SmarAct corner cube retro-reflectors

Abstract
SmarAct offers a few optical components that have been proven in metrology applications. Among these, corner cube retro-reflectors are easy-to-use targets for **PICO**SCALE sensor heads, featuring a large angular acceptance window.

1. INTRODUCTION

Retro-reflectors can be used as target for **PICO**SCALE measurements. They reflect light anti-parallel with respect to the direction of incidence, whereas the orientation of the reflector plays a minor role. Thus, alignment of sensor heads to the target becomes very easy: The measurement beam must only hit the retro-reflector in the center and light will be reflected back into the sensor head so that the **PICO**SCALE can track the displacement. Furthermore, due to the very limited angular tolerance of a sensor head in combination with a plane mirror, retro-reflectors are often the only possibility to measure large angles. A photograph of variants of retro-reflectors is shown in Figure 1.

Figure 1. *Photograph of SmarAct's retro-reflectors with a 10 mm diameter marble for size comparison.*

2. NOTES

Retro-reflectors are an easy-to-use option when it comes to setting up an experiment. However, they may suffer a few limitations in measurement accuracy, including

- Due to the refraction of the glass, there exists a pointing error: The tip of the reflector appears to be at a different point.
- The glass has a temperature-dependent refractive index so that the measurement may suffer thermal drifts that need to be carefully compensated for.

A more detailed treatment on measurement errors when using retro-reflectors can be found in:
Harding, Kevin, ed. *Handbook of optical dimensional metrology*. CRC Press, 2013.

3. SPECIFICATION

3.1 Tolerance to lateral shift

The maximum interference contrast is given if the **PICO**SCALE measurement beam hits the center of the retro-reflector. However, due to the non-zero beam diameter, some portion of the light is still interfering with the reference beam even if there are lateral shifts of the retro-reflector with respect to the measurement beam. Measurements with both retro-reflectors (3 and 10 mm diameter) have been performed using a PS-SH-C03 sensor head. Lateral shifts in the order of the beam radius (800 µm, $1/e^2$) can be tolerated, cf. Figure 2.

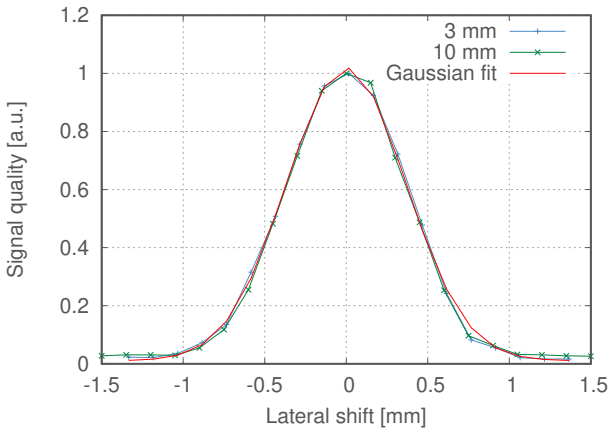

Figure 2. **PICO**SCALE *signal quality as function of the lateral shift of the retro-reflectors (3 mm and 10 mm diameter) with respect to the center of the measurement beam of a PS-SH-C03 sensor head.*

3.2 Summary

Please find an overview on the specifications of our retro-reflectors on the next page.

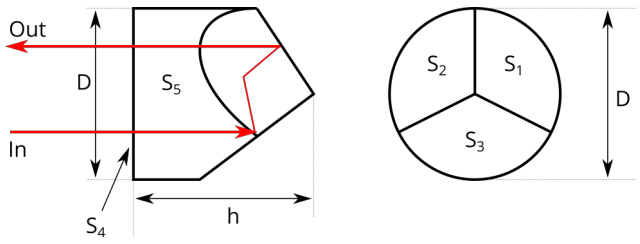

Table 1. *Summary of specifications of the retro-reflectors. (n.s. = not specified)*

Version	3 mm	10 mm
Type	Corner-cube retro-reflector	Corner-cube retro-reflector
Diameter D	$3.0^{+0.1}_{-0.1}$ mm	$10^{+0.0}_{-0.1}$ mm
Height h	$3.5^{+0.5}_{-0.5}$ mm	$7.5^{+0.15}_{-0.15}$ mm
Parallelism of input and output beam	20″	5″
Chamfer (roof edges)	n.s.	<0.1 mm
Chamfer (other edges)	n.s.	<0.3 mm
Blind spot diameter	≈ 340 µm	≈ 280 µm
Surfaces S1, S2, S3	silver coating (R>94%) black overpaint	Ag/Cu coating black overpaint
Surface S4	AR coating at 633 and 1550 nm, R<0.5%	AR coating at 1550 nm, R<0.25%
Surface S5	fine ground with black overpaint	fine ground with black overpaint
Clear aperture	85%	85%
Order code	PS-ACC-TA-R-3-C	PS-ACC-TA-R-10-C

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