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Author: Dr. Fei Yan  
Shanghai Institute of Space Propulsion, China, yanfei.801@126.com

DEVELOPMENT OF A METAL CORRUGATED DIAPHRAGM TANK FOR USE IN LIQUID  
BIPROPELLANT PROPULSION SYSTEMS

**Abstract**

A new diaphragm tank that is capable of managing two kinds of propellants synchronously is required for use in liquid bipropellant propulsion systems. This bipropellant tank must be low cost, light weight, high space utilization, and highly reliable. Shanghai Institute of Space Propulsion (SISP) was contracted to develop this bipropellant tank in 2006. The bipropellant tank has a spherical shape and two hemispherical cavities that are used to contain the fuel and the oxidizer respectively. It isolates the fuel and the oxidizer from pressurizing gas by two metal corrugated diaphragms located the equator. The mechanical isolation prevents not only the pressurizing gas from dissolving in the propellants, but also the fuel and the oxidizer from a chemical reaction. This bipropellant tank has a minimum pressurized volume of 280 liter at the maximum expected operating pressure of 3.5MPa and a maximum internal diameter of 816 millimeter. The required minimum burst pressure is 5.25MPa, and the maximum empty tank weight is 28 kilogram. The tank shell is constructed of the Al-Mg-Sc alloy called after 5B70, while the metal corrugated diaphragm is formed with pure aluminum called after 1060. These materials perform good compatibility with the propellants, formability and weldability. The Finite Element Analyses (FEAs) was performed to design and validate the tank for the mission environment. A complete qualification testing program was conducted to qualify the new tank, including vibration test and pressure test. The qualification program was successfully completed in 2010. The results show that the tank can be qualified to meet the contract requirements. The bipropellant tank is SISP's first metal corrugated diaphragm tank that is actually used in the bipropellant propulsion system of a demonstration project. One tank is required for each spacecraft. Several tanks have been delivered to date, and two tanks have successfully flown.