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Fire Protection and Prevention

The Occupational Safety and Health Administration (OSHA) requires employers to implement fire protection and prevention programs in the workplace. The regulations that apply to fire protection and prevention can be found mainly in Subpart F of the construction standards, though the requirement for a fire prevention program is first set out in Subpart C. The following sections of the construction standards contain requirements for fire protection that are of significance to roofing contractors:

- 1926.24 Subpart C, Fire protection and prevention programs*
- 1926.150 Fire protection*
- 1926.151 Fire prevention*
- 1926.152 Flammable and combustible liquids*
- 1926.153 Liquefied petroleum gas (LP-Gas)*
- 1926.154 Temporary heating devices*
- 1926.155 Definitions*
- 1926.550 Subpart N, Cranes and derricks*

Following this chapter, there is a list of fire safety work practices addressing many fire hazards found in the roofing workplace, including field operations and shop activities. Contractors should review the elements of the list most applicable to their companies' operations and consider including them in their companies' health and safety program.

Fire Protection

Fire is a chemical reaction that requires three elements to be present for the reaction to take place and continue. The three elements are:

- *Heat, or an ignition source*
- *Fuel*
- *Oxygen*

These three elements typically are referred to as the "fire triangle." Fire is the result of the reaction between the fuel and oxygen in the air. Scientists developed the concept of a fire triangle to aid in understanding of the cause of fires and how they can be prevented and extinguished. Heat, fuel and oxygen must combine in a precise way for a fire to start and continue to burn. If one element of the fire triangle is not present or removed, fire will not start or, if already burning, will extinguish.

Ignition sources can include any material, equipment or operation that emits a spark or flame—including obvious items, such as torches, as well as less obvious items, such as static electricity and grinding operations. Equipment

or components that radiate heat, such as kettles, catalytic converters and mufflers, also can be ignition sources.

Fuel sources include combustible materials, such as wood, paper, trash and clothing; flammable liquids, such as gasoline or solvents; and flammable gases, such as propane or natural gas.

Oxygen in the fire triangle comes from the air in the atmosphere. Air contains approximately 79 percent nitrogen and 21 percent oxygen. OSHA describes a hazardous atmosphere as one which is oxygen-deficient because it has less than 19.5 percent oxygen, or oxygen enriched because it has greater than 23.5 percent oxygen. Either instance is regarded by OSHA as an atmosphere immediately dangerous to life and health (IDLH) for reasons unrelated to the presence of fire. Depending on the type of fuel involved, fires can occur with much lower volume of oxygen present than needed to support human respiration.

Every roofing project has all three of the fire triangle elements present in abundance. The key to preventing fires is to keep heat and ignition sources away from materials, equipment and structures that could act as fuel to complete the fire triangle.

Fire Classifications

Fires are classified as A, B, C, D or K based on the type of substance that is the fuel for the fire, as follows:

Class A—fires involving ordinary combustibles, such as paper, trash, some plastics, wood and cloth. A rule of thumb is if it leaves an ash behind, it is a Class A fire.

Class B—fires involving flammable gases or liquids, such as propane, oil and gasoline

Class C—fires involving energized electrical components

Class D—fires involving metal. A rule of thumb is if the name of the metal ends with the letters “um,” it is a Class D fire. Examples of this are aluminum, magnesium, beryllium and sodium. Class D fires rarely occur in the roofing industry.

Class K—fires involving vegetable or animal cooking oils or fats; common in commercial cooking operations using deep fat fryers

Fire Extinguishers

There are different types of fire extinguishers designed to put out the different classes of fire. Selecting the appropriate fire extinguisher is an

important consideration for a roofing contractor. The wrong extinguisher actually may make a fire emergency worse. For example, failing to use a C-rated extinguisher on energized electrical components may endanger workers by causing the extinguishing material to be electrified by the energized components that are on fire. C-rated fire extinguishers put out the fire by using a chemical that does not conduct electricity.

The following table illustrates the types of extinguishers, fire classes for which each is used and the limitations of each extinguisher.

<i>Fire Extinguisher Type</i>	<i>Class of Fire it Extinguishes</i>	<i>Extinguisher Limitations/ Comments</i>
<i>Dry Chemical (multipurpose)</i>	<i>A, B, C</i>	<i>Generally good for use in roofing industry</i>
<i>Foam—alcohol-resistant B and aqueous film-forming foam (AFFF) types</i>		<i>Expensive; effective on Class B only; limited shelf life; generally not needed in roofing industry</i>
<i>Water</i>	<i>A</i>	<i>Good only for Class A fires</i>
<i>Metal X</i>	<i>D</i>	<i>Expensive; must be kept dry; ineffective on A, B, C;</i>
<i>Carbon Dioxide</i>	<i>B, C</i>	<i>If used in confined areas, will create oxygen deficiency; not effective in windy conditions; can cause frostbite during discharge; typically not used in roofing industry</i>
<i>Halon</i>	<i>B, C</i>	<i>Expensive; not effective in windy conditions; toxic gases may be released in extremely hot fires because of decomposition; generally not used in roofing industry</i>
<i>Potassium Acetate</i>	<i>K</i>	<i>Expensive, wet chemical extinguisher for commercial cooking operations using oils and fats</i>

Roofing contractors typically purchase dry-chemical fire extinguishers because they can extinguish three fire classes (A, B and C).

OSHA requires a minimum-rated 10B fire extinguisher be provided within 50 feet of the point of job site use of more than 5 gallons of flammable or combustible liquids or 5 pounds of flammable gas. Examples of flammable and combustible liquids include gasoline, kerosene, acetone, MEK, single-ply adhesives, splice cleaners and asphalt cutback products. Fire extinguishers must be rated by a nationally recognized testing laboratory.

Extinguishers also must be inspected on a regular basis and maintained fully charged.

Using Fire Extinguishers

When using fire extinguishers, employees should employ the “PASS” system of early-stage firefighting.

P—Pull the pin on the extinguisher

A—Aim at the base of the fire

S—Squeeze the handle

S—Sweep at the fire, moving from side to side

Employees should be instructed that if a fire cannot be extinguished using one full extinguisher, they should evacuate the site and let the fire department handle the situation.

Fire Prevention

Fire prevention requires segregating the three elements of the fire triangle. In practice, a method to achieve that goal is to post—and enforce—no-smoking signs around flammable liquids and gases and have fire watches on all work involving torch-applied materials of a minimum of two hours after the last torch is turned off.

Flammable and Combustible Liquids

Proper storage and handling of flammable and combustible liquids will help prevent fires from occurring; only approved, closed containers for storage of flammable or combustible liquids may be used under OSHA rules. Such containers include safety cans or containers approved by the U.S. Department of Transportation. A safety can is a container that has a self-closing lid, internal-pressure relief and flame arrestor with a capacity of not more than 5 gallons. Inexpensive, plastic cans without those features previously mentioned, such as those typically bought at hardware stores or gas stations, are not approved for use in roofing operations. However, manufacturers do sell plastic containers that meet the OSHA requirements for safety cans.

Flammable liquids that are extremely viscous, or difficult to pour, like single-ply adhesive, can be left in their original shipping containers. Similarly, OSHA allows the use of original containers of flammable liquids that are in quantities of one gallon or less.

Static electricity may be generated when transferring liquids, gases or solids through pipes or hoses. It is important to dissipate this electric charge when handling flammable and combustible materials. When transferring flammable or combustible liquids from one container to another, the two containers must be “bonded” together. The bonding process involves attaching a wire with alligator clips on each end to both containers. The clips must penetrate

the container coating and touch metal. You may need to score the paint with the alligator clips. To dissipate static, the container receiving the liquid must be in contact with the ground and not insulated from contact with the ground. For example, plastic or composite pickup truck bed liners prevent the flow of static electricity to ground because the liner does not conduct electricity. The receptacle container must have a clear path to ground, by direct contact or use of a grounding strap or wire, to effectively eliminate static.

Service or fueling areas at job sites must have a 20BC-rated fire extinguisher within 75 feet of each pump.

Safety cabinets allow for greater quantities of flammable and combustible liquids to be stored safely inside buildings. Up to 60 gallons of a flammable liquid or as much as 120 gallons of a combustible liquid may be stored indoors in a safety cabinet. Each cabinet must be labeled “Flammable—Keep Fire Away.” Up to three cabinets may be stored in one room. Without a safety cabinet, only 25 gallons of either flammable or combustible liquids are allowed to be stored inside a building.

Liquefied Petroleum Gas

Liquefied petroleum gas (LP gas) is used widely in the roofing industry to heat kettles and torches. Because LP gas is a compressed gas, fairly large quantities can be stored in relatively small containers. As a point of reference, LP gas expands at a ratio of 270-to-1. This means that one liquid drop of LP gas would expand to a gas state 270 times greater in volume.

LP gas collects in low-lying areas because its vapor density is heavier than air. Employees should be warned that if they suspect a leak in a cylinder, they must not use fire to attempt to find the hole. Instead, they are to use soapy water and look for bubbles.

Employees should not attempt to extinguish fires involving LP gas. If an LP gas fire breaks out, employees should evacuate the area immediately and call the fire department. Fighting an LP gas fire requires specialized training that only the fire department can provide. Employee attempts to extinguish the fire could create larger hazards.

Torch-applied Roofing Materials

Torch-applied roofing materials pose a serious fire hazard to roofing contractors and building owners. Sometimes the hazards are obvious—such as torching to a combustible deck or near flammable liquids, while other concerns are less obvious—such as torching around drains or penetrations where flames can be drawn into a building.

Roofing contractors must instruct employees that they must:

- *Never torch directly to combustible decks or materials*
- *Never torch to areas that cannot be seen fully*
- *Not use torches near vents or air intakes*
- *Never use a torch to heat a propane tank that begins to frost on the outside*
- *Have appropriate fire extinguishers within easy reach at all times*

Whenever working with torch-applied roofing materials, fire-watch inspections must be conducted for at least two hours after the work has been completed and the last torch has been turned off.

More information on torch safety can be found in NRCA/MRCA Certified Roofing Torch Applicator Program at NRCA's Web site, www.nrca.net.

Fire Alarm Devices

OSHA requires an alarm system be established by an employer to alert workers on the job site and local fire departments of fire emergencies. Job-site telephones and employee entrances must have alarm codes and reporting instructions at employee entrances.

A roofing contractor's emergency action plan for the job site must include:

- *Emergency escape procedures*
- *Equipment operation procedures prior to evacuation*
- *Procedures to account for all employees*
- *Rescue and medical duties for those employees responsible for such duties*
- *Preferred means of reporting emergencies*
- *Names and titles of employees with duties under the plan*

Employee Training

OSHA requires that all employees be trained to use fire extinguishers. Training is required upon employment and at least annually thereafter. It is recommended the training session cover how to determine when a fire is too big to handle; what type of extinguisher to use; and the PASS system of early-stage firefighting. It also is recommended that live fire training be conducted periodically (this level of training is not needed each year). Live training exposes employees to the pressure released from a fire extinguisher when the handle is squeezed and provides hands-on practice extinguishing a fire. Some local fire departments and most fire extinguisher suppliers offer this type of training.

All company fire-prevention training sessions should be documented. If an outside organization conducts the training, it would be a good idea to obtain training certificates for the attendees.

List of Safe Work Practices

Fire Protection and Prevention Safe Work Practices

[Company name] will take all necessary steps to prevent fires. Inspections during various operations will be made to ensure fire-prevention objectives are being met. The steps are listed below.

Reporting and Extinguishing a Fire

- The fire department and area supervisor will be notified when a fire is spotted.*
- All workers will be alerted and evacuated as needed.*
- The PASS method will be used to extinguish the fire by those employees who have been properly trained.*
- The area will be evacuated immediately if the fire is large.*

Fire Protection

- Before each project begins, the project manager or designee will contact the local fire department and determine whether any variations from the company's standard fire-prevention procedures are required.*
- No-smoking signs will be posted in all regulated areas.*
- Only approved containers will be used to store flammable or combustible materials.*
- All containers will be bonded together and grounded when transferring flammable or combustible liquids.*
- All work areas will be kept free of debris and other combustible materials.*

- *Inside company-owned or leased buildings, fire extinguishers will be spaced no more than 100 feet apart and will have no less than a 2A rating for every 3,000 feet of protected building.*
- *All employees will be trained on the use of fire extinguishers initially upon hire and annually thereafter.*
- *No employee will be permitted to use an extinguisher without having been fully trained.*
- *Fire extinguishers will be stored at a distance no greater than 10 feet from torch users.*
- *A fire extinguisher, rated not less than 10B, will be provided within 50 feet of the location where more than 5 gallons of flammable or combustible liquids or 5 pounds of a flammable gas are used on a job site.*
- *Mops will be “spun out” and placed on a noncombustible surface at the end of each day on projects involving hot bitumen.*
- *A fire watch will be posted for two hours after work has concluded for torch-applied roof systems.*

Flammable and Combustible Liquid Storage

- *No more than 25 gallons of flammable and combustible liquids will be stored outside approved safety cabinets in indoor locations.*
- *No more than 60 gallons of flammable liquids will be stored inside an approved safety cabinet in indoor locations.*
- *Combustible liquids will not exceed 120-gallon capacity inside approved safety cabinets.*
- *The number of approved safety cabinets in one room will not exceed three.*
- *Gasoline will not be used as a solvent for cleaning.*
- *All containers will be labeled in accordance with OSHA’s Hazard Communication Standard.*
- *Buildings or structures containing flammable liquids or gases must be constructed of fire-resistant material.*

- *Flammable liquids or gases will be kept away from heat and ignition sources including welding work or any other operation involving flames or sparks.*

Handling Flammable Gases

- *LPG cylinders will be placed on a firm foundation and secured in an upright position.*
- *All LPG cylinders will be equipped with valve-protection devices.*
- *LPG cylinders will not be stored closer than 10 feet to the kettle.*
- *LPG cylinders will be placed away from vehicular traffic.*
- *LPG cylinders will not be stored inside buildings.*
- *Acetylene bottles will be stored in the upright position and secured.*
- *When in transport or not in use, acetylene bottles will have caps in place.*
- *Oxygen cylinders must be stored at least 20 feet from acetylene cylinders.*

Handling Flammable and Combustible Liquids

- *During refueling operations, all engines and motors will be turned off and allowed to cool.*
- *Open flames or other ignition sources must be kept at least 50 feet away from flammable or combustible liquids.*
- *No smoking will be permitted during the fueling process.*
- *Containers being filled will be placed directly on the ground or a grounding strap attached to form a connection to ground.*
- *No flammable liquid or gas will be used unless it has been positively identified beforehand.*
- *Health and physical hazards will be communicated to employees in accordance with OSHA's Hazard Communication Standard before the product is used.*
- *When flammable liquids and gases are being transported, all Department of Transportation rules will be followed.*

Fire Extinguishers

- *In buildings, all fire extinguishers will be mounted on a wall and properly marked.*
- *All vehicles will carry at least one ABC-rated extinguisher.*
- *When at a job site, all employees will know the location of each fire extinguisher.*
- *Before using an extinguisher, all employees will be trained and familiar with the PASS method of firefighting.*
- *Each fire extinguisher will be inspected monthly to make sure it is in its designated location and has not been tampered with or actuated.*
- *Each fire extinguisher will be clearly visible with nothing obstructing or obscuring it from view.*

All fire extinguishers will be examined at least yearly and/or recharged or repaired to ensure operability and safety. A tag must be attached to show the maintenance or recharge date and the signature or initials of the person performing the service.