

Crucial Qualification Test of Fuel Drop Tank of Tejas Aircraft

Carried out at the CSIR-Structural Engineering Research Centre, Chennai

The Aeronautical Development Agency (ADA), Bengaluru has designed and developed the Light Combat Aircraft (LCA) - Tejas, for the Indian Air Force, with Hindustan Aeronautics Limited (HAL) as the Principal Partner and with other agencies including CSIR. The 1200 litres fuel drop tank of Tejas (5 m long and 640 mm diameter) needs to be qualified for slosh and vibration loadings simultaneously as a mandatory requirement. In this connection, simultaneous slosh and vibration test has been carried out as per MIL (US Military Standard) specifications and to substantiate that air vehicle maneuvering will not be affected due to adverse effects of fuel slosh and vibration. The drop tank is made of GFRP composite, in three sections viz. nose cone, rear cone and centre section. The **crucial** qualification test on the fuel drop tank with 2/3 water filled has been successfully conducted at the CSIR-Structural Engineering Research Centre (CSIR-SERC), Chennai, **for the first time in the country**. A team of scientists from the Fatigue & Fracture Laboratory and the Advanced Seismic Testing and Research Laboratory, CSIR-SERC have designed and developed the test methodology to carry out this crucial and complicated qualification test in consultation with ADA and HAL. The simulation test was carried out using a specially fabricated test fixture. A mechanical shaker mounted at the top of the test fixture vibrates the fuel drop tank to a frequency as specified in MIL Standard and similarly, a computer controlled servo hydraulic actuator pitches the fuel drop tank to a slosh angle as specified in MIL Standard. Vibration isolators were designed and developed using helical springs to absorb the vibrations generated by the mechanical shaker so as to protect the servo hydraulic actuator. This vibration isolation is very essential for proper functioning of computer controlled servo hydraulic actuator used for pitching the fuel tank about its Centre of Gravity. Vibration isolators were used to absorb the vibrations generated by the mechanical shaker. The fuel drop tank was extensively instrumented at critical locations with strain gauge based pressure transducers mounted inside the fuel tank on baffle walls for pressure measurement during sloshing. For measurement of surface strain, rosette type strain gauges were mounted at various critical locations of drop tank. Accelerometers were also mounted at different locations of drop tank to measure the acceleration during the test. Before the start of the slosh and vibration test, resonance search on test fixture, empty drop tank and partially filled with water were carried out using sine sweep excitation as per the requirement and the responses were monitored at the attachment points using accelerometers mounted at various locations. The fuel drop tank withstood 25 hours of sloshing and vibration and 15 hours of only sloshing as per MIL Standard and complied. These very important and crucial tests are a FOC (Final Operation Clearance) requirement for enhancing the drop tank life to 3000 flying hours and to obtain the full certification.



Fig. 1 Typical views of fuel drop tank during simultaneous slosh and vibration test