Infrastructure Health & Safety Association™

Work Safe for Life

Boilermakers

Health & Safety Manual

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This manual was developed, reviewed, and endorsed by the Boilermakers Labour-Management Health and Safety Committee in association with IHSA. Manual IHSA editor: Lori-Lynn Bonnell, design and illustrations: Philippa Giancontieri; project manager: Mike Russo.

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The working group included representatives from the Boilermaker Contractors' Association (BCA) as well as:

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- Blair Allin – International Brotherhood of Boilermakers, Local 128 – Apprenticeship & Training
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APPENDICES

CHAPTER 1—Act and Regulations

Each workplace party has certain responsibilities that contribute to a safe and healthy workplace.

Before beginning work, it is important for everyone to know and understand their rights and responsibilities. This chapter outlines the various responsibilities and rights that are listed in Ontario's *Occupational Health and Safety Act* (OHSA) and applicable regulations. It also lists the documents that must be posted in an accessible location at all jobsites.

Duties of workplace parties

An essential part of Ontario's Health and Safety legislation is the importance of having a strong "Internal Responsibility System" (IRS) where everyone in the workplace takes responsibility for health and safety.

The *Occupational Health and Safety Act* sets out specific duties for each workplace party. The following sections of the Act define those duties. Additional responsibilities can be found in the Regulations for Construction Projects (213/91).

Constructor

23. (1) *A constructor shall ensure, on a project undertaken by the constructor that,*

(a) the measures and procedures prescribed by this Act and the regulations are carried out on the project;

(b) every employer and every worker performing work on the project complies with this Act and the regulations; and

(c) the health and safety of workers on the project is protected.

Employer

25. (1) *An employer shall ensure that,*

(a) the equipment, materials and protective devices as prescribed are provided;

(b) the equipment, materials and protective devices provided by the employer are maintained in good condition;

(c) the measures and procedures prescribed are carried out in the workplace;

(d) the equipment, materials and protective devices provided by the employer are used as prescribed; and

(e) a building, structure, or any part thereof, or any other part of a workplace, whether temporary or permanent, is capable of supporting any loads that may be applied to it,

(i) as determined by the applicable design requirements established under the version of the Building Code that was in force at the time of its construction,

(ii) in accordance with such other requirements as may be prescribed, or

(iii) in accordance with good engineering practice, if subclauses (i) and (ii) do not apply.

(2) *Without limiting the strict duty imposed by subsection (1), an employer shall,*

(a) provide information, instruction and supervision to a worker to protect the health or safety of the worker;

(b) in a medical emergency for the purpose of diagnosis or treatment, provide, upon request, information in the possession of the employer, including confidential business information, to a legally qualified medical practitioner and to such other persons as may be prescribed;

(c) when appointing a supervisor, appoint a competent person;

(d) acquaint a worker or a person in authority over a worker with any hazard in the work and in the handling, storage, use, disposal and transport of any article, device, equipment or a biological, chemical or physical agent;

(e) afford assistance and co-operation to a committee and a health and safety representative in the carrying out by the committee and the health and safety representative of any of their functions;

(f) only employ in or about a workplace a person over such age as may be prescribed;

(g) not knowingly permit a person who is under such age as may be prescribed to be in or about a workplace;

(h) take every precaution reasonable in the circumstances for the protection of a worker;

(i) post, in the workplace, a copy of this Act and any explanatory material prepared by the Ministry, both in English and the majority language of the workplace, outlining the rights, responsibilities and duties of workers;

(j) prepare and review at least annually a written occupational health and safety policy and develop and maintain a program to implement that policy;

(k) post at a conspicuous location in the workplace a copy of the occupational health and safety policy;

(l) provide to the committee or to a health and safety representative the results of a report respecting occupational health and safety that is in the employer's possession and, if that report is in writing, a copy of the portions of the report that concern occupational health and safety; and

(m) advise workers of the results of a report referred to in clause (l) and, if the report is in writing, make available to them on request copies of the portions of the report that concern occupational health and safety.

Note: Additional duties of employers are listed in section 26 of the OHSA.

Supervisor

27. (1) *A supervisor shall ensure that a worker,*

(a) works in the manner and with the protective devices, measures and procedures required by this Act and the regulations; and

(b) uses or wears the equipment, protective devices or clothing that the worker's employer requires to be used or worn.

(2) *Without limiting the duty imposed by subsection (1), a supervisor shall,*

(a) advise a worker of the existence of any potential or actual danger to the health or safety of the worker of which the supervisor is aware;

(b) where so prescribed, provide a worker with written instructions as to the measures and procedures to be taken for protection of the worker; and

(c) take every precaution reasonable in the circumstances for the protection of a worker.

Worker

28. (1) *A worker shall,*

(a) work in compliance with the provisions of this Act and the regulations;

(b) use or wear the equipment, protective devices or clothing that the worker's employer requires to be used or worn;

(c) report to his or her employer or supervisor the absence of or defect in any equipment or protective device of which the worker is aware and which may endanger himself, herself or another worker; and

(d) report to his or her employer or supervisor any contravention of this Act or the regulations or the existence of any hazard of which he or she knows.

(2) *No worker shall,*

(a) remove or make ineffective any protective device required by the regulations or by his or her employer, without providing an adequate temporary protective device and when the need for removing or making ineffective the protective device has ceased, the protective device shall be replaced immediately;

(b) use or operate any equipment, machine, device or thing or work in a manner that may endanger himself, herself or any other worker; or

(c) engage in any prank, contest, feat of strength, unnecessary running or rough and boisterous conduct.

In addition to the Act and Regulations, there may be jobsite-specific rules that workers must follow.

Jobsite Postings

The *Occupational Health and Safety Act*, the Regulations for Construction Projects (213/91), and regulations under the *Workplace Safety and Insurance Act* specify items that must be posted or available at a jobsite.

- *Occupational Health and Safety Act and Regulations for Construction Projects* (the "green book")
- Regulation 1101 (First Aid Requirements)
- Company health and safety policy and program
- Ministry of Labour (MOL) inspector's orders and report
- Emergency response plan
- *In Case of Injury* poster issued by the Workplace Safety and Insurance Board (P085 available at ihsa.ca)
- MOL Form 0175: "Notice of Project" if the project is valued at more than $50,000 or falls under one of the other conditions in section 6 of the Regulation for Construction Projects (213/91)
- Address and phone number of the nearest MOL office
- MOL Form 1000: "Registration of Constructors and Employers Engaged in Construction" (available)
- MOL's *Health and Safety at Work: Prevention Starts Here* poster
- Company workplace violence and harassment policy
- Name, trade, and employer of Joint Health and Safety Committee members or health and safety representative
- MSDS of any hazardous physical agents that may be used at the jobsite (available)
- Name of constructor and head office info
- DANGER signs in hazardous areas (if applicable)
- Location of toilets and clean-up facilities
- Valid certificate of first-aider on duty
- Inspection card for first aid box.

JHSCs and Health and Safety Representatives

On some projects, a Joint Health and Safety Committee (JHSC) or a health and safety representative is required to look after the health and safety interests of workers on the jobsite. A JHSC is composed of an equal number of worker and employer representatives. Health and safety representatives and worker representatives of the JHSC and are chosen by the workers or the workers' union.

Legislative Requirements

The OHSA requires a health and safety representative or JHSC under the following circumstances.

No. of Workers	Legislative Requirement
1 to 5	You are not required to have a JHSC or a health and safety representative unless your workplace uses designated substances.
6 to 19	You are required to have one health and safety representative who is selected by the other workers or their union. If your workplace uses designated substances, you are required to have a JHSC.
20 to 49	You are required to have a JHSC with at least two members—one management representative and one non-management worker.
50 plus	You are required to have a JHSC with at least four members—two management representatives (at least one must be certified) and two non-management workers (at least one must be certified).

Certified members of the JHSC receive special training in workplace health and safety, giving them additional powers under the OHSA. Collectively, management-certified and worker-certified members can order the employer or constructor to stop work if they have "reason to believe" that dangerous circumstances exist in the workplace.

Principle Functions

In addition to the principle functions of a JHSC or health and safety representative listed below, a number of other powers and responsibilities can be found in sections 8 and 9 of the OHSA.

- To identify actual and potential workplace hazards
- To inspect the workplace at least once a month or, if that is not practical, at least once a year and at least part of the workplace each month in accordance with a schedule agreed upon by the representative and the employer (constructor)
- To be consulted about and be present at the beginning of health- and safety-related testing in the workplace
- To make recommendations to the employer about health and safety in the workplace,
- To participate in the first and second stage investigation of work refusals and to inspect workplaces when there are critical injuries or fatalities.

Worker's Rights

Workers in Ontario have three basic rights:

- **The right to know** what hazards are in the workplace (The employer has a duty to give that information to the health and safety representative.)
- **The right to participate** in keeping the workplace healthy and safe by joining a Health and Safety Committee or becoming a health and safety representative.
- **The right to refuse unsafe work** that the worker believes endangers his or her health or safety or the health or safety of others. (The procedures for refusal are described in section 43 (3) of the OHSA.)

Site Communication and Coordination

On many construction projects, workers from different companies may be working at the same time. As a result, the work of one company may affect the health and safety of workers from another company.

The Act gives overall authority for health and safety at a construction project to the constructor.

The constructor is the workplace party who:

- undertakes a project for an owner
- has the greatest degree of control over health and safety at the entire project
- is ultimately responsible for the health and safety of all workers
- must ensure that all the employers and workers on the project comply with the Act and its regulations.

Since the constructor is in the best position to coordinate work, they also have the best opportunity to coordinate health and safety.

Planning for health and safety should be done before the project starts and before each new phase. A lack of effective planning and communication about hazards in the workplace may put workers in danger.

It is important for the constructor to work with individual contractors to anticipate and identify the hazards that will be created and to ensure that necessary precautions are taken and explained to all workers. Employers and workers must work together to identify hazards and control them.

CHAPTER 2—Personal Protective Equipment

Personal protective equipment (PPE) is something that is used by all construction workers. It is designed to protect workers from physical dangers and/or health hazards.

Equipment such as hard hats, safety glasses, and safety boots are designed to prevent an injury or reduce the severity of an injury if one occurs. Other PPE (e.g., hearing and respiratory protection) is designed to prevent illnesses and damage to the worker's health.

It is important to remember that PPE only reduces the risk—it does not remove the hazard. The kind of PPE that is required depends on the individual, the job, and the site conditions. For the legal requirements for PPE, consult the relevant sections of the Regulations for Construction Projects (213/91).

The *Occupational Health and Safety Act* (OHSA) makes employers and supervisors responsible for ensuring that workers wear the PPE required by the OHSA. Workers, meanwhile, have a duty under the OHSA to wear or use the PPE required by the employer.

Section 21 of the Regulations for Construction Projects states that "a worker shall wear such protective clothing and use such personal protective equipment or devices as are necessary to protect the worker against the hazards to which the worker may be exposed." It also states that the worker must be trained in the use and care of this clothing, equipment, or device.

Regulations often refer to the Canadian Standards Association (CSA) or other equipment standards to indicate the type of equipment that is acceptable. CSA-certified equipment can be recognized by the CSA logo (Figure 1).

Figure 1: CSA Logo

There are CSA standards for different kinds of personal protective equipment such as these:

- Head Protection – CSA Z94.1-15
- Eye Protection – CSA Z94.3.1-09 and Z94.3-07
- Foot Protection – CSA Z195-14 and Z195.1-02

Many jurisdictions require that respiratory protection be approved by the National Institute for Occupational Safety and Health (NIOSH).

Eye Protection

Proper eye protection can greatly reduce the risk of an eye injury. Boilermakers may encounter a variety of eye hazards.

- **Flying Objects –** A piece of metal can pierce the cornea and eyeball and possibly cause the loss of an eye.
- **Dust –** Dust, sawdust, etc., can cause irritation resulting in a corneal ulcer, which is a breakdown of corneal tissue causing red, watery eyes or a discharge.
- **Heat –** Heat can burn and severely damage the eyes.
- **Splashed Acid –** Splashes of acid or other chemicals can burn the cornea, eyelid, and conjunctiva (the mucus membrane covering the front of the eye and the inside of the eyelids) and can cause blindness.
- **Abrasives –** Sand can cause a corneal abrasion, which can result in blindness.
- **Glare –** Glare can make it difficult to see and can cause extreme fatigue to the eye.
- **Radiation –** Ultraviolet (UV) light from a welding arc can damage the cornea.

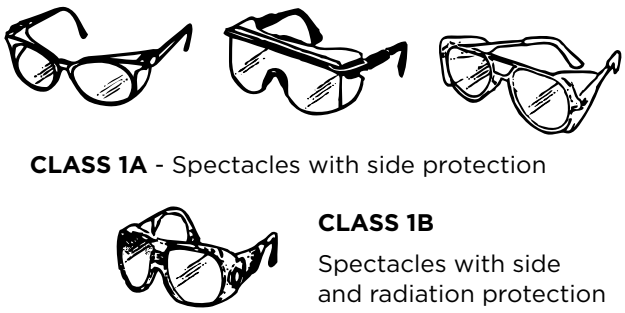
Choosing Eye Protection

When choosing eye protection, be sure it is properly fitted and is industrial quality. IHSA recommends that your safety glasses meet CSA Standard Z94.3 Class 1. Look for the CSA logo (Figure 1) and the manufacturer's ID mark on both the frame and the lens. These indicate that the safety glasses are industrial quality.

The following kinds of eye protection are available for different hazards.

Class 1 – Spectacles

Spectacles must have side shields. Spectacles are intended to prevent injury to the eyes from flying objects such as concrete and dust, and from glare or stray light (Figure 2).



CLASS 1A - Spectacles with side protection

CLASS 1B

Spectacles with side and radiation protection

Figure 2: Class 1 Spectacles

Class 2 – Goggles

Goggles come in vented and non-vented models. Vented models have small openings that allow air into the goggles to minimize fogging. However, these are not ideal for dust and splashes, which can get in through the openings. Non-vented and indirect-ventilated goggles are better at keeping out liquids and dusts.

Class 3 – Welding Helmets

Class 4 – Welding Hand Shields

Class 5 – Hoods

Class 6 – Face Shields

Class 7 – Respirator Facepieces

Care and Use

Like all equipment, eye protection must be cared for and inspected to make sure it works properly.

- Inspect the lenses regularly for pitting and scratches, which can make it difficult to see clearly.
- Repair scratched or pitted lenses and loose frames or arms as soon as possible or replace them with parts from the original manufacturer.
- Clean the lenses with clear water to remove abrasive dust. Cleaning lenses when they are dry can scratch the surface.
- Anti-fog solutions can be used on glass or plastic lenses.
- Handle frames with care and check daily for cracks and scratches.
- Never throw eye protectors into toolboxes, where they can be scratched or damaged.
- Cases should be provided. Use them to protect the lenses when you aren't using the spectacles.

Contact Lenses

Contact lenses are not a substitute for protective eyewear. If dust and dirt get behind a contact lens, it will cause discomfort and you will find it hard to see.

Contact lenses are also difficult to keep clean when they have to be removed or inserted since there are seldom suitable washing-up facilities on a jobsite.

It is recommended that contact lenses not be worn on construction sites. However, when they must be worn to correct an eye defect, the worker should get a written statement from an ophthalmologist or optometrist saying that the person needs to wear contact lenses in order to work safely. In these cases, eye protection, preferably goggles, must be worn with the contact lenses.

Head Protection

Requirements for head protection are specified in section 22 of the Regulation for Construction Projects (213/91).

Under this regulation, hard hats are mandatory for all construction workers on the job in Ontario. The hard hat must protect the wearer's head against impact and against small flying or falling objects, and it must be able to withstand an electrical contact equal to 20,000 volts phase to ground.

The Ministry of Labour considers the following classes of hard hats to be in compliance with the regulation.

CSA

- Z94.1-05: Class E, Type 1
- Z94.1-05: Class E, Type 2
- Z94.1-1992: Class E

ANSI

- ANSI Z89.1-2009: Class E, Type I
- ANSI Z89.1-2009: Class E, Type II
- ANSI Z89.1-2003: Class E, Type I
- ANSI Z89.1-2003: Class E, Type II

The Type and Class of hard hat can be found on the CSA or ANSI label. Some manufacturers also stamp the CSA or ANSI classification into the shell of the hat under the brim.

Class E Hard Hats

Class E hard hats come in three basic styles:

1. Standard design with a front brim, rain gutter, and attachment points for accessories such as hearing protection.
2. Standard design with front brim and attachment points for accessories, but without a rain gutter.
3. Full-brim design with attachment points for accessories and a brim that extends completely around the hat for greater protection from the sun.

You should normally wear your hard hat facing forward. A hard hat can be worn backwards only if

- it has a reverse orientation mark (Figure 3)
- it needs to be worn backwards because of the job, task, or work environment (e.g., wearing a face shield or welding helmet).

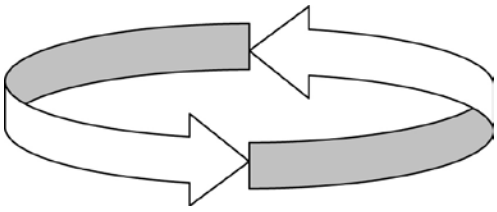


Figure 3: Reverse Orientation Marking

Care and Use

- Always consult the manufacturer's instructions for use and care.
- Inspect the shell, suspension, and liner every day before you use it. Look for cracks, dents, cuts, or gouges.
- If your hard hat is struck by an object, do not continue to use it.
- Don't store a hard hat in direct sunlight—it will age quicker and may become brittle.
- Regularly clean the shell, suspension, and liner with mild soap and water.
- Never alter your hard hat by painting it, making holes in it, etc.
- Don't carry things inside your hard hat.
- Don't wear a baseball cap under your hard hat.
- Check the service life of your hard hat by contacting the manufacturer or reading the manufacturer's instructions.

Foot Protection

Ankle injuries represent the majority of all foot injuries in construction. To help prevent those injuries, a CSA-certified Grade 1 workboot must be worn. This type of boot offers the highest protection and is the only one that meets the requirements of section 23 of the Regulation for Construction Projects (Figure 4).

Grade 1 Workboot

Grade 1 boots can be identified by

- a green triangular patch containing the CSA logo on the outside of the boot, and
- a green label indicating Grade 1 protection on the inside of the boot (Figure 4).

Grade 1 boots are also available with metatarsal and dielectric protection. A white label with the Greek letter omega in orange means that the boot protects against electric shock under dry conditions.

Figure 4:
Properly Laced Safety Boot with CSA Label

Hand Protection

In construction, exposed hands and skin are susceptible to physical, chemical, and radiation hazards. Hand and skin protection is often the only practical means of preventing injury from

- **Physical hazards** such as sharp or jagged edges on materials and vibration from tools
- **Chemical hazards** such as corrosive or toxic substances
- **Radiation hazards** such as ultraviolet (UV) light.

Physical Hazards

For physical hazards such as sharp edges, splinters, and heat, leather gloves are the best protection. Cotton or other materials do not stand up well and are recommended only for light-duty jobs.

Vibration from tools and equipment can damage the hands and arms. Workers who use vibrating tools such as jackhammers, grinders, riveters, and compactors every day may develop hand-arm vibration syndrome (HAVS).

Anti-vibration gloves are available from various suppliers. However, other measures may still be needed, such as limiting your exposure time, using lower-vibration tools, and maintaining your tools properly.

Chemical Hazards

For protection against chemical hazards, consult the material safety data sheet (MSDS) for the product you're using to see whether you need gloves and, if so, what they should be made of. An MSDS must be available for each controlled product being used on the site.

If the MSDS does not specify it, consult the manufacturer to find out if the type of glove you are using will provide adequate protection from the chemical hazard.

Radiation Hazards

Construction workers are particularly exposed to ultraviolet (UV) radiation because they often work outdoors. Sunlight is the main source of UV radiation, which can damage the skin and cause skin cancer.

Sun Protection

Although most construction workers usually cover up their arms, legs, and body on site, their faces and necks are still exposed to the sun's harmful rays. In addition, the tips of the ears and the lips are often overlooked when it comes to sun protection. The type of skin cancer that develops on the ear or the lip has a high chance of spreading to other parts of the body and causing death. Workers too often leave these critical areas exposed.

> **Remember:** Even on cloudy or hazy days, UV radiation can penetrate the atmosphere and burn your skin.

What Workers Can Do

- Apply a broad-spectrum sunscreen with a sun protection factor (SPF) of 30 or greater to all exposed skin. Be sure to cover your ears and the back of your neck. Apply sunscreen 20 to 30 minutes before you go out in the sun. Re-apply sunscreen every two hours.
- Use a sunscreen lip balm with an SPF of 30 or higher, and re-apply every two hours. Skin cancers can develop on lips.
- Wear clothing that covers as much of the skin as possible. Tightly woven material offers greater protection from UV rays.
- If you sweat heavily, you may need to re-apply sunscreen more often. In addition, wet clothing provides less protection from the sun's rays. Be sure you have additional dry clothing available.
- Wear UV-absorbent safety glasses (CSA-approved polycarbonate glasses have this feature).
- Try to find a shaded area for your breaks and lunch.
- Wear a wide-brimmed hard hat to protect your face and neck from the sun. Adding a glare guard under the peak of your hard hat will help reduce reflected UV rays (Figure 5).
- You can add UV protection to the back of your neck by using a fabric neck protector that clips onto your hard hat (Figure 5).

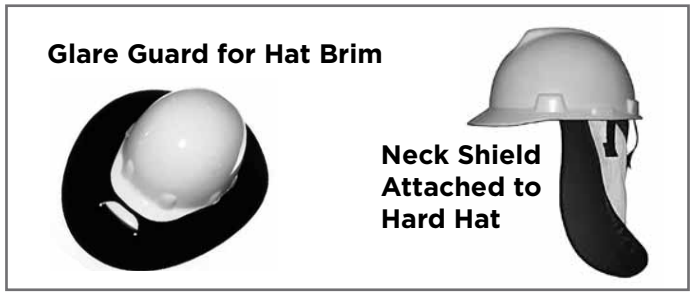


Figure 5: Hard Hat Sun Shields

High-Visibility Clothing

Sections 69.1 and 106 of the Regulation for Construction Projects (213/91) require that signallers and workers who may be endangered by vehicular traffic on a project wear a high-visibility garment.

There are two distinct features to high-visibility clothing.

1. Background Material

This is the fabric that the garment is made of. It must be fluorescent orange or bright orange, and it must make the wearer more visible in the daytime. Fluorescent orange is recommended because it is easier to see.

2. Retroreflective Stripes or Bands

The stripes or bands must be fluorescent and retroreflective. There must be two vertical stripes down the front of the garment and two forming an X on the back. The stripes must be yellow and 50 mm (2 in) wide. Retroreflective stripes make the worker visible both in low light and at night.

For nightime work, additional stripes or bands are required on the arms and legs. One way to meet this requirement is for workers to wear fluorescent orange coveralls with retroreflective bands or stripes (Figure 6).

Figure 6:
Boilermaker with coveralls and retroreflective bands that comply with CSA Z96-09 (2014)

Respiratory Protection

Construction workers are often exposed to respiratory hazards in the form of dangerous dusts, gases, fumes, mists, and vapours. When these hazards cannot be eliminated, controlled at their source (i.e., by ventilation), or along the path (i.e., by enclosures), respiratory protection is needed.

A wide variety of equipment can be used to protect workers from respiratory hazards. Most equipment can be divided into two classes:

1. **Air-purifying respirators**
2. **Supplied-air respirators.**

Air-Purifying Respirators

These devices purify the air drawn through them. There are two main types of air-purifying respirators:

1. **Non-powered** – Air is drawn through the air-purifying filter, cartridge, or canister when the wearer breathes in (Figure 7).
2. **Powered** – A fan forces air through the air-purifier and into the facepiece.

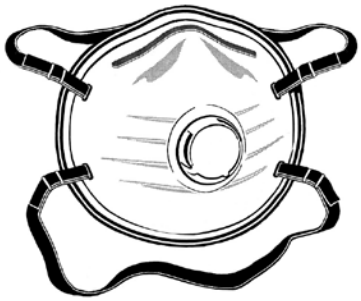


Figure 7:
Filtering Facepiece with Exhalation Valve

Air-purifying respirators have limitations and should not be used in the following situations:

- where there is too little oxygen (less than 19.5%)
- where there are very high concentrations of contaminants.

Although there are many kinds of filters for specific hazards, three basic types are used with air-purifying respirators:

1. **Particulate Filter** – This type removes solid particles such as dusts, fumes, or mists. When a particulate filter fills up with dust or fume, it becomes harder to breathe through but more efficient, since air is being filtered through the layer of particles as well. Particulate filters cannot filter out gases or vapours because the molecules are too small.

   Particulate filters for non-powered air-purifying respirators are divided into three levels of filter efficiency: 95%, 99%, and 99.97%. These numbers refer to the percentage of particles the filter can remove, based on the particle size most difficult to trap.

   Oil can ruin the filtering ability of some filter material. Therefore, particulate filters are also rated for their resistance to oil.

   Particulate filters have an N, R, or P rating:

   - **N** – **Not** resistant to oil
   - **R** – **Resistant** to oil
   - **P** – oil-**Proof**.

2. **Gas/Vapour Cartridge Filter** – This type uses substances that absorb or neutralize gases and vapours. Unlike particulate filters, gas and vapour cartridge filters become less efficient the longer they are used. The following are some common gas and vapour cartridge filters.

   - **Organic Vapour Cartridges** remove vapours such as toluene, xylene, and mineral spirits found in paints, adhesives, and cleaners.
   - **Acid Gas Cartridges** remove hydrogen chloride, sulphur dioxide, and chlorine.
   - **Ammonia Cartridges** remove ammonia gases.

   Some cartridges have an end-of-service-life indicator. This indicator changes colour to warn the user to change the cartridge. If the respirator does not have an indicator, a change-out schedule is needed to calculate when the cartridge needs to be replaced. Consult the respirator manufacturer for guidance on creating this schedule.

3. **Combination Particulate/Gas/Vapour Cartridge with Filter** – This type removes particulate matter, vapours, and gases from the air. It is used where more than one type of hazard may be present.

Supplied-Air Respirators

Supplied-air respirators provide clean breathing air from an uncontaminated source, usually a special compressor located in a clean environment, or from cylinders containing compressed breathing air. There are three basic types:

1. **Airline Unit** – relies on a hose connecting the respirator to cylinders of compressed breathing air. An abrasive blasting supplied-air hood is one example (Figure 8).

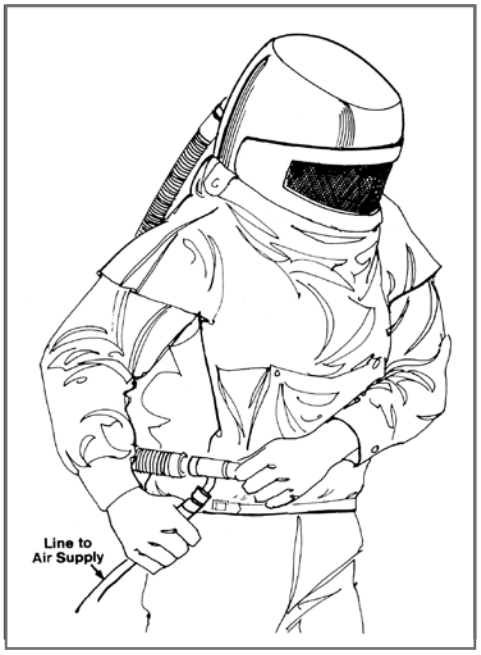


Figure 8:
Abrasive Blasting Supplied-Air Hood

2. **Ambient Air Blower** – draws air through an inlet hose (positioned where the air is clean) and pumps the air under fairly low pressure to the worker's hood, helmet, or facepiece. A powered air-purifying respirator (PAPR) is one example. It provides more comfort when working conditions are hot and humid. However, it cannot be used under oxygen-deficient conditions (Figure 9).

3. **Self-contained Breathing Apparatus (SCBA)** – uses a cylinder of air carried by the wearer. SCBAs are awkward and heavy, and they require frequent cylinder changes.

   Combination airline/SCBA units are available for use in confined spaces and other high-risk work where reserve protection is required. If an atmosphere is immediately dangerous to life or health, a combination airline/SCBA unit must be used (Figure 10).

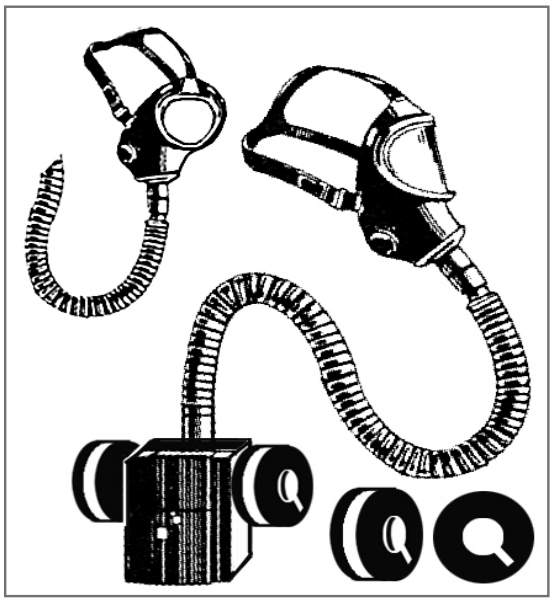
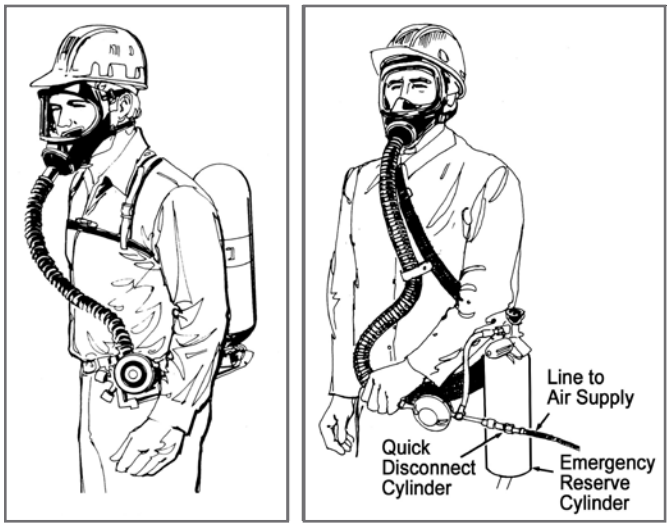


Figure 9:
Powered Air-Purifying Respirator (PAPR)



Self-Contained Breathing Apparatus (SCBA)

Combination Airline/SCBA Unit

Figure 10: Examples of Self-Contained Breathing Apparatus (SCBA)

Modes of Operation

Respirators can operate in the following modes:

1. **Negative Pressure (Demand) Mode** – Air is delivered only when the wearer inhales. Pressure inside the facepiece is lower than pressure outside the facepiece, allowing air to pass through the filters or activating a valve that allows air into the facepiece. They have limited use in high-exposure conditions because contaminated air can leak inward around the facepiece.
2. **Constant-Flow Mode** – A constant flow of air is delivered to the wearer. Sandblasting hoods use a simple valve to control the flow of "clean" air from the compressor (Figure 8). PAPRs use a battery-powered fan to draw air through the filter and then blow it into the facepiece (Figure 9). Minimum flow rates must be maintained to minimize inward leakage of contaminated air and still provide adequate breathing air.
3. **Positive Pressure (Pressure-Demand) Mode** – In addition to supplying additional air on demand, thiis mode maintains positive pressure inside the facepiece at all times. If leakage occurs, the high pressure inside the facepiece directs it away from the facepiece rather than allowing it in.

Fit Testing and Seal Checks

Once a respirator has been selected, it is important to make sure that it fits properly. The only way to do that is to have the respirator wearer fit-tested while it's being worn. Fit tests can either be qualitative or quantitative.

Qualitative Fit Tests

1. **Irritant Smoke Test** – This tests the fit of a P100 particulate filter respirator. A cloud of irritant smoke is created around the wearer. If leakage is detected the respirator should be adjusted.
2. **Iso Amyl Acetate (Banana Oil) Test** – The wearer puts on a respirator that has "organic vapour" cartridge filters. A cotton swab dipped in an iso amyl acetate solution, which smells like very ripe bananas, is passed along the outline of the facepiece. If the wearer smells the solution, the respirator should be adjusted.
3. **Saccharin Test** – Similar to the iso amyl acetate test except that it uses saccharin as the test material and a respirator equipped with a particulate filter. If the sweet taste or smell of saccharin is detected, the fit must be adjusted.
4. **Bitrex Solution Aerosol Test** – The wearer puts on the respirator with any particulate filter. A hood or test enclosure is put over the wearer's head and shoulders. Bitrex, which is a very bitter solution, is then sprayed into the hood or enclosure. If the wearer cannot taste the Bitrex, then the respirator fits properly.

Qualitative Fit Tests

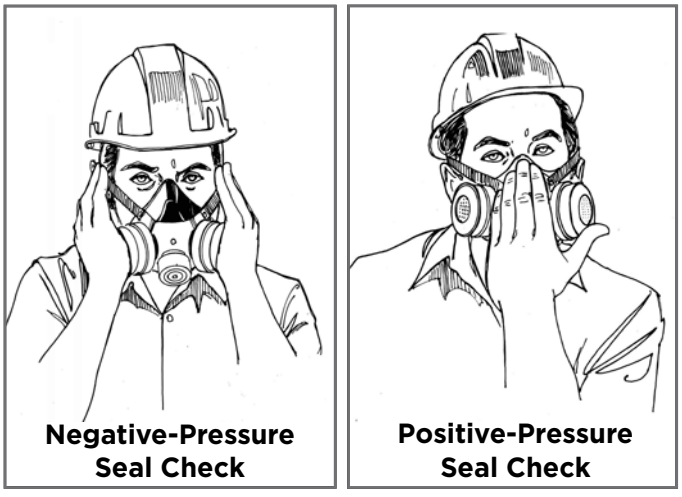
In these tests, the wearer puts on a special respirator that has a probe mounted inside the facepiece. There are three ways to determine an adequate fit:

1. By comparing the amount of test aerosol outside the respirator to the amount inside the respirator
2. By comparing the amount of ambient aerosol outside of the respirator to the amount inside the respirator
3. By measuring the amount of pressure that leaks from the respirator.

User Seal Checks

Every time you put on a respirator, check the seal using the negative-pressure and positive-pressure method.

1. **Negative-Pressure Seal Check** — The wearer puts on the respirator and adjusts it so that it feels fairly comfortable. Then the air inlets are blocked with the hands or a plastic cover, and the wearer inhales gently and holds his breath for five seconds. If the respirator is properly fitted, it should collapse slightly and not permit any air into the facepiece. If leakage is detected, the mask should be readjusted and the test repeated until the fit is satisfactory (Figure 11).
2. **Positive-Pressure Seal Check** — The wearer puts on the respirator and adjusts it so that it feels fairly comfortable. Then the exhaust port of the respirator is covered and the wearer tries to exhale gently. The facepiece should puff away from the wearer, but there should be no leakage (Figure 11).



Negative-Pressure Seal Check | **Positive-Pressure Seal Check**

Figure 11: User Seal Checks

Respirator Maintenance

Like any equipment, respirators require maintenance. The following instructions cover the major points.

1. **Change filters and cartridges** as follows:
   a. **Dust/mist/fume filters** should be changed when there is noticeable resistance to normal breathing.
   b. **Chemical cartridges** should be replaced when warned by the end-of-service-life indicator or according to the replacement schedule.
   c. **Any filter** should be changed at the frequency specified by the manufacturer or when damaged in any way.
2. **Check inhalation and exhalation valves** before the respirator is used.
3. **Replace damaged facepieces, straps, filters, valves**, or **other parts** with parts from the equipment manufacturer.
4. **Wash facepieces** with mild soapy water as often as necessary to keep them clean and wearable.
5. **Assign respirators** to the exclusive use of an individual worker, if possible.
6. **Disinfect a respirator after each use** if it has been assigned to more than one worker. Consult the manufacturer about acceptable sanitizers or disinfectants.
7. **Check all supply hoses, valves, and regulators** on supplied-air respirators as specified by the manufacturer.
8. **Use and maintain SCBA units and high-pressure cylinders of compressed breathing air** in accordance with current CSA Standards Z180.1-13 *Compressed Breathing Air and Systems*, and Z94.4-11 *Selection, Care and Use of Respirators.*
9. **Maintain compressors and filtration systems** used with supplied-air respirators in accordance with the manufacturer's instructions.
10. **Consult the manufacturer** for information on replacing respirator cartridges.

IHSA recommends that only NIOSH-approved equipment be used for protection against respiratory hazards.

Respirator Selection Guide for Common Construction Activities

	Air purifying										Supplied air	
	Half facepiece							Full facepiece		Powered Air-Purifying Respirator (PAPR), tight-fitting	Hood or Helmet NIOSH type CE pressure demand Half-facepiece pressure demand	SCBA or SCBA + airline, full facepiece and positive pressure
	Filtering facepiece		Elastomeric facepiece									
												
Filter efficiency and type	95	100	95	100	Organic vapour	95+ organic vapour	100+ organic vapour	95	100	100+ organic vapour	HEPA		
Assigned Protection Factor* (NIOSH 1987)	10	10	10	10	10	10	10	10	50	50	50	1000	10,000
Lead													
Application of lead-containing coatings with a brush or roller			Optional ✔ N, R, or P										
Spray application of lead-containing coatings											✔ Hood or helmet		
Removal of lead-containing coatings or materials by scraping or sanding using non-powered hand tools			✔ N, R, or P										
Removal of lead-containing coatings or materials using non-powered hand tools—other than manual scraping or sanding			Optional ✔ N, R, or P										
Removal of lead-containing coatings with a chemical gel or paste and fibrous laminated cloth wrap			Optional ✔ N, R, or P										
Removal of lead-containing coatings or materials using a power tool *without* a dust collection system equipped with a HEPA filter (airborne dust ≥ 0.05 mg/m³)											✔ Full facepiece		

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N = Not resistant to oil **R** = Oil-resistant **P** = Oil-proof **OV** = Organic vapour cartridge

✔ indicates suitable protection. If oil mist is present, use R or P filters.

* Assigned protection factor: The protection factor assigned by NIOSH, the US National Institute for Occupational Safety and Health. It's a measure of the effectiveness of a type of respirator and suitable filter. Higher numbers mean greater protection. You may use a respirator with a greater protection factor than the one recommended for your task. Never use a respirator with a smaller protection factor.

These recommendations will provide adequate protection in most circumstances. Factors such as ventilation, duration of exposure, and user characteristics can affect how well a respirator protects you. If unsure about the respirator required for a task, contact the manufacturer or IHSA at 1-800-263-5024, www.ihsa.ca.

Respirator Selection Guide for Common Construction Activities

	Air purifying										Supplied air	
	Half facepiece						Full facepiece		Powered Air-Purifying Respirator (PAPR), tight-fitting		Hood or Helmet NIOSH type CE pressure demand Half facepiece pressure demand	SCBA or SCBA + airline, full facepiece and positive pressure
	Filtering facepiece		Elastomeric facepiece									
Filter efficiency and type	95	100	95	100	Organic vapour	95+ organic vapour	100+ organic vapour	95	100	100+ organic vapour	HEPA		
Assigned Protection Factor* (NIOSH 1987)	10	10	10	10	10	10	10	10	50	50	50	1000	10,000
Lead cont'd													
Removal of lead-containing coatings or materials using a power tool *with* a dust collection system equipped with a HEPA filter (airborne dust must be controlled to <0.05 mg/m^3)			Optional ✔ N, R, or P										
Abrasive blasting of lead-containing coatings or materials												✔ Type CE blasting; positive pressure; tight-fitting half facepiece	
Dry removal of lead-containing mortar using an electric or pneumatic cutting device											✔ Tight-fitting full facepiece		
Welding or high-temperature cutting of lead-containing coatings or materials indoors or in a confined space											✔ Tight-fitting full facepiece		
Welding or high-temperature cutting of lead-containing coatings or materials outdoors—long-term operations or if material not pre-stripped											✔ Tight-fitting full facepiece		
Welding or high-temperature cutting of previously stripped lead-containing coatings or materials outdoors—short-term only			✔ N, R, or P										
Burning of a surface containing lead											✔ Tight-fitting full facepiece		
Soldering			Optional ✔ N, R, or P										
Installation or removal of lead-containing sheet metal			Optional ✔ N, R, or P										
Installation or removal of lead-containing packing, babbit, or similar material			Optional ✔ N, R, or P										

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Respirator Selection Guide for Common Construction Activities

	Air purifying										Supplied air	
	Half facepiece						Full facepiece	Powered Air-Purifying Respirator (PAPR), tight-fitting	Hood or Helmet NIOSH type CE pressure demand Half facepiece pressure demand	SCBA or SCBA + airline, full facepiece and positive pressure
	Filtering facepiece		Elastomeric facepiece							
										
Filter efficiency and type	95	100	95	100	Organic vapour	95+ organic vapour	100+ organic vapour	95	100	100+ organic vapour	HEPA		
Assigned Protection Factor* (NIOSH 1987)	10	10	10	10	10	10	10	10	50	50	50	1000	10,000

Lead cont'd													
Demolition or cleanup of a facility where lead-containing products were manufactured											✔ Tight-fitting full facepiece		
Manual demolition of lead-painted plaster walls or building components using a sledgehammer or similar tool		✔ N, R, or P											
Removal of lead-containing dust using an air-mist extraction system												✔ Pressure demand; full facepiece	
Removal or repair of a ventilation system used for controlling lead exposure											✔ Tight-fitting full facepiece		
An operation that may expose a worker to lead dust, fume, or mist, that is not a Type 1, Type 2, or Type 3 operation											✔ Tight-fitting full facepiece		

Painting													
Spraying latex paint	✔ N, R, or P (small-scale)		✔ N, R, or P (small-scale)			✔ N, R, or P (large-scale)							
Alkyds, enamels, and sealers: brush and roller application indoors but well-ventilated					✔ R or P								
Alkyds and enamels: spray painting in well-ventilated area						✔ R or P							
Alkyds and enamels: painting in a confined space													✔
Epoxy or polyurethane spray painting												✔	
Spraying lead paint										✔ N, R, or P	✔		
Spraying stucco						✔ R or P							

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Respirator Selection Guide for Common Construction Activities

	Air purifying											Supplied air	
	Half facepiece							Full facepiece		Powered Air-Purifying Respirator (PAPR), tight-fitting		Hood or Helmet NIOSH type CE pressure demand Half facepiece pressure demand	SCBA or SCBA + airline, full facepiece and positive pressure
	Filtering facepiece		Elastomeric facepiece										
Filter efficiency and type	95	100	95	100	Organic vapour	95+ organic vapour	100+ organic vapour	95	100	100+ organic vapour	HEPA		
Assigned Protection Factor* (NIOSH 1987)	10	10	10	10	10	10	10	10	50	50	50	1000	10,000
Roofing													
Removal of roofing material (built-up roofing, no asbestos)	✔ R or P		✔ R or P					✔ R or P					
Heat welding roofing membrane	✔ N, R, or P		✔ N, R, or P										
Adhesive welding roofing membrane					✔ N, R, or P								
Roofing kettle operators (asphalt)										✔ N, R, or P	✔ +OV		
Silica													
Breaking concrete outdoors	✔ N, R, or P		✔ N, R, or P									✔	
Crushing rock and gravel			✔ N, R, or P	✔ N, R, or P									
Blasting rock			✔ N, R, or P	✔ N, R, or P									
Abrasive blasting—either ≥ 1% silica in the abrasive blasting media or ≥ 1% silica in the target material being blasted													
Drywall sanding	For short-term applications, a filtering facepiece respirator may be appropriate		✔ N, R, or P	✔ N, R, or P									
Machine mixing concrete or mortar			✔ N, R, or P	✔ N, R, or P									
Drilling holes in concrete or rock that is not part of a tunnelling operation or road construction			✔ N, R, or P	✔ N, R, or P									
Milling of asphalt from concrete highway pavement			✔ N, R, or P	✔ N, R, or P									
Charging mixers and hoppers with silica sand (sand consisting of at least 95% silica) or silica flour (finely ground sand consisting of at least 95% silica)			✔ N, R, or P	✔ N, R, or P									
Any other operation at a project that requires the handling of silica-containing material in a way that a worker may be exposed to airborne silica			✔ N, R, or P	✔ N, R, or P									

Continued on next page . . .

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Respirator Selection Guide for Common Construction Activities

	Air purifying										Supplied air	
	Half facepiece						Full facepiece			Powered Air-Purifying Respirator (PAPR), tight-fitting	Hood or Helmet NIOSH type CE pressure demand Half facepiece pressure demand	SCBA or SCBA + airline, full facepiece and positive pressure
	Filtering facepiece		Elastomeric facepiece									
Filter efficiency and type	95	100	95	100	Organic vapour	95+ organic vapour	100+ organic vapour	95	100	100+ organic vapour	HEPA		
Assigned Protection Factor* (NIOSH 1987)	10	10	10	10	10	10	10	10	50	50	50	1000	10,000

Silica cont'd												
Entry—for less than 15 minutes—into a dry mortar-removal or abrasive-blasting area for inspection or sampling where airborne dust is visible	For short-term applications, a filtering facepiece respirator may be appropriate	✔ N, R, or P	✔ N, R, or P									
Entry into an area where abrasive blasting is being carried out for more than 15 minutes	For short-term applications or applications involving tools or equipment with adequate controls (local exhaust ventilation or water), a half-facepiece respirator may be appropriate							✔ N, R, or P		✔		
Dry method dust clean-up from abrasive blasting operations								✔ N, R, or P		✔		
Removal of silica-containing refractory materials with a jackhammer								✔ N, R, or P		✔		
Drilling holes in concrete or rock as part of a tunnelling operation or road construction								✔ N, R, or P		✔		
Using a power tool to cut, grind, or polish concrete, masonry, terrazzo, or refractory materials								✔ N, R, or P		✔		
Using a power tool to remove silica-containing materials								✔ N, R, or P		✔		
Using a power tool indoors to chip or break and remove concrete, masonry, stone, terrazzo, or refractory materials								✔ N, R, or P		✔		
Tunnelling (operation of tunnel boring machine, tunnel drilling, tunnel mesh insulation)								✔ N, R, or P		✔		
Tuckpointing and surface grinding								✔ N, R, or P		✔		
Dry-mortar removal with an electric or pneumatic cutting device								✔ N, R, or P		✔		
Using compressed air outdoors to remove silica dust								✔ N, R, or P		✔		

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Respirator Selection Guide for Common Construction Activities

	Air purifying											Supplied air	
	Half facepiece							Full facepiece			Powered Air-Purifying Respirator (PAPR), tight-fitting	Hood or Helmet NIOSH type CE pressure demand Half facepiece pressure demand	SCBA or SCBA + airline, full facepiece and positive pressure
	Filtering facepiece		Elastomeric facepiece										
Filter efficiency and type	95	100	95	100	Organic vapour	95+ organic vapour	100+ organic vapour	95	100	100+ organic vapour	HEPA		
Assigned Protection Factor* (NIOSH 1987)	10	10	10	10	10	10	10	10	50	50	50	1000	10,000

Synthetic Vitreous Fibres (Man-made mineral fibres)													
Installation, removal, or blowing cellulose, fiberglass, mineral wool, or calcium silicate	✔ N, R, or P	✔ N, R, or P	✔ N, R, or P	✔ N, R, or P									
Installation of refractory ceramic fibres (silica may be present)				✔ N, R, or P									
Removal of refractory ceramic fibres (silica may be present)									✔ N, R, or P		✔		

Other dust and fibre exposure													
Removal of roofing material (built-up roofing, no asbestos)	✔ R or P		✔ R or P					✔ R or P					
Dry method dust clean-up from abrasive blasting operations	For short-term applications or applications involving tools or equipment with adequate controls (local exhaust ventilation or water) a half-facepiece respirator may be appropriate.								✔ N, R, or P		✔		
Wood dust, including pressure-treated wood dust	✔ N, R, or P		✔ N, R, or P										
Vinyl or laminate floor sanding	✔ N, R, or P		✔ N, R, or P										

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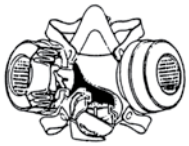
Respirator Selection Guide for Common Construction Activities

	Air purifying										Supplied air	
	Half facepiece						Full facepiece	Powered Air-Purifying Respirator (PAPR), tight-fitting	Hood or Helmet NIOSH type CE pressure demand Half facepiece pressure demand	SCBA or SCBA + airline, full facepiece and positive pressure
	Filtering facepiece		Elastomeric facepiece							
										
Filter efficiency and type	95	100	95	100	Organic vapour	95+ organic vapour	100+ organic vapour	95	100	100+ organic vapour	HEPA		
Assigned Protection Factor* (NIOSH 1987)	10	10	10	10	10	10	10	10	50	50	50	1000	10,000
Welding and flame-cutting													
Any welding in confined spaces when the atmosphere is not monitored													✔
Aluminum**	✔ N, R, or P		✔ N, R, or P										
Mild steel	✔ N, R, or P		✔ N, R, or P										
Stainless steel	✔ N, R, or P		✔ N, R, or P										
Galvanized or plated metals	✔ N, R, or P		✔ N, R, or P										
Lead-painted steel: flame cutting or welding, short-term, not repeated, material stripped before work			✔ N, R, or P	✔ N, R, or P									
Welding or high-temperature cutting of lead-containing coatings or materials indoors or in a confined space									✔ N, R, or P		✔	✔	
Miscellaneous													
Epoxy adhesive (large-scale use)												✔	
Solvents, adhesives, and epoxy (small scale)					✔ R or P								
Caulking compounds, solvent-based, large-scale use					✔ R or P								
Form oil spraying						✔ R or P							
Paving						✔ R or P							

** Protection from ozone may be required in some circumstances. Contact the respirator manufacturer.

N = Not resistant to oil **R** = Oil-resistant **P** = Oil-proof **OV** = Organic vapour cartridge

CHAPTER 3—Fall Prevention

Section 26 of the Regulation for Construction Projects (213/91) sets out minimum requirements for fall protection. In addition, new training requirements came into effect with the Occupational Health and Safety Awareness and Training regulation (287/13).

This manual provides practical compliance information on fall protection for workers and contractors in the boilermaker trade. However, since each workplace is unique and can pose hazards not covered here, consult the regulations to make sure additional precautions are not required.

Definitions and Terminology

The following definitions are from section 1 of the Regulation for Construction Projects (213/91), as amended.

"Competent worker", in relation to specific work, means a worker who,

(a) is qualified because of knowledge, training and experience to perform the work,

(b) is familiar with the *Occupational Health and Safety Act* and with the provisions of the regulations that apply to the work, and

(c) has knowledge of all potential or actual danger to health or safety in the work.

"Fall arrest system" means an assembly of components joined together so that when the assembly is connected to a fixed support, it is capable of arresting a worker's fall.

"Fall restricting system" means a type of fall arrest system that has been designed to limit a worker's fall to a specified distance.

"Fixed support" means a permanent or temporary structure or a component of such a structure that can withstand all loads and forces the structure or component is intended to support or resist and is sufficient to protect a worker's health and safety, and includes equipment or devices that are securely fastened to the structure or component.

"Full-body harness" means a device that can arrest an accidental vertical or near vertical fall of a worker and which can guide and distribute the impact forces of the fall by means of leg and shoulder strap supports and an upper dorsal suspension assembly which, after the arrest, will not by itself permit the release or further lowering of the worker.

"Professional engineer" means a person who is a professional engineer within the meaning of the *Professional Engineers Act.*

"Safety net" means a safety net that complies with section 26.8 of the regulation, and is located and supported in such a way that it arrests the fall of a worker who may fall into it without endangering the worker.

"Suitable", in relation to a procedure, material, device, object or thing, means sufficient to protect a worker from damage to the worker's body or health.

"Travel restraint system" means an assembly of components capable of restricting a worker's movement on a work surface and preventing the worker from reaching a location from which he or she could fall.

Fall Protection Procedures and Equipment

Fall protection systems must be provided where a worker is exposed to any of the following:

- falling more than 3 m (10 ft)
- falling more than 1.2 m (4 ft) if the work area is used as a path for a wheelbarrow or similar equipment
- falling into operating machinery
- falling into water or another liquid
- falling into or onto a hazardous substance or object
- falling though an opening on a work surface.

Fall Prevention Systems

Fall prevention systems are devices or equipment that minimize or eliminate the possibility of an accidental fall by a worker while they are performing various activities.

These systems are different from a *fall arrest systems.* A *fall prevention* system prevents a worker from falling; a *fall arrest* system is designed to arrest the fall of a worker who is already falling. The fall prevention system uses such devices as guardrails, covers over floor and roof openings, and travel restraint systems.

Adequate fall prevention for boilermaker work must be planned in advance. Ideally, the planning should take place at the design stage. In many cases, anchors and other parts of a fall prevention system can be done at the fabrication stage, before the equipment arrives on the project site.

First and foremost, the aim in fall prevention planning is to protect a worker so he or she cannot fall. Usually, the first line of defence against a fall is to install guardrails. The next line of defence is the use of travel restraint. Guardrails and travel restraint systems are the preferred means of fall prevention because they both prevent the worker from actually falling. When that is not practical, a fall arrest system is used to protect a worker who is exposed to a fall.

The kind of fall prevention equipment chosen may depend on the kind of work being done. For instance, welding and cutting operations may demand flame-resistant lifelines, harnesses, and lanyards or the use of a metal or wire rope guardrail rather than wood. When fall prevention equipment and devices are being chosen, be sure to take the kind of work and the environment into account.

Regardless of type, every fall prevention system used in Ontario construction must comply with the *Occupational Health and Safety Act*, the Regulation for Construction Projects (213/91), and any applicable standards designated as National Standards of Canada.

Any worker who has to use a fall protection system must be trained in its safe use. The training should be for the specific application for which it will be used. A record of that training must be kept.

Access Systems

In many cases, fall hazards can be minimized by providing proper access to structures or equipment.

Wherever possible, permanent stairs, catwalks, ladders, and landings should be erected along with the tank, vessel, or structure to provide safe and convenient access for fitting, welding, and other work.

Guardrails, ladder cages or ladder climbing safety devices, and other similar equipment must be installed completely before being used.

The access locations should be arranged to minimize travel while aloft. If a worker must travel aloft at a height greater than 3 m (10 ft) and if fall prevention systems cannot be provided, a fall arrest system must be used.

Portable extension ladders must be in good condition, must extend at least 1 m above a landing or platform area, and must be secured at a slope of 4 to 1. For example, for every 1 ft out, the ladder should be no higher than 4 ft.

A scaffold platform or other work platform made of sawn lumber planks must have planks of number 1 grade spruce or better, and be so identified. The planks must not have any defect affecting their load-carrying capacity.

- Planks used for platforms or side bracket scaffolds must be full-sized 48 mm x 248 mm (2 in x 10 in).
- The span for these planks must not exceed 2.1 m (7 ft).
- Planks must overhang their supports by at least 150 mm (6 in) but not more than 300 mm (12 in).
- Planks must be cleated or otherwise secured against slipping.

Planks should be inspected before use. Any material in poor condition should be discarded.

Guardrail Systems

Guardrails must be installed no farther than 300 mm (12 in) from an edge (Figure 12).

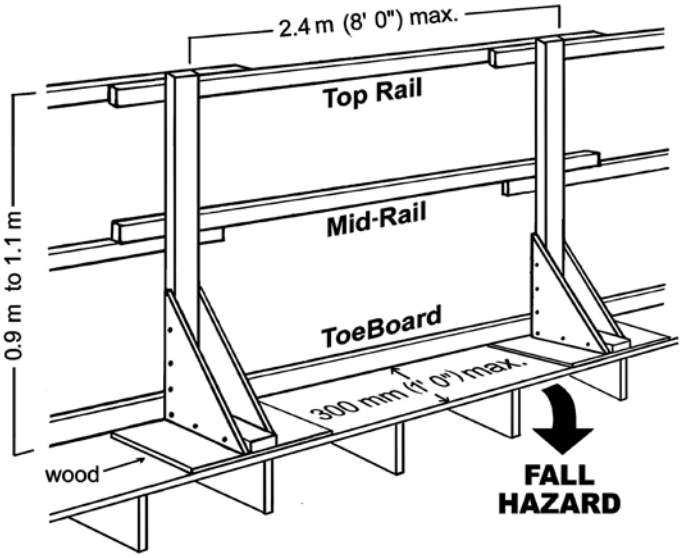


Figure 12: Typical Dimensions for Guardrails

Guardrails must be capable of resisting the following loads. These loads are applied separately anywhere along the length and must not exceed the allowable unit stress for each material used.

- a point load of 675 newtons (150 lb) applied laterally to the top rail
- a point load of 450 newtons (100 lb) applied to the top rail in a vertical downward direction
- a point load of 450 newtons (100 lb) applied to the mid-rail in a lateral or vertical downward direction
- a point load of 225 newtons (50 lb) applied laterally to the toeboard.

Note: If a guardrail system that is made of wood is constructed and installed so that it is capable of resisting all loads that it may be subjected to by a worker, the requirements above do not apply.

Wood Guardrails

Basic requirements for wood guardrails are the following:

- Top rail, mid-rail, and toeboard must be secured to vertical supports.
- The top rail must be between .9 m (3 ft) and 1.1 m (3 ft 7 in) high.
- The toeboard must be at least 89 mm (3½ in) high (100 mm or 4 in if the material is other than wood) and installed flush with the surface.
- The posts must be at least 38 mm (1½ in) by 89 mm (3½ in) and no more than 2.4 m (8 ft) apart.

For maximum resistance to lateral force, the top rail of a wood guardrail system should be laid flat (with the larger dimension horizontal). It must be fastened securely to the top of each post so that the rails cannot be pulled off the posts.

To strengthen the guardrails, reduce the spacing of the posts and double the thickness of the top rail.

Temporary Removal

It is often necessary to remove a section of guardrail in order to land and unload material or equipment.

Before removing the guardrail, workers in the area must tie off with a travel restraint or fall arrest system.

The area should be cordoned off with caution tape or a bump line at least 2 m (6 ft 6 in) from either side of the opening and from the edge of the work surface. Warning signs should also be posted.

If guardrail posts need to be removed temporarily, they should be unfastened from the deck with proper tools, not pried or pulled off. They should then be placed safely out of the way.

When it is time to replace a section of guardrail, a competent worker using the specified type and number of fasteners and the proper tools should install new posts according to the original design requirements.

Travel Restraint Systems

A travel restraint system is a system of fall protection components that allows a worker to travel just far enough to reach the edge but not far enough to fall over (Figure 13).

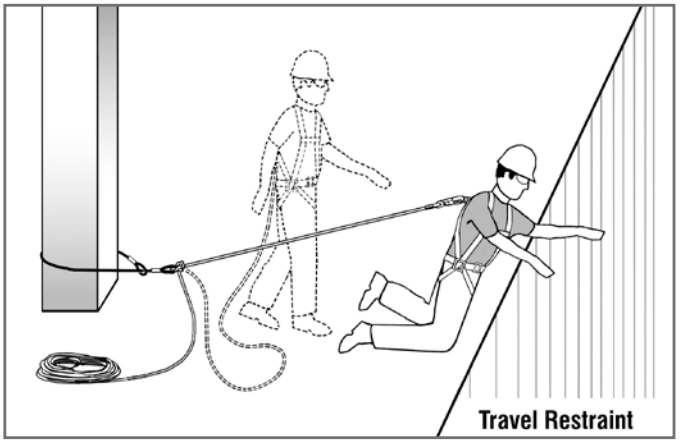


Figure 13: Travel Restraint System

A self-retractable lifeline may also be used instead of a static vertical rope lifeline.

A basic travel restraint system consists of

- CSA-approved full-body harness
- lanyard
- lifeline
- rope grab to attach harness or lanyard to lifeline
- adequate anchorage (capable of supporting a static load of 2 kilonewtons, or 450 lb, with a recommended safety factor of at least 2, that is, 4 kilonewtons, or 900 lb).

Travel restraint arrangements must be planned thoroughly, with careful consideration to

- choice of appropriate components
- location of adequate anchor points
- identification of every fall hazard in the proposed work area.

Try to choose an anchor point that is perpendicular to the unprotected edge and at the centre of the work area.

All fall hazards in the work area must be identified. Pay special attention to work areas that have floor openings or irregular perimeters, or that are near corners. A fully extended lifeline and/or lanyard that restrains a worker adequately from a fall hazard in one section of the work area may be too long to provide the same protection in other, adjacent sections of the work area.

Points where the system cannot provide travel restraint should be blocked off by bump lines or warning barriers, or guardrails should be left in place. Protective barriers can be removed once the anchorage is adjusted to provide travel restraint at these points.

Types of Travel Restraint

The following two methods of travel restraint are commonly used in construction.

1. Connecting a securely anchored lifeline directly to the D-ring of the worker's full-body harness. The lifeline **must** be short enough to restrain the worker from any fall hazard.

2. Connecting a lanyard from the D-ring of the worker's full-body harness to a rope grab that can travel on a securely anchored lifeline. There must be some means—such as a knot in the lifeline—to prevent the rope grab from sliding off the lifeline.

Fall Arrest Systems

A fall arrest system typically consists of a CSA-approved full-body harness connected to an energy-absorbing lanyard that is attached to an anchor, either directly or through a lifeline (Figure 14).

Figure 14: Parts of a Fall Arrest System

The fall arrest system must be attached to a fixed support. The system must not subject the worker to a peak fall arrest force greater than 8 kilonewtons.

A competent worker must inspect fall protection equipment for damage, wear, and obvious defects before each use.

- Stitching should show no signs of unravelling.
- Webbing should be free of burn holes, abrading, and discoloration.
- Grommets should show no signs of loosening or separating from webbing.
- Buckles and D-rings should show no signs of wear, bending, or cracks.
- Lifelines should be free of fraying, discoloration, cuts, and flaking fibres.

For some activities, where work will be done in the same area for long periods of time, safety nets may be a practical method of fall protection. Such activities include work on the interior and exterior of stacks, on expansion joints in ductwork or breeching, and on the inside of large boilers.

Vertical Lifelines

Vertical lifelines are usually made of synthetic rope that is 16-mm (5/8-in) in diameter or larger. If there is a possibility of damage (e.g., from welding or cutting operations), a wire rope may be used. A rope grab must be designed for the lifeline material, that is, sized correctly for the diameter and designed for either rope or wire. Vertical lifelines and associated equipment must comply with the applicable CSA standard.

A self-retracting lifeline (SRL) may also be used instead of a vertical lifeline. This device has a wire or synthetic rope and a clutch assembly designed to arrest the fall of a worker. A locking mechanism lets the line unwind off the drum under slight tension, but it locks up when a quick movement, such as that caused by a fall, is applied (Figure 15).

Only one person at a time should be attached to a vertical lifeline.

Horizontal Lifelines

A horizontal lifeline must be designed by a professional engineer. The design must clearly indicate anchor points, specify all required components, state the number of workers that can be safely attached to each line, spell out instructions for installation, inspection, and maintenance, and specify all the design loads.

The system must be inspected before each use by the engineer or a competent worker designated by a supervisor.

A horizontal lifeline normally consists of a wire rope held snugly but not tightly between fixed points with intermediate control points for wide spans. The design may be a standard design or specifically engineered for the site. A complete and current copy of the design must be kept on site as long as the system is in use.

Rescue Procedures

The Regulation for Construction Projects (213/91) requires that before workers use any fall arrest system on a project, the employer must develop written rescue procedures. Plans should cover the on-site equipment, personnel, and procedures for different types of rescue. Any off-site rescue services that might be required should be contacted in advance and arrangements made to familiarize them with the project.

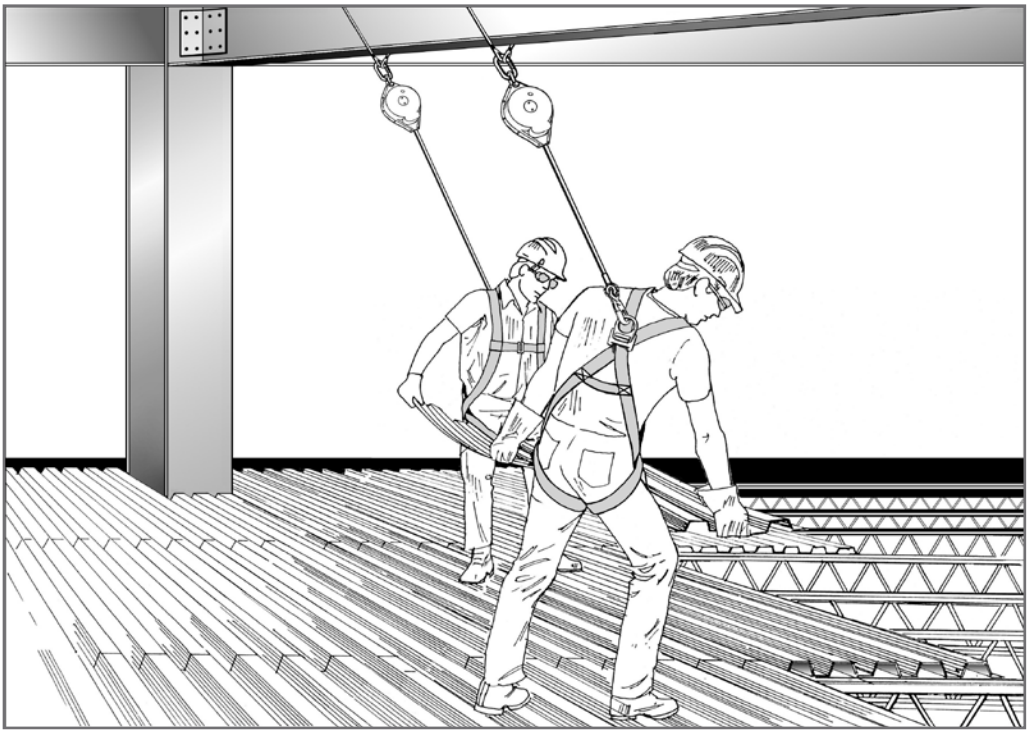


Figure 15: Self-Retracting Lifeline

Falling Objects

When working below other work areas or working at heights, there is a possibility that objects from above, such as tools, debris, or equipment, could fall to lower levels. This can cause serious injury and even death for those working below. The best way to prevent these types of injuries is to develop and implement procedural and physical controls.

Procedural Controls

Procedural controls involve changing the way you work so that objects can't fall.

- Develop a plan to control or prevent situations where objects may fall from overhead.
- Conduct a Job Safety Analysis (JSA) to identify and control hazards from working overhead.
- Post warning signs at all points of access to the area below any overhead hazards.
- When lifting, make sure the load is balanced and secured. Check for small or loose pieces before you lift. If placing a load on a scaffold or platform, make sure the work area has properly built guardrails.
- Always use proper hoisting and rigging procedures. Never lift, lower, or swing a load over anyone's head. Use barricades to block off areas where loads are being lifted or lowered. Use a signaller if the operator's view is impeded in any way. Make sure the equipment is in good condition.
- Keep tools and other materials away from edges, railings, and other elevated surfaces. Stack materials on a flat surface and secure them.
- Be aware of your surroundings and be careful not to accidentally knock or hit something off the level you are working on down to the level below.
- Place materials and equipment at least six feet away from an edge. If working near an opening, cover it or arrange materials so that they can't roll or slide towards the opening.
- Ensure that the site and work areas are cleaned up as frequently as possible and that enough waste containers are available and are being used to prevent a buildup of scrap material.

Physical Controls

Physical controls physically stop an object from falling or from falling very far.

- Install toeboards on all guardrails to stop objects from falling down to the level below. Do not pile tools, equipment, or materials higher than the top edge of the toeboard (3½ in) unless you use panelling or screening to stop small objects from falling through the openings between the rails.
- If working on open grating, place non-slip fire-retardant plywood or a similar product on top of the grating to prevent small objects from falling through.
- Use tool lanyards and tethers that attach tools directly to the worker's harness or tool belt.
- Use a cart with sides when moving equipment, tools, or material. The cart should be the correct size for what you're moving. If anything extends over the sides of the cart, secure it and make sure the cart is stable.
- Use barricades to set up exclusion zones below the work area or hoisting area and put up signs indicating that entry is prohibited.
- If barricades are not practical, use overhead protective structures that meet the legislative requirements of section 64 (3) in the Regulation for Construction Projects (213/91).

CHAPTER 4—Tank Construction

General Procedures

Tank construction is usually organized to provide platforms for the fitting and welding of sidewalls. The platforms are often supported by knee-brace brackets attached to lugs or welded onto the tank wall. Such platforms must have guardrails. With adequate guardrails and the platform completely decked in, fall arrest is not required.

Often, these platforms can be installed progressively with the platform below being used to install the next higher level of brackets and platform material. If this cannot be done, other access methods will be needed, along with an appropriate fall protection system. For example, access for the installation of platform brackets and lugs could be provided by a powered elevating work platform (PEWP).

Tank Roof Construction

Whenever possible, tank roofs should be designed for fabrication on the ground as one piece (or in large sections). If the roof is constructed on the ground and hoisted to the top of the tank in one piece, there will be less risk of workers falling. After the roof is hoisted onto the tank wall, they will only need to work at the perimeter to fix it in place.

If work on the roof is expected, a guardrail can be fixed at the roof perimeter. When working on sloped roofs or when there are hazards such as frost, ice, snow, and heavy winds, other fall protection may be needed in addition to the guardrail.

When the tank roof consists of a structure of columns and beams, the method of fall protection may require a customized approach. It may be necessary to review fall protection instructions from the manufacturer or consult a professional engineer.

In most cases, two of the rafters and a column can be connected on the ground and lifted into place as a unit. A fall arrest system, such as a horizontal lifeline and Y lanyard, is provided on the rafters so that workers can travel out on them to release rigging gear and connect additional rafters as they are hoisted into place (Figure 16).

An alternative would be to attach a vertical lifeline to the top of the column before lifting. A worker would then climb to the top of the column with a ladder. If you use a ladder to access the top of the column, then you must use fall protection. Try to keep the anchor as close as possible above your head to prevent the pendulum effect.

In both situations, workers must not proceed onto either the column or the rafters until the rafter column unit has been fastened securely in position. The task of connecting the unit should be done from a scaffold or elevating work platform at the perimeter of the tank.

Once the rafter column unit is connected securely to the tank, the rafters can be erected, with one worker at the column tied off to the structure and using a fall arrest system. Other workers involved should be able to do their work from the scaffold at the tank perimeter.

When a fall arrest system is used on the rafters, some type of stanchion must be used, and anchoring lugs would have to be provided at the ends. Temporary adjustable stanchions would probably be needed (Figure 16).

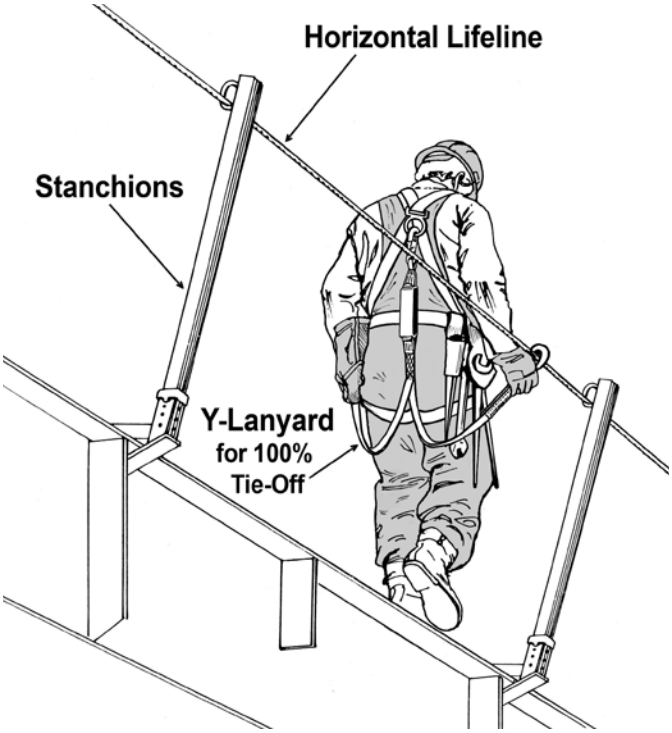


Figure 16: Beam Static Line

Holes or attachment lugs can be provided at the ends of the rafters when they are fabricated so that they won't need to be installed in the field.

If there are no fall arrest systems on the structure, other ways for workers to reach the work may be provided by one of the following:

- powered elevating work platforms where access permits; or
- tube-and-clamp scaffolding, system scaffolding, or frame scaffolding.

When a tank roof is sectional and does not have a separate column and rafter structure, a system of erection similar to the column and rafter arrangement is usually employed. The first unit makes use of two roof sections (instead of rafters), and a temporary column is used and arranged in a similar fashion.

The result is a structure that simulates the column and rafter arrangement. The fall protection system should also be similar. Workers must keep off that section of roof until it is fixed in place.

Knee Brace Scaffolding

Boilermakers often use knee brace scaffolding, especially in tank construction (Figure 17).

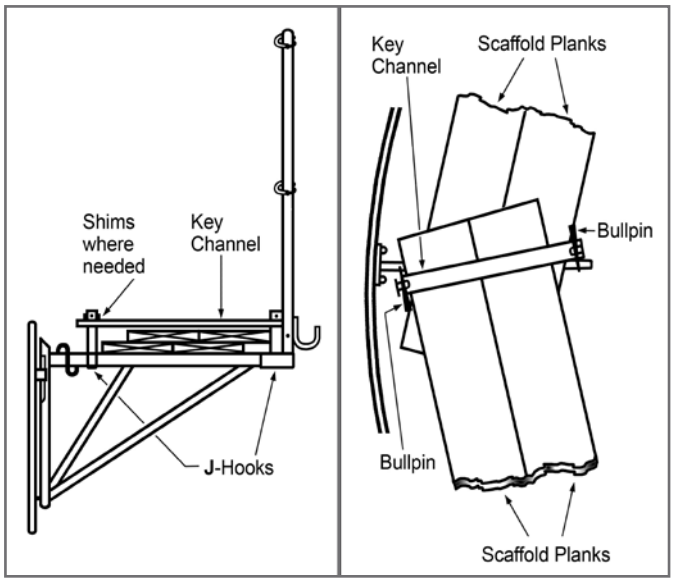


Figure 17: Knee Brace Scaffolding

The common arrangement is to weld knee brace scaffold clips to the tank or vessel. (See page 4-4 on Wind Girder Scaffolding). The knee braces have a guardrail post to which wire-rope guardrails are attached. There may also be a device to secure planks (usually two planks side by side) to the brace.

Knee brace scaffolds must be designed by a professional engineer and welded by a certified welder. A sketch of the scaffolding arrangements, together with erection and dismantling procedures, must be available to the field crew and be kept on the project while in use.

The sketch should indicate maximum spacing between knee braces; the size, length, and type of welds; and other information necessary to erect, use, and dismantle the system safely.

Knee brace scaffold clips must be welded according to the design. It is preferable to start at the centre when welding the clips. The welds on each knee brace scaffold clip must be completed before moving to the next one.

Knee brace scaffolds are often raised or "jumped" from one level to another. This can be done by welding knee brace scaffold clips at the next level so that it can be reached from the level below.

When a knee brace scaffold is being "jumped" around a tank or other vessel, boilermakers must be protected by a fall arrest system. The tie-off anchor can be a secure hook placed at the top of the tank plates or a knee brace scaffold clip located behind the worker.

Scaffold jumping is illustrated in Figure 18. The procedure requires 2 extra planks (3 if a 3-plank scaffold is used), 4 extra brackets, and 2 extra bracket arms.

Knee brace scaffold jumping is done as follows:

- Start at the trap door and work in the direction of the board overlap.
- Install the 4 extra brackets on the level above the working scaffold.
- Install the extra planks on the extra brackets.
- Install and secure the 2 extra bracket arms.
- Disassemble all key channels, J-hooks, and bull pins.
- Close off the open ends of both levels of the scaffold. Run a hand line through the nuts welded to the shell to close off the ends, or place scaffold closing devices at least 2 m (6 ft) back from the open end.

- Pass equipment (key plates, key channels, 4-lb hammers, loose tool containers, etc.) to the person above as work proceeds around the scaffold.
- Break the hand lines on the lower scaffold temporarily.
- Run the hand lines up through the pigtails on the upper bracket arms, and secure the ends.
- The top rail of a guardrail must be between 900 mm (35 in) and 1,100 mm (43 in) high.

The scaffold is now ready to be raised:

- Remove the planks from the lower scaffold directly under the extra scaffold section above.
- Maintain the hand line on both levels of scaffold so workers are behind the hand lines.

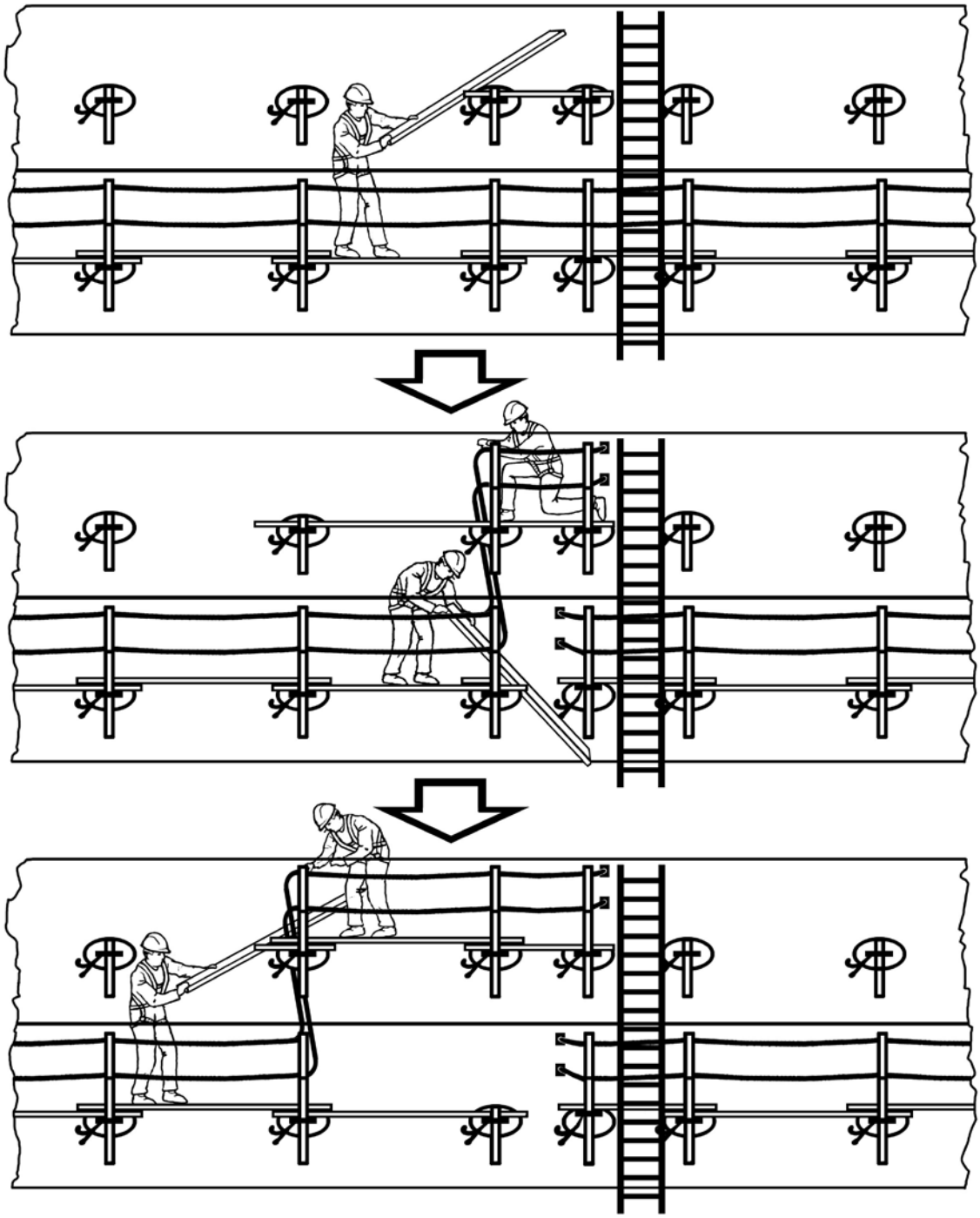


Figure 18: Scaffold Jumping

- Place pieces of wood under the trap door that are the same thickness as the planks that were removed, and re-tie the trap door to the bracket.
- Keep your back towards the shell as you handle scaffold planks.
- Use a rope tied to a hook device to pull out the brackets from the scaffold below.
- Secure all bracket arms with weld wire or pins as you proceed around the tank shell.
- Continue around the tank shell until the upper section is complete.
- Pass the trap door and remaining hardware to the person above.
- If the remaining section of scaffold is left in place, make sure the open ends are closed off.
- Tighten all hand lines.
- Tighten all scaffold planks with key channels, J-hooks, and bull pins if required.

Wind Girder Scaffolding

A *stiffening ring* is a continuous ring that is usually constructed of structural sections, formed plates, or some combination of the two, used to maintain the roundness of the tank. A wind girder is an additional stiffening ring used to stiffen the tank against wind loads (Figure 21).

Wind girders are attached near the top of the tank, where the tank is most vulnerable to the effects of the wind. It often doubles as an access system and a maintenance platform. Some type of structure is usually available for attaching or supporting access equipment and fall arrest systems. Using permanent equipment as temporary scaffolding is common with wind girders on larger tanks with open tops.

A wind girder is fitted and welded for permanent attachment. As the tanked is constructed, the sections of the wind girder are attached temporarily to each finished course with fitting nuts and bull pins. A system of chain falls on rolling trolleys is placed on the top edge of the completed course to be used to raise the wind girder to the next course, where it is used as a temporary scaffold. This operation is very similar to jumping scaffolding.

Once the wind girder is hoisted to the final course, it is fitted and welded permanently to its final position. It serves not only as a stiffener ring for the vessel but also as a platform from which to inspect the contents of the tank and the condition of the inside of the tank.

Where neither the structure nor the equipment can be equipped with a means of access, frame or tube-and-clamp scaffolding may be needed.

Figure 19: Plate Anchor

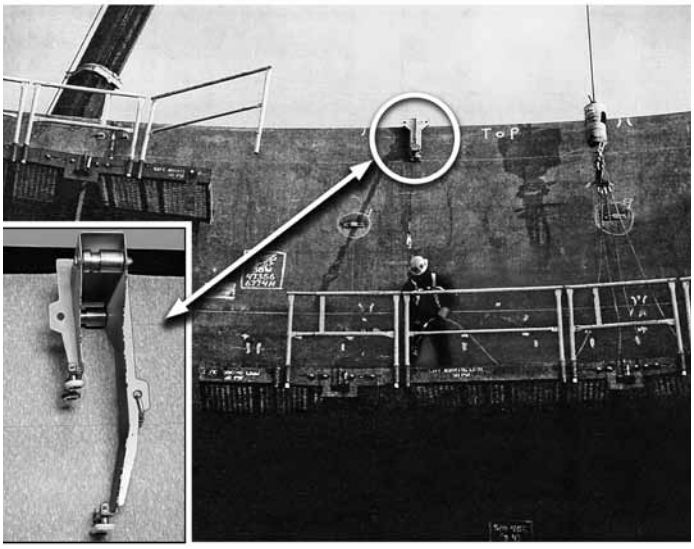


Figure 20: Roller Anchor

Figure 21: Wind Girder Scaffolding

Wind Girder Scaffolding – Example of Work Procedures

The scaffold must be erected, dismantled, and inspected under the supervision of a competent person in accordance with the engineered drawing.

- Under the supervision of a competent person, bracket clips, scaffold brackets, platforms, ladders, guardrails, etc. are all to be individually examined for defects before the scaffold is erected and again before it is used. Damaged or defective pieces must be identified as "defective" and sent out for repair, and/or replaced.
- Access to the scaffold must be by tank ladders attached to the shell. Platform doors and vertical lifelines must be used as required.
- Access ladders fixed to the shell must have rest platforms at intervals of 6½ m (21 ft).
- Whenever there is the risk of falling 2 m (6 ft) or more, workers must use a fall prevention system. A competent person must train all employees who will be required to use fall protection equipment. Engineered trolleys can be used as anchor points.
- Only qualified welders may weld the bracket clips to the shell. The welder must initial and circle each clip immediately after the weld is complete.
- Follow best practices for all hoisting and rigging.
- Weld a fitting nut to the shell just above every second bracket, above the third ring (outside the tank only), to prevent the bracket from being pulled out of the clip in the event of high winds.
- Filler plates must be secured to the platform.
- Working loads must not exceed the maximum load that the scaffold components are designed to withstand. In no case may they exceed the following:
    - 225 newtons (50 lb) per square-foot load on the scaffold platform
    - a point load of 675 newtons (150 lb) applied laterally to the top rail
    - a point load of 450 newtons (100 lb) applied in a vertical downward direction to the top rail
    - a point load of 450 newtons (100 lb) applied in a lateral or vertical downward direction to the mid-rail
    - a point load of 225 newtons (50 lb) applied laterally to the toeboard.
- Refer to engineered drawings for further details.
- A supervisor must state in writing that the scaffold has been erected in accordance with the drawings. The scaffold drawings and statement must be kept on the project site.
- All objects must be secured against falling. Keep scaffolding free of debris. Keep small objects such as small tools, wedges, pins, and fitting nuts in pails, and keep the pails secured to the safety posts.
- The area on the ground around the tank must be kept off limits to unauthorized persons. Post DANGER signs warning that overhead work is being done on the scaffolding and that everyone is to keep out of the area.
- Before using a crane to move a section of scaffold, ensure that all wires, hoses, and tools are secured to the scaffold.

Alternative to Using Toeboards on Knee Brace Scaffolding

An alternative to toeboards can be used on knee brace scaffolding if the arrangement provides the following:

- protection of workers and passersby from falling objects;
- notice to all workers in the immediate area of the alternative arrangement; and
- notification in writing of the alternative to workers and their health and safety representatives.

> See section 3 of the Regulation for Construction Projects (213/91) ("Alternative Methods and Materials")

Safety Measures Required with Alternative Method

1. Keep scaffolds clear of debris, tools, or other objects that can fall off the platform or be knocked off. Store these things in work pouches, buckets, or buggies fastened securely to the scaffolding or tank shell. Workers can also carry some equipment on their tool belts.

2. The "falling hazard area" around the scaffold must be cordoned off and signs posted. The areas near the base of the scaffold must be cordoned off by a barricade (such as a rope or a fence) placed at a distance far enough from the scaffold to protect workers and other persons outside the barricaded area from falling objects. Signs with such wording as "No Entry—Authorized Personnel Only" must be attached to the barricade.

3. Signs must be posted at the base of the scaffolding (e.g., "Danger Due To No Toeboards") to remind workers inside the barricade of the hazard.

4. Overhead protection (in accordance with the Regulation for Construction Projects), must be placed:
   - at the point of access to and egress from the worksite
   - where pedestrian or other traffic is expected to pass under the scaffolding.

5. A designated pathway must be provided outside the cordoned-off area to direct pedestrian and other traffic around the cordoned-off area.

Any worker who temporarily enters the cordoned-off area must exercise caution. Workers directly above must be alerted and must stop work while another worker is below. If it is not practical to have the workers above stop work, the "falling hazard area" below must be off limits to everyone while the work is going on.

Work should be scheduled to minimize situations where work is done above another worker. When that situation is unavoidable, there must be overhead protection to protect anyone entering, leaving, or working in the area below.

Enough signs must be used that at least one sign is visible from any point of the barricade and no one can enter without having an opportunity to read a sign.

> **Note:** Even with toeboards, it would be a good practice to employ these safety measures.

CHAPTER 5—Duct Installation

Vertical Ladders

The points where vertical ladders are attached to stacks or ductwork must be inspected carefully. Attachment fastening systems can deteriorate with time, weather, and corrosion. The inspection can be done from a ladder. If the fastening system appears loose or severely corroded, it must be replaced or repaired before the ladder is used.

The ladder rungs should be tight and not bent or damaged. Similarly, the ladder rails should be in good condition and not severely pitted or weakened by corrosion.

Vertical Ladder Requirements

When an access ladder is fixed in position,

- it must be vertical
- it must have rest platforms at least every 9 m (30 ft)
- it must be offset at each rest platform
- where the ladder extends over 3 m (10 ft) above grade or above a floor or landing, it must have a safety cage starting not more than 2.2 m (7 ft) above grade, floor, or landing and continuing at least 90 cm (3 ft) above the top landing with openings to permit worker access to rest platforms or to the top landing
- it must have side rails that extend 90 cm (3 ft) above the landing
- it must have rungs that are at least 15 cm (6 in) from the wall and spaced at regular intervals.

The above requirements do not apply to an access ladder on a tower, water tank, chimney, or similar structure that has a safety device that will provide protection if a worker using the ladder should fall.

Horizontal Ducts

Fall protection for installation of horizontal ducts is provided by a fall arrest system. For this system, an arrangement of anchorage points and horizontal static lifelines must be provided. This will require planning and the attachment of anchorage lugs and stanchions to the ductwork for long runs.

If another structure will be supporting the ductwork, it may be possible in some cases to attach a horizontal lifeline to the structure (Figure 15 on page 3-5). If support or hangers must be installed before such a lifeline can be used, scaffolds or powered elevating work platforms may be necessary.

Horizontal lifelines must always be designed by a professional engineer (Figure 22).

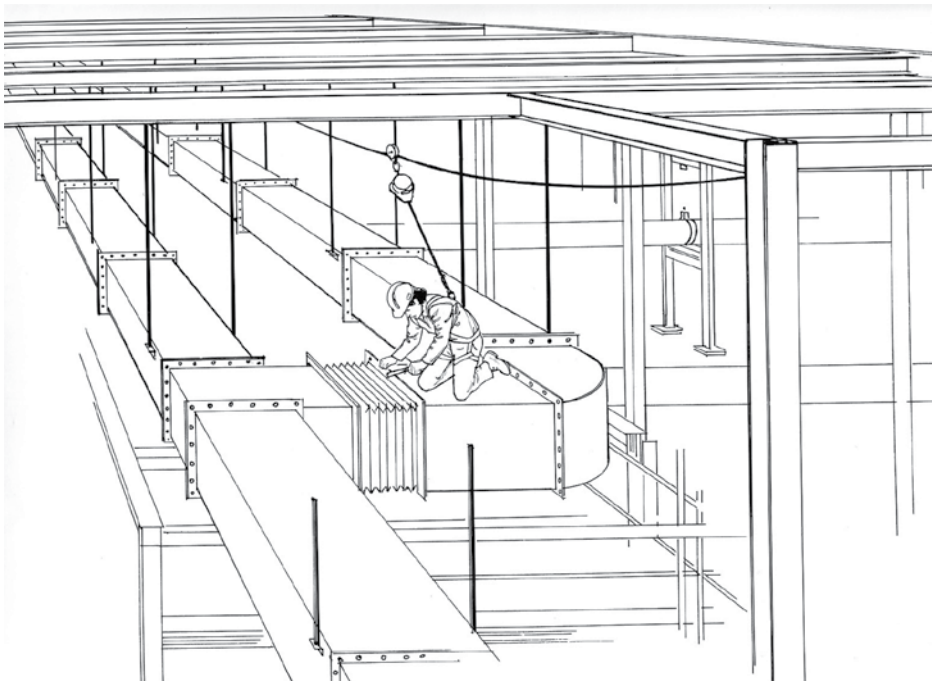


Figure 22:

Horizontal static lifeline fall arrest system (designed by a professional engineer)

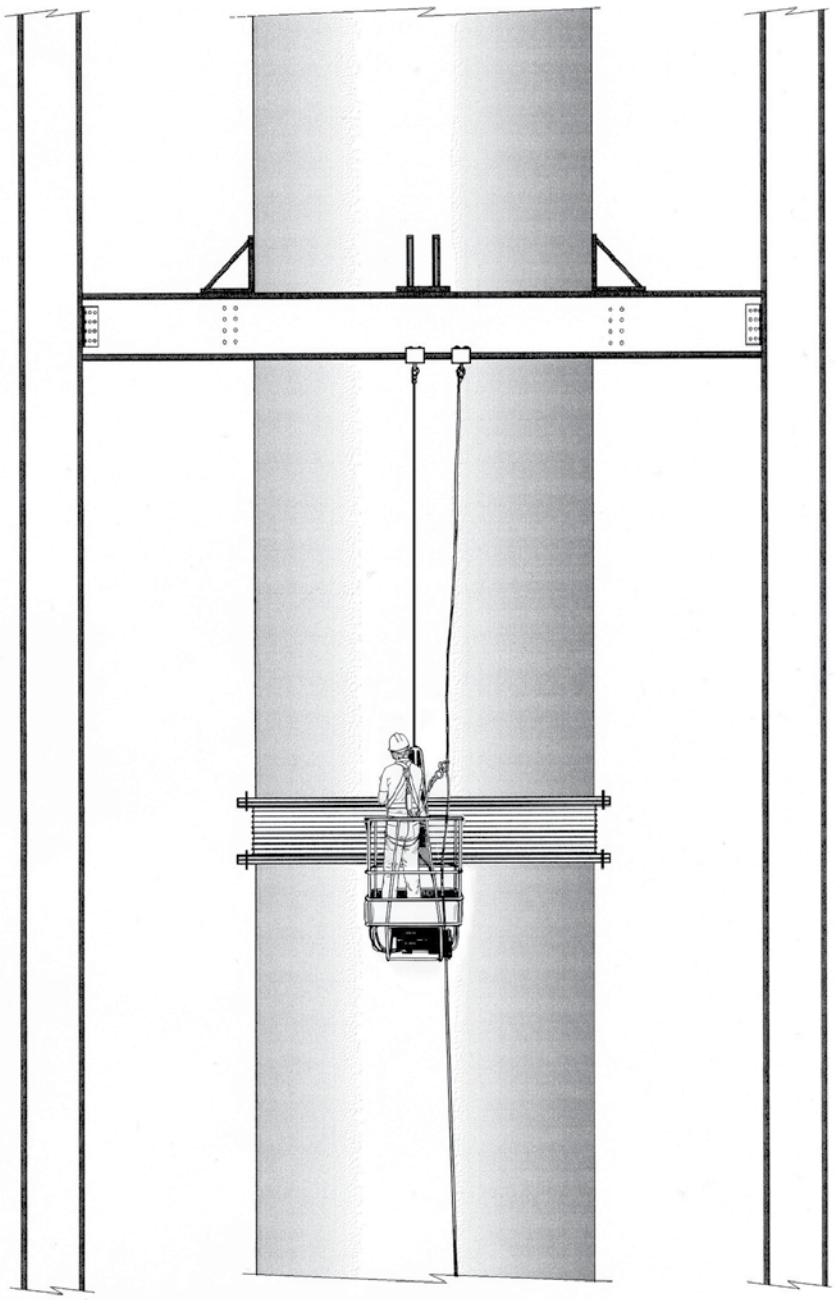


Figure 23: **Engineered Anchor Points**

Figure 23 shows two independent means of worker fall protection attached to an engineered anchor point.

(1) a chair suspension system

(2) an independent lifeline.

Vertical Ducts

The fall protection required for vertical-duct installation when the ductwork is self-supporting may be more complex. For self-supporting ductwork, a scaffold may be necessary to provide access. When there is a supporting platform or ground area below, the scaffold can be a knee-brace scaffold with guardrails attached to the ductwork such as in tank construction, a frame scaffold, or combinations of tube and clamp scaffold.

Boom-type powered elevating work platforms may provide more convenient access than scaffolds. Where there is room to use them, they are likely to be used for the whole operation.

If an overhead structure is available, it may be possible to use a suspended-stage arrangement.

If scaffolds are used, a complete platform, including guardrails and access ladders, will be required. The fall arrest system will have to be tied off to a fixed support or to the scaffold structure during erection.

If possible, the vertical sections should be fitted and welded on the ground. The sections will then be lifted into position for fitting to horizontal sections.

If fall protection and/or suspended access equipment are to be used, separate anchor lugs for the platform and for fall protection will be needed (Figure 14). These can be installed before the structure is erected. In addition, a means of access, such as boom-type powered elevating work platforms, will be needed for the attachment of the suspension lines and lifelines to the anchors.

If vertical ladders, such as scaling ladders, are used between scaffold platform levels, a means of fall protection is required.

CHAPTER 6—Stack Construction and Repair

General Procedures

Stacks should be constructed with scaling ladders, secure anchors, rest platforms, and ladder climbing safety devices (Figure 24). If these have not been installed on existing stacks, their installation should be considered a first priority in retrofitting or repair.

Exceptions may be made to this requirement if access is provided by boom type powered elevating work platforms or by scaffolding.

WARNING

Employers who have a Class Frontal-Fixed Rail Ladder (Class FRL) Fall Protection System installed must ensure, before it is used, that the system is capable of protecting a worker from any type of fall (including a backward fall). Employers must take reasonable precautions, which can include using alternative fall protection or access systems, as appropriate, for the adequate protection of the worker.

For more information, see Ministry of Labour Alert "Fixed Rail Ladder (FRL) Fall Protection System" issued in 2014.

Ladder Installation and Inspection

Ladders for new stack sections should be installed on the ground before the section is lifted or fitted into place.

Existing ladders should be inspected before they are used. Access for the inspection may be provided by any of the following:

- a boom-type powered elevating work platform
- an extension ladder
- the existing scaling ladder, either
  - o with the existing ladder-climbing device for fall protection or
  - o with a Y-lanyard with one lanyard leg always connected to the ladder.

Note: If this method of access is used, any defect in the ladder or attachments that are found must be repaired before the person doing the inspection ascends further.

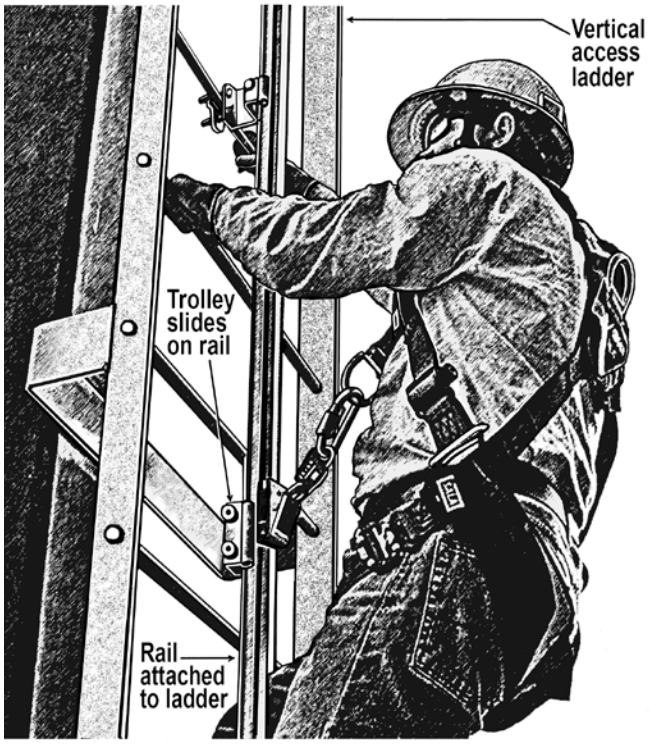


Figure 24: Ladder with Climbing Protection

Scaffold Platforms and Suspended Platforms

Both scaffolds and suspended work platforms are used during construction and repair of stacks.

Frame scaffolds or tube and clamp scaffolds require support on a roof or the ground. The scaffold must be erected and inspected by a competent person. During erection of these scaffolds, workers must use a fall arrest system anchored to a fixed support or to the scaffold structure.

A scaffold platform cannot be considered erected completely until it is fully planked or "decked", guardrails are installed, and access is provided. Only then is fall arrest no longer required.

Suspended work platforms are supported with suspension lines anchored to the stack. Every worker who is erecting or working on a suspended platform must be protected by a personal fall arrest system, which must be anchored independently from the suspended scaffold supports.

The workers on the stack must be able to communicate with workers on the ground or on another access level. Workers on the ground or other access level must be prepared and equipped to rescue the workers on the stack in case of an emergency. The employer must have written procedures, equipment, and trained personnel for rescuing the worker in the event of a fall.

If work on the scaffold is likely to result in debris falling, the area below the scaffold must be cordoned off to prevent workers from entering it.

CHAPTER 7—Boiler Construction and Maintenance

Suspended Access Equipment

Suspended access equipment (SAE) includes suspended platforms (i.e., swing stages), suspended scaffolds, and work cages.

Training in the proper selection, rigging, operation, and maintenance of suspended access equipment is essential. Fall protection must be a major part of the instruction.

Design

A professional engineer's designs are required for any suspended scaffold system consisting of more than one platform or weighing more than 525 kg (1,160 lb). The system must be erected according to the design and be inspected and approved in writing by the engineer. Design drawings must be kept on the project as long as the system is in place.

Fall Protection

A worker who is getting on or off suspended access equipment must wear a full-body harness as part of a fall arrest system. Safety belts are not allowed with this equipment. The basic rule is that there must be the two following independent means of support:

1. Support for the equipment by the suspension system of the equipment (including suspension lines, climbers, outrigger beams, counterweights, etc.)
2. Support for the worker through a fall arrest system.

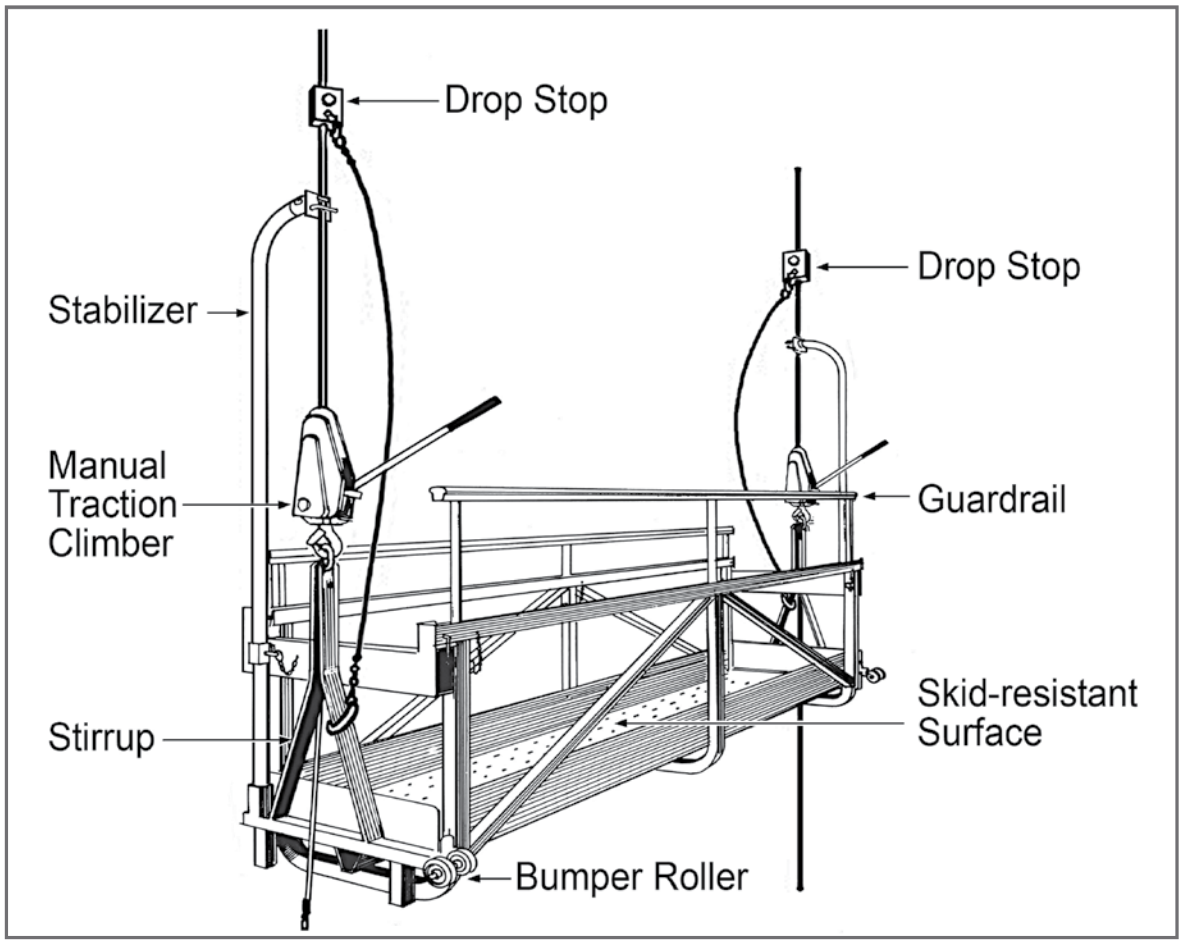


Figure 25: Swing Stage Components

Note: A vertical lifeline must meet the CAN/CSA-Z259.2.5-12 standard, "Fall Arresters and Vertical Lifelines." Vertical lifelines sold on a reel or in a container will have the CSA standard information attached or etched on the container or reel.

Once the lifeline is removed from the original packaging, pertinent information, such as the purchase order number and CSA certification, should be shown on the lifeline (with tags or otherwise) to ensure it does not get confused with hoisting rope and cable. The lifeline should be stored separately from hoisting ropes and cables.

There must be one lifeline for each worker on the suspended equipment. Each lifeline must be:

- secured to an anchorage that is independent of other lifelines and of suspension lines. The construction regulation requires that anchorage for temporary fixed support must be capable of supporting a static force of at least 8 kilonewtons (1,800 lb). However, it is good practice to consult the manufacturer for recommended specifications.
- built to the Ontario Building Code if the fixed support is to be a permanent anchor system support
- protected from abrasion
- protected from getting tangled with other lines
- long enough to reach the ground or a level where the worker can dismount safely, or have a positive stop to prevent a rope grab or similar device from running off the end.

If the platform has two or more means of support or suspension and failure of one means of support will not cause any part of the platform to collapse, the fall arrest system may be secured to the platform.

Suspension Lines

Suspension lines must be

- the type, size, construction, and grade of wire rope recommended by the climber manufacturer
- free of kinks, birdcaging, excessive wear, and other defects
- anchored securely above and capable of withstanding 5,000 lb
- set the same distance apart as the stirrups on the stage. Otherwise, as the stage goes up, the angle of suspension lines increases, causing dangerous side loads (Figure 27).

Two independent means of support can include two complete suspension systems. Each suspension system must be capable of providing full support if the other should fail. In that case, lifelines are not required, but workers must still tie off to, for example, a static line on the stage.

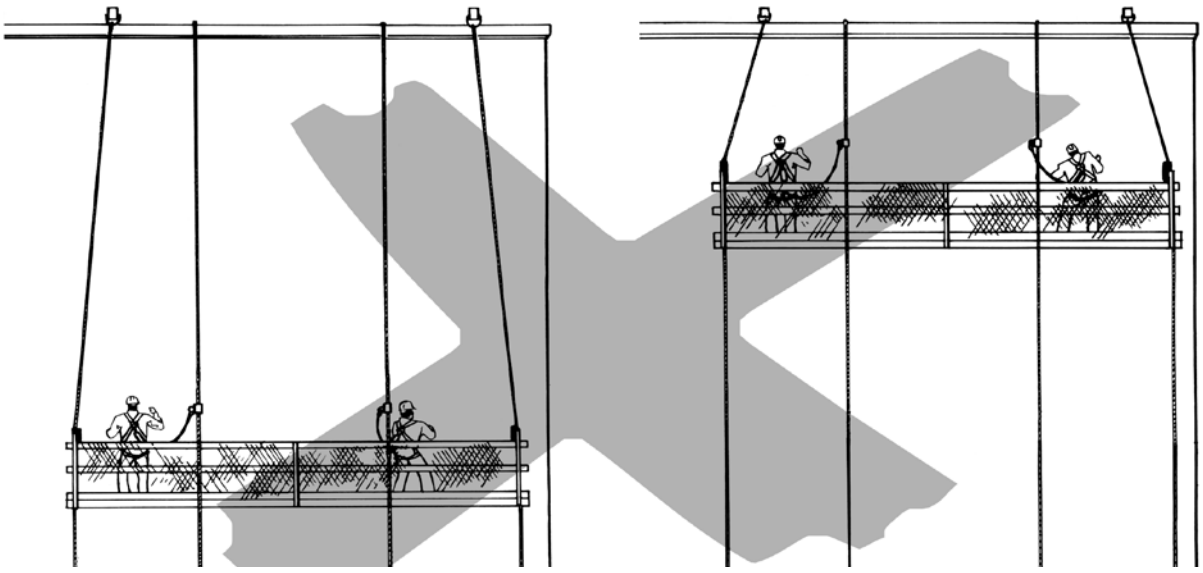


Figure 27:
Improper Spacing of Outrigger Beams

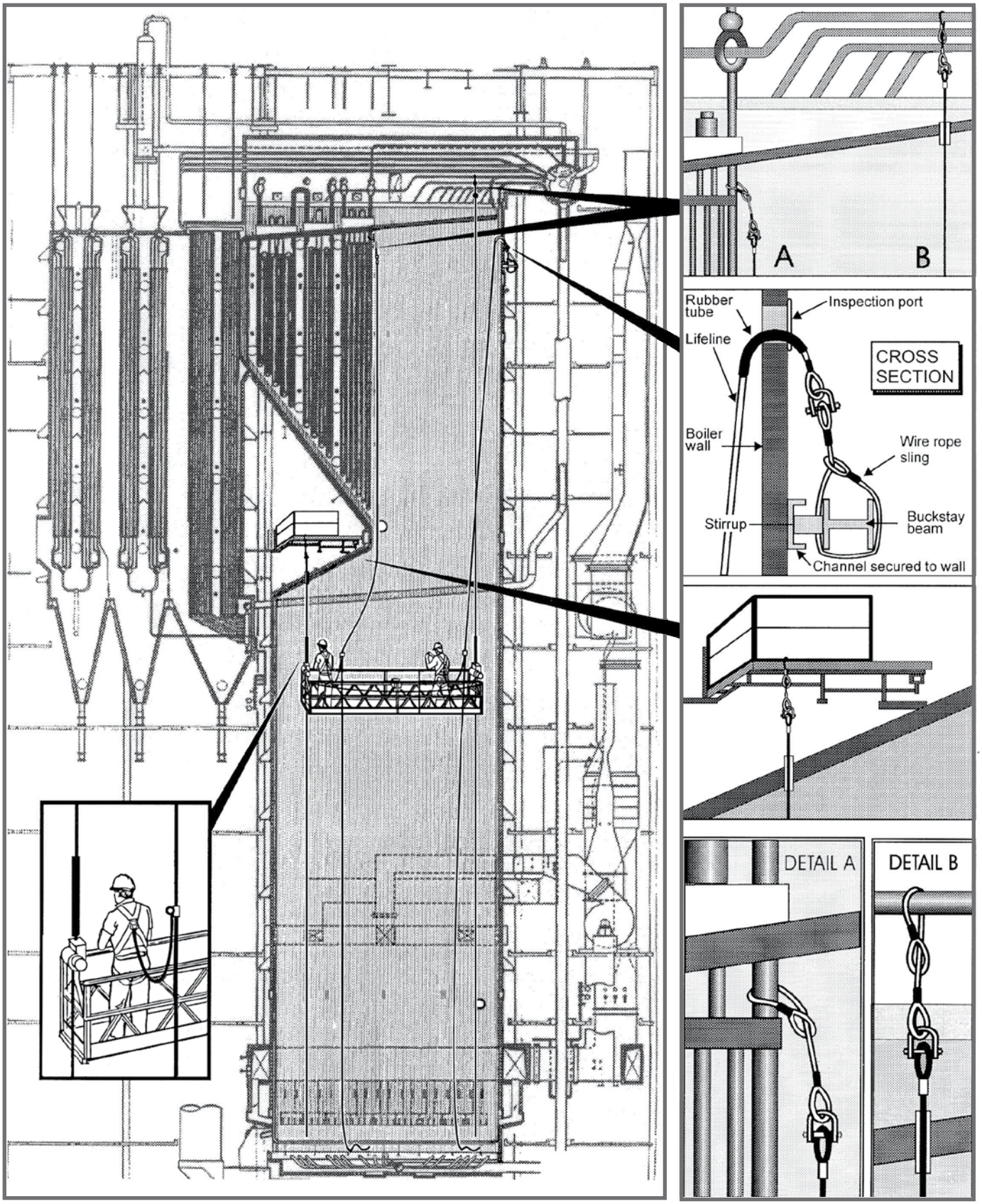


Figure 26: Anchorage Points for Suspended Platform on Boiler

Common Types of SAE

The following types of suspended access equipment are commonly used in construction.

Stage Equipped with Manual Traction Climber

Although more and more stages are now equipped with powered climbers, there are still situations in which manual traction climbers can do the job safely and efficiently. Manual traction climbers are particularly useful where the stage will remain in the same position and only limited climbing is required (Figure 28).

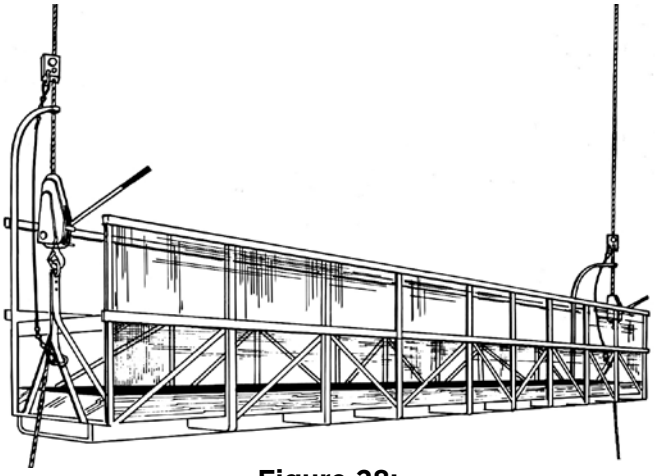


Figure 28:
Stage Equipped with Manual Traction Climber

Wire rope used with manual traction climbers should be the size and type recommended by the manufacturer. For example, do not replace solid core wire rope with fibre core wire rope. Fibre core wire rope may compress under certain loads and slip through the traction climber. The manual traction climber must be suitable for the load being hoisted. That is especially important when large platforms are being raised.

Secondary Safety Device

A secondary safety device, also known as a drop stop, is a wire-rope grabbing device that provides protection in case the wire rope connection or primary hoisting system fails. Figure 29 shows how the device is mounted on each wire rope above the hoist with a whip or sling connected to the stirrup of the stage. This device may also be a fixed component on powered climbers. As this device moves along on the wire rope, the jaws open slightly to let the rope pass through. When there is a sharp downward pull, the jaws automatically close on the rope and grip it with a degree of tightness determined by the load.

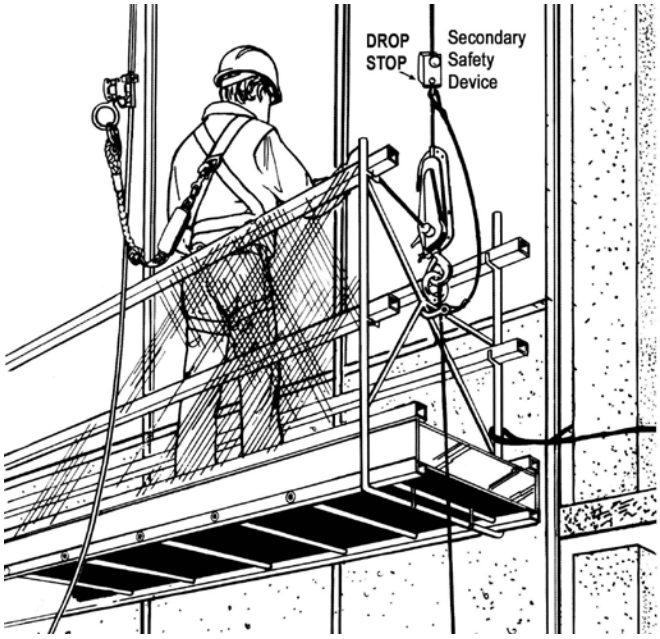


Figure 29:
Manual Traction Climber with Secondary Safety Device

Stage Equipped with Powered Traction Climber

Stages equipped with drill-powered traction climbers incorporate specially designed electric drills. They operate on 120 volts rather than the 220 volts commonly required by larger powered climbers, and they climb more slowly. When drills are not in use, they can be removed and stored for protection from the weather and vandalism.

The stage equipped with a powered traction climber is the workhorse of the industry. Because it climbs quickly (up to 35 ft a minute), it is ideal for large distances and frequent movement. Since it is usually powered by 220 volts, a temporary electrical supply may have to be installed. Pneumatic models are also available.

Due to the relatively fast rate of ascent and descent, operators must take care that the stage does not catch on obstructions such as architectural features and overload the suspension system. This caution, of course, applies to all devices, but it is most important where climbers operate at greater speeds. In addition, it is important to keep your fall arrest system in sync with the elevation of the swing stage. This ensures that your anchor point remains above your head.

Stage Equipped with Powered Drum Hoist Climber

This equipment is common in the industry today (Figure 30). One advantage is that the suspension lines are wound up on the drum of a hoist rather than hanging down to the ground. That keeps the free ends of suspension lines from crossing, catching on the building, getting tangled, or otherwise hindering safe operation. This feature makes the equipment safer. Other types of climbers can also be equipped with a reel to wind up the suspension lines, though that is not common.

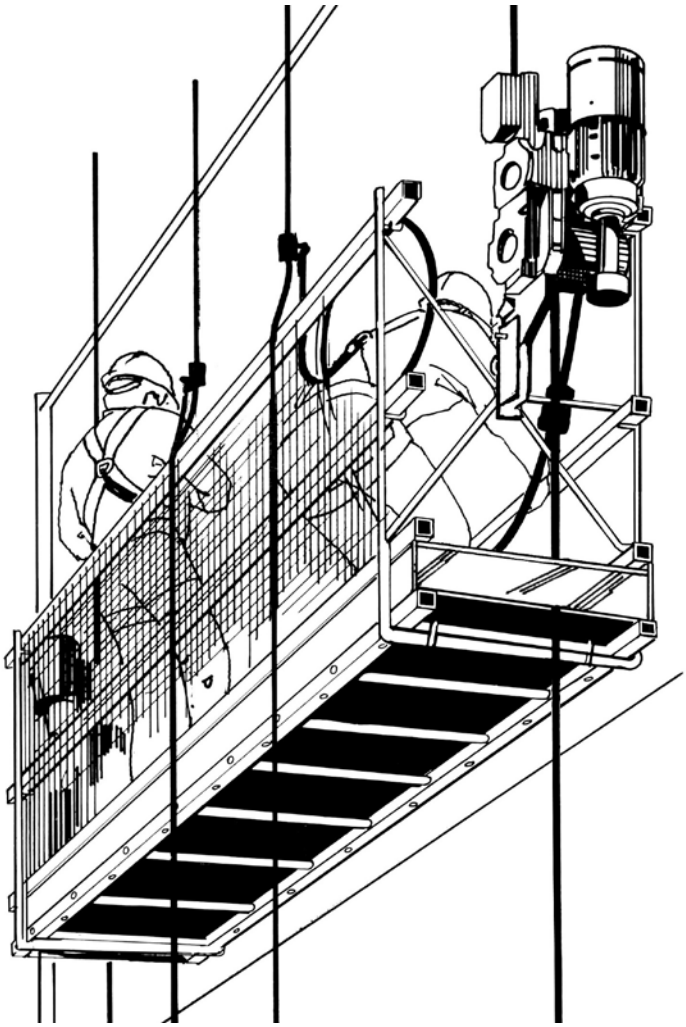


Figure 30:
Stage Equipped with Powered Drum Hoist Climber

Multi-point Suspended Access Equipment

This type of equipment has at least four suspension lines and is usually suspended from a structure. The lines are anchored to beam clamps or welded lugs, or are simply wrapped around structural supports and fastened with cable clips. Multi-point systems are often used when a platform larger than a typical suspended stage is required.

These platforms must be designed by a professional engineer and approved before they are used. Adequate redundancy must be built into the suspension system to ensure that, if a suspension line should fail, the device continues to support itself and its load.

A written erection and dismantling procedure approved by the design engineer is also required. Drawings and sketches must be kept on the project while the device is being used.

Workers on the platform must use a fall arrest system tied off to an independent support during erection and dismantling of the platform. A fall arrest system is not required, however, once a properly designed system has been fully set up and equipped with guardrails.

CHAPTER 8—Tagging and Lockout

All workplaces must have lockout procedures. A lockout procedure involves clearly defined steps with assigned responsibilities. Boilermakers employ lockout procedures during repair and maintenance work at mills, refineries, factories, and other operating plants. For the health and safety of the worker, co-operation between client and contractor is crucial.

When work involves equipment such as precipitators, tanks, boilers, and flues, boilermakers need protection from heat, vapours, corrosive liquids, toxic gases, and other products released into work areas. These hazards occur for reasons such as pumps kicking in, product control gates opening, forced draft fans starting, and other devices operating unexpectedly.

Such hazards can be prevented by consultation between the contractor and the client beforehand, and agreement on procedures to follow during work. In some cases, procedures for both confined spaces and lockout must be followed together. When workers will be entering a confined space, any energy source that may be dangerous must be locked out before work begins.

Lockout procedures often incorporate a work permit system. Under a typical work permit system, someone is assigned the task of verifying that the lockout steps have been taken. This person will not issue a work permit until all tasks in the lockout procedure have been done. Until the permit is issued, no work can begin.

Worker training in lockout is important. Large workplaces may also have a special health and safety subcommittee to deal with more complex lockouts.

When working in an operating facility, contractors must consult with the client before locking out any systems. Usually the owner's in-plant procedures take precedence over the practices of outside contractors. This makes sense because the client knows the energy sources and systems involved and has tried and proven procedures that have been developed over time. However, the contractor and workers must assure themselves that the client's lockout procedures are adequate and have been applied fully—these procedures must still comply with Ontario regulations.

Even with the most thorough procedures, lockout still demands that you expect the unexpected. Consultation between the client and the contractor helps to ensure that everyone involved is properly informed and that each step in the procedure will not only be carried out but will also be confirmed.

Zero Energy State

Essentially, lockout is about achieving a zero energy state in the workplace. In reality, energy may still be present in parts of the system, but it must be controlled. Zero energy state is a condition where ALL energy sources have been identified, de-energized (or controlled), and locked out so that they cannot be re-energized.

Some simple systems are powered by only one energy source. Much more common in the trade, however, are energy systems that have many power sources. Lockout must ensure that all energy sources are controlled.

Shutting off the power does not always achieve this, however. Elastic potential energy, which is a result of compression or tension, can be stored in such items as springs, rubber bands, and bungee cords. In addition, gravitational potential energy can cause objects that are stopped to move. For example, a machine stopped in mid-cycle with the components elevated may slam shut when energy is released. In other cases, trapped pressure may cause parts to drop, slide, or rotate unexpectedly.

Some equipment may pose unexpected hazards. For example, a machine may have an electrically operated component with a hydraulic or pneumatic primary power source or may become activated on a timed schedule. Gravity and momentum can also present unexpected hazards with some types of equipment. If conditions such as these are not recognized and controlled, they can present serious hazards.

Zero energy requires that every energy source be controlled. Valves may have to be chained, piping systems blanked, slide gates locked, pressure bled off, capacitors discharged, electrical switches locked, counterweights blocked, and drive belts removed.

In consultation with the client, boilermakers may need to refer to drawings and operating manuals or even contact manufacturers for more precise information. They may also have to trace product piping systems or check with operators to ensure that the equipment functions are disabled as expected.

Even after every system is identified and de-energized, it must still be re-tested to guarantee a zero energy state.

Lockout Procedure

Lockout isolates and controls energy, preventing electric shock, sudden movement of components, and other actions that can endanger lives.

Tagging indicates that a device is locked out and conveys information about the lockout. Tagged devices and systems must not be re-energized without the authority of the persons named on the tag.

It is absolutely essential for an employer to have an effective lockout and tag policy and to make sure it is followed diligently without exception.

> A source of detailed information on lockout and control of hazardous energy is the CSA Standard Z460-05, *Control of Hazardous Energy—Lockout and Other Methods*

A written safe work procedure for lockout and tagging is essential to ensure that lockout and tagging have been carried out thoroughly and effectively before work begins and that no energy is available to endanger anyone during lockout.

Written procedures should cover points such as

- training requirements for workers and supervisors
- quality, type, and colour of locks, scissors, chains, blanks, blinds, and other lockout devices
- method of identifying lock owners
- control of keys for locks
- colour, shape, size, and material for tags
- method of securing tags
- information to be included on tags
- communication and authorization procedure for shutting down and starting up machinery and equipment
- procedure for removing a lock when the owner of the lock is not available
- record-keeping requirements
- itemized steps to meet lockout objectives.

> **Know the Law**
>
> The Construction Regulation (O. Reg. 213/91) and Confined Spaces Regulation (O. Reg. 632/05) require written procedures for locking out when the work involves electrical hazards and confined spaces.

Three Methods of Lockout

There are three generally recommended methods of locking out equipment: **individual lockout, group lockout**, and **complex group lockout**.

Every lock must be identified by its owner's name. The name or some other means of identifying the owner, such as a colour, a tag, or some other marking must be applied directly to the lock. There must also be a means of determining the date and reason for lockout. This information can be written on a tag attached to the lock, or the lock can be marked with a symbol that can be used to look up the required information. The application of a lockout device must not itself create a hazard. Workers must recognize that, even though the disconnect switch may already be locked, they are not protected until they attach their own lock.

A **tag** is required on the lockout device. The tag must give the name of the person who disconnected the equipment and that person's employer, the date and time of lockout, and the reason for the lockout. A tag alone should not be relied on as proof that a machine or system is locked out. The tag provides information about the lockout, but it does not guarantee that the energy has been isolated. Tags may also be used to identify the owner of the lock.

Signs must be put on the system to say that it is not to be energized or operated and that guards, locks, temporary ground cables, chains, tags, and other safeguards are not to be tampered with or removed. If more than one worker is involved in the lockout, information must be posted or otherwise communicated to these workers and operators of equipment to show the purpose and status of the lockout.

Individual Lockout

Individual lockout is the basic and preferred approach to lockout. It requires every worker to be authorized to perform lockout. The authorized person knows what is dangerous about the machine, equipment, or process to be isolated, as well as the method of isolation required to protect workers. Each person involved in the work is accountable for making sure that before work begins, the mandatory devices are in place to isolate and control hazardous energy, that they are locked in place with their personal locks, and that they are tagged.

The machine, equipment, or process is then verified as de-energized. If several workers or trades are working on the circuit, use a lockout bar to provide space for additional locks. This arrangement can accommodate any number of locks by placing another lockout bar in the last hole of the previous bar.

Group Lockout

Group lockout simplifies the lockout process when there are many devices to lock out and many authorized workers. Group lockout still allows individual authorized workers to control dangerous energy with their own locks. Here are typical steps for group lockout:

1. The primary authorized person, who may be part of plant operations, is given responsibility for controlling all energy sources by applying any required energy-isolating devices and placing a lock and tag on each.
2. The key for each lock applied to lockout devices is placed in a lockable container such as a lock box. The lock box is then in turn locked by the primary authorized person, and a tag is applied.
3. Zero energy is then verified to make sure the lockout is effective. Ideally, the verification is done in the presence of the work crew.
4. Before work begins, each worker assesses the lockout procedure and its adequacy for achieving zero energy for the work they will do. Once satisfied, each worker applies their own identifiable lock (and tag if used) to the lock box.
5. When each worker has finished their work, they each take their own lock (and tag if used) off the lock box.
6. Once all crew members have removed their personal locks and tags from the lock box, the primary authorized person who has been given responsibility for the lockout inspects the site to check that all tools and workers are clear. Then, each lock and isolating device is removed.

Complex Group Lockout

A workplace can use complex group lockout when it is not practicable to use individual lockout or group lockout for any of the following reasons:

- the physical extent of the equipment and/or process being serviced
- the inaccessibility of the energy-isolating devices
- the number of energy-isolating devices
- the length of time the equipment or processes will be isolated
- the number of authorized persons involved
- the interdependence and interrelationship of the components in the system or between different systems.

A complex group lockout must provide the same level of protection to each member of the work crew as is afforded by individual lockout. Complex group lockout uses control measures such as work permits, administrative control measures, and control boards. After all energy sources are isolated and locked out, work crew members verify the isolation and the effectiveness of the energy isolation for the work they are performing.

For very large processes such as a nuclear plant shut down, verification may be achieved by understanding and having confidence in the process for the shutdown and lockout. Individual crew members do not apply their personal locks to each isolation device, but rather rely on the process and controls put in place to assure them that lockout is reliable.

Return to Service

The primary authorized individual who was assigned to de-energize and lock out equipment will usually be the one to return the equipment to service. Before lockout devices and locks are removed, the work area is inspected to make sure that all crew members have been cleared from any hazardous areas and that all are accounted for.

In addition, this person makes sure that all non-essential articles have been removed and that the machine, equipment, or process is operationally intact. Anyone who could be affected by the re-energizing and start-up of the equipment must be notified by the person assigned to return the equipment to service. Once satisfied that the machine, equipment, or process is in a ready state, the primary authorized person removes any locks, energy isolating devices, and tags. After lockout devices have been removed, a formal start-up procedure begins if necessary. If the equipment is to sit idle for a period of time, there should be a separate pre-start-up process for meeting the notification requirements.

Lockout and Tag Removal Without Authorized Person

Occasionally a worker leaves the jobsite and leaves a lock in place, either intentionally or accidentally, and may not be present when the equipment needs to be re-energized. If another worker removes the lock, that person, and possibly others, may be exposed to danger. Therefore there must be a written procedure for removing such lockout devices and tags safely.

Part of the procedure must be to find the absent worker and obtain permission to remove the lock. The procedure must also specify how, if the worker cannot be found, to determine if it is safe to cut the lock from the lockout device and re-energize the system. The person removing the lock should be named in the lockout documentation.

Contractor's Personnel

Communication is a key element of a hazardous-energy control program. The plant and the contractor should each designate a representative to be responsible for determining their relationship, as well as their individual responsibilities and obligations regarding hazardous-energy control. To prevent confusion during contractor-controlled lockouts, it may be useful for the plant to provide locks and tags that are recognizable by plant personnel. The designated plant representative must advise the contractor of any special or unique hazards—to which the service contractor's workers could be exposed—and that related to the machinery, equipment, or process at the facility. The contractor's own lockout program must be either replaced with the plant's program or coordinated with the plant's hazardous-energy control program. The program that is used must be understood and agreed upon by both parties, and communicated to all workplaces parties involved in the operation.

Discontinued Use

Equipment, installations, and conductors that will not be used for the purpose for which they were designed must be removed or left in a non-hazardous condition by being:

- disconnected
- de-energized
- tagged
- either grounded (if a powerline) or locked out (in the case of electrical equipment).

Planning

Specific step-by-step procedures to meet lockout objectives will vary depending on the work to be done and the processes to be shut down. Figure 31 on page 8-5 gives a general outline for developing a specific procedure.

Lockout Planning Steps

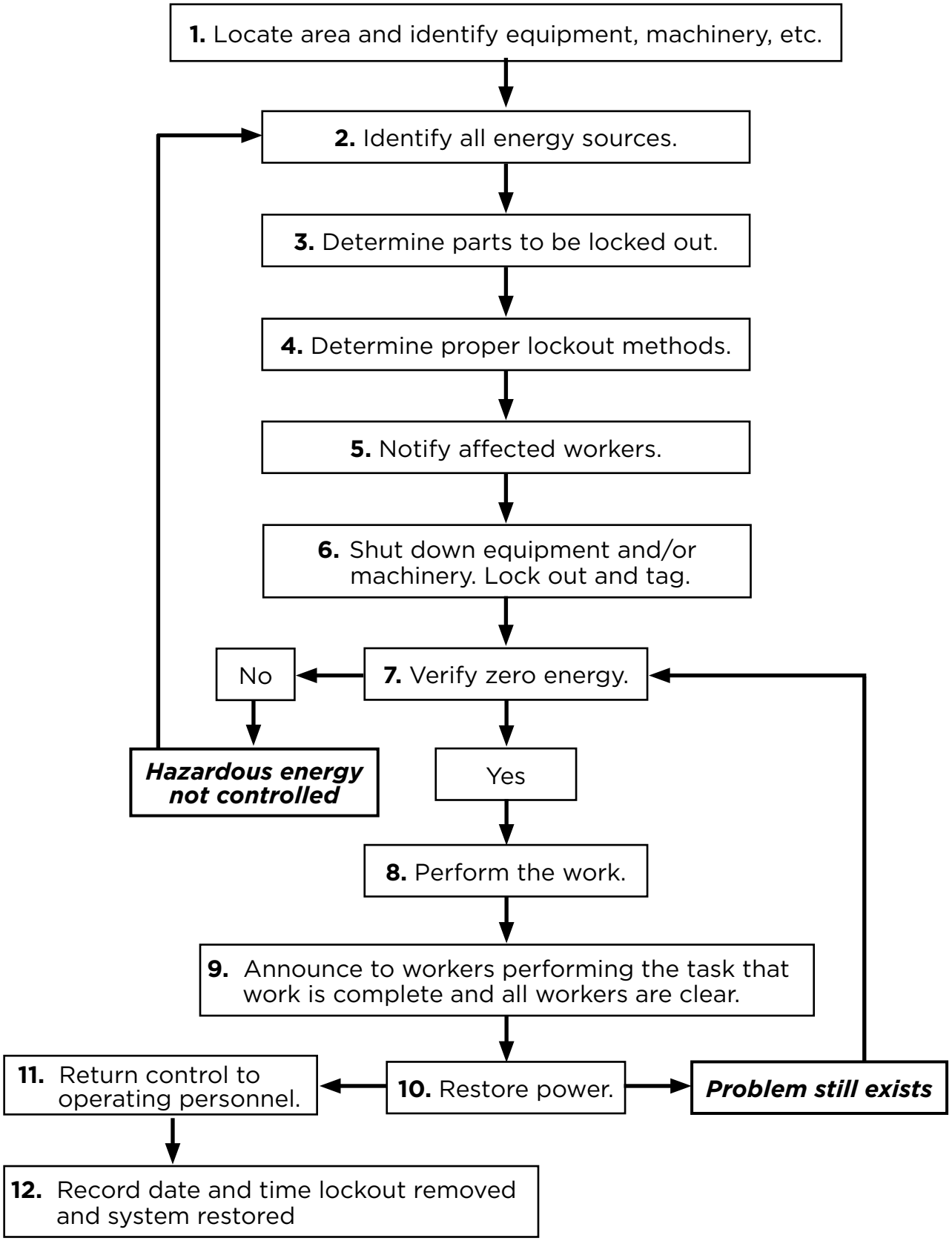
Step 1:

Locate the work area and identify equipment, machinery, or other system components to be worked on.

Identify the area with references such as floor, room name, elevation, or column number. Identify the equipment that is the target of the work, such as

- chiller, boiler unit, assembly line, cooling tower, hydraulic compressed-gas lines, etc.
- electric motors, gears, and other equipment components.

Figure 31: Lockout Planning Steps



Step 2:

Identify all energy sources.

All energy sources affecting the equipment or machinery must be identified. Identify energy sources to be locked out, such as electrical, momentum, pneumatic, hydraulic, steam, elastic, and gravitational.

Step 3:

Determine parts to be locked out or isolated.

Identify systems that affect, or are affected by, the work being performed. These may include primary, secondary, backup or emergency systems, and interlocked remote equipment.

Review current system drawings for remote energy sources and, when required, identify and confirm with the client or owner any switches, power sources, controls, interlocks, or other devices necessary to isolate the system.

Remember that equipment may also be affected by

- time restrictions for completing the work
- time-activated devices.

Step 4:

Determine which lockout method(s) to use.

Determine if the lockout of all energy sources is possible. Some equipment may have to be kept operational to maintain service to other equipment that cannot be shut down.

Take steps to provide protection for workers while they are working near this equipment. Other equipment that can be locked out must be locked out by the method(s) most appropriate to the hazards present.

Step 5:

Notify all personnel affected.

Shutting down equipment may affect operations in other parts of a plant, incoming shifts, or other trades that may be planning to operate the locked-out system. Before proceeding with the lockout, inform everyone who will be affected.

At construction sites with a large workforce or at relatively large factories, special methods of communication and permits or approvals may be required.

> In-plant procedures specified by the owner or client take precedence over the procedures outlined here, provided there is no contravention of legislation.

Step 6:

Shut down equipment and machinery. Then lock it out and tag it.

Qualified personnel must do the following:

1. **Shut down the equipment**, machinery, or other system components identified.
2. **Install lockout devices** (such as locks and lockout bars), and attach tags indicating name, employer, time, date, and reason for the lockout.

All apparatus that is capable of being energized or activated electrically, pneumatically, or hydraulically must be de-energized or de-activated by physically disconnecting or otherwise making the apparatus inoperable.

Switches, power sources, controls, interlocks, pneumatics, hydraulics, computer-controlled sources, robotics, or other devices must be locked out and tagged by each worker involved in the operation.

Step 6 is complicated and requires more detailed explanation (see pages 8-6 to 8-9). Step 7 of the Lockout Planning Steps can be found on page 8-9.

---

1) Shut down the equipment and place it in a zero energy state.

Always make sure the client and operators are aware of the plan to shut down and lock out equipment, machinery, or other system components. In some cases, certain components must be shut down by operations personnel or equipment operators because of their special qualifications or knowledge of the system.

In deciding what needs to be shut down and locked out, consider the different energy sources that may be found in the system. There are three general categories of energy to consider:

1. **Electrical Energy**
2. **Gravity or Momentum Energy**
3. **Stored Energy.**

1. Electrical Energy

To place an electrical system in a zero energy state, take the following steps:

1. Have main power shut off and locked out by, or under the supervision of, the person in charge.
2. First stop or shut down the machine in the normal manner, for example, by pushing the stop button, shutting off valves, opening bleed valves, or blanking lines as necessary. Turn off switches and controls.
3. After the machine has stopped, shut off the power in electrical lines. The main disconnect switch should be opened and locked in the open (OFF) position by the person in charge or by a qualified person under his direction such as an electrician (Figure 32).
4. Test for voltages with a CSA-certified potential tester to make sure each phase of the main disconnect has been de-energized. Ensure that all components are de-energized and de-activated, including interlocking or dependent systems that could feed into the system being isolated, either mechanically or electronically.

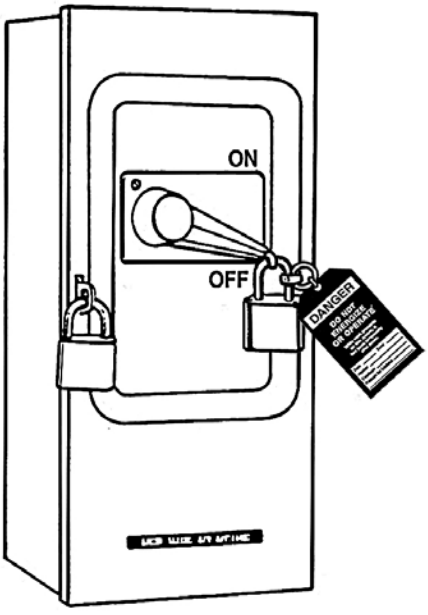


Figure 32: Electrical Lockout

Notes

- Before testing the components of a magnetic starter, be sure to turn off the manual disconnect switch and/or take out the fuses ahead of the magnetic starter. Always be aware that there may be more than one power source, and use proper fuse pullers (Figure 33).

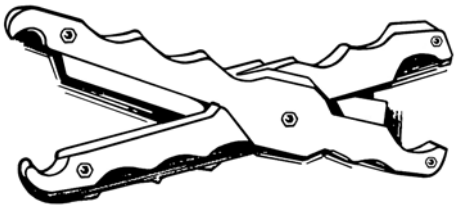


Figure 33: Fuse puller

- All electric motors and equipment with electric components, whether permanently installed or portable, must be grounded. That is, a ground wire must be connected to their frames and to earth, a water pipe, or other metal system in permanent contact with the earth.
- Ground all phases. The de-energized electrical system must be discharged by short circuit and phased to ground. A temporary ground cable must be attached to the system and remain in place until the work is finished.
- After the disconnect switch has been locked out, workers must keep clear of machinery until the start button or switch has been pushed to check that the correct master switch has been disconnected.

2. Gravity or Momentum Energy

To place system in a zero energy state, take the following steps:

- Allow parts to come to rest.
- Keep parts from moving by using clamps, pins, blocking, or chains.
- Relieve tension from springs.
- Control momentum by applying brakes.

3. Stored Energy

To place system in a zero energy state, take the following steps for each of the conditions indicated.

▶ **Changes of state**

Substances or environments can change with the work being done in the area. Beware of any dusts, fumes, smoke, mists, vapours, and gases that may form. Be prepared for liquids to solidify or solids to melt.

▶ **Chemicals**

Chemicals may be corrosive, noxious, toxic, or oxygen-depleting. They can be released or generated from the opening of enclosed systems, from trapped cleaning or flushing substances, and from incomplete cleaning or flushing of the system.

- **Gravity**

  Allow gravity-driven parts to come to rest. Check for components that may fall or move when pressure is released. Block, clamp, crib, pin, or chain as necessary.

- **Steam and heat**

  Allow system to cool. Check for vacuum in the system. Take care not to collapse equipment under vacuum conditions—in particular, cylinders, drums, and tanks.

- **Vacuum**

  A vacuum may be present under normal operations or as a result of a shutdown. Operate valves to bleed the system.

- **Cold**

  Allow the system to warm. Check for pressure buildup in the system. Take care not to exceed system pressures. Check that relief valves (if any) are working and not blocked or plugged. Relief valves may vent.

- **Refrigerant gases**

  Allow the system to equalize. Note energy stored in liquid, regulators, or powered control valves.

- **Pressure**

  Never rely on the system pressure gauges for an indication of pressure in the system. Bleed pressure off before opening the system.

Zero Energy State

Wherever possible, trace all systems to find energy sources and lock them out. For example, the main source may be electrical, but pneumatic and other forms of energy may also be involved. Always look for other possible energy sources.

Step 6-2:
Install lockout devices and attach tags

Locks

After the circuit has been de-energized and locked out by the person in charge, each worker involved in the lockout must be protected by placing his or her personal lock on the isolating device. The worker placing the lock on the isolating device must keep the key while the lock is in place.

Only the worker in charge of the lock should have a key. Locks should be of the high-quality pin type, key-operated, and numbered to identify the users.

Figure 34: **Safety Locks and Scissors**

Multiple Locks and Lockout Bars

When several workers or trades are working on a machine, a lockout bar can be used to allow for additional locks. Lockout bars can accommodate any number of locks if another lockout bar is put in the last hole of the previous bar.

Remember—Even though the disconnect is already locked out, you are not protected until you attach your own safety lock. If the lockout procedure does not permit individual workers to place personal locks on the isolating device or a lock box, the lockout then becomes a more complex procedure and requires other protective measures as part of a program to ensure that the protection achieved is equal to that obtained with a lock.

Notes

- Merely removing a fuse doesn't constitute lockout because the fuse could easily be replaced. The fuse should be removed and the box locked out.
- The attachment of lockout devices to one system should not prevent access to controls and energy-isolating devices for another system.
- If the lockout device will not accept a lock, take additional measures or use other lockout devices (e.g., blocks or cribbing) to prevent the device from being removed inadvertently.

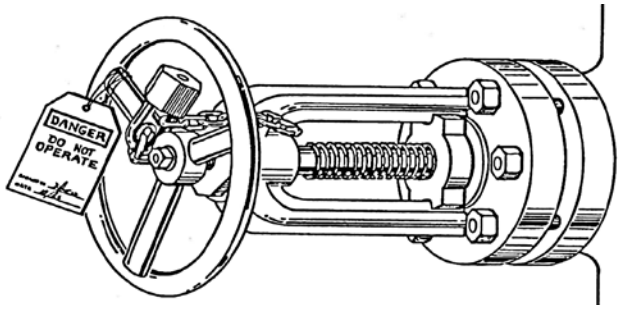


Figure 35: Valve Lockout

Lockout Devices

Scissors accommodate locks and should be made of hardened steel.

Chains should be high-quality and snug-fitting.

Blocks or cribbing prevent or restrict movement of parts.

Blanks or blinds are solid metal plates inserted (with gaskets) at flanged connections to prevent the flow of liquids or gases (Figure 36).

Pins and clamps should be of high-quality materials and designed to fit the system.

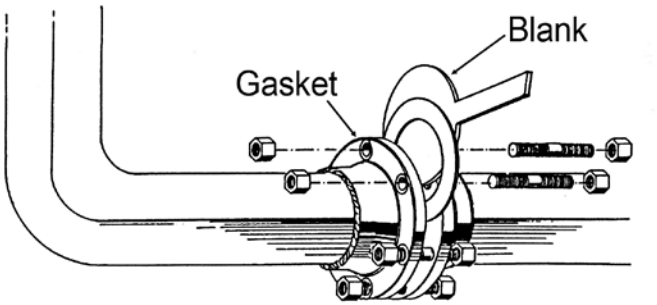


Figure 36: Blanked Flange

Tags

Each worker involved in a lockout operation should attach a durable tag to his or her own lock. The *Danger Do Not Energize or Operate Tag* (V011) shown in Figure 37 is available to order from **ihsa.ca/products**.

The tag must show the worker's name, the worker's employer, the date and time of lockout, and the reason for the lockout. Be aware that a tag in itself is no evidence that a machine or system is locked out. It simply provides information about the lockout.

Signs or stickers should also be placed on the system indicating that it is not to be energized or operated, and that guards, locks, temporary ground cables, chains, tags, and other safeguards are not to be tampered with or removed until work is complete. *Danger Do Not Operate Stickers* (S025) and *Danger Alive Tags* (V003) are also available to order at **ihsa.ca/products**

Figure 37: Lockout Tags

Step 7: Verify Zero Energy State

Test the system to ensure that all electrical components are de-energized and de-activated, including interlocking and dependent systems that could feed into the system, either mechanically or electrically. After any power or product remaining in the equipment has been discharged or disconnected by a qualified person, verify that everyone is clear of the equipment. Using caution, try to start the equipment manually. Look for any movement or functions. If none are observed, reconfirm that all energy sources are at zero energy state.

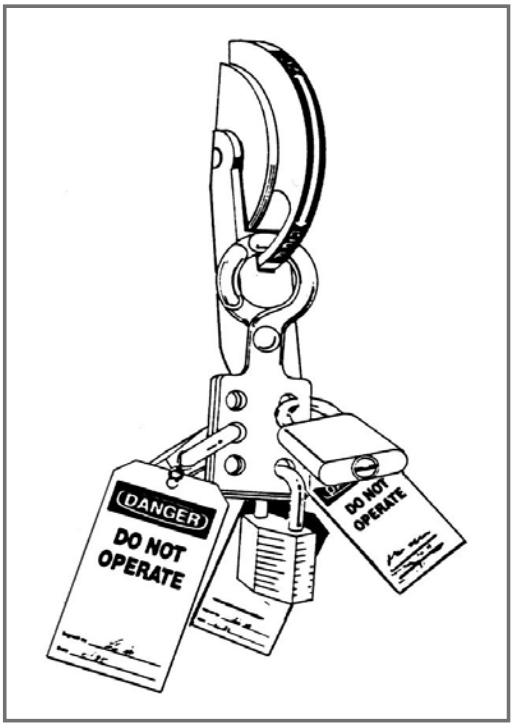


Figure 38: Multiple Tags

Step 8:

Perform the Work

Carry out and complete the work assignment.

Step 9:

Communicate that work is complete and all personnel are clear

Notify plant operations and those involved in the work, that work is complete and that everyone is clear.

- Make sure everyone is clear of the locked-out equipment, machinery, or system.
- Make sure each worker removes only his or her own lock and tag.
- Tell everyone who was originally informed of the lockout that the equipment, machinery, or system is no longer locked out.

Note: This is a critical part of lockout that too often results in injury. If workers are not careful, those who remain in a work area or re-enter later may believe that the equipment is still inoperable, when in fact lockout devices have been removed. Even though systems may not have been re-energized, once locks have been removed, energy isolation devices are free to be operated and release energy.

Step 10:

Restore Power

Return systems to operational status and switches to power-on positions. Have qualified persons restart the machinery or equipment if necessary.

Step 11:

Return Control to Operating Personnel

When all work is completed, the person in charge of the lockout operation should formally return control of the equipment or system to the operating personnel.

Step 12:

Record Date and Time That Lockout Was Removed and System Restored

This last step is important. It records and saves information that might otherwise be lost. Persons who were involved in the shutdown may not always be there, and owners or operators may need this information to help them plan future shutdowns.

Summary

Lockout may consist of a single mechanic working alone to torque down some bolts. Or it may involve hundreds of workers. In either situation, a procedure for safe lockout and tagging must be written down and followed step-by-step.

Lockout and tagging procedures help to ensure

- that all energy sources are identified and locked out
- that energy is not inadvertently restored while work is proceeding
- that maintenance, repair, installation, and other jobs can be done safely
- that records are kept.

Always prepare your lockout plan for the specific machine or system you will be working on. Take your time to be certain that ALL energy sources are locked out. Achieving and confirming a zero energy state is your assurance of safety during any lockout operation.

Example of a Lockout

A contractor has successfully bid on a project to rehabilitate an electrostatic precipitator (Figure 39). The project will require replacement of electrodes and worn plates in ductwork elbows, collecting surfaces, and hoppers, as well as repairs to the hanger-frame assembly structure.

How the System Operates

- Gas and fumes from a boiler enter the precipitator through the boiler exhaust duct. A forced-draft fan at the precipitator keeps the gas and fumes flowing at a constant speed. The boiler exhaust ducts connect several boilers, all with induced-draft fans. The stack breeching connects two precipitators, one of which will continue to operate while the other is taken out of service.
- In the precipitator, large high-voltage electrodes attract and clean the particulate in the fumes so that the emission can then be exhausted to the atmosphere in the stack system.
- The gas discharged from the precipitator is fed to the stack breeching by an induced-draft fan. The gas then flows through the stack breeching to the stack.
- In the precipitator, water is introduced to create a slurry of water and particles.
- The water and light particulate slurry will be pumped to a settling pond.
- A check valve is located on the discharge side of the pumps. Water entering the precipitator from the plant water system may be shut off by a hand-operated valve on the inlet line.

A preliminary meeting of the contractor, the supervisor, and the the in-plant personnel has verified that a lockout system used by the plant for such work will be in effect. Workers must also be trained in procedures for working in confined spaces before the job starts.

The following energy sources are identified:

- pressure from the boiler exhaust gas ducts
- electricity to the forced-draft fan in the ductwork leading to the precipitator
- electricity to the transformer rectifier feeding the electrodes
- capacitance in the electrode system
- open-top screw conveyors in the collecting area of the precipitator

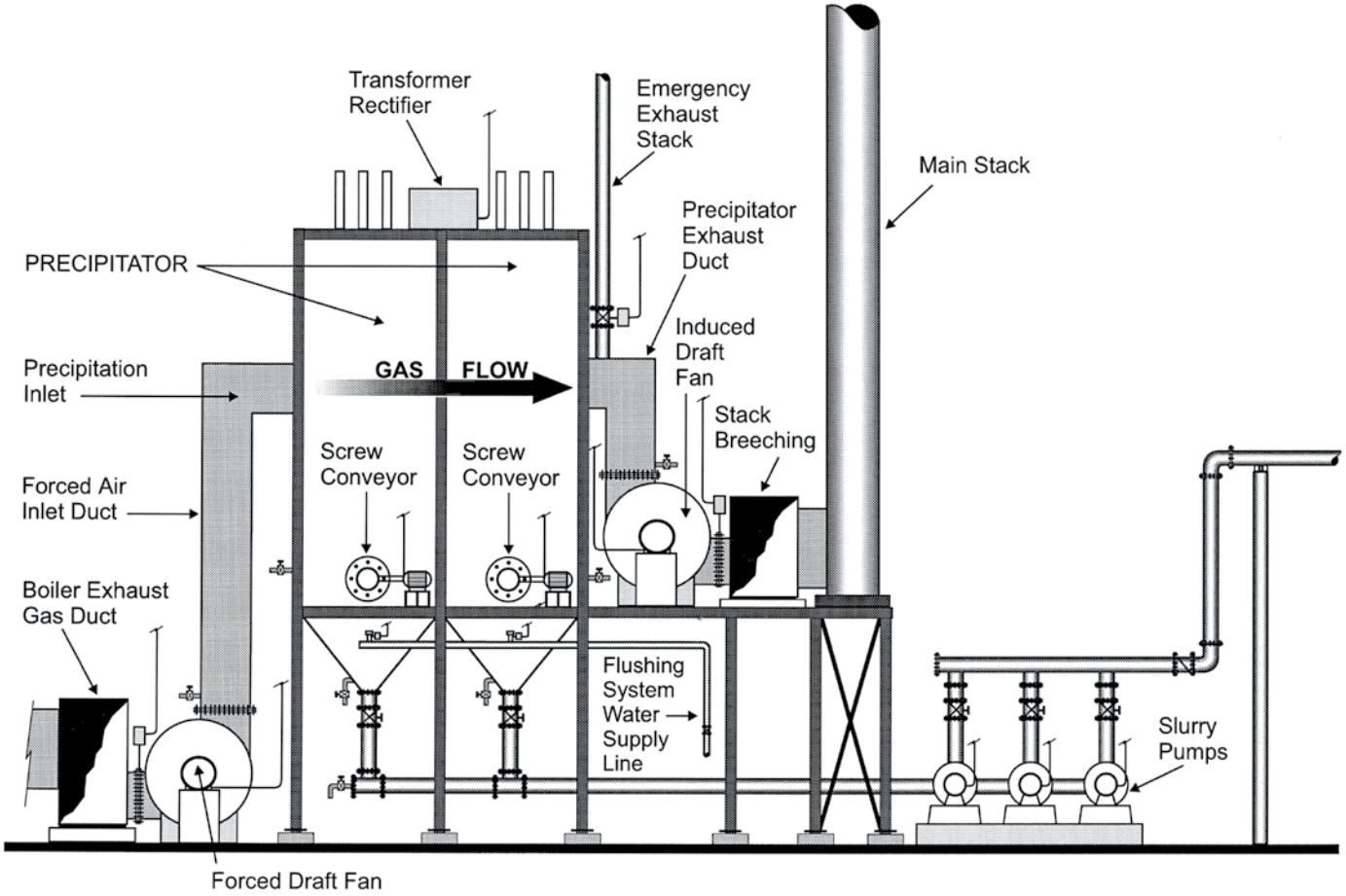


Figure 39: Precipitator

- water pressure from the water-flushing system fed by the plant's water supply
- electricity to the pumps removing slurry from the hoppers to the settling pond
- slurry back pressure due to the elevation of the settling pond
- electricity to the induced-draft fan removing gas from the precipitator
- gas under pressure in the exhaust gas stack breeching
- instrumentation for fan speed and flush valve operators

There is a 48-in electrically or air-operated slide gate at the boiler exhaust gas breeching. The slide gate operator is attached to the boiler control room. Another precipitator beside the one that will be repaired will continue to operate. Therefore the system must be isolated from the boiler exhaust gas breeching and the precipitator exhaust gas breeching. The client and contractor have agreed that the boilermaker repair crew will apply the lockout under the supervision of the boiler shift manager. The boiler shift manager will sign the work permit before work is allowed to start. The contractor has conducted a training session to familiarize his crew with plant procedures.

To prepare for the lockout, the following actions are taken:

- Plant employees are reminded that precipitator No. 1 is being taken out of service at 8:00 am,
- At 8:15 am, the operator closes the 48-in slide gate from the exhaust gas duct in front of the boilers. The forced-draft fan is then shut down. Immediately after this, the 48-in slide gate on the exhaust duct from the induced-draft fan to the stack breeching is also closed and power to the induced draft fan is shut off.
- Simultaneously, the 12-in valve on the emergency exhaust stack is opened to allow gases in the precipitator to escape.
- Air vent lines to the forced-air inlet duct, the precipitator, and the precipitator exhaust duct are attached to the in-plant air system. These airlines are then opened to help vent process gases and to cool the precipitator and attached systems.
- While the system is being vented by the plant operators, the contractor's supervisor and the boiler plant supervisor confirm that the 48-in slide gate to the forced-draft fan from the boiler exhaust gas duct has been closed. Lockout scissors are then placed on this slide gate to prevent it from opening. The supervisor or an assigned person responsible for the lockout attaches a lock to the scissors. A tag is also attached (Figure 40).

Figure 40: Tag Information

- The keys from each individual lock applied by the assigned person are placed in a lockbox. Each crew member will attach a personal lock to the lockbox.
- The motor control centre for the forced-draft fan is located in the electrical room; it is released and locked out by means of scissors with personal locks and tags as in the previous step.
- The crew next moves to the induced-draft fan along with the boiler plant supervisor and places scissors with personal locks and tags on the 48-in slide gate as before.
- The group then returns to the control room and locks out the motor control centre for the induced-draft fan, again attaching scissors, locks, and tags.
- During these activities the inner workings of the precipitator have remained fully powered. A check on the gas leaving the emergency vent stack shows that the boiler exhaust gas level is not detectable, so the precipitator internal system, with the exception of screw conveyors and hopper flushing systems, is shut down.

- The power supply to the transformer and rectifier is disconnected, and lockout scissors, personal locks, and tags are attached as before.
- A boiler plant electrician attaches a ground connector to the safety grounding device to discharge capacitance in the system and confirms that the system is dead by testing it.
- It is almost two hours since the system was isolated from the boiler breeching. By observing the clarity of the flush water on the flush line drain, the plant supervisor determines that the screw conveyors and the flushing system can be shut down.
- The screw conveyors are shut down first. The motor control centres are locked out, and scissor locks and tags are attached. There are four of these conveyors.
- The pumps for the flushing-system water supply and the slurry pumps cannot be shut down because they are connected to other precipitators. They must be isolated from the precipitator that will be worked on. The water supply line valve is closed manually and locked with scissors and a chain with locks and tags attached. These lines are blanked off.
- The drain valves on the hopper are opened, and when water stops running out, the suction lines on the slurry system at the bottom of the hopper are closed manually and locked with a chain, scissors, and tag. These lines are also blanked off.

> **Note:** Work performed in confined spaces is subject to the requirements of a confined space program.

- Boiler exhaust gas levels are checked by inserting probes into the hoppers, upper precipitator, and inlet and exhaust ducts. Only trace levels of gas are detected, and the boiler plant supervisor gives the contractor's crew the okay to remove sections of pipe between the water valves and the hopper. This will provide ventilation to the whole system and allow material in the hoppers to drop out. At this point the system is allowed to purge and cool through natural ventilation until the next morning.
- The following morning at 8:00 am, the plant technician again tests the ducts, hopper, and precipitator for pockets of harmful gas and for adequate oxygen levels. No boiler gas is detected, and adequate oxygen is present. Hatch covers at the top of the precipitator are removed, and testing probes are extended into the centre of the precipitator from the top hatch. When no gas is detected, the boiler plant supervisor issues the permit to allow the contractor to start work.
- Before work begins or anyone enters the system, Joe and his crew go over the system from the slide gate at the boiler exhaust gas duct to the slide gate at the exhaust gas breeching to the stack to verify that lockout and zero energy state are still in effect. After checking that everything has been shut off and/or all energy sources have been neutralized, Joe gets the crew organized to start work.

When the work is finished, the following actions are taken:

- Joe informs the boiler plant supervisor that the precipitator is ready to go back on line. The boiler plant supervisor checks the work over inside and outside. When he is satisfied that everything is satisfactory, the system is ready to be activated. Temporary air line valves are closed and air lines removed. Hatches are replaced on the top of the precipitator. Disconnected suction pipes are reinstalled at the bottom of the hoppers. The valve on the emergency exhaust stack is closed. Drain lines on the hoppers are closed. The system is basically restored to startup readiness.
- All personnel are accounted for, and a start-up procedure begins. Crew members remove their locks from the lock box, and the authorized lockout person removes the locks installed on each lockout device. Blanks and other lockout devices are also removed in a coordinated manner. When all locks and lockout devices have been removed, control is turned over to plant operations to re-energize the system.
- In general, the first startup operation is to open the 48-in slide gate from the boiler breeching to the forced-draft fan. The forced-draft fan is then turned on, along with the transformer rectifier and the induced-draft fan. The 48-in slide gate to the stack breeching is then opened, and the gas system is in operation. Next, the flush water is turned on and valves to the slurry suction line are unlocked and opened.

CHAPTER 9—Confined Spaces

Before a worker enters a confined space, the employer must develop a written Confined Space Program that meets the requirements of Regulation 632, Confined Spaces. The employer must maintain the program.

Confined Space Program

A confined space program must include these elements:

1. a method for **recognizing a confined space**
2. a method for **assessing the hazards** to which workers may be exposed
3. a plan for **controlling the hazards**
4. a method for **training workers**
5. an **entry permit system** setting out measures and procedures to be followed by everyone working in a confined space.

1. Recognizing a Confined Space

As defined by Regulation 632, a confined space is a space

1. that is **partially or fully enclosed**,
2. that is not both designed and constructed for **continuous human occupancy**, and
3. in which **atmospheric hazards** may occur because of its construction, location, or contents, or because of work that is done in it.

All three criteria have to be met before a space is defined as a confined space.

Air cannot move freely in and out of a partially or fully enclosed space, so there is a potential for a hazardous atmosphere to be generated inside.

A confined space is not designed or constructed to be worked in regularly. It is usually intended for storing material, transporting products, or enclosing a process. But occasionally, some work must be done inside the space.

A hazardous atmosphere is one that contains any of the following:

- an accumulation of flammable, combustible, or explosive agents
- less than 19.5% or more than 23% oxygen
- an accumulation of atmospheric contaminants that could pose an immediate threat to life or interfere with a person's ability to escape unaided from a confined space.

2. Assessing the Hazards

Each time before a worker enters a confined space, a person with adequate knowledge, training, and experience must do a written hazard assessment.

The hazard assessment must take the following into account:

- the hazards that may exist in the confined space
- the hazards that may develop while work is done inside the confined space
- general safety hazards in the confined space.

The employer must ensure that the assessment remains up-to-date. If the chemical hazard changes because of a change in process or equipment, then the assessment must be changed.

An assessment is generally required for each confined space. But if there are two or more similar confined spaces containing the same hazards, only one assessment is needed.

Hazards in confined spaces can be divided into two categories**:**

1. **Physical hazards**
2. **Atmospheric hazards.**

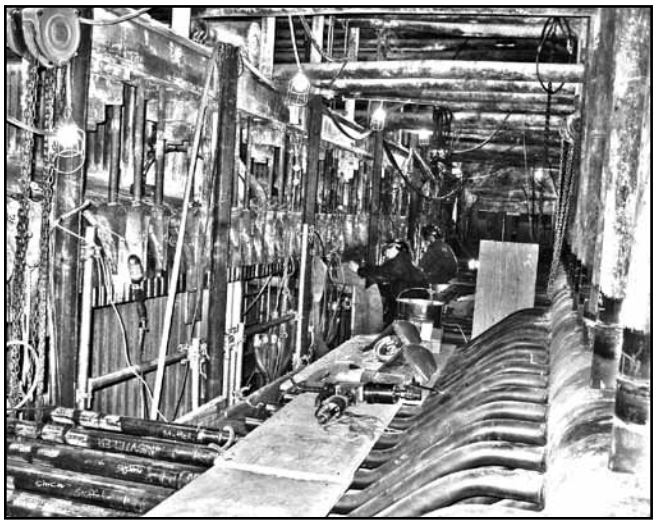


Figure 41:
Examples of Confined Spaces

Physical Hazards

Physical hazards often present a greater danger inside an enclosed space than they do outside. These are the most common physical hazards:

- noise and vibration
- temperature extremes
- cramped work spaces
- poor access or means of exit
- rotating or moving equipment
- electrical hazards
- engulfment hazard from the uncontrolled movement of liquids and solids
- slick or wet surfaces
- inadequate lighting.

Atmospheric Hazards

In general, three kinds of atmospheric hazards may be found in a confined space:

1. flammable, combustible, or explosive atmospheres
2. oxygen-enriched or oxygen-deficient atmospheres
3. atmospheric contaminants.

Atmospheric hazards may be caused by existing conditions (e.g., residue in a tank), or they may be created by work being done inside the confined space (e.g., welding, cutting, or gouging). In some cases, the removal of sludge or scale can release pockets of gas or vapour and create a hazardous atmosphere.

Flammable, Combustible, or Explosive Atmospheres

Flammable atmospheres are generally caused by

- evaporation of flammable liquids (e.g., gasoline)
- by-products of chemical reactions (e.g., decomposition of organic matter to form methane).

Explosive atmospheres are those in which a flammable gas or vapour is present in quantities between the lower explosive limit (LEL) and the upper explosive limit (UEL). These limits define the "explosive range," which varies from one substance to another. For that information, refer to the Material Safety Data Sheet (MSDS) for the product.

The LEL is the lowest concentration of gas or vapour that will support combustion, and the UEL is the highest. For example, gasoline has an LEL of 1.4% and a UEL of 7.6%. Below 1.4% there is not enough fuel to burn, while above 7.6% there is too much fuel and not enough oxygen to burn (Figure 42).

Combustible atmospheres can occur in some industrial buildings, such as bag houses, because of the large quantities of dust that is generated. You need to recognize that possibility whenever you are working in those places.

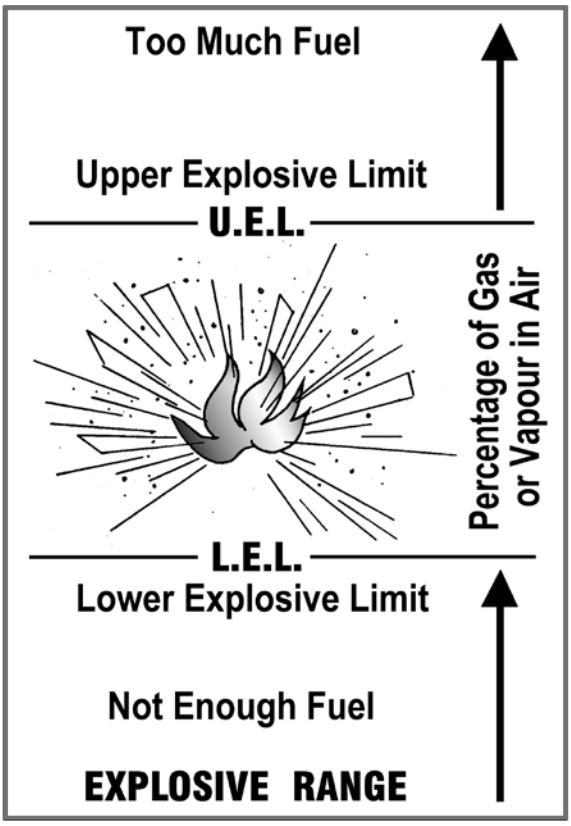


Figure 42: Explosive Limits

Oxygen-Enriched and Oxygen- Deficient Atmospheres

Normal outside air contains about 21% oxygen. If the concentration of oxygen exceeds 23%, it is considered "enriched" and will increase the flammability of a material. Oxygen-enriched atmospheres usually occur when pure oxygen is escaping from a leaking or ruptured oxyacetylene hose or—on projects in industrial plants—from an oxygen line in an industrial or manufacturing process.

Oxygen-deficient atmospheres may result from

- work being done (such as welding)
- bacterial action (which consumes oxygen)
- chemical reactions (such as rusting).

Oxygen may also be displaced by another gas or vapour (e.g., carbon dioxide or nitrogen used to purge tanks, pipe, and vessels).

Atmospheric Contaminants

Because confined spaces are poorly ventilated, atmospheric contaminants can build up to dangerous levels very quickly. For construction in an industrial setting, the kind of airborne hazard that may be encountered depends on

- products stored in the confined space
- the kind of work being done in the confined space
- the work or processes near the confined space.

The most common atmospheric contaminants in construction include hydrogen sulphide, carbon monoxide, sulphur dioxide, chlorine, and ammonia.

3. Plan for Controlling Hazards

Once the hazards have been identified in the assessment, a person with adequate training, knowledge, and experience must develop a plan to eliminate or control the hazards. The goal is to eliminate the hazard before anyone enters the confined space. If that is not possible, then controls, measures, and procedures must be put in place to ensure that workers are not in danger.

If more than one confined space is of similar construction and presents the same hazards, a single plan may be used for all of them. However, each confined space must be identified in both the hazard assessment and the plan.

The plan is the program element that has to meet the most regulatory requirements. Section 7 (3) of the Confined Spaces Regulation lists 11 things that must be in the plan:

1. Duties of workers
2. Co-ordination document (prepared by the constructor) if workers of more than one contractor will enter the same confined space
3. On-site rescue procedures
4. Rescue equipment and methods of communication
5. Protective clothing and equipment
6. Isolation of energy and control of material movement
7. Attendants
8. Adequate means of entering and exiting the space
9. Atmospheric testing (conducted by a competent worker)
10. Adequate procedures for working in the presence of explosive or flammable substances
11. Ventilation and purging.

Duties of Workers

a) If the confined space has been left unoccupied and unattended, do not enter or re-enter unless testing has been done.

b) Know the hazards that you may encounter when you enter the space.

c) Know how to use the equipment properly (including personal protective equipment and tools).

d) Maintain communication with the attendant so that he or she can monitor your safety and be able to warn workers to evacuate the confined space in an emergency.

e) Alert the attendant whenever
   - you recognize any warning sign or symptoms of exposure
   - you see a dangerous situation
   - an alarm is activated.

f) Get out of the confined space immediately whenever
   - a warning system indicating a ventilation failure is activated
   - the attendant gives an evacuation order
   - a worker recognizes any signs or symptoms of exposure
   - a person inside detects a dangerous condition
   - an evacuation alarm is activated.

Co-ordination Document

When workers of more than one employer are working in the same confined space, the constructor must coordinate entry into the space. A copy of the coordination document must be provided to each employer of workers who perform work in the confined space and to the project's Joint Health and Safety Committee or health and safety representative.

Rescue Procedures

The confined space plan must include written procedures for safe on-site rescue that can be followed immediately in an emergency. Enough people must be available to carry out the rescue immediately. They must be trained in

a) the on-site rescue procedures

b) first aid and cardiopulmonary resuscitation (CPR)

c) how to use the rescue equipment necessary to carry out the rescue.

Dialing 911 is not an adequate rescue response.

Rescue Equipment and Communications

The rescue equipment must be readily available, suitable for the confined space, and inspected by a person with adequate knowledge, training, and experience. That person must keep a written record of the inspection. Rescue equipment might include harnesses and lifelines, hoist or retrieval systems, respirators, and other personal protective equipment.

Even with the best planned and executed entry, conditions may suddenly change. The change could be due to factors recognized earlier but for which no absolute protection exists, such as the failure of a respirator, the introduction of a new hazard, or a heart attack or sudden illness. In such cases, you need a rescue plan that has been practised and that works.

Protective Clothing and Equipment

Protective clothing and equipment that are suitable for one situation may not be suitable for others. For example, polyvinyl chloride (PVC) plastic is resistant to most acids, but it can be softened or penetrated by many common solvents such as benzene, toluene, and xylene. For that reason, a knowledgeable person should assess the protective clothing and equipment needed (e.g., gloves, boots, chemical suits, and fire-resistant coveralls—as well as hearing, respiratory, eye, and face protection). Don't forget that if workers need personal protective equipment, they must be trained in its use.

Where ventilation is impractical or inadequate, respiratory protective equipment should be used. Certain basic rules apply to the equipment. The proper kind of respirator must be chosen. Oxygen-deficient atmospheres require supplied-air respirators—either air line with emergency reserves or SCBA (self-contained breathing apparatus).

When respirators are used, they should be approved by the National Institute of Occupational Safety and Health (NIOSH). Someone who is competent in respirator selection must decide what kind of respirators to use.

Workers required to wear respirators must be fitted for them and instructed in how to inspect, use, store, and maintain them.

Isolation of Energy and Control of Material Movement

Equipment that moves in any way (even rotating) must be isolated by

- disconnecting the equipment from its power source and de-energizing the equipment, or
- lockout and tagging.

See Chapter 8 on tagging and lockout in this manual.

Attendants

An attendant must be present whenever a worker enters a confined space. The attendant is not allowed to enter the confined space unless he or she is replaced by another attendant in accordance with the plan.

The attendant must do all of the following:

- remain alert outside and near to the entrance
- be in constant communication (visual or verbal) with all workers in the confined space
- monitor the safety of workers inside the confined space
- give assistance as necessary
- have a device for summoning help in an emergency
- start an adequate rescue procedure in an emergency.

Entry and Exit

The means of entry and exit can be evaluated before entry by checking drawings, by using prior knowledge, or simply by inspecting from outside the space. Openings to confined spaces are generally small and not well situated. For those reasons, the movement of workers and equipment in and out of confined spaces will be restricted. That must be considered in the rescue plan. Entry and exit for top-side openings may require ladders. Ladders must be well secured. An emergency rescue of workers trapped in such places requires careful planning and practice.

Atmospheric Testing

If the hazard assessment finds that there is an atmospheric hazard in the confined space, atmospheric testing must be performed.

a) The employer must appoint a person with adequate training, knowledge, and experience to conduct tests safely before and during the time a worker is in a confined space to ensure that acceptable atmospheric levels are maintained. The person who will do the tests must receive training in the operation, calibration, and maintenance of the instruments. Most manufacturers can provide the necessary training.

b) If the confined space has been left unoccupied and unattended, the testing must be done again.

c) The person with adequate training, knowledge, and experience performing the tests must use properly calibrated and maintained instruments that are suitable for measuring the hazards in the confined space.

d) The results of every sample tested must be recorded on the entry permit. If continuous monitoring is performed, the results must be recorded at adequate intervals.

No one must be allowed to go into a confined space until the necessary tests have been done.

Continuous monitoring is required while hot work is being done

(a) in a confined space with a potentially flammable or explosive atmosphere, or

(b) in a confined space where the flammable or explosive atmosphere has been rendered inert by the addition of an inert gas.

Continuous monitoring should also be considered when conditions in the confined space change rapidly. The test results of continuous monitoring must be recorded at regular intervals.

The equipment's limitations must be known. Consult the manufacturer's instructions for proper use. Temperature, humidity, and interference by other gases can all affect the performance of gas monitors.

If the atmosphere meets acceptable exposure limits, the confined space may be entered. If the atmosphere does not meet acceptable limits, you need to implement controls before anyone can enter.

The test results must be recorded on the work entry permit. The records must be kept by the constructor or employer for at least one year after the project is finished.

Explosive or Flammable Substances

No worker may enter a confined space if airborne combustible dust or mist is present in a concentration sufficient for explosion. If an explosive or flammable atmosphere is detected, work may only be performed under the following conditions:

a) Between 0% and 5% of the LEL, you may do hot work. The following conditions must also be met:

- The oxygen content must be maintained below 23%.
- The atmosphere must be monitored continuously.
- The entry permit must include adequate provision for hot work, and it must specify the measures to be taken.
- An alarm and exit procedure must be in place to provide adequate warning and allow safe escape if the atmospheric concentration exceeds 5% of the LEL or if the oxygen content exceeds 23%.

b) Between 0% and 10% of the LEL, you may do cold work.

c) Between 0% and 25% of the LEL, you may do inspection work.

Alternatively, work may be done in the confined space if the explosive or flammable atmosphere is rendered inert by an inert gas (such as nitrogen, argon, helium, or carbon dioxide). The atmosphere

must be monitored continuously to ensure it remains inert. The worker in the confined space must use adequate respiratory equipment, as well as equipment that will help people outside the confined space find and rescue the worker if necessary.

Ventilation and Purging

The most effective method of controlling atmospheric hazards in a confined space is by ventilation and purging. The space can be purged of dangerous atmospheres by blowing enough fresh air in and/or by removing (or suction venting) the bad air and allowing clean air in (Figure 43). Blowing fresh air into a space close to the bottom is more effective than suction.

4. Worker Training

Workers must be trained before they enter a confined space. The training must include

- recognizing the hazards (including potential hazards) in the confined space
- safe work practices, including the use of all equipment such as ventilation equipment, air monitors, and personal protective equipment.

5. Entry Permit System

Permits are valuable tools for planning, evaluating, and controlling confined space entries. A permit is part of a formal system of procedures; it is issued by the employer before any worker enters the confined space. Before every shift, a competent person must verify that the permit issued complies with the plan. An entry permit must not be valid for longer than the time needed to perform the task. Entry permits should be understood by everyone involved in the job and must be readily available to every person entering the confined space. A Confined Space Entry Permit can be found at the end of this section.

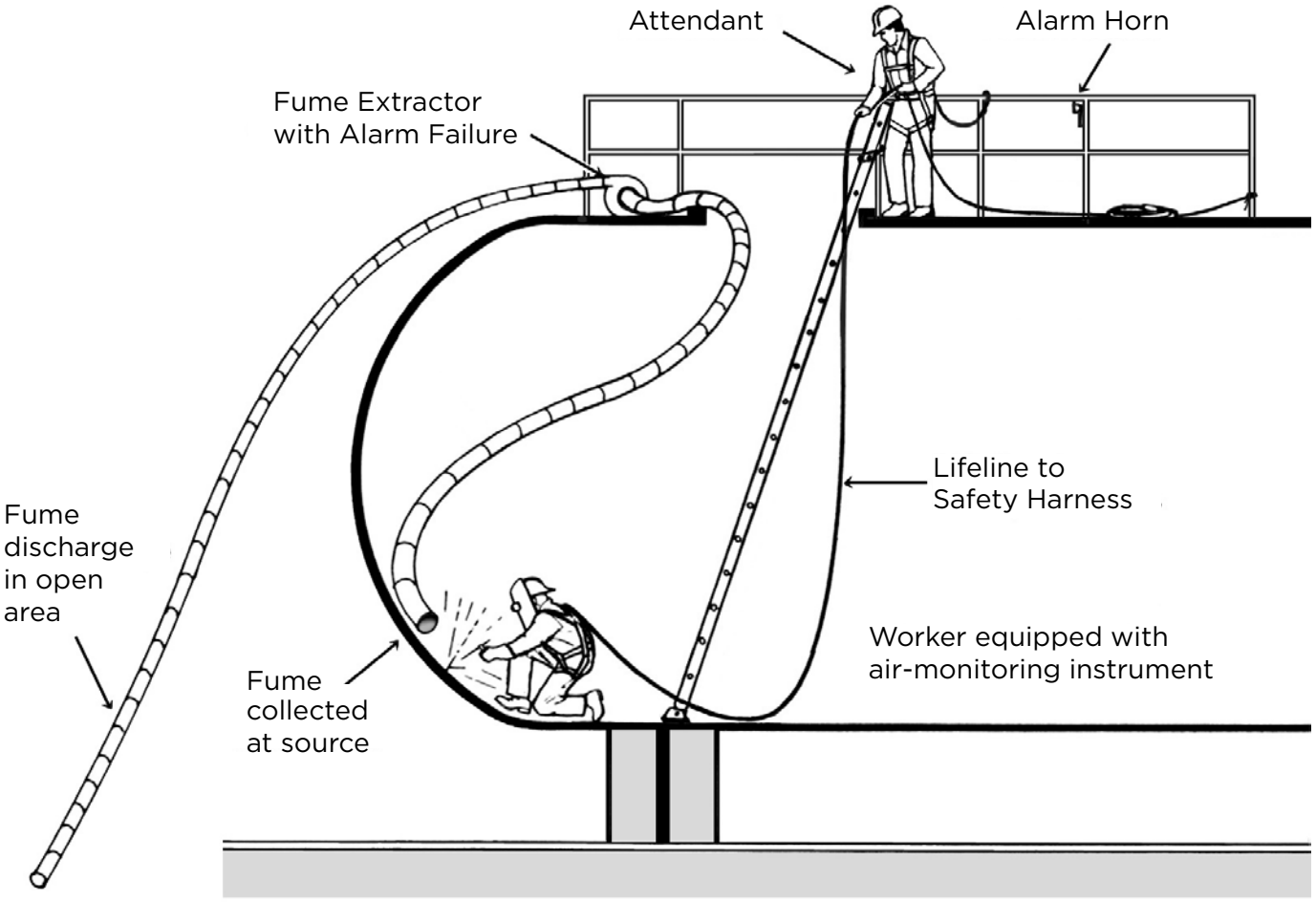


Figure 43: Ventilation and Purging

Record Keeping

The employers must keep records of every

- plan
- assessment
- coordination document
- training
- entry permit
- inspection of rescue equipment
- test.

The records must be kept for at least one year after the project is finished, and they must be available for inspection.

Coordination Document

If workers from more than one employer will be entering the confined space, the constructor must prepare a confined space coordination document. The coordination document sets out who does what to ensure all requirements of the confined space entry are carried out.

Sample Confined Space Entry Permit

Effective: _____ / _____ / _____ **From: ____:____** am pm **To ____: ____** am pm

Location	Location of Confined Space:	Project Name:
	Employer Name:	Competent Person:
	Assessment Performed by:	Name of Permit Issuer:
	Description of Confined Space:	
	Description of Work to be Performed:	

Note: The permit shall comply with the relevant plan.

Air Monitor Name	Serial #	Last Calibration/Bump Test

Air Quality Results	**Time of Test**							
	Oxygen %							
	Combustibles %							
	Carbon monoxide (CO)							
	Hydrogen sulphide (H_2S)							
	Other atmospheric hazard ( )							
	Tester's Name (print):			Signature:				

	Atmospheric/Physical Hazards	Controls	Personal Protective Equipment
Hazards & Controls	❑ Flammable ❑ Toxic ❑ Corrosive ❑ Oxygen deficient/enriched ❑ Hot temperatures ❑ Electrical ❑ Slippery surfaces ❑ Lighting ❑ Hot work ❑ Working at heights ❑ Other	❑ Purging ❑ Mechanical ventilation ❑ Natural ventilation ❑ De-energize, lockout ❑ Blank ❑ Inerting ❑ Other: _____ ❑ Other: _____ ❑ Other: _____	❑ Respirator ❑ Gloves ❑ Boots ❑ Eye protection ❑ Head protection ❑ Fall protection ❑ Other: _____ ❑ Other: _____ ❑ Other: _____

Attendant Entry Log	Worker Name	Permit Reviewed with Workers	Time In	Time Out	Time In	Time Out	Time In	Time Out
		❑						
		❑						
		❑						
		❑						
		❑						
		❑						
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		❑						
		❑						
		❑						
	Attendant's Name (print):			Attendant's Signature:				

Rescue Equipment				
	❑ Winch	❑ Respirator	❑ Ladder	❑ Tripod ❑ Harness
	Other:	Other:	Other:	Other:
	Rescue equipment inspected and in good working order? ❑ Yes ❑ No			

Confirmation of Work Completion	Signature	Date	Time

CHAPTER 10—Musculoskeletal Disorders

From *MSD Hazards and Controls: Boilermakers* (W313).

BOILERMAKERS

Musculoskeletal Hazards and Controls

Musculoskeletal disorders (MSDs), such as chronic back pain or shoulder problems, often take time to develop. Forceful exertion, awkward positions, hand-arm and whole-body vibration, contact stress, and repetitive tasks can add up over time to produce an MSD.

This profile can help you identify and control MSD hazards in your job. We recommend that you add the best practices outlined here to your company's health and safety program. The hazards in a particular job, however, may be different than the ones on this profile, so evaluate the risks of your specific work activities.

When implementing MSD controls, consider the following ergonomic principles:

1. ***Use material-handling equipment when possible.*** The best way to prevent an MSD is to eliminate or reduce the frequency of lifting, carrying, pushing, and pulling. Use material-handling equipment such as carts, dollies, pallet jacks, or manual forklifts.

2. ***Don't lift a load from the floor.*** Lifting from the floor or from below standing knuckle height can put severe stress on your back and reduce your lifting ability. To avoid this, store objects above standing knuckle height and below standing shoulder height.

3. ***Avoid working on the floor.*** Constantly working on the floor can result in injuries to your back, hips, and knees because you usually have to kneel and bend forward. When possible, raise the work height by using a workbench.

4. ***Avoid working above your shoulders.*** High lifting or constantly reaching above your shoulders can be harmful. Most of the work is being done by the smaller muscles in your shoulders and arms instead of by the larger muscles in your back and legs. When your arms are raised, the muscles fatigue more quickly because there is less blood flow. Also, there is a greater chance you could drop the object.

5. ***Get help with large loads or move smaller loads more often.*** Get help from a co-worker if a load is too heavy for you to handle on your own. If possible, divide the load into smaller loads. Smaller weights put less stress on your back than larger weights, even if you have to make more trips.

6. ***Consider exercise programs.*** Regular exercise not only helps prevent MSDs but also promotes general good health.

7. ***Minimize vibration exposure***. Vibration can be transmitted from work processes—such as operating hand-held power tools (hammer drills, chipping guns, jackhammers)—into workers' hands and arms. Frequent exposure to moderate and high-intensity hand-arm vibration can lead to permanent health problems.

New Construction, Maintenance, and Repair

Related components: steel plants (blast furnaces, stoves, coke ovens, tanks, stacks, vessels, ductwork), generating and penstock plants (boilers, ductwork, stacks, precipitators, scrubbers, tanks, rectifiers, burners, water heaters), refineries (towers, exchangers, stacks, crackers), pulp mills (boilers, tanks, ductwork, bag houses), vessels, tanks, towers, hoists, boilers, furnaces and other structures, ancillary equipment and fixtures made of steel, other metals, fibreglass, and other materials.

Tools and equipment: Lifting tools and equipment, levelling and alignment tools, common tools, regulations, and plant policies and procedures.

Tasks	What can happen (Hazards/Risks)	Potential Controls
Mobilizes for work ▶ Transports tools and equipment for maintenance and repair using cranes, forklifts, carts, dollies, etc.	▶ Swinging/dropping loads ▶ Pinch points ▶ Strains and sprains ▶ Heavy manual material handling	▶ Plan ahead to minimize material handling. ▶ Use mechanical lifting equipment whenever possible, especially when loading or unloading material. ▶ Use height-adjustable mobile lift tables for transporting material into the workshop. These tables can also be used to support material when loading machines. A smaller table can be used for smaller sheets of metal or small machines, such as a punch press. A larger table can be used for the “break and bending presses” and for incoming materials. ▶ Use hand trucks and carts when available. ▶ Use motorized pallet jacks whenever possible, especially when moving material frequently or over long distances. ▶ When using carts or hand trucks: • Select models with appropriate wheels for ground conditions. • Select models with swivel wheels on the rear and fixed wheels on the front to make pushing easier over long distances. • Maintain wheels in good condition. • Make sure handles are located at the rear of the cart and at waist level. • Make sure the load height on the cart does not obstruct your vision. • Keep the loads balanced and under the manufacturer's recommended weight limits. ▶ Push rather than pull because pushing reduces lower back bone-on-bone compression. ▶ Whenever possible, use overhead crane devices to lift and transport heavy items. When installing an overhead crane on site, ensure that the system or device is rated for the weight you are going to transport. Consider the movement patterns before installing the crane.

Tasks	What can happen (Hazards/Risks)	Potential Controls
		▶ Consider storing all materials in large containers to make transporting easier. This will reduce material handling and improve efficiency. Large quantities of material (e.g., cables, welding units, hoses, rigging equipment) can be transported at one time using a forklift or crane. ▶ Attach pulley systems to tools or equipment. This reduces the force needed to lift, position, or operate the tools or equipment. ▶ Implement a shelving system that makes it easier to store and move materials, tools, and equipment. The shelving system can position materials within easy reach, allowing you to lift or move objects without bending or twisting. If rack systems are used, store items between knee and shoulder height whenever possible. ▶ Use a pry bar whenever possible. ▶ Use tag lines when a load is above shoulder height. ▶ Use proper lifting techniques (i.e., lift materials with your legs, do not bend over or lift with your back, and keep the load close to your body). See the "Back Care" chapter in IHSA's *Construction Health and Safety Manual* (M029). ▶ Get help with heavy or awkward loads. ▶ Use ladders to climb on and off trailers. Do not jump. ▶ Use proper personal protective equipment when working with powered hand tools (e.g., hearing protection and double eye protection when welding, grinding, etc.). ▶ Consider using anti-vibration gloves to reduce the vibration transmitted to your hands and arms from tools such as grinders, needle guns, and sanders.
Assembles and fits components, fastens components, and repairs or replaces components ▶ Transfers components (hoisting and rigging equipment, carts, and dollies) ▶ Pre-assembles components (welding, bolting, rigging, and hoisting equipments)	▶ Personal injury (e.g., burns, strains, pinch points, etc.) ▶ Heavy manual material handling ▶ Hand-arm vibration exposure from air tools (e.g., impact gun, grinder, hand saw) ▶ Forceful hand exertions from working with hand tools (hammer and air tools)	▶ Use mechanical lifting equipment whenever possible, especially when loading or unloading material. ▶ Use auto-darkening helmets that darken as soon as the welding torch is activated. These helmets eliminate the need for you to snap your helmet closed. They promote neutral neck postures. ▶ Where welding sets have to be handled, select ones with comfortable, well-positioned handles so that you can easily carry them. Try to avoid protruding controls and vents. When selecting larger sets, look for ones that you can comfortably push or pull over uneven surfaces. ▶ Put your welding leads on pulleys. ▶ Use welding guns that have swivels and can be used in either hand.

Tasks	What can happen (Hazards/Risks)	Potential Controls
▶ Transports tools and equipment for maintenance and repair using cranes, forklifts, carts, dollies, etc. ▶ Secures components (securing, lashing, bolting, welding, clamping, and lifting/hoisting components) ▶ Expands tubes ▶ Bolts and tacks components ▶ Maintains and repairs components	▶ Awkward postures such as forward bending, working with your arms above shoulder height, and constant kneeling/squatting.	▶ Use pre-assembly and material handling equipment to reduce unnecessary lifting ▶ Sit on a work stool when the work is low. ▶ Use lifting and turning tables with wheels. ▶ Use a rotating clamp for pipes. ▶ Use a pry bar to avoid strains and pinch points. ▶ Position the work between your waist and shoulders (e.g., use a work table or workbench instead of bending over to work on the ground or floor). ▶ Consider using a sawhorse with a hands-free clamp system. These devices can reduce the force needed to position, turn, or rotate parts, tools, and equipment on a workbench. ▶ Get help with heavy or awkward loads. ▶ Keep cutting tools sharp to reduce the force required to cut. ▶ If you do a lot of cutting, use a power saw. ▶ When working, position yourself close to the work area and centre yourself to the work area to reduce overreaching or bending at the waist. ▶ Use hand tools that have, • low vibration and weight • a comfortable handle that provides a good grip, (e.g., rubber or spongy-type grips) • appropriate-sized grips that are designed to be used by either hand • a power grip for heavy work and a pinch grip for fine work • a neutral wrist posture • a torque reduction and low kickback where possible. ▶ If available, use a scissor lift or other work platform. ▶ Let your supervisor know if you need training on a new tool or process. ▶ Practise good housekeeping. Discard or pick up debris and scrap material to prevent repetitive bending, slips, trips, and falls. Keep pathways clear for carts, wheelbarrows, and dollies. ▶ Change your work position often. Working overhead or in a cramped space forces your body into an awkward posture. To relieve muscle tension and improve circulation, change body position, alternate tasks, and take stretch breaks throughout the day. ▶ When lifting objects, always keep the load or tool close to your body.

Tasks	What can happen (Hazards/Risks)	Potential Controls
		▶ Use portable electromagnetic and air presses that hold parts in place during installation operations. These devices can reduce the awkward postures and forceful exertions associated with manually clamping parts before and during installation. They can also significantly reduce the time needed to complete a job. ▶ Consider a three-point lift method when handling heavy or long material alone. 1) Squat and lift on one end. 2) Walk up the load. 3) Lift the object. ▶ Use elbow pads to protect your elbows from contact stress. They are useful for working in cramped spaces and when you are leaning on your elbows for long periods. Elbow pads should fit snugly, but should not compromise the circulation in your arm. ▶ Use shoulder pads when a heavy item cannot be transported with a cart or other transport device. Carrying heavy objects on your shoulders applies excessive pressure on a small area. Wearing shoulder pads can reduce the contact stress on your shoulders. ▶ Wear proper personal protective equipment at all times (e.g., hearing protection and double eye protection when welding, grinding, etc.). ▶ Consider using anti-vibration gloves to reduce the vibration transmitted to your hands and arms from tools such as grinders, needle guns, and sanders.
Demolishes components ▶ Dismantles components ▶ Removes materials	▶ Heavy manual material handling ▶ Hand-arm vibration exposure from air tools (impact gun, grinder, hand saw) ▶ Awkward postures such as bending forward, working with arms above shoulder height, and constant kneeling or squatting.	▶ Actively assess the job and implement controls before starting work to avoid overexertion and awkward postures. ▶ Use mechanical lifting equipment whenever possible, especially when loading or unloading material. ▶ Use pry bars when applicable to avoid strains and sprains. ▶ Rent or purchase hand tools with minimal vibration and weight. ▶ Wear proper personal protective equipment to avoid vibrations, cuts, burns, lacerations, etc. Face shields must be worn for de-blinding operations. ▶ Be aware of pinch points around your hands and feet. ▶ Use proper lifting techniques to avoid strains and sprains. ▶ Get help with heavy and awkward loads.

CHAPTER 11—Health Hazards

Asbestos

"Asbestos" refers to a group of naturally occurring minerals found in the earth. In the past it was used widely in hundreds of applications in the construction industry.

Hazards

Inhaling asbestos fibres has been shown to cause the following diseases:

- **Mesothelioma**—A rare and fatal cancer of the lining of the chest and/or stomach. Because of past exposure, mesothelioma is the number-one cause of work-related death in construction.
- **Lung cancer**—Appears quite frequently in people exposed to asbestos dust. Asbestos is a well-known cause of lung cancer.
- **Asbestosis**—A disease that causes scar tissue to form on the lungs. This makes it very difficult to inhale and exhale. The disease becomes worse to the point where death often occurs.
- **Other illnesses**—There is some evidence that exposure to asbestos can increase the risk of cancers of the stomach, intestines, and throat. However, the link is not as clear as in the case of lung cancer or mesothelioma.

Where Is Asbestos Found?

Until about the 1980s, asbestos was used in many building materials, including boiler components, because it had excellent heat-resistant properties. Although it is unusual for asbestos to be used today, boilermakers may still encounter asbestos-containing materials (ACM) in buildings and equipment manufactured before the 1980s.

Boilermakers may encounter asbestos in the following products:

- pipe and boiler insulation and lagging (Figures 44 and 45)
- sprayed-on fireproofing
- gasket materials
- insulating refractory
- cement products (i.e., corrugated siding)
- loose-fill insulation.

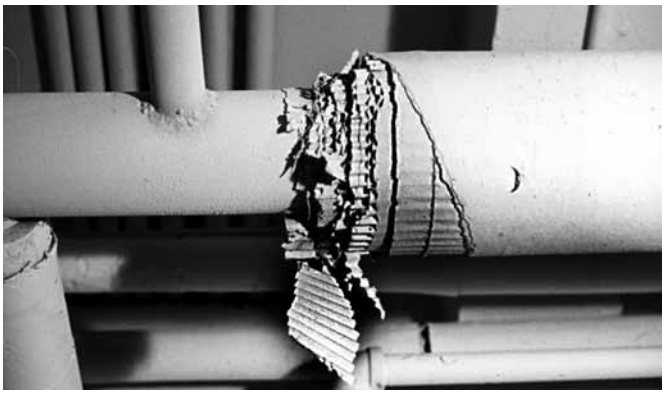


Figure 44:
Air-Cell Insulation Commonly Used Around Pipes

Figure 45:
Boiler Insulation Containing Asbestos

How Can You Be Exposed to It?

If you disturb materials that contain asbestos, fibres may be released into the air, where they can be inhaled. You can disturb the material and cause asbestos fibres to be released by removing, grinding, breaking, or even bumping up against it during your work. Inhaling high levels of asbestos over a long time can result in disease.

Before tendering, the building owner must produce a report stating whether any material that a worker is likely to contact contains asbestos. This report is provided to prospective contractors. The report must show the location of any such material.

The report must be based on laboratory tests or tests conducted previously. If that information is not available, it should be assumed that any material contains asbestos.

Building owners should refer to the *Owner's Duties: Designated Substances on Construction Projects* (W130) available from IHSA.

Note: Some designated substances may have been inadvertently missed due to an oversight or because they were in inaccessible locations or the building was occupied.

Safe Practices

- Consult the owner's report.
- Determine where asbestos is known to be located.
- Tell all workers that there is asbestos on the site and where it is.
- Train workers who could become exposed to asbestos.

Warning: Do not disturb, cut, or handle any material you think contains asbestos unless the proper safety measures are taken.

Certification of Asbestos Removal (Abatement) Workers

Asbestos work is divided into three categories—Type 1, Type 2, and Type 3. Type 3 poses the greatest risk of exposure. All Type 3 asbestos abatement workers and supervisors must take and pass a training program approved by the Ontario Ministry of Training, Colleges and Universities. IHSA offers this training.

Resources

For more information about controlling asbestos exposure, refer to the IHSA manual *Asbestos: Controls for Construction, Renovation, and Demolition* (DS037), available free at ihsa.ca.

For details on safe work methods and personal protective equipment for workers who remove material that contains asbestos, see Ontario Regulation 278/05 (Designated Substance—Asbestos on Construction Projects and in Buildings and Repair Operations). The regulation is available at www.e-laws.gov.on.ca.

Refractory Ceramic Fibres

Refractory ceramic fibres (RCF) are used mainly for specialized applications involving very high temperatures. RCF is sold under such trade names as Fiberfax, Kaowool, Cerwool. It may be used in power stations, furnace linings, gas turbines, or kilns. It is usually manufactured as

- blankets
- modules
- boards
- bulk
- paper
- felt.

What are the health effects of RCF?

Handling, cutting, or sawing RCF without dust control can release significant amounts of fibre. The most common short-term health effect is skin irritation. Other symptoms may include coughing, sneezing, and temporary irritation of the eyes and nose.

Experiments in animals have shown that RCF can produce lung cancer, mesothelioma, and lung fibrosis after long-term inhalation of very high concentrations. But there has been no consistent evidence that workers exposed to RCF are especially likely to develop these diseases. However, a greater prevalence of pleural plaques (thickened patches on lung in RCF-manufacturing workers) has been noted.

The International Agency for Research on Cancer (IARC) believes RCF fibres remain in the body for longer than glass fibres.

The more *biopersistent*, or durable, the fibres are in the body, the more likely they are to cause cancer and other respiratory diseases. For that reason, RCF has been classified as a possible human carcinogen (Group 2B).

When RCF is exposed to temperatures greater than 1,000°C, its silica content changes into a dangerous form known as "cristobalite." When RCF is being removed, special attention is needed to prevent exposure to silica. For more information, see the section on silica on pages 11-9.

Preventing Exposure to RCF

Workers should be trained to understand the hazards of RCF and the proper procedures for working with it safely.

- Keep the material in its packaging as long as it's practical to do so.
- Whenever possible, use work processes that minimize the generation of fibres. For example, use preformed products that require minimal cutting and handling, are fully encapsulated, and are the right size.
- Make sure that the proper housekeeping, removal, and disposal procedures are followed to minimize the creation of fibres and dust. Scrap and dust should be removed at the end of each shift by wet sweeping or with a HEPA vacuum.
- Mist RCF lightly with water while it is being removed and disposed of.
- Don't allow insulating materials to fall freely from one level to another during removal operations.
- Use hand tools if cutting or trimming is required. Power tools without effective dust collection systems are not recommended.
- Do not use compressed air to clean up or blow dust off clothing.
- Waste fibres should be placed carefully and directly in heavy-duty plastic bags. They should be sealed and disposed of in accordance with Ministry of Environment regulations.
- Use soap, water, and dry towels to wash up after leaving the work area.
- Do not eat, drink, or smoke in the work area.
- Wear the personal protective equipment (PPE) provided by the employer.

Respiratory Protection

Respiratory protection is usually recommended only when other control methods such as substitution, isolation, enclosure, work practices, ventilation, and wetting do not eliminate or sufficiently reduce the exposure.

The right kind of respirator to wear is an **air-purifying respirator**. (Figure 46 and Table 1).

- Only use respirators approved by the National Institute of Occupational Safety and Health (NIOSH).
- Make sure you have been fit-tested before wearing any type of respirator.
- Keep your face clean-shaven. Facial hair (even stubble) will allow enough space for some dust to bypass the respirator and be inhaled.

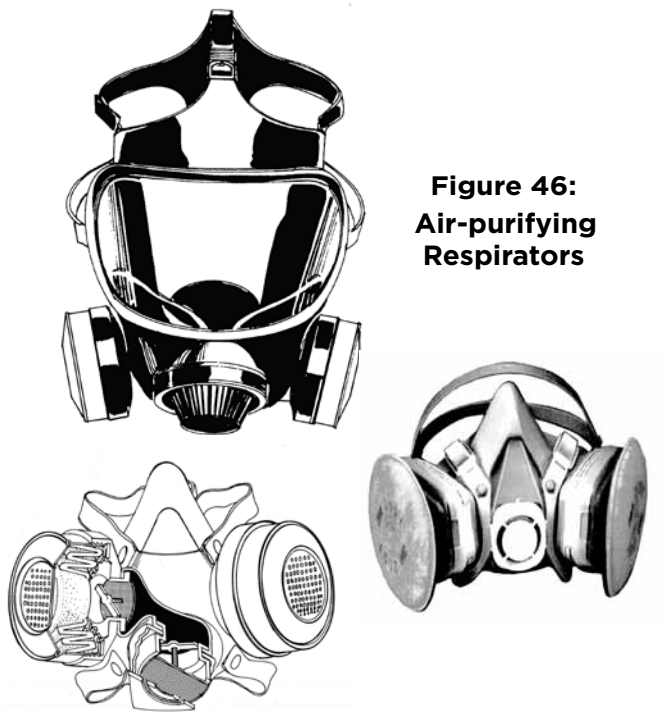


Figure 46: Air-purifying Respirators

Eye Protection

Eye protection such as dust-resistant safety goggles or safety glasses with side shields should be worn in dusty environments. Because of the risk of eye irritation, contact lenses are not recommended for work around fibres unless the eyes are suitably protected by using appropriate eye protection.

Protective Clothing

Protective clothing requirements will vary according to the specific operation (Table 1). The following precautions are recommended.

- When working with RCF, one-piece disposable coveralls with a hood are recommended. Under certain circumstances, such as when there is a fire hazard, disposable coveralls may not be allowed. Discuss such cases with your supervisor.
- In order to protect your family from exposure, do not take clothing home if it is contaminated with RCF.

Table 1: Personal Protective Equipment for Refractory Ceramic Fibres

Type of Work	Respirator Type	Protective Coveralls	Gloves	Eye Protection
Installing RCF Insulation				
Cutting and installing RCF blankets, block, board, or modules	N100 dual-cartridge, half-mask respirator	Disposable coveralls	Cotton	Dust-resistant safety goggles
Gunning RCF	This work practice is *NOT* recommended.			
Cutting and Installing Duct Wrap				
Cutting and installing fully encapsulated duct wrap	N95 air-purifying respirator	Disposable coveralls	Cotton	Safety glasses with side shields
Cutting and installing un-encapsulated duct wrap	N100 dual-cartridge, half-mask respirator	Disposable coveralls	Cotton	Safety glasses with side shields
Removing Refractory insulation				
Removing refractory insulation	N100 full-facepiece respirator, or a powered air-purifying respirator (PAPR) with HEPA filters	Disposable coveralls	Cotton	

Health Hazards at Client Facilities

Boilermakers may work in a variety of plants, such as steel plants and coke ovens, refineries, power plants, chemical plants, factories, and pulp and paper mills.

Each kind of facility has its own health hazards that boilermakers must be aware of before starting work. See Table 2 for more details about the chemical hazards faced by boilermakers.

Table 2: Chemical Hazards Encountered in Industrial Facilities

Chemicals	Where They Are Found	Health Effects
Ammonia	• Compressors • Pulp mills	Very irritating to the eyes, nose, and throat. High exposure can cause choking and breathing difficulties.
Arsine	• Zinc, copper, cadmium mining plants	Symptoms usually develop 1 to 24 hours after exposure. Symptoms include headache, weakness, abdominal pain, nausea, and vomiting. Hemolytic anemia and kidney damage, which can result in death.
Benzene	• Petrochemical plants • Rubber manufacturing	Central nervous system depression and anemia (destroys red blood cells). Long-term exposure can lead to leukemia.
Carbon Monoxide	• Blast furnaces • Reformers and alkylation units • Catalyst regeneration • Flares • Boilers • Other furnaces	Carbon monoxide is a chemical asphyxiant. Can cause headaches, unconsciousness, and death. Can cause cardiovascular problems in people with underlying heart conditions.
Chlorine	• Pulp mills	Corrosive to skin, eye, nose, and throat.
Chlorine Dioxide	• Pulp mills	Severe respiratory irritant. Causes skin burns.
Coal Tar Pitch Volatiles	• Blast furnaces	Skin irritant. Cancer of the lung, skin, scrotum. Can cause skin reactions in presence of sunlight or UV.
Coke Oven Emissions	• Coke ovens	Cancer of the lung, bladder, and kidney. Can cause skin sensitization leading to skin allergy.
Dusts	• Various industries	Toxicity of dust depends on its origin. Dust can include metals (such as mercury, nickel, arsenic, chromium, etc.), insulations (glass wool, calcium silicate), earth, stone, or other substances used in construction or plant processes.
Hydrochloric Acid	• Mining plants • Petrochemical plants • Fertilizer manufacturing • Pickling metal products • Refineries • Boiler and heat exchangers • Water treatment	Corrosive to the eyes, skin, and respiratory tract.

Chemicals	Where They Are Found	Health Effects
Hydrofluoric Acid	• Alkylation units • Electroplating	Corrosive to the eyes, skin, and respiratory tract. Causes rapid decrease in calcium with potential for irregular heart beat and heart failure.
Hydrogen Sulphide	• Sour crudes • Liquid wastes • Crude towers • Cracking operations • Coke ovens • Petrochemical plants	Chemical asphyxiation. Can be instantly fatal.
Lead	• Old painted structures • Mining plants • Sewage treatment plants	Can cause nervous system effects, kidney problems, gastrointestinal problems, effects on the fetus, and infertility in men.
Lime (calcium oxide or calcium hydroxide)	• Pulp mills • Cement plants • Sewage treatment plants • Petrochemical plants	Corrosive to the skin, eyes, nose, and throat.
Methanol	• Pulp mills • Chemical synthesis	Central nervous system depression; headache, nausea, vomiting. Severe exposure can cause blindness.
Methyl Mercaptan	• Pulp mills	Irritating to the eyes, skin, and respiratory tract. Can cause pulmonary edema and respiratory paralysis. Also central nervous system depression.
Oxides of Nitrogen (nitric oxide and nitrogen dioxide)	• Oil refineries • Flares • Boilers	Irritation to respiratory tract. High levels of exposure to nitrogen dioxide can cause pulmonary edema, and respiratory damage.
Polycyclic Aromatic Hydrocarbons (PAHs)	• Coke ovens • Petrochemical plants • Smelters	Some forms cause cancer in the lungs, skin, and urinary tract.
Silica	• Mining plants • Cement plants	Silicosis, lung cancer, and scleroderma (a systemic autoimmune disease).
Sodium Carbonate (soda ash)	• Pulp mills • Steel manufacturing • Mining plants	Corrosive to eyes, nose, and throat.

Chemicals	Where They Are Found	Health Effects
Sodium Hydroxide (caustic soda)	• Pulp mills • Metal treatment processes	Corrosive to the eyes, skin, and respiratory tract. Long-term exposure can cause skin problems.
Solvents (naphthalene, toluene, and xylene)	• Chemical manufacturing • Petrochemical plants • Steel mills	Central nervous system depression. Also skin, eyes, nose and throat irritation. Liver and kidney damage after long-term exposure.
Sulphuric Acid	• Mining plants • Rubber manufacturing • Metal cleaning • Plastic manufacturing • Coke ovens • Petrochemical plants	Highly corrosive and can be dangerously reactive in high concentrations.
Sulphur Dioxide	• Boilers • Blast furnaces • Cracking unit regeneration • Treating operations • Flares • Pulp mills	Irritation to the eyes and upper respiratory tract. Can constrict respiratory tract.

Site Orientation

Since construction workers at client facilities may not be familiar with the hazards in that workplace, all contractors and their workers should receive orientation before work begins. Most facilities make this a requirement.

The orientation is extremely important because it familiarizes you with the hazards on site (both health and safety), various precautionary measures that must be taken, and emergency response plans for that facility.

Before work begins you should also have the following information:

- Material Safety Data Sheets (MSDSs) or Designated Substance Surveys applicable to the work (These should be obtained at the time of bidding. Check with your supervisor if you have not been given this information.)
- the contents of all storage and piping systems.
- location of wash-up and washroom facilities.
- wind socks to identify wind direction.
- rules and plant operating practices and procedures
- who to report hazards to.
- sources of potential air contaminants needing isolation
- places where sudden unexpected exposure might occur
- health and hygiene hazards—acids, carbon monoxide (CO), sulphur dioxide (SO_2), metal fumes, and dusts such as arsenic (As), lead (Pb), and silica (SiO_2).

Noise

Noise-induced hearing loss (NIHL) is a leading cause of non-fatal occupational disease claims to the Workplace Safety and Insurance Board (WSIB). It is something you must take seriously.

Boilermakers are often exposed to noise because of the nature of the work, the workplace environment, and the equipment and tools they use. If you are working in a noisy area or using noisy equipment, consider ways you can minimize your exposure.

The best way of preventing exposure to noise is to control it at the source or along the path. That protects everyone in the area from noise. It is generally more effective than hearing protection, and it allows workers to communicate and hear warning sounds (Table 3).

If it is not possible to control a noise at the source or along the path, then hearing protection must be worn if the noise exceeds 85 decibels.

> **Note:** If you need to yell to be heard by someone standing 2 ft away, the noise probably exceeds 85 decibels (Table 4).

Table 3: Examples of Noise Control

Noise Control	Examples
At the Source	• Use damping materials (e.g., heavy rubber) to minimize rattling and vibrating of chutes, panels, conveyors, tanks, or bins. • Use exhaust silencers. • Replace pneumatic nozzles with quieter ones. • Lease, purchase, or rent quiet equipment. • Bend materials—don't bang them. • Lower materials into place—don't throw them.
Along the Path	• Locate loud equipment away from workers. • Enclose the noise source (e.g., generator, compressor).

Table 4: Noise Levels for Equipment and Tools Used by Boilermakers

Equipment	Sound Level (dBA)	Maximum Exposure Time without Hearing Protection
Crane	78 – 103	7.5 min
Concrete Saw	97 – 103	7.5 min
Jackhammer	100 – 115	< 1 min
Compressor	85 – 104	6 min
Chipping Gun	110	1 min
Vacuum Truck	90 – 103	7.5 min – 2.5 hr

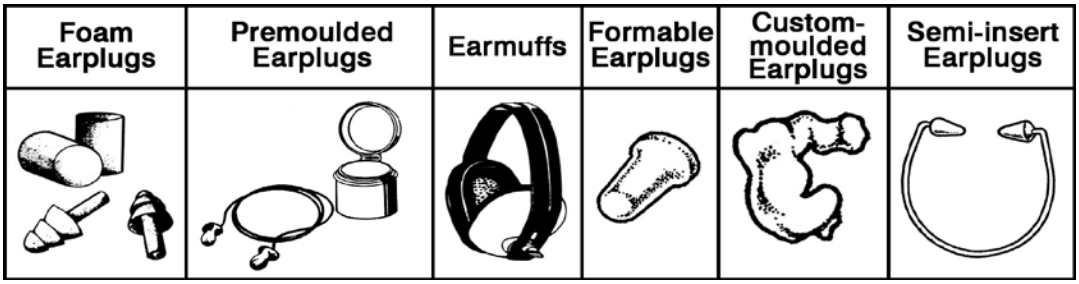
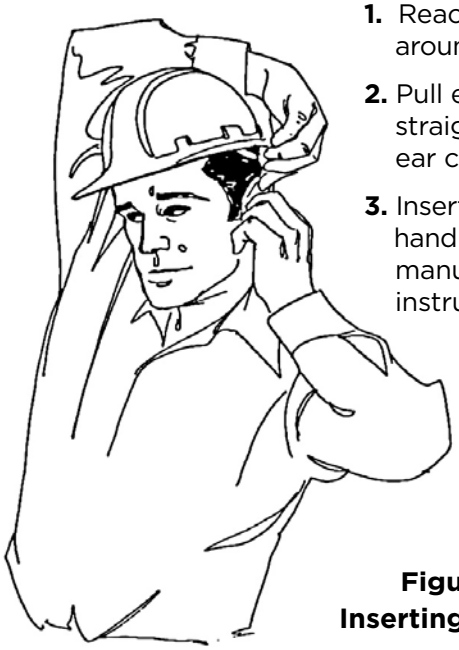


Figure 47: Options for Hearing Protection

Proper Fit

Putting hearing protection on properly is extremely important. Improperly fitted plugs and muffs are essentially useless. There are different sizes and styles of ear plugs, and one size doesn't fit everyone. Follow the manufacturer's instructions (usually found on the package) for inserting plugs.



1. Reach one hand around back of head
2. Pull ear upwards to straighten S-shaped ear canal
3. Insert plug with other hand according to manufacturer's instructions

Figure 48: Inserting Ear Plugs

When to Use It

Even when a noisy task lasts for only a few seconds, the hearing can be damaged if you aren't using hearing protection. For short duration tasks, consider using ear muffs, which don't take as much time to put on as ear plugs.

Comfort

Make sure you choose a type of protector that you can wear comfortably for long periods of time. Earplugs will be somewhat uncomfortable at first. However, within about two weeks the discomfort will disappear.

Silica

Crystalline silica is a component of rock and sand. The silica content depends on the type of rock, such as sandstone and granite.

Silica is dangerous because it can cause a variety of diseases, including

- silicosis—a painful disease that causes scarring and lumps on the lungs, making it difficult to breathe
- lung cancer
- scleroderma (an autoimmune disease)
- chronic obstructive pulmonary disorder (COPD).

Boilermakers may be exposed to silica from a variety of sources, such as:

- process chemicals (e.g., in cement plants, mine refineries, etc.)
- drilling, grinding, breaking concrete,
- disturbing or removing refractory ceramic fibres that have been exposed to high temperatures.

Safe Practices

- Where possible use work processes that minimize airborne silica dust.
  - Use wet cutting.
  - Use power tools equipped with dust extractors.

NOTE: If dust levels are still higher than the exposure limits, use respiratory protection.

- The employer should train workers to recognize and control silica hazards.
- Clean up the workplace frequently to prevent a buildup of dust and silica. Do not dry-sweep or use compressed air.
- Take the wind into consideration when positioning yourself. Make sure the wind isn't blowing dust into your face or towards other workers.
- Use the proper respiratory protection.
- The employer should train the workers to wear the right kind of clothing.
- Wash your face and hands before eating, drinking, or smoking and before going home.

For more detailed information about silica controls, see the Ministry of Labour's guideline *Silica on Construction Projects* at:

www.labour.gov.on.ca/english/hs/pubs/silica/index.php

Lead

Lead is a very dangerous substance and a cause for great concern in the workplace. It can enter the body through inhalation. When hands or clothing are contaminated by lead, it can also get onto food, drinks, and cigarettes and enter the body through the mouth. Once inside the body, lead causes damage in many ways.

- Short-term exposure can cause abdominal pain and damage to the kidneys and brain.
- Long-term exposure can harm the blood, nervous system, kidneys, and reproductive organs. It can also raise the blood pressure and possibly cause cancer.

Lead can be found in many materials and locations such as:

- coatings such as older paint and primers
- cartridges for powder-actuated fastening tools
- pipes
- mortar
- dust from residual oil fly ash at client facilities
- welding fume.

Safe Practices

The most effective way to protect workers from lead is to use work methods that minimize the amount of airborne lead.

These are some ways employers can minimize exposure to lead:

- Have policies and procedures so that workers know how to dispose safely of lead-contaminated materials.
- Showers, washing stations, and locker rooms should be available.
- Post warning signs where required.
- Makes sure that workers who may have been exposed to lead receive medical screening.
- Train workers to decontaminate themselves and change out of work clothes at the end of the shift.

Some ways workers can minimize exposure to lead.

- Keep lead off the hands and skin so that it is not swallowed.
- Use ventilation and air filtration where work on lead will take place.
- Use personal protective clothing and equipment (including respirators).
- Do not smoke, eat, or drink in areas where lead may be a hazard.

For more detailed information about lead controls, see the Ministry of Labour's guideline *Lead on Construction Projects* at:

www.labour.gov.on.ca/english/hs/pubs/lead/index.php

CHAPTER 12—Welding

Welding and cutting are common tasks carried out by boilermakers to assemble vessels and attach cut sections of tubes and plates. A variety of cutting and welding processes may be used, including oxyacetylene torch cutting, gas-tungsten arc welding (TIG welding), shielded metal arc welding (stick welding), and gas-metal arc welding (MIG welding).

The common hazards include

- fumes and gases
- electrical shock
- fire from sparks and slag dropping
- explosions.

Table 5: Welding Airborne Contaminants—Fumes

Fume Component	Source	Health Effects
Hexavalent Chromium	• Stainless steel • Inconel metal	Lung cancer
Manganese	• Mild steel • Welding rod	Central nervous system effects that resemble Parkinson's disease with uncontrollable tremors
Nickel	• Stainless steel • Monel	Bronchitis. Long-term exposure can lead to nasal and lung cancer
Zinc oxide	Galvanized coatings	Metal fume fever, which resembles flu. Lasts for 18-24 hours after exposure
Lead	Paint and primers	Abdominal pain, destruction of red blood cells, damage to kidneys and nervous system
Cadmium	• Some paint pigments • Cadmium-plated hardware	• Kidney damage • Lung cancer
Thorium	Thoriated tungsten electrodes used in TIG welding (mainly alpha and some beta radiation)	Cancer (cannot penetrate skin but a hazard when inhaled)

Welding Fumes and Gases

The fumes and gases caused by welding and cutting can be dangerous to human health. The composition of the fumes and gases depends on various factors, including the following:

- composition of welding rod
- composition of base metal
- surface contamination such as paint, grease, degreasers, etc.

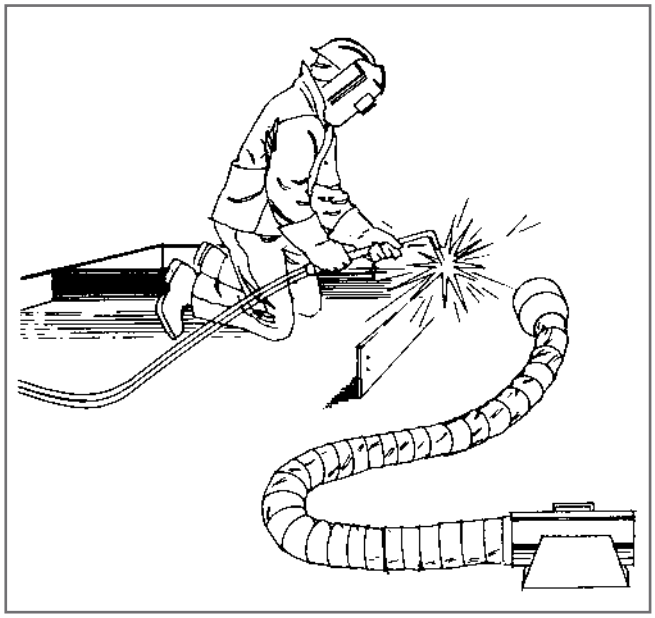
Some of the common hazardous components of welding fume are listed in Tables 5 and 6.

Table 6: Welding Airborne Contaminants—Gases

Gas	Source	Health Effects
Acetylene	From acetylene not completely used up in oxyacetylene welding	In confined spaces can displace oxygen and cause asphyxiation
Argon and Helium	Used in MIG and TIG welding to shield electrode from oxygen	Same as above
Carbon Monoxide	• Welding arc changes carbon dioxide in the air to carbon monoxide • MIG and arc air gouging • Incomplete burning during welding	Headache Dizziness Difficulty concentrating Heart disorders Coma Death
Nitrogen Oxides (NO_2 and NO)	• Welding arc changes nitrogen in air to nitrogen oxides • MIG and plasma arc welding	Respiratory irritation Pulmonary edema
Ozone	• Ultraviolet light used by the welding arc changes oxygen in air to another form of oxygen called ozone • MIG and plasma arc welding	Irritation of eyes, nose, and throat Chest pains Wheezing Pulmonary edema
Phosgene	Ultraviolet radiation from welding arc decomposes chlorinated solvents (degreasers) such as trichloroethylene and 1,1,1 trichloroethane	Respiratory irritation Chest pains Pulmonary edema Death (at high concentrations)

Avoiding Toxic Fumes and Gases

- Check the MSDS for the welding rod and components to be used. Note the composition, and know the health effects of each chemical.
- Use ventilation. Local exhaust ventilation is the ideal solution in many cases because it removes airborne contaminants at the source before they reach the welder or nearby workers. Figure 49 shows two different methods of local exhaust ventilation.
- When using local exhaust ventilation, enclose the welding process as much as possible to prevent disturbances from wind and to improve the capture efficiency of the system.
- Ensure there is enough airflow to pull the contaminants into the ventilation hood.
- Keep the ventilation hood as close as possible to the arc.
- Keep the welding plume as far as possible from your face.
- Clean off any paint before welding, especially if it might be lead-based. See the Ministry of Labour's guideline "Lead on Construction Projects", available at www.labour.gov.on.ca
- Remove any grease or degreasers from the surface.
- If ventilation cannot reduce airborne contaminants to acceptable levels, respiratory protection may be required.
- Grinding thoriated tungsten electrodes can generate radioactive dusts that could be inhaled. In addition to measures that should be taken to avoid gases and fumes, consider the following:
    - o Select thorium-free tungsten electrodes. Alternatives are cerium, lanthanum, yttrium, or zirconium.
    - o If grinding thoriated tungsten electrodes cannot be avoided, use only a high-efficiency dust collection system.
    - o Develop procedures for the storage, grinding, use, housekeeping, and disposal of thoriated tungsten electrodes.
    - o HEPA-vacuum or damp-wipe equipment that may come in contact with these electrodes.



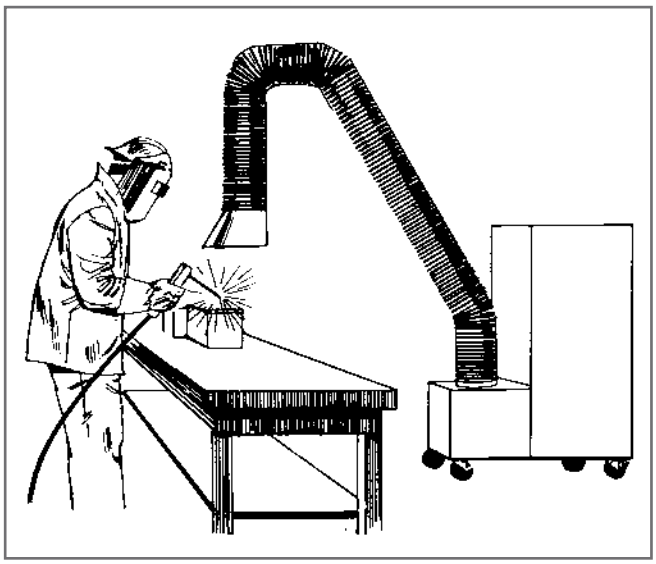


Figure 49:
Local Exhaust Ventilation Methods

Electrical Shock and Burns

Electrical shock from welding may be caused by improper grounding or contact with current through damp clothing, wet floors, and other humid conditions. Even if the shock itself is not fatal, it may still cause a welder to fall from his or her work position.

Electrical burns are an additional hazard. The burns often occur below the skin's surface and can damage muscles and nerves. In severe cases, they can be fatal.

The extent of injury due to electrical shock depends on voltage and the body's resistance to the current passing through it. Even the low voltages used in arc welding can be dangerous under damp or humid conditions.

Precautions

- Any moisture—even sweat—around electric welding machines can cause a shock. Wear dry gloves and shoes with insulated soles. Ensure there are no holes in gloves or shoes. Dry off the workbench and floor if they are wet.
- Ensure that insulation on electrode holders and electrical cables is kept dry and in good condition.
- Use the proper amp rating and duty cycle rating for the electric welding machine. Overheating can damage the insulation and lead to shocks.
- Make sure the grounding cable is attached properly to the work or work table. The ground clamp (work lead) must be firmly attached to the piece to be welded as close to the weld joint as possible. Ensure the ground location is clean and free of rust, scale, paint, or any film that will interfere with the electrical conductivity.
- Never ground to an electrical conduit or to a pipe carrying any gas or flammable liquid.
- Never change electrodes with bare hands or wet gloves, or when standing on wet floors or grounded surfaces.
- Do not allow the leads that carry the welding current to come in contact with chains, wire ropes, hoists, or elevators.
- Disconnect the power supply when moving the welding machine.
- Remove the electrode from its holder when the welding machine is not in use.
- Place electrode holders so that they do not come in contact with people or flammable materials.
- Never cool an electrode holder by putting it in water.
- Make sure that the polarity switch and range switch are not moved while the power source is being used. This can cause a fire and damage the machine.

Fires and Burns

Fires are a common hazard where there is welding or cutting. Fires may be caused by the chemicals used in welding and cutting, by reactions between chemicals, and by the exposure of combustible materials to the heat generated by welding or cutting.

In welding, oxygen and acetylene are the most frequent causes of fires and explosions. Acetylene is highly flammable while pure oxygen can cause other materials to burn much more rapidly than they would in air.

- A hot work permit may be required before any hot work is done. Make sure the proper administrative measures have been taken before welding or cutting.
- Use a flammable gas and oxygen detector to determine whether a hazardous atmosphere exists.
- Provide fire barriers such as metal sheets or fire blankets, and fill cracks or crevices in floors to prevent sparks and slag from passing through.
- Provide fire extinguishers suitable for all the possible types of fire. Know where the extinguishers are and how to use them.
- To ignite a torch flame, use a striker. Using matches or a cigarette lighter can burn your fingers.
- Don't carry a butane lighter in your shirt or pants pocket. It may be ignited by sparks, splatter, or high heat.
- Clear the work area of flammable materials and debris.
- Never lay down a torch while the flame is burning.
- If welding has to be done near flammable or explosive materials, ask the facility management for hot work policies on how long a fire watch may be required on site.
- Never use oxygen to blow dust from your clothes. It's a fire hazard.
- Never oil the oxygen regulator.
- Never use any grease or oil around oxygen. Oxygen mixed with the slightest trace of grease or oil can cause a violent explosion.

Hot work, including welding, grinding, and cutting on containers, can cause serious explosions if the proper procedures are not followed.

- The contents of all containers should be determined before any work is done. Do not rely on the labels, which may be misleading or incorrect. Or the contents may be contaminated by other materials.

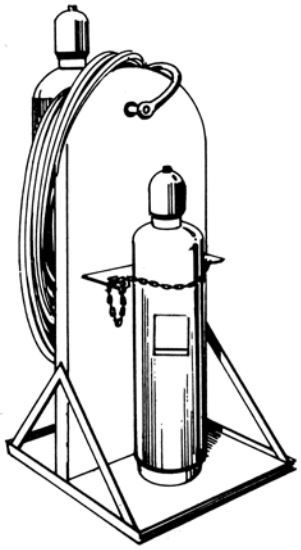
> **Warning:** if it is not absolutely clear what the contents of a container are, you must assume that they may be explosive.

The Ontario Fire Code states that welding or cutting of metal containers must not be done until the containers and compartments within such containers have been cleaned of flammable and combustible materials or purged and checked with a gas monitor. The person who does those tests must be trained to use the instruments according to the manufacturer's instructions.

Compressed Gases

Compressed gas cylinders used for oxyfuel processes can be a hazard. To prevent accidents, they must be stored, handled, and used properly.

- Store cylinders upright and hold them in place with chains or cables (Figure 50).
- Avoid sudden shock and damage to the valve. Use a protective valve cap whenever cylinders are not in use or transported.
- Do not store cylinders near oil, grease, flames, or flammable materials.
- Do not store oxygen cylinders within 20 ft of cylinders of fuel gas such as acetylene, propane, or butane unless they are separated by a partition at least 5 ft high and having a fire resistance rating of at least 30 minutes.
- Use positive-action check valves at both the regulators and torch to prevent the gas from flowing in reverse.
- Never force regulator fittings if they do not match the cylinder threads. Some regulator fittings (such as acetylene) have left-hand threads.
- Never stand in front of the regulator when turning on the cylinder valve. If there is an explosion or fire, it will blow out the front of the regulator.
- Open valves to no more than 1½ turns to allow for quick shutoff in case of an emergency.
- Before removing a regulator, close the cylinder valve and release the gas from the regulator.
- Ensure there is enough airflow to pull the contaminants into the ventilation hood.
- Keep the ventilation hood as close as possible to the arc.
- Keep the welding plume as far as possible from your face.



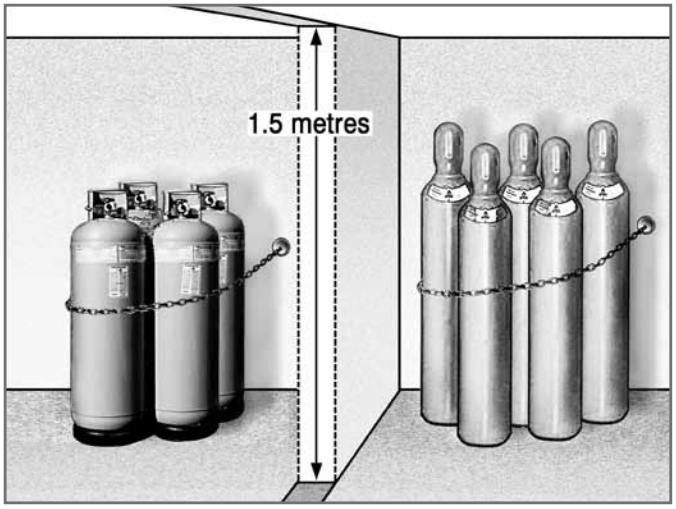


Figure 50: Securing Cylinders

- Clean off any paint before welding, especially if it might be lead-based. See the Ministry of Labour's guideline "Lead on Construction Projects", available at www.labour.gov.on.ca
- Remove any grease or degreasers from the surface.
- If ventilation cannot reduce airborne contaminants to acceptable levels, respiratory protection may be required.
- Never allow any oil to get onto an oxygen regulator. Oxygen under pressure can explode when it contacts oil.
- Use black iron pipe and fittings for acetylene. Never use copper pipe or fittings. Copper and acetylene form acetylides, which explode violently.
- Make sure that the fuel gas hose is red and the oxygen hose is green. Acetylene hoses usually have left-hand threads.
- Open the valve on oxygen cylinders all the way to prevent leakage around the valve stem.
- Close all cylinder valves when you are away from work for any length of time.

Protective Clothing

- Wear cotton or wool clothing if possible. Synthetic fibres are flammable.
- Wear high-top safety shoes laced up, with the pant leg covering the top of shoe. A spark inside a shoe can cause a serious burn.
- Use welding gloves.
- If you have long hair, tuck it under a cap.
- Pants and shirts must not have turned-up cuffs that could catch sparks.
- Wear a long-sleeved shirt to protect your skin from sparks and rays.
- If welding at high amperage for a long time, wear welding leathers.
- If you are welding overhead, wear a welding cap and jacket.
- Do not wear jewellery.
- Use the right shade number for welding lenses. (Table 7.) Both the welder and anyone assisting the welder must wear eye protection.

Safe Welding Techniques

- Position yourself so that sparks go in the safest direction.
- Warn others in the area before striking an arc.
- Set up a screen to protect others from the welding flash.
- Check to see if sparks or molten particles could fall to a lower level or roll along the floor. Be especially careful about this when you are welding from a scaffold or ladder.

Respiratory protection may not be needed for most welding operations if there is proper ventilation. However, when ventilation or other engineering controls are not adequate, or when the welding creates toxic fumes (as with stainless steel and beryllium), respiratory protection must be worn.

Table 7:
Lens Shade Selection Guide for Welding

Operation	Electrode Size mm (32nd in.)	Arc Current (Amperes)	Minimum Protective Shade	Suggested[1] Shade No. (Comfort)
Shielded Metal Arc Welding (SMAW)	less than 2.5 (3)	less than 60	7	–
	2.5-4 (3-5)	60-160	8	10
	4-6.4 (5-8)	>160-250	10	12
	more than 6.4 (8)	>250-550	11	14
Gas Metal Arc Welding and Flux Cored (GMAW)		less than 60	7	–
		60-160	10	11
		>160-250	10	12
		>250-500	10	14
Gas Tungsten Arc Welding (GTAW)		less than 50	8	10
		50-150	8	12
		>150-500	10	14
Air Carbon (light) Arc Cutting (heavy)		less than 500	10	12
		500-1000	11	14
Plasma Arc Welding (PAW)		less than 20	6	6 to 8
		20-100	8	10
		>100-400	10	12
		>400-800	11	14
Plasma Arc Cutting (PAC)				
Light[2]		less than 300	8	9
Medium		300-400	9	12
Heavy		>400-800	10	14
Torch Brazing (TB)		–	–	3 or 4
Torch Soldering (TS)		–	–	2
Carbon Arc Welding (CAW)		–	–	14
		Plate Thickness mm	Plate Thickness in.	
Gas Welding (GW)				
Light		under 3.2	under 1/8	4 or 5
Medium		3.2 to 13	1/8 to 1/2	5 or 6
Heavy		over 13	over 1/2	6 to 8
Oxygen Cutting (OC)				
Light		under 25	under 1	3 or 4
Medium		25 to 150	1 to 6	4 or 5
Heavy		over 150	over 6	5 or 6

[1] Shade numbers are given as a general rule. It is recommended to begin with a shade that is too dark to see the weld zone. Then, go to a lighter shade which gives a sufficient view of the weld zone without going below the minimum. In gas welding or oxygen cutting, where the torch produces a high yellow light, it is desirable to use a filter lens that absorbs the yellow or sodium line in the visible light (spectrum) of the operation.

[2] These values apply where the actual arc is clearly seen. Experience has shown that light filters may be used when the arc is hidden by the workpiece.

CHAPTER 13—Emergency Preparedness

An emergency is any situation that has the potential to harm the life, health, or safety of a person, public property, or the environment. It is an unplanned event. In order for everyone to be prepared for emergencies, every project needs an emergency response plan before work begins.

Emergency Response Plan and Procedures

The purpose of an emergency response plan is to ensure that emergency procedures are in place and every worker is prepared to respond to any emergency in a correct, timely, consistent, and dependable manner.

An effective plan must include the following:

A. Hazard Identification/Assessment

Identify hazards and assess potential risk by answering the questions: What can go wrong? What are the consequences?

B. Emergency Resources

Determine what resources are available for the hazards identified and assessed. Verify that 911 operates in the area. If not, make alternative arrangements. Maintain on-site resources such as fire extinguishers, spills containment equipment, and first aid kits. Outside help may be so far away that on-site resources are necessary, such as fire protection or ambulance and medical resources in remote areas.

C. Communication Systems

To relay accurate information quickly, reliable communications equipment must be used, procedures developed, and personnel trained. A backup system is a good idea in case the emergency destroys phone lines, for instance. The type and location of emergency communication systems must be posted on the project. Emergency phone numbers and the site address or location should be posted beside all site phones.

The *Emergency Response Poster* (P103), available from IHSA, can be used to record this and other information.

D. Administration of the Plan

The person in charge of administering and organizing the plan must ensure that

- everyone clearly understands their roles and responsibilities in the plan
- adequate emergency resources are available for each stage of the project
- the plan is reviewed regularly and always after an emergency to correct any shortcomings.

E. Emergency Response Procedure

The Emergency Procedures chart (Figure 50) outlines standard emergency response procedures. STOP and ASSESS the situation before performing any of the tasks. Stay calm to provide an example to others.

F. Communication of the Procedure

- Review the procedure with subcontractors, workers, and suppliers to ensure that it covers their activities.
- Review it with owner/client in operating plants to ensure that hazards are identified and covered.
- Review it regularly with the JHSC or health and safety rep to address new hazards or significant changes in site conditions.
- Post the procedure in a conspicuous location.

When developing your plan, make sure it always reflects current conditions on the jobsite. For more detailed information on developing emergency response plans, refer to the *Emergency Response Planning* (B030) booklet available from IHSA and the Emergency Response Planning Checklist at the end of this chapter.

Fire and Hot Work

When hot work is performed, **special precautions** are required. Hot work may include any job or task that generates heat, sparks, or fire, such as

- Torch cutting
- Welding, including preheat and post-weld heat
- Air arc gouging
- Grinding

When hot work is performed, thorough **fire prevention** procedures must be in place.

To reduce the risk of a fire starting when no one is on site, some employers insist that workers stop hot work an hour before the end of the work day and before taking breaks.

A fire watch is required for a specific area in which hot work is being done. Workers who are assigned fire-watch duty carry a means of fire suppression, such as a fire extinguisher, and a means of communication such as a cell phone or radio.

Emergency Procedures for Fall Rescue

If a worker is involved in a fall arrest, it is important that the worker be brought to a safe place as quickly as possible without causing further injury or putting the rescuers at risk.

Section 26.1(4) of the Regulation for Construction Projects (213/91) requires that before workers use any fall arrest system or safety net on a project, the employer must develop written rescue procedures.

In many cases, the rescue plan can be simple. A ladder or elevated work platform can be used to reach suspended workers and get them down safely. In other cases, it makes more sense to haul the worker back up to the level from which they fell or pull the worker in through a nearby window or other opening.

Sometimes the rescue may be more complicated. You may need specially trained and equipped rescue workers from the local fire department. Aerial ladder trucks or other high-reach equipment may be necessary. In extreme cases, the fire department may use rappelling techniques to reach trapped workers and lift or lower them to a safe place.

Create a rescue plan that is specific to your jobsite and that covers the different types of

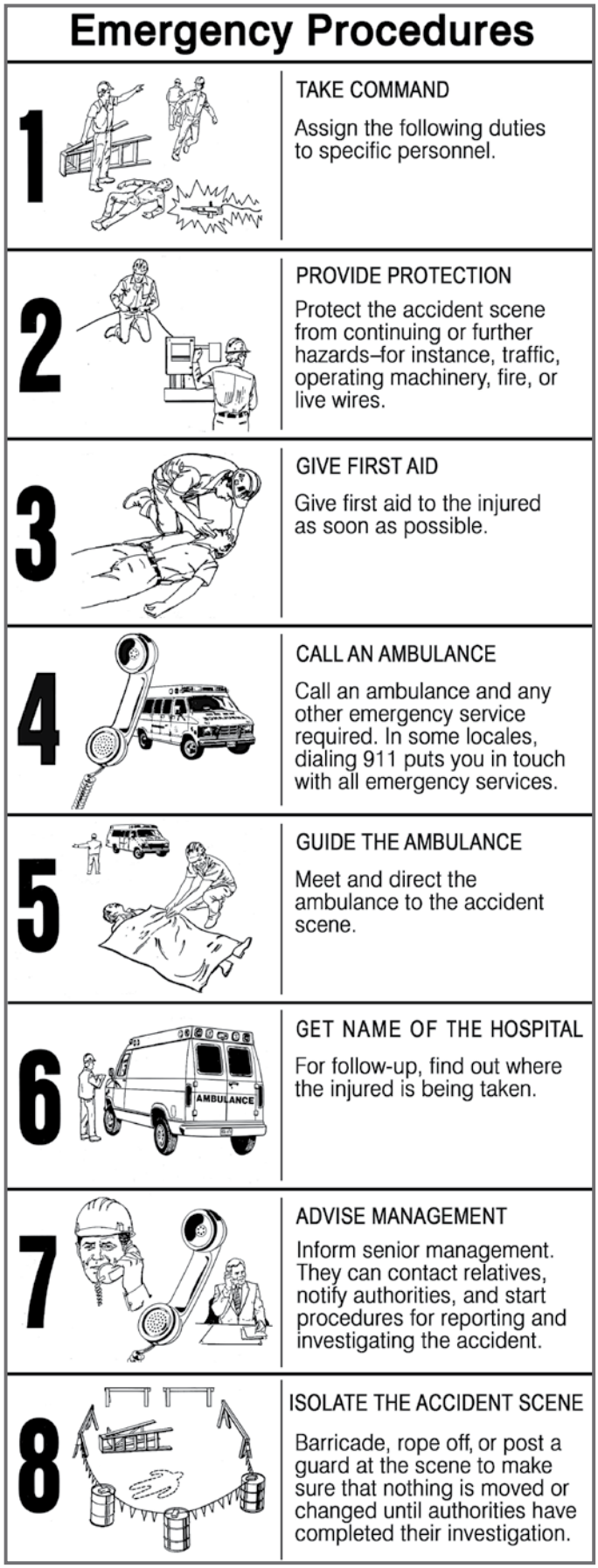


Figure 51

fall-related rescues that may be necessary. The plan should cover the on-site equipment that you will use, the personnel who will use it, and the procedures for different types of rescue. Any off-site rescue services that might be needed should be contacted in advance and arrangements made to familiarize them with the project.

Use IHSA's *Emergency Response Poster* (P103) to list the nearest hospital and the phone numbers of fire, ambulance, and police services.

Once the written plan is developed, you must ensure that

- everyone on site is aware of the rescue plan
- equipment and other resources you will need are available.

Sample Fall Rescue Procedures

Here are some examples of general fall rescue procedures to give you an idea of what your plan should include.

A. If an elevating work platform (EWP) is available on site:

1. Take it to where the suspended worker is.
2. Make sure that rescue workers using the EWP are protected against falling.
3. Be sure the EWP has the load capacity for both the rescuer(s) and the victim.
4. Use the EWP to reach the suspended worker.
5. Position the EWP platform below the worker.
6. Disconnect the suspended worker from his or her lanyard or lifeline when it is safe to do so. If the worker is unconscious or can't help with the rescue, two rescuers may be needed to handle the worker safely.
7. Treat the worker for suspension trauma and any other injuries.
8. Arrange to take the worker to the nearest hospital.

B. If an elevating work platform is not available:

1. Where possible, use a ladder (or ladders) to reach the suspended worker.
2. If the suspended worker is not in an area that rescuers can reach by ladders, move the suspended worker by his or her lifeline to an area that can be safely reached by ladder (if possible).
3. Rig a separate lifeline for each rescuer to use while carrying out the rescue.
4. Position the ladder(s) so that the rescuers can get beneath the suspended worker.
5. Securely attach a separate lowering line to the suspended worker's harness.
6. Rescuers on the ground lower the worker while the rescuers on the ladder(s) guide the worker. If the suspended worker is unconscious or can't help with his or her own rescue, two rescuers may be needed to handle the worker.
7. Once the worker has been taken to a safe location, administer first aid for suspension trauma and any other injuries.
8. Arrange to take the worker to the nearest hospital.

C. If the injured person is suspended near the work area and can be reached safely from the floor below or from the place from which the worker fell:

1. Make sure that all rescuers are protected against falling (such as by travel restraint or fall arrest).
2. If possible, attach a second line securely to the worker's harness to help pull him or her to a safe place. At least two strong workers will probably be needed to pull someone up.
3. Eliminate slack in the retrieving line to avoid slippage.
4. Once the worker has been taken to a safe place, administer first aid for suspension trauma and any other injuries.
5. Arrange to take the worker to the nearest hospital.

D. If a person has fallen and is suspended in an inaccessible place:

You may need trained personnel and specialized rescue techniques to rescue the worker. For example, if the person is suspended on a tower, against a building, or in a structure that has no openings, the rescuer may have to lower himself down to the suspended worker or use a lifeline to retrieve him or her.

Because of the inherent risk in this type of rescue, only people with specialized training should do it.

Emergency Response Planning Checklist

Company:	Date:
Completed by:	Site:

	In Progress	Date Completed
Program Administration (Who is responsible for implementing the plan?)	❑	
Develop an Emergency Response Standard.	❑	
Develop a Site Emergency Plan.	❑	
• Identify emergency access routes.	❑	
• Indicate location of first aid stations/boxes and fire extinguishers.	❑	
• Show job office(s) and storage facilities (storage for blankets and special rescue equipment).	❑	
• Ensure specialized PPE equipment is on site. (Indicate location.)	❑	
• Ensure sufficient medical aid supplies are available on site (splints, stretchers, etc.) and indicate location.	❑	
• Locate other firefighting equipment (standpipes, Siamese connections, and hydrants).	❑	
• Locate main power supply to project.	❑	
• Identify the location of emergency phones. (Post emergency list.)	❑	
• Identify nearest hospital or medical centre.	❑	
• Identify worker evacuation route(s) and assembly area(s).	❑	
• Contact local fire, police, and ambulance and provide them with your site plan and list of potential emergencies.	❑	
• Locate services to the project (both above ground and underground).	❑	
• Develop on-site traffic routes.	❑	

	In Progress	Date Completed
• Locate outside materials storage and fabricating areas.	❑	
• Locate cranes, man/material hoists, and unloading docks.	❑	
• Locate flammable/combustible materials and cylinder storage.	❑	
• Locate garbage dumpsters and recycling bins.	❑	
• Complete *Hazard Identification and Risk Assessment Form**.	❑	
• Identify if "high-level" rescue is a possibility.	❑	
• Develop emergency response procedures for items identified in your hazard assessment.	❑	
• Ensure that all trades on site keep daily personnel lists. (In the event of a major emergency, check names against personnel gathered in the assembly area.)	❑	
• Include requirements for written notices. (What's required? When? Completed by whom? Who does it go to?) See legal obligations.	❑	
• Identify the emergency response (ER) team and alternates. (Post names.)	❑	
• Provide specialized training for ER team members.	❑	
• Designate a contact person to call necessary emergency services and MOL, MOEE, etc.	❑	
• Select member of ER team to meet and direct emergency services vehicles to incident scene.	❑	
• Select team member to deal with media, MOL, MOEE, etc.	❑	
• Ensure all required rescue equipment/materials are readily available on site.	❑	
• Provide for emergency traffic control person (properly trained).	❑	
• Make provisions for cordoning off the accident scene to protect workers.	❑	
• Ensure someone on the ER team documents where the injured worker has been taken (hospital, medical centre, etc.).	❑	
• Set out method of communicating the plan.	❑	

* Available at ihsa.ca/resources (Policy and Program Resources/Hazard Assessment)

Resources

- Infrastructure Health and Safety Association..... **www.ihsa.ca**

- Ontario Ministry of Labour ..... **www.labour.gov.on.ca**

- Workplace Safety & Insurance Board ..... **www.wsib.on.ca**

  - Health Professional's Report (Form 8)
    www.wsib.on.ca/WSIBPortal/faces/WSIBDetailPage?cGUID=WSIB013772&rDef=WSIB_RD_ARTICLE

  - Worker's Report of Injury/Disease (Form 6)

    eForm
    www.wsib.on.ca/WSIBPortal/faces/WSIBDetailPage?cGUID=WSIB013829&rDef=WSIB_RD_ARTICLE

    PDF Form
    www.wsib.on.ca/WSIBPortal/faces/WSIBArticlePage?fGUID=835502100635000274

APPENDICES

APPENDICES

Appendix A

Occupational Health Risks Brochure: Boilermakers (W103)

IHSA, in partnership with the Labour-Management Network, has developed a collection of occupational health risk brochures for workers in trades that are at an increased risk of exposure to hazardous agents and the development of occupational diseases. These brochures include prevention information for workers and a diagnostic toolkit for physicians and primary health providers.

www.ihsa.ca/PDFs/Products/Id/W103.pdf

Appendix B

Boilermaker Exposure Incident Reporting (BEIR) form

In 2010, the International Brotherhood of Boilermakers Canada launched a centralized database called the Boilermakers Exposure Incident Form (BEIR). The goal of the BEIR program is to gather information about uncontrolled/unplanned exposures as close to the time of occurrence as possible to ensure accurate records are collected and maintained.

Link to more information:

www.boilermaker.ca or contact your lodge.

Appendix C

WSIB Construction Exposure Incident Reporting (CEIR) Program

Link to form:

www.wsib.on.ca/cs/idcplg?IdcService=GET_FILE&dDocName=WSIB012691&RevisionSelectionMethod=LatestReleased

Infrastructure Health & Safety Association™

Work Safe for Life

OCCUPATIONAL HEALTH RISKS
BOILERMAKERS

A diagnostic toolkit for physicians and primary health providers. Prevention information for workers.

Give pages 3 and 4 of this booklet to your doctor.
They give your doctor information about the health risks of your job.

This booklet was prepared by the Ontario construction industry's Occupational Disease and Research Labour-Management Health and Safety Committee with assistance from the Infrastructure Health & Safety Association (IHSA), the Ontario Ministry of Labour (MOL), the Workplace Safety and Insurance Board (WSIB), and labour and employers in Ontario construction.

The information presented here is for general information only. It should not be regarded or relied upon as a definitive guide to health risks in the trade. This information is, to the best of our knowledge, current at the time of publication. For more information, contact the Infrastructure Health & Safety Association.

1-800-263-5024 • www.ihsa.ca

Labour Management Network

FOR WORKERS

IHSA.ca Work Safe for Life

Tasks and possible hazards

All tasks

- **Hazardous materials from industrial worksites** (coke ovens, refineries, chemical plants, glass plants, factories, cement plants, pulp and paper mills, power plants)
- **Awkward postures, vibration, and hazardous noise** when using power tools, grinders, saws, and mobile equipment
- **Dust** on construction sites.

Installation, removal, or repair of equipment

- **Asbestos** (could be part of the old insulation—or in building materials)
- **Lead**
- **Solvents, adhesives, and epoxies**
- **Liquids, sludges, or other materials** on, in, or under equipment
- **Exhaust fumes** from gas- or diesel-powered equipment
- **Biological materials** on equipment and in industrial plants.

Welding, torch cutting, soldering, brazing, grinding

- **Lead**
- **Welding fumes, ultraviolet light, heavy metals, and chlorinated compounds**
- **Dust** from grinding activities.

How to protect your health

- Ask your supervisor or employer for safe work **instructions** and training.
- Consult industrial clients on site-specific health and safety **procedures.**
- Ask about any hazardous materials or unknown chemicals when **entering** an industrial site for work.
- Ensure proper **ventilation**.
- Wear a proper **respirator** when
  - you suspect asbestos may be a hazard
  - working in dusty atmospheres
  - welding
  - using solvents, adhesives, or other hazardous substances.
- Wear gloves, coveralls or welding jackets, or use barrier creams to protect the **skin**.
- Consult material safety data sheets (**MSDSs**) for information about hazardous chemicals used at work, and obey workplace health and safety rules.
- **Never eat, drink, smoke, or chew gum** in areas contaminated with asbestos, lead, or toxic chemicals.
- Wash or wipe **hands** clean before eating, drinking, and smoking, and always clean up and change out of contaminated **clothing** before going home at the end of the shift.
- Wash work clothes **separately** from casual and other family members' clothes.
- **Report** hazards to your employer.

Workers who are without symptoms and who have been exposed to asbestos may participate in a research study at Princess Margaret Hospital by volunteering to be screened for mesothelioma/asbestos.
Phone: 416-340-5686 Fax: 416-340-4964

For more information about health and safety in your job, contact your union or

Infrastructure Health & Safety Association: 1-800-263-5024, www.ihsa.ca
Ontario Ministry of Labour: 1-877-202-0008, www.labour.gov.on.ca
Workplace Safety and Insurance Board: 1-800-387-5540, www.wsib.on.ca

Labour Management Network

FOR **PHYSICIANS**

IHSA.ca Work Safe for Life

Occupational diseases and hazardous agents encountered by boilermakers and similar trades

Asbestos-related Diseases

- Asbestosis
- Cancer (lung, mesothelioma, gastrointestinal)—*asbestos*
- Asbestos warts—*asbestos*.

Cancer

- Leukemia—*benzene*
- Lung—*asbestos, coke oven emissions, diesel, dust, environmental tobacco smoke, silica, bioaerosols, nickel, hexavalent chromium*
- Gastrointestinal—*asbestos, hexavalent chromium*
- Haematological/lymphatic—*nickel, vinyl chloride, mineral wool*
- Nasal—*nickel, hexavalent chromium*
- Skin—*coal tar, ultraviolet (UV) light.*

Neurological

- Chronic solvent toxic syndrome—*solvents, paints, chlorinated solvents, degreasers, thinners*
- Hand-arm vibration syndrome—*vibrating tools*
- Lead, subacute toxic effect—*lead*
- Neuropathy, toxic—*lead*
- Parkinsonism—*carbon monoxide, manganese*.

Skin Disorders

- Dermatitis, contact—*hexavalent chromium, coal tar, epoxies, paints, degreasers, glues*
- Contact urticaria—*animal dusts.*

Miscellaneous Disorders

- Asphyxiation—*work in confined spaces*
- Gastroenteritis—*bacteria, animal waste*
- Hantavirus, histoplasmosis, leptospirosis, lymphocytic choriomeningitis—*rodent/bird/bat droppings*
- Hepatitis (chronic solvent toxicity)—*chlorinated solvents*
- Infertility, male—*manganese, lead, chlorinated solvents, water-based paint solvents*
- Noise-induced hearing loss—*noise, power tools, heavy machinery, grinders, industrial noise*
- Renal disease—*cadmium, degreasers, lead, solvents*
- Scleroderma/Systemic sclerosis—*silica.*

Respiratory Diseases

- Asthma, occupational—*fungi/mould, chromium, dust, mineral fibres, epoxies, PVC*
- Benign pneumoconiosis—*welding fume*
- Bronchitis, chronic—*organic dust, construction dust, welding fume, environmental tobacco smoke*
- Hypersensitivity pneumonitis (HP) acute/chronic—*fungi/mould, wood dust*
  - Chronic bronchitis—*ammonia gas*
  - Isocyanate HP—*polyurethane foams, epoxy*
  - Metal fume fever—*welding fume, iron, galvanized metal fumes*
  - Polymer fume fever—*PVC, plastics, teflon*
  - Pontiac fever, Legionnaires' disease—*Legionella*
  - Pulmonary edema—*cadmium, flux, solder, chlorine decomposition, silica*
- Silicosis—*silica* (see Scleroderma/Systemic sclerosis).

The next page provides important diagnostic criteria for screening, early detection, and diagnosis.

This booklet was prepared by the Ontario construction industry's Occupational Disease and Research Labour-Management Health and Safety Committee with assistance from the Infrastructure Health & Safety Association (IHSA), the Ontario Ministry of Labour (MOL), the Workplace Safety and Insurance Board (WSIB), and labour and employers in Ontario construction.

1-800-263-5024 • **www.ihsa.ca**

3

Labour Management Network

DIAGNOSTIC CRITERIA

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Asbestos disease

Asbestos-caused fibrosis of the lungs and pleura may lead to shortness of breath. It usually takes 15 or more years from the onset of exposure for radiographic abnormalities and symptoms to arise. Radiologists should be alerted to the suspected diagnosis. Boilermakers occupationally exposed to asbestos are at increased risk of cancers of the lungs and pleura. Screening for cancer has not been proven to reduce mortality; however, it can result in early detection.

If there is any suspicion of asbestos-related illness (i.e., not screening scenario), patients may be referred directly to Princess Margaret Hospital's program where immediate assistance, rapid assessment and specialized treatments are available. Phone 1-877-LUNG 911 (5864 911) Fax 416-340-3353. Asbestos-exposed workers should be counseled about smoking cessation.
http://www.wsib.on.ca/files/Content/OccDiseaseAsbestos/Asbestos_Related%20Diseases.pdf

Contact dermatitis

Contact dermatitis is an inflammatory skin reaction to direct contact with noxious agents in the environment. Substances that produce this condition after single or multiple exposures may be either irritant or allergic in nature. Irritant contact dermatitis (ICD) results from contact with external agents that directly damage the epidermis, in contrast to allergic contact dermatitis (ACD) in which the damage occurs through the host's immune response as a result of a delayed type hypersensitivity reaction.

The diagnosis of contact dermatitis should be considered when there is a suspected workplace agent (allergen or irritant). Screening should include determination of the following: (A) Did the skin condition start after the worker started the job? OR Did the skin condition become worse after the worker started the job? AND (B) Are symptoms better on weekends or holidays off work? Referral to a specialist with experience diagnosing and treating occupational contact dermatitis should be considered when any of the following are suspected: all cases of possible ACD; ICD with allergic features; chronic ICD; complicated ICD (e.g., not improving, deteriorating, confounded by another skin disease such as psoriasis).
http://www.wsib.on.ca/en/community/WSIB/ArticleDetail?vgnextoid=ff4de35c819d7210VgnVCM100000449c710aRCRD

Inhalation diseases: Silicosis, welding fume fever & polymer fume fever

Silicosis. An occupational lung disease caused by inhalation of crystalline silica dust. Silica inflammation and scaring is manifested as nodular lesions in the upper lobes of the lungs. Silicosis is progressive and signs may not appear until years after exposure has begun. Symptoms include: dyspnea on exertion, dry cough, and fatigue. The diagnosis is made by radiographic examination. It is preferred that the films be interpreted by a radiologist with experience with occupational lung disease since the finding may be subtle.
http://www.wsib.on.ca/files/Content/OccDiseaseSilicosis/Silicosis.pdf.

Welding Fume Fever. A flu-like illness with a metallic taste in the mouth, throat irritation, and dry cough. Leucocytosis is common. Normal chest x-ray. Occurs 3–10 hours after heavy exposure to zinc oxide fume or dust (e.g., after welding or flame cutting galvanized steel). Resolves spontaneously within 48 hours.

Polymer Fume Fever. A flu-like illness with chest tightness and mild cough occurring 4–8 hours after exposure to pyrolysis products of polytetrafluoroethylene (PTFE—trade names: Fluon, Teflon, Halon). There is leucocytosis but normal chest x-ray. Resolves within 48 hours.

Neurologic effects

Acute toxic effect of solvents: Organic solvents are volatile substances commonly used in the workplace as cleaners and degreasers. The systemic symptoms of acute solvent poisoning resemble those of intoxication from alcoholic beverages.

Toxic Neuropathy: Chemicals that can cause toxic polyneuropathy include lead and N-hexane. Most symmetrical, sensorimotor neuropathies caused by exposure to chemicals are indistinguishable from similar effects caused by systemic diseases such as diabetes or B12 deficiency. The diagnosis of toxic polyneuropathy is usually made on the basis of symptoms following exposure to the chemical and the resolution of symptoms months to years after cessation of exposure.

Noise-induced hearing loss

Noise-induced hearing loss (NIHL), is diagnosed by audiometric testing. With NIHL, there is a characteristic dip (notch) at 4 kHz on the audiogram. This contrasts with presbycusis where there is a continuous dropoff as frequency increases.
http://www.wsib.on.ca/en/community/WSIB/OPMDetail?vgnextoid=9956fcea9bfc7210VgnVCM100000449c710aRCRD

Occupational asthma

Sensitizer-induced occupational asthma is caused by an immune response to specific workplace agents such as low-molecular-weight chemicals (such as diisocyanates, colophony [a pine resin product used in soldering], or epoxy compounds). Once a person has been sensitized to one of these materials, even exposure to extremely low quantities will exacerbate the asthma. If this form of occupational asthma is suspected from the patient's history, objective investigation is required to confirm or refute the diagnosis.

Patients with confirmed sensitizer-induced occupational asthma should have no further exposure to the causative agent, since the best outcome is achieved with early diagnosis and complete avoidance of exposure. An objectively confirmed diagnosis is very important. Patients with suspected sensitizer-induced occupational asthma should be referred as soon as possible to a specialist (a respirologist, an allergist, or an occupational physician) with expertise in this area. Investigations are most helpful if they can be performed while the patient is still working in the suspected causative work area; the primary care physician may be able to initiate some of these.
Source: Occupational asthma: An approach to diagnosis and management. Tarlo and Liss. *Canadian Medical Association Journal.* Apr 1, 2003. 168(7);867-71.
http://www.wsib.on.ca/files/Content/Fact%20Sheet_English0619A/0619A_Asthma_and_Work.pdf

Scleroderma

Scleroderma is sometimes called systemic sclerosis. It is a type of connective tissue disorder. Diagnosis is recognized if the case is characterized by either:

Proximal scleroderma – skin changes suggestive of scleroderma that appear near the finger and wrist joints as well as on other parts of the extremities, face, neck, or trunk of the body. These changes usually appear symmetrically on both sides of the body and almost always include skin changes on fingers and toes.

OR two of the following

- **Sclerodactyl**—skin changes suggestive of scleroderma that is limited to fingers and toes
- **Digital pitting** of fingertips or loss of substance from the finger pad—depressed areas at tips of digits or loss of digital pad tissue
- **Bilateral basilar pulmonary fibrosis**—x-ray evidence of a bilateral pattern of linear or linear-nodular densities in the lower lung that are not due to primary lung disease.

http://www.wsib.on.ca/en/community/WSIB/OPMDetail?vgnextoid=1e27fcea9bfc7210VgnVCM100000449c710aRCRD

For more info about occupational disease and workplace health and safety, contact the Workplace Safety and Insurance Board: 1-877-202-0008

Labour Management Network

INTERNATIONAL BROTHERHOOD OF BOILERMAKERS CANADA

Boilermaker Exposure Incident Reporting Form - BEIR

The following information will assist in recording a workplace exposure incident. Please provide as much detail as possible to ensure that the incident is accurately recorded.

Local # for this incident:

A. Employer's Information

Employer's Name (at time of incident):	
Employer's Address for Correspondence: Contact Name: Street Address: Street Address2: City: Province: Postal Code: Phone: Fax: Email:	**H&S Representative's Address:** Contact Name: Street Address: Street Address2: City: Province: Postal Code: Phone: Fax: Email:
Address for Location of Incident: Street Address: Street Address2: City: Province: Postal Code:	
What is/was the nature of the work done?	

Does the project or workplace have a functioning Joint Health and Safety Committee (JHSC)?	**Does the Project or workplace have a Joint Health and Safety Representative?**
○ Yes ○ No ○ Not Sure	○ Yes ○ No ○ Not Sure

If the answer is **yes** to either or both of the above questions, please attach the report of the Joint Health and Safety Committee or the Joint Health and Safety Representative.

If the answer is **no** to the above questions, please attach the report of the exposed worker(s) if available.

Reports:

B. Please list all workers involved in the exposure incident

C. Detail of Incident

If you have your own incident reporting form, completion of this portion of the form is not required. Please attach the employer reporting form where available. You may be contacted for further information.

Employer Reporting Form:

Chemical or Other Workplace Substances

Date of Exposure:	mm/dd/yyyy	**Time of Exposure:**	:

Please describe in detail, what occurred: (Please check)

☐ leak ☐ spill ☐ rupture ☐ unanticipated emission ☐ explosion ☐ other(Pleaes specify)

If known, what chemical or other workplace substance(s) was the worker(s) exposed to?

What PPE were you wearing at the time of exposure?

Please describe where the worker(s) were at the time and how long they were in the affected area. (What personal protective equipment was being worn by the worker(s)? What emergency measures were taken after the incident? What was done to control the situation? If it would be helpful, a diagram can be attached to this incident below in "Other Incident Related Documents". Attach a diagram to describe the event or another sheet for added information.)

Were any worker compensation claims for an illness, condition or disease related to this incident?

○ Yes ○ No ○ Not Sure

If available, provide claim numbers:

Other Reporting of This Incident

Was a formal report of the incident made to a government agency (e.g. OH&S Inspector)?	○ Yes ○ No ○ Not Sure	If **yes**, did a government official(s) come to the premises because of the incident?	○ Yes ○ No ○ Not Sure
Is any information available about the substance(s) involved in the incident such as MSDSs?	○ Yes ○ No ○ Not Sure	Was exposure monitoring/environmental sampling done followin the incident?	○ Yes ○ No ○ Not Sure

Other Incident Related Documents

If illness or sickness has occurred since exposure contact employer and seek medical attention.

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Workplace Safety & Insurance Board
Commission de la sécurité professionnelle et de l'assurance contre les accidents du travail

Employer's Exposure Incident Reporting Form - CEIR

The attached **Employer's Exposure Incident Reporting Form** (form 3886A) is intended for voluntary use when an unexpected workplace incident exposure has resulted from a leak, spill, rupture, unanticipated emission, explosion or a release of a dangerous chemical or physical substance or contact with an infectious substance or biological agent.

The purpose of this form is to obtain information about the exposure incident experienced by the worker should an illness or disease occur in the future.

This form should be completed by the supervisor and/or the Joint Health and Safety Committee Representative. Workers wishing to participate in the CEIR Program should complete a Worker's Exposure Incident Reporting Form (CEIR) (Form 3885A).

The **Employer's Exposure Incident Reporting Form** should only be completed if there has been an unexpected workplace exposure event where there has been:

- no lost time
- no illness

If workers are experiencing any illness needing medical treatment (*such as diagnostic tests, prescribed medication or ongoing treatment*) as a result of the incident, the employer should file an occupational disease claim using a Form 7.

Forms should be completed and forwarded to:

By Mail
Workplace Safety and Insurance Board
Occupational Disease and Survivor Benefits Program
200 Front Street West, 4th Floor
Toronto, Ontario M5V 3J1

By Fax
416-344-4684
1-888-313-7373

To report an exposure incident by telephone or for questions concerning the Worker's Exposure Incident Reporting Form – CEIR, please contact us at:

Toll Free:	1-800-387-0750
Local Dialing:	416-344-1000
Website:	www.wsib.on.ca
TTY:	1-800-387-0050

3886A (10/12)

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Workplace Safety & Insurance Board
Commission de la sécurité professionnelle et de l'assurance contre les accidents du travail

Employer's Exposure Incident Reporting Form - CEIR

The following information will assist the Workplace Safety and Insurance Board (WSIB) in recording a workplace exposure incident. Please provide as much detail as possible to ensure that the incident is accurately recorded.

Section 1. Employer's Information

Employer's Name (at time of incident)		
Firm No.	Rate No.	Classification Unit Code
Employer's Address for Correspondence (street address/city/town/province)		
		Postal Code
Address for Location of Incident (street address/city/town/province)		
		Postal Code
What is the nature of your business?		

Section 2. Additional Employer's Information

Does the project or workplace have a functioning Joint Health and Safety Committee (JHSC)? ☐ yes ☐ no	Does the project or workplace have a Joint Health and Safety Representative? ☐ yes ☐ no
If the answer is **yes** to either or both of the above questions, please attach the report of the Joint Health and Safety Committee or the Joint Health and Safety Representative. If the answer is **no** to the above questions, please attach the report of the exposed worker(s) if available.	
Is the worker covered by a Union/Collective Agreement? ☐ yes ☐ no	If yes, please provide your union name and local.

Please list all workers involved in the exposure incident (Use additional sheet if necessary).

1. Last Name	Given Name	Date of Birth (dd/mm/yyyy)	Date of Hire
Address (street number & address/city/province)			
Postal Code / Telephone	Sex ☐ male ☐ female	Social Insurance No.	
2. Last Name	Given Name	Date of Birth (dd/mm/yyyy)	Date of Hire
Address (street number & address/city/province)			
Postal Code / Telephone	Sex ☐ male ☐ female	Social Insurance No.	
3. Last Name	Given Name	Date of Birth (dd/mm/yyyy)	Date of Hire
Address (street number & address/city/province)			
Postal Code / Telephone	Sex ☐ male ☐ female	Social Insurance No.	
4. Last Name	Given Name	Date of Birth (dd/mm/yyyy)	Date of Hire
Address (street number & address/city/province)			
Postal Code / Telephone	Sex ☐ male ☐ female	Social Insurance No.	

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wsib cspaat ONTARIO
Workplace Safety & Insurance Board
Commission de la sécurité professionnelle et de l'assurance contre les accidents du travail

Employer's Exposure Incident Reporting Form - CEIR

If you have your own incident reporting form, completion of this portion of the form is not required. Please attach your reporting form. You may, however, be contacted for further information.

Details of Incident

Complete Section A for an exposure to an infectious substance, or
Section B for an exposure to chemical or other workplace substances.

Section A - (Infectious Substances)

Date of Exposure (dd/mm/yyyy)	**Time of Exposure**

What type of exposure was involved? (please check):

☐ cut or scrape ☐ body fluid splash ☐ cough, sneeze ☐ other (please specify) _____

Source of exposure	Area of Body Affected

What infectious substance is suspected? (please check):

☐ tuberculosis ☐ meningitis ☐ rabies ☐ hepatitis ☐ anthrax ☐ campylobacter
☐ salmonella ☐ scabies ☐ shingles ☐ don't know ☐ other (please specify) _____

Section B - (Chemical or Other Workplace Substances)

Date of Exposure (dd/mm/yyyy)	**Time of Exposure**

Please describe, in detail, what occurred: (please check):

☐ leak ☐ rupture ☐ explosion
☐ spill ☐ unanticipated emission ☐ other (please specify) _____

What chemical or other workplace substance was the worker exposed to?

Please describe where the worker(s) were at the time and how long they were in the affected area.
(What personal protective equipment was being worn by worker(s)? What emergency measures were taken after the incident? What was done to control the situation? If it would be helpful, attach a diagram to describe the event or another sheet for added information.)

Were any WSIB claims for an illness, condition or disease related to this incident? ☐ yes ☐ no

Other Reporting of This Incident

Was a formal report of the incident made to the Ministry of Labour?	☐ yes ☐ no	If **yes**, did Ministry of Labour officials come to the premises because of the incident?	☐ yes ☐ no
Was a formal report of the incident made to the Ministry of the Environment?	☐ yes ☐ no	If **yes**, did Ministry of the Environment officials come to the premises because of the incident?	☐ yes ☐ no
Is any information available about the substance(s) involved in the incident such as MSDSs?	☐ yes ☐ no	Was environmental sampling done following the incident?	☐ yes ☐ no

Name of Person Completing Report	Official Title	
Signature	Telephone	Date (dd/mm/yyyy)

SUBMITTING THE EXPOSURE INCIDENT FORM TO THE WORKPLACE SAFETY AND INSURANCE BOARD

If the worker(s) experiencing the unexpected workplace incident are reporting their exposure, please attach all copies of the Worker's Exposure Incident Forms and forward to:

By Mail
Workplace Safety and Insurance Board
Occupational Disease and Survivor Benefits Program
200 Front Street West, 4th Floor
Toronto, Ontario M5V 3J1

By Fax
416-344-4684
1-888-313-7373

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About IHSA

IHSA's vision is workplaces without injuries, illnesses, or fatalities.

We engage with our member firms, workers, and other stakeholders to help them continuously improve their health and safety performance. We do this by providing effective and innovative sector-specific programs, products, and services.

We offer

- Training programs
- Consulting services
- Health and safety audits
- Publications and e-news
- Posters and stickers
- Reference material
- A resource-rich website
- Solutions to high-risk activities
- Due diligence solutions.

Find out what we can do for you at **ihsa.ca**

Infrastructure Health & Safety Association (IHSA)
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