

Orange County Fire Authority

Community Risk Reduction

1 Fire Authority Road, Building A, Irvine, CA. 92602 www.ocfa.org 714-573-6100

Exterior Cryogenic Fluid Vessels



Guideline G-13

Serving the Cities of Aliso Viejo • Buena Park • Cypress • Dana Point • Irvine • Laguna Hills • Laguna Niguel • Laguna Woods • Lake Forest • La Palma • Los Alamitos • Mission Viejo • Placentia • Rancho Santa Margarita • San Clemente • San Juan Capistrano • Seal Beach • Santa Ana • Stanton • Tustin • Villa Park • Westminster • Yorba Linda • and Unincorporated Areas of Orange County

Exterior Cryogenic Fluid Vessels

PURPOSE

The intent of this guideline is to provide the basic requirements and regulations for storage, use and handling of exterior cryogenic fluid vessels. The following submittal requirements outline the minimum information required for plan review as set forth by the 2016 California Fire Code (CFC) Chapter 55 and 58, the general requirements of Chapter 50, NFPA 55 and ANSI/CGA P-18. Plans not conforming to these minimum requirements will be returned as incomplete.

SCOPE

This guideline is applicable to the exterior storage, use and handling of cryogenic fluids in cryogenic vessels and applies to all new installations and/or alterations to existing exterior cryogenic fluid vessels within the jurisdiction of the Orange County Fire Authority (OCFA).

The following definitions are provided to facilitate the consistent application of this guideline:

Cryogenic container – A cryogenic vessel of any size used for the transportation, handling or storage of cryogenic fluids.

Cryogenic fluids – Fluids that have a normal boiling point lower than -130° F at 14.7 pounds per square inch atmosphere.

Cryogenic vessel – A pressure vessel, low-pressure tank, or atmospheric tank designed to contain a cryogenic fluid on which venting, insulation, refrigeration or a combination of these is used in order to maintain an operating pressure within the design pressure and the contents in a liquid phase.

Design pressure – The maximum gauge pressure that a pressure vessel, device, component or system is designed to withstand safely under the temperature and conditions of expected use.

Flammable cryogenic fluid – A cryogenic fluid which is flammable in its vapor state.

Inert gas – Nonflammable, non-toxic, non-oxidizing gases such as argon and nitrogen.

Low-pressure tank – A storage tank designed to withstand an internal pressure greater than 0.5 pounds per square inch gauge (psig) but not greater than 15 psig.

Oxidizer – A material, other than a blasting agent or explosive; that readily yields oxygen or other oxidizing gas, or that readily reacts to promote or initiate combustion of combustible materials.

System – An assembly of equipment consisting of a tank, container or containers, appurtenances, pumps, compressors and connecting piping.

SUBMITTAL REQUIREMENTS

1. **General:** Plans for all exterior cryogenic fluid vessels shall be submitted to the OCFA for review. All new submittals and revisions will consist of **2** hard copies and **1** electronic copy in .pdf format. All electronic copies may be submitted on CD, DVD, or memory stick. Provide 1 copy of the manufacturer's data sheets for the vessel(s). All data sheets shall be current and complete. *Note: Some building departments within OCFA jurisdiction require additional sets; verify plan submittal requirements with the building department prior to submitting.* Plans shall be legible, scaled to nationally recognized standards, and blue-lined. Complete an OCFA Service Request Form, which can be obtained at the building department or OCFA.

A. Required Plan Information

- 1) Building construction type and occupancy classifications of all buildings within 50 feet of the vessel, as defined by the California Building Code (CBC).
- 2) Applicable codes and standards used for the system design (e.g., 2016 CFC, 2016 CBC, etc.).
- 3) Project location – including the full legal address of the facility and the building number (if applicable).
- 4) The contractor's name, telephone number, address and California state contractor's license number.
- 5) A site plan identifying the location of the proposed vessel in relation to the nearest buildings, property lines and public ways.

B. Requirements for All Types of Cryogenic Fluids

Provide diagrams and specifications that indicate that the proposed vessel(s) complies with the following CFC requirements, *regardless of cryogen type*:

- 1) Cryogenic fluid systems shall be suitable for the use intended and designed by persons competent in such design. Equipment, machinery, and processes shall be listed or approved.
- 2) Containers – CFC 5503.1
 - a. Concrete containers shall be built in accordance with the CBC.
 - b. Containers shall be provided with substantial concrete/masonry foundations or with structural steel supports on firm concrete/masonry foundations. Containers shall be supported to prevent the concentration of excessive loads on the supporting portion of the vessel shell. Foundations for horizontal containers shall be constructed to accommodate expansion and contraction of the container. Foundations shall also support the weight of vaporizers or heat exchangers.
 - c. When container foundations or supports are subject to exposure to temperatures below -130° F (-90°C), the foundations or supports shall be constructed of materials to withstand the low-temperature effects of cryogenic fluid spillage.

- 3) Pressure-Relief Devices – CFC 5503.2
 - a. Pressure-relief devices shall be provided at every point in the system where liquid can become trapped to protect containers and systems containing cryogenic fluids from rupture in the event of overpressure and must be designed in accordance with nationally recognized standards.
 - b. Heat exchangers, vaporizers, insulation casings surrounding containers, vessels, and coaxial piping systems in which liquefied cryogenic fluids could be trapped due to leakage from the primary container shall be provided with a pressure relief device.
 - c. Pressure-relief devices shall be sized in accordance with the specifications to which the container was fabricated. The relief device shall have sufficient capacity to prevent the maximum design pressure of the container or system from being exceeded.
 - d. Pressure-relief devices shall be located such that they are readily accessible for inspection and repair. This shall be subject to verification by the OCFA inspector.
 - e. Pressure-relief devices shall be arranged to discharge unobstructed to the open air in such a manner as to avoid entering enclosed spaces and to prevent impingement of escaping gas on personnel, containers, equipment, and adjacent structures.
 - f. Pressure-relief devices shall not be subjected to cryogenic fluid temperatures except when operating.
- 4) Pressure-Relief Vent Piping – CFC 5503.3
 - a. Pressure-relief vent piping systems shall be constructed and arranged so as to remain functional and direct the flow of gas to a safe location.
 - b. Pressure-relief device vent piping shall have a cross-sectional area not less than that of the pressure-relief device vent opening and shall be arranged to not unduly restrict the flow of escaping gas.
 - c. Pressure-relief device vent piping and drains in vent lines shall be arranged so that escaping gas will discharge unobstructed to the open air to avoid entering enclosed spaces and not impinge on personnel, containers, equipment, and adjacent structures. Pressure-relief device vent lines shall be installed in such a manner to exclude or remove moisture and condensation and prevent malfunction of the pressure-relief device due to freezing or ice accumulation.
- 5) Marking – CFC 5503.4
 - a. Cryogenic containers and systems shall be marked in accordance with nationally recognized standards.

- b. Visible hazard identification signs in accordance with NFPA 704 shall be provided at entrances to buildings or areas in which cryogenic fluids are stored, handled or used.
 - c. Stationary containers shall be identified with the manufacturing specifications and maximum allowable working pressure with a permanent nameplate. The nameplate shall be installed on the container in an accessible location and be marked in accordance with nationally recognized standards.
 - d. Container inlet and outlet connections, liquid-level limit controls, valves, and pressure gauges shall be identified in accordance with one of the following: marked with a permanent tag or label identifying their function or identified by a schematic drawing which portrays their function and designates whether they are connected to the vapor or liquid space of the container. Schematic drawings shall be attached to the container and maintained in legible condition. State on the plans the method to be used.
 - e. Piping and tubing shall be labeled per ASME A13.1 to indicate the material conveyed.
 - f. A sign in a clearly visible location shall identify emergency shut-off valves.
- 6) Security – CFC 5503.5
- a. Cryogenic containers and systems shall be secured against accidental dislodgement and against access by unauthorized personnel.
 - b. Stationary containers shall be secured to foundations in accordance with the CBC.
 - c. Vaporizers, heat exchangers, and similar equipment shall be anchored to a suitable foundation, and its connecting piping shall be sufficiently flexible to provide for the effects of expansion and contraction due to temperature changes.
 - d. Containers, piping, valves, pressure-relief devices, regulating equipment and other appurtenances shall be protected against physical damage and against tampering.
- 7) Electrical Wiring and Equipment – CGC 5503.6
- a. Electrical wiring and equipment shall be in accordance with the California Electrical Code.
 - b. Containers and systems shall not be located where they could become part of an electrical circuit or be used for electrical grounding.
- 8) Separation from Hazardous Conditions – CFC 5504.3.1
- a. Cryogenic containers and systems in outdoor storage or use shall be separated from materials and conditions that present exposure hazards.
 - b. Stationary containers, remote transfer points, and fill-connection points shall be separated from exposure hazards in accordance with the

applicable CFC standard for the type of fluid contained and the minimum separation distances required as follows:

Buildings/wall openings	1 foot
Building exits	10 feet
Lot line	5 feet
Air intakes	10 feet
Combustible materials	15 feet
Places of public assembly	50 feet
Non-ambulatory patient areas	50 feet
Other hazardous materials	In accordance with Chapter 50

- c. The surface of the area on which stationary containers are placed and where fill connections are made shall be compatible with the fluid in the container.
- 9) Piping Systems – CFC 5505.1.2
- a. Piping, tubing, valves, joints, and fittings conveying cryogenic fluids shall be installed in accordance with material-specific provisions of the code.
 - b. Piping systems, valves and accessory equipment shall be suitable for the use intended through the full range of pressure and temperature to which they will be subjected and shall be designed and built to provide adequate allowance for expansion, contraction, settlement and fire exposure.
 - c. Accessible shutoff valves shall be provided on all container connections except pressure-relief devices and shall be located as close as practical to the container.
 - d. Shutoff valves shall be installed in cryogenic fluid piping when needed to limit the volume of liquid discharged in the event of piping or equipment failure, or in the event of an emergency. Pressure-relief valves shall be installed when liquid can be trapped between shutoff valves in the piping system.
 - e. Piping systems shall be well supported and protected from physical damage. Piping passing through walls shall be protected from mechanical damage.
 - f. Aboveground piping that is subject to corrosion because of exposure to corrosive atmospheres shall be constructed of materials to resist the corrosive environment or otherwise protected against corrosion. Below-ground piping shall also be protected against corrosion.
- 10) Filling and Dispensing – CFC 5505.4
- a. Piping systems used for filling or dispensing of cryogenic fluids shall be designed and constructed as required for storage (see item 3 above).

- b. Limit controls shall be provided to prevent overfilling of stationary containers during filling operations.
 - 11) Lighting, including emergency lighting, may be required to illuminate fire appliances and operating facilities, such as walkways, control valves, and gates ancillary to stationary containers.
 - 12) The area surrounding stationary containers shall be provided with a means to prevent an accidental discharge of fluids from entering enclosed spaces or endangering personnel, containers, equipment, and adjacent structures.
2. Requirements for Specific Cryogen Types: Provide diagrams and specifications that indicate that the proposed vessel complies with the following CFC requirements.
- A. Oxidizer Cryogenic Fluid/Bulk Oxygen Systems – NFPA 55: The following requirements apply to bulk oxygen systems exceeding 20,000 cubic feet:
 - 1) Bulk oxygen storage systems shall be located aboveground and outdoors (with exceptions), the location of which shall be such that containers and associated equipment shall not be beneath or exposed to the failure of electric power lines, piping containing all classes of flammable or combustible liquids, or piping containing flammable gases.
 - 2) Bulk oxygen systems shall be located not less than 1 foot from buildings of Type I and II construction, not less than 50 feet from buildings of Type III, IV, or V construction, and not less than 5 feet from property lines.
 - 3) Bulk oxygen storage containers shall be equipped with a safety-relief valve meeting the provisions of nationally recognized standards for safety-relief devices for compressed gas storage containers.
 - B. Flammable Cryogenic Fluid – Refer to CFC Chapter 58 and NFPA 55
 - C. Inert Cryogenic Fluid Systems – Refer to ANSI/CGA P-18
3. Notes: Provide the following notes, verbatim, on the plan under the heading “FIRE AUTHORITY NOTES”: (SEE NEXT PAGE)

FIRE AUTHORITY NOTES:

- A. OCFA inspection required. Please schedule all field inspections at least 48 hours in advance. Inspections canceled after 1pm on the day before the scheduled date will be subject to a re-inspection fee. Call OCFA inspection scheduling at 714-573-6150.
- B. When addition of a cryogen tank modifies the existing fire department access, plans for fire department access and fire lane markings shall be submitted to and approved by the OCFA prior to approval of the cryogen tank plans.
- C. Piping systems shall be tested and proven free of leaks after installation, as required by the standards to which they were designed and constructed. Test pressures shall not be less than 150 percent of the maximum allowable working pressure when hydraulic testing is conducted or 110 percent when testing is conducted pneumatically.
- D. The area within 15 feet of any cryogen tank shall be kept free of paper, leaves, weeds, or other combustible debris.
- E. Full face shields, gloves, and aprons shall be worn when handling cryogenic liquids.
- F. A CFC permit is required for cryogenic liquids. This permit will be issued by an OCFA inspector.
- G. Locations and classifications of extinguishers shall be in accordance with CFC 906.2 and Chapter 3, Title 19 California Code of Regulations and placement is subject to the approval of the fire inspector.
- H. Storage, dispensing, or use of any additional hazardous materials shall comply with CFC regulations.
- I. Cryogenic fluid systems shall be suitable for the use intended and designed by persons competent in such design. Where nationally recognized good practices or standards have been established for the process employed, such practices and standards shall be followed.
- J. Concrete containers shall be built in accordance with the CBC. Barrier materials and membranes used in connection with concrete, but not functioning structurally, shall be compatible with the materials contained.
- K. Piping systems, valves and accessory equipment shall be suitable for the use intended through the full range of pressure and temperature to which they will be subjected and shall be designed and built to provide adequate allowance for expansion, contraction, settlement, and fire exposure.
- L. Aboveground piping systems shall be well supported and protected from physical damage. Piping passing through walls shall be protected from mechanical damage.
- M. Pressure-relief devices shall be located such that they are readily accessible for inspection and repair. This shall be subject to verification by the OCFA inspector.
- N. Pressure-relief devices shall not be subjected to cryogenic fluid temperatures except when operating.
- O. Stationary containers shall be identified with the manufacturing specifications and maximum allowable working pressure with a permanent nameplate. The nameplate shall be installed on the container in an accessible location and be marked in accordance with nationally recognized standards.
- P. Container inlet and outlet connections, liquid-level limit controls, valves, and pressure gauges shall be identified in accordance with one of the following: marked with a permanent tag or label identifying their function or identified by a schematic drawing which portrays their function and designates whether they are connected to the vapor or liquid space of the container. Schematic drawings shall be attached to the container and maintained in legible condition.
- Q. Stationary containers shall be secured to foundations in accordance with the CBC.
- R. Electrical wiring and equipment shall be in accordance with the Electrical Code.
- S. Containers and systems shall not be located where they could become part of an electrical circuit or be used for electrical grounding.
- T. Storage containers shall be designed, constructed, and tested in accordance with nationally recognized standards.
- U. After installation, all field-erected piping shall be tested and proved gas tight at operating pressure and temperature. Testing shall be performed in accordance with nationally recognized standards.
- V. Electrical wiring and equipment shall comply with the Electrical Code requirements for Class I locations.
- W. Flammable cryogenic fluid containers and associated piping shall be electrically bonded and grounded.