



National Aeronautics and
Space Administration



TECHNOLOGY SOLUTION

Sensors

Enhanced Fabrication Improves Temperature Sensing in Cryogenic Humid Environments

Useful for energy, industrial, and aerospace applications

Researchers at NASA's Armstrong Flight Research Center have developed a new manufacturing process that improves the ability of fiber optic sensing systems to measure temperature and liquid levels when operating in humid environments. The process involves eliminating moisture from the optical fiber coating, then completing the sensor assembly within humidity-controlled conditions. The resulting sensor hardware provides precise and accurate measurements even when operating in a humid environment. Originally designed to monitor a rocket's cryogenic fuel levels in conjunction with NASA's patented Fiber Optic Sensing System (FOSS), this technology can be used in many industrial, food, and medical applications.

BENEFITS

- Robust: Provides a moisture-free and mechanically isolated condition for the sensing fibers
- Accurate: Offers excellent thermal conductivity to surrounding area, allowing the sensing fibers to determine temperature correctly
- Reliable: Enables fiber optic sensing systems to operate properly in humid environments



THE TECHNOLOGY

This technology was developed to improve Armstrong's multi-patented FOSS system, which has long been used to measure temperature and liquid levels in cryogenic environments. When the sensing system's fibers trapped humidity from the surrounding environment before their submersion into cryogenic liquids, the moisture adversely affected outputs. A new manufacturing process solves this problem, increasing reliability and accuracy not only of NASA's FOSS but also any fiber optic sensing system.

How It Works

Armstrong has developed a two-step process to assemble the sensors. First, the bare sensor fiber is inserted into an oven to expel all moisture from the fiber coating. Then, the moisture-free fiber is placed inside a humidity-controlled glove box to prevent it from absorbing any new moisture. While inside the glove box, the fiber is inserted into a loose barrier tubing that isolates the fiber yet is still thin enough to provide adequate thermal transfer. The tubing can be further purged with various gases while it is inside the glove box to provide additional moisture isolation.

This innovation is particularly useful for fiber optic systems that measure temperature and that identify any temperature stratifications within cryogenic liquids.

Why It Is Better

This process seals sensor fibers from environmental moisture, enabling fiber optic sensing systems to operate reliably in humid environments. The innovation eliminates erroneous readings that can occur due to moisture collection on the fiber sensors.

For more information about the full portfolio of FOSS technologies, see DRC-TOPS-37 or visit <https://technology.afrc.ndc.nasa.gov/featurestory/fiber-optic-sensing>

APPLICATIONS

The technology has several potential applications:

- Energy: Liquid natural gas and petrochemical storage tanks
- Industrial: Storing cryogenic liquids (e.g., liquid nitrogen)
- Aerospace: Liquid fuel tanks for launch vehicles

PUBLICATIONS

Patent No: 10,422,706