

## Suggestions for amendments to UN Regulation No. 110

In fiscal 2013, we established a 'Study group for CNG cylinders' under the Japan Gas Association, a private association of Japanese gas utilities consisting of experts in high pressure gas cylinders including university professors, members from the High Pressure Gas Safety Institute of Japan (KHK: Kouatsu-Gas Hoan Kyoukai), cylinder manufacturers, cylinder accessory manufacturers and so on, to investigate the safety of UN Regulation No. 110. We have concluded that measures need to be taken for the following issues regarding the regulation and here we suggest concepts for amendment to UN Regulation No. 110.

### 1. Welded metal cylinders

Welded metal cylinders should be deleted from the regulation.

Welded metal cylinders were included in UN Regulation No. 110 in accordance with the suggestion from Germany in 2007. We have heard that the grounds for the introduction of welded metal cylinders were as follows: There are no reasons to exclude welded metal cylinders if the cylinders satisfy specified necessary requirement under the ISO and EN regulations (bending properties and macroscopic weld examination) and other requirement of UN Regulation No. 110.

Welded metal cylinders are not allowed in ISO 11439. We have heard that this is because no test data were submitted during the discussion to examine the introduction of welded metal cylinders.

The drawbacks of welded metal cylinders relate to fatigue.

It is important to establish an inspection technology to find infinitesimal defects as well as to establish a welding technology which eliminates defects of welding. Because production and quality control of welded metal cylinders are both extremely difficult, welded metal cylinders with NWP (nominal working pressure) of 20 MPa should be deleted from the regulation to ensure the safety of cylinders.

According to our research, there are no welded metal cylinders in the world at the moment, and as such, there will be no influence on existing products if welded metal cylinders are deleted from the regulation.

### 2. Steel cylinders (CNG-1 cylinder) and Steel liner cylinders (CNG-2 cylinder)

The presence of water or high humidity may cause deteriorations of strength (delayed fractures) of high-strength steel. It is reported that high-strength steel with a tensile strength of more than 1,200 MPa often undergoes a conspicuous deterioration of strength (delayed fractures). Accordingly, in highly humid regions such as East Asia, the risk of delayed fracture increases because of the increased possibility of cylinders being exposed to water or high humidity.

UN Regulation No. 110 requires sulfide stress cracking testing for CNG-1 cylinder and CNG-2 cylinder using high-strength steel with a tensile strength of more than 950 MPa. But there is no upper requirement for tensile strength.

For steel cylinders (CNG-1 cylinder) and steel liner cylinders (CNG-2 cylinder) built with high-strength steel, some measures such as setting an upper limit of tensile strength are required to ensure safety when

they are used in highly humid areas such as East Asia.

### 3. Regulation for accessories fitted to the cylinder

In the series of six CNG cylinder rupture accidents in South Korea (See attachment), a solenoid cylinder valve defect was found in the 6th accident. To ensure safety of accessories fitted to the cylinder, a batch test (a test conducted for batches consisting of certain numbers of products or conducted for each product) should be required for the certification of accessories.

### 4. Indication of cylinder and accessories fitted to the cylinder

An accident causing one fatality and one serious injury happened in Japan during the scrapping work of a CNG cylinder with a MFP (Maximum Fueling Pressure) of 25 MPa in September, 2012. The accident occurred because they tried to cut the cylinder without checking for residual gas in the cylinder. The cylinder was displaced by the Tsunami caused by the great east Japan earthquake. To ensure the safety of cylinders and accessories, the type of gas, MFP and E-mark should be clearly indicated on both the cylinders and accessories.

Incidentally, in the draft of UNECE regulations for hydrogen fuel cell vehicles, the type of gas and MFP must be indicated on cylinders and accessories.

### 5. LNG tank

From the perspective of ensuring safety, we are examining the suitability of UN Regulation No. 110 regulations for LNG tanks. If any issues are found, some additional measures will be required.

Attachment

No.	Date	Cause of Failure	Casualties	Cylinder Manufact.	Source of Data
1	Jan 2005	Liner failure resulting in rupture	slight injury:1	NK	Hyundai & Korea Gas Safety
2	Aug 2005	Poor heat treatment of liner	slight injury:2	NK	Korea Gas Safety
3	Dec 2007	Bus fire – VTI PRDs outside of fire	slight injury:1	NK	Dynetek
4	July 2008	Rupture – Poor heat treatment of liner	—	NK	Korea Gas Safety
5	July 2009	Leak from crack found during tank filling	—	NK	News report
6	Aug 2010	damage to composite wrap, suspected solenoid valve contributing to overpressure	serious injury:6 slight injury:12	Faber	Faber

(Source) Known in-service failures of approved CNG cylinders, C. Webster, Powertech etc.