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DESIGN AND QUALIFICATION OF AFT BAY THERMAL PROTECTION SYSTEM OF KSLV-II

Abstract

KSLV-II (Korea Space Launch Vehicle) is a three-stage launch vehicle which is planned to be launched in 2020. During the flight, the aft bay of the first stage is exposed to the external heating condition and the TPS(Thermal Protection System) is needed to protect the structure and components of the LV(Launch Vehicle). The TPS is mounted on the base plate and cylindrical side section of the aft bay. The base plate is expected to experience high heating rate by radiative and convective heat transfer from plume gas of four clustered engines. Therefore, an ablative cork insulator which is widely applied to LVs and re-entry vehicles is selected as the TPS material of the base plate. The cylindrical section has relatively lower heating rate, but complex shape. For this reason, sprayable insulation material 64C1-2-A, so called BMS is selected as the TPS material. The minimum thickness of TPS materials is determined by one-dimensional numerical analysis using a commercial software, Thermal Desktop. Two kinds of qualification tests are conducted at the specimen level; the heating test and the environmental test. The former is conducted to verify the insulation performance of TPS materials at given thicknesses. During the test, radiative heat from an electric heater is applied to the surface of the specimen and the temperature of the specimen is measured. As the result of the heating test, both cork and BMS specimens are qualified since the measured inner temperatures are lower than the qualification condition. Both TPS materials are attached to the structure without any mechanical fastener. The environmental test is conducted to verify whether the TPS materials are not vulnerable to the high temperature and vibration environments. It comprises three individual steps; vibration-heating-vibration. For the test, six cork specimens with different shape, manufacturing condition and a BMS specimen are prepared. All specimens are qualified because no separation of TPS from the surface is observed after the test.