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A LIGHTWEIGHT CARGO CARRIER SPACECRAFT THERMAL CONTROL SYSTEM DESIGN TECHNOLOGY

Abstract

Cargo carrier spacecraft is an unmanned transfer vehicle for cargo transportation to space station, also a habitable module while it is berthed to space station. In order to increase cargo transportation capability by reducing cargo carrier spacecraft platform mass, a new lightweight thermal control system is developed. A convection-conduction-radiation coupling thermal control system design method is developed, which is used to the pressurized cabin thermal control design. The designs of passive thermal control systemelectric heating systemventilation system are also provided in this paper. The characteristics of thermal control system, heat loss of the pressurized cabin, adaptability for heat load variation are analyzed and discussed in detail. The thermal control system is verified by system level thermal balance test. According to the test results, the pressurized cabin air temperature can be maintained between 12.8 and 25 centigradepressurized cabin avionics temperature between 11.6 and 34.4 centigrade, unpressurized cabin avionics temperature between -7.6 and 35.7 centigrade during all hot and cold test cases. All test temperature can be maintained within required limits and the thermal control system can adapt well to heat load variations from 240 to 990 Watt. The thermal control system mass is merely 2% of the spacecraft total mass. The marked advantage of such a thermal control system design is lower mass and cost compared to any active thermal control system.