



## Aluminum Cylinders

Gas cylinders conforming to the requirements of the Canadian *Transportation of Dangerous Goods Regulations*, including cylinders made of aluminum, are very safe. Millions of cylinders are in use in Canada, and failures of any kind are extremely rare.

On April 19, 1999, the first known rupture of an aluminum cylinder in Canada occurred in Campbell River, British Columbia. The SCUBA cylinder failed while being refilled, rupturing into three pieces. Markings on the seamless aluminum cylinder indicated that it was manufactured in 1974, in accordance with United States Department of Transportation special permit DOT-SP 6498, and had a service pressure of 3000 psi (206 bar).

Analysis showed that the cylinder failed due to pre-existing cracks in the neck and shoulder areas.

The cylinder was manufactured from aluminum alloy 6351. Studies have indicated that cylinders manufactured with this alloy may develop cracks in the neck and shoulder areas.<sup>1</sup>

This 6351 alloy was used in the manufacture of cylinders for use in North America until July 1990. The alloy was used for seamless aluminum cylinders and for liners of composite cylinders. The cylinders were manufactured in accordance with CTC (Canadian Transport Commission) and DOT (United States Department of Transportation) specifications, special permits, and exemptions. (For details regarding a particular cylinder, the cylinder manufacturer or distributor should be contacted.)

The *Transportation of Dangerous Goods Regulations* require that cylinders be requalified periodically.<sup>2</sup> Typically, seamless aluminum cylinders must be requalified at least every 5 years, and composite cylinders must be requalified at least every 3 years. Requalification includes a hydrostatic test, as well as external and internal visual inspections, and must be done at a Transport Canada registered facility.

The importance of the internal visual inspection in maintaining the safety of cylinders must be emphasised. Cracks, such as those which led to the Campbell River failure, can be detected with a careful and proper visual inspection of the cylinder neck and shoulder areas, at the time of requalification. A fine line running through the threads, parallel to the longitudinal axis of the neck, or one or more lines radiating outward on the machined top face of the cylinder neck is indicative of cracking. Any fold in the internal shoulder area, where the uneven surface has a peak or depression which is sharp or deep, may be a starting point for a crack. **Any cylinder with a crack or fold must be condemned and must not be returned to service.**

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<sup>1</sup> The mechanism is known as sustained load cracking (SLC).

<sup>2</sup> *Transportation of Dangerous Goods Regulations* § 7.32 and § 8.4.2.

Seamless aluminum cylinders must be visually inspected in accordance with CGA Publication C-6.1, and composite cylinders must be inspected in accordance with CGA Publication C-6.2.<sup>3</sup>

**A cylinder that is due for requalification must not be filled.** Each time before filling a cylinder, it must be inspected to verify that there is no visible damage that could weaken its pressure retention integrity.<sup>4</sup>

Transport Canada will continue to monitor this issue. In order to facilitate any further investigation into this matter, we request that information on any cylinder failures be reported to:

Senior Specialist, Cylinders  
Regulatory Affairs Branch  
Transport Dangerous Goods Directorate  
Transport Canada  
Place de Ville, Tower C  
330 Sparks Street, 9<sup>th</sup> Floor  
Ottawa, Ontario  
K1A 0N5

Any questions or comments may be also directed by telephone to Amy Park at (613) 990-1137.

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<sup>3</sup> CGA C-6.1, "Standards for Visual Inspection of High Pressure Aluminum Compressed Gas Cylinders", and CGA C-6.2, "Guidelines for Visual Inspection and Requalification of Fiber Reinforced High Pressure Cylinders", are available from the Compressed Gas Association at (703) 412-0900.

<sup>4</sup> *Transportation of Dangerous Goods Regulations* §§ 7.32(1) and §§ 8.4.2(1), and CSA B340, "Selection and Use of Cylinders, Spheres, Tubes, and Other Containers for the Transportation of Dangerous Goods, Class 2", clause 5.1.3. CSA B340 is available from the Canadian Standards Association at 1-800-463-6727.