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ASSESSMENT OF STRUCTURAL INTEGRITY OF HPS3 FLEX SEAL SUB ASSEMBLY TO CONVERGENT SUB ASSEMBLY UNDER REDUCED PRE LOAD CONDITION

Abstract

HPS3 Motor is positioned in the third stage of ISRO's PSLV vehicle. HPS3 Motor has a submerged flex Nozzle assembly. This assembly has the various interfaces. Flex seal subassembly (FSA) to convergent sub assembly, CSA (Throat housing) is considered in this paper. 64 nos. of M6x1, unbrako make button head screws with hexagonal socket were used earlier at the interface of FSA to CSA. From C24 flight onwards, M/s Ankit Fasteners make M6x1, button head screws with hexagonal socket and black oxide coating are proposed to be used at the above interface in place of unbrako fasteners. The raw material for new batch of screws is 35NCD16 whereas the raw material used for unbrako is unknown. It is observed that the failure torques (i.e. the max torque that can be applied on the screw through allen key) of both old and new batches of screws are different. On detailed investigation, two differences could be noted. One is the higher hardness (40-44 Rc) of old batch screws compared to new batch (39-40 Rc). Secondly the differences in configuration. Socket depth in new batch is 2.08-2.21 mm against 2.32-2.40 mm for old batch. Also, a taper configuration exist near the head to shank fillet radius in the old batch against taper less configuration in new batch. The observed failure torque values varied between 12 to 14.5 N.m which are nearly 50 percent less compared to old batch. Torque being applied in flight assembly is 1 kgf. m (9.8 N.m). Since experimentally evaluated nut factor for the black oxide coated fastener was not available, the preload generated in the screws and the confirmation on its adequacy etc. could not be carried out with the required accuracy. An experiment was carried out at for finding out the nut factor of this fastener with simulated flight interface. 5 nos. of screws after wiping of oil with banian waste (similar to what followed in flight assembly) and another 5 nos. after thorough cleaning with acetone were used in the tests. Using the nut factor evaluated from the tests, the preload was estimated. Using the calculated preload, finite element analysis was carried out for the HPS3 Nozzle assembly for the NPT condition. The stresses in the fasteners and O-ring compression etc. under this condition were tabulated. This paper covers the details of the results of the friction factor evaluation and subsequent analysis carried out.