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Tech talk #7: “Under pressure – feeling and filling in control” part 1

A whole lot of topics randomly cross my mind just thinking about the subject of filling cylinders; inevitably including ‘exploding cylinders’. Fortunately, those ‘explosions’ do not happen that often; however, it appears that most of these incidents happen at the fill station or during the filling process (around 90%). So let’s have a look this week at some of the issues associated with cylinder fills.

Cylinders do not really explode in a way of a bomb going off. Cylinders rupture at the weakest point once the internal pressure is high enough or cylinder valves blow out of the cylinder when cylinder and valve threads form a non matching pair. When this happens they pretty much take of like an unguided rocket trying to destroy everything in their path. A fair analogy would be to inflate a balloon and to hold its stem closed. You then let go off the stem and the balloon will behave in a very unpredictable way. Google some pictures of ‘scuba cylinder explosion’ to get yourself a clearer picture of how cylinders rupture, you will notice that they are literally peeled open and fragments go missing... These fragments or shrapnel most certainly have the power to cause a fair bit of damage often flying several meters away, penetrating walls, flying through roofs... for sure carnage in the dive locker. To appreciate the destructive forces, you can as well have a look at the attached videos (controlled circumstances).

As mentioned, ruptures will occur at the weakest point and these weak points can occur due to external or internal damage, metal fatigue caused by overfilling. So in order to prevent this from happening, cylinders need TLC, avoiding damages and inspect them at regular intervals to detect those damages before they become dangerous. Therefore knowledgeable fill station operators will always perform a cursory visual inspection on the outside of the cylinder to ensure the cylinder is in a good condition, in doubt, they will refuse a fill until the cylinder is proven to be in a healthy state. Furthermore those fill station operators will not fill cylinder which does not have a current visual or hydro.

But explosions in the true sense of explosion can occur as well, but those will be linked to cylinder fills where pure oxygen is involved. In order to fill cylinders with pure oxygen, both the cylinder and valve should be oxygen clean and compatible and maintained in that state. Again a responsibility of the fill station operator to ensure that cylinders to be filled with pure O₂ are in date for oxygen cleaning, if not or in doubt they are, refrain from filling. Remember a while ago getting some

cylinders in for a visual inspection, as they were to be used for Nitrox this would mean as well an oxygen service. Although an oxygen service sticker was still affixed to the cylinder and still in date, when removing the cylinder valve, I discovered the valve to be inserted with silicone grease. Not really a reassuring thought, so in doubt, check it out.

In the end a cursory visual inspection and ensuring cylinders are in date is not only good practice in safe filling operations, in many countries this would be a legal requirement. It just doesn't stop there, certain countries will require fill station operators to be trained and retrained on a regular basis. The latter certainly applies to the US but also within the European community and especially the UK strict rules are enforced. Did you know that just not any type of cylinder can be filled in any country or that fill stations should have operating procedures available?

So is there anything we can do to protect ourselves and customers? Yes there is but unfortunately the top of the range solution: total or partial containment systems are very pricy and unlikely to be within the financial reach of most dive centres. These types of fill Stations are designed to protect the operator during the filling of SCBA and SCUBA cylinders. In the unlikely event of a cylinder rupture during the filling process the SCBA/ SCUBA fill stations are designed to vent the rapidly expanding air while containing all fragments inside the fill station.

Enough about worst case scenarios let's focus on some simple tips to improve your safe filling procedures and some points to consider when setting-up or improving your fill station.

- Only fill cylinders that are in date (visual and hydro) and are of a legal type to be filled.
- Keep your customers away from your filling station; it should be authorized personal areas only; in addition keep the filling panel away from your retail area.
- Check you fill whips on a daily basis, if they look or are damaged, replace them. Keep your fill whips as short as possible.
- You could consider a blast wall between the cylinders to be filled and your filling panel. It would be good practise to locate the control/fill panel in a way so that the fill station operator is not directly exposed to the cylinder being filled.
- Do not overfill cylinders and do not exceed recommended filling rates, more about that next week.
- When filling cylinders avoid the possibility of them falling over, a filling rack could be considered.
- When handling a cylinder by the valve, keep the cylinder valve opening away from your hand.
- Also the compressor poses a safety hazard: moisture separators and filter towers are pressure vessels and should be inspected and maintained on a regular basis. When they reach their useful life, they should be replaced as per manufacturer's recommendations in the instruction manual.
- Have safety measures in place like a remote crash stop for the compressor, shut-off valves for your air bank... just in case the filling gets a little out of control.
- In some countries, health and safety regulation might require the fill station operator to be equipped with personal protective equipment like safety glasses, shoes and ear defenders.

