

A Code Review for Acetylene Welding

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I. INTRODUCTION

The following is a summary of the fire and building code requirements for using an acetylene welder inside a fully sprinklered building. These code requirements are based on the 2008 edition of the *National Electrical Code* (NFPA 70), the 2005 edition of the *Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks Code* (NFPA 55), the 2006 edition of the *International Fire Code* (IFC), and the 2006 edition of the *International Building Code* (IBC).

II. EXECUTIVE SUMMARY

This section is a broad overview of the fire and building code requirements for various quantities of compressed oxygen and acetylene. A section number is listed in parenthesis after each code requirement. This section number refers to the portion of this document in which more detailed requirements can be found.

- A. If the quantity of acetylene is less than 500 cubic feet, and there is no oxygen, the following requirements must be met.
 - a. Floor and floor supporting construction must be 2 hour rated (V.A), unless the total quantity of acetylene and other unstable/reactive material in the entire building is less than 500 cubic feet.
 - b. The room or space must have a mechanical exhaust ventilation system or natural ventilation approved by FLS (V.B).
 - c. Any required mechanical ventilation, alarm, detection, or other electrically operated systems are required to be provided with an emergency or standby power system, unless an approved fail-safe engineered system is installed (V.C).
 - d. Containers, tubing, and equipment are required to be approved and maintained (V.D).
 - e. "No Smoking" and "Compressed Gas" signs are required to be installed (V.E).
 - f. Compressed gas containers, cylinders, and tanks are to be secured to prevent falling caused by contact, vibration, or seismic activity (V.F).
 - g. Combustible material and acetylene tanks must be separated by a 10 ft distance or a noncombustible wall which extends not less than 18 in. above and to the sides of the area used for combustible material (V.G).

- B. If the quantity of acetylene is greater than 500 cubic feet but less than 2,000 cubic feet, and there is no oxygen, the following requirements must be met.
 - a. All of the requirements listed above in section II.A must be met.
 - b. A fire detection system and a fire suppression system are required. A fire sprinkler system designed for 3,000 square feet of ordinary hazard group 2 is acceptable (VI.A).
 - c. The space used for welding must be separated from the remainder of the building by one hour rated construction (VI.B).
 - d. The room or space must have a mechanical ventilation system (VI.C).
 - e. Acetylene should not be transported through corridors unless an emergency telephone system, a local manual alarm station or an approved alarm initiating device is installed at not more than 150 foot intervals and at each exit and exit access doorway throughout the transportation route (VI.D).
 - f. All H-3 occupancy requirements apply.
- C. If both acetylene and oxygen are present and the quantities of acetylene and oxygen are each less than 250 cubic feet, the following requirements must be met.
 - a. All of the requirements listed above in section II.A must be met.
 - b. The oxygen and acetylene tanks must be separated by a 20 ft distance or a wall constructed of noncombustible material with a fire resistance rating of at least 30 minutes extended 18 inches above and to the sides of the cylinders. The wall should be a minimum height of 5 ft (VII.A).
- D. If the quantity of acetylene is greater than 250 cubic feet but less than 500 cubic feet and the quantity of oxygen is less than 3,000 cubic feet, the following requirements must be met.
 - a. All of the requirements listed above in section II.A and II.C must be met.
 - b. The space used for welding must be separated from the remainder of the building by one hour rated construction (VIII.A).
- E. If the quantity of acetylene is greater than 500 cubic feet but less than 2,000 cubic feet and oxygen is in any quantity, the following requirements must be met.
 - a. All of the requirements listed above in section II.A, II.B, and II.C must be met.
 - b. All H-3 occupancy requirements apply.

III. GENERAL

- A. Section 2703.7.2 of the IFC states that open flames and high-temperature devices are not to be used in a manner which creates a hazardous condition.

IV. OCCUPANCY CLASSIFICATION

- A. Section 307.1 of the IBC states that high-hazard Group H occupancy includes, among others, the use of a building or structure, or a portion thereof, that involves the manufacturing, processing, generation, or storage of materials that constitute a physical or health hazard in quantities in excess of those allowed in control areas.
- B. Table 307.1(1) of the IBC states that the maximum quantity per control area of an unstable/reactive gas class 2 is 500 cubic feet for a sprinklered building. Occupancies with greater than 500 cubic feet are to be classified as Group H-3 occupancies.
- C. Section 6.3.1.3.1 of NFPA 55 states that flammable and oxidizing gases are not to be stored or used in other than industrial and storage occupancies.

Exception: Section 6.3.1.3.2 of NFPA 55 states that containers, cylinders, or tanks not exceeding 250 cubic feet and used for maintenance purposes, patient care, or operation of equipment are to be permitted.

- D. Table 508.3.3 of the IBC states that industrial and business occupancies are to be separated by 1 hour rated construction.

V. REQUIREMENTS FOR ACETYLENE IN QUANTITIES LESS THAN 500 CU. FT. WITH NO OXYGEN PRESENT (NO OCCUPANCY CHANGE)

A. Fire Resistance Rating Requirements

- a. Section 414.2.4 of the IBC states that the floor construction of a control area and the construction supporting the floor of the control area are to have a minimum 2-hour fire-resistance rating.

Exception: The floor construction of the control area and the construction supporting the floor of the control area are allowed to be 1-hour rated in buildings of Type IIA, IIIA, and VA construction, provided the following conditions exist:

1. *The building is equipped throughout with an automatic sprinkler system.*
2. *The building is three stories or less in height.*

The building is Type IIB construction. Therefore the exception is not met.

B. Ventilation Requirements

- a. Section 6.16 of NFPA 55 states that indoor storage and use areas for compressed gases are to be provided with mechanical exhaust ventilation or natural ventilation, where natural ventilation can be shown to be acceptable for the material as used.
- b. Section 6.16.1 of NFPA 55 states that where mechanical ventilation is provided, the system is to be operational during the time the building or space is occupied.

- c. Section 6.16.3 of NFPA 55 states that the mechanical ventilation rate is to be at a rate of not less than $1 \text{ ft}^3/\text{min}/\text{ft}^2$ of floor area over the area of storage or use.
- d. Section 6.16.4 of NFPA 55 states that systems are to operate continuously unless an alternate design is approved by the code official.
- e. Section 6.16.5 of NFPA 55 states that where powered ventilation is provided, a manual shutoff switch is to be provided outside of the room in a position adjacent to the principal access door to the room or in an approved location.
- f. Section 6.16.6 of NFPA 55 states that the switch is to be the break-glass type and is to be labeled as follows: “WARNING: VENTILATION SYSTEM EMERGENCY SHUTOFF.”
- g. Section 6.16.7.1 of NFPA 55 states that the exhaust ventilation system design is to take into account the density of the potential gases released.
- h. Section 6.16.7.3 of NFPA 55 states that for gases that are lighter than air, exhaust is to be taken from a point within 12 in of the ceiling.
- i. Section 6.16.9 of NFPA 55 states that exhaust ventilation is not to be recirculated within the room or building if the cylinders, containers, or tanks stored are capable of releasing hazardous gases.
- j. Section 6.16.10 of NFPA 55 states that ventilation systems are to discharge a minimum of 50 ft from intakes of air-handling systems, air-conditioning equipment, and air compressors.
- k. Section 6.16.11 of NFPA 55 states that use of compressed gases is to be located not less than 50 ft. from air intakes.

C. Emergency Power Requirements

- a. Section 414.5.4 of the IBC states that where mechanical ventilation, treatment systems, temperature control, alarm, detection, or other electrically operated systems are required, such systems are to be provided with an emergency or standby power system. Please note that acetylene is a Class 4 flammable gas and an unstable-reactive 2 material.

Exceptions:

1. *Storage areas for Class I and II oxidizers.*
2. *Storage areas for Class III, IV, and V organic peroxides*
3. *Storage, use, and handling areas for highly toxic or toxic materials as provided for in the International Fire Code.*
4. *Standby power for mechanical ventilation, treatment systems, and temperature control systems is no to be required where an approved fail-safe engineered system is installed.*

D. Container, Tubing, and Equipment Requirements

- a. Section 2703.2.1 of the IFC states that containers, cylinders, and tanks are to be designed and constructed in accordance with approved standards.
- b. Section 414.4 of the IBC states that systems involving hazardous materials are to be suitable for the intended application. Controls are to be designed to prevent materials from entering or leaving process or reaction systems at other than the intended time, rate, or path. Automatic controls, where provided, are to be fail safe.
- c. Section 2703.2.6 of the IFC states that equipment, machinery, and required detection and alarm systems associated with hazardous materials are to be maintained in an operable condition. Defective containers, cylinders, and tanks are to be removed from service, repaired or disposed of in an approved manner. Defective equipment or machinery is to be removed from service and repaired or replaced. Required detection and alarm systems are to be replaced or repaired where defective.
- d. Section 2703.2.2.1 of the IFC states that piping, tubing, valves, and fittings conveying hazardous materials are to be in accordance with the following:
 1. Piping, tubing, valves, fittings, and related components are to be designed and fabricated from materials that are compatible with the material to be contained and are to be of adequate strength and durability to withstand the pressure, structural and seismic stress and exposure to which they are subject.
 2. Piping and tubing is to be identified in accordance with ASME A13.1 to indicate the material conveyed.
 3. Readily accessible manual valves or automatic remotely activated fail-safe emergency shutoff valves are to be installed on supply piping and tubing at the following locations:
 - 3.1. The point of use
 - 3.2. The tank, cylinder, or bulk source.
 4. Manual emergency shutoff valves and controls for remotely activated emergency shutoff valves is to be identified and the location is to be clearly visible, accessible, and indicated by means of a sign.
 5. Backflow prevention or check valves are to be provided when the backflow of hazardous material could create a hazardous condition or cause an unauthorized discharge of hazardous materials.

6. Where gases with a flammability rating of 4, i.e., acetylene, are carried in pressurized piping above 15 pounds per square inch gauge (psig), an approved means of leak detection and emergency shutoff or excess flow control are to be provided. Where the piping originates from within a hazardous material storage room or area, the excess flow control is to be located within the storage room or area. Where the piping originates from a bulk sources, the excess flow control is to be located as close to the bulk sources as practical.

Exceptions:

1. *Piping for inlet connections designed to prevent backflow.*
2. *Piping for pressure relief devices.*

E. Sign Requirements

- a. Section 2703.5 of the IFC states that unless exempted by the fire code official, visible hazard identification signs for the specific material contained are to be placed on stationary containers and above-ground tanks and at entrances to locations where hazardous materials are stored, dispensed, used, or handled in quantities requiring a permit and at specific entrances and locations designated by the fire code official.
- b. Section 2703.5.1 of the IFC states that individual containers, cartons, or packages are to be conspicuously marked or labeled in an approved manner. Rooms or cabinets containing compressed gases are to be conspicuously labeled: COMPRESSED GAS.
- c. Section 2703.7.1 of the IFC states that smoking is to be prohibited and “No Smoking” signs provided as follows:
 1. In rooms or areas where hazardous materials are stored or dispensed or used in open systems.
 2. Within 25 feet of outdoor storage, dispensing or open use areas.
 3. Facilities or areas within facilities that have been designated as totally “no smoking” shall have “No Smoking” signs placed at all entrances to the facility or area. Designated areas within such facilities where smoking is permitted whether permanently or temporarily, are to be identified with signs designating that smoking is permitted in these areas only.
 4. In rooms or areas where flammable or combustible hazardous materials are stored, dispensed, or used.

Signs required by this section are to be in English as a primary language.

F. Anchoring Requirements

- a. Section 3003.5.3 of the IFC states that compressed gas containers, cylinders, and tanks are to be secured to prevent falling caused by contact, vibration, or seismic activity.

G. Separation Requirements

- a. Section 7.1.6.3 of NFPA 55 states that combustible waste, vegetation, and similar materials are to be kept a minimum 10 ft from compressed gas containers, cylinders, tanks, and systems.

Exception: Sections 7.1.6.3.1 and 7.1.6.3.1 of NFPA 55 states that a noncombustible partition without openings or penetrations and extending sides not less than 18 in. above and to the sides of the storage area is permitted in lieu of the minimum distance. The noncombustible partition is to either be an independent structure or the exterior wall of the building adjacent to the storage area.

VI. REQUIREMENTS FOR ACETYLENE IN QUANTITIES GREATER THAN 500 CU. FT. BUT LESS THAN 2,000 CU. FT. WITH NO OXYGEN PRESENT (GROUP H-3 OCCUPANCY)

Please note: In addition to the requirements listed below, the requirements of part V must also be met.

A. Fire Extinguishing and Detection Requirements

- a. Section 414.5.3 of the IBC states that Group H occupancies are to be provided with an automatic fire detection system.
- b. Section 2705.1.8 of the IFC states that indoor rooms or areas in which hazardous materials are dispensed or used are to be protected by an automatic fire-extinguishing system. Sprinkler system design is not to be less than that required for Ordinary Hazard, Group 2, with a minimum design area of 3,000 square feet. Where materials or storage arrangement are required by other regulations to be provided with a higher level of sprinkler system protection, the higher level of sprinkler protection is to be provided.
- c. Section 2705.1 of the IFC states that manual alarm detection and automatic fire-extinguishing systems required by other provisions of Section 2705 are to be supervised by an approved central, proprietary or remote station service or are to initiate an audible and visual signal at a constantly attended on-site location.

B. Required Fire Wall Separation

- a. Section 508.3.1.3 of the IBC states that Group H occupancies are to be separated from all other all other occupancies in accordance with table 508.3.3.
- b. Table 508.3.3 of the IBC states that Group H-3 occupancies must be separated from fully sprinklered business occupancies by 1 hour rated construction.

C. Ventilation Requirements

- a. Section 2705.1.9 of the IFC states that indoor dispensing and use areas are to be provided with exhaust ventilation in accordance with Section 2704.3.

- b. Section 2704.3.1 of the IFC states that exhaust ventilation systems are to comply with the following:
1. Installation is to be in accordance with the IMC.
 2. Mechanical ventilation is to be at a rate of not less than 1 cubic foot per minute per square foot of floor area over the storage area.
 3. Systems are to operate continuously unless alternative designs are approved.
 4. A manual shutoff control is to be provided outside of the room in a position adjacent to the access door to the room or in an approved location. The switch is to be a break-glass or other approved type and is to be labeled: VENTILATION SYSTEM EMERGENCY SHUTOFF.
 5. Exhaust ventilation is to be designed to consider the density of the potential fumes or vapors released. For fumes or vapors that are heavier than air, exhaust is to be taken from a point within 12 inches of the floor. For fumes or vapors that are lighter than air, exhaust is to be taken from a point within 12 inches from the highest point of the room.
 6. The location of both the exhaust and inlet air openings is to be designed to provide air movement across all portions of the floor or room to prevent the accumulation of vapors.
 7. Exhaust air is not to be recirculated to occupied areas if the materials stored are capable of emitting hazardous vapors and contaminants have not been removed. Air-contaminated with explosive or flammable vapors, fumes or dusts; flammable, highly toxic or toxic gases; or radioactive materials is not to be recirculated.
- c. Section 414.3 of the IBC states that ducts conveying explosives or flammable vapors, fumes, or dusts are to extend directly to the exterior of the building without entering other spaces. Exhaust ducts are not to extend into or through ducts and plenums.

Exception: Ducts conveying vapor or fumes having flammable constituents less than 25 percent of their lower flammable limit (LFL) are permitted to pass through other spaces.

D. Transportation Requirements

- a. Section 2705.4.4 of the IFC states that where hazardous materials are excess of the exempt amounts (e.g. >500 cu. ft. for acetylene in a sprinklered building) and have a hazard ranking of 3 or 4, i.e., acetylene, are transported through corridors or exit enclosures, there is to be an emergency telephone system, a local manual alarm station or an approved alarm-initiating device at not more than 150-foot intervals and at each exit and exit access doorway throughout the transport route. The signal is to be relayed to an approved central station, proprietary supervising station, or a remote supervising station or a constantly attended on-site location and it is also to initiate a local audible alarm.

VII. REQUIREMENTS FOR ACETYLENE AND OXYGEN EACH IN QUANTITIES LESS THAN 250 CU. FT. WHERE BOTH ACETYLENE AND OXYGEN ARE PRESENT (NO OCCUPANCY CHANGE)

Please note: In addition to the requirements listed below, the requirements of section V must also be met.

A. Separation Distances

- a. Section 7.1.6.2 of NFPA 55 states that flammable and oxidizing gases are to be separated by 20 ft.
- b. Section 7.1.6.2.1 of NFPA 55 states that the 20 ft distance is permitted to be reduced without limit when separated by a barrier of noncombustible material at least 5 ft high that has a fire resistance rating of at least 0.5 hr.
- c. Section 2703.9.8 of the IFC states that incompatible materials having a capacity of more than 0.5 gallons are to be separated by 20 ft or a noncombustible partition extending not less than 18 in above and to the sides of the stored material.

VIII. REQUIREMENTS FOR ACETYLENE IN QUANTITIES GREATER THAN 250 CU. FT. BUT LESS THAN 500 CU. FT. WITH OXYGEN IN QUANTITIES LESS THAN 3,000 CU. FT. (INDUSTRIAL OCCUPANCY)

Please note: In addition to the requirements listed below, the requirements of sections V and VII must also be met.

A. Fire Resistance Rating Requirements

- a. Table 508.3.3 of the IBC states that industrial and business occupancies are to be separated by 1 hour rated construction.

IX. REQUIREMENTS FOR ACETYLENE IN QUANTITIES GREATER THAN 500 CU. FT. BUT LESS THAN 2,000 CU. FT. WITH OXYGEN IN ANY QUANTITY (GROUP H-3 OCCUPANCY)

The requirements of sections V, VI, and VII must be met.

X. QUANTITIES OF ACETYLENE GREATER THAN 2,000 CU. FT.

Section 6.5 of NFPA 55 states that if more than 2,000 cu. ft. of an unstable reactive class 3 compressed gas, i.e., acetylene, is used, then the building must be detached.