



U.S. Department
of Transportation

1200 New Jersey Avenue SE
Washington, DC 20590

**Pipeline and Hazardous
Materials Safety
Administration**

JAN 11 2012

Mr. I. Keith Hall
Engineering Manager
CVA, Inc.
9528 Warren Road
P.O. Box 1230
Mont Belvieu, TX 77580

Reference No. 10-0147

Dear Mr. Hall:

This is in response to your e-mail and subsequent telephone conversations with members of my staff requesting clarification of the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180) applicable to DOT Specification 4L welded, insulated cylinders. You state your company wants to construct these cylinders to contain "UN 1073, Oxygen, refrigerated liquid (cryogenic liquid), 2.2 (non-flammable gas), 5.1 (oxidizer)" that it will transport by van motor vehicle for an in-home medical oxygen delivery service. We have paraphrased your questions and answered them in the order provided.

Q1. You ask if, under §§ 173.316(c) and 178.57, the cylinder may be constructed to operate in a horizontal instead of vertical position.

A1. DOT 4L cylinders that contain cryogenic liquids, such as refrigerated liquid oxygen, are required to be transported in the vertical position in conformance with § 173.316(c). The HMR also requires that DOT 4L cylinder have openings in the cylinder head only (see § 178.57(h)(1)). Further, DOT 4L cylinders must also be equipped with one or more pressure relief devices that are installed and located so the cooling effect of the cylinder contents during venting will not prevent the device from operating effectively (see § 173.316(a)(6) and (a)(7)). Although § 178.57(p)(4) requires DOT 4L cylinders with openings at the top of the cylinder to be marked with special orientation instructions, such as "THIS END UP" when used in other than a vertical orientation, this section does not authorize the cylinder's construction in a non-vertical orientation. Therefore, to operate a DOT 4L specification cylinder in the horizontal position, the cylinder's design, including its pressure relief system, must be authorized under the terms of a special permit. The procedure for applying for a special permit can be found in 49 CFR Part 107, Subpart B, and can also be found on our website at "<http://www.phmsa.dot.gov/hazmat>" under "Special Permits."

For pressure relief devices on cylinders that contain liquefied gases to operate effectively, it is the opinion of this Office that these devices must be designed and installed to operate within the inlet port located in the vapor space of the cylinder. It is also the opinion of this Office that releasing compressed gas in liquid form through a cylinder's pressure relief device can create unsafe conditions in transportation, such as: 1) an extremely flammable or toxic environment, respectively, if the gas released is a Division 2.1 (flammable) gas or a Division 2.3 (poisonous) material, or; 2) an asphyxiant environment if the released gas displaces the normal concentration of oxygen in breathable atmosphere. Unsafe conditions specific to released cryogenic liquefied oxygen include: 1) oxygen-enriched air and materials that can explosively combust and/or sustain burning if an ignition source is present; 2) extreme cold; and 3) explosion from rapid pressure rise if the cylinder is damaged in an accident, loses thermal protection, or is exposed to an external heat source such as fire. The Pipeline and Hazardous Materials Safety Administration (PHMSA) will address the location of pressure relief devices in packagings authorized to transport cryogenic liquefied gases in a future rulemaking.

Please note a valve or valve fitting made of aluminum with internal rubbing or abrading aluminum parts that may come in contact with cryogenic liquefied oxygen may not be installed on a cylinder used to transport cryogenic liquefied oxygen unless the parts are anodized in conformance with ASTM Standard B 580 (see § 173.316(a)(4)). Also, the DOT 4L's carriage by highway is subject to the conditions specified in § 177.840(a) of the HMR (see § 173.316(c)(3)(iii)). Section 177.840(a)(1) requires cylinders transporting Class 2 (compressed gas) materials to be securely restrained in an upright or horizontal position, loaded in racks, or packed in boxes or crates to prevent the cylinders from being shifted, overturned, or ejected from the motor vehicle under normal transportation conditions.

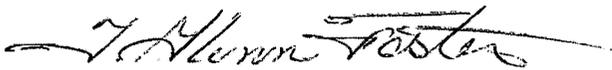
- Q2. You ask if, under §§ 173.316(c) and 178.57, the cylinder may have relief valves designed to operate at 22, 100, and 110 pounds per square inch (psi).
- A2. Under the HMR, pressure control systems for cylinders in cryogenic liquid service must be designed and installed in a manner that complies with the requirements prescribed in § 173.301(f) and prevents the cylinder from becoming liquid full. This means the pressure relief devices within these systems must be suitable for the intended service in that they are the correct size, type, quantity, pressure, in the correct location, and tested for the cylinder and material transported in conformance with Compressed Gas Association (CGA) pamphlets CGA S-1.1 (pressure relief valves), except CGA Section 9.1.1.1 and CGA C-7 (labeling). PHMSA incorporates these pamphlets by reference under § 171.7(a)(3). CGA S-1.1 states the set pressure of the pressure relief device must not be less than 75 percent or more than 100 percent of the minimum required test pressure of the cylinder on which the pressure valve is installed (see CGA Section 4.3.2). In

addition, CGA S-1.1 states the pressure control valve for a DOT 4L cylinder must “have a set pressure not to exceed 1-1/4 times the marked service pressure of the cylinder less 15 psi if vacuum insulation is used” (see CGA Section 5.8.3). You state the marked service pressure for your DOT 4L cylinder is 115 psi and it does have vacuum insulation. Based on the information you provided, it is the opinion of this Office that the cylinder you described may be equipped with pressure relief valves designed to operate at 128.75 psi. For the pressure relief valve to be designed to operate at 22, 100, and 110 psi, the marked service pressure of the cylinder must be 5.6, 68, and 76 psi, respectively.

- Q3. You ask if, under §§ 173.316(c) and 178.57, the cylinder may be loaded and unloaded while mounted to a vehicle.
- A3. The answer is no. In accordance with § 177.834(h), discharge of the contents of any container subject to the HMR, other than a cargo tank or IM portable tank, must not be made before the container is removed from the motor vehicle.
- Q4. You also ask if the design you propose must be approved under a special permit issued by PHMSA.
- A4. The answer is yes. See Answer A1.

I hope this satisfies your request.

Sincerely,



T. Glenn Foster
Chief, Regulatory Review and Reinvention Branch
Standards and Rulemaking Division

Edmonson
§ 178.57

Drakeford, Carolyn (PHMSA)

From: INFOCNTR (PHMSA)
Sent: Tuesday, June 29, 2010 1:17 PM
To: Drakeford, Carolyn (PHMSA)
Subject: FW: Request for formal written interpretation of horizontal DOT 4L cryogenic liquid cylinders

Cylinders
10-0147

Carolyn,
Yet another request for a formal interpretation of the regulations.
Thanks,
Rob

From: Keith Hall [mailto:khall@cvatanks.com]
Sent: Tuesday, June 29, 2010 12:34 PM
To: INFOCNTR (PHMSA)
Subject: Request for formal written interpretation of horizontal DOT 4L cryogenic liquid cylinders

The purpose of this communication is to request formal written interpretation as to the fabrication of horizontal, versus vertical, DOT 4L cryogenic liquid cylinders per Part 178.57, subpart c, Specification 4L welded insulated cylinders.

CVA is a registered DOT facility, #CT-8039. CVA has the opportunity to quote on fabricating a specific type of a DOT 4L cylinder. These cylinders will comply in all aspect to Part 178.57, except they will be transported and used in the horizontal position (the piping remains on the head of the cylinder, which will be one end of the vessel in the horizontal position). Such cryogenic liquid cylinders were previously manufactured by Taylor-Wharton (Theodore, AL). We do not know if they had an exemption/special permit to fabricate them – or if we are required to seek such.

These vessels are transported in a van for home medical oxygen delivery. They are designed with a relief valves to operate at 22 psi, 100 psi, or 110 psi.

The only reference to cylinder orientation that we found in 178-57 – (p) (4) states: “Special orientation instructions must be marked on the cylinder (for example, THIS END UP), if the cylinder is used in an orientation other than vertical with openings at the top of the cylinder.”

This would lead us to believe that we can manufacture horizontal cylinders, but would need to mark which side is up. As previously explained, the openings would still be on the head, just like other DOT 4L cylinders, but as they would be in the horizontal position the openings would be on the end; “with openings on the top of the cylinder” is ambiguous in this application.

In a related section, 173.316 (c), states: **Specification cylinder requirements and filling limits.** Specification DOT-4L cylinders (§178.57 of this sub-chapter) are authorized for the transportation of cryogenic liquids when carried in the vertical position as follows:”

Filling in the horizontal position is not addressed. Is a special permit/exemption required to fill these horizontal liquid cylinders? Would a special permit/exemption be required if we wanted to fill these horizontal vessels while in the van, versus unloading them for filling every time, as it would be difficult to fill by weight? Would this be possible were we to demonstrate that they are always filled under the DOT fill limit via a full trycock set for liquid saturated at the MAWP of the vessel, and or by a liquid level gauge?

I appreciate your timely interpretation of these questions, and thank you for your assistance.

Sincerely,



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