TankSIM: A Cryogenic Tank Performance Prediction Program

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Accurate prediction of the thermodynamic state of the cryogenic propellants in launch vehicle tanks is necessary for mission planning and successful execution. Cryogenic propellant storage and transfer in space environments requires that tank pressure be controlled. The pressure rise rate is determined by the complex interaction of external heat leak, fluid temperature stratification, and interfacial heat and mass transfer. If the required storage duration of a space mission is longer than the period in which the tank pressure reaches its allowable maximum, an appropriate pressure control method must be applied. Therefore, predictions of the pressurization rate and performance of pressure control techniques in cryogenic tanks are required for development of cryogenic fluid long-duration storage technology and planning of future space exploration missions.

This paper describes an analytical tool, Tank System Integrated Model (TankSIM), which can be used for modeling pressure control and predicting the behavior of cryogenic propellant for long-term storage for future space missions. It is written in the FORTRAN 90 language and can be compiled with any Visual FORTRAN compiler. A thermodynamic vent system (TVS) is used to achieve tank pressure control. Utilizing TankSIM, the following processes can be modeled: tank self-pressurization, boiloff, ullage venting, and mixing. Details of the TankSIM program and comparisons of its predictions with test data for liquid hydrogen and liquid methane will be presented in the final paper.

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