

## **Structural-Metals Considerations for Hydrogen Gas Containment**

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Two important safety considerations for the containment of hydrogen gas involve interactions between hydrogen and the structural metals that contain the gas: (1) hydrogen can permeate through metals creating an effective leak, and (2) hydrogen dissolved in the metal can promote embrittlement. Both hydrogen-material interactions are related to the propensity for molecular hydrogen to dissociate on the surfaces of metal structures, producing atomic hydrogen that diffuses into these metals. All structural metals can be vulnerable to hydrogen embrittlement under some intersection of microstructural, mechanical, and environmental conditions, thus it is important to develop a comprehensive understanding of the service conditions for a given application. Important service variables include gas pressure, temperature, and mechanical loading mode. In this presentation, we describe hydrogen embrittlement and its relationship to service variables that can be expected in hydrogen containment applications. Furthermore, we use data from the literature and data generated in our own laboratory to demonstrate these general trends. Our continuing work is motivated by the needs of the engineering community for material properties that can be used to define safety margins for components exposed to hydrogen gas. As part of this work we emphasize appropriate materials testing and structural design protocols that enable the construction of safe and efficient high-pressure hydrogen components.