STP-PT-043

ASME FLAWED CYLINDER TESTING

ASME STANDARDS TECHNOLOGY, LLC

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FOREWORD

The ASME BPV Project Team on Hydrogen Tanks, in conjunction with other ASME Codes and Standards groups, is developing Code Cases and revisions to the Boiler & Pressure Vessel Code, including such to address the design of composite pressure vessels. The project team had an interest in further understanding the effect of cuts to the surface of composite tanks, and how the burst pressure would be affected during the lifetime of the pressure vessel.

A test program was initiated to provide data on initial burst pressure, and burst pressure after pressure cycling, of composite cylinders with cuts of different depths. These results were considered during the development and approval of the ASME Code Cases and Code revisions.

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ABSTRACT

The effect of flaws with and without cyclic loading was investigated on a composite overwrapped pressure vessel with a non-load sharing polymer liner. Flaws were machined in the structure to four depths and then were cycled for 0, 10,000 and 20,000 cycles. Finally, the cylinders were hydrostatically burst. These data were compared to a reference burst value of a cylinder without flaws or cycles. The cylinder was 406 mm (16 in.) in diameter by 1020 mm (40 in.) long with a service pressure rating of 24.8 MPa (3600 psi).

The lowest burst-to-operating pressure ratio was 2.13, which occurred with the flaws cut 40% into the structure and no cycles. Even with the deepest flaw and cycling, the resulting burst pressure margin would allow safe operation of the pressure vessel over a period of time. The lack of significant additional strength loss with cycling gives a degree of confidence that even if flaws are not found immediately, the risk of a failure due to the flaw is low.