

Acetylene is one of the most dangerous flammable gases...

There is a Way to Make It Safer



SPECIAL FEATURE



Acetylene cylinder filling

New hose technology improves safety

By David Birch

Acetylene is one of the most dangerous flammable gases. Because of its molecular triple carbon bond it inherently has a great deal of stored energy able to be released either in a controlled process, such as welding and cutting, or in an uncontrolled fashion during decomposition. It will burn in air with a very wide flammable range of between 2.5% and 82%, according to ENGA document 123. Significantly it can decompose in the absence of an oxidant that it has been categorized in the past as a pressure explosive and hence the upper limit of 82% is almost academic for practical purposes.

Use of certain metals with acetylene is forbidden e.g. copper and silver, as metallic acetylide compounds can be formed that are unstable and explosive.

Cylinder filling
Filling acetylene cylinders is a relatively complex process compared to filling normal atmospheric gases such as nitrogen, oxygen, and argon. Because of its unstable nature acetylene is not allowed by law to be filled under simple gas pressurization into cylinders. This

is because, beyond approximately 9 psig (59.62 bar), a decomposition in the gas would occur so quickly that a cylinder would be unable to withstand the resulting pressure rise and deformation. Acetylene is usually dissolved into certain solvents.

Internally acetone is used but increasingly dimethyl formamide (DMF) may be employed, particularly for bottle applications or in hot climates because of its reduced volatility. The solvent is contained within a gas cylinder by being welded into a sponge like material called the porous material or "spon". This material has a microcellular structure such that there are no large pockets where the gas could accumulate.

Prior to the filling process, careful weighing of incoming cylinders accompanied by measuring their temperature and pressure is required. Calculations are then made to determine the amount of solvent and the amount of acetylene to be added to allow a safe change to be achieved.

Cylinders used for acetylene must undergo regular inspection to ensure that the cylinder shell is fit for purpose and that the porous material is showing no visible signs of degradation.

Influence of the filling hose
Because of the accuracy of weighing necessary prior to the filling process, beginning, it is essential that an acetylene filling hose should not be too stiff, such that it affects the weighing process. The hose must be able to attach readily to a variety of cylinder sizes governed by filling, and these may well have height differences that could lead to weighing inaccuracies or leaking if the hose is inflexible.

Hose standards and construction
Acetylene hoses have to pass an extreme acetylene decomposition test detailed in ISO 14113:2013 Annex A. This is a "normative" test. Pressures during the test can be expected to rise to more than 900 bar. The ISO standard therefore demands that acetylene hoses shall have a burst pressure in excess of 1,000 bar (14,500 psig) even though in service acetylene filling systems normally operate at pressures only up to 25 bar (363 psig). Such demands for strength can result in a very stiff hose if conventional hydraulic hose construction "rules" are followed.

These "rules" based around traditional hydraulic hose practice, are intended to ensure hoses have a burst pressure of 4 times design pressure. The design pressure for acetylene filling systems constructed to meet ENGA recommendations is 300 bar, therefore such conventionally constructed hoses have a burst pressure in excess of 1,200 bar. However, hoses with burst pressures even higher than this have in the past failed the ISO decomposition test because of the extremely rapid rate of pressurization inherent in the test.

Some years ago it was documented that a spiral wire running inside the hose will reduce the end pressure during the decomposition test from its peak of 900 bar. It does this by preventing a sudden shock wave developing between the decomposed gas caused by the hot and the un-decomposed gas ahead of the flame front. Therefore, there is a mixing of the reacted and unreacted gases at the flame front instead of a very rapid parametric pressurization of the unreacted gas to a point where it would detonate under the influence of pressure and temperature.

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In the December issue of **GASWORLD**, David Birch, a leading expert on cylinder valve technology and member of numerous ISO Committees, has authored an extremely informative paper on the risks of acetylene and how passive safety technology can mitigate against these risks.

He concluded: "In my review of this technology, I found using acetylene filling hoses equipped with the LifeGuard patented safety system should lead to an increase in process safety."

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In addition, Mr. Rob Moyer, President, Rexarc International Inc. , the industry's leading acetylene equipment supplier emphasized the importance of our patented technology by stating:

"The LifeGuard Technologies hose is an innovative product that not only has a superior life cycle, but also has the flow stop feature which adds an additional safety factor should a damaged lead be unintentionally kept in service and fail. is feature will also help protect the entire system should an incident occur beyond an individual cylinder."

Because of its molecular triple carbon bond acetylene inherently has a great deal of stored energy able to be released either in a controlled process, such as welding and cutting, or in an uncontrolled fashion during decomposition.



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