

# Type2 Pressure Vessels for Hydrogen Refueling Station

## 1 Introduction

While an increasing number of hydrogen refueling stations (HRSs) are being established in Japan for fuel cell vehicles (FCVs), the high capital cost of the equipment is one of the big challenges.

NIPPON STEEL & SUMIKIN Pipeline & Engineering (NSPE) has since 2014 been involved in the design, construction, and maintenance of safe and reliable HRSs that are also less expensive, working in a technical collaboration with Air Products and Chemicals Inc. (Air Products). A key item of equipment at HRSs is the storage vessel that stores the hydrogen at high pressure. Part of NSPE's work in this area has been the introduction into Japan of an American-made type 2 pressure vessel that is less expensive than the vessels widely used in Japan.

## 2 Overview of Type 2 Pressure Vessel

HRSs typically use a compressor to pressurize hydrogen gas to about 82 MPa, store it in a number of high-pressure gas storage vessels, and use it to fill FCVs.

Along with storing the hydrogen gas at high pressure, the pressure vessels also need to have a high level of safety to prevent the leakage of hydrogen in the event of an equipment problem. Most HRSs in Japan use either steel pressure vessels (type 1) or composite pressure vessels made from an aluminum alloy liner with the exterior fully wrapped in carbon fiber reinforced plastic (CFRP) (type 3).

The type 2 pressure vessels being imported by NSPE have a steel liner with CFRP hoop-wrapped in the cylinder part. These vessels are safe and are widely used in the USA. They are manufactured by FIBA Technologies (FIBA), a US company in a tie-up with

Air Products, and NSPE is the exclusive Japanese importer.

## 3 Features of Type 2 Pressure Vessel

The features of the FIBA type 2 pressure vessel are:

- [1] HRSs can have smaller foundations because the vessel weighs less than a type 1 pressure vessel,
- [2] Longer product life cycle than type 3 pressure vessels,
- [3] Lower cost than type 1 or type 3 vessels, and
- [4] Approximately 10% higher storage capacity for the same amount of space, being available in a wide range of capacities from 150 to 700 L.

Table 1 Specifications of FIBA type 2 pressure vessel

Type	Hoop-wrapped pressure vessel (Type 2)
Capacity	343 L
Dimensions and weight	0.4 m diameter × 4.4 m length 1,651 kg
Design pressure	103.4 MPa
Life	20 years
Standards compliance	ASME Section VIII, Div. 3 The vessel complies with designated equipment laws, with preliminary approval by KHK and special approval by METI



Figure 1 Installed FIBA type 2 pressure vessel

## 4 Example Installations of Type 2 Pressure Vessel

[Shikaoi Hydrogen Farm™]

As one of the participants in a project commissioned by the Ministry of the Environment, NSPE undertook the design and construction of a HRS at a facility for the “Hydrogen Energy Supply Chain Demonstration Project from Livestock Manure” in Shikaoi Town, Hokkaido. This included the supply of the first FIBA type 2 pressure vessels to be installed in Japan.



Figure 2 Shikaoi Hydrogen Farm™



Figure 3 Composite storage vessels  
White: Type 2  
Black: Type 3

[Centrair Hydrogen Refueling Station]

Because it is intended to supply hydrogen to fuel cell buses, this HRS requires a larger hydrogen storage capacity and so needs a large number of high-pressure hydrogen pressure vessels (more than 10, rather than the usual complement of three or four). By installing low-cost FIBA type 2 pressure vessels, NSPE achieved considerable cost savings while still satisfying the capacity requirement. (Completion is scheduled for February 2019)



Figure 4 Artist's impression of completed Centrair HRS  
(Supplied by Toho Gas)

## 5 Conclusions

FIBA type 2 pressure vessels are low-cost and have had extensive use in HRSs outside Japan. By introducing the vessels into Japan, NSPE is helping bring down the cost of construction of HRSs. Keeping technical innovations and developments in the technologies and products used to supply hydrogen, NSPE intends to supply hydrogen infrastructure solutions that meet customer needs by continuing to introduce new technologies and products.

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