BA cylinders for life?

Composite pressure vessels using aluminum liners with glass, Kevlar or carbon reinforcement fibres have been available for over 30 years. But how aware is the industry of their performance and dramatic weight reduction compared to aluminum or steel? Pierre Tecon from Florida-based Structural Composites Industries (SCI) focusses on developments in long service life cylinders.

Top right: 6.8-litre, 45 minutes SCBA cylinder with Duralite finish.

While some types of composite cylinders are being manufactured using steel or plastic liners, in this article we will be focusing on so-called "Type III" composite cylinders that use aluminum liners with reinforcement fibres.

Type III cylinders offer a balanced combination of technical benefits (weight, pressure) and safety. In a worst case scenario, the failure of a Type III cylinder will be through leaking before rupture (the Leak-Before-Break ((LBB)) test), as contrasted with the possible sudden bursting which can be experienced with other types of composite pressure vessels. The aluminium liner also provides a guaranteed leak-proof container with a robust connection for the valve. To date, SCI has manufactured over three million Type III cylinders with an unblemished safety record and no field failures. The qualification tests include hydraulic burst tests, ambient cycle tests, bonfire and gun fire tests, thermal cycle tests, drop tests and stress analysis. To insure compliance with design and manufacturing safety requirements of composite cylinders, third-party surveillance is mandatory in accordance with applicable specifications, such as the PED (Pressure Equipment Directives) in the EU.

SCI has been active in the development of new high pressure lightweight large volume tanks for breathing air, used in cascades, air reserves and foam applications. For instance, an 88-litre high pressure cylinder (5,000 PSI, 345 bar) is currently being used as cascade on emergency vehicles and for foam applications (CAFS).

Self-Contained Breathing Apparatus (SCBA) systems used by firefighters have been fitted with composite cylinders for many years. These cylinders have had, until now, a service life limited to 15 years, with a five-year periodical inspection and pressure test. When the cylinder then reaches the 15 years prescribed service life, it has to be discarded and can no longer be pressurised.

For some organisations the cylinders have still been in excellent condition after 15 years service life, and so questions as to why they could no longer be used have been raised. Consequently there has been an interest in the European market for cylinders with longer service lives, up to 30 years, or even with "non-limited life". SCI has obtained European certification for longer service life cylinders (30 years and non-limited life) and US DOT certification for 30 years service life cylinders. Fire departments have recognised the benefits of these extended service life cylinders, even though their costs are slightly higher than standard cylinders, and have responded enthusiastically. SCI is the only manufacturer presently offering aluminum-lined longer life SCBA cylinders to the fire services.

Composite cylinders are also now being used more and more in the new generation of closed circuit, long duration rebreathers. These are used both for underground deep penetration rescue and also for underwater applications, professional and military. The lighter weight and improved buoyancy characteristics makes them easier to use both on land and in the water.

The technical benefits and the safety factors offered by Type III composite cylinders are widely recognised and accepted in the fire, rescue and industrial markets. With composite pressure vessels available from sub-litre water volume up to over 300 litre or more, and service pressure up to 10,000 PSI, SCI offers solutions to a wider and wider range of users and applications.