



PHILTEC



June 2009



AEROSPACE APPLICATIONS

Aerospace Customer References

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; $\frac{3}{4}$ 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

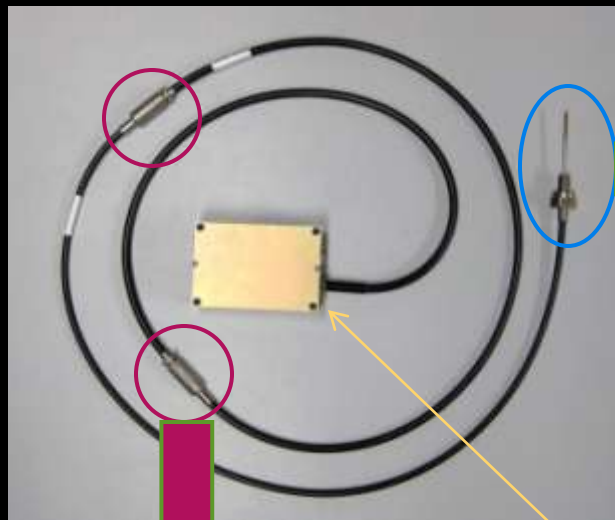
A customer required the smallest sensor for integration into a flying object.

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



Small Lightweight
Electronics Package

2 Connectors
Enable Use Of
Extension
Cables

Icing Research

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



High Speed Spin Tests

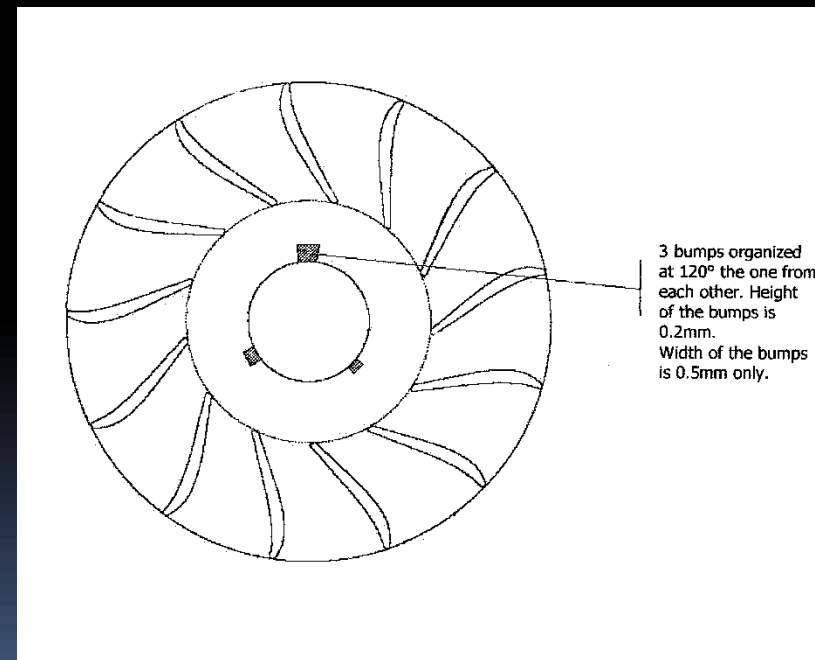
- 90° Probes Measure Radial Growth



Fiber Optic Probe

Micro-Turbine Development

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

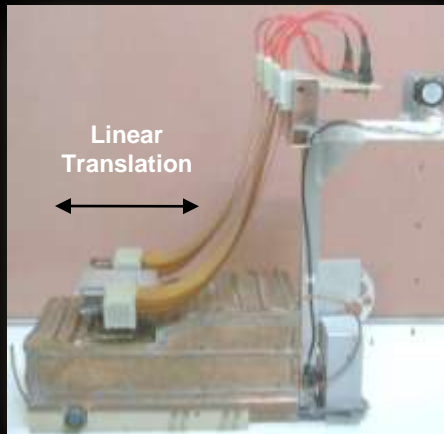


Mars Rover Mission

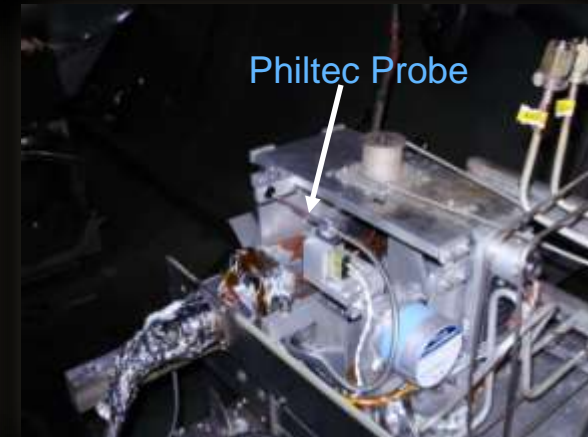
- NASA's JPL Ultrasonic Driller
- Developed by Cybersonics, Inc.
- Philtec sensor model RC25-HQ was used to characterize the harmonic analysis and axial motion of the drill.



Satellite Propulsion Thrust Testing



Busek Test Stand



Busek Co, Inc is a leading R&D company engaged in applied research and development in satellite propulsion systems.

Busek performs these measurements via custom-built thrust stands. Thruster performance is gauged by directly measuring the linear force output. Two major requirements were accuracy and complete resistance to stray electrical noise. By equating the applied thrust with the linear displacement via Philtec D63 fiber optic displacement sensors, the force output can be measured precisely and noise free

Note: The Philtec probes operate in vacuum and are equipped with vacuum passthru hardware to route the electronics outside the test chamber.

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



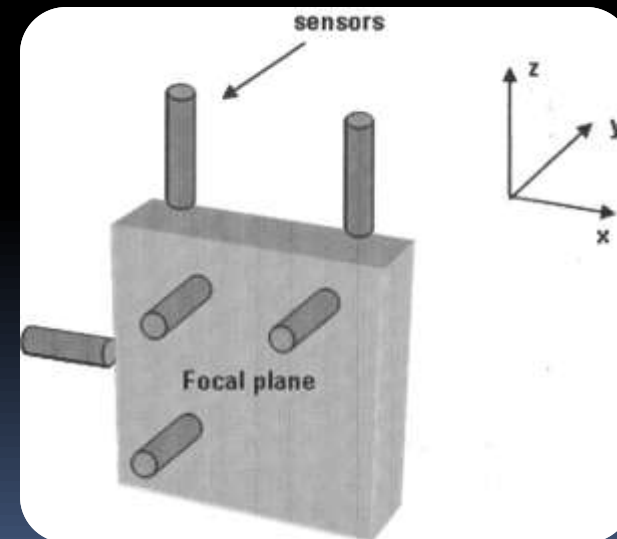
Philtec sensors were used to measure micron level mirror adjustments in high vacuum

Multi-Channel Vacuum Passthru

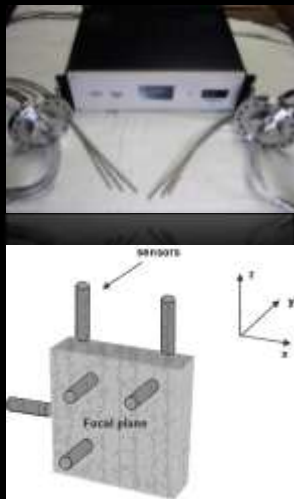
ESA's Sentinel 3 Satellite



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.



Testimonial From Thales Alenia Space

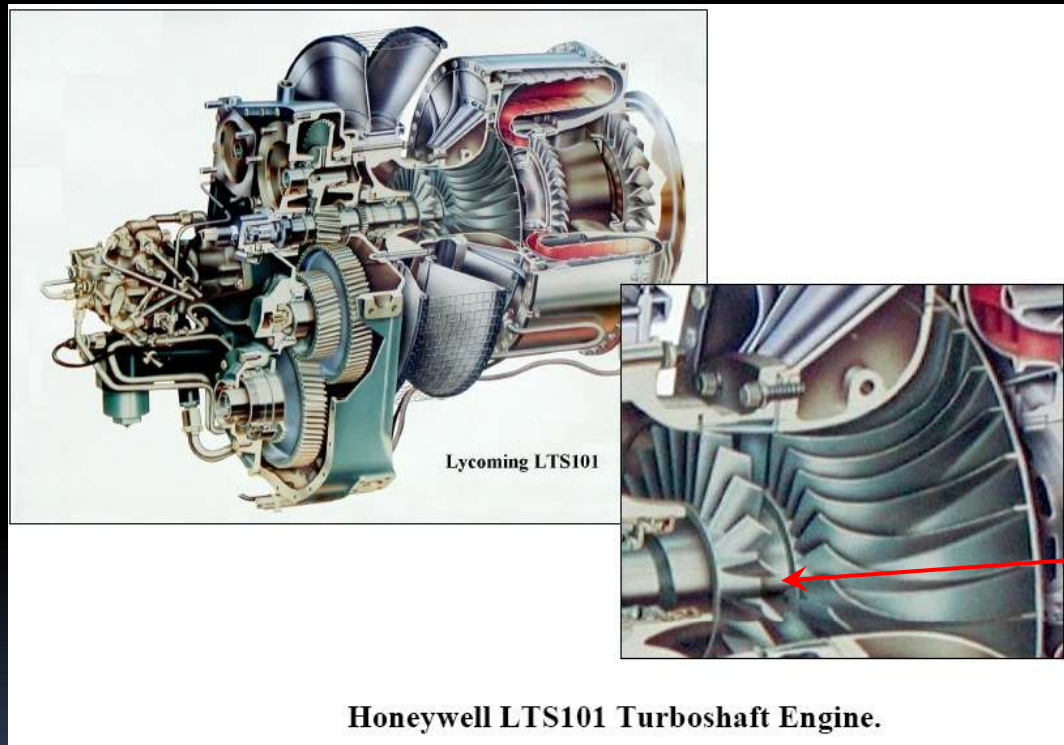


- The sensors performed well, as expected. They have been used for the validation campaign of our breadboard and are still installed in the setup.
- Now our breadboard is being upgraded to correct the problems discovered during the test campaign.
- People working on other projects currently under development have found these sensors very interesting.
- Two of our sensors have been used also for a test on the prototype of ISA instrument, a high sensitivity accelerometer to be integrated in BepiColombo mission to Mercury.

BvF Multi-Channel Vacuum Passthru



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.
- Blade vibration can be detected directly from the deviation in expected arrival time curves for each blade.