IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
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Author: Mr. Paul Murugan J
Vikram Sarabhai Space Centre, ISRO, Thiruvananthapuram, India, paulmurugan1iitm@gmail.com

Mr. Shitij Arora
Vikram Sarabhai Space Centre (VSSC), India, sarora2512@gmail.com
Mr. Thomas Kurian
Indian Space Research Organization (ISRO), India, tomji23@gmail.com
Mr. sivakumar Sivaram
Vikram Sarabhai Space Centre, ISRO, Thiruvananthapuram, India, sivakumarsivaram@gmail.com

STRUCTURAL ASSESSMENT OF SOLID ROCKET MOTOR HARDWARE FROM THE MEASURED RESIDUAL STRAIN AND 3-D PROFILE IN THE LONG SEAM WELD LOCATION

Abstract

The hardware assembly of the motor case made of 15CDV6 material and Nozzle convergent was subjected to the proof pressure along with the corresponding enclosures as part of hardware acceptance protocols. Since the hoop strain measured was higher in the long seam weld location at a pressure level less than the maximum expected operating pressure (MEOP), the pressure was brought down to near zero pressure. During the unloading, the offset strain measured was above 0.2 percent proof strain. Due to this nonlinear behaviour, additional strain gauges were deployed adjacent to higher strain location and acceptance test was successfully completed. Strains beyond acceptable level were recorded in hoop direction at the old and new strain gauge location also. Margin of safety over 0.2 percent proof stress was negative at this location. To investigate on this issue, profile casting was taken using 3-D mould at near the weld and parent metal location. 3-D CMM was used for measuring the profile coordinates. This data was used for 3-D finite element modelling of that profile. The challenge was the 3-D modelling of the larger amount of data measured from the 3-D CMM. Detailed analyses were carried out to capture the residual stress field at that location. Burst pressure estimation at the location was carried out considering the measured residual strain by iterating the stress-strain curve of this material. The estimated burst pressure was observed to be meeting design requirement. As the material exhibits strain hardening effect, acceptance of the hardware was no issue after the burst pressure estimation. This motor was designed for the pad abort test of the crew escape Motor. This paper covers the details of the pressure test, 3-D mould/casting details, profile measurement, 3-D finite element analysis, results, clearance and acceptance approach of the hardware