REFRIGERATION AND AIR CONDITIONING TRADE SAFETY FOR CONSTRUCTION, SERVICE, AND MAINTENANCE WORKERS

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FOREWORD

In the air conditioning and refrigeration industry, hazards consist of three basic types—mechanical, electrical, and chemical.

Mechanical hazards are posed by sharp edges, moving machine parts, and tools. When lifting and moving heavy equipment, workers are exposed to the hazard of falling on slippery surfaces and to injury from overexertion. Workers using ladders and scaffolds are also exposed to the hazard of falling.

Electrical hazards are associated with power tools and electrically driven mechanical equipment with complex automatic control systems. There are also dangers of electrical contact and shock under damp and wet conditions, or during installation and repair work that takes place near live apparatus.

Chemical hazards in the industry are widespread and diverse. Mechanical refrigeration and air conditioning require the use of several potentially hazardous gases and/or liquids under pressure which present the danger of burns, asphyxiation, fire, and explosion. Workers may also suffer short-term and long-term health effects from accidental or repeated exposure to some of these substances.

Each year, about 25% of all injuries in the industry involve overexertion during installation and servicing. Another 25% are due to slips and falls, whether from one level to another or on the same level. Up to 10% of the remaining injuries are caused by failure to wear adequate protective gear such as safety glasses, gloves, hard hats, and safety boots.

Injuries occur during common trade activities such as lifting and carrying materials or equipment, installing or replacing equipment, climbing on ladders and steps, crossing work surfaces such as floors and rooftops, and working with metal or piping.

Staying healthy through regular exercise and proper diet can help prevent or minimize injuries from overexertion and contribute to well-being both on and off the job.

By adhering to the legal responsibilities and recommended practices outlined in this manual, labor and management can work together to reduce or eliminate many of these injuries and improve the health and safety of all those who work in the refrigeration and air conditioning industry.

ABBREVIATIONS USED IN THIS MANUAL

CPR cardiopulmonary resuscitation

CSA Canadian Standards Association

NIOSH National Institute of Occupational Safety and Health (USA)
CONSTRUCTOR

The constructor is the person who undertakes a job for an owner and can include the owner when the owner undertakes all or part of a job alone or with more than one employer.

The constructor must ensure that

1. the measures and procedures required by the current Occupational Health and Safety Act and Regulations for Construction Projects are carried out on the jobsite;

2. employers and workers on the jobsite comply with The Act and Regulations;

3. the health and safety of workers on the jobsite is protected.

EMPLOYER

The employer must ensure that

1. the equipment, materials and protective devices required by law are provided;

2. the equipment, materials and protective devices provided are maintained in good condition and used as prescribed;

3. the measures and procedures required by law are carried out;

4. information, instruction and supervision are provided to protect the health and safety of workers;

5. a competent person is appointed as supervisor.

SUPERVISOR

The supervisor must ensure that

1. workers work in the manner and with the protective devices, measures and procedures required by The Act and the Regulations;

2. workers use or wear the equipment, protective devices or clothing that the employer requires to be used or worn;
3. workers are advised of any potential or actual danger to their health or safety;

4. workers are provided with instructions as to the measures and procedures to follow for their protection.

WORKER

The worker must

1. work in compliance with the provisions of The Act and the Regulations;

2. use or wear the equipment, protective devices or clothing that the employer requires to be used or worn;

3. a. report to the employer or supervisor any problem with equipment which may endanger the worker or other workers;

   b. report to the employer or supervisor any contravention of The Act or the Regulations and any hazard on the jobsite;

4. never work in a manner that may endanger anyone;

5. never engage in any prank, contest, feat of strength, unnecessary running or rough and boisterous conduct on the jobsite.

For the selection and duties of the health and safety representative, consult The Occupational Health and Safety Act.

HEALTH AND SAFETY REPRESENTATIVE

GENERAL DUTIES

The health and safety representative performs site inspections; helps to mediate disputes over unsafe conditions; may assist in investigating serious accidents; and confers with supervisors, workers and Ministry of Labour inspectors whenever necessary. A health and safety representative will be effective only where there is full cooperation and respect between representative, management and workforce.

REQUIREMENTS

1. The constructor must cause the workers on a jobsite to select at least one health and safety representative where the number of workers on the site regularly exceeds twenty.

2. The selection must be made from among workers who do not exercise managerial functions.

3. The selection must be made by workers or by the trade union or unions which represent them.

4. The employer and workers must provide the health and safety representative with any information and assistance necessary to carry out inspections on the jobsite.
GUIDELINES

1. The health and safety representative should have current first aid and cardiopulmonary resuscitation (CPR) certificates. This training is available through St. John Ambulance.

2. The representative must be familiar with requirements of the current Occupational Health and Safety Act and Regulations for Construction Projects.

3. The representative should follow the **Guidelines for Health and Safety Representatives** (B018) available from the Construction Safety Association of Ontario.

4. The representative should be familiar with the procedures involved in a refusal to work where health and safety is in danger.

INSPECTORS

A Ministry of Labour inspector can visit a jobsite at almost any time and exercise fairly broad powers to inspect, ask questions and give orders. If the inspector approaches a worker directly, the worker should answer questions and cooperate. The supervisor must be informed of any orders given or recommendations made.

REPORTING ACCIDENTS

All accidents, regardless of severity, must be reported promptly to management and immediate supervision. A record should be kept at the jobsite. In the event of a serious or fatal injury, the Ministry of Labour, the employer and the trade union, if any, must be notified immediately. Labour and management should cooperate fully in conducting an investigation.

The current Occupational Health and Safety Act specifies the types of incident which must be reported and the requirements for notification in the event of fatalities, injuries and accidents.

In the event of a serious accident which requires reporting and investigation, take care not to disturb the accident scene or remove any of the equipment or tools.
BRIEFING THE NEW WORKER

The new worker on the job must be briefed on the following points:

- the need to be familiar with the contents of this manual
- proper methods of access to work above and below ground
- location of job facilities such as first aid station, fire extinguishers, exits and toilets
- possible hazard areas
- work methods and emergency procedures
- the name of the health and safety representative on the project
- the extent of the work the worker is authorized to perform.

2. PERSONAL PROTECTIVE EQUIPMENT

GENERAL

1. On the job do not wear
   - loose or ragged clothing or cuffs
   - greasy or oily clothing, gloves and boots
   - finger rings.

2. Keep neck chains under clothing so they don’t hang out. Long hair should be tied back.

3. Clothing made of synthetic fibers can be readily ignited and melted by electrical flash. Cotton or wool fabrics are more flame-retardant and therefore recommended as work clothes.

4. In case of skin contact, wash refrigerant off immediately with water to avoid burns and/or frostbite. Refrigerant that soaks into clothing will continue to evaporate and can also cause frostbite. Remove the clothes at once, but carefully, since they may be stuck to the skin.
HEAD PROTECTION

1. On the jobsite, workers must wear a Canadian Standards Association (CSA) certified Class B hard hat.

2. Do not paint hard hats. Paint can reduce impact resistance.

3. Inspect the shell and suspension of your hard hat regularly and replace when cracked, deeply scratched or otherwise defective.

FOOT PROTECTION

1. On the jobsite, workers must wear CSA-certified Grade 1 footwear or CSA-certified footwear with heavy-duty toe and sole protection.

2. Workers purchasing new boots should obtain CSA-certified Grade 1 footwear with a green triangular CSA patch on the outside and a rectangular green label on the inside.

3. It is recommended that workers in the refrigeration and air-conditioning industry wear electrical shock resistant footwear identified by a white rectangular label bearing the CSA trademark and the Greek letter omega in orange.

EYE PROTECTION

1. Properly fitted industrial quality eye protection, in the form of spectacles and side shields, should be worn on the job (Figure 2).

2. Cover goggles for dust and flying particles are recommended for workers drilling overhead or into concrete and masonry or using powder-actuated tools (Figure 3).

3. Goggles or faceshields providing splash protection are recommended for personnel working with refrigerants during transfer, charging and repair operations; and with hydrochloric acid during the cleaning of condensers and compressors equipped with water-cooled accessories (Figure 4).

For more information, refer to The Selection of Eye Protection (DS002), available from the Construction Safety Association of Ontario.

HEARING PROTECTION

Personnel working in noisy areas or with noisy equipment should wear hearing protection. Prolonged exposure to noise levels exceeding 90 decibels is harmful.

The table below indicates maximum exposures for workers not equipped with hearing protection.
For instance, a worker exposed to 99 decibels risks hearing damage after one hour, but could safely work the shift if properly fitted hearing protection is worn.

Remember that the decibel scale is logarithmic. For example, 93 decibels is twice as much noise as 90 decibels; 100 decibels is ten times more noise than 90!

<table>
<thead>
<tr>
<th>Sound Level—Decibels</th>
<th>Exposure Duration—Hours per 24-Hour Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>8</td>
</tr>
<tr>
<td>93</td>
<td>4</td>
</tr>
<tr>
<td>96</td>
<td>2</td>
</tr>
<tr>
<td>99</td>
<td>1</td>
</tr>
<tr>
<td>102</td>
<td>1/2</td>
</tr>
<tr>
<td>105</td>
<td>1/4</td>
</tr>
<tr>
<td>108 and up</td>
<td>No exposure without hearing protection</td>
</tr>
</tbody>
</table>

Hearing protection is available in three general types (Figure 5):

- disposable earplugs (made of pliable material, one size fits all but can be used once only)
- permanent plugs (must be fitted to provide a good seal but can be washed and reused)
- earmuffs (when properly fitted and worn, these generally provide more protection than earplugs).

For more information, refer to Hearing Protection for the Construction Industry (DS016), available from the Construction Safety Association of Ontario.
RESPIRATORY PROTECTION

1. Work areas must be ventilated to reduce the hazards of fumes, gases and vapors from various refrigerants and from procedures such as flame-cutting, soldering, brazing, welding and acid washing and chemical coil cleaning.

2. Where ventilation is not practical, workers must be provided with respirators appropriate to the hazard and be trained to use and maintain the respirators properly.

3. Respirators should carry approval by the National Institute for Occupational Safety and Health (NIOSH), a U.S. government agency which tests and approves such equipment.

4. Respirators can be divided into two types: 1) air-purifying and 2) supplied-air. The first purify the surrounding air but cannot replenish or increase its oxygen content. The second supply clean breathing air from a compressor or cylinder (Figure 6).

5. Where disputes arise over the need for ventilation or the type of protection to be worn, the Ministry of Labour must be summoned to settle the dispute and indicate the proper methods and equipment to be used. Workers affected must not enter the area in question until the Ministry has resolved the dispute.
COLOR CODING FOR RESPIRATOR CARTRIDGES AND FILTERS

- Dusts, Mists, Fume: Grey
- Dust, Mist, Fume and Radionuclides: Purple
- Organic Vapors: Black
- Acid Gases: White
- Ammonia: Green
- Acid Gases and Organic Vapors: Yellow

For more information, refer to Respiratory Protection for the Construction Industry (DS017), available from the Construction Safety Association of Ontario.

Air-purifying respirators simply remove certain airborne hazards. They do not increase or replenish the oxygen content of the air and should never be worn in atmospheres containing less than 19.5% oxygen.

FALL PROTECTION

1. WORKING FROM SCAFFOLDS

- Work platforms must be fully planked.
- Guardrails consisting of top rail, mid-rail and toeboard are required when the platform is 2.5 metres (8 feet) or more above floor level.
- Wheels and castors must be locked when personnel are working from the scaffold.
- A rolling scaffold more than 2.5 metres (8 feet) high must not be moved with workers on it unless
  a. they wear safety belts or safety harnesses with lanyards tied off to independent support, and
  b. the floor is smooth and level.

2. WORKING FROM LADDERS

Refer to the requirements in section 6.1, “Ladders” (DS008), available from the Construction Safety Association of Ontario.

3. WORKING FROM SUSPENDED ACCESS EQUIPMENT

A worker must wear a safety belt or safety harness with the lanyard tied off to

- an independent lifeline if the stage has only two independent suspension lines, or
- the stage if it has four independent suspension lines (two at each end).
4. WORKING NEAR UNPROTECTED OPENINGS AND EDGES

When exposed to the risk of falling more than 3 metres (10 feet) or into operating machinery, toxic substances, liquid tanks or other hazardous materials, a worker must wear a safety belt or safety harness with the lanyard tied off to a fixed support.

5. SAFETY BELTS, SAFETY HARNESSSES AND LANYARDS

- Safety belts, safety harnesses and lanyards must be CSA-certified. Such equipment will carry the CSA label.
- Safety harnesses must be snug-fitting and worn with all hardware and straps intact and properly fastened.
- Lanyards must be 16-millimetre (5/8 inch) diameter nylon or equivalent.
- When the lanyard is wire rope or nylon webbing, a shock absorber must be used.

For more information, refer to Safety Belts, Harnesses, Lanyards and Lifelines (B011), available from the Construction Safety Association of Ontario.

6. LIFELINES

All lifelines must be

- 16-millimetre (5/8") diameter polypropylene or equivalent
- used by only one worker at a time
- free from any danger of chafing
- free of cuts, abrasions and other defects
- long enough to reach the ground or knotted at the end to prevent the lanyard from running off the line
- secured to a solid object (stopping a worker’s fall can put a load as high as 2,000 pounds on the lifeline anchorage).

7. ROPE-GRABBING DEVICES

To attach a lanyard to a lifeline, use a mechanical rope-grab that meets CSA Standard Z259.2 (Figure 7).

If a mechanical rope-grab is not available, then use a triple sliding hitch (Figure 8).
• Tie the hitch as illustrated. (The hitch may also be used with a lanyard on a safety harness.)

• Be sure to allow a 12-inch dead end.

• Tighten the hitch on the lifeline so the hitch won’t slip.

• Position the hitch on the lifeline above head height.

• Lifeline must reach the ground or reach a secure and accessible level above ground or be knotted, cable-clipped or otherwise provided with a positive stop to keep the hitch from running off the end of the lifeline.

• If you fall, do not grab the hitch, lanyard or lifeline. To work properly the hitch must come under a load.

3. TAGGING AND LOCKING-OUT PROCEDURES

A qualified refrigeration/air-conditioning mechanic is authorized to service components within a refrigeration/air-conditioning system.

For electrical work outside the refrigeration/air-conditioning system it is required under many codes to call in a qualified electrician.

1. In-plant procedures specified by the owner or client take precedence over the procedures outlined here, providing there is no contravention of existing codes or statutes.
2. All electric motors and equipment with electrical components, whether permanently installed or portable, must be grounded; that is, a ground wire must connect their frames to earth or to a water pipe or other metal system in permanent contact with the earth.

3. All apparatus capable of being energized or activated electrically, pneumatically or hydraulically must be de-energized or de-activated by locking out, physically disconnecting or otherwise rendering the apparatus inoperable. Switches, power sources, controls, interlocks, pneumatics, hydraulics, computer-controlled sources, robotics or other such devices must be appropriately tagged and personally locked out by each worker involved in the operation.

4. Test the system with a Canadian Standards Association (CSA) certified potential test indicator to ensure that all components are de-energized and de-activated, including interlocking or dependent systems which could feed into the system being isolated, either mechanically or electrically. Potential test indicators should not be used beyond the voltage limits for which they are rated.

5. Observe the following safeguards for locking out and tagging.

   a. After the circuit has been de-energized and locked out by the person in charge, you must be protected by personally placing your own safety lock on the disconnect device (Figure 9). The key for your lock must be retained on your person while your lock is in place on the disconnect device.

   b. Where several workers or trades are working on the circuit, provision for additional locks can be made through the use of a lockout bar. This arrangement can accommodate any number of locks by placing another lockout bar in the last hole of the previous bar.

   c. Each worker must attach to his/her lock a durable tag filled out with the information indicated.

   d. You must recognize that, even though the disconnect switch may be already locked, you are not protected until you attach your personal safety lock.

6. The electrical system must be de-energized and temporarily grounded. All hydraulic and pneumatic systems must be depressurized and tested before work commences.

7. A record must be kept of all switches, power sources, controls, interlocks, pneumatics, hydraulics, computer-controlled sources, robotics or other such devices opened, locked off or otherwise rendered inoperable so that all of these can be reactivated once work is complete.

8. Signs must 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.

9. Workers testing electrical systems must

   a. remove all watches, rings, neck chains or other current-conducting jewelry

   b. wear electrical shock resistant footwear

   c. wear safety glasses with side shields.
10. Workers must never use metal ladders or ladders with metal reinforcing when working on or near live electrical apparatus.

11. 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 beware of more than one power source and use proper fuse pullers (Figure 10).

12. All operating electrical equipment must be kept in safe and proper working condition. Defective equipment must be either repaired or removed.

13. Avoiding electrical shock in handling a capacitor requires not only disconnecting it but also discharging it to zero volts in a safe manner.

14. Adequate illumination must be provided to allow for safe servicing and repair of equipment.

15. Flammable material must not be stored or placed near live electrical equipment.

16. Adequate ventilation must be provided to prevent air temperatures higher than those tolerable around electrical equipment.

17. Bare live parts must be guarded by approved cabinets to prevent accidental contact and their covers must be kept in place.

4. ACCES EQUIPMENT

LADDERS

1. All portable ladders must be equipped with non-slip bases.

2. Set ladders up on a firm level surface. Use a mud sill on uncompacted soil.

3. Tie off or otherwise secure ladders to prevent movement. If this is not possible, one worker should hold the base of the ladder while another uses it.

4. When work must be done from an extension ladder, the ladder should be long enough that a worker will stand on a rung no higher than the fourth from the top.

5. When climbing up or down a ladder, always maintain three points of contact (two feet and one hand, or one foot and two hands) and always face the ladder.

6. Unless suitable barricades have been erected, or other adequate protection provided, do not set up ladders in passageways, doorways, driveways or other locations where they can be struck or bumped.

7. Do not erect ladders on boxes, carts, tables, scaffold platforms, manlift platforms, vehicles or garbage bins.
8. Ladders should be set up one foot out for every three or four feet up, depending on length.

9. Workers must never use metal ladders or ladders with metal reinforcing when working on or near live electrical apparatus.

10. Do not paint wooden ladders. Paint can hide defects. Finish with a clear nonconductive preservative.

11. All ladders erected between levels must be securely fastened, extend 90 centimetres (3 feet) above the top landing, and afford clear access at top and bottom (Figure 11).

12. Ladders with broken, bent or missing steps, broken or bent side rails, damaged or missing bases, or other defects must not be used. They should be tagged and removed from the site.

13. Do not use ladders horizontally as scaffold platforms, runways or any other service for which they are not designed.

14. Ladders transported on the top or side of vehicles should be supported and secured in proper racks to withstand braking and bumps.

15. Ladders transported inside vehicles should be protected from damage by other equipment or material.

16. Ladders should always be top freight—nothing should be piled on them.

17. Never straddle the space between a ladder and another object (Figure 12).

18. When working from a stepladder, stand no higher than the second step from the top.

19. The use and maintenance of vertical fixed ladders requires care and attention. Don’t trust a ladder showing signs of deterioration or damage—loose or missing bolts, excessive corrosion, cracked welds, or general lack of maintenance. Anchors, rungs or side rails may be defective and fail under your weight.

20. Regulations require that a vertical access ladder fixed in position must

   a. have rest platforms at not more than 9-metre intervals;

   b. be offset at each rest platform;

   c. where the ladder extends over 5 metres above grade or a floor or landing, have a safety cage commencing not more than 2.2 metres above grade or the floor or landing and continuing at least 90 centimetres above the top landing with openings to permit access by a person to rest platforms or to the top landing;

   d. have side rails that extend 90 centimetres above the landing; and

   e. have rungs that are at least 15 centimetres from the wall.

**SCAFFOLDS**

1. The erection and dismantling of scaffolds must be carried out under the supervision of personnel knowledgeable and experienced in such operations.
2. Scaffolds must be equipped with guardrails consisting of a top rail, mid-rail and toeboard (Figure 13).

3. Scaffold platforms must be at least 46 centimetres (18 inches) wide and should be planked across their full width.

4. Frames must be properly pinned together where scaffolds are two frames or more in height or used as rolling scaffold towers (Figure 13).

5. Scaffold planks must be good quality, free of defects, rough sawn, No. 1 spruce or better when new, and secured to prevent sliding.
6. Scaffolds must be erected, used and maintained in a plumb condition.

7. Scaffolds must be equipped with a proper ladder for access. Vertical ladders must be equipped with 15-centimetre (6 inch) stand-off brackets. A fall protection device or safety cage is required for ladders higher than 5 metres (16 feet).

8. Castors on rolling scaffolds must be equipped with braking devices. Castors should be securely pinned to the scaffold frame so they cannot drop off over holes or depressions (Figure 13).

For more information, refer to Scaffolds (DS023), available from the Construction Safety Association of Ontario.

MANLIFTS

1. A manlift device should only be operated by a worker who has been instructed in
   - operating the machine
   - the daily inspections and maintenance required by the manufacturer
   - the types of working surface on which the machine is designed to be used
   - its maximum rated working load
   - any special machine limitations
   - the significance and location of alarms and emergency controls.

2. Do not use a manlift that is damaged or not working properly. Have it repaired by a qualified mechanic.

3. In the raised position, a manlift device should only be used on surfaces specified by the manufacturer and never be driven close to holes, depressions, trenches or similar hazards.

4. A manlift device should not bear more than its rated working load and where possible the loads should be distributed over the platform.

5. When manliffs are used to lift materials, ensure that the materials are firmly secured to the platform. Avoid lifting overhanging loads.

6. The platform or any other part of the manlift should not be moved closer than 3 metres (10 feet) to overhead powerlines, unless the device is equipped for live electrical line work and the workers on the platform are qualified for such work.

7. A manlift device should not be used for pulling, pushing or dragging materials.

8. Do not try to extend the platform by using planks or similar materials. Use only the extension devices supplied by the manufacturer.

9. Never use planks or other material to bridge the gap between the platform and the work surface.

10. Always maintain 3-point contact (two feet and one hand, or two hands and one foot) when getting on or off the manlift platform.
11. For all types of off-slab units the terrain must be firm enough to support the machine and its rated working load.

12. Do not use manlifts under high wind conditions. This is especially important for smaller scissor lifts and boom-type machines.

13. When the manlift is not being used, turn off the power system to prevent exhaust fumes from accumulating in enclosed areas.

14. Manlifts used on ramps or on sloping or uneven surfaces must be designed for such use and properly secured against horizontal and vertical movement.

15. On construction sites, a forklift must not be used to support, raise or lower personnel.

16. In other workplaces, a forklift may be used to support, raise or lower personnel, provided certain requirements are met.

For more information, refer to Powered Elevating Work Platforms (DS025), available from the Construction Safety Association of Ontario.

5. MATERIALS HANDLING

1. Know your physical limitations and the approximate weight of the object you intend to lift. Get help when a lifting task may be more than you can safely handle.

2. Wherever practical, heavy lifts should be done with mechanical lifting devices.

3. When manual handling is required, dollies, trucks and similar devices should be used.

4. When a ladder is the only way to reach the work area, use a hoistline to lift and lower tools and material. Don’t carry anything in your hands when climbing up or down a ladder.

For more information, refer to Stand/Lift/Carry (M017), available from the Construction Safety Association of Ontario

6. RIGGING

1. Safe rigging depends on knowing

2. Inspect slings, hooks, shackles and other hardware before use. Defective equipment should not merely be discarded but destroyed to prevent inadvertent use.

3. Rig the load with its centre of gravity directly under the hook to ensure stability and avoid tipping or drifting. The load line should be vertical before the lift is made.

4. Keep loads away from overhead powerlines. A signal person must direct the operator of a hoisting device whenever
the device or load is closer than one boom length to a powerline. Observe the minimum distances below.

5. Ensure that sling angle is always more than 45° from the horizontal. Lower angles can dramatically increase the load on each leg (Figure 15).

<table>
<thead>
<tr>
<th>Voltage Rating of Powerline</th>
<th>Minimum Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>750 to 150,000 volts</td>
<td>3 metres (10')</td>
</tr>
<tr>
<td>150,001 to 250,000 volts</td>
<td>4.5 metres (15')</td>
</tr>
<tr>
<td>Over 250,000 volts</td>
<td>6 metres (20')</td>
</tr>
</tbody>
</table>

Housekeeping includes

7. HOUSEKEEPING

- proper storage of material and equipment
- regular clean-up and disposal of waste and debris
- fire prevention and protection.

1. Material must be piled, stacked or otherwise stored to prevent tipping and collapsing.

2. Materials to be lifted by a crane or other hoisting device must not be stored near or under overhead powerlines.
3. Waste and debris must be removed from work and traffic areas regularly or at least once a day or at the end of each job if less than a day.

4. Waste and debris must not be thrown from one level to another but carried down, lowered in containers, or deposited in a disposal chute.

5. Work and traffic areas should be kept clear of material, equipment and tools that are not being used. The areas must also be adequately lit. Missing or burned-out bulbs must be replaced.

6. Components of refrigeration/air-conditioning systems must be kept clean in order to avoid fire hazards. Cleaning also aids the service mechanic, who cannot work effectively and safely if components are dirty and greasy.

7. Proper storage and housekeeping will minimize fire hazards. In case of fire, ensure that fire extinguishers are accessible, properly maintained, regularly inspected and promptly refilled after use.

8. Extinguishers are classified according to their capacity for handling specific types of fires (Figure 16).

1. Follow the common sense rules of good driving and keep service vehicles in good condition.

8. SERVICE VEHICLES

2. Before you drive, make sure that equipment and materials are evenly distributed.

3. Secure any cargo that could shift during travel, especially cylinders of compressed gas, which must be kept in an upright position (Figure 17).

4. There is a blind area behind most vans and trucks. Don’t back up without assistance, particularly on cramped or congested sites.
5. Don’t let scrap and debris accumulate in the vehicle.

6. For the safe transportation of flammable liquids, see the “Hazardous Materials” Section.

It is the employer’s responsibility to supply and maintain shop tools and other power equipment in good repair. It is the worker’s responsibility to use such tools properly and to report any defect to the supervisor.

**EXTENSION CORDS**

**9. TOOLS**

1. All extension cords must be the outdoor type, rated for 600 volts, and have an insulated grounding conductor.

2. Defective cords must not be used. They should either be destroyed or be tagged and removed from the workplace until repaired.

3. Extension cords in use should be protected against damage from sharp edges, traffic, materials handling, flame cutting and other operations.

4. Extension cords used in hazardous areas such as metal enclosures or damp locations should be equipped with approved ground fault protection such as ground fault circuit interrupters (GFCI or GFI) (Figure 18).

5. In confined spaces where there is the danger of fire or explosion from flammable gases, extension cords must be explosion proof and properly grounded.

1. The employer should not supply or require workers to use high-velocity powder-actuated tools. Only low-velocity, light or heavy duty, CSA-certified tools should be used.

**POWER-ACTUATED TOOLS**

2. Powder-actuated tools must be used only by workers who have been instructed to operate the tools properly and safely.

3. Workers using powder-actuated tools must wear impact-resistant cover goggles.

4. Workers using heavy-duty powder-actuated tools to fire into steel or in a confined space must wear hearing protection.

1. Hazardous areas should be cordoned off with barricades or danger tape to warn workers.

**10. BARRICADES AND GUARDRAILS**

2. Guardrails consisting of a top rail, mid-rail and toeboard must be provided
   - at all edges or openings where workers may fall more than 2.5 metres (8 feet)
• at all edges or openings where workers may fall into operating machinery, toxic substances, liquid tanks or other hazardous materials

• around the open sides of work platforms such as scaffolds.

3. When barricades, guardrails or covers over floor openings must be removed for work to proceed, first obtain permission from the supervisor. Once guardrails or covers are temporarily removed, workers in the area must be protected by a safety belt or safety harness with the lanyard properly tied off. Barricades, guardrails and covers must be replaced immediately after work is completed.

Under no circumstances is a worker to ride on any piece of equipment unless properly occupying a place or seat designated for that purpose. This is especially important around forklifts, aerial devices, hoists and cranes.

11. PERSONAL CONDUCT

RIDING ON EQUIPMENT

1. No person under the influence of, or carrying, intoxicating alcoholic beverages is to enter or knowingly be permitted to enter the workplace.

ALCOHOL AND DRUGS

2. No person under the influence of, or carrying, an illicit drug is to enter or knowingly be permitted to enter the workplace.

3. The use of intoxicating beverages during working hours, including rest or lunch breaks, is prohibited.

4. The use of drugs during working hours, including rest or lunch breaks, is prohibited without written clearance from a physician stating that the drug will not impair the employee’s ability to work safely.

5. When alcohol or drugs affect a person’s work, treatment can and should be a condition of continued employment. The employee or employer can initiate professional treatment by contacting one of the following groups:

—The Addiction Research Foundation (416) 595-6021
—the Donwood Institute (416) 425-3930
—Alcoholics Anonymous (416) 487-5591
12. HAZARDOUS MATERIALS

WHMIS

In effect across Canada since October 31, 1988, WHMIS is designed to protect the health and safety of workers by providing information about hazardous materials on the job. (See Hazardous Materials Chart.)

WHMIS gives everyone the right to know about the hazards of workplace materials and provides information in three ways.

1. LABELS

Supplier Labels are required on controlled products with a volume of more than 100 millilitres and must include:

- product identifier
- appropriate hazard symbol(s)
- risk phrases (such as “dangerous if inhaled”)
- precautions (such as “wear rubber gloves”)
- first aid measures
- supplier identifier
- statement that a material safety data sheet (MSDS) is available for the product

Workplace Labels are required when controlled products are produced onsite or have been transferred from a supplier-labelled container to a different container. Workplace labels must include:

- product identifier
- safe handling instructions
- statement that an MSDS is available for the product.

MSDSs must provide

- product information
- hazardous ingredients
- physical data
- fire and explosion data
• reactivity data
• information on health effects
• preventive measures
• first aid measures
• name and phone number of party preparing the MSDS and date of preparation.

The employer must

• develop and provide a program of worker instruction
• ensure that workers are trained to apply the information
• provide all hazard information received from suppliers and other sources
• review the program at least annually.

Training must include

• explanation of the content and purpose of labels and MSDSs
• procedures for the safe storage, handling and disposal of controlled products
• emergency procedures.

For more information, refer to WHMIS in Construction (DS028), available from the Construction Safety Association of Ontario.

**GASOLINE**

1. Gasoline and other flammable liquids must not be carried in the passenger compartment of a vehicle.

2. Gasoline and other flammable liquids must be transported and stored in approved containers bearing the CSA or ULC (Underwriters’ Laboratories of Canada) label.

3. Ensure that containers are not damaged and that caps or fittings are properly secured after filling.

4. Flammable liquids must be transported in an upright position, braced or otherwise secured to prevent overturning.

5. When transporting flammable liquids in a van, place the containers in the rear with adequate ventilation. Remove the containers immediately upon arrival at your destination.
6. Keep an ABC fire extinguisher in the driver’s compartment when transporting gasoline or other flammable liquids in a van.

7. Do not use gasoline as a cleaner.

8. Gasoline engines should be shut off and allowed to cool before refueling.

OXYGEN AND ACETYLENE

1. Oxygen and acetylene cylinders must be secured in an upright position at all times during storage, use and transportation (Figure 19).

2. Store cylinders in a well-ventilated area—preferably outside with overhead protection from the weather.

3. Keep acetylene cylinders away from heat sources. The surrounding temperature should be kept below 54°C (130°F).

4. Store full and empty cylinders separately. Store acetylene and oxygen cylinders separately.

5. Protective caps must be in place when the cylinders are not in use or when they are being moved.

6. Place cylinders where materials and equipment will not strike, fall on or knock them over.

7. Do not store or use cylinders where they can become part of an electric circuit or be struck by a welding rod.

8. Before moving cylinders, close the valves and replace the protective caps.

9. Cylinders must be hoisted in properly rigged racks or baskets to keep them secure and upright.

10. Before using regulators, hoses or torches, make sure that they work properly. Protect supply hoses from traffic.

11. A 4A40BC fire extinguisher must be available wherever oxyacetylene cutting, welding, soldering or brazing is done.

12. When using an oxyacetylene cutting torch, workers must wear leather gauntlet gloves and goggles with No. 4 or 5 lens shade. No. 4 or 5 lenses do not remove arc welding rays. For arc welding, No. 10 or 12 lenses are required.

13. Workers doing oxyacetylene work should not carry butane lighters.

14. Do not use oxyacetylene torches to blow dust from work surfaces, clothing or skin.

15. Use the proper T-wrench or key to open acetylene cylinders and leave the wrench or key on the valve for emergency shut-off.
16. Use only a spark lighter to ignite torches. Never use matches or cigarette lighters.

17. A leaking gas cylinder must be shut off and removed to an outdoor location away from ignition sources and marked to be readily identifiable. Notify the supplier immediately.

18. When handling a leaking cylinder, remember that your clothing can be saturated with gas and you can draw a trail of gas behind you. Stay away from all ignition sources.

19. Never use oxygen or acetylene to pressure test for leaks in a refrigeration/air-conditioning system. These gases can react explosively with oil in the system.

1. Unless designed for horizontal use, propane cylinders must be kept in an upright position (Figure 20).

2. Store propane cylinders in a well-ventilated area away from heat sources and preferably outdoors and above grade.

3. When not in use, propane cylinders and hose-connected devices should not be left in trenches or other low-lying areas. Propane is heavier than air and can settle in dangerous concentrations at the bottom of vaults, vessels, equipment wells, basements and similar places.

4. Use only approved hoses, fittings and correct wrenches to connect a cylinder to tools and equipment.

5. Never look for leaks in a propane cylinder with a match or torch. Use soapy water (Figure 21).

6. When handling a leaking cylinder, remember that your clothing can be saturated with propane and you can draw a trail of gas behind you. Stay away from all ignition sources.

7. Wherever possible, position safety relief valves so that they face away from likely sources of heat.

**NATURAL GAS**

8. Personnel working on propane appliances and equipment must hold a valid Certificate of Qualification issued pursuant to the Energy Act 1971.

**PCB’S**

Like propane, natural gas must be handled with caution because of its flammable and explosive properties. Personnel working on natural gas appliances and equipment must hold a valid Certificate of Qualification issued pursuant to the Energy Act 1971.
Older transformers, capacitors and other high-voltage equipment may contain polychlorinated biphenyl (PCB). A common trade name is Askarel.

Transformers containing PCB or Askarel bear the letter “L” on the nameplate, such as LFAF or LNW. Transformers containing mineral oil bear the letter “O” on the nameplate, such as ONAN.

Be extremely careful when handling or cleaning up spills of Askarel and other PCB’s. Conduct all work in accordance with the guidelines issued by the Ontario Ministry of the Environment. Contact the Ministry for more information.

Do not smoke or eat in or near PCB operations. Wash your hands and face with soap and water immediately after any contact with PCB’s and before eating, smoking or going to the toilet.

**ASBESTOS**

Asbestos fireproofing and insulation can be found in many buildings. Disturbing the material during renovation and repairs or maintenance can release hazardous dust.

### 13. BARRICADES AND GUARDRAILS

**GENERAL PRECAUTIONS**

Air-conditioning and refrigeration personnel can be exposed to asbestos—for instance, when repairing or maintaining pipe in insulated ceilings, when drilling through insulated walls, or when servicing refrigeration/air-conditioning components that may contain asbestos products.

Asbestos operations are classified by potential risk of exposure. For more information, refer to **Asbestos in Construction** (two volumes, DS018 and DS019), available from the Construction Safety Association of Ontario.

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>HAZARD</th>
<th>SAFEGUARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vapors may decompose on contact with flame or hot surfaces.</td>
<td>Inhalation of decomposition products can be fatal.</td>
<td>Avoid contact with flame or hot surfaces. Use fans or blowers to improve ventilation. In confined spaces, use lifelines and wear SCBA.</td>
</tr>
<tr>
<td>Vapors are 4-5 times heavier than air. High concentrations may accumulate in low places.</td>
<td>Inhalation of concentrated vapors can be fatal.</td>
<td>Vent refrigerant outdoors. Use fans or blowers to improve ventilation. In confined spaces use lifelines and wear SCBA.</td>
</tr>
<tr>
<td>Deliberate inhalation to produce intoxication. Some fluorocarbon liquids remove natural oils from skin.</td>
<td>Can be fatal Skin irritations and dryness. Possible absorption into body through skin. Liquids with lower boiling points may be splashed.</td>
<td>Education in health and safety risks. Gloves and protective clothing made of polyvinyl alcohol or neoprene.</td>
</tr>
<tr>
<td>• On Skin</td>
<td>Freezing of skin.</td>
<td>Gloves and protective clothing made of polyvinyl alcohol or neoprene.</td>
</tr>
<tr>
<td>• In Eyes</td>
<td>Freezing, burns and impairment or loss of sight.</td>
<td>Wear goggles for chemical splash. In event of contact flush eyes 15-20 minutes with running water. Get medical attention.</td>
</tr>
<tr>
<td>• Contact with highly reactive metals.</td>
<td>Violent explosion may occur.</td>
<td>Test proposed systems before use. Take appropriate precautions.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PARTS PER MILLION (PPM)</th>
<th>Percent</th>
<th>Ammonia Vapor Concentrations (Physiological Effects)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 5</td>
<td>0.0005</td>
<td>Odor detectable by most persons</td>
</tr>
<tr>
<td>25</td>
<td>0.0025</td>
<td>Possible irritations of eyes and throat</td>
</tr>
<tr>
<td>35</td>
<td>0.0035</td>
<td>Irritation of eyes, nose and throat</td>
</tr>
<tr>
<td>Over 500</td>
<td>0.05</td>
<td>Immediate dangerous to life and health. (IDLH)</td>
</tr>
</tbody>
</table>

Maximum allowable concentration for 8 hours working exposure. Maximum allowable concentration for 15 minutes. No allowable exposure — may be fatal after a short time.
Refrigerant cylinders and containers are designed and manufactured for specified maximum pressures, contents and temperatures. Increases over any of these maximums may result in leaking or bursting.

1. Do not apply flame or heat to cylinders or fittings. Do not put cylinders in hot areas or near heat sources such as radiators and boilers. Do not store cylinders in direct sunlight.

2. Keep cylinders and containers tightly closed and use only with adequate ventilation.

3. If cylinder pressure drops before a job is done, put the cylinder in a pan or bucket of warm water (80-110°F) or near a heat lamp to increase pressure. Never apply a torch and never heat over 125°F.

4. Store cylinders in a clean, dry place and secure them upright with a chain or rope. Keep valves closed and outlet plugs and protective caps in place when cylinders are not in use (Figure 22).

5. Never force connections that do not fit. Contact the supplier for proper components.

6. Always ensure that no one is in a direct line with the openings of valves or fittings, particularly safety relief valves.

7. Never stack relief valves (Figure 23). Always allow venting to the atmosphere.

8. Do not refill disposable cylinders.

9. Never let cylinders drag, slide, drop or strike anything, including each other.

**FLUOROCARBON REFRIGERANTS**

**GENERAL PROPERTIES**

Flammability—None of the fluorocarbon refrigerants are flammable or explosive.

Toxicity—Toxicity is low under normal handling and usage.

Density—Fluorocarbon refrigerant vapors are several times heavier than air. Areas where high concentrations may accumulate and displace oxygen must be well ventilated.
SPECIFIC HANDLING

1. Fluorocarbon refrigerants will decompose on contact with open flames or hot metal surfaces such as heating elements. The resulting acid gases can corrode the metal in equipment and the cotton in clothing and often have a sharp, obvious odor. All personnel should leave the area until the air is cleared.

2. Use a suitable leak detector or soap solution to locate leaks. All personnel should leave the area until refrigerant vapor has been dispersed with forced-air ventilation.

3. Inhaling concentrated fluorocarbon refrigerant vapor can be fatal. Liquid contact with eyes or skin may cause burns.

4. Do not vent fluorocarbon vapors indoors or allow fluorocarbon liquids to run into floor drains.

AMMONIA REFRIGERANT

GENERAL PROPERTIES

Anhydrous ammonia is a gas under atmospheric pressure but is compressed to a liquid for handling. As a gas, it is colorless, considerably lighter than air, and has a pungent, irritating odor readily identifiable at low concentrations.

Voluntary exposure to dangerous concentrations is therefore unlikely. But prolonged exposure even to low amounts should be avoided, since breathing ammonia vapor can damage the mucous membranes and lungs while contact with the liquid or with the concentrated vapor can cause burns and blindness.

Ammonia vapor is flammable at a high ignition temperature within a very limited range of concentration generally obtainable only under laboratory conditions. For all practical purposes, ammonia can be regarded as non-flammable.

Personnel working with anhydrous ammonia should be trained and experienced in its safe handling. That includes hazard recognition, proper use of personal protective equipment, and knowledge of first aid.

1. Ammonia refrigerant cylinders must be stored in an upright position and be secured in place.

SPECIFIC HANDLING

2. When connecting, disconnecting or otherwise working with ammonia cylinders, wear approved goggles or faceshield, protective gloves and preferably cotton clothing. For work in refrigeration and mechanical rooms, it is also advisable to wear aprons, pants and slickers made of rubber or other material impervious to ammonia.

AMMONIA IN CYLINDERS

3. Make sure that connections, regulators, gauges, hoses and other components are specifically designed and stamped for use with anhydrous ammonia.

4. If ammonia vapor leaks between the stem and packing nut on opening, close the valve, then tighten the nut by turning it counterclockwise. Reopen valve. If leaking persists, call supplier immediately.

5. Never use compressed ammonia gas where the cylinder can be contaminated by feedback unless the cylinder is protected by suitable check valves.
AMMONIA IN SYSTEMS

The requirements for entering and working in confined spaces apply to any refrigeration or machinery room where hazards are created by restricted entry and exit, limited ventilation, or the presence of anhydrous ammonia or other refrigerants.

1. Before attempting maintenance or repair, make sure that all ammonia is out of the system, including compressors, condensers and accumulators.

2. Wherever possible, stand upwind during any ammonia transfer operation.

1. Wherever refrigerants are used, any appliance producing an open flame must have the flame enclosed and vented outdoors.

14. REFRIGERATION/AIR CONDITIONING SYSTEMS

2. Adequate space and lighting must be provided for the safe inspection and repair of refrigeration/air-conditioning systems.

3. Keep all guards on belt-drive and direct drive equipment in place and in good repair.

4. The ventilation required to remove refrigerant vapor must be determined by the refrigerant content of the largest system in the mechanical room (Table 1). Air supply and return ducts must serve no other area.

<table>
<thead>
<tr>
<th>Weight of refrigerant in system, lbs.</th>
<th>TABLE I — Minimum Air Duct Areas and Openings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mechanical discharge of air, cfm</td>
</tr>
<tr>
<td>up to 20</td>
<td>150</td>
</tr>
<tr>
<td>50</td>
<td>250</td>
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<tr>
<td>100</td>
<td>400</td>
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<td>400</td>
<td>1,100</td>
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<tr>
<td>500</td>
<td>1,275</td>
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<tr>
<td>600</td>
<td>1,450</td>
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<tr>
<td>700</td>
<td>1,630</td>
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<td>800</td>
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<tr>
<td>900</td>
<td>1,950</td>
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<td>1,750</td>
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<tr>
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<td>19,400</td>
</tr>
<tr>
<td>40,000</td>
<td>20,500</td>
</tr>
<tr>
<td>45,000</td>
<td>21,600</td>
</tr>
</tbody>
</table>
When isolating a section of piping or component of a mechanical system for inspection or repair (Figure 24), exercise caution to prevent damage and potential hazards from liquid expansion. An increase in ambient temperatures around a section of piping or mechanical component containing trapped liquid refrigerant and oil will create extremely high pressure within the isolated area. This may result in a ruptured gasket, valve, pipe or component and is a threat to workers’ safety and health. Whenever possible during inspection and repair, avoid leaving refrigerant and/or oil trapped between valves or in lines and components.

PRESSURE-TESTING

1. Oxygen, or any combustible gas or combustible mixture of gases, must not be used to test for pressure or leaks, since such gases can react explosively with oil in the system.

2. Never use the system compressor to build up pressure for testing.

3. Use the proper refrigerant or gas for pressure testing: that is, do not use fluorocarbons or carbon dioxide to test an ammonia system, or ammonia to test a fluorocarbon system.

4. Take special care when using dry nitrogen for testing. The pressure in a nitrogen cylinder at room temperature is well above the bursting pressure of system components. For this reason, always use an approved nitrogen pressure-reducing valve or regulator between the cylinder and the system, in accordance with CSA Standard B52-M1983 “Mechanical Refrigeration Code.” Figure 25 shows an assembly with built-in relief valve.

SOLDERING, BRAZING AND WELDING

To repair leaks or replace components in all types of refrigeration/air-conditioning systems, it is sometimes necessary to cut lines. The following points apply to breaking, cleaning and rejoining piping and connections.

1. Never apply heat to a line under refrigerant pressure. Never apply a flame to any part of a system containing refrigerant. Rupture can result.

2. When fluorocarbon refrigerant is heated, it breaks down to form hydrochloric and hydrofluoric acids, which can damage mucous membranes and lungs if inhaled and blister skin if contacted, as well as rapidly corrode metal.

3. To separate a soldered joint, clean the outside and apply flux. Then heat the fitting evenly until the solder melts and the joint can be separated.

4. Fittings and connections are always liable to some corrosion from the decomposition of refrigerant. Clean mating parts thoroughly before rejoining them.

5. When soldering, brazing and welding, provide ventilation to remove fumes created by the heating of refrigerant residues.
REPAIRING COMPRESSORS

The first step in repairing or servicing compressors is to isolate the compressor if possible and/or remove the refrigerant.

1. Turn off the disconnect switch and follow tagging and locking-out procedure. This must be done before opening the compressor or touching any associated wiring.

2. Do not remove bolts on compressor heads without the studs and nuts in place. Never jar the heads without the studs and nuts in place. The heads can be spring-loaded and fly off if not held tight.

CLEANING WATER-COOL ED CONDENSORS

1. When cleaning the condenser by circulating acid solution through a pump (Figure 27) use only equipment, fittings and transfer lines designed for acid use. Do not leave the process unattended.

2. When using hydrochloric acid, wear approved goggles and gloves. Avoid breathing the fumes or spilling the acid. In the event of skin contact, flush with water, then with water containing baking soda. For eye contact, flush with water for at least 15 minutes and get medical attention.

3. Always handle hydrochloric acid with care. Containers must be labeled, kept tightly closed, and vented periodically to relieve internal pressure, particularly in hot weather. Keep containers away from heat and ignition sources. Never reuse containers for other purposes. Even washed containers retain residues and should be disposed of as hazardous waste.

Always add the acid to the water. Adding the water to the acid can make the solution boil up and splash you.

15. WORK IN CONFINED SPACES

1. Before work begins in any refrigeration/air-conditioning mechanical room or other confined space where there may be hazardous fumes or oxygen deficiency, the air quality must be tested by a person trained to use the appropriate air-quality test equipment.

2. Where proper tests competently performed indicate safe air quality, workers may be allowed to enter the work area.

3. Where tests indicate a hazardous level of fumes, gases or oxygen deficiency, entry must not be allowed until the space has been adequately ventilated and subsequent tests indicate safe air quality.
4. Where possible, mechanical venting should be continued in any confined space found to contain hazardous levels of fumes, gases or oxygen deficiency, even after mechanical venting has corrected the hazard. The confined space must also be continuously monitored while personnel are working there.

5. Where mechanical venting has corrected hazardous levels of fumes, gases or oxygen deficiency in a confined space but cannot be continuously provided, workers entering the space must wear rescue harness attached to individual lifelines. A worker must be posted at the entrance prepared and equipped to provide rescue in case of emergency. In some situations, workers entering the confined space should also wear supplied-air respirators. See Figure 28.

16. FIRST AID

Air-conditioning and refrigeration workers are advised to enroll in the standard 16-hour St. John Ambulance first aid course. Prompt and correct treatment of injuries not only reduces pain and suffering but also saves lives.

BREATHING

If the casualty is not breathing, start artificial respiration immediately. The most efficient method is the mouth-to-mouth technique.

BLEEDING

If the casualty is bleeding from an external wound, control the bleeding immediately.

- Apply direct pressure to the wound with a clean, preferably lint-free dressing.
- Lay the casualty down in a comfortable position.
- Elevate the injured part if possible.

The simple formula for controlling bleeding is RED—Rest, Elevate, Direct Pressure.
HEAT BURNS

- For minor burns, flush the area with cool water to relieve pain and swelling. Cover the burned area lightly with a clean, lint-free, loose dressing. Get medical help.

- In the case of serious burns, cover the area with a clean, damp dressing. Get medical help.

- Do not apply creams, lotions or ointments.

- Do not prick blisters or pull clothing stuck to the burn.

AMMONIA EXPOSURE

Inhalation — Remove casualty to an uncontaminated area. Brief exposure to minor concentrations usually requires no treatment. Longer exposure to higher concentrations may require oxygen or mouth-to-mouth resuscitation. Keep casualty warm and reclining with head and shoulders slightly raised.

Ingestion — Have the casualty drink large amounts of water to dilute the ammonia. Do not induce vomiting if the casualty is in shock, extreme pain or unconscious. If vomiting begins, place the casualty face down with head lower than hips to prevent vomit from entering the lungs.

Skin Contact — Flush skin immediately with running water and continue for at least 15 minutes. Do not cover burned area. Get medical help for serious burns. Do not apply salves or ointments for 24 hours after injury.

Eye Contact — Flush immediately with water and continue for 15 minutes. Hold eyelids apart to ensure that entire eye is flushed. Call a physician as soon as possible. If physician does not arrive after 15 minutes, continue to flush for another 15 minutes. It is then permissible to instill two or three drops of 0.5% pontocaine solution or equally effective water-based anesthetic. Do not administer oils or oily drops unless specifically directed by physician.

SHOCK

Casualties with serious injuries may lapse into shock. Symptoms include drowsiness, paleness, clammy skin and weak pulse. Get medical help as soon as possible.

- Reassure the casualty that help is coming.

- Place casualty on back with feet elevated unless injuries make this difficult. Otherwise place casualty in position that allows for easiest breathing.

- Loosen clothing around neck, waist and chest and keep casualty warm.

- Watch for trouble in breathing.
CPR

CPR is a technique used to restore a casualty’s heartbeat but requires special training. Do not attempt CPR unless you are trained to do so.

HYPOTHERMIA

Also known as exposure, hypothermia is a condition caused by lowered deep body temperature. It can develop quickly and be fatal.

As the casualty’s deep or core body temperature drops, the following symptoms appear.

- Move the casualty to a warm place.
- Remove wet clothes and dress casualty in dry clothes or wrap in blanket.
- Give hot non-alcoholic drinks.
- Give sweets—they are foods turned into heat the fastest.

In more severe cases, with symptoms such as disorientation, drowsiness and irregular pulse, do the following.

- Keep the casualty awake.
- Call a doctor or take the casualty to hospital.
- Do not unnecessarily move the casualty suffering from severe hypothermia. Too much motion can stop the heart.
- Place warm bottles at sides of chest and in groin.

In any case of hypothermia, **never** administer hot or warm baths, alcohol or massage.

FIRST AID KITS

Every project is required to have a first aid kit maintained in accordance with the Workers’ Compensation Act. Size and contents of the kit will vary with the size of the workforce.

Know where the first aid kit is located. Service crews must keep a first aid kit in the service vehicle.

In addition to the basic kit, air-conditioning and refrigeration workers should have water available for first aid in case of eye or skin contact with refrigerant.