

Space Shuttle Refueling Operation

- EdgeTech Two-Stage Sensor
- Reliable Safety Checks
- Verify Dryness

"We've been using these [EdgeTech's] instruments for a long time to obtain accurate measurements"

-Mr. Erich Schatzle
Test Engineer
Lockheed Martin

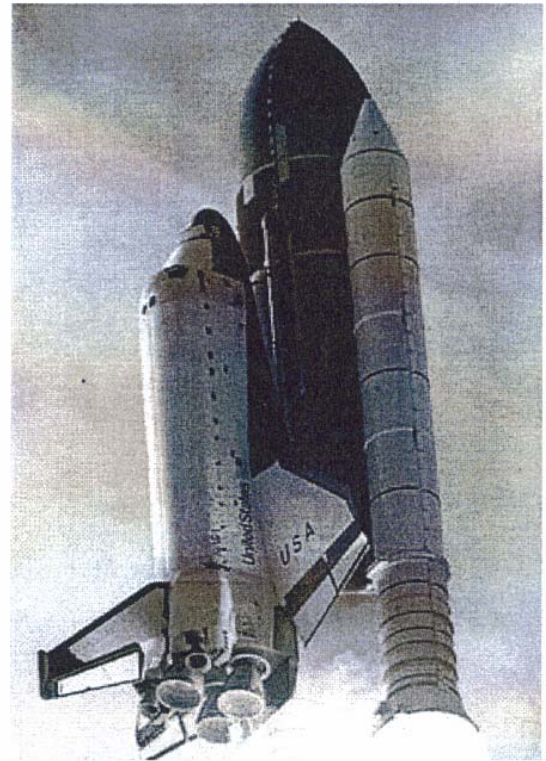
The preparation of the Space Shuttle's external fuel tank is an area where exceptionally high tolerances must be maintained. The large orange tank (familiar to shuttle watchers) is manufactured and supplied to NASA by Michoud Space Systems, a Lockheed Martin company located in Louisiana. Constructed from ultra-lightweight aluminum-lithium, the external tank actually consists of two smaller tanks, one filled with liquid oxygen and the other liquid hydrogen.

Before delivering the tanks to NASA for use on a shuttle mission, Lockheed Martin performs a host of final acceptance tests. One particularly important test involves verifying the dew point level inside the tanks before they are pressurized and shipped.

The Task:

The sheer size of the Space Shuttle's external fuel tank presents a difficult task for the engineers who must perform the final acceptance tests. The tank measures approximately 154 feet in length and 28 feet in diameter, and holds 1.3 million pounds of liquid oxygen and 227 thousand pounds of liquid hydrogen. Test technicians and engineers first pressurized the tank to approximately 6 psig then checked for leaks.

The tank is then purged with nitrogen gas over a



three to four hour period, after which dew point readings are taken.

NASA specifications require that the dew point level of the outgoing gas be $\leq -15^{\circ}\text{C}$ (5°F) purged. Purging continues until the dew point is below the specified level.

Excess moisture that has been allowed to remain in the tank creates the potential for corrosion, which could weaken the external tank. As such, precise, reliable measurement of dew point is a must.

The Solution:

Lockheed Martin uses EdgeTech's two-stage chilled mirror sensor technology for processing the external fuel tank. The two-stage sensor (S2) was selected for its performance capability of achieving dew points well below the -15°C (5°F) specification. The EdgeTech S2 has a dew point measurement range of -50°C to 100°C (-58 to 212°F). The heart of the sensor is a hermetically sealed module containing a rhodium mirror attached to a two stage thermo-electric cooler.

The mirror module is designed as an integral unit to eliminate the potential of intermittent thermal conductivity.

"NASA gave us a requirement for dew point that we must consistently meet. We've been using these [EdgeTech] instruments for a long time...and our technicians have not experienced any problems."

Mr. Erich Schatzle
Test Engineer
Lockheed Martin

Consistent quality is critical to meet these demanding safety requirements. Chilled mirror technology is a primary measurement technique that provides accurate and consistent NIST traceable measurement. A chilled mirror does not need to be compensated for temperatures that may vary during dew point verification procedures.