Pipeline and Hazardous Materials Safety Admin., DOT  § 173.316

§ 173.316 Cryogenic liquids in cylinders.

(a) General requirements. (1) A cylinder may not be loaded with a cryogenic liquid colder than the design service temperature of the packaging.

(2) A cylinder may not be loaded with any material which may combine chemically with any residue in the packaging to produce an unsafe condition.

(3) The jacket covering the insulation on a cylinder used to transport any flammable cryogenic liquid must be made of steel.

(4) A valve or fitting made of aluminum with internal rubbing or abrading aluminum parts that may come in contact with oxygen in the cryogenic
liquid form may not be installed on any cylinder used to transport oxygen, cryogenic liquid unless the parts are anodized in accordance with ASTM Standard B 580 (IBR, see §171.7 of this subchapter).

(5) An aluminum valve, pipe or fitting may not be installed on any cylinder used to transport any flammable cryogenic liquid.

(6) Each cylinder must be provided with one or more pressure relief devices, which must be installed and maintained in compliance with the requirements of this subchapter.

(7) Each pressure relief device must be installed and located so that the cooling effect of the contents during venting will not prevent effective operation of the device.

(8) All pressure relief device inlets must under maximum filling conditions be situated in the vapor space of the closed cryogenic receptacle and the devices must be arranged to ensure that the escaping vapor is discharged unobstructed.

(9) The maximum weight of the contents in a cylinder with a design service temperature colder than −320 °F. may not exceed the design weight marked on the cylinder (see §178.35 of this subchapter).

(b) Pressure control systems. Each cylinder containing a cryogenic liquid must have a pressure control system that conforms to §173.301(f) and is designed and installed so that it will prevent the cylinder from becoming liquid full.

(c) Specification cylinder requirements and filling limits. Specification DOT-4L cylinders (§178.57 of this subchapter) are authorized for the transportation of cryogenic liquids when carried in the vertical position as follows:

(1) For purposes of this section, “filling density,” except for hydrogen, is defined as the percent ratio of the weight of lading in the packaging to the weight of water that the packaging will hold at 60 °F. (1 lb. of water = 27.737 cubic inches at 60 °F.).

(2) The cryogenic liquids of argon, nitrogen, oxygen, helium and neon must be loaded and shipped in accordance with the following table:

<table>
<thead>
<tr>
<th>Pressure control valve setting (maximum start-to-discharge pressure psig)</th>
<th>Maximum permitted filling density (percent by weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>Argon</td>
</tr>
<tr>
<td>45</td>
<td>82.5</td>
</tr>
<tr>
<td>75</td>
<td>80.3</td>
</tr>
<tr>
<td>105</td>
<td>78.4</td>
</tr>
<tr>
<td>170</td>
<td>76.2</td>
</tr>
<tr>
<td>230</td>
<td>75.1</td>
</tr>
<tr>
<td>295</td>
<td>73.3</td>
</tr>
<tr>
<td>360</td>
<td>70.7</td>
</tr>
<tr>
<td>450</td>
<td>66.9</td>
</tr>
<tr>
<td>540</td>
<td>62.9</td>
</tr>
<tr>
<td>625</td>
<td>60.1</td>
</tr>
</tbody>
</table>

(3) Hydrogen (minimum 95 percent parahydrogen) must be loaded and shipped as follows:

<table>
<thead>
<tr>
<th>Column 1</th>
<th>Column 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design service temperature (°F.)</td>
<td>−320</td>
</tr>
</tbody>
</table>

Maximum permitted filling density, based on cylinder capacity at minus 423 °F (see Note 1).

The pressure control valve must be designed and set to limit the pressure in the cylinder to not more than 17 psig.

NOTE 1: The filling density for hydrogen, cryogenic liquid is defined as the percent ratio of the weight of lading in a packaging to the weight of water that the packaging will hold at minus 423 °F. The volume of the packaging at minus 423 °F is determined in cubic inches. The volume is converted to pounds of water (1 lb. of water = 27.737 cubic inches).

(i) Each cylinder must be constructed, insulated and maintained so that during transportation the total rate of venting shall not exceed 30 SCFH of hydrogen per hour.

(ii) In addition to the marking requirements in §178.35 of this subchapter, the total rate of venting in SCF per hour (SCFH) shall be marked
§ 173.318 Cryogenic liquids in cargo tanks.

(a) General requirements. (1) A cargo tank may not be loaded with a cryogenic liquid colder than the design service temperature of the packaging.

(2) A cargo tank may not be loaded with any material that may combine chemically with any residue in the packaging to produce an unsafe condition (see §178.338–15).

(3) The jacket covering the insulation on a tank used to transport a cryogenic liquid must be made of steel if the cryogenic liquid:

(i) Is to be transported by vessel (see §176.76(g) of this subchapter); or

(ii) Is oxygen or a flammable material.

(4) A valve or fitting made of aluminum with internal rubbing or abrading aluminum parts that may come in contact with oxygen in the cryogenic liquid form may not be installed on any cargo tank used to transport oxygen, cryogenic liquid or any flammable cryogenic liquid.

(6) A cargo tank used to transport oxygen, cryogenic liquid must be provided with a manhole (see §178.338–6 of this subchapter).

(b) Pressure relief systems and pressure control valves—(1) Types of pressure relief systems—(i) Tanks in oxygen and flammable cryogenic liquid service. Except as otherwise provided in this paragraph, each tank in oxygen and flammable cryogenic liquid service must be protected by two independent pressure relief systems which are not connected in series, namely:

(A) A primary system of one or more pressure relief valves; and

(B) A secondary system of one or more flangible discs or pressure relief valves. For a tank in carbon monoxide service, the secondary system must be pressure relief valves only.

(ii) Tanks in helium and atmospheric gas (except oxygen) cryogenic liquid service. For a tank used in helium and atmospheric gas (except oxygen) cryogenic liquid service, the tank must be protected by at least one pressure relief system consisting of:

(A) One or more pressure relief valves; or

(B) A combination of one or more pressure relief valves and one or more flangible discs.

(2) Capacities of pressure relief systems—(i) Tanks in oxygen or flammable cryogenic liquid service. For tanks in oxygen or flammable cryogenic liquid service, the primary system and the secondary system of pressure relief devices must each have a flow capacity equal to or greater than that calculated by the applicable formula in paragraph 5.3.2 or paragraph 5.3.3 of CGA S-1.2 (IBR, see §171.7 of this subchapter). In addition:

(A) The primary pressure relief system must have a total flow capacity at a pressure not exceeding 120 percent of the tank’s design pressure.

(B) The secondary pressure relief system must have a total flow capacity at a pressure not exceeding 150 percent of the tank’s design pressure.

(C) The flow capacity and rating must be verified and marked by the manufacturer of the device in accordance with CGA Pamphlet S-1.2.