Measurement Facilities: *High-Pressure Gaseous-Hydrogen Fatigue and Fracture Test Facility*

The Materials Reliability Division has established a unique, state-of-the-art high-pressure gaseous hydrogen test facility dedicated to measuring the mechanical properties of metallic and composite structural materials proposed for use for the transport and storage of hydrogen gas. The facility has the capability of testing at hydrogen pressures up to 138 MPa. This laboratory was designed first and foremost with safety in mind. Safety features include explosion-proof (EP) switches, EP outlets, EP lighting, high air exchange rate, regional lightning detection system, and a fail-safe pressurized hydrogen gas cut-off system. The control room is remote from the testing lab, enhancing the personnel safety aspect of the facility.

Hydrogen Testing Facility (left) and Remote Control Room (right)

Tensile Testing

Currently, the laboratory has a 100 kN force capacity load frame with plans for the immediate installation of a second load frame with a 250kN force capacity. Tensile testing is performed in this facility to determine the mechanical properties of materials proposed for use in the transport and storage of gaseous hydrogen. Typically, hydrogen tensile testing will be performed on smooth round tensile bars which exhibit a lower reduction of area for many alloys, when exposed to hydrogen. Notched tensile specimens will also be tested so that the effects of hydrogen on notch strength can be evaluated. This data will be distributed to other hydrogen materials researchers as well as to the ASME for use by pipeline designers.

Fatigue Testing

In FY10 fatigue testing of existing and new pipeline steels that are proposed for hydrogen service will be conducted. The current load frame is capable of fatigue loading up to 100 kN, and our test chamber can provide pressures of up to 138 MPa for testing in gaseous atmospheres. In FY10, we will add a 250 kN fatigue machine and we will construct a new test chamber that will accommodate 10 fatigue specimens that can be simultaneously tested. This will provide critical design data in one-tenth of the normally expected time.

100kN fatigue test machine with 138 MPa hydrogen chamber.

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