

	PRINCETON PLASMA PHYSICS LABORATORY ES&H DIRECTIVES	
	<b>ES&amp;HD 5008 SECTION 5, CHAPTER 7</b> Fire Prevention Practices	
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## CHAPTER 7, FIRE PREVENTION PRACTICES

Deviation from the Fire Protection Practices detailed below will require the written approval of the Fire Protection engineer and the applicable Department Head.

### 7.1 EQUIPMENT PROCUREMENT APPROVAL

7.1.1 All equipment procured for fire protection application shall be tested or approved for its intended use by a nationally recognized laboratory. The M&O FPE shall approve all purchase requisitions for fire protection equipment, except exact replacement items.

### 7.2 Fire Watch Requirements

7.2.1. Fire watches for hot work (welding, cutting, grinding, or open flame activity) shall be performed per paragraph 7.4, "Cutting, Welding, Grinding and Open Flame Work".

7.2.2 When automatic fire suppression or alarm systems are installed but are out of service, and the affected area is unattended, management shall ensure that a fire watch is initiated. The frequency of tours will depend on the value and programmatic importance of the area, the availability of additional automatic systems to provide detection or suppression and the probability of ignition. The frequency will be established by the Fire Protection Engineer in consultation with Site Protection. Typically, fire watch frequency will be:

- A. Continuous for permitted open flame work per paragraph 7.4.
- B. Continuous for very important areas with no automatic detection or suppression.
- C. Continuous when an alarm or sprinkler system required for life safety is out of service for more than 4 hours and the building continues to be occupied.
- D. Once every two hours for areas other than in a) above which have no automatic alarm capability.

7.2.3. The fire watch shall:

- A. Understand the specific nature of the impairment and the area affected.
- B. Be a roving watch and cover all areas affected by the impairment.
- C. Understand the appropriate emergency actions such as: sounding an alarm, manually tripping suppression systems and using portable extinguishers, as appropriate.

- D. Have been instructed in the frequency of the fire watch tours.
- E. Have received portable fire extinguisher training (including actual fire extinguishment).
- F. Maintain a record of fire watch service completed.

### **7.3 Portable Space Heaters**

- A. Portable space heaters shall be used in a safe manner.
- B. Management shall ensure that:
  - 1. Electrical circuits are not overloaded by portable heaters.
  - 2. Manufacturer's recommendations are observed for the following.
    - a) Adequate clearance to combustible furnishings, surfaces, or materials.
    - b) Adequate ventilation for fuel fired heaters to prevent products of combustion buildup and to maintain stable flame quality.
  - 3. Heaters are Underwriters Laboratories (UL) listed or American Gas Association (AGA) certified.
  - 4. Fuel for heaters is stored and handled in accordance with the requirements of Section 5, Chapter 7, Paragraph 7.6, "Flammable and Combustible Liquids."
  - 5. Fuel fired heaters are located outside and heat is ducted indoors, unless otherwise approved by the M&O FPE.
  - 6. Indoor use of liquid petroleum gas fired heaters is temporary and only under the following conditions:
    - a) In buildings under construction or undergoing repairs or modifications.
    - b) As temporary heat in noncombustible industrial occupancies.
    - c) In other buildings for temporary emergency heating purposes as necessary to prevent damage to the building or contents, and a fire watch is provided.
  - 7. Portable electric heaters are equipped with tip-over protection, which automatically shuts off the unit when the unit is tipped from its upright position.

## 7.4 Hot Work (Cutting, Welding, Grinding and Open Flame Work)

THIS PARAGRAPH ADDRESSES ONLY FIRE PROTECTION CONCERNS. OTHER SAFETY AND HYGIENE ISSUES RELATED TO HOT WORK ARE COVERED IN SECTION 9, CHAPTER 15.

### 7.4.1 Definitions

- A. Designated Hot Work Area – Locations specifically approved for Hot Work where no Hot Work Permit or Fire Watch is required. Approval for such areas is the joint responsibility of the M&O Fire Protection Engineer, Site Protection and the manager of the area being designated.
- B. Hot Work – Work involving burning, welding, cutting, grinding, soldering or similar operations that is capable of initiating fires or explosions.
- C. Hot Work Fire Watch – An individual designated on a hot work permit who is responsible for fire safety during the permitted work. As a minimum, the fire watch must be trained in proper use of fire extinguishers.
- D. Hot Work Permit - A written permit, issued by ESU, which must be obtained prior to conducting hot work outside of a designated hot work area.

7.4.2 Cutting and welding with electric arcs, oxygen-fuel gas flames and other forms of hot work such as open flames, grinding, or brazing activities shall be conducted in a safe manner.

7.4.3 Hot work shall comply with NFPA 51B, "Fire Prevention in Use of Cutting and Welding Processes," and the applicable Compressed Gas Association publications.

7.4.4 Management and craft supervisors shall ensure that:

- A. Cutting and welding are done by authorized personnel in designated cutting and welding areas (shops), to the greatest extent practical.
- B. Torches, regulators, pressure-reducing valves, and manifolds are Underwriters Laboratory listed or Factory Mutual approved.
- C. Oxygen-fuel gas systems (e.g., oxygen/acetylene welders) are equipped with listed and/or approved backflow valves and pressure-relief devices.
- D. Personal protective equipment does not create a fire hazard. In the event that combustible clothing must be worn for radiation contamination control, continuous observation by a fire watch with suitable fire extinguishing equipment will be required. Refer to Section 9 which is the primary source for personal protective equipment requirements.
- E. Confined spaces such as tanks are tested to ensure that the atmosphere is not in excess of 10% of the lower flammable limit prior to cutting or welding in or on the tank. Tests are repeated as conditions warrant, once each shift as a minimum. Mechanical ventilation is continuous when cutting or

welding in or on a confined space. Refer to Section 8, Chapter 5 of this HSD which is the primary source of requirements for confined space operations.

- F. When cutting or welding must be done on small tanks, piping, or containers that cannot be entered, they are cleaned, purged, and tested prior to starting the work. For work on combustible liquid or gas piping or tanks, intermittent testing is done during the work and a Job Hazard Analysis is provided.
- G. The long-term use of oxygen/acetylene welding carts should be done judiciously. If welding carts are not being used for more than 24 hours the oxygen and acetylene cylinders are to be removed from the cart and properly segregated and stored.

**7.4.5 Hot Work Outside Designated Areas** - When cutting and welding are done outside of designated areas, the following actions are performed:

- A. A Hot Work Permit (issued and tracked by ESU) is obtained. Normally permits are issued for a maximum of one day; however, longer durations may be approved by the manager of Site Protection when that can be done without compromising fire safety.
- B. A continuous fire watch is maintained by designated, qualified and instructed employees. The fire watch responsibilities are listed in paragraph 7.4.6 below.
- C. A member of supervision (i.e., craft supervisor) inspects the job site at least once before the start of each job and at least once every 24 hours until the completion of the job.
- D. A craft supervisor determines the best locations for the fire watch and verifies that automatic fire protection is in service, that precautions taken are adequate, and that information on the Permit is correct.
- E. Combustible materials, equipment, or building surfaces within 20 feet of the work or below the work must be either covered with fire-resistant welding blankets, moved, or wetted down. Openings in ducts, tanks, or other confined spaces within 20 feet of the work are also covered or plugged. Fire-resistant welding blankets are used for electric arc operations instead of wetting the work down.
- F. In areas protected by preaction sprinkler systems, the automatic charging of the system will be disabled when considered appropriate by the permitting ESU officer. In this case the following additional steps must be taken:
  - 1. The permitting officer will instruct the fire watch in the location and operation of the control that manually initiates charging of the sprinkler pipes.
  - 2. The permitting officer will instruct the fire watch to operate that control any time a fire is observed or whenever instructed by ESU to do so.

#### 7.4.6 Fire Watch Responsibilities

Fire watches are responsible for:

- A. Understanding the inherent hazards of the work site and of the hot work.
- B. Ensuring that safe work conditions are maintained during hot work operations.
- C. Stopping work if unsafe conditions develop.
- D. Having fire-extinguishing equipment readily available and being trained in its use.
- E. Being familiar with the facilities and procedures for sounding an alarm in the event of a fire. If the hot work area is protected by a preaction sprinkler system then the fire watch must also know how to manually charge the sprinkler pipes.
- F. Watching for fires in all exposed areas, sounding the alarm if one occurs, and extinguishing it only when the fire is obviously within the capacity of the equipment available.
- G. Manually charging the preaction sprinkler system in the event of a fire or if instructed to do so by ESU.
- H. Not performing any tasks that could distract him or her from the fire watch responsibilities.
- I. Remaining for at least one-half hour after completion of the hot work in order to detect and extinguish smoldering fires.

#### 7.4.7 ESU Permit-Issuing Responsibilities

When issuing hot work permits ESU is responsible for:

- A. Inspecting the area where Hot Work is to be performed to ensure that flammable or combustible materials, hazardous processes or other potential fire hazards are not present.
- B. Verifying the qualifications of the welders and fire watches prior to issuing a Hot Work Permit to ensure that proper training has been completed.
- C. Ensuring that the proper fire extinguishing equipment is present in the area.
- D. Ensuring that a fire watch is posted where needed, including on the opposite sides of walls, partitions, ceilings, or roofs as appropriate.
- E. Reviewing the emergency notification process with the Fire Watch.
- F. Reviewing how and when to manually charge the preaction sprinkler system, if applicable.
- G. Issuing a Hot Work Permit to allow for work to begin.

- H. Impairing fire systems (typically bells and preaction sprinklers) when appropriate.
- I. Logging and following up on impairments in accordance with ENG-026.

#### 7.4.8 **Prohibitions** - Hot work is prohibited in the following situations.

- A. In sprinklered areas while sprinkler protection is out-of- service unless reviewed and approved by the Fire Protection Engineer. For the purpose of this paragraph, “out of service” means that the system is not functional and cannot be quickly restored to a functional state. It is not intended to pertain to inhibiting the automatic operation of preaction systems as covered elsewhere in this chapter.
- B. In explosive atmospheres of gases, vapors, or dusts or where explosive atmospheres could develop from residues or accumulations in confined spaces. (see Section 8, Industrial Hygiene for additional information on confined spaces.)
- C. On metal walls, ceilings, or roofs built of combustible sandwich-type panel construction or having combustible covering.

### 7.5 **Maintenance for Ventilation, Exhaust & Blower Systems**

7.5.1 Ventilation, exhaust & blower systems shall be maintained in a safe manner.

7.5.2 Ventilation, exhaust & blower systems consist of ventilation systems (including intake and exhaust openings, plenums, etc.) for change-rooms, exhaust and blower systems in laboratories, paint booths, metal and woodworking areas, and other similar areas where flammable/combustible vapors, residues, lint, and/or fibers may accumulate.

7.5.3 Management shall ensure that:

- A. Compliance with the applicable sections of the following NFPA Standards is met:
  - 1. NFPA 90A, “Installation of Air Conditioning and Ventilating Systems”
  - 2. NFPA 90B, “Installation of Warm Air Heating and Air Conditioning Systems”
  - 3. NFPA 91, “Installation of Blower and Exhaust Systems for Dust, Stock and Vapor Removal or Conveying”
  - 4. NFPA 96, “Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment”

NOTE: Ducts with known radiological contamination are excluded from this standard, except where the potential fire hazard is severe. Fire Protection requirements for HEPA filtration systems are provided in the “Fire Protection Criteria for Containment Ventilation Filter Plenum Systems” located in the DOE Fire Protection Resource Manual.

- B. All building ventilation, exhaust, and blower systems where flammable/combustible vapors, residues, lint, and/or fibers accumulate are identified and documented.
- C. All systems identified in item 2, are included in a minimum, annual preventive maintenance (PM) program. The frequency must be increased when conditions warrant.
- D. The PM includes an inspection of all components of the systems and is documented for auditing purposes.
- E. The PM includes but is not limited to cleaning grill plates, replacing filter media if design permits, and removing any buildup of foreign material from the duct interior if conditions warrant.
- F. A list of all systems, identified in item 2, above, is forwarded to Fire Protection.

## 7.6 Flammable & Combustible Liquids

7.6.1 The use, storage, and handling of flammable/combustible liquids shall be accomplished in a safe manner.

7.6.2 Flammable/combustible liquids are classified as follows.

- A. Flammable Liquid. A liquid having a flash point below 100°F (37.8°C) is known as Class I liquid.

Class I liquids are subdivided as follows.

- 1. Class IA liquids include those having flash points below 73°F (22.8°C) and having a boiling point below 100°F (37.8°C).
- 2. Class IB liquids include those having flash points below 73°F (22.8°C) and having a boiling point at or above 100°F (37.8°C).
- 3. Class IC liquids include those having flash points at or above 73°F (22.8°C) but below 100°F (37.8°C).

- B. Combustible Liquid. A liquid having a flash point at or above 100°F (37.8°C).

Combustible liquids are subdivided as follows.

- 1. Class II liquids include those having flash points at or above 100°F (37.8°C) and below 140°F (60°C).
- 2. Class IIIA liquids include those having flash points at or above 140°F (60°C) and below 200°F (93°C).
- 3. Class IIIB liquids include those having flash points at or above 200°F (93°C).

7.6.3 Management shall ensure that:

A. The requirements of the following are met:

1. NFPA 30, "Flammable and Combustible Liquids Code,"
2. NFPA 45, "Fire Protection for Laboratories Using Chemicals,"
3. NFPA 395, "Storage of Flammable and Combustible Liquids on Farms and Isolated Sites."
4. Occupational Safety and Health Administration (OSHA), 29 CFR 1910.106, "Flammable and Combustible Liquids"

B. The following general requirements are met:

1. Whenever possible, an environmentally benign, non-flammable liquid is substituted for a flammable liquid.
2. Minimum quantities are in the workplace. No more than a weeks supply.
3. Users of flammable/combustible liquids are familiar with the hazard classification of the material they are using.
4. Proper ventilation is in place before using flammable liquids.
5. Sources of ignition (sparks, open flame, hot surfaces, etc.) have been eliminated. Since flammable liquid fumes are heavier than air, they may "travel" to ignition sources.
6. Combustible waste and residue is stored in a listed, closed, metal, waste container, and is disposed of daily into a satellite accumulation area.
7. Unneeded and waste flammable liquids are turned over to the Materiel & Environmental Services (MES) Division for disposal.
8. Gasoline shall be stored in approved containers (less than two gallons) and in areas approved by the M&O FPE.

C. Containers, for the handling and use of flammable materials in the workplace, are limited to:

1. End -use containers that are no larger than the a single day's supply or one gallon for Class IA liquids or 5 gallons for other liquids, whichever is smaller, and
2. Containers listed by Underwriters Laboratory, Factory Mutual, or another nationally recognized testing laboratory, except as noted in paragraph 3 below.
3. Squeeze bottles\* not exceeding one liter are allowed for application but not for storage.

\* Squeeze bottles are not recommended for flammable liquids and shall only be used in those cases where the work cannot be accomplished using listed containers.

D. The following storage requirements are met:

1. Not more than one gallon of Class IA liquids or 5 gallons of other flammable or combustible liquids may be stored in a single fire zone outside of an approved flammable liquid storage cabinet, and
2. Storage in flammable liquid storage cabinets is limited to not more than 120 gallons of Class I, II, and IIIA liquids. Of this total, not more than 60 gallons may be of Class I and II liquids, and
3. When flammable liquid storage cabinets are used, not more than three cabinets may be stored in a single fire zone (6 cabinets for fully sprinklered buildings). In industrial facilities, additional cabinets (limited to a maximum group of three) may be stored in the same fire area, provided the groups of cabinets are separated by 100 feet, and
4. When flammable liquid storage cabinets are used, the vent openings are sealed with properly fitted metal bungs; or when the cabinets are required to be vented, they must be vented to the outside, and
5. When storage quantities exceed that permitted in a) or b), the liquids are stored in rooms or facilities complying with NFPA 30, and OSHA, 29 CFR 1910.106, and
6. All flammable/combustible liquids (except Class IIIB) in nuclear facilities shall be stored in approved flammable liquid storage cabinets or rooms/buildings complying with NFPA 30 and 29 CFR 1910.106 (This requirement does not apply to laboratories), and
7. Class IA and IB liquids may be stored in glass containers of not more than 1 gallon, if required for liquid purity or to avoid excessive corrosion of metal containers, and
8. The storage of liquids does not obstruct corridors, aisles, or exit doors, and liquids are not stored in exit enclosures (e.g., stairwells), and
9. Outdoor storage requirements comply with NFPA 30 and 29 CFR 1910, and
10. Inside storage rooms comply with NFPA 30 and 29 CFR 1910.106, and
11. Storage areas, for the purpose of dispensing shall be limited to C- and D- Sites, comply with Section 5, Chapter 7, Paragraph 7.6, and be determined by the Waste Minimization Task Force. A Single individual will be assigned primary responsibility for each dispensing location.

E. The following dispensing requirements are met:

1. Dispensing shall be permitted in designated dispensing areas only; and
2. When dispensing from drums, the drums are equipped with Underwriters Laboratories, Inc.- (UL) listed or Factory Mutual- (FM) approved dispensing devices; and
3. When transferring liquids between conductive containers, the containers are bonded with a wire. The bonding wire or one of the containers must be grounded; and

4. When transferring Class I liquids in laboratories from containers of less than 5-gallon capacity, the transfer is made in one of the following manners:
  - a) With the use of a laboratory fume hood; or
  - b) In an area provided with ventilation to prevent the accumulation of a flammable vapor/air mixture exceeding 25% of the lower flammable limit; or
5. When transferring Class I liquids in laboratories from containers of 5-gallon capacity or more, the transfer is made in one of the following manners:
  - a) From a separate area outside the building; or
  - b) In a separate, inside storage room that complies with the requirements of NFPA 30 and 29 CFR 1910.106; and
6. In non-laboratory areas, mechanical ventilation is provided which meets the following criteria, when transferring Class I liquids:
  - a) The ventilation flow rate must be  $1 \text{ ft}^3/\text{min}/\text{ft}^2$  of floor area but in no case less than 150  $\text{ft}^3/\text{min}$ .
  - b) The intake and exhaust points must be within 12 inches of the floor and positioned at opposite sides or ends of the room.
  - c) A flow monitor or equivalent mechanism must be provided so an audible alarm will sound if the ventilation system fails.
7. When flammable liquid storage cabinets are used for dispensing flammable liquids, the cabinet must be grounded in addition to the requirements noted above.

## **7.7 Employee Training**

### **7.7.1 Management shall ensure that:**

- A. All employees receive basic fire prevention training which includes the following items as a minimum:
  1. Good housekeeping practices.
  2. Proper response/notification in the event of a fire.
  3. Instruction on the use of portable fire extinguishers.
  4. Recognition of potential fire hazards.

- B. Employees who perform fire watches receive hands-on portable fire extinguisher training.
- C. All training is documented for auditing purposes.

## **7.8 Control of Combustibles**

7.8.1. Combustible materials shall be limited to quantities that are as low as practical.

7.8.2 Management shall ensure that:

- A. The applicable sections of NFPA 1, “Fire Prevention Code” are met.
- B. Housekeeping inspections are performed monthly in their facilities to ensure equipment and materials are maintained in an orderly arrangement at all times.
- C. At least 18 inches vertical clearance is maintained between the top of storage and sprinkler head deflectors.
- D. Combustible materials are limited to the quantity required for current needs, and are separated from ignition sources.
- E. Workroom floors are maintained clean and dry to the extent practicable.
- F. Noncombustible or fire retardant materials are used whenever possible.
- G. Combustible waste is collected in metal containers and provided with lids. (Lids are not required for office waste cans.)
- H. Combustible waste does not accumulate inside or adjacent to buildings.
- I. In nuclear facilities, wood, plastic, and paper materials are strictly limited for uses that are essential to the operation of the facilities, and which do not have a noncombustible substitute.
- J. Nuclear facilities shall develop and implement a combustible materials tracking program that includes review and approval for all changes in the combustible loading by a fire protection engineer.

## **7.9 Compressed Gas Cylinders**

7.9.1 The storage, transportation, identification, and use of compressed gas cylinders shall be accomplished in a safe manner.

7.9.2 The design, use, and storage of compressed gas cylinders and systems shall comply with the following standards as applicable:

- A. NFPA 50, “Bulk Oxygen Systems at Consumer Sites”
- B. NFPA 50A, “Gaseous Hydrogen Systems at Consumer Sites”

- C. NFPA 50B, “Liquefied Hydrogen Systems at Consumer Sites”
- D. NFPA 51, “Design and Installation of Oxygen-Fuel Gas Systems for Welding Cutting and Allied Processes”
- E. NFPA 51B, “Cutting and Welding Processes”
- F. NFPA 52, “Compressed Natural Gas Vehicular Fuel Systems”
- G. NFPA 54, “National Fuel Gas Code”
- H. NFPA 55, “Storage, Use and Handling of Compressed and Liquefied Gases in Portable Cylinders”
- I. NFPA 58, “Liquefied Petroleum Gas Code”
- J. NFPA 59, “Storage and Handling of Liquefied Petroleum Gases at Utility Gas Plants”
- K. NFPA 59A, “Production, Storage and Handling of Liquefied Natural Gas”
- L. Occupational Safety and Health Administration (OSHA), 29 CFR 1910.166 to 1910.169, “Compressed Gas and Compressed Air Equipment”
- M. Occupational Safety and Health Administration (OSHA), 29 CFR 1910.101, “Compressed gases (general requirements)”
- N. Occupational Safety and Health Administration (OSHA), 29 CFR 1910.102, “Acetylene”
- O. Occupational Safety and Health Administration (OSHA), 29 CFR 1910.103, “Hydrogen”
- P. Occupational Safety and Health Administration (OSHA), 29 CFR 1910.104, “Oxygen”
- Q. Compressed Gas Association Publications

7.9.3 Management shall ensure that:

- A. Cylinders in transit or storage are provided with protective valve caps and secured in the upright position.
- B. All storage areas are clearly identified.
- C. The storage of compressed gas cylinders within buildings shall be limited to the quantity required for daily operations unless additional quantities are permitted by the applicable NFPA Standard.
- D. Containers when stored inside shall not be located near exits, stairways, or in areas normally used or intended for the safe exit of people.
- E. The storage of compressed gas cylinders outside of buildings shall be in accordance with the applicable NFPA Standard.

- F. Flammable and oxidizing compressed gas cylinders are separated by 20 feet or with a minimum five-foot high, 30-minute fire-rated wall.
- G. Empty and full gas cylinders are segregated, and empty cylinders are tagged “empty.”
- H. Compressed gas cylinders are not exposed to temperatures above 125°F and are protected from direct sun and weather elements.
- I. Compressed gas cylinders are identified regarding their contents; they are free of defects and are within their hydrostatic test date.
- J. Gases are not mixed or transferred from one compressed gas cylinder to another and are refilled only by trained personnel.
- K. Cylinders are not lifted by magnetic devices or by their protective caps. They must be secured to a cradle or platform and never dragged, dropped, or struck.
- L. Compressed gas cylinders do not come in contact with electrical circuits, open flames, or arcs.
- M. Compressed gas cylinders are not used for any purpose other than compressed gas containment.
- N. Gas is not used from compressed gas cylinders without approved pressure reducing regulators.
- O. Connecting devices are free of oil, grease, and dirt and have threads corresponding to the cylinder valve.
- P. Valves must be closed when cylinders are transported, moved at sites, and when connecting for use.
- Q. All devices used on compressed gas cylinders comply with the American National Standards Institute and Compressed Gas Association Standards C-4 and V-1.
- R. All compressed gas manifolds are designed in accordance with the applicable NFPA Standard.
- S. Personnel who use compressed gas cylinders are trained in accordance with Human Resources requirements.

## **7.10 Smoking Policy**

7.10.1 Smoking is not allowed inside Laboratory facilities.

7.10.2 Management shall ensure that smoking is prohibited in the following areas:

- A. All government vehicles.
- B. Near hazardous or toxic materials.

7.10.3 Areas where smoking is permitted shall be designated.

## **7.11 Construction Sites**

For special fire protection requirements for construction sites, see Section 1.