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ULTRALIGHT PBO COMPOSITE OVERWRAPPED PRESSURE VESSELS FOR LUNAR PROBES

Abstract

Three kinds of aluminum-lined Composite Overwrapped Pressure Vessels (COPVs) were designed and manufactured by Shanghai Institute of Space Propulsion (SISP) of China for aerospace applications for lunar probes. One of the most important mission goals of lunar probes is to reduce the weight, while increasing their technical capabilities. These ultralight COPVs, which provide gaseous helium to the propulsion systems of lunar probes, are the key hardware components to reduce weight to achieve the mission goal. These vessels were designed and qualified per the design specifications. All three kinds of COPVs are made of thin-wall seamless 6061-T6 aluminum liner overwrapped with polybenzoxazole (PBO) fiber, the minimum volume is respectively 16 liters, 53 liters and 78 liters at the Maximum Expected Operating Pressure (MEOP) of 35MPa. The required minimum burst pressure is 70MPa and the maximum empty vessel weight is respectively 3.6 kilograms, 10.8 kilograms and 15 kilograms. Unique design, processing and inspection techniques were employed to assure program success. These COPVs were successfully qualified at the beginning of 2015, which demonstrated a minimum burst pressure of 75MPa and a minimum PV/W of 36 kilometers. The design, fabrication, damage control, development, and qualification of these COPVs are presented.