Reprinted with permission; April 2016 CryoGas International

What Makes a High Pressure Cylinder Safe to Fill?

By Jon Davignon

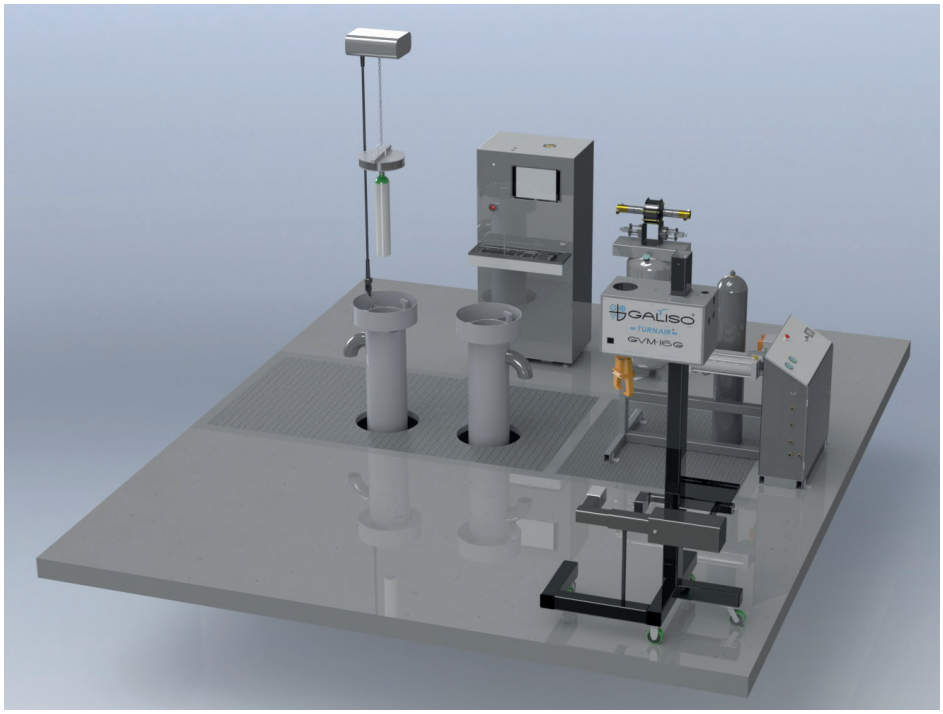
I always enjoy hearing stories from CEOs and company owners in which they describe working their way up the ladder by starting out testing cylinders in the "Pit." Cylinder testing equipment actually sits above a sunken area in the floor, known in the trade as the Pit. The water from the testing drains into this area to be pumped out. It is not an especially glamorous job, which may be another reason why it is known by that term. But those who have worked around the pit understand the importance of the job and typically have an appreciation for the work involved.

To me, working the Pit is similar to a military service where you have to serve on the frontlines to earn your command. If you have served on our industry's frontline, you have gained my respect. Here is why:

The majority of cylinders are failed by visual inspection. The cylinder tester, therefore, is the company's first line of defense in identifying cylinders that need to be taken out of the service stream. The typical time between tests is five years. What were you doing five years ago? How much wear and tear have you seen in that period of time? Since a cylinder may be filled and emptied many times between tests, it is critical to evaluate the cylinder externally and internally. The external surface is easier to evaluate than the internal surface.

De-Valving

Cylinders normally arrive at the test station with a valve, but before the valve is removed, you must make sure there is no pressure in the cylinder. Opening the valve does not constitute an empty cylinder. You need to verify that each cylinder is empty by adding air through the inlet while the valve is opened and listen for the air to come back out of the cylinder. Failure to make sure the cylinder is empty may have serious consequence or can be fatal. We have a recommended procedure on our website, *galiso.com/Videos/mp4Videos/CylSafety.mp4*. We also recommend a safety shield when using valving machines. Accidents and miscommunications happen and safety shields have proven their value on more than one occasion.



"The Pit"

The cylinder tester is the company's first line of defense in identifying cylinders that need to be taken out of the service stream.

Have you ever removed a lug nut from your car that was difficult to break free? Lug nuts are typically 80-140 ft/lbs of torque and are attached to a stationary vehicle for ease of removal. You don't have that luxury with a valve on a cylinder. Their torque can be up to 350 ft/lbs for one-inch thread valves. It is no joke when someone mentions a six-foot cheater bar (handle extension). Thankfully, today a valving/de-valving machine quickly makes light work of removing valves with adjustable torque up to 800+ ft/lbs at around 55 rpm.

Inspection

Once you have removed the valve, the inspection process takes place. First the neck thread on the cylinder is inspected. This is of utmost importance on aluminum cylinders, as there is a higher frequency for cracking at the neck thread than there is on a steel cylinder. Cracking is not caused by inserting or removing the valves on aluminum cylinders, as these are straight thread cylinders and have an O-Ring seal. There is no forced metal to metal contact.

Cracking is typically caused by a material defect and can be identified through visual examination or what is called an Eddy Current Evaluation. In an Eddy Current Evaluation an electromagnetic wave is introduced and normally follows a circular pattern. Any deviation or spike of this wave indicates a longer path the wave must take and

denotes an imperfection. There is also a high intensity light that is used for internally viewing the cylinder. The water jacket cylinder testing method is performed after visual examination.

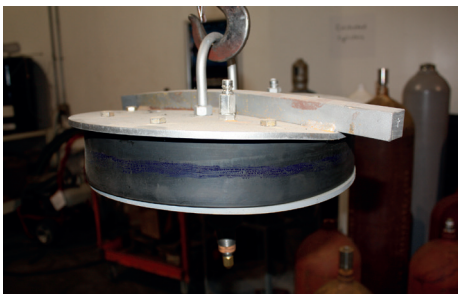
Testing

Cylinders come with many different neck threads. Once you have determined the neck thread, the cylinder is filled with water and the test head is connected to the cylinder. Galiso has manufactured over 150 different connections for cylinder testers worldwide.

Before the invention of the Pneumatic Test Head with Speed Seal in the 1970s, every connection required either an O-Ring seal for Straight Thread Cylinders, or that the connection be taped with Teflon and tightened to a point to make sure there was no leakage at required test pressure (for example 10,000 psi on a 3AA6000 cylinder). This method could be problematic as it required the tester to pressurize the cylinder to determine if it had a good seal.

The Speed Seal, introduced in 1971, significantly helped with this aspect of testing by only requiring that the tester turn the head and adapter into the cylinder hand tight. Once the cylinder is in the jacket it is rotated under safety retaining arms. Low pressure air is connected to the test head which seals the speed seal at the cylinder, and simultaneously seals the test head inside the test jacket.

At Galiso, we take operator safety very seriously and have designed our equipment to withstand a catastrophic cylinder failure inside the test jacket. There are important safety components on the test jacket, to keep the operator safe. For example, there is a retaining bar that is one-inch steel on the test head, which is retained by brackets on the jacket in the event of a cylinder rupture.



Test head after a cylinder failure.

The burst disk, which is found protruding from the side wall of our jackets, is designed to shatter in event of a cylinder rupture thus preventing pressure buildup inside the jacket. It is made out of crystal glass, which is batch tested to burst at 20-30 psi. This part of the water jacket should never be blocked off with untested regular glass or any other material that is not designed to release pressure instantaneously. Otherwise, damage, like that shown in the first photo, can occur.

This CO_2 cylinder burst at the sidewall, where it is designed to burst. There was no damage to the equipment. Photo Courtesy Gilbert Price.

Cylinder Washing, Drying, Re-valving

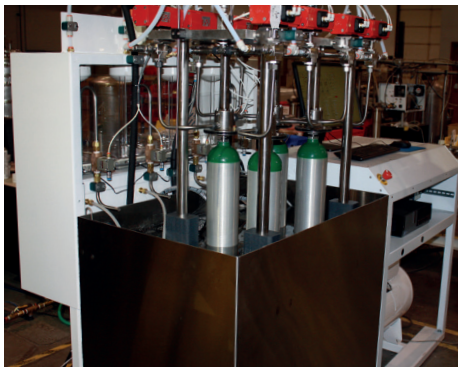
Once a cylinder has been tested, the cylinder is drained, washed, and then dried. Then another visual inspection is done at this stage, to verify the cylinder is clean and dry.

The detergent we recommend for washing is SD-13. This has been specially formulated for washing cylinders and is injected into the cylinder during the wash cycle on our Inverter Wash Dryer. Two cylinders can be dried in as little as three minutes when used according to specifications. Once dried, cylinders are stamped with a test date and RIN, the valve is inserted, and the cylinder is ready to be put back into service.

Safe and Efficient

This may sound like a lot of work, but these steps are valuable to ensure that cylinders are ready for another period of service and are safe to be in use. Good equipment will make the job easier without skipping any steps.

New methods enable us to perform cylinder testing more efficiently. For example, Galiso has an Aluminum Small Cylinder Tester that can test 88 medical E cylinders per hour with one operator. It is loaded by the operator empty, then automatically filled with water, tested, and removed empty.



Testing medical E cylinders.

If you have a cylinder capable of 10,000 test pressure cycles, I would rather use some of those test cycles to verify beyond a doubt that a cylinder is physically capable of holding the pressure it was designed to hold. I have seen cylinders that look like they are good, but when volumetric expansion-tested, it becomes apparent that the cylinders were not safe to contain pressure. Volumetric expansion testing is a proven method to reveal the ductility of a cylinder and ensure that a cylinder can contain a lesser pressure safely.

To learn more about these cylinder testing methods and others, visit *galiso.com*.

Jon Davignon is Marketing Manager at Galiso Incorporated in Montrose, Colorado. Since 1962, Galiso has helped to set the standard in hydrostatic testing equipment for gas cylinders and continues to produce innovative equipment in this industry. Jon can be reached at jd@galiso.com.