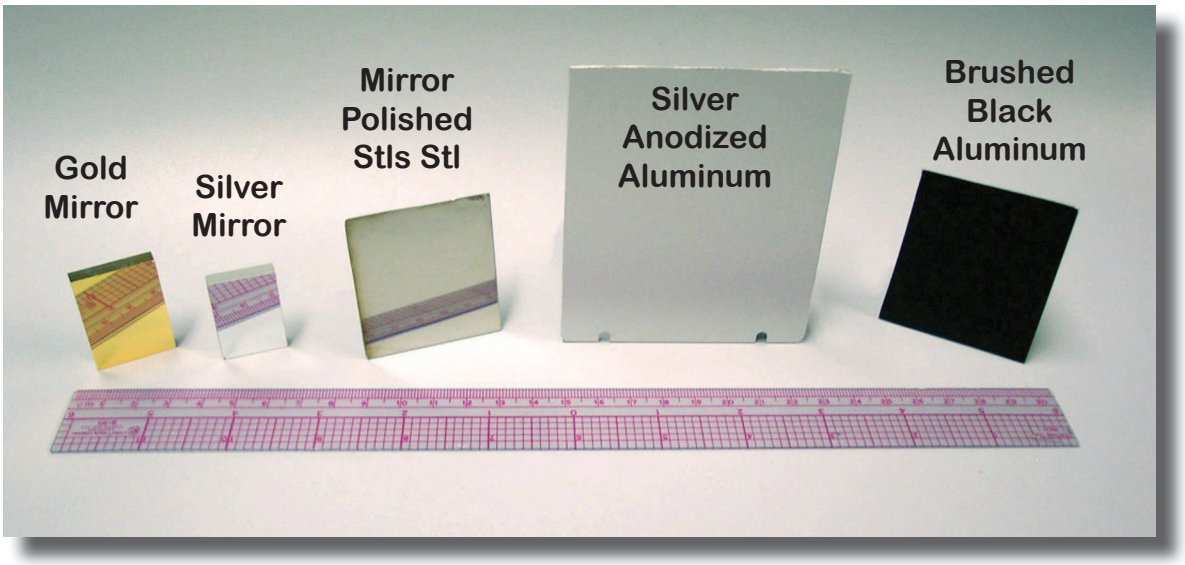
Philtec Application Note

No. 25
June 2026

RC Type Sensors - Reflectance Compensated

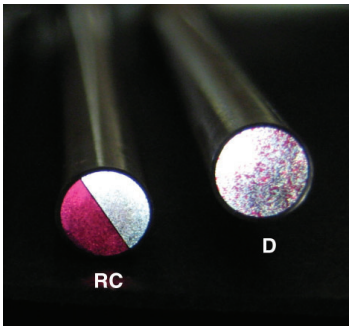


The Problem

The output signal from an intensity-based reflective optical displacement sensor (Philtec D Type) varies proportionately with the reflectivity of the target surface and with distance: i.e., the shinier the target, the higher the signal. This limits successful distance measuring applications to targets having a single axis reciprocating or vibratory motion (reflectivity is unchanging).

The Solution

PHILTEC developed the ***Reflectance Compensated*** fiberoptic sensor to overcome the limitations of D Type sensors, by providing a sensor whose output signal is blind to reflectance variations. The RC type sensor is a more general purpose optical sensor that can make accurate distance measurements to rotating or translating targets as well as measure part-to-part size variations in production parts.



RC Sensors

Light is transmitted to the target thru one side of adjacent fiberoptic bundles. The reflected light is captured in two separate fiber bundles which follow independent paths back to the electronics. A ratiometric calculation provides the distance measurement which is independent of target reflectivity variations; i.e., **reflectance compensated.**

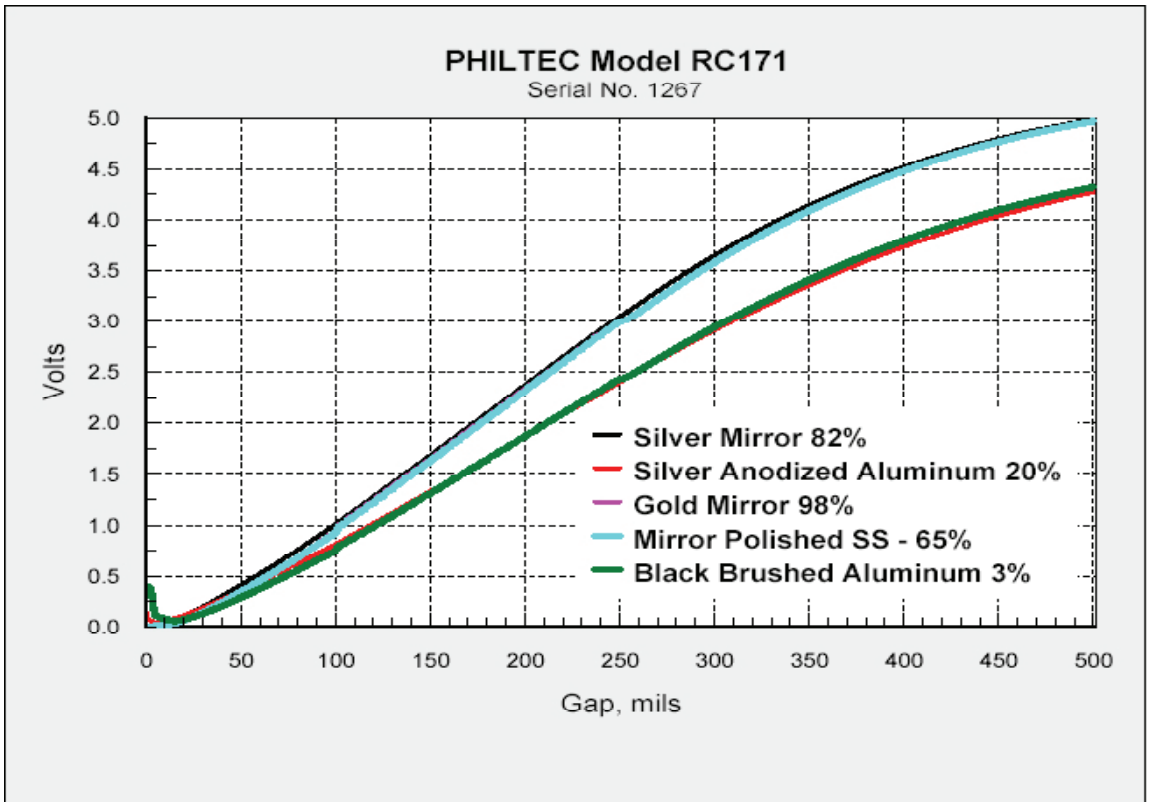
RC Type Sensors - Specular vs. Diffuse

Specular (Mirrored) Targets

All targets with mirror smooth surface finish generate identical output responses. This is illustrated in the chart below where the gold, silver and stainless steel mirrors generate identical outputs even though their surface reflectances vary from 65 to 98%.

Diffuse (Dull) Targets

Dull or matte finish targets will generate output curves less steep than specular targets. This is illustrated in the chart below where the silver anodized aluminum and black brushed aluminum generate identical outputs even though their surfaces vary from 20% to 3% reflectance.



This chart illustrates that reflectance compensation works over a very wide range of target reflectances, nearly 100::1. These data also demonstrate that **reflectance compensation does not correct for the differences between specular and diffuse reflectors. Specular (smooth and shiny) targets generate about 15% higher sensitivity than diffuse reflective targets... and therefore, different calibrations are required for different surface roughnesses (but not for different reflectance materials).**

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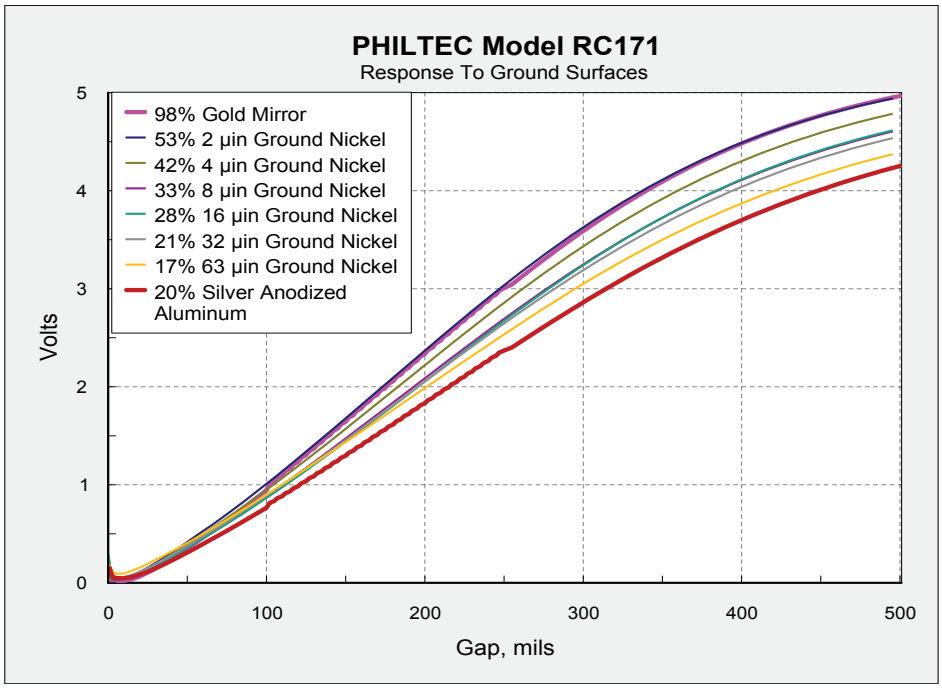
RC Type Sensors - Specular vs. Diffuse

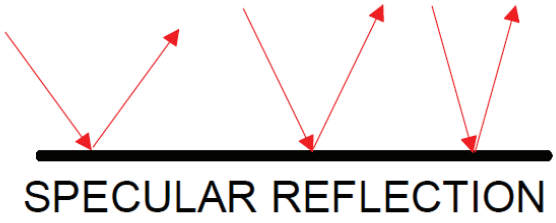
Machined Surfaces

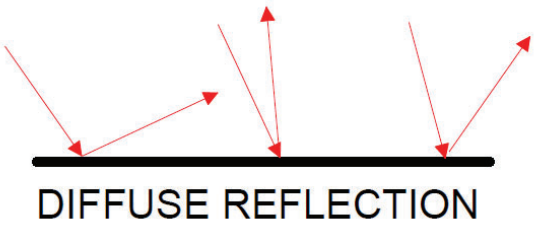
Machined surfaces span the range from diffuse to specular. Rough machined surfaces are diffuse reflectors. Ground finishes can be in between totally diffuse and specular. This is illustrated in the chart here: a 2 microinch ground finish acts essentially as a mirrored surface; a 63 microinch ground surface is essentially a diffuse reflector. For best results, it is always good practice to calibrate a sensor to the same surface finish as the target to be measured.

A model RC171 was calibrated to a variety of machine ground surfaces from 2 to 63 microinch. The reflectance of ground surface samples are provided here.

Differences between the ground surfaces are <u>proportional to the surface roughness values</u>, not to the reflectivity of those surfaces.







Automated Parts Inspection Bearing/Rotor Dynamics Commutator Profile Hard Drive Assembly Deformation Studies	Distance To Glass Distance To Paper Dynamic Expansion Hard Disc Thickness Precision Grinding	Process Control Rotor Runout Shaft Orbits Structural Deformation Surface Finish	Turbine Blade Growth Ultrasonic Vibration Ultra-High Vacuum Vibration Studies