

Modeling of Current Standards for Selecting Pressure Vessel Steels to Transport Hydrogen-Bearing Gases

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Objective

- **Develop a model to be used for evaluating standards and test methods in selecting suitable steels for construction of pressure vessels that are used in the transportation of hydrogen bearing gases such as CNG/LNG**
- **Our objective during development and completion of this R&D project are maximum outreach and collaborations from experts representing industry and other government agencies.**



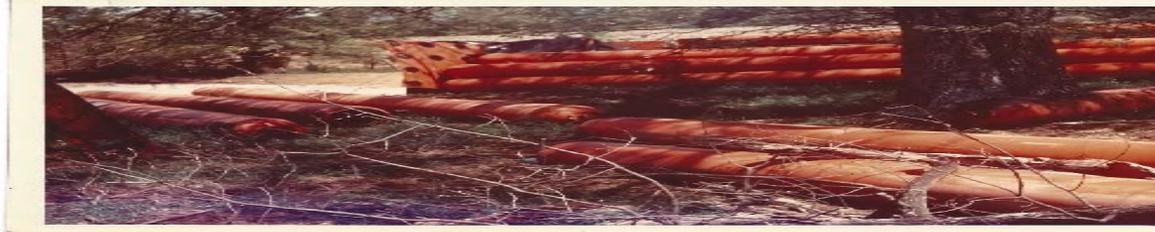
Metallic Pressure Vessels in CNG Service Failure

1978-DOT 3T used for transport of CNG



Metallic Pressure Vessels Failure Due Hydrogen Embrittlement Cracking

DOT 3T Tube in CNG Service - Ruptured in 1978



CNG Steel Pressure Vessels Failure

Rawalpindi, Pakistan, May 7, 2014

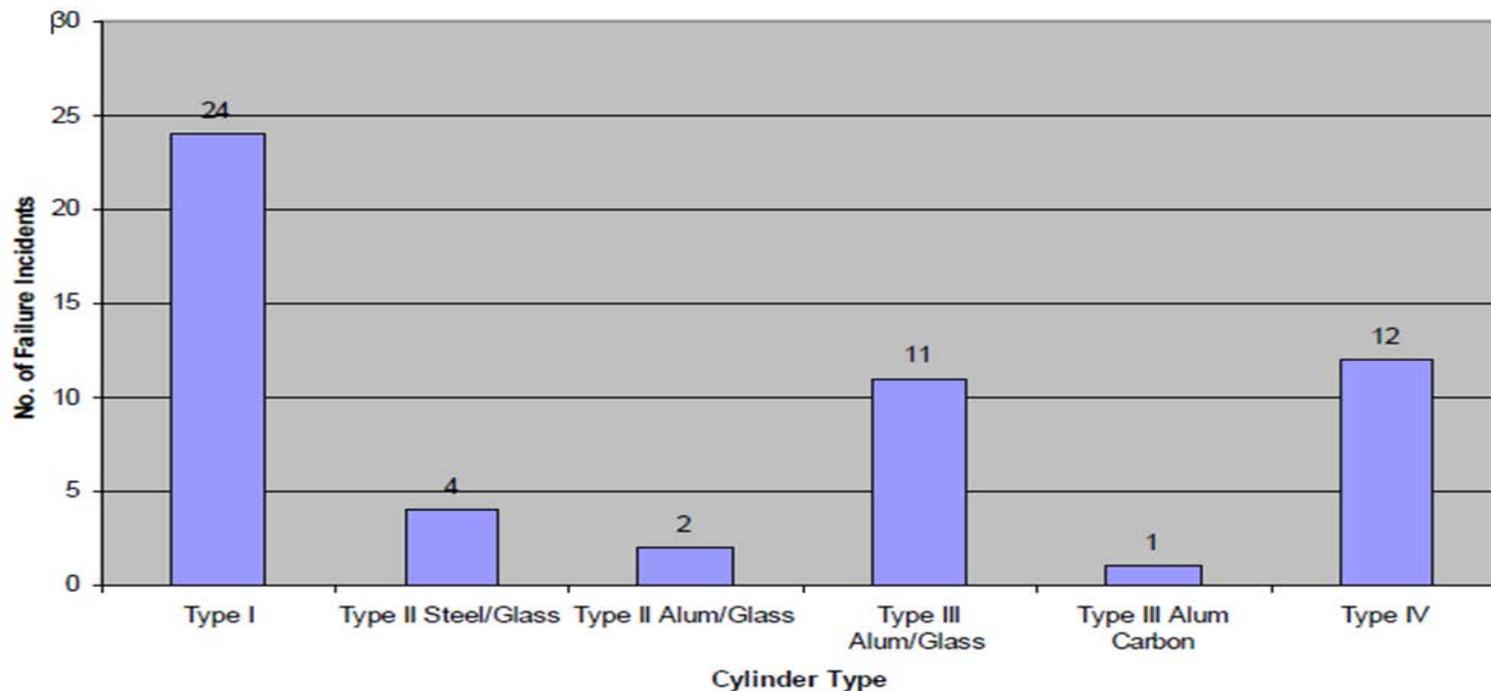


CNG Steel Pressure Vessels Failure



CNG Fully Steel or Steel Metal Liner Pressure Vessels Failure

- Type 1 steel cylinders involved in nearly 50% of failure incidents



Short Term Plan (Phase I)

- Review of current standards and test methods
- Review of regulatory requirements and limits for materials and gas composition
- Identify materials of interest (vessel materials used domestically and internationally)
- Conduct a rudimentary comparison between the failure mechanisms that result from the three accepted test methods in ISO 11114-4 and in-service failures, according to our industry experts.



Long Term Plan (Phase II)

Develop a model for evaluating current standards and test methods that includes:

- **CNG/LNG Sampling and Analysis capability**
- **Metallurgical Analysis and Testing of the Selected Steels**
- **Comparative Test Matrix (Methods A, B & C) Listed in ISO 11114-1 for H2, CNG/LNG at appropriate conditions**



Outcomes (Expected)

Performance Based Model

- **The model will be used for evaluating national and International standards and test method(s). The standards will be considered in UN Model regulations or 49 CFR for selection of steels used for construction of cylinders, tubes and cargo tanks - intended to transport hydrogen-bearing gases such as compressed natural gas (CNG), liquefied natural gas (LNG), hydrogen, and other hydrogen-bearing.**

