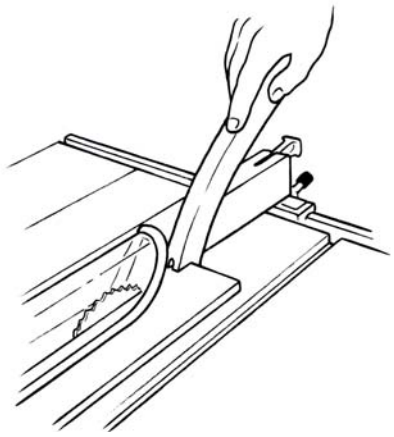
Figure 22.19 Alternate approaches to providing overhead protection



Section 319 Push stick or block

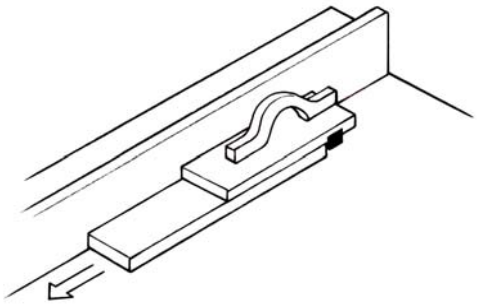
This section is intended to protect workers from hazards inherent in the operation of equipment such as powered carpentry, wood milling or metal milling machinery. Push sticks and push blocks control the work piece, significantly reducing the possibility of the worker's hands contacting the cutting devices.

Figure 22.20 Example of push stick



The push stick shown in Figure 22.20 should be used on small work pieces and when the distance between the blade and fence is narrow. A push block as shown in Figure 22.21 should be used on a jointer or planer to keep the operator's thumbs and fingers away from the cutting head.

Figure 22.21 Example of push block



Section 320 Safety nets

The term "safety net" includes both personnel and debris nets. Personnel nets are designed to safely catch workers who fall from a height; debris nets are designed to catch small, lightweight debris, tools, building materials, and other materials that might be dropped, pushed, knocked off or blown from a structure.

Personnel nets are made of a variety of natural and synthetic materials. Ropes or strips are used to produce webbing that is strong enough to withstand the force of a person falling, and a mesh size small enough to minimize personal injury.

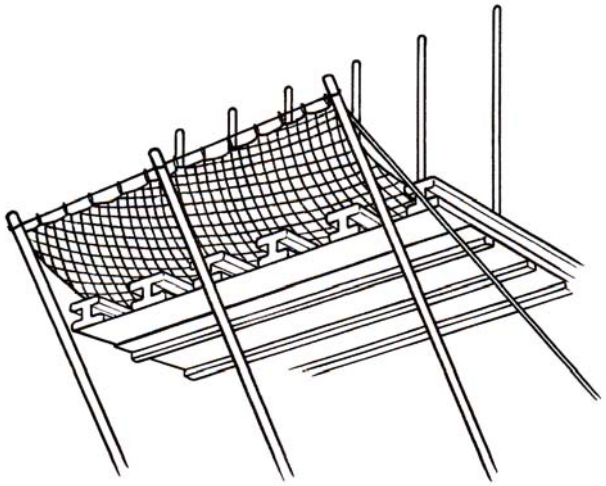
The mesh size of debris nets depends on the application. These nets are available in many sizes and strengths depending on the size and weight of the debris to be contained. Safety nets for debris can provide overhead protection in cases where workers are required to work beneath an area exposed to falling debris. In general, safety nets tend to be most commonly used by the construction industry.

ANSI Standard A10.11-1989 (R1998), *Construction and Demolition Operations — Personnel and Debris Nets*, establishes safety requirements for the selection, installation, and use of personnel and debris nets during construction, repair, and demolition operations. The standard allows nets to be made of natural e.g. manila, sisal, hemp, etc. or synthetic fibres. Procedures to be used by manufacturers during the testing of their products for compliance with the standard are also described.

To meet the requirements of the Standard, personnel nets must be permanently labelled with the following information:
(a) name of manufacturer;
(b) identification of net material;
(c) date of manufacture;
(d) date of prototype test;
(e) name of testing agency; and
(f) serial number.
The Standard does not require debris nets to be labelled.

The ultimate strength of safety hooks and shackles is specified in subsection (2) to ensure that hooks and shackles are sufficiently strong. Connections or joints between safety net panels must be as strong as the net panels themselves. Safety nets should be installed as close as practicable under the walking or working surface on which workers are walking or working, and never more than 6 metres below that surface. Safety nets must be installed with sufficient clearance underneath to prevent contact with the surface or structure below (see Figure 22.22).

Figure 22.22 Example of safety net in use



Out of necessity, safety nets are often secured to some type of supporting structure. As a result, a professional engineer must certify any structure to which a personnel safety net is attached. The certification must indicate that the structure is capable of withstanding any load the net is likely to impose on it e.g. depending on the circumstances of the work site, one or more tool-laden workers falling the maximum distance of 6 metres.

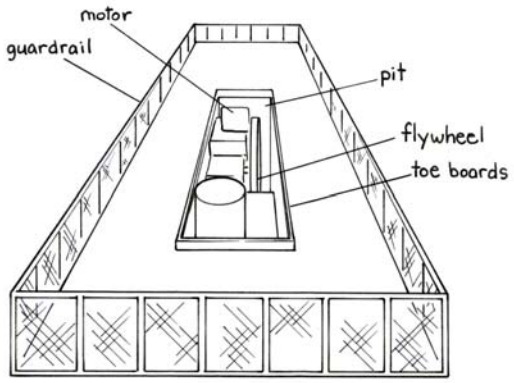
Section 321 Toe boards

Toe boards are intended to prevent tools and materials from being dislodged from the edge of an elevated platform and falling on persons below. The maximum 6 millimetre gap allowed between the walking or working surface and the bottom of the toe board is new to the requirement for toe boards.

Without a maximum gap height, toe boards could be installed that would fail to prevent tools and materials from falling from elevated platforms. This new 6 millimetre requirement does not apply retroactively to toe boards already in place.

Toe boards must be installed around pits in which rotating machinery operates and in which workers may be working. The toe boards prevent objects from falling into rotating machinery and becoming projectiles capable of injuring workers (see Figure 22.23).

Figure 22.23 Toe boards at perimeter of machinery pit



Section 322 Wire mesh

Wire mesh can be used to create protective enclosures. Such enclosures may for example, restrain materials, prevent worker limbs from extending beyond work platforms or into moving machinery, or prevent loose materials from falling into underground shaft openings.

The thickness of the wire determines its strength and although the term "diameter" is used, a wire that is not round may be used but must be at least 1.63 millimetres (1/16 inch) thick across its thinnest dimension. The spaces of the wire mesh must be sufficiently small to prevent a 40 millimetre (1 9/16 inches) diameter object from passing through the openings with minimal effort.