



PHILTEC



Feb 2024



AEROSPACE APPLICATIONS

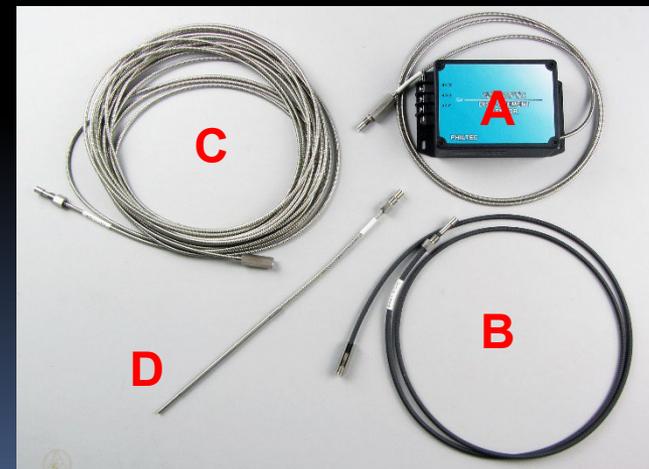
Rocket Engine Turbopumps

CONDITIONS

- Cryogenic fluids
- LOX, CH₄, Kerosene
- High Pressure

SENSOR REQUIREMENTS

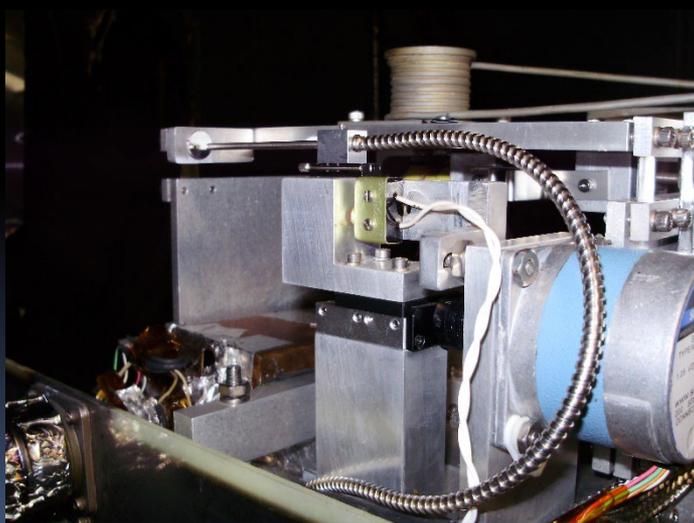
- Custom Probe Casings
- 40-60 Ft long FO Cables
- Vibration Proof Connectors
- 75 KHz Sensor Bandwidth
- Multi-Part Systems



Satellite Propulsion Systems

CONDITIONS

- Vacuum
- Linear translation
- Low Noise



FO Probe Inside
Thrust Stand



Sensor System with Vacuum Flange

Aircraft Engine Tests

CONDITIONS

- Bird Strikes
- Catastrophic Loss of an Engine

SENSOR REQUIREMENTS

- 30 mm Displacement of Engine Support Structure
- Side-Viewing Probes
- 12 m Fiberoptic Cables
- 20 KHz Sensor Bandwidth



Airbus 380 Flight Test

Philtec sensors were used to measure Thrust Reverser performance during static and flight tests of the A380.

90° Probe measured the distance between the inverter and engine.

SENSOR REQUIREMENTS

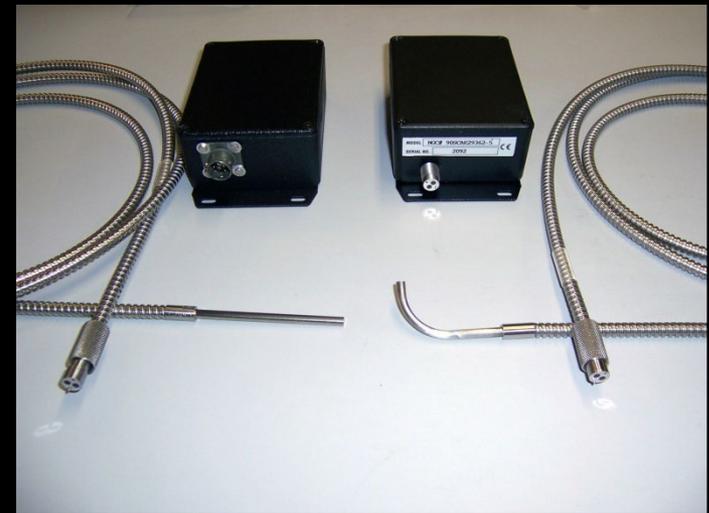
- ± 15 mm Displacement
- -55°C to $+150^{\circ}\text{C}$
- 90° Sensor Probes
- 300 Hz Frequency Response



Flight Test Sensors

'Fiberoptic Tachometer'

- Weight: 2 lbs. amplifier; ¾ lb. each fiberoptic ass'y
- Displacement Range: 2 inch (50 mm)
- Vibration: 5 g rms, 5 Hz -2KHz, in any axis
- MS style connector for (+28 volt) input power and output signal
- Detachable Probes, Straight Tips and 90° Tips
- Tip Operating temp. -45C to 200C

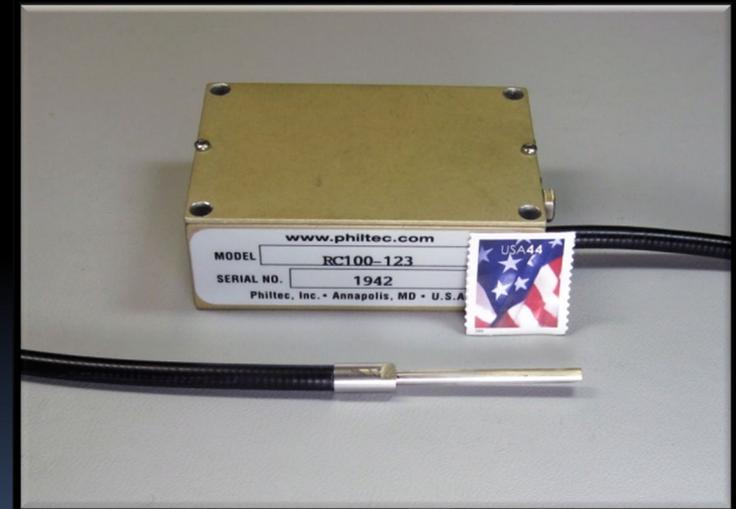


Small Flight Test Sensors

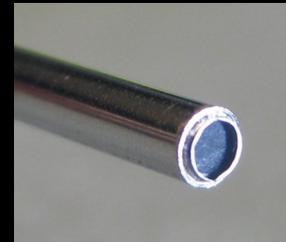
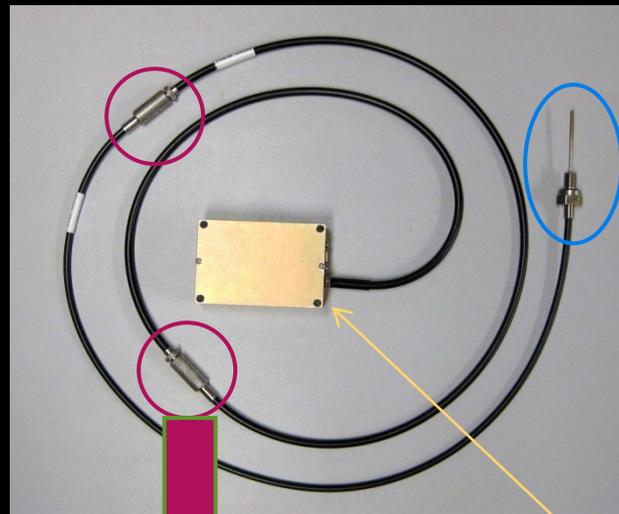
A customer required the smallest sensor for integration into a flying object.

Sensor Features

- Electronics Weight : 6.5 ounces
- Size : 25 x 50 x 75 mm (1" x 2" x 3")
- Input/Output via Micro-D Connector MIL-DTL-83513
- Grounded Enclosure with Thru Hole Mounting



Small Flight Test Sensors



Brazed Window for
 $P = 6 \text{ bars}$
 $T < 450^\circ \text{ C}$



2 Connectors
Enable Use Of
Extension
Cables

Small Lightweight
Electronics Package

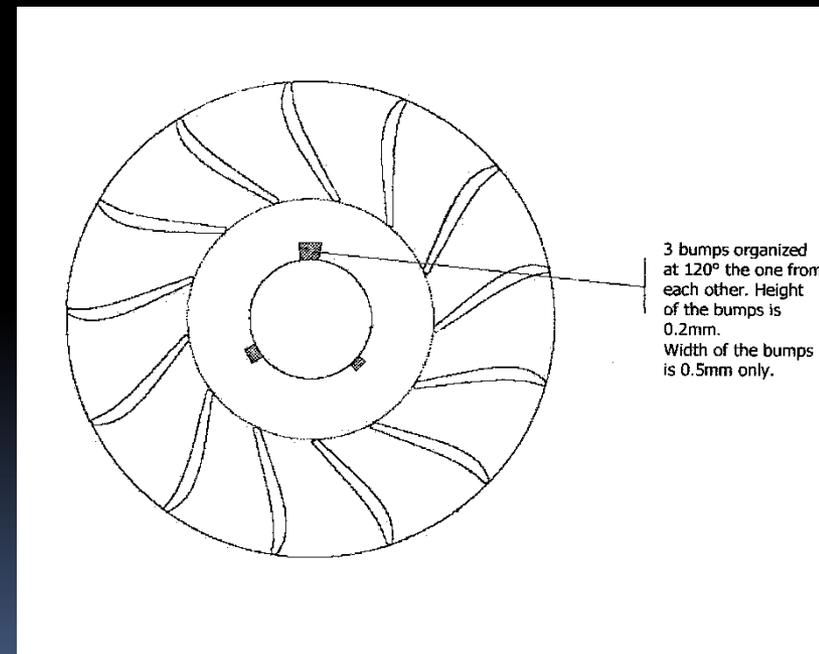
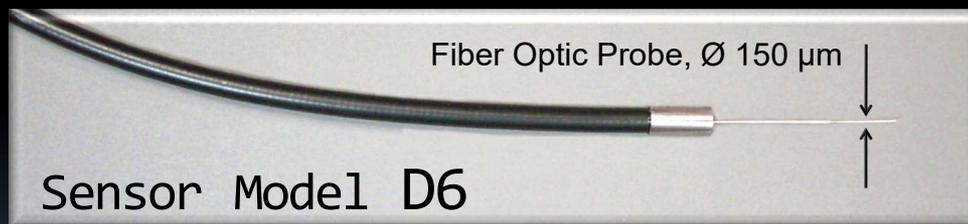
Icing Research

- 90° Sensor Tips
- Measure Wing Tip Vibrations
- With Icing Conditions



Micro-Turbine Development

- 1,000,000 rpm Speed Counting
 - M.I.T.
 - Columbia University
 - Johns Hopkins Applied Physics Lab
 - Onera, French Aerospace Lab



Mars Rover Mission

- NASA's JPL Ultrasonic Driller
- Developed by Cybersonics, Inc.
- Philtec sensor model RC25-HQ was used to characterize the harmonic analysis and axial motion of the drill.



Space Shuttle

- NASA's Marshall Space Flight Center used Philtec probes in a LOX pressurized cryogenic environment to monitor bearing deflections in the Space Shuttle Main Engine



Space Shuttle

- In the wake of the Challenger disaster, Thiokol engineers used Philtec sensors installed between the joints of rocket sections to determine how much separation occurred during firing.



Probes For Cryogenic Turbo Pump

- To Measure Shaft Displacements

OPERATING ENVIRONMENT

Liquid Hydrogen (probe tip immersed)

Operational Temp: -420°F

Non-Op Temp: 0°F to 130°F

Pressure: 2500psia (max)

OPERATING ENVIRONMENT

Hydrogen Gas (probe tip immersed)

Operational Temp: 40°F

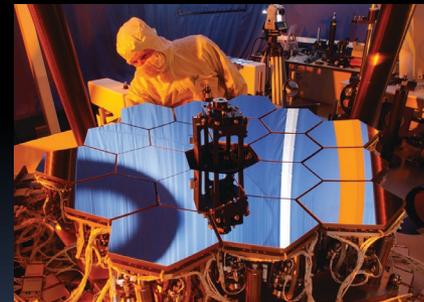
Pressure: 1000 psig



Imager for the Hubble Replacement Telescope



These sensors were used to measure thermal distortions of critical components at low temperatures



Space Telescope Lens Focus



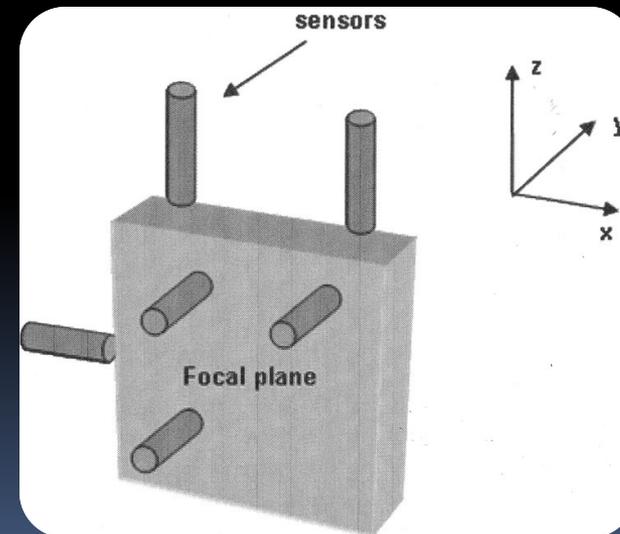
Philtec sensors were used to measure micron level mirror adjustments in high vacuum

Multi-Channel Vacuum Passthru

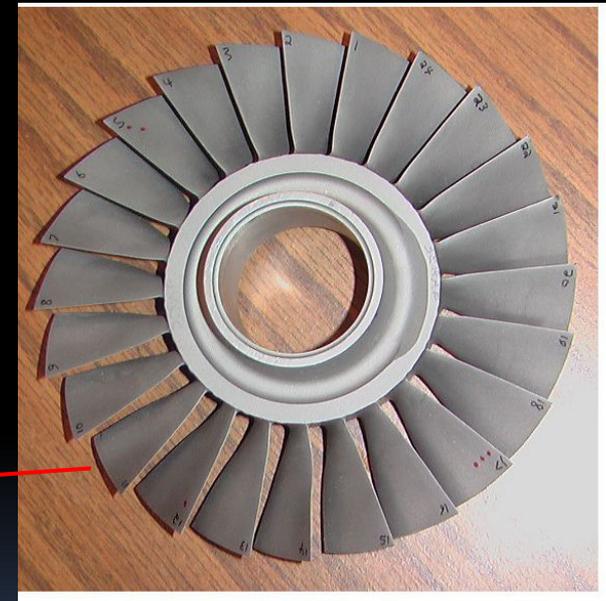
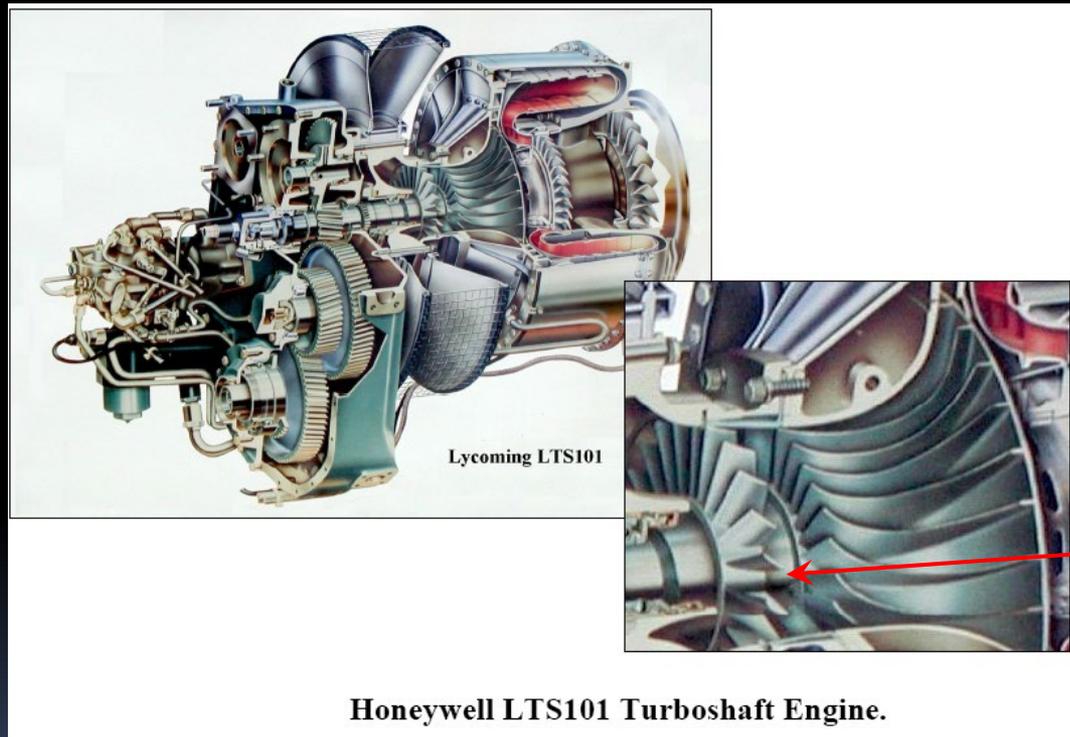
ESA's Sentinel 3 Satellite



This 6-channel displacement measurement system with vacuum passthru hardware was used to measure displacements and calculate rotations of the satellite's focal plane structure.

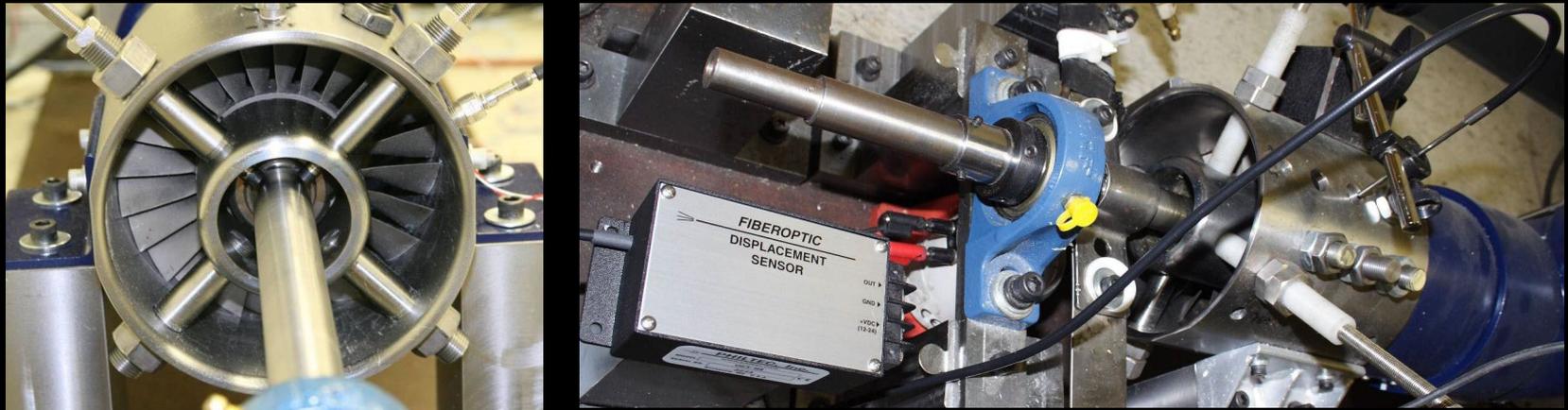


High Speed Compressor Blade Vibration Tests



The compressor test rig uses a small axial blisk from a 2 stage LTS101 Turboshaft Engine.

High Speed Compressor Blade Vibration Tests



- A High Speed Philtec D63 Probe was attached to the shroud and pointed radially inward at the blade tips.
- The time of arrival (TOA) of each blade was recorded using an 80 MHz NI counter timer card.
- The blade vibration can be detected directly from the deviation in expected arrival time curves for each blade.