Principle of Operation

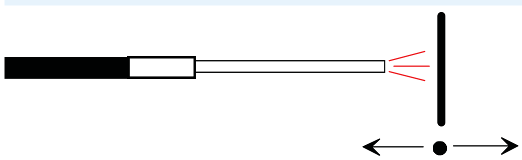
These sensors are reflective type fiberoptic displacement transducers utilizing bundled glass fibers to transmit to and reflect light from target surfaces.
Based upon detecting the intensity of reflected light, various displacement sensitivities and operating ranges have been created via unique combinations of light sources, fiber types, fiber bundle shapes and sizes, distributions of light-transmitting and light-receiving fibers, and arrangements of light-transmitting and light-receiving bundles.

Sensor Types

Two types of fiberoptic displacement sensors are found in this catalog:

1. TYPE D - Reflectance Dependent

Recommended for applications where the target moves along the axis of the sensor...

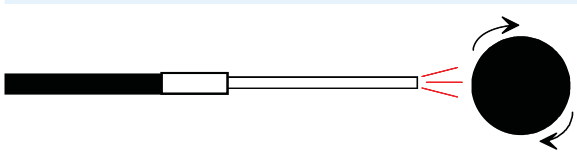


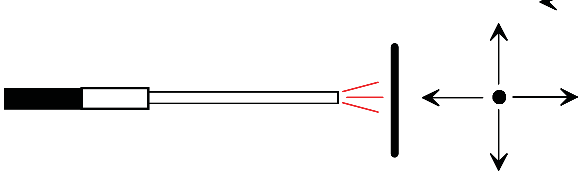
With **REFLECTANCE DEPENDENT Sensors,** the output voltage is proportional to the distance between the sensor tip and target surface **AS WELL AS** the reflectivity of the target surface.

D TYPE sensors are commonly used in applications where the target has a reciprocating or vibratory motion parallel to the axis of the sensor.

2. TYPE RC - Reflectance Compensated

Recommended for applications where the target rotates or moves past the sensor...





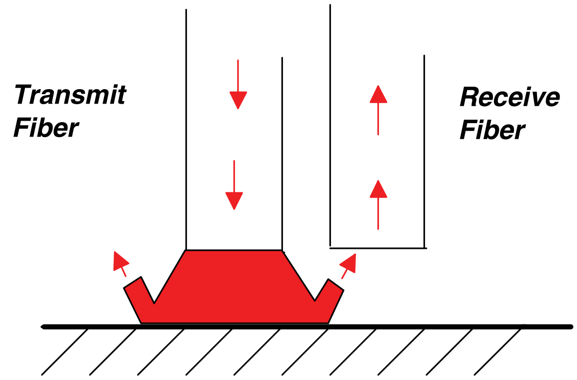
With **REFLECTANCE COMPENSATED Sensors,** the output voltage is only proportional to the distance between the sensor tip and the target surface.

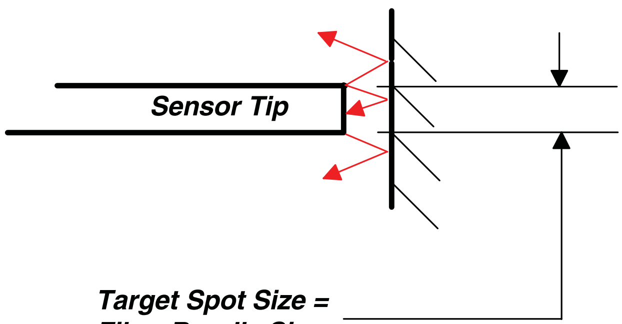
RC TYPE sensors can be used for vibratory motion **AND** for applications where a moving target rotates or translates in a direction perpendicular to the axis of the sensor.

About the Sensors

TARGET SPOT SIZE (Flat Targets)

Cones of light rays at all angles from 0 thru 66° fill the transmit fibers and reflect off targets into the receive fibers *(Philtec's fiberoptic sensors do not use collimated light sources).*





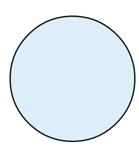
Any light rays diverging outward and away from the perimeter of the sensor tip are reflected further away from the tip. Therefore, **the target spot size is equal to the area of the fiber- optic bundle in the sensor tip.** The target should be equal to or larger than the fiberoptic area to achieve rated specifications.

SMALL TARGETS

- D6 is the smallest D model with 0.006" diameter spot size.
- RC20 is the smallest RC model with a 0.020" diameter spot size.

SURFACE CONTRAST

Highly reflective surfaces are the *best choice for optimum perfor- mance*.



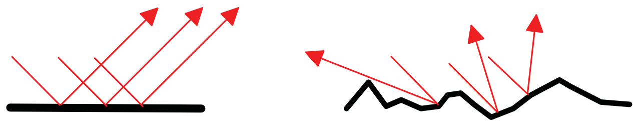
Any polished metal is an excellent reflector.

Less reflective surfaces can also be measured with good results, however the resolution will not be as good as with shiny targets. If a sensor is purchased to make measurements to targets with less than 10% reflectance, the factory should be so informed.

TARGET	% REFLECTANCE
Mirror, Front Surface	100
Polished Silicon Wafer	65
Polished Aluminum	60
Ground Steel	20
Gloss Silver/White Paint	15/10
Bright White Ink Jet Paper	7
Glossy Black	5
Water	2
Flat Black	1

SURFACE ROUGHNESS

Smooth surfaces are best. Rough surfaces degrade repeatability.



Smooth (Specular)

Rough Texture (Diffuse)

The best accuracy and repeatability is obtained with specularly reflective objects such as finely ground, lapped, mirrored, polished, shiny or glossy surfaces where the rays of light reflect predictably.

Diffuse reflectors such as matte finishes and rough surface finishes scatter light rays randomly, thereby reducing sensor repeatability.

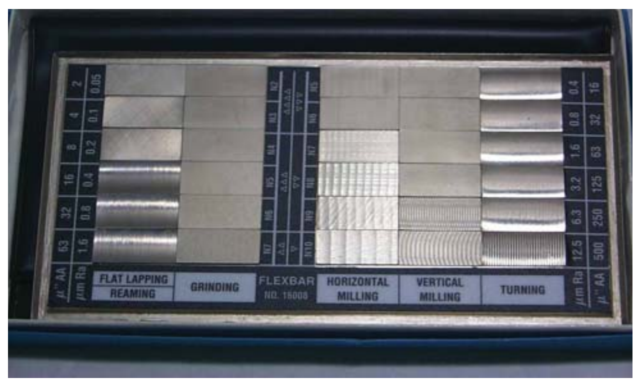
With smooth targets, a single point measurement suffices to measure distance. With rough surfaces, data averaging is recommended to average out the effects of scattering light rays.

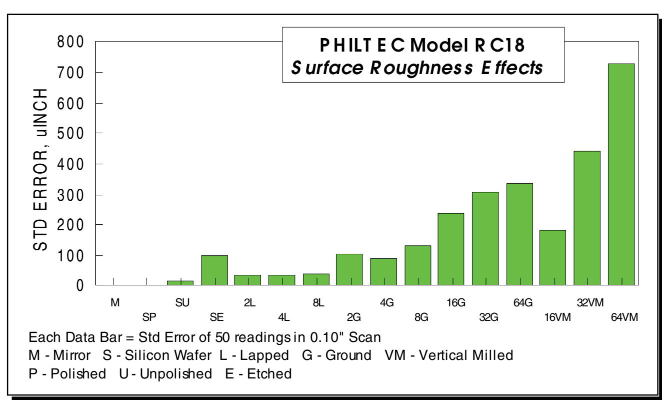
For example, we scanned at a fixed distance over standard surface roughness specimens shown here, as well as silicon wafers that were polished, unpolished and etched.

We recorded 50 data samplings over each target as the sensor moved 0.002" between each data point.

The chart shows the variance of the data, wherein we calculated the voltage variance in terms of microinches, based on the sensitivity of the model RC18 sensor. The data bars generally increase with increasing surface roughness.

NOTE. The Surface Roughness Standards used in these tests are calibrated in microinch AA with contact gaging. The total Peak-to-Valley depth of Roughness...which is the profile "seen" by the RC18 fiberoptic sensor...varies from 4 to 12 times the AA values. This difference between contact and non-contact gaging can explain why the fiberoptic data does not match the contact gage data 1 to 1 throughout the range of specimens.





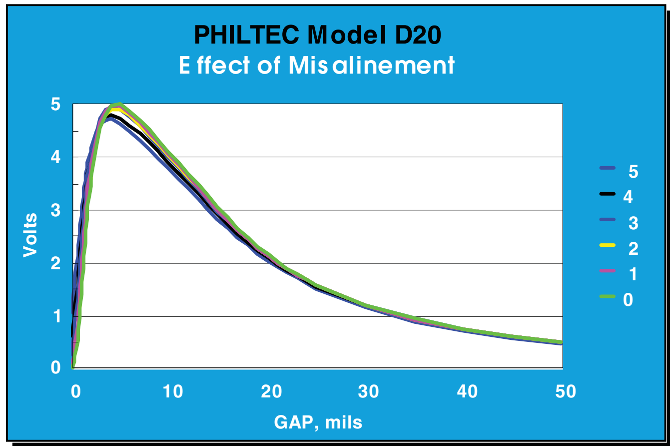
PERPENDICULARITY

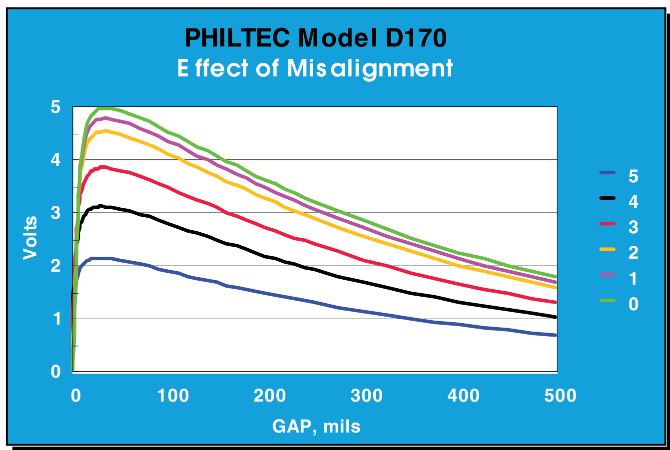
To achieve the maximum linear range afforded by these devices, perpendicularity to the target surfaces should be within ±0.5°. In general, small cross-section sensors are much less sensitive to tilt than are the large cross-section sensors.

D Models

When a target surface tilts under a probe tip the output voltage drops. However, small diameter tips such as D6 and D20 models are much less sensitive to misalinement than larger tips like the D170, where ±0.5° perpendicularity is recommended.

If the probe is mounted with a fixed angle of misalignement, the probe peak output can be calibrated at that angle and the sensor operated normally.

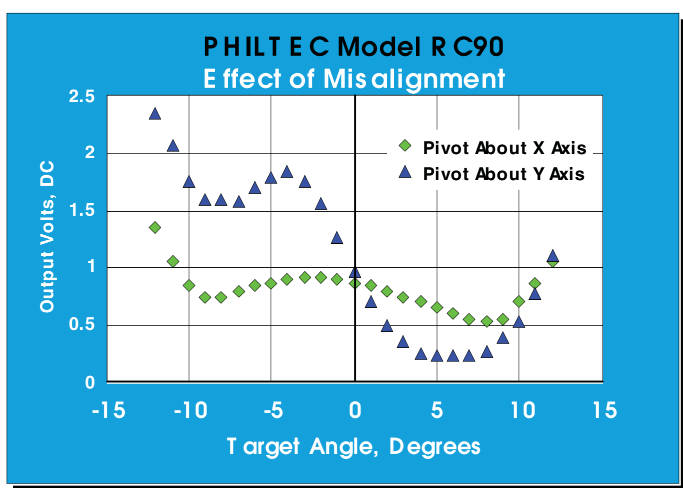




RC Models

Unlike the D model probes with one round fiberoptic bundle, RC models have two adjacent bundles of fibers. Orientation of the adjacent bundles across the axis of tilt provides favorable results.

For example, when the sensor tilts about the Y axis shown here, the device is very sensitive to tilt, and operation should stay within ±0.5°. However, for tilt about the X axis, the device is very insensitive to tilt, giving good results between ±10°.



Fiberoptic Area
In RC Sensor