



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: November 30, 1993

In Reply Refer To: I-93-1 and -2

Ms. Rose McMurray
Acting Administrator
Research and Special Programs Administration
400 Seventh Street, S.W.
Washington, D.C. 20590

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About 9:40 a.m. on March 1, 1993, a Department of Transportation (DOT) specification 3AA compressed gas cylinder filled with 600 pounds of poisonous anhydrous hydrogen chloride gas began leaking inside a tractor semitrailer on Interstate 35 (I-35) near Des Moines, Iowa. The escaping gas combined with water vapor in the air to form a white vapor cloud of hydrochloric acid. The internal pressure in the cylinder was calculated to be about 354 psig when the leak began.

The driver of the tractor semitrailer pulled the vehicle onto the shoulder of the highway after he received a call on the CB radio from a person who observed white vapor, initially thought to be smoke, coming from inside the semitrailer. The driver called the local emergency response phone number. After the emergency response personnel arrived and identified the hazardous material that was being carried in the vehicle, they closed a 2-mile section of I-35 and evacuated about 500 persons. There were no serious injuries.

Postincident testing revealed that the cylinder was leaking anhydrous hydrogen chloride gas through the threads between the cylinder neck and the pressure relief device. Examination and measurement of the cylinder neck threads revealed severe corrosion on the interior section of the tapered threads.¹ The corrosion was likely due to the corrosive action of hydrochloric acid resulting from the combination of anhydrous hydrogen chloride gas with minute amounts of water or water vapor inside the cylinder.

¹ The cylinder threads were 1-11.5 National Gas Taper threads. As used in this letter, the outer section threads refer to the first two to three complete threads within the cylinder neck opening. The interior section threads refer to the threads inside the cylinder neck, below the outer section.

National Gas Taper threads are designed to provide a gas-tight seal at the point where the lowest threads on the safety relief device or other fitting engage the interior section threads in the cylinder neck. It is likely that the corrosion of the interior section threads in the cylinder neck prevented an effective gas seal on the safety relief device.

Records of the Vulcan Materials Company (the cylinder owner and retester) show that this cylinder was visually examined for thread damage on February 20, 1993, during a periodic retest performed in accordance with Title 49 Code of Federal Regulations (CFR) Section 173.34(e). A Vulcan official said that an L1 thread gauge was used during periodic retests of their cylinders. An L1 thread gauge measures only the outer section threads of cylinders.²

Postincident visual examination of the cylinder revealed minimal corrosion damage on the outer section threads in the cylinder. Measurement of the outer section threads during postincident testing, with an L1 thread gauge similar to the type used by Vulcan during periodic retesting, indicated that the cylinder neck had adequate thread engagement for fittings. Postincident measurements were also taken on the interior section threads using an L9 thread gauge.³ These measurements and additional examinations revealed severe corrosion. The L9 thread gauge did not engage the tapered cylinder neck threads until approximately 3.75 turns past the maximum insertion limit on the gauge.

After the periodic tests of the cylinder, Vulcan employees used Teflon tape to ease the installation of the fittings, including the safety relief device, into the cylinder neck threads. The Teflon tape may have formed a temporary barrier to the leak path in the threads and delayed the onset of the leak that occurred on March 1, 1993.

Title 49 CFR Section 173.34(e) requires that DOT 3AA specification cylinders used in the transportation of anhydrous hydrogen chloride gas be retested at least once every 5 years. The retest must include a visual examination in accordance with the Compressed Gas Association's (CGA) pamphlet C-6, *Standards for Visual Inspection of Compressed Gas Cylinders*, 1984. Pamphlet C-6 requires a visual examination of cylinder neck threads to ensure that corrosion of the threads does not preclude a gas-tight seal. The pamphlet does not mention the use of thread gauges. The CGA's *Handbook of Compressed Gases*, however, recommends that cylinder neck threads be measured with an L9 gauge in the area where the threads engage the lower end of the valve threads to ensure a gas-tight seal. The Safety Board's investigation of the Des Moines accident determined that a visual inspection of the cylinder's neck threads was not adequate. Therefore, the Board believes that the Research and Special Programs Administration (RSPA) should coordinate with the CGA in amending pamphlet C-6,

² An L1 thread gauge measures the insertion depth of the hand-tight engagement for a standard fitting by indicating when the tapered threads in the cylinder mate with the tapered threads on the gauge. This measurement determines if the cylinder threads are adequate for the installation of a specific fitting.

³ An L9 thread gauge measures the insertion depth at which the tapered threads in the cylinder engage the tapered threads on the gauge. The failure of the threads on the gauge to mate with the threads on the cylinder at a given insertion depth inside the cylinder is indicative that the cylinder threads were improperly machined or were damaged since manufacture.

referenced in Section 173.34(e), to require, during periodic examinations of cylinders, the use of a thread gauge that measures the interior section threads in cylinder necks to identify severe corrosion on cylinders used to transport gases that have corrosive properties. The Safety Board has issued a companion recommendation (I-93-3) to the CGA.

Section 173.34(e) also contains criteria for condemning from service cylinders found to be damaged or defective. This section requires cylinders to be condemned when they leak, or when internal or external corrosion, denting, bulging, or evidence of rough usage exists to the extent that the cylinder is likely to be weakened appreciably. Because severely corroded interior threads can result in failure to attain an effective gas-tight seal on fittings installed in cylinders, the Board believes that the Federal regulations should also contain criteria for rejecting a cylinder that has been proven, through gauge measurement, to have severely corroded neck threads.


Therefore, the National Transportation Safety Board recommends that the Research and Special Programs Administration:

Coordinate with the Compressed Gas Association, Inc., in amending pamphlet C-6, *Standard for Visual Inspection of Compressed Gas Cylinders*, to require the use of a thread gauge, such as an L9 or equivalent, to measure the interior section neck threads for acceptance or rejection during periodic examination of cylinders that are used to transport gases with corrosive properties. (Class II, Priority Action) (I-93-1)

Prohibit the use of cylinders that do not meet the acceptance criteria for cylinder neck threads established in CGA pamphlet C-6, *Standard for Visual Inspection of Compressed Gas Cylinders*. (Class II, Priority Action) (I-93-2)

Because some time will be required to amend and distribute the revised pamphlet, the Safety Board has also recommended to the CGA (in Safety Recommendation I-93-4) that it inform its members of the circumstances of this incident, and emphasize the importance of using an L9 thread gauge, or equivalent, to ensure a gas-tight seal in cylinders used to transport gases with corrosive properties.

Chairman VOGT, Vice Chairman COUGHLIN, and Members LAUBER, HAMMERSCHMIDT, and HART concurred in these recommendations.


By: Carl W. Vogt
Chairman