

The inert gas will replace all of the **oxygen** as well as the combustible gases in the confined space. Workers entering the confined space must use NIOSH-approved **air-supplied** respirators. After work is completed, the confined space must be properly ventilated, and a competent worker must test the confined space to see if it is safe.

### Ventilation and Purging

This is the most effective method of control. 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 33-9). Studies have shown that the best results are obtained by blowing fresh air into a space close to the bottom. Check the efficiency of ventilation by re-testing the atmosphere with the gas detection equipment before entry.

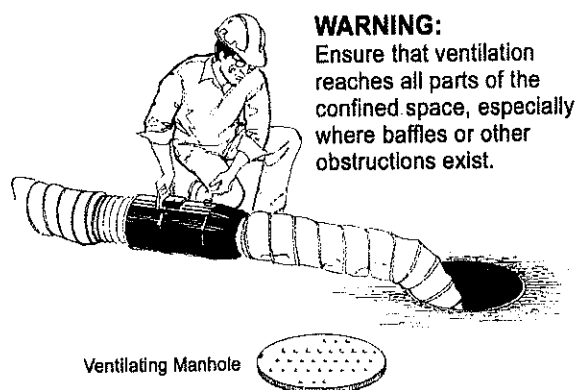


Figure 33-9: Ventilating Confined Space

When ventilation is used to improve the air in a confined space, ensure that the toxic or flammable gases or vapours removed from the space do not pose a risk to other workers. "Exhaust air" should not be discharged into another work area.

If you use mechanical ventilation to maintain acceptable atmospheric levels by providing a continuous supply of fresh air, you must have a warning system (i.e., an alarm) and exit procedure in case there is a ventilation failure. The alarm should be activated by a pressure switch *at the fan* rather than by electrical failure. This ensures that the alarm is activated if the fan belt fails.

In cases where the concentration of explosive gas or vapour is higher than the UEL, ventilation will bring the concentration down into the "Explosive Range." This is one reason why you should use only "explosion-proof" fans. These may be specially designed fans powered by electricity or compressed air. Some pneumatic air movers may also be suitable.

For manholes, you can use portable fans. These usually provide around 750-1,000 cubic feet of air per minute.

A typical manhole 10 feet deep and 5 feet wide contains 196 cubic feet. Blowing in 750 cubic feet per minute should provide an air change every 15 seconds and easily dilute or displace most dangerous atmospheres.

Fans capable of moving 5,000 cubic feet per minute are available for use in larger tanks and vessels.

This type of ventilation may not be adequate in situations where additional toxic or explosive gases or vapours may be generated (e.g., during cleaning and resurfacing tanks or by disturbing sludge and scale).

In the case of welding or other work that generates a localized source of toxic gas, fume, or vapour, an exhaust ventilator can be used to draw out and discharge the hazard in an open area (Figure 33-10).

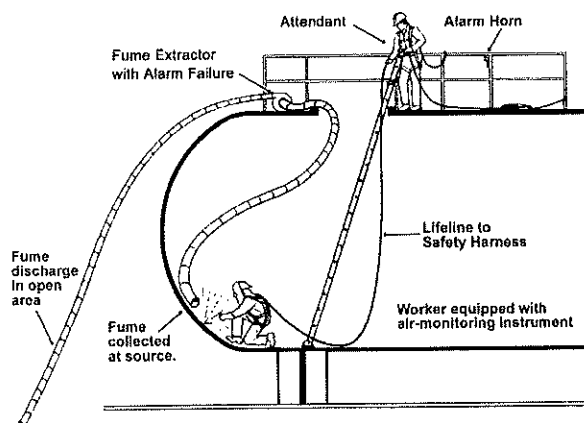


Figure 33-10: Exhausting and Discharging Hazardous Atmosphere

Options must be evaluated by someone who understands the risks of the work being done.

### 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.

It is strongly recommended that

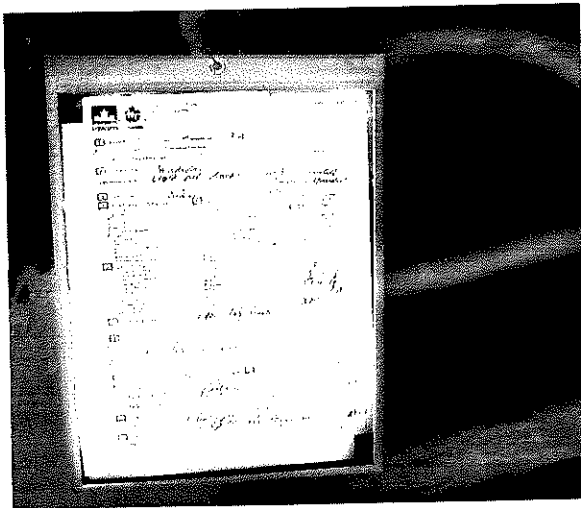
- The employer use an evaluation procedure (a test) to ensure that workers have acquired the knowledge necessary to safely perform their duties
- Inexperienced workers team up with experienced workers.

The content of the training must be reviewed at least annually and whenever there is a change in circumstances such as modifications to an industrial process. If the review indicates that the training is not adequate, you must provide additional training.

Keep a record of the names of trainers, trainees, as well as the date of training. If the project's Joint Health and Safety Committee or Health and Safety Representative wants a copy of the record, it must be provided.

### Entry Permits

Permits are valuable tools for planning, evaluating, and controlling confined space entries (Figure 33-11).



**Figure 33-11: Confined Space Entry Permit**

A permit involves a formal system of procedures and is issued by the employer before any worker enters the confined space. A competent person must verify that the permit issued complies with the plan before every shift. The duration of an entry permit must not exceed the time required to complete 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.

At the very least, the entry permit must include

- The location and description of the confined space
- A description of the work
- A description of the hazards and the corresponding controls
- The time period for which the entry permit applies
- The name of the attendant
- A record of each worker who enters and leaves
- A list of the equipment required for entry and rescue, and verification that the equipment is in good working order
- The results of the atmospheric testing
- Additional procedures and control measures if hot work is to be done.

The entry permit may also include

- A record of the hazard assessment
- The hazard control plan
- The training records.

(See Sample Confined Space Entry Permit at the end of this chapter.)

### Unauthorized entry

The constructor must ensure that each entrance to the confined space is secured against unauthorized entry and/or has adequate barricades or signs warning against unauthorized entry.



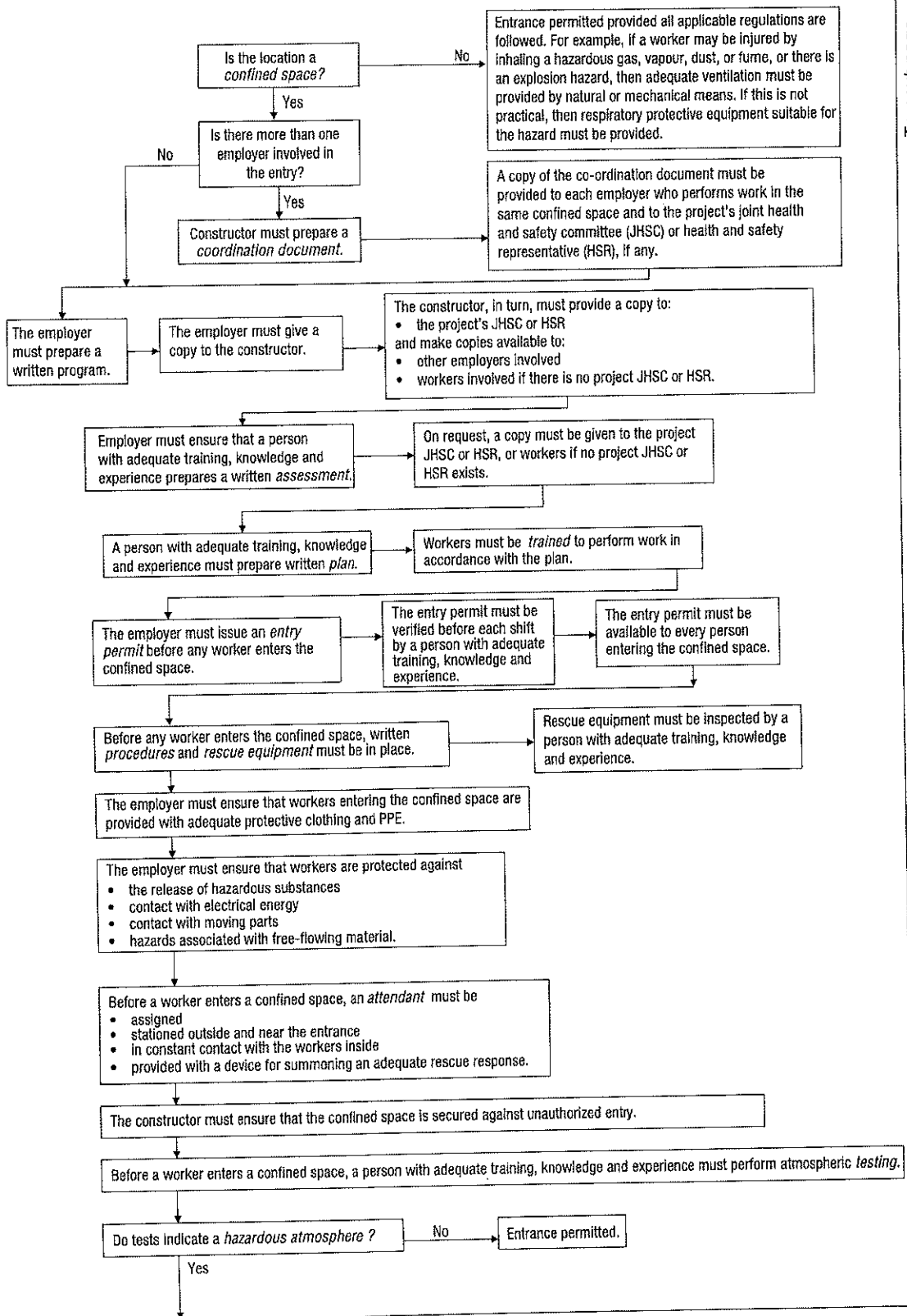
### Recordkeeping

The employers must keep records of every

- Plan
- Assessment
- Coordination document
- Training
- Entry permit
- Record of rescue equipment inspection
- Record of tests.

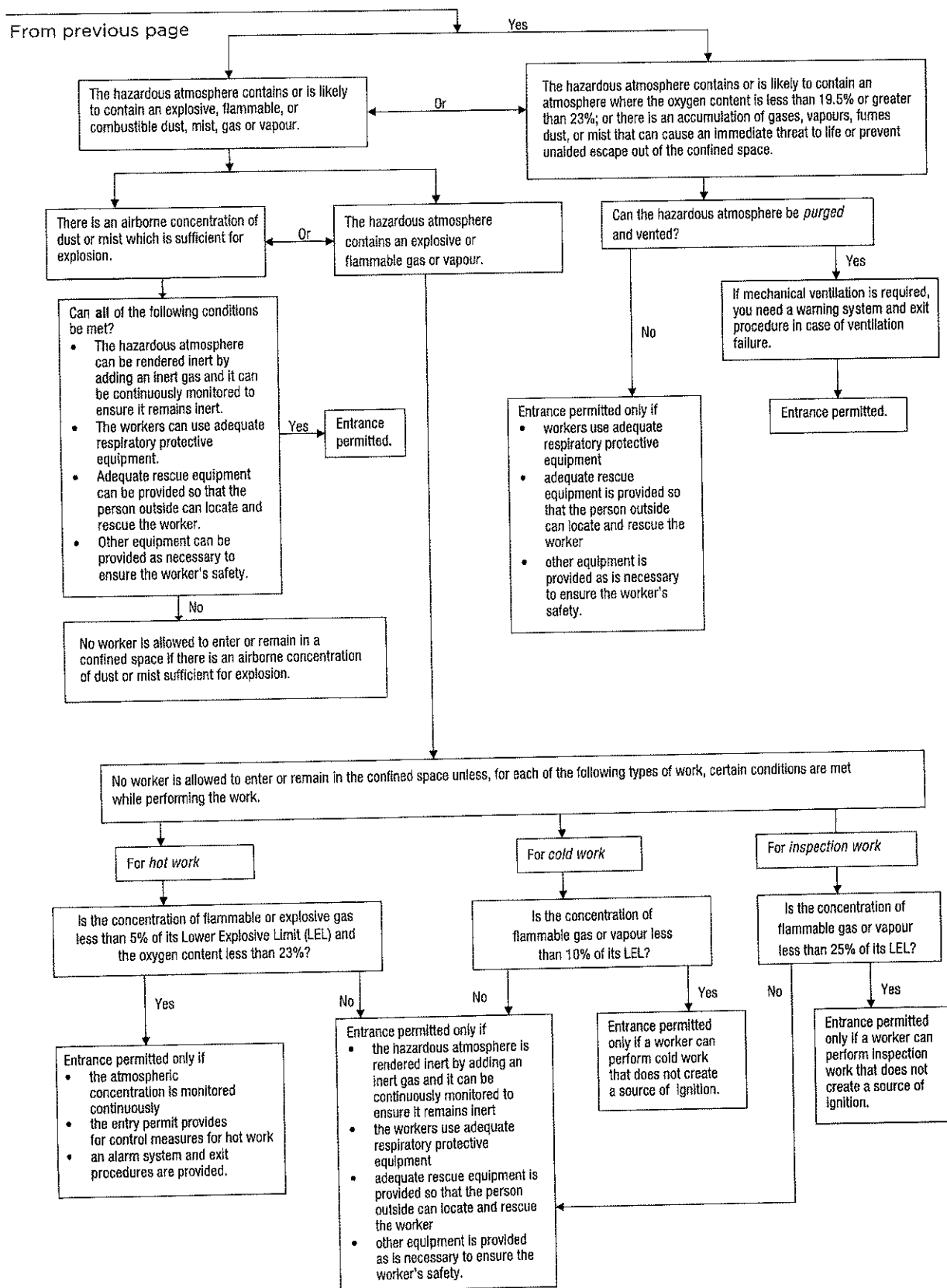
The records must be kept for at least one year after the project is finished, and they must be available for review by an inspector.

# DECISION TREE FOR CONFINED SPACES



To next page

# CONFINED SPACES



## Sample Confined Space Entry Permit

Effective: \_\_\_\_ / \_\_\_\_ / \_\_\_\_      From: \_\_\_\_:\_\_\_\_ <sup>am</sup>/<sub>pm</sub>      To \_\_\_\_:\_\_\_\_ <sup>am</sup>/<sub>pm</sub>

<b>Location</b>	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

<b>Air Quality Results</b>	Time of Test							
	Oxygen %							
	Combustibles %							
	Carbon monoxide (CO)							
	Hydrogen sulphide (H <sub>2</sub> S)							
	Other atmospheric hazard (                      )							
	Tester's Name (print):		Signature:					

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

# **CONFINED SPACES**

<b>Attendant Entry Log</b>	Worker Name	Permit Reviewed with Workers	Time In	Time Out	Time In	Time Out	Time In	Time Out	
		<input type="checkbox"/>							
		<input type="checkbox"/>							
		<input type="checkbox"/>							
		<input type="checkbox"/>							
		<input type="checkbox"/>							
		<input type="checkbox"/>							
		<input type="checkbox"/>							
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		<input type="checkbox"/>							
		<input type="checkbox"/>							
		<input type="checkbox"/>							
		<input type="checkbox"/>							
		<input type="checkbox"/>							
	Attendant's Name (print):				Attendant's Signature:				

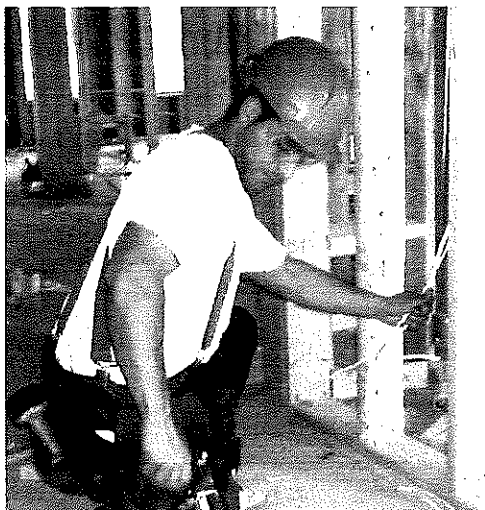
<b>Rescue Equipment</b>	<input type="checkbox"/> Winch	<input type="checkbox"/> Respirator	<input type="checkbox"/> Ladder	<input type="checkbox"/> Tripod	<input type="checkbox"/> Harness
	Other:	Other:	Other:	Other:	
	Rescue equipment inspected and in good working order? <input type="checkbox"/> Yes <input type="checkbox"/> No				

<b>Confirmation of Work Completion</b>	<b>Signature</b>	<b>Date</b>	<b>Time</b>

# ELECTRICAL HAZARDS

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## 26 ELECTRICAL HAZARDS



An **electrical hazard** can be defined as

- a dangerous condition where a worker could make electrical contact with energized equipment or a conductor, and from which the person may sustain an injury from shock; and/or,
- there is potential for the worker to receive an arc flash burn, thermal burn, or blast injury.

**NOTE:** An electrical hazard is considered to be removed when protective measures are put in place at the source (remove hazard or de-energize), or along the path (place electrical insulation/barrier between the worker and the electrical hazard). Where PPE is relied upon for worker protection, an electrical hazard is considered to remain and it is still necessary to address safety requirements for other workers in the area.

Injuries resulting from a worker making electrical contact represent a relatively small portion (7.7%) of the lost-time injuries electricians experience, according to 1997-1999 statistics. It is reasonable to assume that the situation is similar today. Other mechanical trades that do some electrical work can probably expect even fewer electrical injuries.

Nevertheless, working on or near electrical hazards is dangerous and can be fatal. Any work on or near energized equipment must be done only when measures are in place to provide protection from electric shock and burn. With adequate safety measures in place, every electrical injury and fatality can be prevented.

The law requires safe work practices. Under the *Occupational Health and Safety Act and Regulations for Construction Projects* (the green book), employers, supervisors, and workers each have legal responsibilities to ensure that work is being carried out in a safe manner.

There are also restrictions in the Construction Projects regulation (O. Reg. 213/91, s. 182) on who can work on electrical equipment:

1. *No worker shall connect, maintain or modify electrical equipment or installations unless,*
  - (a) *the worker holds a certificate of qualification issued under the Ontario College of Trades and Apprenticeship Act, 2009, that is not suspended, in the trade of,*
    - (i) *electrician — construction and maintenance, or*
    - (ii) *electrician — domestic and rural, if the worker is performing work that is limited to the scope of practice for that trade; or*
  - (b) *the worker is otherwise permitted to connect, maintain or modify electrical equipment or installations under the Ontario College of Trades and Apprenticeship Act, 2009 or the Technical Standards and Safety Act, 2000. O. Reg. 627/05, s. 4; O. Reg. 88/13, s. 2.*
2. *A worker who does not meet the requirements of clause (1) (a) or (b) may insert an attachment plug cap on the cord of electrical equipment or an electrical tool into, or remove it from, a convenience receptacle.*

Guidelines for working on or near electrical equipment and conductors are found in several documents:

- Construction Regulation (O. Reg. 213/91)
- Ontario Electrical Safety Code
- Operating manuals for different tools and equipment.
- CAN/CSA-Z462: *Workplace Electrical Safety*.

An important aspect of electrical work involves isolating electrical energy. A reference for detailed information on lockout and control of hazardous energy is the CAN/CSA-Z460: *Control of Hazardous Energy—Lockout and Other Methods*.

### Electrical Injuries

There are basically two ways to be injured by electricity. One is by electric shock and the other is by arc flash.

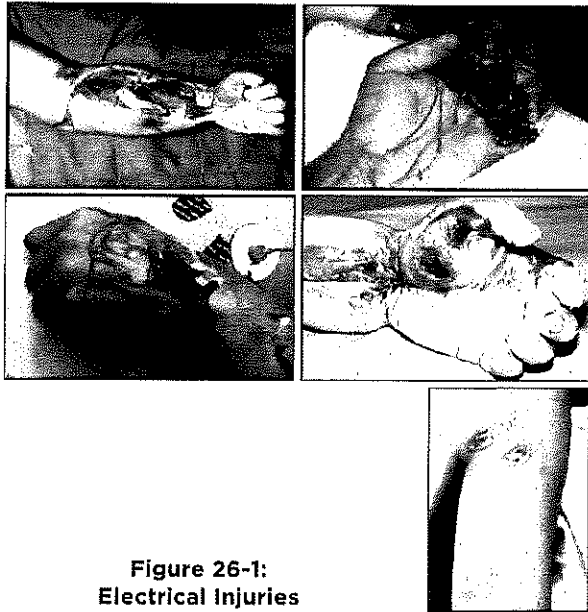
**Electric shock** is the passing of electric current through the body. Electrical contact can cause involuntary physical movements. The electrical current may do the following.

- Prevent you from releasing your grip from a live conductor
- Throw you into contact with a higher voltage conductor
- Cause you to lose your balance and fall
- Cause severe internal and external burns
- Kill you.

A household 125-volt circuit can deliver 15 amps. Current as low as 30/1000 of 1 amp (30 mA) can cause breathing to stop. A 15-amp circuit contains many times the current needed to cause death.



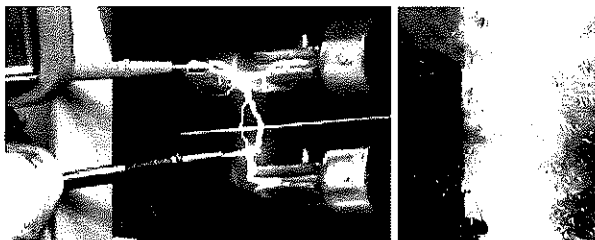
A major cause of accidents involving electricity comes from the failure to identify the hazards associated with live electrical equipment and wiring (Figure 26-1).



**Figure 26-1:**  
Electrical Injuries

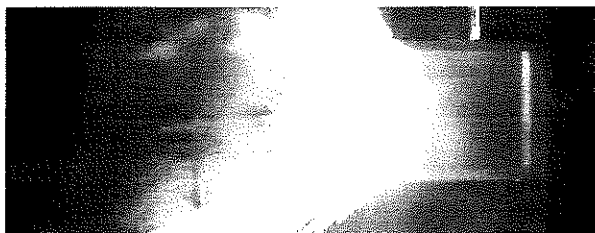
An **arc flash** is a release of energy caused by an electric arc (Figure 26-2). The flash causes an explosive expansion of air and metal. The blast produces

- A dangerous pressure wave
- A dangerous sound wave
- Shrapnel
- Extreme heat
- Extreme light.



**Figure 26-2: Electric Arc**

These dangers can result in blast injuries, lung injuries, ruptured eardrums, shrapnel wounds, severe burns, and blindness. Arc flash injuries can also result in death (Figure 26-3).



**Figure 26-3: Arc Flash**

## Safeguards

### Protective Tools and Equipment

Workers exposed to an electrical hazard must use mats, gloves, shields, flame resistant clothing, and any other protective equipment required to protect themselves from electric shock and burn. As part of everyday work, electrical workers should always do the following.

- Remove watches, rings, neck chains, or other current-conducting apparel.
- Wear electric-shock-resistant footwear.
- Wear a CSA-approved Class E hard hat or equivalent.
- Wear safety glasses with side shields.
- Wear under and outer clothing that has flame-resistance properties.

Tools, devices, and equipment—including personal protective equipment—used for live work must be designed, tested, maintained, and used so as to provide adequate protection for workers.

Where there is the potential for an arc flash, **all** PPE should be chosen with consideration for the kinds of hazards that can result from an arc flash. (See "Flash hazard arc flash protection" below.)

The following information provides guidelines on appropriate and required personal protective equipment. Check the reference documents identified at the beginning of this chapter to determine your job-specific needs. See also the chapters on personal protective equipment in this manual.

### Clothing

Whether or not the day's planned work involves working near an electrical hazard, workers that do electrical work should choose everyday clothing that offers some flame-resistance properties. When work must be done in the presence of an electrical hazard, ensure that all clothing is chosen to provide adequate protection from the potential hazards. (See "Flash Hazard (Arc Flash) Protection" section in this chapter.)

### Head Protection

The following types of hard hats comply with the Construction Projects regulation (213/91):

- Class E, Type 1 or 2 (CAN/CSA-Z94.1)
- Type II, Class E (ANSI Z89.1)
- Type I, Class E (ANSI Z89.1).

Type 1 hard hats provide protection to the top of the head, while Type 2 hard hats provide protection to the top and sides of the head. Because it protects against side impact, CSA Type 2 hard hats are recommended for construction work. Class E hard hats are able to withstand an electrical contact equal to 20,000 volts (phase-to-ground).

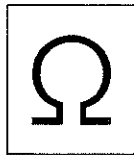
### Foot Protection

Construction workers require Grade 1 toe protection with sole puncture protection in accordance with CAN/CSA Z195-14; *Protective Footwear*. A green triangular patch on the tongue or the ankle of protective footwear indicates that it meets the requirements of the Construction Projects regulation (213/91).

Construction workers who are exposed to electrical hazards (e.g., mechanical tradespeople) should also wear protective footwear that resists electric shock. This is indicated by a white rectangular label bearing the CSA logo and the Greek letter omega in orange.



CSA logo



omega label

### Eye Protection

CAN/CSA Z94.3-15: *Eye and Face Protectors* can assist you in classifying hazards and recommending eye protectors. Appropriate protection chosen according to this standard meets with the intent of the Construction Projects regulation (213/91) regarding eye protection worn on the job.

In any case, eye protection should be of industrial quality eye protection in the form of safety glasses incorporating side-shields or a wrap-around style. Arc flash protection requires a face shield that is rated for arc flash, with safety glasses underneath.

Regular plastic face shields do not provide arc flash protection. They can burn and melt in an arc flash incident. Use a face shield that is designed and rated for arc flash protection.



### Hearing Protection

Hearing protection is important at work since continuous exposure to excessive noise can lead to hearing loss and tinnitus. Hearing protection is required for some arc flash hazards. Hearing protection is available in three general types:

1. Disposable ear plugs made of pliable material. One size fits all, but they should only be used once.
2. Reusable custom-fit ear plugs are available to provide protection for specific frequencies of noise. These provide a good seal and can be washed and reused.
3. Earmuffs. They need to be fitted to provide maximum protection.

### Shock Protection

The passage of electricity through the body is called shock. Effects can range from a tingling sensation to death. A shock that may not be enough to cause injury can nonetheless startle a worker, causing an involuntary reaction that can result in serious injuries or death.

A household 125-volt circuit can deliver 15 amps. Current as low as 30/1000 of 1 amp (30 mA) can cause breathing to stop. A 15-amp circuit has many times the current needed to cause death.

Rubber gloves and leather protectors are the most common personal protective equipment used for shock protection. These must be adequate to protect the worker from electrical shock or burn. The rubber gloves must have been tested and certified.

Class 0 and Class 00 gloves must be air-tested and visually inspected for damage and adequacy immediately before each use. Class 0 and Class 00 are exempt from regular recertification unless work is carried out under the Electrical Utility Safety Rules (see RB-ELEC available at [ihsa.ca](http://ihsa.ca)). Rubber gloves rated for use with voltages above 5,000 volts AC must be regularly tested and certified to ensure that they can withstand the voltages for which they are rated,

- At least once every three months if they are in service, or
- Once every six months, if they are not in service.

Workers must be trained in the proper use, care, and storage of rubber gloves and leather protectors.

Rubber mats and shields can also be used with standard personal protective equipment to protect the worker from electric shock or burn. The rubber mat must have been tested and certified.

The best shock protection is afforded by turning off or isolating the electrical power from the worker. The Construction Regulation requires all work to be done with the system de-energized unless certain specified conditions are met. (See "Working on Energized Systems" in this chapter.)

## Flash Hazard (Arc Flash) Protection

A **flash hazard** is defined as a dangerous condition associated with the release of energy caused by an electric arc (NFPA 70E 2004). The release of energy is often referred to as an arc flash.

An arc flash produces thermal energy which is measured in calories/cm<sup>2</sup>. Adhering to arc flash protection calculations can still expose a worker to second degree burns, or 1.2 calories/cm<sup>2</sup>.

One calorie is the amount of heat needed to raise the temperature of one gram of water by 1°C.

Second degree burn results from exposure to 1.2 cal/cm<sup>2</sup> for more than 0.1 second.

1.2 calories/cm<sup>2</sup> is equivalent to holding your finger in the blue part of a butane lighter flame for one second.

These conditions can lead to arc flash:

- Accidental contact between two conductors
- Wiring errors
- Insulation deterioration or failure
- Corrosion of equipment
- Contamination of the equipment (e.g., dust, moisture)
- Animals, tools, or fallen parts that short-circuit the equipment
- Poor maintenance
- Workers using improper or non-rated tools.

If a worker is close to energized electrical equipment, the worker may be exposed to a flash hazard, even if the source of the arc flash is not being worked on. Employers and supervisors need to ensure these workers are protected from flash hazards, and should educate workers on flash hazard recognition.

It may be possible to eliminate the electrical hazard with equipment designed to offer flash protection. The plugs in Figures 26-4 and 26-5 are designed for flash protection and can be used as a disconnect switch.

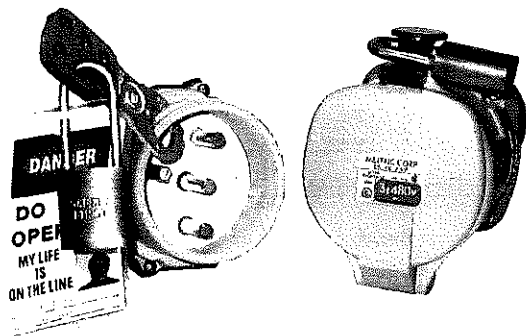


Figure 26-4: Flash Hazard Switch Plug

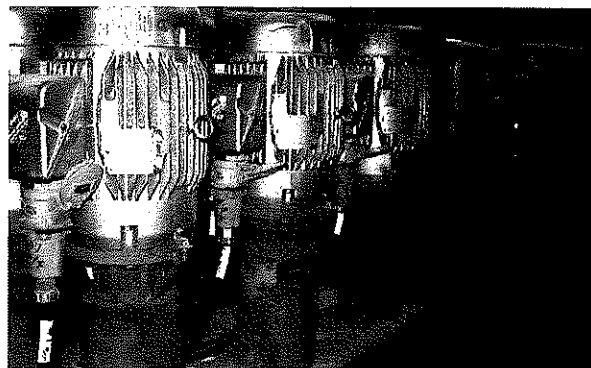


Figure 26-5: Flash Protection Designed into Disconnect Switch/Plug

Mechanical workers who are potentially exposed to arc flash should always wear clothing that provides for some level of arc-flash protection. Clothing made of synthetic fibres can be readily ignited by arc flash and melt to the workers' skin. Cotton or wool fabrics are more flame-retardant and are therefore recommended as outer-wear and inner-wear for work clothes. Clothing that is arc-flash rated to provide protection up to a specified hazard category must be worn when there is a flash hazard.

Protection from an arc flash is afforded by protective clothing and equipment such as

- Arc-rated clothing
- Flame-resistant eye protection (arc-rated face shield is often required as well)
- Hand protection
- Hearing protection.

There are a number of levels of arc-rated clothing, ranging from cotton-like clothes to the higher arc-rated suits and face shields (Figure 26-6). The level of protection necessary is determined by a calculation using tables or a computer program.



Figure 26-6: Flash Suit and Face Shield

**A hypothetical example:**

For voltage testing on an energized part, 240 volts or less, a worker may require the following.

- Arc-rated pants and shirt (each rated to withstand 4 calories/cm<sup>2</sup>)
- Arc-rated face shield and safety goggles
- 500-Volt-rated class 00 gloves (class 0 gloves protect up to 1000 volts)
- 1000-Volt-rated tools
- Approved hard hat
- Hearing protection.

Actual calculations for this task may yield different results.

Workers who encounter a flash hazard can take additional precautions to reduce exposure.

- Standing as far away as possible from the hazard lowers the calorie intensity of an arc flash.
- Standing to the side when opening electrical-box doors can reduce exposure to the full force of a blast.

Information is available to assist with arc-flash energy calculations. Here are some sources:

- The (US) National Fire Protection Association's Standard for Electrical Safety in the Workplace (NFPA 70E). Contact the NFPA: [www.nfpa.org](http://www.nfpa.org)
- The Institute of Electrical and Electronics Engineers' standard 1584, Guide for Performing Arc-Flash Hazard Calculations. Contact the IEEE: [www.ieee.org](http://www.ieee.org)
- CSA standard Z462 *Workplace Electrical Safety*. Contact the CSA: [www.csagroup.org](http://www.csagroup.org)

**Working on Energized Systems**

What if there's an electrical hazard but work must be done on or near enough to the hazard to make electrical contact, or near enough to be exposed to injury from an arc flash? In such cases, working while the system is energized is permitted only if specific conditions are met.

Work on energized equipment is permitted only in one of the following situations.

- It is not reasonably possible to disconnect the equipment, installation, or conductor from the power supply.
- The equipment is rated at a nominal voltage of 600 volts or less, and disconnecting the equipment would create a greater hazard to workers than proceeding without disconnecting it.
- The work consists only of diagnostic testing.

**NOTE:** Testing with a meter is working on energized equipment, and requires appropriate protection including personal protective equipment.

Unless the work consists only of diagnostic testing or involves a nominal voltage under 300 volts, an adequately equipped competent worker who can perform rescue operations, including cardiopulmonary resuscitation (CPR), must be stationed where he or she can see the workers performing the live work.

Work on energized equipment nominally rated greater than 400 amperes and greater than 200 volts, or greater than 200 amperes and greater than 300 volts, can only be done if all of the following conditions are met.

1. The owner of the equipment provides the employer and the constructor with a record showing that it has been maintained according to the manufacturer's specifications.
2. A copy of the maintenance record is readily available at the project.
3. The employer has determined from the maintenance record that work on the equipment can be performed safely without disconnecting it.
4. Before beginning live work, the worker has verified that requirements 1), 2), and 3) have been met.

**Repair or permanently disconnect defective equipment.**

Section 2-300 of the Ontario Electrical Safety Code requires operating electrical equipment to be kept in safe and proper working condition.

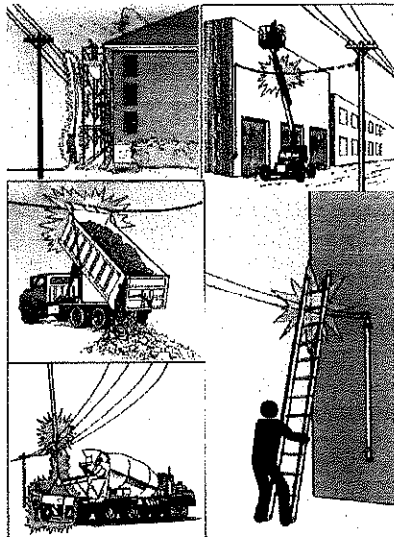
The constructor must ensure that written procedures for work on or near live equipment are produced and implemented to protect workers from electrical shock and burn. The constructor must have copies of the procedures available for employers on the project.

The employer must provide and explain the written procedures to workers before they start work on or near live equipment. The constructor and the employer both have a general duty to ensure that the health and safety of workers are protected.

**Operating Equipment Near Energized Powerlines**

Incidental powerline contact happens too often, especially considering the potential severity of the consequences. The Ministry of Labour reported 108 powerline contacts in 1998. That number rose to 196 in 2005. See Table 26-1.

Constructors must be aware of electrical hazards when equipment such as a crane, dump truck, or other vehicle is going to be operated near an energized overhead electrical conductor, or when excavating equipment such as a backhoe will be operated near underground powerlines (Figure 26-7).



**Figure 26-7: Electrical Hazards Near Overhead Powerlines**

When equipment operates within reach of, and could therefore encroach on, the minimum permitted distances from live overhead powerlines (as listed in Table 26-2), the constructor is required to have written procedures in place to prevent it from occurring and to have copies of the procedure available for every employer on the project.

**NOTE:** The wind can blow powerlines, hoist lines, or your load. This can cause them to cross the minimum distance.

Overhead powerlines are most frequently hit by dump trucks and cranes; however, elevating work platforms and low-tech equipment such as ladders and rolling scaffolds are also involved. Keep in mind that many powerline contacts involve low-voltage service and buried cable.

**Table 26-1: Summary of Powerline Contacts**

Year	Overhead Lines				Buried Cables		
	Crane	Dump truck	Tree felling	Other	Digging	Other	Total
2005	19	21	9	87	45	15	196
2004	11	16	5	57	53	9	151
2003	16	19	9	63	35	6	148
2002	16	20	4	50	36	6	132
2001	16	22	5	43	27	7	120
2000	15	10	3	59	32	3	122
1999	11	26	2	48	27	1	115
1998	10	17	8	39	27	7	108
<b>TOTALS</b>	<b>114</b>	<b>151</b>	<b>46</b>	<b>446</b>	<b>282</b>	<b>54</b>	

Source: Ontario Ministry of Labour

**Table 26-2: Minimum Distance from Powerlines**

Voltage Rating of Powerline	Minimum Distance
750 to 150,000 volts	3 m (10 ft)
150,001 to 250,000 volts	4.5 m (15 ft)
over 250,000 volts	6 m (20 ft)

Source: O. Reg. 213/91, s. 188

### Safety Measures

Written measures and procedures required by the Construction Projects regulation (213/91) include the following:

- Place enough warning devices in the area of the hazard so that at least one is always visible to the operator. The warning devices must be visible to the operator under any conditions in which the equipment may be operating (night, rain, fog, etc.), and must be specific about the hazard. Provide a sign meeting the requirements of O. Reg. 213/91, s. 44, stating, for example, "Danger! Electrical Powerlines Overhead." We recommend that you include the voltage (Figure 26-8).

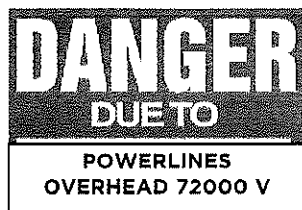


Figure 26-8: Warning Sign

- Ensure the equipment operator has been provided with written notification of the electrical hazard before beginning the work.
- Ensure there is a sign warning of the hazard that is visible to the operator at the operator's station. This may come as a sticker with the machine. Check to ensure the sticker is still legible.
- Before the operator starts work, ensure that the employer of the equipment operator provides and explains the procedures to the equipment operator.
- A competent worker must be designated as a signaller to warn the operator when any part of the equipment, load, or hoist line may approach the minimum distance. The signaller must then be in full view of the operator and have a clear view of the equipment and the conductor. Section 106 of the Construction Regulation also applies with respect to the designated signaller.

An exemption to these measures is only allowed if, under the authority of the owner of the electrical conductor (typically the local utility), protective devices and equipment are installed, and written procedures are implemented (e.g., using the Electrical Utilities Safety Rules) that are adequate to protect the equipment operator from electrical shock and burn.

### Prevention

Ensure that contractors and workers understand that work should be planned to avoid powerlines. Prepare for work that must be done in close proximity to energized powerlines by developing written procedures ahead of time.

Have overhead powerlines moved, insulated, or de-energized where possible. Insulating or "rubberizing" powerlines offers some protection against brush contact in some circumstances. The local utility may provide this service.

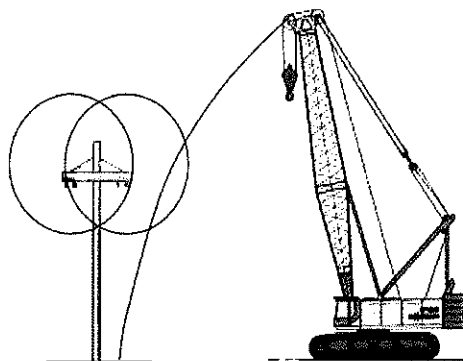


Figure 26-9: Inside the Limit of Approach to the Powerline

Identify the voltage of the service by checking markings on the utility pole and calling the utility. If material must be stored under powerlines, hang warning flags and signs to inform workers about the hazard and the need to obtain written procedures if hoisting (Figure 26-10).



Figure 26-10: Warning Signs on Utility Poles

Provide instruction as part of site orientation.

- Tell operators of large equipment where overhead and buried powerlines are and where overhead powerlines may be lower than expected.
- Remind workers not to let a ladder, scaffold, or elevated work platform lean or drift toward overhead powerlines. Always maintain minimum allowable clearances.
- Inform all workers how powerline hazards are identified on site and that written procedures are required prior to operating near them.
- Review an appropriate emergency response for equipment operators and workers assisting operators, in case contact should occur.

## In the event of contact between equipment and overhead powerlines:

1. **Stay on equipment.** Don't touch equipment and the ground at the same time. Touching anything in contact with the ground can be fatal. Stay on the equipment unless forced off because of a life-threatening hazard such as fire.
2. **Keep others away.** Warn everyone not to touch the equipment or its load. That includes buckets, outriggers, load lines, and any other part of the machine. Beware of time-delayed relays. After line damage trips a breaker, relays may still try to restore power. They may reset automatically two or three times.
3. **Break contact.** If possible, break contact by moving the equipment clear of the wires. This may not be feasible where contact has welded conductors to equipment, the hoist line, or the load.
4. **Call the local utility.** Get someone to call the local electrical utility for help. Stay on the equipment until the utility shuts down the line and confirms that power is off. Report incidents of powerline contact so that the utility can check for damage that could cause the line to fail later.
5. **Jump clear.** If forced to leave the equipment, jump carefully off the equipment onto the ground landing only on your feet, with your feet together. Touching the equipment and the ground at the same time can be fatal. Touching the ground at different points can also be fatal. Shuffle slowly away from the equipment using very small steps to minimize the contact area with the ground.
6. **Report the contact.** See "Reporting Electrical Incidents" in this chapter.

## Hidden Power Supplies

Digging into buried cable resulted in 282 powerline contacts between 1998 and 2005 (see Table 26-1). A great many of these resulted from excavating prior to getting a locate on the service (Figure 26-11). If the electrical power cannot be shut off during excavation, the owner (of the service) must be present to supervise the uncovering of the powerline.

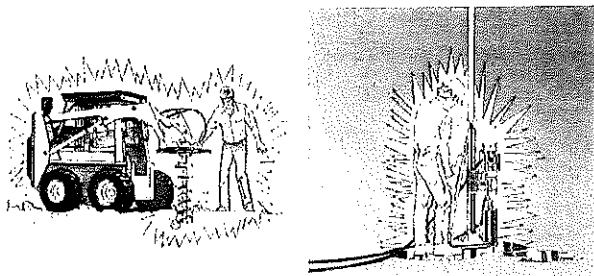


Figure 26-11: Underground Powerline Hazards

The following are some prevention measures for hidden powerlines.

## For underground powerlines:

- Before excavating, request that the owner of the service locate and mark underground powerlines.
- Contact the utility through Ontario One Call to locate all underground services.
- Locate and mark underground lines on drawings that will be used for excavating.
- Post warning signs along the route of underground powerlines.
- When operators of excavation equipment arrive on site, tell them where underground services are located and how they are identified.

## For powerlines embedded in concrete:

- Ensure various trades provide sleeving when concrete is poured to reduce the need to drill.
- Try to have powerlines laid along dedicated sections of flooring and walls.
- Mark powerline locations on drawings that will be referenced for drilling.
- Use a location service to x-ray the concrete and locate embedded powerlines.

## Multimeters

In the process of troubleshooting, electrical workers face the risk of injury from improper multimeter selection or use (Figure 26-12). Multimeters that are designed to meet the International Electrotechnical Commission (IEC) 1010 and overvoltage category standards, when properly used, offer the electrician an acceptable level of protection that is recognized by the electrical industry. The use of fused leads provides additional protection for the worker.

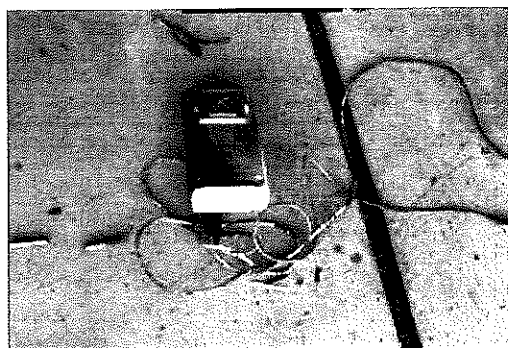


Figure 26-12: A Failed Multimeter

Table 26-3: Multimeter Overvoltage Categories

OVERVOLTAGE CATEGORY	IN BRIEF	EXAMPLES
CAT IV	Three-phase at utility connection, any outdoors conductors	<ul style="list-style-type: none"> <li>Refers to the "origin of installation" (i.e., where low-voltage) connection is made to utility power.</li> <li>Electricity meters, primary overcurrent protection equipment.</li> <li>Outside and service entrance, service drop from pole to building, run between meter and panel.</li> <li>Overhead line to detached building, underground line to well pump.</li> </ul>
CAT III	Three-phase distribution, including single-phase commercial lighting	<ul style="list-style-type: none"> <li>Equipment in fixed installations, such as switchgear and polyphase motors.</li> <li>Bus and feeder in industrial plants.</li> <li>Feeders and short branch circuits, distribution panel devices.</li> <li>Lighting systems in larger buildings.</li> <li>Appliance outlets with short connections to service entrance.</li> </ul>
CAT II	Single-phase receptacle connected loads	<ul style="list-style-type: none"> <li>Appliance, portable tools, and other household and similar loads.</li> <li>Outlet and long branch circuits.               <ul style="list-style-type: none"> <li>Outlets at more than 10 meters (30 feet) from CAT III source.</li> <li>Outlets at more that 20 meters (60 feet) from CAT IV source.</li> </ul> </li> </ul>
CAT I	Electronic	<ul style="list-style-type: none"> <li>Protected electronic equipment.</li> <li>Equipment connected to (source) circuits in which measures are taken to limit transient overvoltages to an appropriately low level.</li> <li>Any high-voltage, low-energy source derived from a high-winding resistance transformer, such as the high-voltage section of a copier.</li> </ul>

Parts of this table are reprinted with permission from Fluke Electronics Canada Inc.

### Overvoltage Categories

Momentary high-voltage transients or spikes can travel through a multimeter at any time and without warning. Motors, capacitors, lightning, and power conversion equipment such as variable speed drives are all possible sources of spikes.

The IEC 1010 standard defines categories I through IV that are abbreviated as CAT I, CAT II, CAT III, etc. The higher-numbered categories represent an electrical environment that is susceptible to higher-energy spikes. For example, multimeters that are designed to the CAT IV standard provide the worker more protection from high transient voltage spikes than do CAT III, CAT II, or CAT I designs. See Figure 26-13 and Table 26-3 for an explanation of each category.

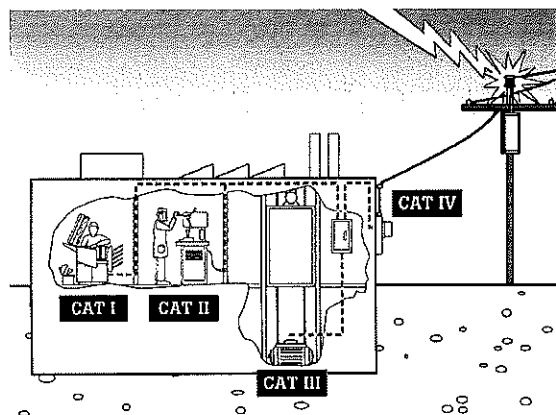


Figure 26-13: Examples of Overvoltage Categories



Be sure that the multimeter model has been tested. Simply being designed to the CAT III standard, for example, does not mean the multimeter was also tested to that standard.

**Look for proof of independent testing by an organization accredited by the Standards Council of Canada—such as the CSA (Canadian Standards Association) International logo—along with the appropriate category rating on the equipment.**



Test leads should also be rated at the same or greater voltage than the multimeter.

### Understanding Overvoltage Installation Categories

The division of a power distribution system into categories is based on the fact that a dangerous high-energy transient such as a lightning strike will be attenuated or dampened as it travels through the impedance (AC resistance) of the system. A higher CAT number refers to an electrical environment with higher power available and higher-energy transients.

Therefore, a multimeter designed to the CAT III standard is resistant to much higher-energy transients than one designed to the CAT II standard. Categories I through IV apply to low voltage (less than 1000 V) test equipment.

### Safe Use of Multimeters

- Use only multimeters that display both the CSA logo (or equivalent) and the CAT (I, II, III, or IV) designation. Categories I through IV apply to low voltage (less than 1000 V) test equipment.
- Use personal protective equipment such as arc flash fire-resistant clothing; eye and face protection; long-sleeved shirts; dielectric safety boots; rubber gloves with leather protectors; and mats, blankets, or shields as required (Figure 26-14). **Do not wear synthetic inner or outer clothing that can melt if an arc flash occurs.**



**Figure 26-14: Wear Arc-Rated PPE When Using Multimeters**

- Check to ensure that the meter's voltage rating is appropriate for the work being done. Be aware of multimeters with maximum voltage ratings typical of other countries (550 V for example).
- Check the manufacturer's manual for special cautions. Moisture and cold may affect the performance of your meter.
- Wipe the multimeter and test leads clean to remove any surface contamination prior to use.
- Use fused test leads. Ensure fused leads and internal probe fuses are rated as high as or higher than the equipment you are going to work on. A minimum of 30 kA is recommended (200 kA is desirable).
- Ensure that test leads are in the correct input jacks.
- When the values to be measured are uncertain, start testing with high ranges of the multimeter, then move to the lower ranges.
- Connect to the ground first, and disconnect from ground last.
- Test the multimeter on a known power source to verify that the meter is functioning properly before and after testing the suspect circuit, using the same power function for all three tests.

### Testing for Power with a Meter

Set the meter to the power function to be used for validating the zero energy. Test to ensure the meter is functioning correctly by testing on a known power source, then test the locked out circuit to verify that the power has been effectively isolated, and finally re-test on the same known power supply to verify the meter's fuse has not blown and the meter is still functioning correctly on that power setting.

### Portable Tools and Extension Cords

1. Unless they are double-insulated, tools must have:
  - a) the casing grounded
  - b) a polarized plug connection.
2. Extension cords must be of the outdoor type, rated for 300 volts, and have an insulated grounding conductor.
3. Defective cords must not be used. They should be either destroyed or tagged and removed from the jobsite until they are repaired.
4. Extension cords should be protected during use to prevent damage.
5. Extension cords should be plugged into Class A ground fault circuit interruptors (GFCIs). When built-in GFCI receptacles are not available, protection can be attained with an in-line GFCI plugged directly into the supply receptacle.

To plug-in safely while working outside, follow the directions in Figure 26-15.

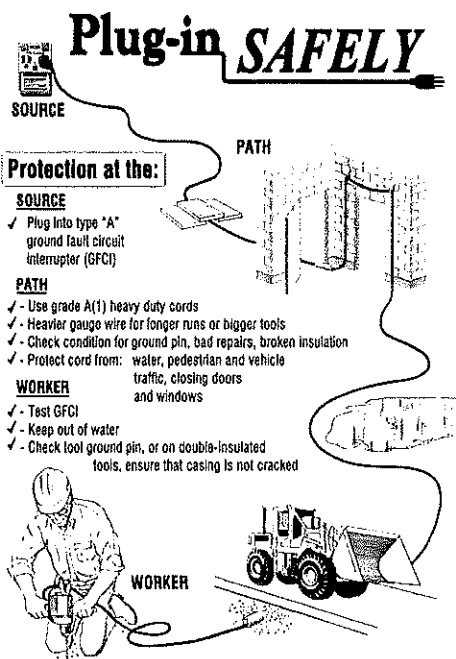


Figure 26-15: Plug-in Safely

Electric tools used outdoors or in wet locations must be protected by a Class A GFCI (Figure 26-16).

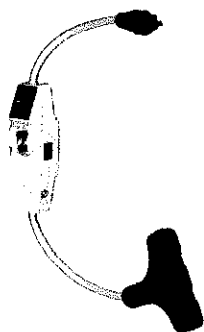


Photo courtesy of EGS Electrical Group Canada Ltd.

Figure 26-16: In-line Class A GFCI

### Temporary Wiring and Power

1. **Temporary wiring** for construction or demolition projects must be installed in accordance with the *Ontario Electrical Safety Code* 2015, 26th edition. Copies are available from Orderline by visiting [www.orderline.com](http://www.orderline.com).
2. **Temporary wiring** must be inspected and approved when initially installed and should be checked regularly. (OESC 2015, Rules 2-004, 2-014, 2-016)
3. **Temporary installations** shall be constructed as separate installations and shall not be interconnected with any of the circuits of the permanent installations except by special permission. (OESC 2015, Rule 76-014)

4. **Feeders** supplying fixed distribution centers shall be installed in armoured cable or the equivalent. A feeder supplying a portable distribution center is permitted to be flexible cord or power cable of the outdoor type suitable for extra-hard usage, feeders shall be protected at all times from mechanical damage. (OESC 2015, Rule 76-010).
5. **A switch and panel board** must meet the following requirements (as per O. Reg. 213/91, s. 194):
  - a) Must be securely mounted on a soundly constructed vertical surface
  - b) Must have a cover over uninsulated parts carrying current
  - c) Must be located in an area where water will not accumulate and be within easy reach of workers and readily accessible to them
  - d) must be kept clear of obstructions in the area in front of the panel board (O. Reg. 213/91, s. 194)
6. **The switch** that controls a service entrance, service feeder, or branch circuit providing temporary power
  - must not be locked in the energized position and
  - must be housed in an enclosure that can be locked and is provided with a locking device (Figure 26-17). (O. Reg. 213/91, s. 194)

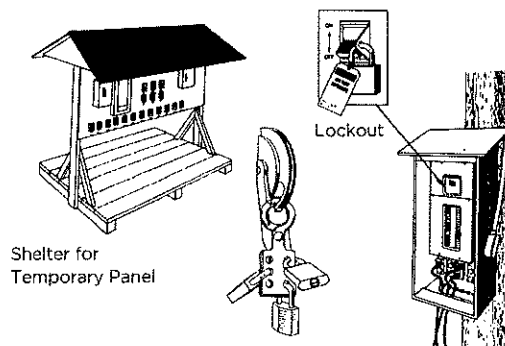


Figure 26-17: Shelter and Lockouts for Temporary Panels

7. **When supplying power** to tools that will be used outdoors or in wet locations, the receptacle must be protected by a class A GFCI (Figure 26-18). (O. Reg. 213/91, s. 195.2)

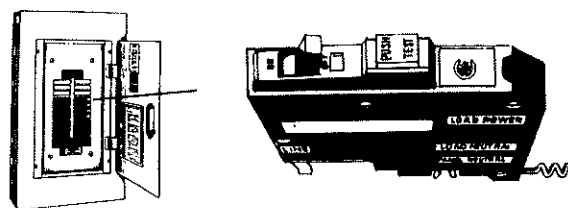
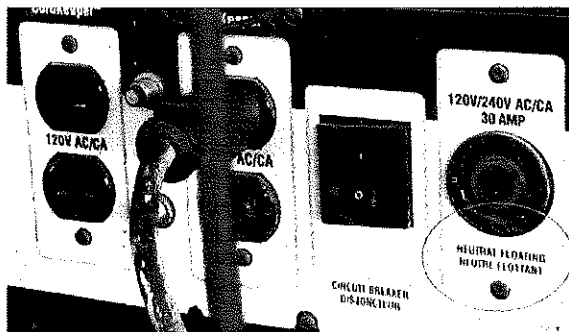


Figure 26-18: GFCI in Panel Box

8. **Portable generators** with no connection between the neutral and the case cannot be used as a stand-alone electrical supply for the operation of portable electrical equipment. Typically, generators with no connection between the neutral and the case are intended to be connected through a transfer switch to a distribution system for use as a standby back-up system in a residential home, in case of power outage.
9. **"Generators supplied by equipment rental stores for use as a stand-alone supply to portable electrical devices shall be a generator with the neutral bonded to the case to facilitate the operation of the overcurrent protection device(s)"** (Electrical Safety Authority Flash notice 03-03-FL).
10. **Labeling on newer portable generators** must indicate the status of the neutral conductor and shall be marked on each machine as follows: NEUTRAL FLOATING or NEUTRAL BONDED TO FRAME (Figure 26-19).



**Figure 26-19: "Neutral Floating"  
Label on Generator**

## Other Electrical Issues

### Electromagnetic induction

Electromagnetic induction can create an electric current in a dead circuit. The condition occurs when a magnetic field from another wire, circuit, or device cuts across a wire in its path and produces a charge in that wire. Temporary grounding will prevent electromagnetic induction. The temporary grounding cable must be the same size conductor as the one found within the circuit.

### Grounding

A ground conductor provides a direct physical connection to the mass of the earth. It limits the voltage or current to the ground during normal operation, and also prevents excessive voltages due to lightning strikes.

A temporary ground provides a direct physical connection to the mass of the earth. Temporary grounding typically involves the use of a wire or cable that has one end connected to a de-energized circuit and the other end to a known grounded connection.

The known grounded connection can be the equipment frame (note that if the equipment is electrically isolated, the frame may not provide an effective grounded connection), a metal water pipe, a ground electrode, or other acceptable grounding medium.

Ground all phases. Attach a temporary ground cable to the system and keep it in place until work is completed.

### Connecting and disconnecting conductors

Any disconnect devices used to isolate electrical equipment must be certified by CSA International or another certification body accredited by the Standards Council of Canada. It is important that the device has the appropriate rating for the available current and load it is serving. Never assume a circuit has been de-energized when the disconnect is in the open position. Check for power in all conductors, then follow prescribed lockout and tagging procedures before beginning work.

### Capacitors

Isolate the capacitor by opening the circuit breaker or the isolation device connecting it to the circuit. Drain off the accumulated charge for five to ten minutes with the system device. Short circuit and ground the capacitor using a hot stick and required personal protective equipment.

### Electrical fires

- Report fires immediately.
- Never put water on fires in live electrical equipment or wiring. Water is a conductor and increases the risk of arc flash and electrocution.
- An electrical fire in a confined space can rapidly deplete oxygen and may release toxic fumes. If possible, switch off power. Avoid inhaling fumes and vacate the area at once. If necessary, breathe through a damp cloth and stay close to the floor.
- Wiring or equipment involved in a fire must be inspected by the electrical utility inspector before being reactivated.
- Use a Class C fire extinguisher. Intended for electrical fires, Class C extinguishers employ a non-conductive extinguishing agent. An ABC fire extinguisher may also be used on an electrical fire.

**REMEMBER:** Every worker who may be required to use a fire extinguisher must be trained in its use.

## Reporting Electrical Incidents

All incidents, regardless of severity, must be reported promptly to management and the immediate supervisor, and a record should be kept at the jobsite. When a serious or fatal injury involves a union member, the union office and steward must be notified immediately. Labour and management should cooperate fully in conducting an investigation.

Part VII of the OHSA specifies the requirements for notification in the event of fatalities, injuries, and incidents. In the event of an incident that requires reporting and investigation, care should be taken not to disturb the incident scene, nor should equipment or tools involved in the incident be removed.

### Contact with an overhead powerline

Contact with an overhead powerline must be reported to multiple parties.

If accidental contact occurs with an energized powerline carrying 750 V or more, report the contact to the inspection department of the Electrical Safety Authority (ESA), and provide written notice to the Ministry of Labour, Joint Health and Safety Committee or Health and Safety Representative, and trade union.

### Fatality or critical injury

A written report is required under subsection 51 (1) of the Act, respecting an occurrence in which a person is killed or critically injured. (See box below.)

#### Know the Law

For the purpose of the Act, the Regulations, and the Ontario Electrical Safety Code, "critically injured" means an injury of a serious nature that,

- places life in jeopardy;
- produces unconsciousness;
- results in substantial loss of blood;
- involves the fracture of a leg or arm but not a finger or toe;
- involves the amputation of a leg, arm, hand, or foot but not a finger or toe;
- consists of burns to a major portion of the body; or,
- causes the loss of sight in an eye.

Note: O. Reg. 834 and Ontario Electrical Safety Code (OESC) (26th edition, 2015) use virtually identical wording for the definition of "critically injured."

**Section 53 of the Act:** Where a notice or report is not required under section 51 or 52, and an

- accident
- premature or unexpected explosion, fire, flood or inrush of water
- failure of any equipment, machine, device, article, or thing
- cave-in, subsidence, rockburst
- or other incident as prescribed (see box below)

occurs at a project site, mine, or mining plant, notice in writing of the occurrence shall be given to a director, the Joint Health and Safety Committee or Health and Safety Representative, and trade union, if any, by the constructor of the project or the owner of the mine or mining plant within two days of the occurrence containing such information and particulars as are prescribed.

#### Know the Law

For the purpose of section 53 of the Act, a "prescribed incident" includes:

- accidental contact by a worker or by a worker's tool or equipment with energized electrical equipment, installations or conductors. (s.11 O. Reg. 213/91)
- Accidental contact by a crane, similar hoisting device, backhoe, power shovel or other vehicle or equipment or its load with an energized electrical conductor rated at more than 750 volts. (s.11 O. Reg. 213/91)

### Reporting serious electrical incidents to the ESA

An owner, contractor, or operator of a facility must report any serious electrical incident to the Inspection Department of the ESA within 48 hours after the occurrence.

#### Know the Law

"Serious electrical incident" means,

- a) Any electrical contact which causes death or critical\* injury to a person, or
- b) Any fire or any explosion or any condition suspected of being electrical in origin which might have caused a fire, explosion, loss of life, critical\* injury to a person, or damage to property, or
- c) Any electrical contact with electrical equipment operating at over 750 volts, or
- d) Any explosion or fire of electrical equipment operating at over 750 volts.

– OESC 2015

\*See definition of "critically injured" under "Fatality or critical injury" above.

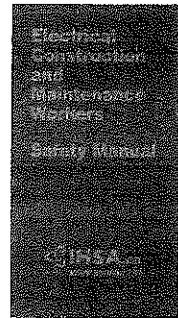
### Notice of accident, explosion or fire causing injury

If a person is disabled from performing his or her usual work or requires medical attention because of an accident, explosion, or fire at a workplace, but no person dies or is critically injured because of that occurrence, the employer shall, within four days of the occurrence, give written notice of the occurrence containing the prescribed information and particulars to the following:

1. The Joint Health and Safety Committee or the Health and Safety Representative, and the trade union, if any
2. The Director, if an inspector requires notification of the Director.

### Want More Information?

More info on electrical safety can be found in IHSA's *Electrical Construction and Maintenance Workers' Safety Manual* (M010). This pocket-sized manual was written for electrical workers and is a useful tool that apprentices, journeypersons, supervisors, and management can use to help keep safety in mind when planning work.



# TRAFFIC CONTROL

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## 29 TRAFFIC CONTROL



The green book (OHSA and Construction Regs) makes it mandatory for traffic control persons (TCPs) to be protected from hazards. This includes not only wearing personal protective clothing and equipment but also putting measures and devices in place to guard against the dangers of vehicular traffic. Safety should receive prime consideration in planning for traffic control.

### Objectives

The objectives of traffic control are as follows:

- To protect construction workers and the motoring public by regulating traffic flow.
- To stop traffic whenever required by the progress of work. Otherwise to keep traffic moving at reduced speeds to avoid tie-ups and delays.
- To allow construction to proceed safely and efficiently.
- To ensure that public traffic has priority over construction equipment.

### Instructions

Section 69(4) of the Construction Projects regulation (213/91) requires that TCPs be given written and oral instructions regarding their duties.

*A worker who is required to direct vehicular traffic,*

- (a) *shall be a competent worker;*
- (b) *shall not perform any other work while directing vehicular traffic;*
- (c) *shall be positioned in such a way that he or she is endangered as little as possible by vehicular traffic; and*
- (d) *shall be given adequate written and oral instructions, in a language that he or she understands, with respect to directing vehicular traffic, and those instructions shall include a description of the signals that are to be used.*

These written instructions must be kept on the project.

### Equipment

#### Protective Devices

Section 67(2) of the Construction Projects regulation (213/91) requires that all workers at a project on a highway who may be endangered by traffic must be protected by using as many of the following measures as is necessary:

1. Barriers
2. Barricades
3. Delineators
4. Lane control devices
5. Warning signs
6. Flashing lights
7. Flares
8. Traffic control devices
9. Blocker trucks
10. Crash trucks
11. Sign trucks
12. Speed control devices
13. Longitudinal buffer areas.

#### Personal Protective Equipment

- Hard hat that meets regulated requirements.
- Safety boots, CSA-certified, Grade 1 (green triangular CSA patch outside, green rectangular label inside).
- Garment, usually a vest, covering upper body and meeting these requirements:
  - The main material should be fluorescent blaze or international orange in colour according to the construction regulations. However, any colour listed in the CSA standard is acceptable (i.e., fluorescent/bright yellow-green, fluorescent/bright orange-red, fluorescent red).
  - It must have retroreflective and fluorescent stripes—two vertical stripes (5 cm wide) on the front that cover at least 500 cm<sup>2</sup> and two diagonal stripes (5 cm wide) on the back that are arranged in an X pattern and cover at least 570 cm<sup>2</sup>.
  - For nighttime work, additional retroreflective silver stripes or bands that encircle each arm and leg are required.
  - If the garment is a vest, it must have an adjustable fit. If the vest is made of nylon, it must have a side and front tear-away feature.

We recommend that garments comply with Canadian standard CSA Z96-15: *High-Visibility Safety Apparel*. In particular, a Class 2 garment, Level 1 or Level 2.

## After Dark

Section 69.1(4) of the Construction Projects regulation (213/91) requires workers who may be endangered by traffic to wear retroreflective silver stripes encircling each arm and leg, or equivalent side visibility-enhancing stripes with a minimum area of 50 cm<sup>2</sup> per side.

The following measures are also recommended:

- Wear a hard hat with reflective tape.
- Use a flashlight with a red cone attachment as well as the sign and carry spare batteries.
- Place flashing amber lights ahead of your post.
- Stand in a lighted area under temporary or street lighting, or illuminated by light from a parked vehicle (stand fully in the light without creating a silhouette).

## Sign

A sign used to direct traffic must have the following features.

- Octagonal in shape, 450 mm wide, and mounted on a pole 1.2 m long
- Made of material with at least the rigidity of plywood 6 mm thick
- High-intensity retroreflective red colour on one side, with STOP printed in high-intensity retroreflective white letters 150 mm high
- On the other side, high-intensity retroreflective micro-prismatic fluorescent chartreuse colour, with a black diamond-shaped border, at least 317 mm x 317 mm, with SLOW printed in black letters 120 mm high.

## Preparation

Before starting work, make sure that you know the following:

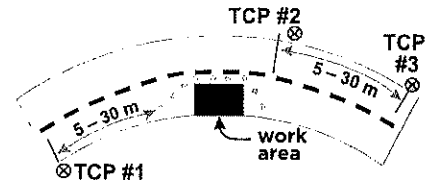
- The type of construction you will be involved with—paving, installing pipe, grading, cut and fill, etc.
- The type of equipment to be used, such as scrapers, trucks, compactors, and graders
- How the equipment will be operating—for instance, crossing the road, along the shoulder, in culverts, or on a bridge
- Whether you will have to protect workers settling up components of the traffic control system such as signs, delineators, cones, and barriers
- Any special conditions of the contract governing road use (for instance, many contracts forbid work during urban rush hours)
- How public traffic will flow—for example, along a two-lane highway, around curves or hills, by detour or on a road narrowed to a single lane.

This last point is a very common situation and requires two traffic control persons to ensure that vehicles do not move in opposing directions at the same time (Figure 29-1). In some cases, such as on a curve or hill where the two cannot see one another, a third TCP is necessary to keep both in view and relay instructions (Figure 29-1).

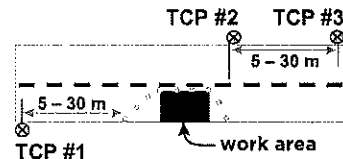
### Straight Road



### Curve



### Hill



### Hill (cross-section)

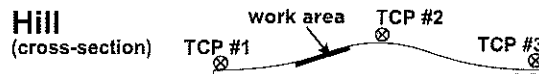


Figure 29-1: Positioning of TCPs

## Requirements of a Good TCP

- Sound health, good vision and hearing, and mental and physical alertness
- Mature judgment and a pleasant manner
- A good eye for speed and distance to gauge oncoming traffic
- A driver's licence (preferably)
- The ability to give motorists simple directions, explain hazards, and answer questions
- Liking, understanding, and respect for the responsibilities of the job.

## What to check each day

- Make sure that the STOP-SLOW sign is clean, undamaged, and meets height and size requirements.
- Place the TRAFFIC CONTROL PERSON AHEAD sign at an appropriate distance to afford motorists adequate warning (Figure 29-2).
- Remove or cover all traffic control signs at quitting time or when traffic control is temporarily suspended.
- Arrange with the supervisor for meal, coffee, and toilet breaks.



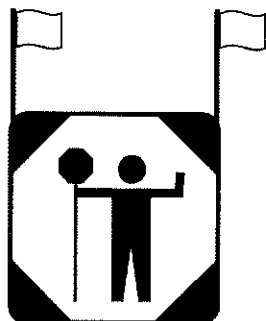


Figure 29-2: Sign Indicating TCP Ahead

#### Where to stand

- Stand the correct distance from the work area. (Refer to Table 29-1 below and Figure 29-3.)
- Do not stand on the travelled portion of the roadway and always face oncoming traffic.
- Be alert at all times. Be aware of construction traffic around you and oncoming traffic on the roadway.
- Stand alone. Don't allow a group to gather around you.
- Stand at your post. Sitting is hazardous because your visibility is reduced and the ability of a motorist to see you is reduced.
- Adjust distances to suit road, weather and speed conditions. Remember these points:
  - Traffic must have room to react to your direction to stop (e.g., vehicles may need twice the stopping distance on wet or icy roads).
  - Stand where you can see and be seen by approaching traffic for at least 150 m (500 ft).
  - Beware of the danger of being backed over or hit by your own equipment.
- Hills and curves call for three TCPs or some other means of communication. The job of the TCP in the middle is to relay signals between the other two.
- Once you have been designated a TCP by your supervisor, look over the area for methods of escape (i.e., a place to get to in order to avoid being injured by a vehicle heading your way if the driver has disregarded your signals). If this should happen, protect yourself first by moving out of the path of the vehicle and then warn the crew.

Table 29-1: TCP Placement

Normal Regulatory Posted Speed	60 km/h or lower, one lane or reduced to one lane		70 km/h to 90 km/h, one lane or reduced to one lane	
Traffic Volume	Low	High	Low	High
Distance of TCP From First Cone of Transition Taper	5 - 10 m	10 - 15 m	15 - 25 m	20 - 30 m

Source: Ontario Traffic Manual, Book 7: Temporary Conditions, 2014 ed.

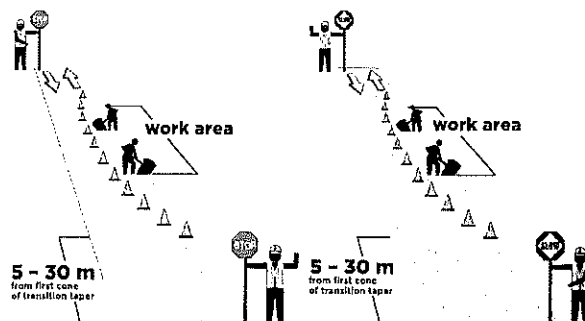


Figure 29-3: Typical Arrangement on a Two-Lane Roadway

#### Where Not to Direct Traffic

According to the construction regulations:

- A worker shall not direct vehicular traffic for more than one lane in the same direction. (O. Reg. 213/91, s. 69(2))
- A worker shall not direct vehicular traffic if the normal posted speed limit of the public way is more than 90 kilometres per hour. (O. Reg. 213/91, s. 69(3))

#### How to Signal

- Use the STOP-SLOW sign and your arms as shown in Figure 29-4. Hold your sign firmly in full view of oncoming traffic.
- Stay alert, keep your eyes on approaching traffic, and make your hand signals crisp and positive.
- Give the motorist plenty of warning. Don't show the STOP sign when the motorist is too close. The average stopping distance for a vehicle travelling at 50 km/h (30 mph) is 45 m (150 ft). Higher speeds require more stopping distance.
- When showing the SLOW sign, avoid bringing traffic to a complete halt. When motorists have slowed down, signal them to keep moving slowly.
- When showing the STOP sign, use firm hand signals and indicate where you want traffic to stop. After the first few vehicles stop, move to a point on the road where traffic in the queue can see you.
- Before moving traffic from a stopped position, make sure the opposing traffic has stopped and that the last opposing vehicle has passed your post. Then turn your sign and step back on the shoulder of the road.
- Coordinate your effort with nearby traffic signals to avoid unnecessary delays, tie-ups, and confusion. Do not use flags to control traffic.
- In some situations, two-way traffic may be allowed through the work zone at reduced speed, with a traffic control person assigned to each direction. Since motorists can be confused or misled by seeing the STOP side of the sign used in the opposite lane, the signs must be modified. The STOP side must be covered to conceal its distinctive shape and command. This should prevent drivers from stopping unexpectedly.