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RUBBER AS AN ADVANCED STRUCTURAL MATERIAL FOR THERMAL CONDITIONING SYSTEM INTERFACES

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In integrated launch vehicles, one of the systems responsible for successful launch preparation and support is a ground thermal conditioning system supplying low-pressure thermostatic air to the "dry" compartments and head blocks of a launch vehicle. To connect the thermal conditioning system to the launch vehicle, a special interface is used. The proper functioning of the interface is critical to the reliability of the ground equipment of the system, the launch vehicle, and the space complex as a whole. This article describes key requirements to the interfaces of the thermal conditioning system and the drawbacks of their existing designs. The article proposes a new concept of interface design, according to which the pipeline of the ground thermal conditioning system is connected to the inlet tube of the launch vehicle via a corrugated rubber hose composed of three basic parts. The hose is attached to the inlet tube of the launch vehicle with the help of a metal lock/unlock device. The proposed solution provides good air tightness, ease of operation, easy multiple connections to the launch vehicle at different angles, and an automatic disconnection at launch or a manual disconnection in the case of a cancelled launch. Using rubber, which is a high-elasticity structural material, in the manufacturing of hoses makes it possible to minimise the effort required to disconnect the interface from the launch vehicle. In a high elasticity state, rubber can absorb and dissipate mechanical energy over a wide range of temperatures, which precludes the vibration caused by the engine operation from being transmitted to the ground thermal conditioning system. The article presents the key properties of rubber used as a structural material and its features to be considered in the design of similar devices. In contrast to metal, which shows two types of deformation (elastic and plastic), rubber can exhibit three types (elastic, superelastic, and plastic). During the design of interfaces, two types of deformation were taken into account: elastic and superelastic. Experimental tests of the interface presented in the article showed its full compliance with the requirements specification.

Keywords: *vehicle inlet tube, corrugated rubber horse, lock/unlock device, superelastic deformation, air tightness.*

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