

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Advanced Materials and Structures for High Temperature Applications (4)

Author: Mr. edward schaefer
JHU Applied Physics Laboratory, United States, Edward.Schaefer@jhuapl.edu

DESIGNING BUILDING AND TESTING OF A THERMAL PROTECTION SYSTEM FOR A
SPACECRAFT WHICH CANNOT BE QUALIFIED USING THE STANDARD METHODOLOGY

Abstract

This is a case study of the thermal protection system (TPS) currently in use on the Parker Solar Probe spacecraft, which over its seven year life it will experience surface temperatures in excess of 1400C. The traditional methodology for qualifying a space structure, using the old adage, “test what you fly and fly what you test” was simply not practical based on the selected materials, the size of the TPS, and a space environment characterized by its hard vacuum and high temperatures.

The approach to risk mitigation both in terms of the materials selected and its qualification for flight was complicated by the fact that both the selected materials and the typical qualification approach were beyond the current state of the art. The strength of materials, capable of operating in the 1400C temperature range severely restricted the design options, requiring a substantial materials test program. The basic building block approach was followed to the extent applicable to this program. Carbon-carbon composites have been used for a number of years, however a solid carbon-carbon TPS was not feasible due to weight and mission requirements. Further, currently there are no test facilities capable of testing such a structure in the expected environment. Thus both a material and component structural qualification test programs required significant development.