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Short-term test of ±55 filament wound GRE composite pipes under multiaxial stress ratios

Abstract

This paper discusses the the development of an automated pressure testing rig to perform a short term test; Ultimate Elastic Wall Stress (UEWS) for ±55˚ glass fibre reinforced epoxy (GRE) composite pipe under various stress ratios. The prototype is capable of determining the stress-strain response caused by the static and cyclic pressure. This developed rig is to provide an alternative solution for the current qualification procedure explained in ISO14692 through ASTM 2992. As part of the work, an automated testing rig powered by labview program is developed with the aid of pressure sensors, solenoid valves and strain gauges which are interfaced through hardware modules from National Instruments. The UEWS test for the five stress ratios namely pure hydrostatic (2H:1A), pure hoop (1H:0A), pure axial (0H:1A), hoop to axial (1H:1A) and quad hoop to axial loading (4H:1A) were performed upon the ±55° filament wound glass-reinforced epoxy pipes. The changes in the stress strain response are captured from the strain gauge measurements and the UEWS failure points are calculated for all the loading conditions. The failure envelope developed from the failure points can be used to predict the long term performance of the GRE pipes and provide the benchmark for the design of composite pipes under various stress ratios.

Keywords — GRE composite pipes, Ultimate elastic wall stress (UEWS), stress strain response, multiaxial loadings