Douglas Electrical Components

HERMETIC FEEDTHROUGHS PREPARE DRAGONFLY ROTORCRAFT FOR TITAN MISSION

Hermetic electrical feedthroughs are commonly used to create a hermetic barrier for space simulation Thermal Vacuum Chambers, or TVAC, to test, measure, and simulate conditions in space. Vacuum chambers can reach 120 feet high and 100 feet in diameter, permitting larger equipment to be tested fully assembled. Each feedthrough can contain hundreds to thousands of interconnect points to measure various properties such as pressure and temperature.

THE MISSION

Engineers at Johns Hopkins Applied Physics Laboratory are designing Dragonfly, a space-bound rotorcraft lander. It will be used to take various measurements and data from Titan, Saturn's largest moon and the only one in our solar system with a dense atmosphere. According to the APL website, "The abundant complex organic material accessible on Titan's surface makes it an ideal destination for studying the conditions necessary for the habitability of an extraterrestrial environment and the kinds of chemical interactions that occurred before life developed on Earth".

REPLICATING CONDITIONS TO AVOID FAILURE

Johns Hopkins APL's 3,000 cubic foot Titan Chamber, the largest environmental simulator ever deployed at APL, is designed to conduct environmental and operational testing. The Dragonfly will be using various cameras, sensors, and sampling systems to increase the understanding of Titan's environmental conditions.

The chamber is used to replicate the environment expected on the surface of Titan, with ambient temperatures reaching minus 180 °C. While smaller chambers can fully simulate the environment, the large chamber has the capacity to accommodate larger assemblies. Temperature measurements are used to determine the best ways to insulate Dragonfly from the harsh thermal conditions as well as ensure continuous operation of all electrical and mechanical systems within the unmanned rotorcraft.

CHAMBER SPECIFICATIONS	
Dimensions	Exterior: 15ft x 15ft x 15ft Interior: 12ft x 12ft x 12 ft
Weight	165,000 lbs.
Material	304 stainless steel with carbon steel stiffeners
Payload	10,000 lbs.

ENTER FEEDTHROUGHS

As mentioned earlier, hermetic feedthroughs permit the penetration of conductors and optical fibers into test chambers. At Douglas Electrical, we employ a hermetic, NASA certified low outgassing epoxy tested per ASTM E-595-93 (0.33% TML. 0.00% CVCM) to hermetically seal directly at the conductor(s) and mechanical interface. Epoxy technology is popular in a variety of environments, from cryogenic temperatures to 200°C. It permits an extremely high-density feedthrough with the design flexibility to combine multiple conductor and connection types in a single assembly. For space simulation and thermal vacuum chambers, Douglas is a leading supplier of standard and custom solutions.

A PotCon hermetic bulkhead connector is a popular option for small to medium thermal vacuum chambers. It is traditionally manufactured with a vacuum face seal housing with circular MIL-spec rated connectors, such as MIL-DTL-5015, MIL-DTL-38999, or MIL-DTL-26482 series connectors in a plug-to-receptacle configuration. The feedthrough is either mounted directly to the chamber wall with the face seal utilized to maintain the environmental seal or the PotCons are mounted individually to a larger chamber plate that penetrates the vacuum chamber.

For larger chamber assemblies, PortPlate hermetic feedthrough assemblies are designed. PortPlate assemblies allow for multiple feedthrough connections and types within a single flange assembly. This allows engineers operating chambers the flexibility to manage various electrical connection types independently bundle certain connectors, wires, or cables together. These connections can be mechanically and electrically isolated to ensure proper signal transmission during testing and operation.

One other major benefit to a PortPlate design is testing conducted at the factory. Each electrical connection is tested to specification to ensure signal transmission and Hipot tested. The individual electrical connections are tested via mass spectrometer to the specification on the assembly drawing (typically < $1x10^{-8}$ He cc/sec). Finally, a vacuum test is conducted on the Assembled port plate assembly PortPlate assemblies can deliver from our New Jersey manufacturing facility to the lab packaged, crated, and ready to install for plug-and-play operation.

TITAN PROJECT

The Titan Project will utilize a variety of PotCon vacuum-rated plug-to-receptacle hermetic bulkhead connectors. Feedthroughs will feature a variety of vacuum face seal sizes including standard diameters of 1 ¾" and 2 ¾" sizes.

For example, Douglas' part number "24056" is one of the most popular hermetic feedthroughs in the space simulation industry. It features a 61-pin hermetic plug to receptacle design, Stainless steel vacuum faceseal housing, and a vacuum leak rate of $<1x10^{-8}$ He cc/sec. The high pin count creates a high-density feedthrough in a compact package. Overall, the Titan chamber will receive over 40 new PotCons for testing for years to come.

Bulkhead feedthroughs can be packaged as a set, including mating connectors for both the atmospheric and vacuum connection points. This ensures the proper mating connectors are sourced and used when building the wiring harness.

Lastly, the chamber will use vacuum rated mating harness assemblies. These harnesses are manufactured by IPC-620 certified technicians. 1000V PTFE wires are installed in each of the 61 conductors for the 24056 feedthrough with white Expando covering the wires. Each wire is marked and tagged indicating the pin assignment.

DESIGN WITH US

Douglas Electrical Components supports various vacuum feedthrough requirements in the test and measurement industry. Our teams will partner with you to create the right combination of connectors, conductors, or optical fibers into the mechanical interface you need.

https://www.jhuapl.edu/news/news-releases/231120-dragonfly-titan-chamber

https://ttu-ir.tdl.org/items/79364f8b-9721-4562-a029-3dee16adab8d

https://dragonfly.jhuapl.edu/Why-Titan/

https://dragonfly.jhuapl.edu/What-Is-Dragonfly/

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