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Author: Mr. Theodore Southern
Final Frontier Design, United States, ted@finalfrontierdesign.com

Mr. Nikolay Moiseev
Final Frontier Design, United States, nik@finalfrontierdesign.com

A COMMERCIAL EXTRA-VEHICULAR ACTIVITY SPACE SUIT SYSTEM

Abstract

Extra-Vehicular Activity (EVA) space suits are complex, expensive, and difficult to operate and manage. However, EVA is all but required for any human space flight operation in orbit or beyond. A long and proud history of safe EVA has enabled every space station mission and countless flights, because of the flexibility and capability that human operations in open space allow. Any future planetary missions must certainly include EVA; in our opinion human space flight is pointless without EVA.

Final Frontier Design (FFD) has developed and is currently in beta testing of a commercially focused and complete EVA space suit system, including the entire suit and life support system. This paper presents the research and development, testing, and preliminary validation of FFD's EVA Space Suit Enclosure (ESSE) systems, including the Liquid Cooling Garment (LCG), Pressure Garment, Bearings, Hatch, Outer Garment, Life Support System, Interfaces, Support Equipment, and Test Procedures.

The ESSE leverages a decade of work with NASA and a career of engineering with Zvezda. The paper includes novel inventions to increase efficiency of the LCG, with flat-tube panels maximizing cooling surface area contact with the body while minimizing bulk and restrictions. The pressure garment includes dual-redundant enclosures while maintaining light weight and high mobility. The bearings include built-in restraint elements and minimized part count, eliminating the bolt-hole circle interface for a more simple in-line clamp. ESSE's gloves are highly developed and compete with current NASA systems. ESSE is optimized to include multiple 3D printed restraint elements. ESSE has a rear entry hatch, with a goal to be both redundant in closure and self don-able. The outer garment of the ESSE is optimized for LEO operations, utilizing heritage technology and methods. The 10-EVA capable life support system leverages commercial diving and hazmat operations. FFD has developed ground support equipment for lab testing and is partnering with Integrated Spaceflight Services to create an immersive test protocol for validation of the systems including a 2 degree gravity offset system.

The introduction of a complete, commercial EVA system is unique and unprecedented. While multiple companies have developed IVA space suits alone, the EVA suit system is massively more complex and traditionally has been assembled using multiple contractors. FFD aims to offer a complete system in house with ESSE.