# Reliable Power at Record-Breaking Depths

Teledyne DGO

Interconnect

**Product:**
DGO Penetrators

**Application:**
Deep Sea Manned Vehicles

**Project:**
James Cameron's "Deep Sea Challenge" documentary

**Customer:**
Earthship Productions

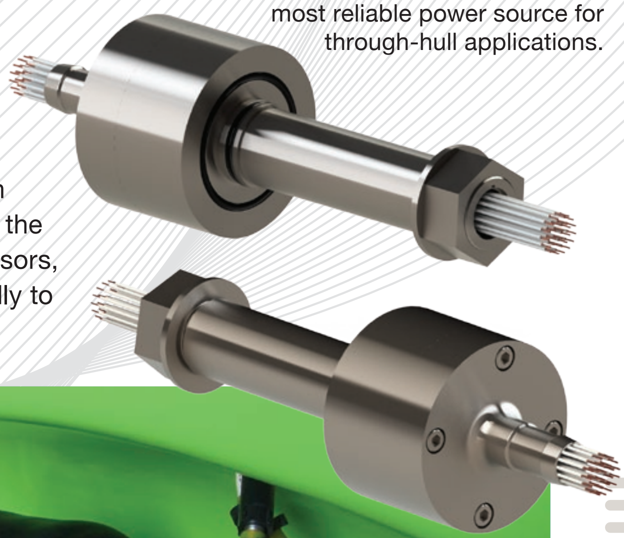
## Background

On March 26, 2012, James Cameron made a record-breaking solo dive to the Earth's deepest point, successfully piloting the DEEPSEA CHALLENGER nearly 7 miles (11 kilometers) to the Challenger Deep in the Mariana Trench.

Teledyne DGO provided electrical hull penetrators to power lights, cameras, and other sensors on the vessel. This critical technology enabled the submersible to survive crushing pressure at 36,000 feet, and carry a human where no one has been before.

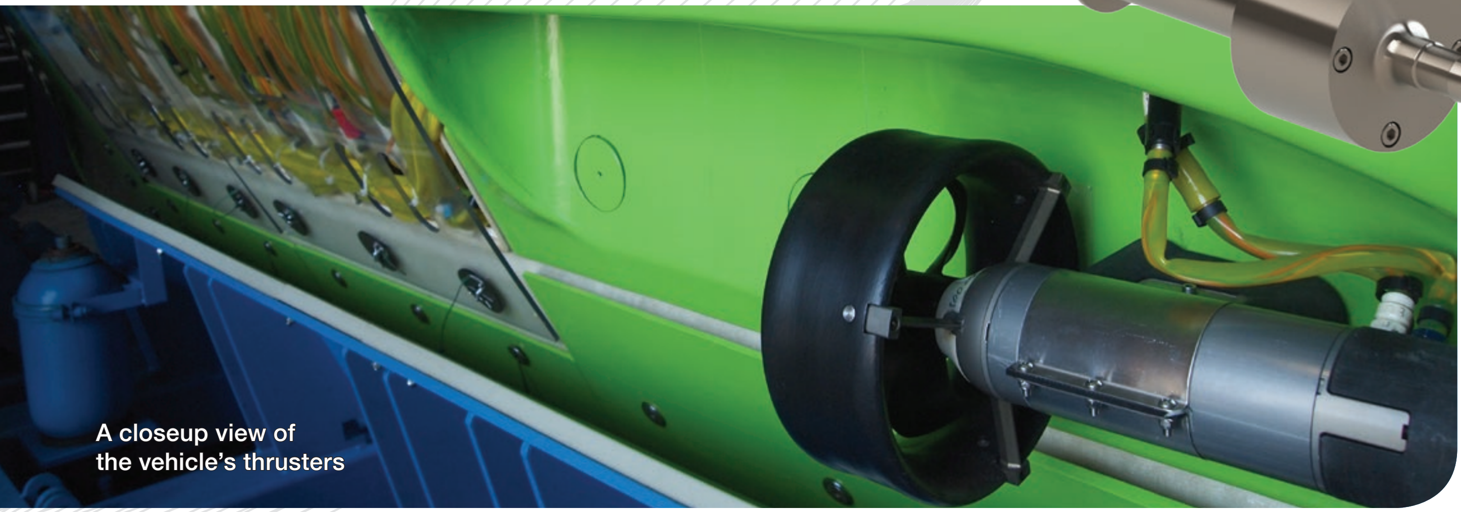
Cameron and his production team's goal was to film at the bottom of the Marianas Trench, the deepest point in the ocean. The team's previous project, filming the Titanic, had contracted existing manned vehicles and used a different type of electrical penetrator for their work. The team experienced a number of connection issues on the project that affected their HD signals. As a result, this new project would involve building a custom deep diving manned vehicle to film in HD and IMAX formats. Additionally, the engineering team concluded that it is best to eliminate as many connection points as possible. For this new project, the IMAX camera and the entire HD recording and processing equipment would be housed in a single 45-inch diameter sphere, thereby eliminating connections between spheres. The sphere would have a penetrator plate on one end and a view port on the other.

Glass-to-metal sealed penetrators provide the safest, most reliable power source for through-hull applications.



## What were the project challenges?

The Deepsea Challenge team recognized the critical impact of a reliable electrical system to support power and communications during the dive. An electrical hull penetrator functions by providing an insulated pass-through of electrical power and communication from the pilot control center to several elements of the vessel, including sensors, sonars, life support and cameras. A penetrator failure could be deadly to



A closeup view of the vehicle's thrusters the pilot inside the submersible if one of the electrical pins shorts out and melts. Seawater would erode the interior of the penetrator, allowing water to blast inside at extremely high pressure (16,000 psi).

## What were the innovative technical solutions available for the project team?

The alternative solution was to proceed as in previous projects, leasing existing submersible vehicles and using similar electrical systems as in the Titanic project. The challenges of this new project — going deeper into the ocean than ever before — led the team to the conclusion that a custom-built submersible with higher performance electrical penetrators would provide both the utmost safety for the pilot (Cameron himself), as well as reliably capture the deep sea video they were seeking.

## What was the final engineered technical solution?

The Deepsea Challenge team selected a submarine hull penetrator assembly with 26 gauge conductive pins from Teledyne DGO to provide a high pressure electrically insulating seal to power these critical systems. Teledyne DGO has decades of experience providing electrical submarine hull penetrators to the US Navy with no known failures to date, giving the team confidence in the reliability of the technology. The penetrator for the DeepSea Challenger is required to function at full ocean depth, as the sub dove to a depth of 36,960ft (7 miles), with pressures up to 16,500psi.

The body of the penetrator that DGO developed for the submersible is made from corrosion resistant alloy K500, and utilizes glass to metal seals between the body and the conductive pins. To ensure the performance of the penetrator prior to the dive, the penetrator assembly was tested at the DGO facility to 20,000psi in a hyperbaric tank. In addition, multiple electrical tests were performed to verify the integrity of the insulation.

## What were the benefits of selecting this particular approach/solution compared with the others proposed?

The benefit of selecting the DGO glass-to-metal sealed penetrator gave the team the confidence that Cameron would return from the depths with the video footage necessary to complete a groundbreaking documentary film about the journey.

During the dive, the penetrator performed with zero failures, bringing Cameron back to the surface safely with samples, data, and imagery from a previously unexplored region. A film documentary about the dive was released in 2017 and received critical acclaim for its breathtaking scenes and dramatic storyline.

Visit www.deepseachallenge.com for information about the project and film.

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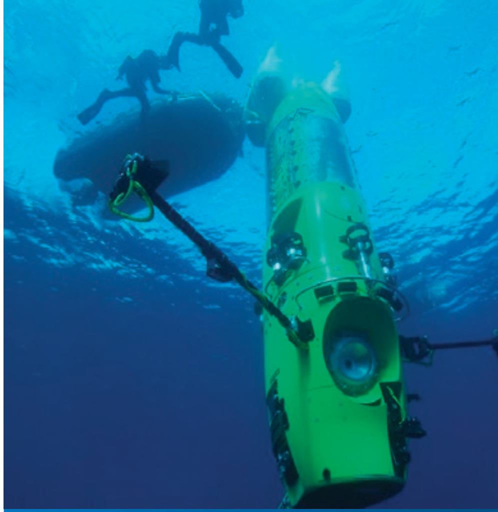

Deepsea Challenger is a 24 ft deep-diving submersible designed to reach the deepest-known point on Earth. The vehicle operates in a vertical attitude, and carries ballast weight that allows it to sink to the bottom, and when released, rise to the surface.

Photo Credit: National Geographic

## The penetrators had the following requirements:

- Full ocean depth capability
- Redundant sealing headers
- 4 fiber optics
- #20 gauge pins for communications circuits and #16 gauge pins for power
- Each penetrator should be equipped with 20 feet of Teflon insulated outboard wire and 10 feet of inboard wire

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