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CHARACTERIZATION OF MLI THERMAL PERFOMANCE USING OPTICAL FIBERS AS TEMPERATURE SENSOR

Abstract

The MLI thermal behavior is typically described by a parameter called "Effective Emissivity". The analytic description of this parameter is difficult to achieve due to the large number of factors involved. These complications lead to the need to perform a series of thermal performance tests in order to estimate the effective emissivity of the MLI Blankets. A series of thermal performance test is performed on different MLI samples, equipped with optical fibers temperature sensor on all layers, measuring the temperatures in order to estimate the effective emissivity of the thermal blanket using the formula for the radiative heat transfer. The results already present in literature, deriving from previous test, show how the MLI performance depends from different factors. Scope of the test campaign is to characterize the effects of this factors on blankets thermal behavior. For this reason, the tests performed are focused on investigate various configuration of MLI blankets, considering different materials, different patterns of perforation for the reflective layers and changing the MLI lay-up in terms of number of layers. Another important aspect evaluated in this test campaign is related to the shape of the MLI, considering flat 2D and 3D box shaped MLI samples. As far as concern the effects of the MLI finishing on the blanket effective emissivity, typical elements have been placed on the MLI and temperature sensors placed in proximity, in order to measure and evaluate the heat leaks in these positions. An important aspect of a thermal performance test is to achieve the right balance between the number of temperature sensors and the disturbance introduced in the temperature measurement. A large number of temperature sensor leads to more reliable measures, but less accurate. The use of optical fibers as temperature sensors eliminate this problem, allowing to perform temperature measurements in more points, with less disturbance, with respect to the use of standard thermal performance. The results of the test campaign are used to perform a comparison between the different MLI configurations tested. Considering the relevance of the mass factor in a Space mission, importance has been provided to the comparison of the effective emissivity of MLI sample with different number of layers, in order to verify the effects on the blanket performance. For the same reason it is also significant to evaluate how different materials can lead to an improvement in MLI thermal behavior.