

## Ultra Stable Hard-mounted Retroreflector - USHM™

### Description

The Ultra Stable Hard-Mounted Hollow Retroreflector (USHM™) is a self-compensating mirror that is totally insensitive to position and movement, such as tilt or rotation.

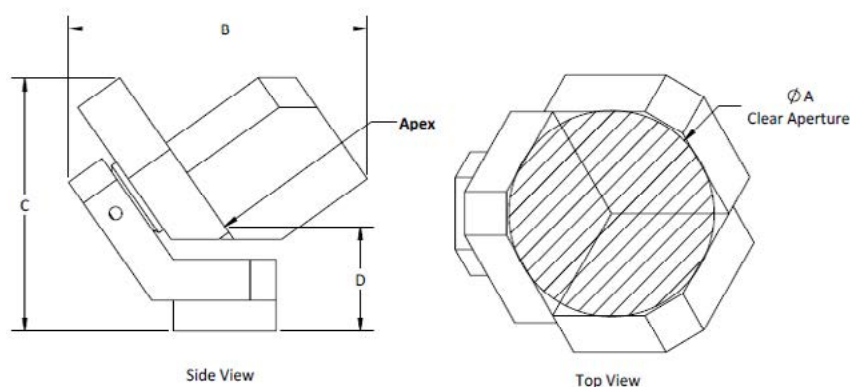
### Features / Characteristics

Parallel incident light that hits the USHM™ will be returned with great accuracy to the light source, regardless of the USHM™'s physical orientation. The USHM™ is an improved hard mount solidly connecting the retroreflector to the next assembly. USHM™'s robust mountings and mirror technology offer properties which enable them to perform exceptionally well in critical applications and harsh conditions.



### Applications

USHM™ configurations have been utilized in military and space applications and are especially well suited for interferometers where high stability of the OPD and concentricity of the apex to the mounting thread are critical requirements.



## Specifications

|                  |  |
|------------------|--|
| Substrate        | Pyrex                                      |
| Housing material | Invar                                      |
| Surface flatness | $\lambda/10 - \lambda/20 @ 633 \text{ nm}$ |
| Surface quality  | 80 – 50 Scratch-Dig                        |
| Beam deviation   | 0.5 – 30.0 Arcsecond                       |

| Item    | Beam Deviation | Exiting Wavefront<br>(p.v. 633 nm) | Weight<br>(grams) |
|---------|----------------|------------------------------------|-------------------|
| USHM-10 | 1.0 - 30.0     | 0.15 - 3.50                        | 34                |
| USHM-15 | 0.5 - 30.0     | 0.10 - 5.25                        | 73                |
| USHM-20 | 0.5 - 30.0     | 0.15 - 7.00                        | 126 - 136         |
| USHM-25 | 0.5 - 30.0     | 0.25 - 9.00                        | 206 - 227         |
| USHM-50 | 0.5 - 30.0     | 0.45 - 18.00                       | 369 - 855         |

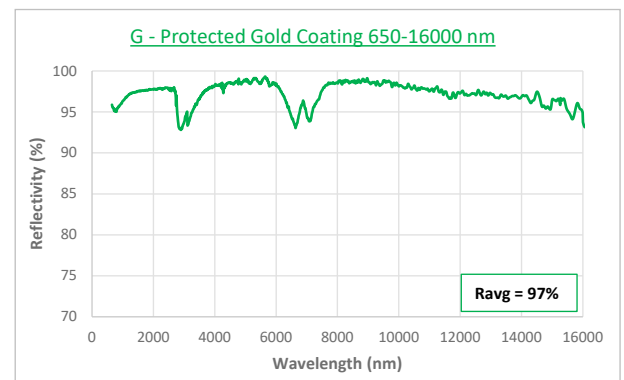
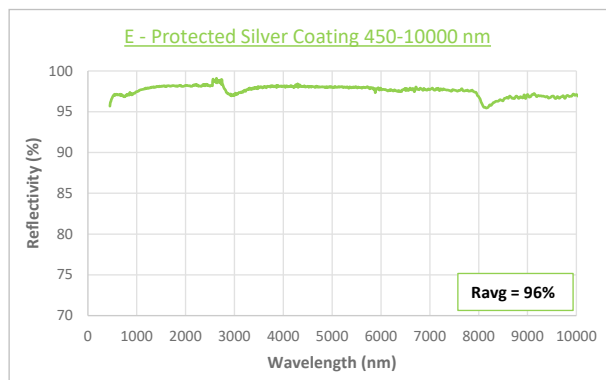
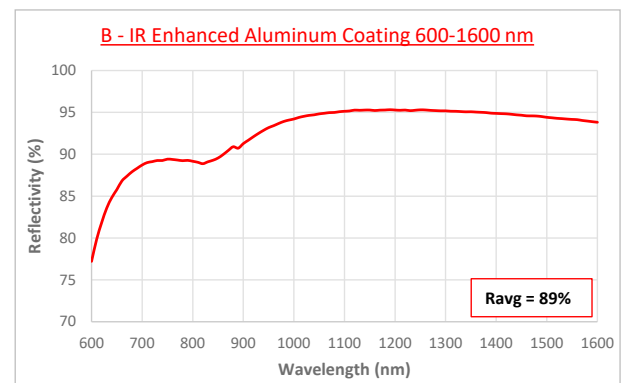
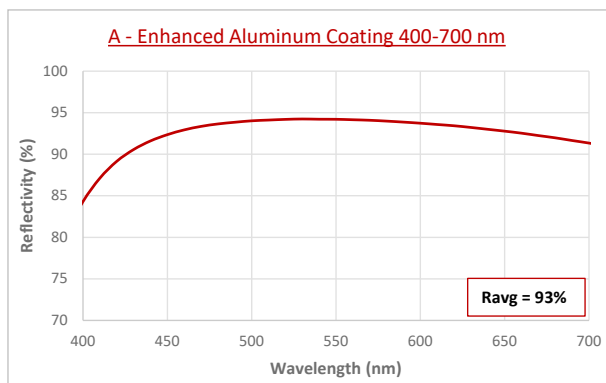
| Item    | Accuracy<br>(arc. sec.) | ØA (in/mm)  | B (in/mm)   | C (in/mm)   | D (in/mm)  |
|---------|-------------------------|-------------|-------------|-------------|------------|
| USHM-10 | 1.0 - 30.0              | 1.00/25.40  | 1.45/36.92  | 1.23/31.28  | 0.51/12.95 |
| USHM-15 | 0.5 - 30.0              | 1.50/38.10  | 1.94/49.26  | 1.69/43.03  | 0.65/16.48 |
| USHM-20 | 0.5 - 1.0               | 2.00/50.80  | 2.55/64.81  | 1.98/50.24  | 0.58/14.61 |
| USHM-20 | 2.0 - 30.0              | 2.00/50.80  | 2.48/62.94  | 1.98/50.24  | 0.58/14.61 |
| USHM-25 | 0.5 - 1.0               | 2.38/60.33  | 3.00/76.32  | 2.32/58.96  | 0.65/16.43 |
| USHM-25 | 2.0 - 30.0              | 2.38/60.33  | 2.93/74.45  | 2.27/57.64  | 0.60/15.11 |
| USHM-50 | 0.5 - 1.0               | 4.56/115.89 | 5.52/140.09 | 4.43/112.47 | 0.73/18.62 |
| USHM-50 | 2.0 - 30.0              | 4.56/115.89 | 5.47/138.85 | 4.36/110.67 | 0.66/16.81 |

Standard USHM™ mirror coatings are aluminum, silver and gold, in both bare metal and with protective overcoats. All protected coatings meet MIL-SPEC durability and adhesion requirements. Unprotected metallic coatings work well for interferometric applications.

## Simulations

### Coating Types

|                                       |   |
|---------------------------------------|---|
| Enhanced Aluminum (400-700 nm),       | 93% (AOI 55° per surface reflectance average) |
| IR Enhanced Aluminum (600-1.600 nm)   | 89% (AOI 55° per surface reflectance average) |
| Unprotected Aluminum (225- 10.000 nm) | 90% (AOI 55° per surface reflectance average) |
| UV Enhanced Aluminum (225-700 nm)     | 89% (AOI 55° per surface reflectance average) |
| Protected Silver (450-10.000 nm)      | 96% (AOI 55° per surface reflectance average) |
| Protected Gold (650 -16.000 nm)       | 97% (AOI 55° per surface reflectance average) |
| Unprotected Gold (650-20.000 nm)      | 97% (AOI 55° per surface reflectance average) |
| Protected Aluminum (400-750 nm)       | 87% (AOI 55° per surface reflectance average) |



**Note:** Coatings meet Ravg requirement, but coating curves are for reference as  $R(\lambda)$  may vary  $\pm 2\%$   
 Detailed drawings and detailed coating curves are available on request.

## Good to know

- USHM™s are **vacuum compatible** and can be positioned about the permanently connected post in any orientation, providing greater freedom for different mounting configurations.
- **Lighter weight** aluminum mounted versions are available.
- **Custom coatings** are available.
- **Beam Deviation** is the maximum deviation from parallelism, expressed in seconds of arc, of any single return beam from any of the 6 sub-apertures of the retroreflector, when the retroreflector is fully-illuminated.
- **Exiting Wavefront** is the resultant maximum peak-to-valley wavefront deformation from a fully-illuminated retroreflector, where  $\lambda = 633 \text{ nm}$ .
- Beam deviation and exiting wavefront are interrelated, and it is only necessary to specify one.
- Certain high accuracy models may be heavier than indicated here. Check with us for actual weight.
- **Custom configurations for specialized applications upon request**  
 Engineers can create a custom Hollow Retroreflector for your application. Potential variations include: smaller and larger apertures; modified hard mounts to meet your interface; super-critical accuracies; dielectric mirror coatings for high-powered lasers; and units able to withstand military and space environments.

### For inquiries we need to know:

- Which type of retroreflector
- CA
- Beam deviation
- Coating

## Product Code

Type of retroreflector -

CA -(inch)

Beam deviation (arc.sec)

Coating

For example:

USHM-10-5PS Ultra Stable H/M Ret. Reflector, ap 1.0", ac 5", M6

(Ultra Stable Hard-Mounted Retroreflector, CA 1 inch, beam deviation=5 arcsec with protected silver coating, with M6 threaded hole)