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SLOSHING AND PRESSURIZATION TESTS FOR MEMBRANE TANK: TESTS, VALIDATION AND
MODELS

Abstract

This paper presents recent 1:1 scaled tests results for sloshing, pressurization and evacuation behavior in a membrane tanks used for spacecraft's and satellites.

The first 1:1 scale sloshing test setup evaluates fluid reaction forces for axial, lateral and spin excitations at different fill level. Evaluation and determination of sloshing forces during relevant flight phases is important for flight stability and GNC layout. The test evaluates the impact of pressure level, membrane position, acceleration level and excitation direction. Mathematical reaction force models for accelerated and ballistic flight phases are presented.

The second 1:1 scale pressurization test setup show the transient membrane position during Helium pressurization and evacuation at realistic flow rates. During launch in depressurized condition the mechanical impact on the membrane launch may be reduced in the membrane tank such that the membrane is supported by the tank wall and surrounded by vapor and dissolved gas bellow the membrane. The tests provide important information of the membrane state for drying, filling procedures and on-flight pressurizations effects. The membrane position during depressurization is dependent on fill level, vapor generation, dissolved gas amount in the test fluid and pressurization rate. The paper evaluates this evaporation and condensation effect bellow the membrane during the depressurization and repressurization process. Video recordings show the membrane position and gas state inside the membrane tank. In addition complementary test in a vacuum chamber are presented to support the analysis and allow optical observation from the outside.