

FROM
INNER SPACE
TO
OUTER SPACE
PHILTEC
FIBEROPTIC SENSORS
SOLVE
YOUR
MEASUREMENT
PROBLEMS



PHILTEC
FIBEROPTIC SENSORS

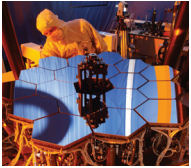


DISTANCE | DISPLACEMENT | VIBRATION

PHILTEC APPLICATIONS

Aerospace sensor applications are among the most demanding in the world. Philtec sensor systems have been successfully engineered into these extreme environments:

- Pressurized Cryogenic Fluids - LOX, LN2, CH4
- Extreme Temperatures - down to 4°K and up to +400°C
- Ultra-High Vacuum
- Strong Vibrations



James Webb Space Telescope

Philtec sensors & vacuum passthru hardware were used to measure displacements of critical components of this Hubble Replacement Telescope as they were brought down to the cold temperatures of outer space.



Rocket Turbopumps

Propulsion engineers are using Philtec Fiber optic sensors to measure radial and axial rotor displacements and rotational speed of rocket turbopumps using new fuels such as methane, propane and kerosene. Long fiber optic cables (45 - 60 ft.) keep the electronics away from the heat and vibration at the engine test stands.



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, to help solve the o-ring leak problems.



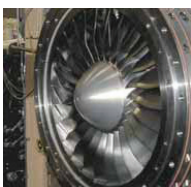
Space Shuttle

Nasa's MSFC used Philtec probes in a LOX pressurized cryogenic environment to monitor bearing deflections in the Space Shuttle Main Engine.



Flight Tests

Philtec 90° tip sensors were used for Airbus 380 flight tests to measure displacement of thrust reversors.



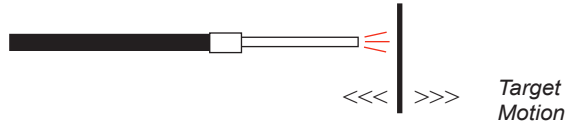
Turbine Applications

Philtec sensors have been used for various measurements such as speed of 1,000,000 rpm micro-turbines; shaft displacements, time-of-arrival and flutter in gas turbine and turboshaft engines. Wireless sensors have been used to measure cold clearance in large power gas turbines.

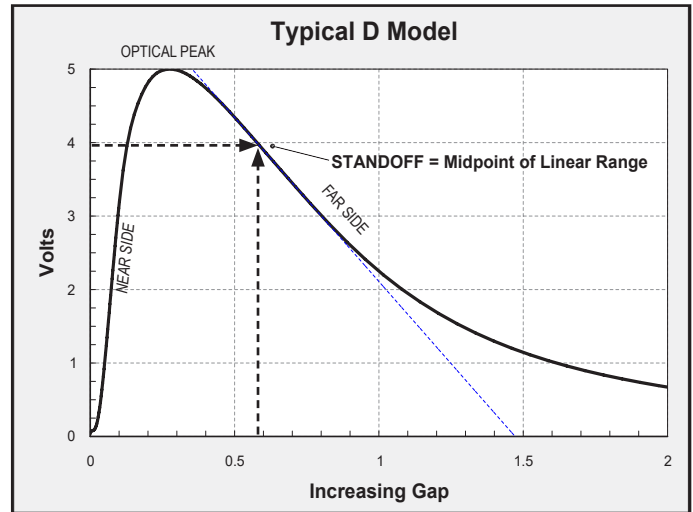
D TYPE SENSORS REFLECTANCE DEPENDENT

Maximum range 76 mm

Philtec D Type Sensors are recommended when the target moves along the axis of the sensor; i.e., single axis vibration where the target reflectivity is constant.



D type sensors provide an output proportional to distance and reflectance of the target. The output function is double-valued: Near Side operation gives highest resolution; Far Side operation gives moderate sensitivity with larger operating range.



ANALOG OUTPUT MODELS

Feature	Unit	D6	D12	D20	D21	D47	D63	D64	D100	D125	D169	D170	D171	D240	
Tip Diameter	mm	0.81	0.81	0.81	0.81	1.61	3.18	3.18	3.18	3.96	4.76	4.76	4.76	7.92	
Fiber Diameter	mm	0.15	0.3	0.51	0.53	1.16	1.6	1.63	2.54	3.18	4.32	4.32	4.32	6.1	
Total Range	mm mils	1 40	2 80	1.3 50	2 80	5 200	3 125	6 240	10 400	15 600	20 800	30 1200	50 2000	76 3000	
Optical Peak	mm	0.25	0.25	0.12	0.25	0.3	0.15	0.3	0.4	0.4	0.65	0.9	8	14	
NEAR SIDE															
Standoff	mm	.09	.087	.03	.06	.06	.038	.07	.07	.05	.04	.08	2.4	3	
Linear Range	mm	.05	.045	.02	.04	.046	.02	.04	.05	.05	.04	.06	1.9	3.2	
Sensitivity	mv/ μm	40	40	90	40	45	100	40	39	37	40	33	0.71	0.6	
Resolution 100 Hz	μm	.025	.02	.004	.025	.010	.005	.018	.013	.005	.001	1	0.15	0.5	
Resolution 20 KHz	μm	.05	.03	.008	.05	.035	.01	.035	.03	.03	.02	7	1.5	2	
Resolution 200 Hz	μm	0.1	.06	.02	.1	.07	.02	.05	.1	.06	.04	17	3	4	
FAR SIDE															
Standoff	mm	0.38	0.53	0.3	0.7	1.1	.50	1.1	2.2	2.4	3.3	3.8	13	22	
Linear Range	mm	0.33	0.41	0.25	0.7	1.3	.70	1.3	2.3	3	4.7	6.0	4.7	12	
Sensitivity	mv/ μm	5	4.4	8	3	1.3	3.2	1.3	0.8	0.75	0.75	0.3	0.3	0.2	
Resolution 100 Hz	μm	0.17	0.1	0.05	0.08	0.4	0.17	0.3	0.6	1	1	1.4	0.8	2.5	
Resolution 20 KHz	μm	.35	0.2	0.1	0.8	0.8	0.35	2.5	1.2	2	2	2.8	5.6	5	
Resolution 200KHz	μm	.7	0.4	.25	1.3	1.6	0.7	5	2.4	4	4	5.6	12	10	

APPLICATIONS FOR D TYPE SENSORS

Actuator Dynamics
Bearing Vibration
Casting Porosity Check
Diaphragm Deflection
Fuel Injector Dynamics

Impact & Shock Studies
Parts Positioning
Piezoelectric Crystal Vibration
Piston Registration (TDC)
Piston Stroke

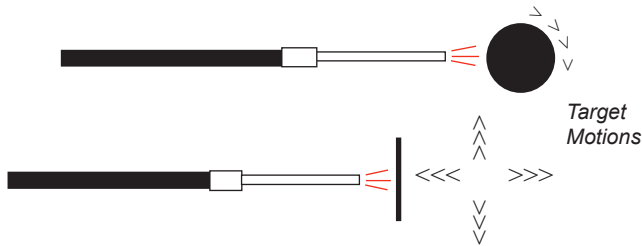
Scratch Detection
Servo-Control
Solenoid Travel
Speed Sensing
Structural Deformation

Surface Finish Evaluation
Turbine Blade Vibration
Ultrasonic Vibration
Vacuum Process Control
Valve Dynamics & Stroke

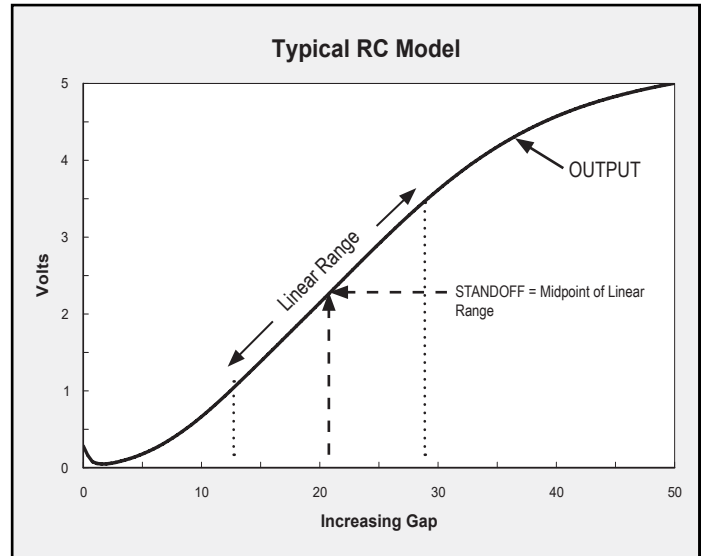
RC TYPE SENSORS REFLECTANCE COMPENSATED

Maximum range 35 mm

Philtec RC Type Sensors are recommended when the target rotates or moves past the sensor.



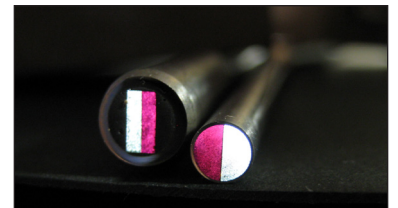
RC Sensors provide an output signal proportional to distance only. Reflectance changes of the target do not effect the output. The output function is single-valued.



ANALOG OUTPUT MODELS

Feature		RC19	RC20	RC25	RC32	RC59	RC60	RC100	RC125	RC171	RC220	RC290
Tip Diameter	mm	0.81	0.81	4.75	1.27	1.83	1.83	3.18	3.96	4.75	6.35	7.92
Fiberoptic Area	mm	∅ 0.5	∅ 0.5	0.64 x 3.18	∅ 0.81	∅ 1.52	∅ 1.52	∅ 2.54	∅ 3.18	∅ 4.34	∅ 5.6	∅ 7.44
Total Range	mm	0.76	1.65	0.76	2	2	4	5.1	9	12.7	25.4	35
	mils	30	65	30	80	80	160	200	350	500	1000	1380
Standoff	mm	0.46	1	0.3	1	1	1.8	2	4	4.4	15.5	20
Linear Range	mm	.3	0.6	0.18	.75	.75	1	2.2	1.5	3.8	4.8	10
Sensitivity	mv/μm	9	4	10	3	3	2	0.9	0.8	0.5	0.4	0.22
Resolution 100 Hz	μm	0.05	0.3	.05	0.25	0.25	0.4	0.8	0.6	1.3	5	15
Resolution 20 KHz	μm	0.4	1	0.3	1	1	1	2.5	4	6	10	30
Resolution 200KHz	μm	0.8	2	0.6	2	2	2	5	8	12	20	60

OPERATING PRINCIPLE: Two fiber bundles are arranged side-by-side. Light exits one side, reflects off the target and returns to the sensor thru both sides. A ratiometric calculation of those two signals provides the distance measurement which is independent of target reflectance variations; i.e., **reflectance compensated**.



APPLICATIONS FOR RC TYPE SENSORS

Automated Parts Inspection Bearing/Rotor Dynamics Commutator Profile Computer Disc Assembly Deformation Studies	Distance To Glass Distance To Paper Distance To Plastic Dynamic Expansion Hard Disc Thickness	Process Control Rotor Runout Shaft Orbits Structural Deformation Surface Finish Evaluation	Turbine Blade Clearance Ultrasonic Vibration Ultra-High Vacuum Vibration Studies Warpage
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PHILTEC FIBEROPTICS

Standard sensor cables use glass fibers with a protective sheathing. Cable and tip materials are chosen for best compatibility with the application's environment. In the most extreme conditions, the glass fibers can be exposed to cryogenic temperatures near absolute zero and elevated temperatures above 300°C (up to 400°C).

- Philtec Sensors Are Commonly Used**
- Inside of Mechanisms
 - In Cryogenic Environments
 - In High Electrical Fields
 - In Hazardous Environments
 - In High Magnetic fields
 - At High Temperatures
 - At High Pressures
 - Submerged in Oils, Water, or Other Fluid
 - In Vacuum

FO CABLE JACKET MATERIALS

Standard - A PVC jacket over a flat steel ribbon monocoil is the standard cable jacket, which is an excellent combination for general purpose usage.

Alternatives - Interlocking Stainless Steel is the most popular alternative jacket, providing the highest temperature capability and maximum crush resistance with good flexibility.

For vacuum & cryogenic applications, low outgassing materials are required. SS Interlock, PTFE and polyolefin are good choices.

CUSTOM PROBES

Custom Probes Made to Customer Specifications Are Common

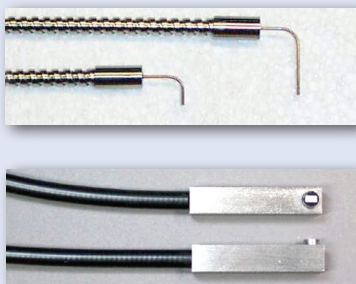
Very Small Probes



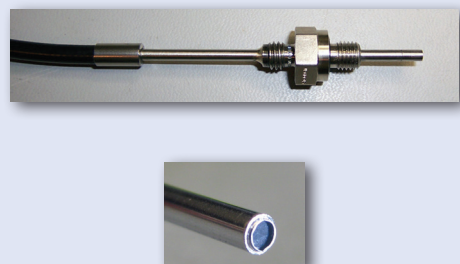
Threaded Probes



90° Probes



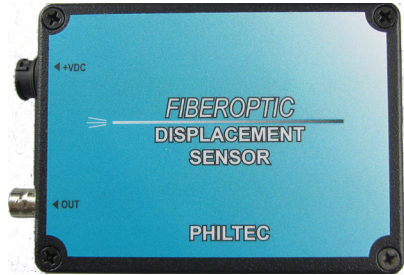
High Pressure Probes



SENSOR HARDWARE

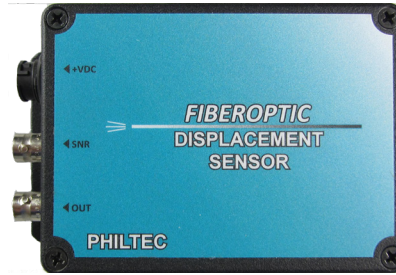
Analog sensors are fast responding units ideal for relative motion measurements in dynamic applications. Available in D and RC type single channel packages.

- **Analog Output** 0 - 5 volt with 20 KHz standard bandwidth.



D

Reflectance Dependent



RC

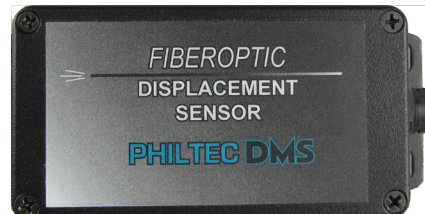
Reflectance Compensated

Digital sensors with linearized distance output are the best choice for multiplexing and process control applications. Calibration data stored on-board. D and RC models available.

- **Digital Output** Linearized distance output with 5000 sps max data rates.



muDMS - USB



mDMS - RS232

FREE SOFTWARE INCLUDED!

DMS Control software that enables you to use your PC to:

- Setup Sensors For Operation
 - Select Calibration Tables For Specific Targets
 - Store Additional Calibrations
 - View Live Graphs Of Sensor Outputs
 - Save Data To File
-

Wireless WiFi radios are incorporated into the sensor amplifier package. They feature long battery life (8 hours active; 2 weeks standby) and extended transmission range. Contact the factory for details.

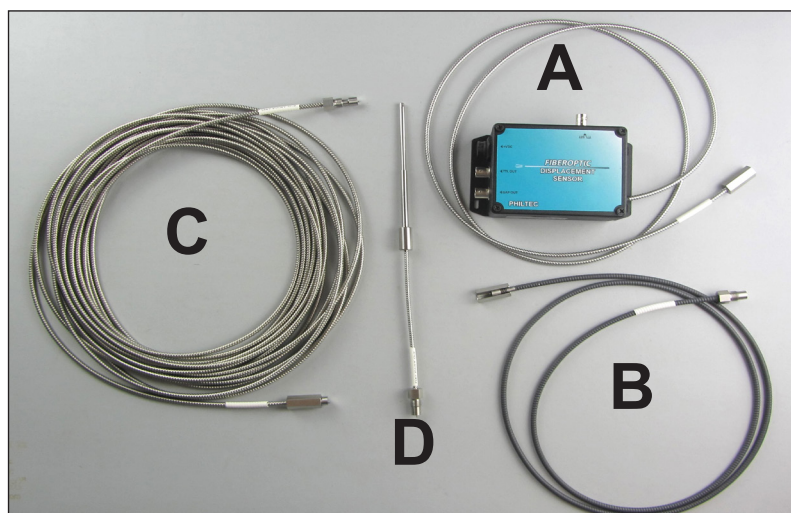
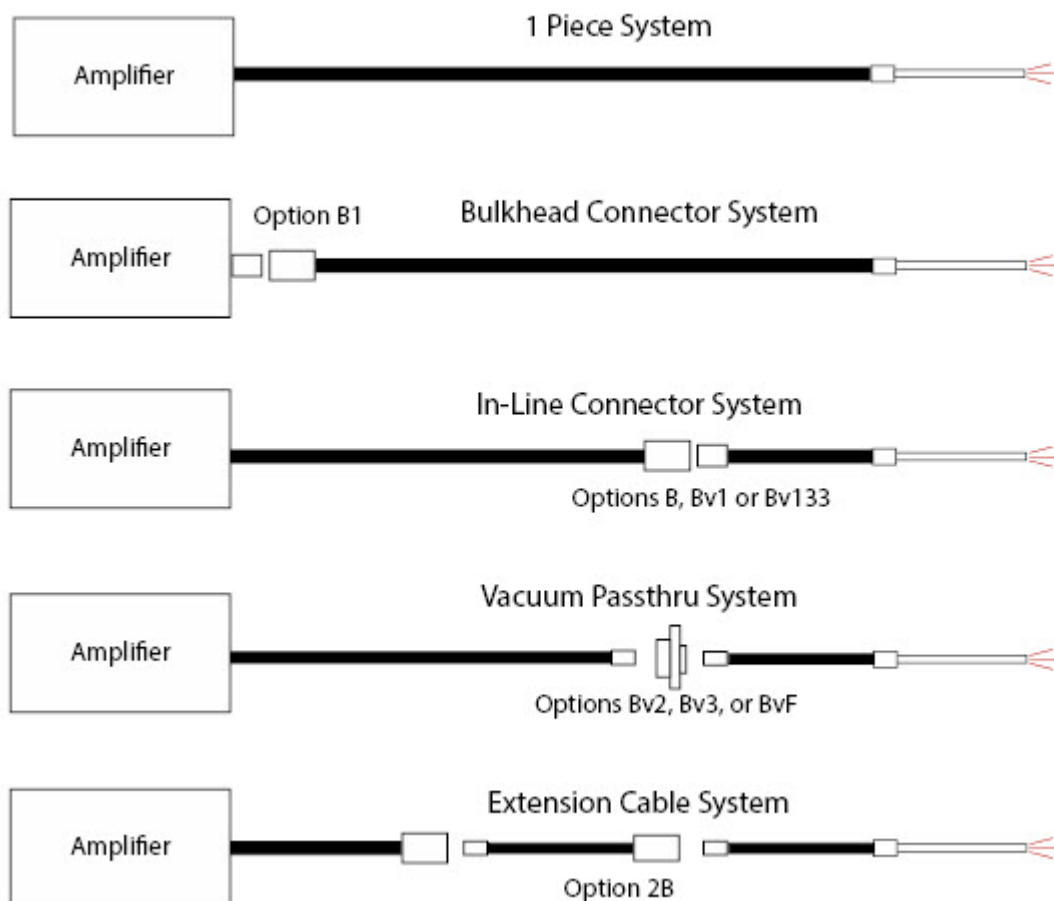
NEW



SENSOR HARDWARE

Multi-Part Sensor Systems

All sensor models can be supplied as a 2 part system with one connector interface. Some models can be supplied with as many as four parts with three connector interfaces. Please contact the factory for design guidance with these options.



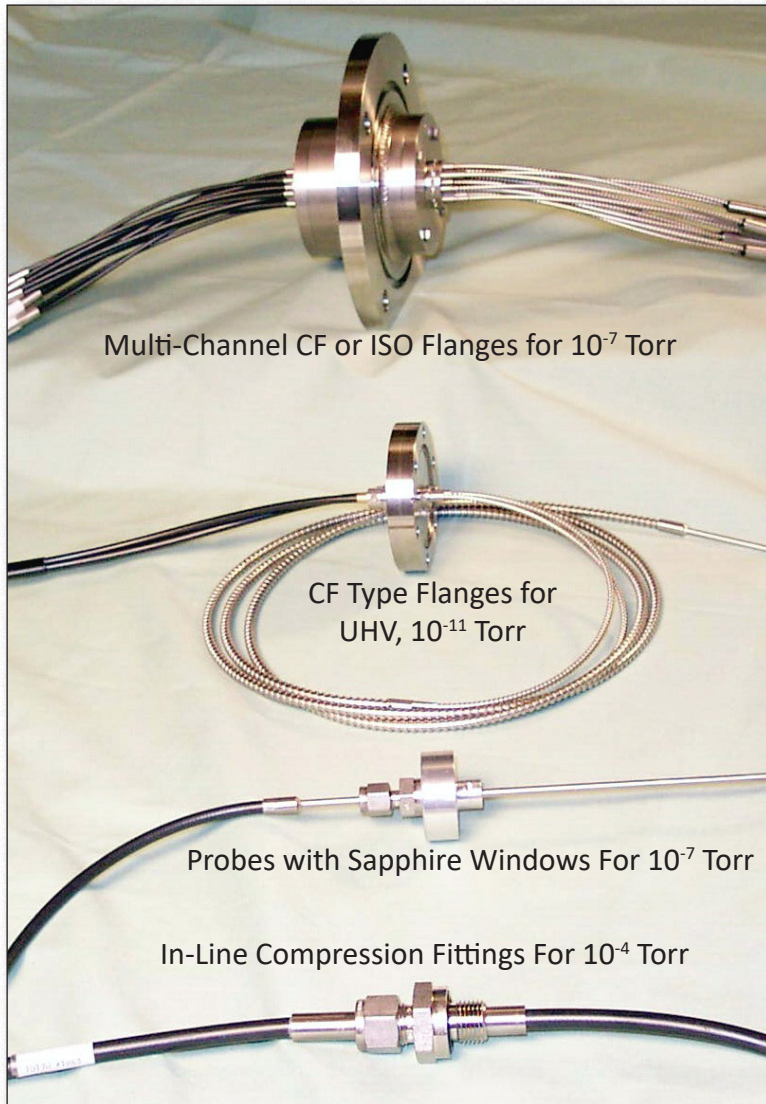
Example (for rocket engine testing)

- Part A - Amplifier with 5 Ft Cable
- Part B - 5 Ft Extension Cable
- Part C - 40 Ft Extension Cable
- Part D - Probe with 6" Cable

VACUUM HARDWARE

Fiberoptic Displacement Sensors are ideal for displacement and position measurements in vacuum. They have a wide temperature range, are UHV compatible, small in size and can have sub-micron accuracy.

Philtec's line of vacuum passthru hardware enables the installation of fiberoptic probes into vacuum chambers over a wide variety of applications, such as:



- In High Electrical Fields
- In High Magnetic fields
- At High Temperatures
- At High Pressures
- In Ultra High Vacuum
- In Cryogenic Fluids
- At Cryogenic Temperatures

MEASUREMENTS IN VACUUM OUR SPECIALTY

Custom Systems to Customer Specifications

PHILTEC FIBEROPTIC SENSORS

 Non-Contact

▶ No Effect On Target

 Small Size

▶ Small Target Spot Size

 Configurable

▶ Access Hard to Reach Targets

 Fiberoptics

▶ Intrinsically Safe

▶ EMF Noise Immunity

▶ Vibration & Shock Resistant

▶ Survive Extreme Environments

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