file: IT2SF_gas_storage_00 p 1 of 2 prepared April 2005 / printed: SPIRIG ERNEST SWITZERLAND Fax (+41) 55 222 6969 (+41) Phone 55 222 6900 E-mail: info@spirig.com www.spirig.com

Technical Information

Safety and Risks of Using Pressurized Gas Tanks

Again and again incidents with pressurized gas containers do cause harm and destroy properties. These incidents sometimes do find entry into the local news.

The general public but also employees in factories are not aware what type of risk sometimes resides nearby, be it in a store, a factory or even in a residential areas.

A pressurized gas container (Acetylene or Oxygen) used in welding, brazing or soldering applications), be it in a full blown factory, a car / body repair shop, a jewellers / goldsmith atelier to make or repair jewelry or a research laboratory contains an **enormous** stored

(a) mechanical energy in the compressed gas

(b) chemical energy released as the content reacts with the ambient.

In case of an accident what are the results of the both freed energy contents?

To create a volume of stored compressed gases in a closed container usually an electric motor driven mechanical gas compressor pushes gas into the closed volume of a storage vessel (container, bottle, ..) until a certain pressure is reached. Then the vessel is closed and all that mechanical pumping energy delivered by the electric motor is now caught in that volume to be later released again to deliver mechanical work by decompression, eg in a turbine.

To better understand the energy contained, for example to propel a torpedo with 90 km/hours (60 miles / hour) over a distance of 2000 meters (approx 2000 yards). This is pure mechanical energy and safely contained in properly designed / law regulated bottles.

What's the weak point of safety there? as long as the bottle carries its valve protective cover the bottle can take a lot of rough mechanical abuse, it is and must be designed and certified to do so. As this protective cover is removed a first line of defence is lowered. User will have to mount a pressure regulation valve system on top creating a first "weak" spot which can be damaged by negligence. Bottles must be operated in a vertical position to keep any fluid residues at the bottom of the bottle. That is not the stablest position. The bottle must be safely secured to a wall. If the bottle would topple over and that high pressure valve would break off then the bottle will be its self-propelled torpedo body easily hitting through walls. Remember having seen kids playing with one of those elastic balloons blown up and then released with open filler mouth. Imagine what type of dance the pressurized bottle will perform with a minimum 500 - 1000 times higher starting pressure!

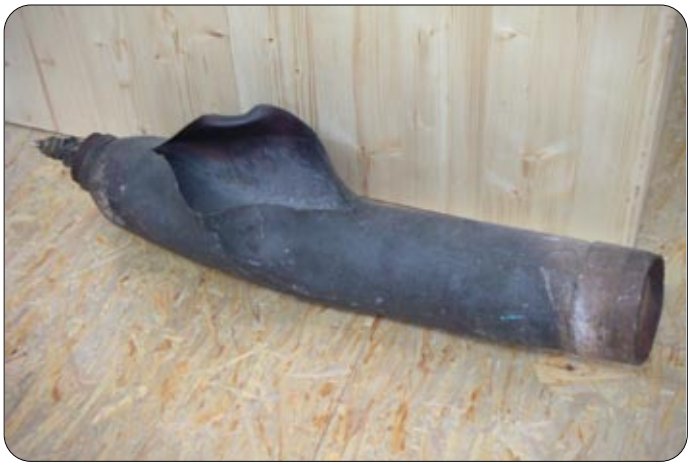

fig. 1 Exploded acetylene gas tank shown as a reminder of gas tank risks at a recent crafts exhibition at Munich. ©Spirig

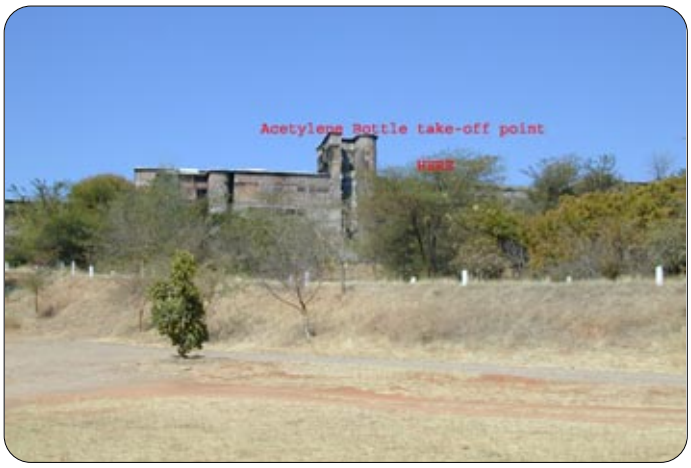

fig. 2 On top of this building was a jewelry repair shop. "Possible" origin of desaster an exploded acetylene gas tank. ©Spirig

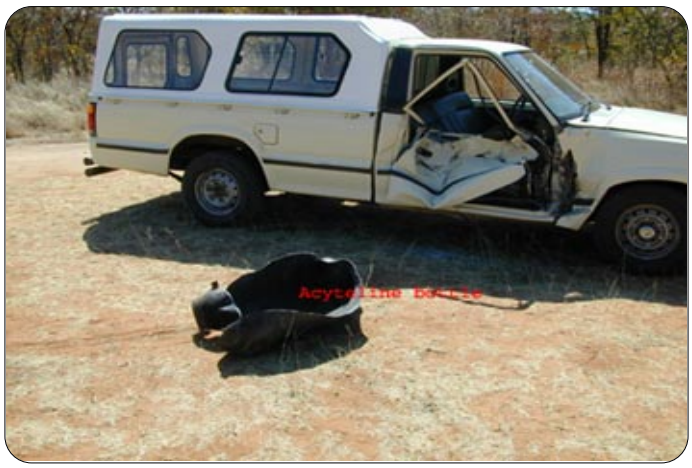

fig. 3 The exploded acetylene gas tank traveled almost 200 meters before hitting on a nearby parking lot the side of a car. ©Spirig

Now the above scenario might still be visually and acoustically "amusing" when seen from a remote location. The result will hopefully be only mechanical damages to the surrounding ambient.

But what happens if that compressed gas is for example of combustible nature, like hydrogen or acetylene?

Now you have a bottle sized self-propelled torpedo acting like a welding torch or a starting rocket. Such an incident is simply said a catastrophe! See images.

Argument goes: "this will never happen, we handle the bottles carefully, we follow carefully all safety instructions, and, and ...!"
Well and it still happens, regularly,each day, each month, each country more or less frequent.

Such a self-propelled gas tank might consume itself like that mentioned kids balloon. After a certain time of having mechanically damaged the surroundings it simply dies because of lack of propelling gas pressure.

However probability is very high that the combustible gas will be ignited by a friction created spark (metallic tanks) and starts-up as a self-propelled gas tank welding torch. This torch might also peacefully die after stored gas is consumed, but after having first burnt and ignited the surroundings.

If this "peaceful" self-propelled welding torch might be blocked it might well weld open its own steel walls and explode in one giant energy release burst. Mechanical and chemical energy released in one burst. This would be close to the worst case situation and very similar to a past accident with a hydrogen propelled booster rocket in space research.

Above scenario will hopefully never happen, as it would be caused by user negligence.

But what happens in case of a fire, the gas storage tank exposed to heat?

This is now the really worst case. Before explosion the heat around the tank will increase the gas internal mechanical pressure until the steel container disintegrates.

Actually the heat energy flowing into the tank increases there the mechanical energy stored. At disintegration point the contained combustible gas can start its own chemical energy releasing reaction with the ambient atmosphere. This reaction is additionally propelled by the mechanical and following explosive expansion into an enormous fire ball.

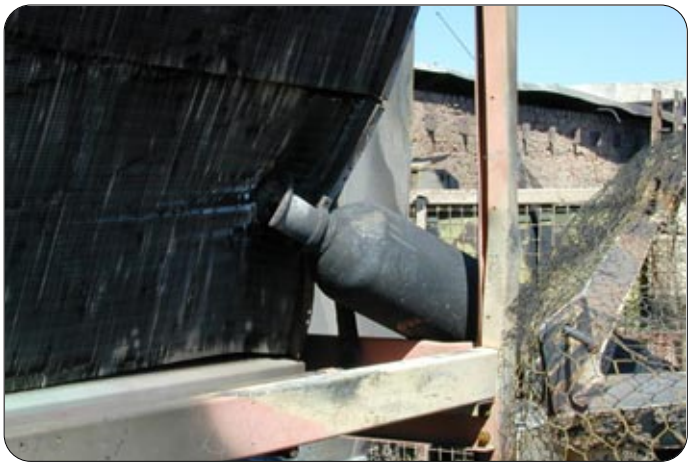

fig. 4 Luckily the flying oxygen gas tank was trapped in the steel construction of the aircon water cooling tower and kept from moving on. ©Spirig

fig. 5 View on the damaged floor after some clearing from major rubles. ©Spirig

fig. 6 View on area taken for evidence gatherings immediately after incident. ©Spirig