National Torch Safety Program

Roofer Self Study Workbook
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Note: The names of persons or products used in this manual are fictional. Any resemblance to actual persons or products is coincidental.
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How To Use This Program

This is a self-study program so work through it on your own time and place.

Feel free to write in the self-study workbook as this is a personal copy of the training program and should be kept for future reference. The workbook is needed for your classroom training session.

This training program provides specific safety training for roofing mechanics. Training in membrane application, fire fighting and transportation of dangerous goods is provided elsewhere.

When answering questions use the information provided in the workbook. Complete all the questions before turning to check answers on the following page. If answers are incomplete or incorrect be sure to go back and review the material before filling in the correct answer(s) and before moving to the next section. Note unclear sections and bring them to the attention of your instructor during classroom training.

Please bring the complete workbook to the classroom training session. The trainer will review the workbook and answer questions or concerns relative to torch safety. Additional instruction may be required.

When the trainer is satisfied the material relating to torch safety is understood a test must be completed with achievement at the 80% level. A Certificate of Training and a wallet-sized copy will be issued upon successful program completion.

NAME: __________________________

COMPANY: ________________________
Introduction

The Canadian Roofing Contractors’ Association (CRCA) promotes safe torch practices in the workplace. This means that anyone who installed modified bitumen membranes and operates torching equipment must be safety trained. A registered torch mechanic will have the knowledge and understanding as indicated by:

- Module 1: Propane Systems and Handling
- Module 2: Torch Welding Equipment
- Module 3: Torch Welding Equipment Set-Up
- Module 4: Operation of a Hand Torch
- Module 5: Safe Work Practices
- Module 6: Fire Prevention Techniques

This training program has been developed by CRCA for use by roofing contractors to meet worker safety training needs.

Torch Safety Program

The program consists of three parts:

PART 1  Self Study

The roofer studies this workbook and answers the contained questions.

PART 2  Classroom Training

The trainer reviews the course content and responds to questions.

PART 3  Registration

For program registration, each roofer undertakes a written test and if successful, a Certificate of Training is issued.
MODULE 1
Propane Systems and Handling Propane

Propane is the most commonly used liquefied petroleum gas used in roofing. Propane is a non-toxic, non-poisonous, odorless and invisible gas. At temperatures above -42°C propane is an invisible gas. For these reasons, an identifying odor is added during production so it can be detected quickly. This odor is similar to boiled cabbage or rotten eggs.

To reduce its storage requirements, propane is liquefied by compressing and/or cooling and placed in metal cylinders designed for that purpose. One litre of liquid propane produces approximately 270 litres of propane gas. This compression rate is why so much heating value can be stored in each propane cylinder.

The heat required to convert liquid propane into a gas vapour in the storage cylinder is from the surrounding air. This occurs when the exterior temperature is above -42°C.

Because propane gas is heavier than air, escaping gas could collect in low places and create a flammable mixture. Ensure all areas are well ventilated.

When gas vapour is drawn from the cylinder at a fast rate, cylinder pressure and temperature are reduced causing frost build-up on the cylinder’s exterior.

<table>
<thead>
<tr>
<th>Q1</th>
<th>Propane is a liquid below -42°C?</th>
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<td>TRUE _______ FALSE _______</td>
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<th>Q2</th>
<th>Propane gas released from a storage cylinder has a foul and uncommon odor?</th>
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<tr>
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<td>TRUE _______ FALSE _______</td>
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(Answers to questions can be found on the following pages)
Cylinder Components

A. Cylinder Valve
B. Protective Collar
C. Foot Ring
D. Weld

Propane Cylinder Types

Propane cylinders are manufactured to suit the type of burner used on the appliance and are identified by the type of valve installed on the cylinder. Hand-held torches usually operate with vapour-withdrawal cylinders. Kettles and tankers use liquid withdrawal cylinders and burners.

Vapour Withdrawal System

Most hand held torching equipment is designed to work with vapour withdrawal propane cylinders.

Vapour withdrawal cylinders are identified by the cylinder valve, which incorporates a female fitting with internal threads. The matching connector has a male fitting with external threads, which installs into it with a counter clockwise rotation.

Each cylinder contains a safety relief valve set at 2585 kPa (375 P.S.I.).

A storage cylinder should never be filled beyond 80% of its volume with liquid propane. A space above the liquid is provided to contain the gas vapour and to allow for expansion of the liquid due to temperature change. The vapour that collects above the liquid is expelled by pressure within the cylinder. The pressure forces the gas vapour to the burner where it is ignited and burned.

Liquid Withdrawal System

Most roofing kettles and tankers are designed to work on a liquid withdrawal system.

The cylinder valve that incorporates a male fitting with external threads identifies liquid withdrawal storage cylinders. The matching connector has a female fitting with internal threads, which install with counter clockwise rotation. (POL – put on left).

Each cylinder valve contains a safety relief set at 2585 kPa (375 P.S.I.) as well as an internal excess flow valve. This valve stops the flow of liquid propane should the outlet nipple break off or become damaged.

Liquid propane is drawn from the bottom of the storage cylinder (by pressure within the cylinder) through a dip tube that attaches to the cylinder valve assembly. Liquid propane is transferred to the burner where it is first vaporized then ignited.
Propane tanks should be transported or used only when positioned as designated.

**A1** TRUE – Liquid is converted to a gas at temperatures above -42°C by the surrounding air.

**A2** TRUE – An odor is added to assist in the detection of leaking or accumulated gas.

**Cylinder Valve (Vapour Withdrawal System)**

The cylinder valve operates by hand wheel rotation.

- Do not use tools to turn the stem.
- Do not force the hand wheel if it appears frozen, instead take the cylinder out of service and have it inspected. Uncontrolled discharge of propane could result if the bonnet is damaged. Damaged cylinder valves must be replaced by a trained service person.

To prevent ordinary pipes or hoses from being connected directly to propane cylinders, the cylinder valve outlet connections are manufactured with left-hand threads.

To prevent leaks around the valve stem, cylinder valves should be fully open to provide a full flow of gas from the cylinder.

On one side of the cylinder valve there is a safety relief valve. It is designed to release gas vapour in the event that cylinder temperature exceeds 74°C or internal pressure exceeds 2585
kPa (375 P.S.I.). The outlet of the safety relief device should be regularly inspected (visually) for obstructions and cleaned so it functions properly.

Do not stand in front of cylinder relief valves during filling as they can discharge without warning. Point safety relief valves away from the work area, sources of ignition, windows, doors, ventilation openings and roof access points. **Never hoist propane cylinders by cylinder valves.** Cylinder valves must be protected from damage by a protective collar welded to the cylinder by the manufacturer or by a threaded collar screwed onto the collar of cap-type cylinders.

**Transportation of Propane**

Propane is classified as liquefied petroleum gas and is a dangerous good classified as Class 2.1, UN1075. It’s T.D.G. label shown below is red and should be placed on the shoulder of the cylinder and by visible from outside the vehicle.

![T.D.G. Label for Propane](image)

The transportation of propane cylinders is regulated by the Government under the Transportation of Dangerous Goods Act.

**PERSONS TRANSPORTING PROPANE SHOULD COMPLETE A T.D.G. SAFETY TRAINING COURSE.**
Q3 Your propane supplier delivers propane cylinders that have cylinder valves that have male fittings with external threads. What propane cylinder type is described?

A. Vapour Withdrawal  
B. Liquid Withdrawal

Q4 The outlet of the safety relief device should be inspected and cleared of any obstruction?

TRUE ________  FALSE ________

Job Site Storage of Propane

Empty or filled propane cylinders are dangerous and should be stored outside. They must be treated with care at all times.

Never store propane in a heated or inhabited space. Always close cylinder valves completely and install a valve plug to prevent moisture seepage into empty cylinders during storage. When a cylinder valve is left open, the propane cylinder must be purged of air and moisture prior to refilling. Failure to purge cylinders can cause excessive tank pressure and poor operation, which includes: constant adjustment of torching equipment and flameouts. When a flameout occurs, propane may continue to flow and find a source of ignition.
Local codes should be checked regarding roof top storage of propane cylinders and storage near vehicular traffic.

Cylinders should be:

- stored outside at ground level,
- on a level non-combustible base,
- in an upright position,
- with plastic valve plugs in place,
- firmly secured around their middles to prevent tipping and damage.

If stored directly on frozen ground, cylinders could tip when the ground thaws.

All hoses and equipment must be disconnected prior to propane cylinder storage or handling. Do not store other materials on or near propane cylinders.

**A3**  B. Liquid Withdrawal

(Answer to question on Page 10)

**A4**  TRUE – In order to operate properly the outlet of the safety relief device must be clear of obstructions.

**Q5**  When you arrive at roof level you see that the propane cylinders are lying randomly on their sides. How should you correct this storage problem?


**Handling, Lifting and Hoisting of LP-Gas Cylinders**

Avoid dropping, bumping or rolling cylinders when they are moved. Always handle cylinders in an upright position on wheeled carts.

A hoisting cage or properly designed hoisting apparatus must be used when transporting cylinders to roof level. Do not transport propane cylinders to and from the roof by ladder.
Do not use a rope sling through the protective collar to hoist or lower propane cylinders. In addition, never lift cylinders by cylinder valves.

When moving 100 lb. Cylinders by hand, two people are required. One person lifts the cylinder by the foot ring and the other by the protective collar. Do not pull or drag cylinders across roof membranes.

Propane cylinder valves must be protected from damage by protective collars, welded to the shoulder of the tank or by threaded collars screwed to the threaded collar on cap-type propane cylinders.

**WARNING: BREAKING OF CYLINDER VALVE WILL CAUSE A HAZARDOUS CONDITION**

Protect roof membranes from damage while handling or storing cylinders on the roof surface. The best way to move cylinders is with a wheeled cart designed for that purpose.

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(Answer to question on Page 11)

A5 Place cylinders in an upright position on a level base and firmly secure to prevent tipping.
MODULE 2
Torch Welding Equipment

Typical Hand Held Torching Assembly (Vapour Withdrawal)

a) Propane Cylinder  
b) Cylinder Valve  
c) Propane Connector (P.O.L.)  
d) Regulator  
e) Hose Connector to Regulator  
f) Hose  
g) Hose Connector to Torch  
h) Torch Handle  
i) Torch Trigger Valve  
j) Torch Control Valve (pilot)  
k) Extension Tube  
l) Stand/Legs  
m) Torch Head

Propane Cylinder Size

Select the propane cylinder size to suit the torch manufacturer’s recommendations for;

- the B.T.U. rating,
- the prevailing weather conditions,
- the prevention of cylinder wall frosting.

The size of the propane cylinder is designated by the weight of the propane it contains when properly filled to the eighty percent (80%) level.

E.g.  *A standard 20-pound cylinder contains 9 kg (20 lb) of propane. This type of cylinder weighs approximately 8.2 kg (18 lb) empty and 17.2 kg (38 lb) filled.*

The propane cylinder should have the correct cylinder and safety relief valve installed by the cylinder manufacturer.
Q6 A standard 100 pound propane cylinder contains 100 pounds of fuel?

TRUE _________  FALSE _______

P.O.L. Propane Connectors

P.O.L. fittings which connect the torching equipment to the cylinder valve are manufactured in two styles: soft nose and standard. The standard fitting is tapered and is a metal-to-metal connection. Soft nose fittings are manufactured with an “O” ring, which permits the fitting to seal with minimum hand pressure.

Vapour Withdrawal Systems

P.O.L. connectors for vapour withdrawal systems are male connectors with an external left-hand thread pattern.

Liquid Withdrawal Systems

P.O.L. connectors for liquid withdrawal systems are female connectors with internal left-hand thread pattern.

Regulators

Regulators are the “HEART ♥” of any LP-Gas system because they reduce and control the gas pressure to provide a constant delivery pressure.

Regulators are usually painted red or green.

“Inlet” and “Outlet” connections are marked on the regulator to assist with the correct installation of connecting parts and fittings.

Regulators are adjusted with a hand wheel and an accompanying pressure gauge or may be preset at a specific pressure by the regulator manufacturer (non-adjustable).

Frequently check the regulator vent hold to ensure propane flow through the regulator diaphragm valve.

Cylinders equipped with soft-nose connectors requiring an “O” ring must be checked every time a cylinder is connected. Replace the “O” ring if it is out of round, torn or cracked.
Q7  A regulator controls and maintains gas pressure from the cylinder to the torch.

TRUE _________  FALSE _______

A regulator malfunction can cause nuisance pilot outage and low or high burner flame. During winter conditions, regulators frequently freeze causing internal diaphragm damage and fluctuations in gas pressure.

Remove a defective or frozen regulator from service and replace it with a functioning unit.

**Typical LP-Gas Regulator**

a) Adjusting Screw Knob  
b) Vent Hold  
c) Outlet  
d) Pressure Gauge Connection  
e) Inlet

**Propane Hoses**

Use only the hoses that are ULC, C.S.A., or C.G.A. approved for LP-Gas service and for appropriate withdrawal system types.

For vapour withdrawal systems, the hose fittings are rated for 862 kPa (125 psi) working pressure and are not to be used for liquid withdrawal systems.

For liquid withdrawal systems, the hose and fittings are rated for 2413 kPa (350 psi) working pressure and may also be used for vapour withdrawal systems.

Hose type can be identified by an assembly tag attached near a fitting or by a stamp on the hose.

It is recommended that a workable hose length be used with each torch. Coupling of hoses for greater lengths is not recommended. Long propane hoses are a safety hazard as they contain
large amounts of propane, awkward to move, confusing, and may cause a tripping hazard.

A damaged propane hose should be replaced or repaired by a qualified service technician.

A6  TRUE

Q8  A damaged hose can be easily repaired at roof level with hand tools?

TRUE _________ FALSE _________

Torches

The extension tube length, burner head size, and gas orifice sizes are adjustable to vary BTU ratings to meet job conditions. These changes must be undertaken by a qualified service person in accordance with the torch manufacturer guidelines and should not be undertaken by the roofer.

In addition to the trigger, torches for LP-Gas service incorporate controls for pilot adjustment and for flame adjustment (torch control valve). All hand held torches must have a stand attached to the extension tube to direct the flame away from combustibles when laid on the roof surface.
Defective torches should be tagged for repair and taken out of service

A7  TRUE

A8  NO – A damaged hose must be replaced with a new hose.
MODULE 3
Torch Welding Equipment Set-Up

Preset Up Checks

Prior to set-up, it is imperative that all system components be visually inspected for signs of physical damage or restrictions. Do not attempt to use damaged propane cylinders, regulators, propane hoses or torches. Check the interior of all connectors for foreign matter and clear obstructions as required. Tag any unserviceable equipment for repair and replace with serviceable equipment prior to use.

Check that the cylinder is filled and ensure all fittings and connectors are tightened using an appropriately sized wrench or crescent wrench. Do not use pliers, channel locks, or pipe wrenches, which may damage connectors or fittings. Remove the plastic valve plug from the propane cylinder valve-outlet opening.

Q9 As the result of a preset-up check you find the propane hose fitting threads are damaged at one connector. What should be done to rectify the problem?

______________________________

______________________________

______________________________

______________________________

Q10 All standard metal propane system connectors should be tightened with vice grips or a pipe wrench?

TRUE ____________  FALSE ____________
Step-by-Step Assembly

1. Attach propane hose to the torch by threading the hose connector into the torch handle fitting and snug with a crescent wrench or proper sized open-end wrench.

2. Attach the propane hose to the regulator by threading the hose connector at the other end of the hose into the “OUT” fitting of the regulator and snug with a wrench.

NOTE: REGULATOR OUTLET FITTING & P.O.L. CONNECTORS ARE USUALLY INSTALLED BY SUPPLIER
3. Connect the regulator to the propane cylinder valve by threading P.O.L. connector into the cylinder valve fitting and snug with a wrench.

![Diagram of step 3]

4. Close the torch valve while fully opening the cylinder valve to charge the system with propane. Leak-check all connections.

**Leak Checks**

A leak check, using a mixture of soap and water, must be done each time a torch unit is connected and should be done by the torch operator.

![Diagram of leak check]

Once all the connections are completed, the system can be pressurized by closing the torch control valve and slowly opening the cylinder valve. Adjust the regulator to the correct operating pressure if an adjustable regulator type is used.
Check all connections for leaks by liberally applying a leak-check solution to all fittings. When the soapy solution bubbles a gas leak is present. If a gas leak is detected, close the cylinder valve and make the necessary corrections. Re-inspect the system for leaks after the corrections have been made. For leak checks performed during winter conditions, a non-freezing commercial leak detector fluid is recommended.

*Note: Periodic soapy solution gas leak inspections of torching equipment should be made throughout the day or anytime a gas smell is detected.*

| A9 | Remove hose, tag it for repair and replace it with a serviceable hose. |
| A10 | FALSE – All metal connectors should be snug tight using the correct sized wrench for the fitting. |
| Q11 | After set-up, a leak check must be done with a soapy solution by the torch operator?  

**TRUE __________  FALSE __________**

Use a leak-check solution to check for propane leaks. Use the correct sized wrench to tighten fittings that leak and re-check for leaking at:

3a) the POL connector
3b) both sides of the regulator
3c) hose to torch
3d) torch head
(answer to question on Page 21)

A11 YES
MODULE 4
Operation of a Hand Torch

Pre-Start Procedure Checklist

1. Wear proper clothing i.e. safety boots, long pants, long sleeves and fire resistant gloves. In winter, wear coveralls or non-synthetic winter clothing and headgear.

2. Clean the work area of debris such as: poly wrappers, loose papers, empty primer and adhesive pails, tear off debris and tools.

3. Place a 9 kg (20 lb) ABC type fire extinguisher (rated 10A 40BC) approximately 3 metres (10 ft) from work area and propane cylinders.

4. Place propane cylinders upright approximately 3 metres (10 ft) from work area on a wheeled cart.

5. Extend propane hose and torch assembly using approximately 8 metres (25 ft) of hose.

6. Check that all system control valves are closed such as: torch control valve, regulator, and cylinder valve. (Leak check if not done previously).

7. Place spark lighter beside torch.

---

Q12 Sid is preparing to torch the cap sheet on the west section of a large warehouse re-roof. Circle the items that he should check prior to lighting the torch.

A) System control valves are closed
B) Debris has been cleared from the work area
C) His butane cigarette lighter is full
D) An ABC type fire extinguisher is 3 meters from his work area

---

Torch Start-Up

1. Fully open the cylinder valve slowly ensuring that relief device is pointing away from people and sources of ignition.

2. Where required, open the regulator by turning the hand wheel and set pressure.
3. Point the torch away from the body, open the torch control valve and ignite LP-Gas with spark lighter.

4. Depress torch trigger valve and test for torch flame. Check operation of pilot, trigger valve, and regulator. If they are not working replace defective parts. Repeat procedure if flame goes out.

Torch Shut-down

As a general rule, a torch should be shut down if not needed for more than two (2) minutes or when the operator is leaving the work area.

When not in use, place the torch on its stand pointing away from the roofing system and all combustibles.

Allow the torch to cool down before storage at day’s end.
WARNING: NEVER LEAVE A LIT TORCH UNATTENDED FOR ANY REASON

Intermittent Torch Shut Down

1. Hold lit torch in one hand pointing away from the body and cylinder then close torch control valve and allow flame to burn out.

2. Place the hot torch on stand pointing away from combustibles until cool.
End of Day Torch Shutdown

1. While the torch is burning, slowly close propane cylinder valve until snugly shut.

2. Pointing the torch away from people and cylinder, burn off LP-Gas contained within the hose until the torch flame is out.

4. Place the hot torch on its stand and when cool disconnect the regulator, hose, and torch assembly from the cylinder valve.

5. When cooled, disconnect hose/torch assembly from the cylinder and store in a lock-box protecting it from debris and damage.

Q13 Bob is torching membrane stripping along a parapet wall when he hears the horn of the coffee truck. Bob places his lit torch on its stand and proceeds down the ladder for coffee with his crew. Has Bob left his torch in a safe condition?

YES___________ NO_____________
**Q14** At the end of the day, Sam closes the cylinder valve and burns off the propane contained in the hose. As well, he closes all control valves and coils up the hose and torch and places this coiled equipment around the collar of the propane cylinder before going home. Has Sam followed the correct shut down procedure?

YES__________  NO__________

**Torch Safety Check Lists**

**Equipment Checks**

- Store cylinders in a level upright position with plastic valve plugs in place and firmly secured from tipping.
- While on the roof, transport cylinders in an upright position in a wheeled cart designed for this purpose.
- Check that equipment is in good operating condition.
- Use properly sized wrenches to tighten connections and never force fittings as threads could be damaged.
- Leak-check connections with a leak-check solution.
- Point cylinder relief valve away from any sources of ignition, ventilators and access points.
- Never leave propane in hoses for extended periods of time. Always burn it off.
- Protect torching equipment from damage and maintain proper working order.
- Always place hot or burning torch on stand pointing away from combustibles.

**DO NOT LEAVE A LIT TORCH UNATTENDED FOR ANY REASON.**
Roof Top Safety Checks

- Each torch operator is responsible for the safety of fellow workers and job site fire safety while torching.
- Workers other than torch operator should be no closer than 1 metre (3 ft) from the open flame.
- Ensure that a fully charged 9 kg (20 lb) ABC type fire extinguisher (rated 10A 40BC) is provided for each torch operator and is placed in each work area away from propane cylinders.
- Remove combustible debris from the work area.
- Protect combustible materials from fire.
- Avoid heat contact with lead, metal flashings, plastic piping or any other materials which may be damaged by torch heat.
- Never torch where flame is not visible at all times.
- Do not torch directly around open access points.

Q15 When Fred is checking his torching equipment prior to torching. Should he also be checking the construction and composition of the building’s roof and wall assemblies in the area that he is working in?

YES __________ NO __________

Building Fire Prevention Checks

- Identify and locate any openings or equipment that may draw in open flame.
- Shut down roof top ventilators and fans in the vicinity of torching activity.
- Determine construction and composition of roof and especially wall assemblies before torching.
- Ensure good roof top house keeping.
- Inform building occupants of torching activity.
• Post a fire watch at the end of the day for a minimum of one (1) hour after the last torch is shut down (see Fire Watch, p. 34)

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<th>Question</th>
<th>Answer</th>
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<tr>
<td>A13</td>
<td>NO</td>
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<tr>
<td>A14</td>
<td>NO</td>
</tr>
<tr>
<td>A15</td>
<td>YES</td>
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MODULE 5
Safe Work Practices

Torch Welding Safety

Torch Safety is the responsibility of each roofer involved with the torch application on modified bitumen membranes. The torch applicator assumes responsibility for the installation and inspection of all safety devices. A foreman or supervisor should over-see torching operations.

Job planning prior to torch application should provide for the safety of the roofers, the building, building occupants as well as the general public.

An emergency response procedure should become part of the company safety program.

Application Training

The roofing contractor in conjunction with the membrane manufacturer shall ensure that each roofer involved with adhered modified bitumen membranes is properly trained in the safe application procedures, operation and maintenance of torching equipment.

It is recommended that each mechanic applying torch adhered membranes successfully complete this torch application course.

Some manufacturers and suppliers provide training for the application of their products and systems. Whenever possible, workers should take these courses. Workers should become familiar with the installation requirements and application procedures of the manufacturer for their particular modified bitumen membrane products and systems.

FIRE PREVENTION AND PROTECTION

A constant threat to safety in torch welded roofing is the possibility for fire. A roof top fire can cause fatalities, and tremendous damage to personal property. No one wants to be responsible for the loss of innocent lives. It is vital that you take careful measures in regards to fire prevention and protection, before, during and after torch welding a roof.
Combustibility Concerns

No torch welding shall begin unless the surrounding atmosphere is non-flammable and unless combustibles are moved away or properly protected from fire hazards. Any combustible materials that are present on a roof, such as insulation wrappers, solvents, primers, and roof cements, must be moved to a safe location. Combustible materials that are present on a roof and are not moveable must be protected from fire hazards.

The risk of fire to combustible roof decks or materials can be minimized by mechanically fastening or mopping down a base sheet, or applying a self-adhering membrane, taking care to close all openings or cracks around edge details, mechanical equipment curbs, vent pipes and drains. Combustible materials present on adjoining building surfaces (e.g. shake shingles or wood siding) should be protected by covering of fire retardant blankets or a protective shield.

Fire Watch

Fire watch is one of the most important aspects of torch welding safety. The fire watch process must begin during application. A fire watch requires both visual and physical check be done for fire and roofing hot spots at the end of each day’s torching operations. A designated person must be assigned to conduct a fire watch during application. If the mechanic torching is just a one-person repair crew, then extra attention should be paid to the area being repaired to watch for signs of fire.

The person conducting fire watch shall be trained in the use of fire extinguishing equipment and shall be familiar with the facilities for sounding an alarm in the event of a fire. The person conducting fire watch should be knowledgeable about the types of fires that may start as well as possible locations for fires to start, etc. The person should watch for smoldering materials (hot spots), or fires on all areas of the roof construction. Try to extinguish fires only when the fire is within the limits of the fire extinguishing equipment available, or otherwise sound the alarm.

Individuals conducting a fire watch must be properly equipped with:

- a fully charged 9kg ABC fire extinguisher
- an infrared thermometer
- a cell phone, two way radio, or other two way communication device
- a 20 litre water pail
- a roofers knife
- a trowel
- a spade
- a hatchet
Fire watch must also be conducted at the end of the working day, regardless of the size of the job being performed. Fire watch should last for at least one (1) hour after all torches have been extinguished for the day. Although the minimum recommended fire watch duration is one (1) hour after the crew has left for the day, this generally applies to new construction. Older buildings may require additional fire watch time. Due to the nature of their design, construction and condition of the building elements, they may be more susceptible to fires or hot spots.

Q16 A fire watch should be carried out for a maximum of one hour after all the torches have been shut off?

**TRUE** ________ **FALSE** ________

The following steps should be followed when performing end-of-the-day fire watch:

1. At the beginning of the one (1) hour fire watch, be sure all torches are turned off and every tool is stored properly and that all workmen have left the roof for the day.
2. Check all propane cylinders to see that they are all turned off securely at the valve. Move cylinders to the ground. If not possible, then see that they are gathered in one area and secured in a group. The spot should be away from any projections, walls or the edge of the roof, if possible. An area in the center of the roof would be best. Be sure they do not cause any obstruction or block the flow of water.
3. Walk around. Check fans or other units that were turned off during work that might be back in service. Be particularly careful to check these areas first for hot spots.
4. An infrared detector is required when carrying out a fire watch. The person carrying out the fire watch must be thoroughly trained in the use of the particular type and model of infrared detector employed.
5. The first phase of the fire watch consists of checking the areas most susceptible to smoldering combustion. Recheck areas of intake pipes, vents, etc.
6. After having completed the first phase, walk all the perimeters, check vents, drains, scuppers or all placed that torching might come in contact with breaks in the structure.
7. Use your bare hand to feel along flashings and around vent pipes, etc., for any hot spots or other areas of concern.
8. Repeat steps 5 and 6 as necessary to ensure that there are no suspected hot spots or other potential fire spots.
9. If possible, walk the interior of the building before leaving.
10. If fire is suspected, first call the Fire Department. Second, evacuate the building. Many smoldering fires are quite extensive.
11. Work with the building occupants to double check for fires, and have all units that were shut off during work put back into service.
12. Be alert to any unusual odors during the entire fire watch period.

**ONLY EXPERIENCED ROOFERS SHOULD UNDERTAKE THE FIRE WATCH!!**

**Fire Department**

Locate and have the crew know where the nearest telephone is, and know the exact address/location of the job site. Have the person calling the Fire Department stay on the phone and direct emergency vehicles. Call the Operator or 911.

If you have a fire, even if it was put out by you or your crew, **always** call the local Fire Department.

Follow the emergency response procedure prepared by your company’s safety program and have the crew know where the nearest telephone is relative to the work area. It is recommended that the person calling the fire department remain on site to direct the emergency vehicles. Small hot spots and smoldering materials may be extinguished during the fire watch using water or a fire extinguisher as directed by the company safety manual.

**IF FIRE IS LARGE DO NOT RETURN TO THE ROOF!!!!!**

**Owner’s Information**

Roofing contractors should request from the building owner information on how to sound fire alarms at the building facilities. Special note should be given to the location of additional fire extinguishers and fire fighting equipment. The roofing contractor should inquire and the building owner should make the roofing contractor aware of any flammable liquids stored on the job site, or any exhaust vents or specialized equipment that may emit flammable vapours.

(Answers to questions on Page 33)

A16 **FALSE**

A fire watch should be a minimum of one (1) hour in duration
Q17 A thorough fire watch includes an inspection of the interior of the building whenever possible.

TRUE _______ FALSE _______

Q18 List 3 of John’s duties during fire watch below?

1. __________________________
2. __________________________
3. __________________________

Q19 Tim locates a small hot spot on the roof during his fire watch. He opens cuts through the membrane and sees that the fibre board is smoldering. He douses the fibre board with water and then phones the fire department.

Are Tim’s actions appropriate for this situation?

YES _______ NO__________

A17 TRUE

Fire prevention safety checks should include checking the building interior whenever possible.
FIRE FACTS

Fire

Contrary to popular belief, fire does not gnaw its way from board to board, nor does flame even need to touch combustible material to ignite it. Have you ever ignited a cigarette by holding the match flame a good inch below the cigarette? The heat that is generated by the match is enough to bring the tobacco to its ignition point. The same principle applies in a fire. Hot air mushrooms when it hits the ceiling, and pours through open doorways, bathing the rooms in tremendous heat. If the air is hot enough, it will cause the materials it touches to ignite.

Consequently, decks, insulation and walls may all be exploding into flames at the same instant in various parts of the building. Your escape margin is drastically cut.

If you detect a fire, remember wood is a very poor conductor of heat, and the fact that you can sense or feel heat means that tremendous temperatures and smoke are on the other side, waiting to burst in on you. Evacuate the roof, call the Fire Department, and evacuate the building.

If smoke and/or flames are not yet visible, return to the roof with caution and investigate the area of the fire. Good judgment is needed here. It is always best to wait for the Fire Department and give them reliable direction.

(Answers to questions on Page 35)

A18  Visually and physically check for hot spots and fires using a detector or a bare hand.

Be alert to any unusual odors

Check interior of building for fire before leaving for home.

A19  YES

Smoke – The Real Killer

Smoke, not flames, is the real killer in a fire. Actually, very few people burn to death. The vast majority (as many as 80%) are asphyxiated by toxic fumes long before the flames ever touch them. Many corpses are hauled out without a burn mark on them.

What you see as “smoke” is a mixture of a dozen or more poisonous gases. Always present in
large quantities is dreaded carbon-monoxide – the killer you cannot see, smell or taste. A concentration of only 1.25 percent in the air can knock you unconscious after two or three breaths and kill you in two or three minutes.

Besides carbon-monoxide, you must contend with other poisonous gases which when combined, could kill you. Many of these gases have no odor, and some that do anesthetize your sense of smell, thereby preventing detection. It is not possible to tell when smoke is most threatening, for color and density are not at all reliable clues.

Thin, slightly gray smoke can be just as deadly as thick, soupy stuff.

Whenever there is smoke, there is potential danger, so get off the roof and get off fast!

**Q20** Flame has to touch a combustible material to ignite it.

TRUE _______  FALSE _______

**Q21** Tim sees thin slightly grey smoke on one corner of the roof. Because it is not thick and black he believes it is not harmful and goes over to the location of the smoke to investigate. Are Tim’s action appropriate for this situation

YES _________  NO _________
ROOF TOP FIRE HAZARDS

1. **Working near any wall flashing**
   Be cautious of any small opening that might receive fire. Do not torch anywhere you can’t directly see, as you could be igniting something and be unaware of it. Consider the use of the torch and flop method wherever possible.

2. **Openings that exhaust vapours**
   Be aware of any vents or equipment that might emit vapours that could ignite. An example would be sewer gas. Restaurant and food service exhaust vents can contain grease. Exhaust vents for Laundromats in condominiums, apartments, and other multiple tenant dwellings can contain lint and debris. Open flames should be kept clear of all vents.

3. **Wires and electrical conduit pipes**
   Use proper protection or avoid these protrusions. Keep torch clear at all times.

   - **Natural gas lines**
     Be aware of any odor of gas around HVAC units. Keep torch clear at all times.

4. **Openings that draw vapours**
   Even with extreme caution, a slight application of an open flame to an inlet vent may cause fire. Cover openings. All intake fans should be shut off during application with special care taken to keep torches away from openings.
Drain openings, vent stacks and pipes
Flames can be drawn into drain openings, vent stacks, pipes.

Blowing debris that will cause fire
Burning wrappers are hard to notice in daylight. Be sure that the rooftop is clear of debris prior to beginning roofing.

Anytime the wind is more than 8km/h
Even a light wind should be treated as a problem as this may create local areas of negative pressure and the sucking in of flames. Extra fine alert should be carried out under windy conditions. Changes in wind direction can result in pressure changes and changes in conditions. Be aware that the flame from a torch may blow off line with wind. Use smaller pieces for torch and flop.

Beware of blow-back from wind
Use eye protection. It is recommended that long sleeved shirts be worn. Wear fire resistant gloves.

Where fire can cause damage
Polystyrene and other combustible insulations may be out of sight in walls. Wood and plywood decks may also easily catch fire. Wood and fibre cant strips are extremely flammable and should be removed or prepared to receive torch welding.

Lead flashings
Many roofing materials, such as lead flashings, and soldered joints can be damaged by too much heat.

Chemicals and other combustibles
Beware of combustibles used with other roofing systems that might be present. Never torch directly to roof cement. Keep flammable and combustible liquids off of the roof while torching.

Grease, oil and any other spills
Spills might be on the roof from fans and other openings. Be aware of where they might be. Keep torch clear.

Hazardous materials
Flammable and solvent-based materials (e.g. plastic cement and mastic cement) should not be exposed to flame. Whenever any primer is being used or has been used, allow enough time for solvents to evaporate. Drying time may vary depending on outside weather conditions.

Work Practices That Avoid Fires
Do not lay lighted torches over the edge of the roof – Do not place lighted torches over boxes or on any projection where it may fall and cause a fire. Do not torch directly to wood, fiberboard, or other combustible materials.
Do not leave the torch unattended on the roof with open flame – The operator must stay in the immediate area. Whenever the torch is set down, it must be resting on its stand and pointed away from any projections, walls or materials.

Understanding the materials and design of the building – Before using torches, examine and determine the type of decks. Remember that while the owner is having a new roof applied, he or she might decide to have the interior painted also. Block exterior vents that may release these vapours. Discuss this with the building owner. Never torch directly to a wood deck. Use an approved base sheet.

Do not have gasoline or other solvents on the roof – Buckets with gasoline for cleaning tools should not be allowed, as well as primers and other combustible solvents.

Do not use a torch to dry the roof – The same precautions must be followed when you are torching around openings and walls.

Removing trash from the roof – Wind-blown trash can result in fire that will travel fast.

Not being reluctant to call the Fire Department – Don’t forget that fires are their specialty. Let them do their job. Smoldering fires can be especially tricky. The fire may seem to be out as there is no smoke or flame, but it will still be smoldering out of sight and control.

Using caution when the torch and flop technique is used – Warming, cleaning or drying old roof flashings using the torch and flop method will cause dust and dirt to pick up the flame and possibly cause a fire. Use a brush to clean the flashings. Allow moisture to evaporate.
COMMON ROOF DANGER POINTS

The following pages contain examples of common fire danger points. Careful attention must be paid when performing torch work around these areas.

A. Plumbing Vents
B. Old Wood Blocking & Cants
C. Lint, Dust & Grease Accumulations
D. Exhaust Openings
E. Service Lines
F. Scuppers
G. Wall Louvres
H. Wall Flashings and Caulking
I. Parapets
J. Air Conditioners/H.V.A.C Units
K. Ducts
L. Gum boxes/Pitch Pans
M. Curbs
N. Counter Flashings
O. Lead Flashings
P. Drains
Q. Open Intakes
R. Roof Jacks & Storm Collars
S. Fans
T. Cap Flashings

Note: The most dangerous fires are the ones you don’t see.
By the time you notice them it may be too late!
A. **Plumbing Vents**

Plumbing vents emit gases and vapours, which could ignite.

![Diagram of sewer gas emission](image)

B. **Old Wood Blocking & Cants**

Old wood elements may be susceptible to fire due to dry conditions. Checking and shrinkage of wood may create spaces for flames to go through.

C. **Grease/Lint/Dust Accumulations**

These accumulations are highly flammable within torch area. Remove whenever possible prior to torching.

![Diagram of grease accumulation](image)
D. Exhaust Openings

Flame can be drawn in around flashings and openings. Shut off equipment.

E. Service Lines

Flame can ignite fluids and electrical conductors contained within service lines.

F. Scuppers

Flame can enter under flashings and ignite exposed membranes or debris.

G. Wall Louvres

Flame can be drawn into or around louver frames and openings. Shut of equipment.

H. Wall Flashings & Caulking

Painted flashing and sealant materials can be ignited by flame.
I. Parapets

Flame can be drawn under metal flashings and enter building where inadequate air seals exist.

J. Air Conditioners / H.V.A.C Units

Debris and petroleum products can accumulate under and around this roof-mounted equipment. Remove large accumulations of bird droppings and feathers. Do not torch under these units unless flame is visible at all times.

K. Ducts

Dust and debris accumulations contained within and around ducts can be ignited by heat or flame.

L. Gum Boxes/Pitch Pans

Sealants and packing materials sealing penetrations may be ignited.

M. Curbs

Flame can be drawn into openings, ductwork, covers or under the metal flashings of curbs.
N. Counter Flashings

Flame can ignite accumulated debris and bituminous materials beneath flashings.

A20  FALSE
If the air is hot enough it will cause the material it touches to ignite. It is not necessary to have materials come in contact with open flame.

A21  NO
Slightly grey smoke can be as deadly as thick black smoke. Time should have immediately called the fire department.

O. Lead Flashings

Leads can be melted by heat of torch flame permitting flame to enter openings.
P. **Drains**

Flame can be drawn into drain hopper and lead flashings.

---

Q. **Open Intakes**

Flame is readily drawn into open intakes, so ensure units are shut down.

---

R. **Roof Jacks & Storm Collars**

Flame can melt solder at flashing joints or be drawn into building around the storm collar.

---

S. **Fans**

Flames can be drawn into openings or ignite materials within units.
T. Cap Flashings

Flame can be drawn under metal flashings and ignite debris or roofing materials beneath.

**Q22** Dust and dirt that accumulate are flammable?

TRUE ___________  FALSE ___________

**Q23** Torch flames drawn into building around roof openings and curbed penetrations cause fires?

TRUE ___________  FALSE ___________

**Q24** A good rule of thumb when torching in difficult places is to torch only where torch flame is visible at all times?

TRUE ___________  FALSE ___________

**Other Common Roof Top Hazards**

- Burning wrappers and construction debris can cause a fire so ensure good rooftop housekeeping at all times.

- Modified bitumen adhesives, primers and mastics are flammable. Before using, follow the usage directions printed on their containers at all times. Drying times will vary with each product and with weather conditions.

- Wind will cause torch flame to go off line so be alert to this problem.

- Natural gas lines are dangerous, be aware of any gas odour around lines or H.V.A.C. units. Remove gas lines whenever possible.

- Some vapours exhausted from inside a building such as paint or chemical fumes may ignite. Shut down exhaust units.
• Filters contained within H.V.A.C. units should be removed prior to torching as they may contain highly flammable dust and debris accumulations.

• The surface of modified bitumen base sheets may be slippery when snow or frost-covered. Exercise caution when working near the roof edge during winter months.

• Take extra care when torching close to dusk or dawn. Long shadows can mask smoke making a smoldering fire difficult to detect.

**Job Site Prevention Procedures**

Among the most dangerous types of roof constructions are those that contain hidden roof spaces without accessible attics. These are often flat roofs on joists that are insulated below the deck, or cathedral ceilings. Because of the requirement to vent these hidden roof spaces there are often convective air currents, or negative pressure below the deck that can draw in flame. Once it enters, fire can easily and rapidly travel through the roof space undetected. Often there are combustible materials, such as framing members, blocking or insulation that will fuel a fire.

**ROOF SPACES – HIDDEN DANGER**

If flame gets into combustible materials such as insulation, the Fire Department must be called immediately. The fire can smolder inside insulation undetected for long periods. Insulation removal may be necessary to prevent a serious fire.
SBS Primers and Adhesives

Store adhesives and primers away from buildings and work areas; do not store on the roof.

Only enough materials for each day’s work should be transported to the roof.

Remove empty containers and pails from work areas and roof each day.

Use these products in accordance with manufacturer’s written usage instructions printed on containers. Read labels prior to use.

These products contain flammable petroleum volatiles, which must “flash off” prior to adhering membranes to them. The flash off period is affected by weather conditions. On windy warm days, the volatile flash off period will be reduced. However, during humid, calm or winter conditions, flash off periods may be extended.

Priming surfaces the day prior to torching operations is strongly recommended during humid or winter conditions. It is recommended that primers and adhesives be applied well in advance of membrane application. It may be necessary to apply primers early in the morning to allow volatile flash off prior to torching later in the workday.

Hand-test primed surfaces prior to directing the torch flame at them. This procedure reduces the likelihood of these primers igniting when torching membranes over them.

(Answers to question on page 47)

A22 TRUE
Dust and dirt accumulations can be ignited by the torch flame.

A23 TRUE

Q25 Primed surfaces can be torched onto within ten minutes of the application of the primer

TRUE _________ FALSE _________

Torching at Roof / Wall Junctions

The most susceptible locations for ignition of existing building components are at roof penetrations and wall junctions.
Cut tests and investigation of existing construction at these locations must be undertaken prior
to torching whenever re-roofing or repairs are being carried out.

Do not torch directly onto fibre boards or any other combustible surfaces at anytime. Fibreboards must be covered or removed and replaced with non-flammable materials. Never torch directly to fibreboard cants.

Modified bitumen membranes may not require installation of cants at vertical to horizontal roof junctions. Whenever possible, non-combustible cants (perlite, fibreglass) or cants that have been treated with a torchable covering, such as a self adhering modified membrane should be used. In some instances, wooden cants may be specified at parapets and wall junctions. Cover wood cants prior to torching with an acceptable layer of self-adhering, mopped-on, cold or factory applied membrane. Ensure the no gaps exist between the wood cant, decking, and parapet as flames may be drawn in to these openings igniting combustible building components.

(Answer to question on page 47)

A24  TRUE
Do not torch anything unless the torch flame is seen at all times!!!

Employ modified bitumen membrane gussets at inside and outside corners, to reduce the possibility of flame infiltration at these locations. Use the recommendations of the modified bitumen membrane manufacturers.

Openings between roofing and existing wall coverings must be covered prior to torching. Flames can be quickly drawn into these openings and may ignite wall material obscured from view, such as building paper, dust, and insulations.

Many wall finishes, such at stucco and metal siding, are applied over building papers or other combustible materials that may be ignited if not protected from the torch flame (see Detail 1).

Q26  The flash off time for primers and adhesives may be increased during periods of humid or winter conditions.

TRUE ___________  FALSE ___________

Pre cast wall panels, are welded to metal building ties extending from the structure. A void is usually contained behind the panels that may contain insulation or dust accumulations that
may ignite if the torch flame contacts them (see Detail 2).

The recommended procedure to prevent flame infiltration at openings between roofing and existing wall materials is to install a barrier to temporarily or permanently cover any openings. The two most common prevention methods are to install self-adhering (peel and stick) S.B.S. compatible membranes to cover openings or by back torching membranes and pushing them into place by hand. Permanent sheet metal flashing backing may be installed prior to torching membranes at these critical locations (see Detail 3).

**Q27** List methods which roofers use to reduce the risk of fires when torching at roof penetrations and roof/wall junctions.

1. 
2. 
3. 
4. 

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DETAIL 1: Typical Exterior Wall Junction

DETAIL 2: Precast Junction
DETAIL 3: Permanent Flashing

(Assertion on question on Page 49)

**A25 False**

The amount of time needed for the primer to dry depends on the time it takes the volatiles to “flash off”. This depends on the exterior conditions. The volatiles will flash off more quickly on a hot dry day than a damp and humid cool day.

**Q28 Are modified bitumen adhesives, primers and mastics rooftop fire hazards?**

YES _____________  NO _____________
COMMON RISKS AND SOLUTIONS

Fire risk at curbs:

Solutions:
Risk at parapet walls

Solution A
flame arrester
(metal, self-adhering membrane, etc.)

self-adhering membrane,
mopped or cold applied base sheet

cant (optional)

flame proof
compressible insulation

Solution B
flame arrester
(metal, self-adhering membrane, etc.)

base sheet
(mopped, cold applied,
or self-adhering)

cant (optional)

flameproof compressible insulation
Risk at Gaps and Roof Openings;

Solution A

Solution B
Risk at Units

Solution
Risk at Vents:

Solution
Risk at Walls

Solution A

- flame arrester (metal, self-adh. membrane, etc.)
- base sheet (mopped, self-adh. or cold applied)
- cant (optional)
- flameproof compressible insulation

Solution B

- flame arrester (metal, self-adh. membrane, etc.)
- base sheet (mopped, self-adh. or cold applied)
- cant (optional)
- flameproof compressible insulation
A26  True

A27

1. Do cut tests and investigations.
2. Cover openings with peel and stick membranes.
3. Use temporary sheet metal barriers.
4. Install permanent sheet metal barriers at junctions and openings.
MODULE 6
Fire Prevention Techniques

1. Shut down air conditioners, H.V.A.C. units, exhaust and intake fans in the work area at their control panel(s) and lock off.

2. Do not torch in an enclosed area where gases and fumes can accumulate.

3. Do not torch directly to combustible materials such as fiberboard, plywood, flammable insulations or cants.

4. Prior to torching the membrane flashing, install gussets to all corners and joints to prevent flame infiltration at these locations.

5. Do not torch anywhere the torch flame cannot be seen.

6. Remove debris from roof and work area as ignition of wind blown materials can result in a fire.

7. Use care when torch drying roof surfaces and materials particularly around openings and at all roof junctions. Dust and dirt are flammable and can be ignited by the flame.

8. Store adhesives, coatings, primers and petroleum products away from the work area in proper containers. Do not use gasoline to clean tools.

9. Examine the condition of roofing system components including decking and insulations (old and new) near the area being torched.

10. Do not leave a lit torch unattended. Shut down the torch and place on a stand when leaving the work area.

11. Do not lay a lit torch over a roof edge, propane cylinders, or containers that permit the torch to fall and cause a fire. When not in use, a lit torch must be resting on its stand pointing away from the roofing system and combustibles.
HOW TO HANDLE SMALL LP-GAS FIRES WITH PORTABLE FIRE EXTINGUISHERS

In the event of a fire involving LP-gas, it is important to react quickly.

Should the Fire be Extinguished?

In any LP-gas fire, flames should not be extinguished, unless by doing so, the fuel supply can be turned off. If the fire is extinguished and a supply of fuel is not turned off, an explosion hazard much greater than the fire hazard may be created. Accordingly, fire fighters should be trained not to extinguish a flammable gas fire until a definite plan of fire control and fuel shut-off has been established and each man has been instructed on his part of the operations.

During the period, water spray from either hand hose lines or fixed piping can be directed upon the equipment to prevent over-heating.

Attack Fire from Upwind

Fires created by ignition of LP-gas escaping from leaks caused by equipment failure must be contained from upwind. The dry chemical stream is directed into the flowing as at the break; utilizing the velocity of the gas to carry the extinguishing agent out of the extinguisher.

Hold your dry chemical stream on the escaping fuel behind the point of combustion. Do not chase after the ball of fire. After the fire is extinguished, you and your extinguisher should remain close by the ready as “stand-by” protection against re-flash during the time persons are working to stop the flow of fuel. Remember that a 9 to 13 kg (20-30 lb.) dry chemical extinguisher will last approximately 20 seconds in use.

Recharge Extinguisher Immediately

Every extinguisher should be re-charged immediately after use. A partially filled extinguisher, for all practical purposes is an empty extinguisher. Do not return it to its normal location. Instead, invert the extinguisher and return your extinguisher to an upright position and transport it to your re-charge station.

Q29 A good fire prevention technique prior to torching is to shut down all mechanical equipment located within the work area.

TRUE ___________ FALSE ___________
Q30 While torching the membrane flashing Sid places his lit torch over the parapet, which could cause a fire. What fire prevention technique should Sid have used?

Inspection of Extinguishers

All extinguishers must be visually inspected every thirty days and a durable type record maintained. At least once a year complete maintenance in accordance with the manufacturer’s instructions must be made and recorded. At 5 to 12 year intervals a hydrostatic test on the extinguisher is required. For information regarding the inspection, testing and maintenance of portable fire extinguishers, consult the Fire Code and Regulations for your particular area of jurisdiction. Most Code requirements are based on Document NFPA 10, “Portable Fire Extinguishers” which is available from the National Fire Protection Association.

This has been only a brief look at the operation and application of dry-chemical portable hand extinguishers. You can get more information on the proper use of fire extinguishers from your company’s safety program.
A28  Yes
Modified bitumen adhesives, primers and mastics are flammable and roof top hazards.

A29  TRUE
Shut down air conditioners, H.V.A.C. units, exhaust and intake fans at their panel(s) and lock off.
FIRST AID INFORMATION

Risk of Heat Related Illnesses

The risk of heat related illnesses increases when working with hot applied roofing systems and torches, especially during hot summer weather. It is important that applicators recognize heat related distress and understand the effects of heat, symptoms and prevention of heat stress disorders. It is important that personal precautions against heat stress disorders be taken.

Heat Related Illness Preventative Measures

Prevent heat-related illnesses by following these guidelines:

- Protect skin and eyes during prolonged sun exposure.
- Allow the body to acclimate to hot conditions before working full days in extreme heat.
- Drink plenty of non-alcoholic/non-caffeine beverages.
- Utilize hats, cool clothing, and cooling devices.
- Manage your work schedule to avoid long period of exposure.

Hazards of Heat

In addition to illness, heat related hazards include:

- Physical discomfort
- Diverted attention
- Poor judgment
- Slippery hands
- Sweat in eyes
- Dizziness
- Slowed reaction time.

Q31 In a LP fire should the fire be extinguished before or after the gas supply has been shut off? Explain.

BEFORE _______  AFTER _________
Heat Stress Symptoms

Mild symptoms include:

- Muscle spasms
- Heavy sweating
- Fatigue
- Normal body temperature.

Serious symptoms include (Heat Exhaustion):

- Cool, wet, pale skin
- Weakness
- Mental confusion
- Nausea
- Headache
- Normal or slightly above body temperature.

Life threatening symptoms include (Heat Stroke):

- Sweating stops
- Red, dry skin
- Rapid pulse
- Rapidly rising body temperature of 40.5°C (105°F) or more.

If any of these symptoms are identified, stop work immediately. It is important to note that cooling a victim too fast may create further complications. Seek shaded cooler areas and drink moderate amounts of non-alcoholic/non-caffeine beverages. If serious or life-threatening symptoms are noted, immediately seek emergency medical attention.

**Q32** A portable fire extinguisher doesn’t need to be recharged until it is completely empty.

TRUE _______  FALSE _______
PERSONAL PROTECTION AND FIRST AID

Personal Injury / Burn Prevention

- Do not light cigarettes with a lit torch because serious facial burns could result. Use a cigarette lighter or match designed for this purpose.

- Wear proper clothing, personal protective equipment, and fireproof gloves when torching.

- Do not light torch with cigarette lighters or matches only use spark igniters.

- Never check for gas leaks with cigarette lighters or matches.

- Do not use excessive lengths of propane hose while torching.

- Do not wear work clothing made from synthetic fabrics when torching, especially during winter months.

- Do not wear shorts or sleeveless shirts when torching.

- Never attempt to thaw a propane tank by applying an open flame.

(Answer to Question on Page 65)

A31 AFTER
If the fuel supply is not shut off there is the risk of an explosion.

(Answer to Question on Page 66)

A32 FALSE
A partially filled extinguisher is an EMPTY extinguisher. All portable extinguishers must be fully recharged immediately after use.
Q33 When someone is suffering from heat stroke it is important to cool down his or her body temperature as quickly as possible

TRUE ________  FALSE ________

First Aid for Burns

First Degree

First degree burns are caused by sunburn, scalding or contact with hot objects such as torch heads. The skin will be red. To relieve the pain, apply cool water applications or submerge the burned area in cool water. Do not apply any ointments or fats. Any person with extensive sunburn or any first degree burn should be seen by a doctor.

Second Degree

Second degree burns are caused by very deep sunburn, contact with hot liquids similar to heated modified bitumens, flash burns from gasoline, open flame from torches and many other ways. Pain can be relieved by excluding air from the wound. Three ways to do this are:

1. Submerge in cool water.
2. Apply a cool pack (clean cloths that have been wrung out in cool water).
3. Cover with a wet dressing under plastic. A dry dressing will tend to adhere to the wound.

Do not break blisters. Do not use antiseptic preparations, ointment, spray or home remedies for severe burns. Do not attempt to remove bitumen that is stuck to the skin.

Third Degree

Third degree burns are caused by flame, ignited clothing, contact with hot objects, immersion in scalding water, or by electricity. The skin will appear white or charred. It involves deeper destruction than second degree burns.

Call for an ambulance immediately. Do not remove adhered particles of charred clothing.

Cover the burned area involved. Keep them higher than the heart.

Burned feet or legs should be elevated. The victim should not be allowed to walk. Do not apply any ointment or commercial burn preparations.

Keep persons with facial burns under close observation for breathing.
Do not apply ointment, commercial burn preparations, greases or any home remedy. In case of electrical burns, if the victim is still touching the source of electricity, do not touch his skin when you are pulling him away from that source as you also become a victim. Grab only the clothing or use a non-conductive material such as heavy cloth, wood or plastic. If the victim’s not conscious, check his breathing and heart beat. If necessary, apply artificial respiration (mouth-to-mouth and external cardiac massage at once) (CPR).

Seek medical attention immediately!!

Q34  When someone is burned by hot bitumen the first thing to do is to remove the bitumen from the skin.

TRUE ___________  FALSE ___________

(Assertion to Question on Page 68)

A33  FALSE
Cooling down a victim too fast may create further complications

First Aid for Propane Freezes

Place the victim in a warm area as soon as possible to allow the injured area to warm gradually. If the area warms too rapidly, further damage may result to the tissue.

Gently cover or drape the injured area with a clean dressing (sheet, etc.)

To relieve pain, you can immerse area in water that is neither hot nor cold, but at a neutral temperature (22 to 30°C [72-85°F]).

If possible, have the victim gradually begin to exercise the injured area.

Give the victim warm liquid (non-alcoholic)

Do not expose the injured area to excess heat or cold such as heat lamps, hot water, snow or ice.

Seek immediate medical assistance!
(Answer to Question on Page 69)

A34  **FALSE**
Attempting to remove the bitumen may break the skin and lead to infection

Q35  If someone sustains injury from a propane freeze they should immerse the injured area in very cold, frigid water.

TRUE __________  FALSE __________

**RECAP OF SAFETY PRECAUTIONS**

**Rooftop Awareness with Propane Torches**

**Equipment**

- Dress appropriately – wear CSA approved safety boots, long pants with no cuffs that extend over the tops of boots – gloves, safety glasses or a face shield.
- Propane cylinders must be stored and transported in an upright and secured position at all times.
- Protective collars must be on cylinders at all times.
- Never force brass or bronze fittings because you will probably strip the thread (see operating instructions).
- Always have a soapy-water solution available to check for leaks.
- After changing cylinders or making new hose connections, check all unions for leaks with soapy water.
- Never use a flame to detect possible leaks. Equipment containing burners must never be towed or transported while a burner is in operation.
- Pressure regulators must be removed from all cylinders when not in use.
- Tank valves must be turned on fully when the system is in operation. The only device regulating the flow of gas should be the pressure regulator.
• All valves must be closed when the torch is not in use.

• Never leave gas in the lines – always burn it off.

• Close valves in the following order (see operating instructions).
  1. Shut off container valve.
  2. Shut down the pressure regulator to minimum. Allow the gas to burn off.
  3. Shut off the torch valve.

**Basic Safety Measures**

• Each work area should have a fire extinguisher (one per torch).

• Always check and secure all fittings, hoses and torch heads before and while using torch equipment.

• Do not use torch equipment that is leaking gas.

• Propane tanks should be secured in an upright position and placed at least 3 m (10ft) from the open flame.

• Never leave lighted torch unattended.

• Torches produce temperatures in excess of 1093°C (2000°F). Avoid contact for any length of time with metals, particularly lead, or anything that high heat will adversely affect.

• Do not use open flame directly around open penetrations

• Make sure combustible materials are covered to prevent fires.

• Remove propane bottles from the rooftop at the end of the workday and store in an appropriate location.

• Walk the roof at the end of each day’s work to check for smoldering fires or hot spots. A minimum one (1) hour watch should be performed each day.

• Never bypass triggers or regulators on torching equipment.

• Workmen, other than the torch operator, should be at least one metre (3ft) from open flame.

• Personnel and property safety are considered the responsibility of the torch user. Follow the local and provincial safety codes.

• Torch units should always be carefully set into support leg position with torch heads at an upward angle when not in use. Failure to properly care for a torch when not in use
can result in damage to the torch and can cause a torch to malfunction. Serious damage can result.

- Never turn a torch on a frosted cylinder.

**To Protect Buildings Against Fire**

- Determine if open flame roofing will be used.
- Review safety precautions with building owner.
- Determine construction of roof and wall assemblies. Fire will melt plastics, and may cause organic materials such as wood fiber to smolder.
- Be sure fire extinguishers are available on top of the roof before work commences.
- Shut off any air intake fans in vicinity of roofing work.
- Post fire watch for at least one (1) hour after last torch is shut down.
- When the point of application is not visible or accessible, use the torch and flop method or other means of ensuring fire safety.
MODIFIED BITUMEN MEMBRANE: APPLICATION

Materials Suitable for Torch Welding

All potentially flammable surfaces must be prepared and installed according to the appropriate manufacturer’s directions or specifications.

Polymer Modified Bitumens (MB) consists of polymer-modified asphalts, combined in the factory with carrier-reinforcing sheets. Other modifiers are sometimes used. There are two general types of MB:

1. **SBS – Styrene Butadiene Styrene**
   SBS is usually torched. It may also be applied using hot asphalt. Some SBS may be laid in cold process adhesive. It is usually provided with a factory applied surfacing, such as mineral granules or metal foil.

2. **APP – Atactic Polypropylene**
   It is usually applied by torch welding. Some manufacturers allow cold process adhesives as an alternate method. It is usually provided unsurfaced or surfaced with mineral granules from the factory. Some manufacturers provide rolls with factory applied metal-foiled surfaces.

Types of reinforcements:

1. Fiberglass;
2. Polyester;
3. Or any combination of glass or polyester.

(Assertion 35: FALSE)
To relieve the pain, immerse the injured area in tepid water (22 to 30°C).
Common Configuration

Most systems using modified bitumen membranes consist of two plies – a base sheet and cap sheets.
Application:
Step by Step Set-Up (Refer to manufacturer’s specific instructions)

Caution: Some regulators require assembly. Refer to the manufacturer's instructions for proper regulator assembly procedures or take the regulator to a qualified person equipped with the tools and facilities needed to properly assemble and test the equipment.

Precautions

Be sure to follow the detailed instructions in the Preparation for Application section of this manual.

Pay careful attention to all connections. They may leak, waste gas, or be a constant source of danger.

Cylinder valves must be closed at all times during storage and transportation with protective caps, collars and plastic plugs in place.

Use of the torch stands provided by the manufacturer is recommended to prevent damage to the membrane while the torch is not in use.

ASSEMBLY INSTRUCTIONS FOR ROOFING TORCH SYSTEMS:

1. Inspect all equipment prior to each use for signs of damage, wear or misuse. Do not use if any problem is suspected or discovered.
   
   Note: Damaged equipment should be repaired only by qualified personnel equipped with the tools and facilities to properly assemble and test the equipment. Only if the equipment appears to be in satisfactory working order should torch system assembly proceed.

2. Inspect the cylinder valve for mud or foreign substances. Clean the inside of the valve with a clean rag or soft brush if necessary. Use compressed air to blow any foreign material that may have accumulated in the valve during storage.

3. With the cylinder valve and regulator adjusting screw in a closed position, attach the regulator or CGA-approved regulatory device to a corresponding CGA cylinder valve.
   
   Note: Pertinent CGA valve information must be obtained from the cylinder supplier or refill station prior to assembly. Do not use pliers during assembly. These may damage brass fittings; an open end or adjustable wrench is preferred. Do not force connection between the cylinder valve and regulator inlet. Needing excessive force may indicate damaged threads. If this happens, remove regulator and re-inspect equipment for damage.
   
   Note: Some CGA-approved POL connections may be tightened by hand: follow the manufacturer’s instructions supplied with your equipment.
4. Proceed to attach the hose end connection to the regulator only if the above conditions have been met. Tighten the hose fitting snugly to the regulator outlet with an open-end or adjustable wrench. Some manufacturers may use other types of connections. Always refer to the manufacturer’s instruction supplied with your equipment. Needing excessive force may indicate damage threads. If this happens, discard damaged hose and proceed to assemble with new hose.

5. Open the propane cylinder valve fully with the regulator-adjusting valve in a closed position. Open the regulator adjusting valve just enough to blow out any manufacturer’s talc, spider webs, or foreign matter from the hose. Return the regulator-adjusting valve to the closed position and return the cylinder valve to the closed position.

6. Attach the loose hose end to the roofing torch with the same care reference in Step 4. **Note:** Hose to torch connections may vary from manufacturer. Also, some torch manufacturers require assembly of the torch prior to connecting the hose. Please read the torch manufacturer’s assembly instructions carefully and completely.

7. With the torch valves in a closed position, open the cylinder valve, turn the regulator adjusting screw to the open position and test all connections with a leak detecting solution or soapy water. Try tightening any leaking connections. If any connection continues to leak and can’t be tightened down; close down the system and have the leaking connection repaired.

**Note:** The gas connections in these systems are designed not to leak when tightened properly. Thread sealant of any type should not be used unless specifically noted in the torch manufacturer’s assembly instructions.

**Lighting a Hand Held Torch**

**Caution:** A propane torch flame may be invisible or difficult to see in daylight. Always assume a torch at rest is lit. Avoid walking in front of the torch equipment. The roofing torch should be shut off when not in use for more than 2 minutes.

1. Have work ready before igniting. Have material available and prepared. Use proper clothing. Clear area of unnecessary equipment or debris. An ABC fire extinguisher should be in the area (at least 3m [10 ft.] from work area and cylinder). Other workers must stay back at least one metre (3 ft.). The fuel gas source must be 3 m (10 ft.) away from the flame. Keep the hose untangled so it moved freely. Avoid kinks in the hose.

2. Plan the work so the tank and hose can be moved easily, and kept off the final membrane as much as possible. Do not use the hose to pull the tank

3. Before lighting, complete the connecting and testing procedure. Be sure all valves are closed and the regulator knob is closed. Unscrew the regulator knob upwards until it feels free. Have a spark lighter ready. Be sure it is operational. Check to see if it needs a new flint.

4. If using a single hand torch, hold it in one hand and direct the head of the torch away
from the body, hoses and tank.

5. Open the cylinder valve slowly and fully.

6. Turn the knob on the regulator clockwise. As it tightens, the regulator will open. Open adjusting knob to the proper pressure setting. Open the safety shut-off valve. See manufacturer’s instructions for recommended pressure settings.

7. Open the pilot knob at its lowest setting allowing the smallest amount of gas to escape. In windy conditions, the setting will be higher.

8. Ignite the gas using the spark lighter. Keep the torch pointed away from your body. Adjust the pilot flame so it burns easily. Test by opening and closing the hand lever.

9. Always have the spark lighter near the torch mouth so it can be struck as the pilot knob is opened. Do not depend on hearing the sound of the gas before striking the lighter. Do not use matches or a cigarette lighter.

Q36 Most modified bitumen membrane systems consist of 2 layers.

TRUE _________  FALSE _________

Q37 Name two of the most commonly types of modified membrane used in Canada.

1. ___________________________________
2. ___________________________________

Lighting a Torch Machine

Slowly open the pilot control. Allow a small amount of gas into the system and, using a spark lighter, individually light each torch head.
Auto Ignition Torches

Auto ignition torches may have a piezo igniter to automatically light the flame as the gas is released, and then automatically extinguish when the trigger is released. Hold the torch away from your body and squeeze the igniter slowly. If it malfunctions, do not look into the barrel of the torch.

Hand Torch Application

If the roofer is advancing the roll of roofing material with his foot, he will be behind and facing the roll and pushing the unrolled portion into location when it is properly heated, so as to accomplish heat welding and bonding as specified by the modified bitumen membrane manufacturer.

The roofer may also stand in front of the roll and pull the heated roll toward him with an cane or hook. Extreme caution and a spotter should be used if walking backwards. This method avoids waking on the finished surface while the membrane is still hot, possibly causing damage to the finished surface. The “cane” or “hook” method is generally preferred with SBS membranes which have a lower softening point temperature and also commonly used with granule surfaced APP membranes.

Machine Torch Application

If the roofer is using a machine or pulling the roll of roofing material with a handle device, he will be in front of the roll and pulling the unrolled portion toward himself as he backs up. The modified bitumen must be properly heated to accomplish heat welding and bonding as specified by the manufacturer.

Walking Backwards on the Roof

If the roofer is walking backwards and pulling the roll either with a cane, then a spotter is recommended to warn of any dangers. Use extreme caution when walking backwards on the roof!

Torch and Flop

The torch and flop, or other methods, shall be used for any application that has potential for a smoldering fire. This method of application is particularly important during flashing operations near any combustible cant strips (where used) or other combustible substances.

Torch Welding

The torch-welding procedure is relatively simple if the mechanic/technician is familiar with the torch equipment and follows certain application rules.
Flame Distance

The end of the torch head should be positioned between 15 and 30 cm (6” to 12”) from the surfaces depending on weather conditions. Maximum heat is obtained at the blue end of the flame.

Adjust the torch-welding speed to suit weather conditions. Torching speed will vary with temperature, humidity and wind. Torching speed will be slower in colder weather than warm. The amount of LP gas consumed will also vary with these conditions. Torch speed can also vary during the day depending on outside conditions. For example extended cloudy periods during an otherwise sunny day may require an adjustment to the torching speed.

Apply the heat from the burner head(s) of the torch to the bottom or underside of the roll of modified bitumen. The torch should be held low so that the heat is applied to the portion of the advancing roll that is about to be mated onto the surface. The hand torch burner flame should be moved back and forth across the full face width of the roll evenly until the material is softened; this is indicated when the film develops a glossy sheen. At the ends of the roll, twist the torch slightly to keep the flame pointed towards the center of the roll.

Heat Direction
The heat from the burner head(s) should be directed at the face of the roll. Some of the heat will curl up toward the top of the roll, and some will curl down onto the base below to soften the base material. Never point the flame (torch head) upside down between the roll and the mating surface. This may entrap air causing blisters and ridges to form.

**Advance Roll Into Location**

As the modified bitumen begins to soften, continuously advance the roll so the next portion of material, which will then become adjacent to the roof deck, can be heated in a like manner.

**Bitumen Flow**

As the full width of softened material is advanced to make full roll contact with the underlying material below, a flow of hot bitumen should extend beyond and be visible at the edge of the membrane, as well as in front of the roll. The visual control just described allows the roofer to know that full contact of heated material and the base or substrate is occurring.

**Lapping**

Adjacent rolls are overlapped onto the previously installed sheet so that the sheets are shingle lapped. Follow the modified bitumen manufacturer’s requirements for the overlap width that is identified by either a factory applied ply line(s) or a granule free (selvedge) edge.

The laps are generally completed at the same time as the sheets are applied to the surface. A small amount of bitumen flow or “bleed out” is an indicator that the overlap is being fused together properly. Follow the modified bitumen manufacturer’s requirements for the correct amount of bleed out. Some modified bitumen manufacturers also require some type of weight or pressure to be applied over the finished lap. Pulling a 9 kg. (20 lb.) steel roller approximately 1.5 m (6 ft) behind the torch, or firm hand pressure with a moistened mason’s sponge float are two of the common methods.

When there is only a small amount of open area, a heated trowel may be inserted into the open area to heat both bitumen surfaced while firm hand pressure is applied with a moistened mason’s sponge float. A small bleed-out of bitumen indicates that the area has been resealed properly. Larger open areas may be resealed by directing the heat from a small detail torch.
into the open area and then applying pressure to the top surface to squeeze a small amount of the softened bitumen.

A36  TRUE

A37  SBS and APP

**Flashing**

After the roofing membrane has been applied in the flat or semi-flat areas of the roof and turned up at walls or projections, a separate base flashing ply (or plies) should be installed. This flashing should extend down the vertical wall (or surface) and out horizontally onto the roof membrane a minimum 100 mm (4 in.). This separate flashing system should be installed so as to provide termination and sealing.

Heating of the underside of the flashing ply should be accomplished by directing the torch heat only at the modified bitumen that will come in contact with the wall. Generally, this heating is done by laying a short length of the modified bitumen flashing sheet flat on the roof and adjacent to the location where it is to be installed.

Heat only the side that is to be installed and turn the hot softened side inward against the wall (torch and flop). Firmly press the flashing sheet into place and apply pressure to help assure bonding. The vertical flashing laps and horizontal laps on the field should be bonded and properly sealed by using a round tipped trowel as described for field laps.

**Maintenance**

All roofing torch equipment shall be maintained in safe condition as recommended by the manufacturer. Inspect your equipment daily before using. Tag and report to the supervisor any defective equipment or safety hazard. Discontinue use until the equipment’s safety has been assured.
Torch System Disassembly – Precautions

Always disconnect the torch system from the fuel gas source (cylinder) when being moved from the job site or put into overnight storage.

Proper care should be given to the torch system and its components when not in use. The system and cylinders should be locked away in suitable containment to prevent damage and theft.

Always inspect the equipment for damage and wear before storing and replace any piece that shows damage or excessive wear.

Procedures

1. Turn the cylinder valve to the closed position and burn off the pressurized gas from the hose by opening the valves on the handle.

2. Return the regulator to a closed position and disconnect the regulator from the cylinder valve. **Note:** It is possible for a small amount of fuel gas to remain in the hose unless the regulator or torch valve is briefly opened after being disconnected from the fuel source.

3. The torch system should be completely dismantled into its separate components for long term storage. For short term storage, the hose, torch and regulator may be left assembled after all the fuel gas has been drained from the system. **Note:** After fuel gas is drained, refer to the equipment manufacturer’s instructions to dismantle the torch system.

<table>
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<th>Q38</th>
<th>Auto ignition torches automatically extinguish when the trigger is released.</th>
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<td>TRUE ___________       FALSE ___________</td>
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<th>Q39</th>
<th>THE torch and flop method should be used whenever there is a danger of a smoldering fire.</th>
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<td>TRUE ___________       FALSE ___________</td>
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Q40 List the three (3) main steps in shutting down a torch

1. ____________________________

2. ____________________________

3. ____________________________
GENERAL

Torching safety is the responsibility of each roof mechanic/technician involved in the application of torch applied modified bitumen. The roofing contractor should appoint a foreman or supervisor to oversee the overall job involving torch applied modified bitumen. A supervisor should be present any time work is being done.

The roofing contractor must ensure that each mechanic/technician involved in the application of torch applied modified bitumen has been properly trained. The issuance of the National Torch Safety card shall be evidence of proper training. The roofing contractor shall maintain a copy of each mechanic’s National Torch Safety card.

Safety

All available safety devices shall be employed and maintained in working order. No job shall be undertaken without prior planning for the safety of the crew, building and general public.

Everyone should have an interest in torch welding safety. An accident can mean severe property damage, harm your credibility as a roofer, or worse, cause loss of life.

(Answer to Question on Page 82)

A38 TRUE

(Answer to Question on Page 82)

A39 TRUE

(Answer to question on Page 83)

A40 The 3 main steps to shutting down a torch are:

1. Shut off the container valve.
2. Shut down the pressure regulator and let the gas burn off.
3. Shut off the torch valve.