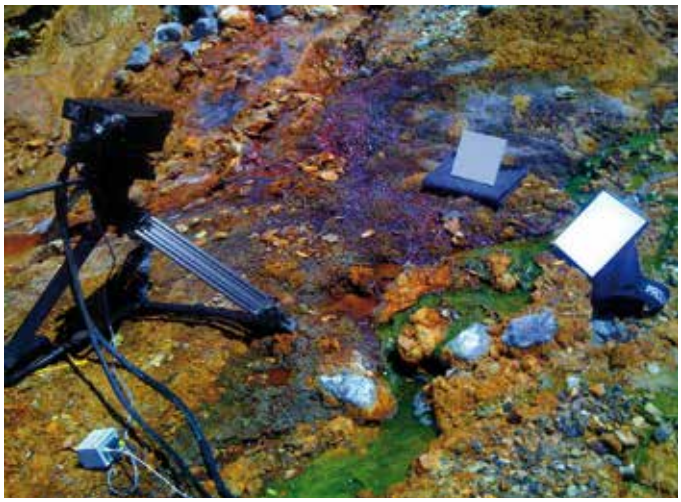


Zenith Polymer® Diffuse Reflectance Standards, Targets and Materials

FOR USE OVER THE UV, VIS AND NIR SPECTRAL REGIONS

SphereOptics

... your Partner in Lighting Technology!

Properties of Zenith Polymer® – optical PTFE

All SphereOptics GmbH Zenith Polymer® products are made from our proprietary Zenith Polymer® reflectance material. This highly reflecting, PTFE-based material is resistant to harsh environments and exposures and its unique optical properties, when produced under strict clean conditions, makes it the ideal reflectance material for standards or targets. Our products are all produced using the highest purity PTFE powder material available in Germany and throughout the production process, including pressing and sintering, the highest level of cleanness is maintained. All machines used to obtain the final product are reserved exclusively for PTFE use to keep the high level of purity.
Manufactured in Germany under ISO/TS 16949 conditions, we act as a reliable and qualified partner in the European industry.

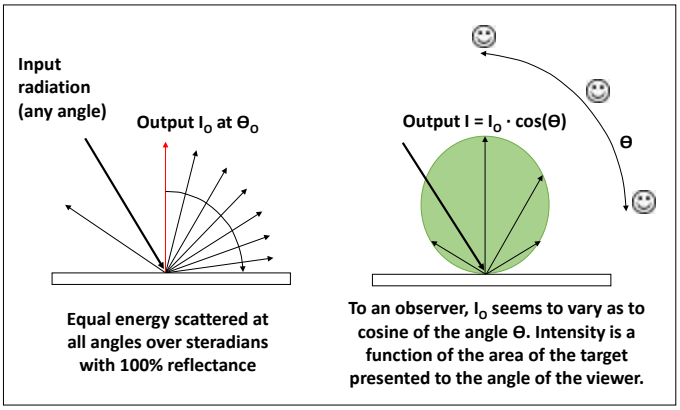
MECHANICAL/CHEMICAL PROPERTIES:

- After sintering, material is easy to machine
- Usable temperature range: - 50 °C to 250 °C
- Usable humidity range: 5 % to 95 %, but water absorption bands will be visible
- Standard pore sizes: 1 µm – 20 µm, average 6 µm
- Surface roughness: 3 µm– 25 µm
- Density: 1.3 g/cm^3 to 1.5 g/cm^3 (depending on the product)
- Non-polar, insulator
- Hydrophobic
- Chemically inert, exception: reacts with organic Lithium and Sodium compounds

OPTICAL PROPERTIES:

- Effective spectral range: 260 nm – 2450 nm
  Reflectance: > 99 % from 350 nm – 1500 nm
  > 95 % from 1500 nm – 2450 nm
  Absorbance: < 20 % above 2700 nm
- Atmospheric UV resistance
- Nearly ideal lambertian, diffuse reflectance
- Nearly ideal diffuse transmittance
- Uniform BRDF over all angles
- No absorption bands in the range of 250 nm – 2450 nm
- Laser damage threshold: 7 J/cm^2
- Vacuum compatible to 10^{-6} Torr

Temperature Range (°C)		*Thermal Linear Coefficient α 10^{-5} (1/K)*
from	*to*	
-100	-50	7.8
-50	10	9.1
10	30	23.7
30	100	10.8
100	200	14
200	260	22.9
260	300	39.3
30	200	12.7
30	260	15.4
30	300	18.4



Zenith Polymer® reflectance material provides the highest diffuse reflectance of any known material over the UV-VIS-NIR region. The reflectance is very flat and generally > 99 % over a range from 400 nm to 1500 nm and > 95 % from 250 nm to 2500 nm. Surface or subsurface contamination may lower the reflectance at the extreme upper and lower ends of the spectral range.

The surface and the porous structure of Zenith Polymer® material exhibits highly lambertian behavior. The material is extremely hydrophobic and shows no sign of optical or physical degradation after long-term immersion testing in fresh water.

NOTE:
All our products can be purchased with a NIST or PTB traceable certificate over the range of 250 nm – 2450 nm.

Zenith Polymer® Diffuse Reflectance Standards

SphereOptics' diffuse 99 % reflectance standard is used industry-wide for calibration of sphere systems, photometers, optical equipment, and spectrophotometers. The range of grey scale standards are generally used to determine the linearity of optical detector systems used in colorimeters, spectrophotometers and densitometers.

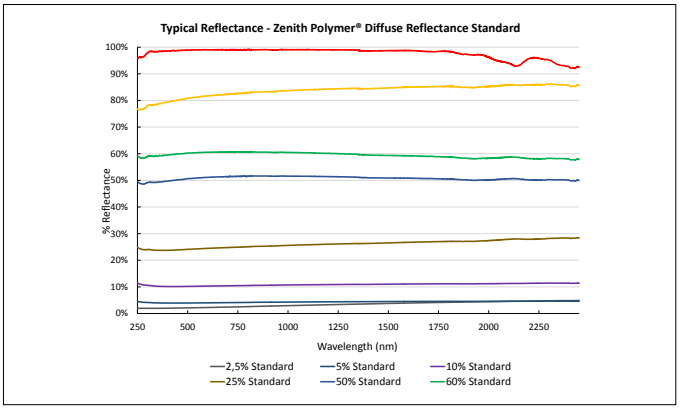
Standards are available in two sizes of 50 mm and 30 mm diameter with reflectance values ranging from 99 % (white) to a 2.5 % grey standard. Reflectance values include 99 %, 80 %, 60 %, 50 %, 25 %, 10 %, 5 % and 2.5 %. Standards are sold individually or in sets of two, four or eight standards with a free choice of reflectance values. Each standard is packaged in a durable holder with a protective cover and comes in a storage box.

SphereOptics maintains a calibration laboratory in Germany and uses standards traceable to both the National Institute of Standards and Technology (NIST) and the Physikalisch-Technische Bundesanstalt (PTB). All standards come with a printed and signed certificate and measurement data in electronic form.

Art.-No.	Reflectivity	Diameter
SG 3051	≈ 99 %	50 mm
SG 3052	≈ 99 %	30 mm
SG 3055	≈ 80 %	50 mm
SG 3067	≈ 80 %	30 mm
SG 3068	≈ 60 %	50 mm
SG 3070	≈ 60 %	30 mm
SG 3071	≈ 50 %	50 mm
SG 3072	≈ 50 %	30 mm
SG 3073	≈ 25 %	50 mm
SG 3074	≈ 25 %	30 mm
SG 3082	≈ 10 %	50 mm
SG 3083	≈ 10 %	30 mm
SG 3075	≈ 5 %	50 mm
SG 3076	≈ 5 %	30 mm
SG 3046	≈ 2.5 %	50 mm
SG 3045	≈ 2.5 %	30 mm
SG 3086	Set of 2 [2]	50 mm
SG 3087	Set of 2 [2]	30 mm
SG 3088	Set of 4 [2]	50 mm
SG 3089	Set of 4 [2]	30 mm
SG 3044	Set of 8 [2]	50 mm
SG 3043	Set of 8 [2]	30 mm

Calibration will be performed on a Perkin Elmer Lambda 950, data will be supplied electronically in 1 nm steps, 50 nm step printed documentation with NIST/PTB traceability with certificate for the range from 250 nm - 2450 nm.

[2] Within the sets, reflectivities are selectable.

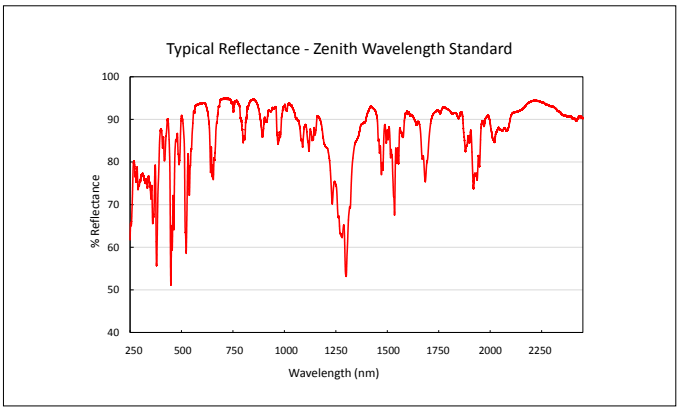


Mixed Rare Earth Oxide Wavelength Standard

The NIST/PTB traceable wavelength calibration standard is a mixture of three pure, rare earth oxides of Holmium, Erbium and Dysprosium, mixed into Zenith Polymer®, which exhibit distinct absorption peaks and which provides a stable reference for validating the wavelength scale of spectrophotometers and calibrating monochromators in the 250 nm to 2450 nm range.

Art.-No.	Description
SG 3333	Wavelength standard, 50 mm diameter rare earth oxides mixed into Zenith Polymer
SG 3334	Wavelength standard, 30 mm diameter rare earth oxides mixed into Zenith Polymer

Calibration will be performed on a Perkin Elmer Lambda 950, data will be supplied electronically in 0.1 nm steps, 50 nm step printed documentation with NIST/PTB traceability with certificate for the range from 250 nm - 2450 nm.



APPLICATIONS:
Calibration of: Sphere Systems • Photometers, Radiometers & Spectrophotometers • Densitometers & Optical Equipment
Test Linearity of: Detector Systems • Colorimeters, Densitometers & Spectrophotometers

Zenith Lite™ Diffuse Targets

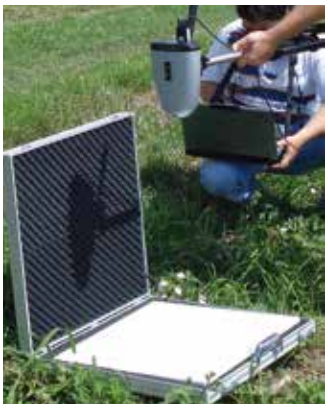
Zenith Lite™ diffuse targets are made from our Zenith Polymer® diffuse reflectance material, which provides nearly ideal diffuse lambertian reflectance over the wavelength range from 250 nm to 2450 nm. Zenith Lite™ targets are constructed using a 1 mm or 2 mm thick Zenith Polymer® panel laminated with a special adhesive to a 10 mm - 20 mm thick aluminium honeycomb structured plate that serves as a solid, but lightweight backing. They are the ideal choice for both laboratory and field applications since they are lightweight and can withstand harsh environments for long exposure periods. Due to their design, very flexible mounting solutions are possible.

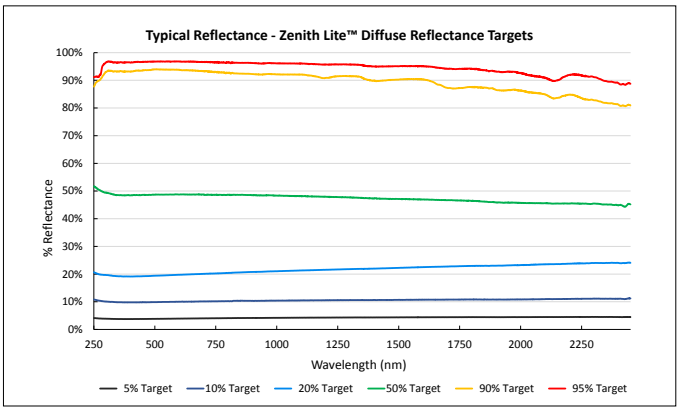
The laminating technique used with Zenith Lite™ diffuse targets allows for multiple reflectance values in one target with almost no visible seams. Targets can be made to any size and combination of white or greyscale reflectance. The aluminium backing can be drilled to allow attachment to a variety of mounting devices. Even with a 1 mm or 2 mm Zenith film, the diffuse optical properties are maintained.

All targets can be provided with National Institute of Standards and Technology (NIST) / Physikalisch-Technische Bundesanstalt (PTB) traceable calibration certificates from 250 nm to 2450 nm. For the targets bigger than 300 mm x 300 mm a smaller reference target (witness sample) is provided and the calibration is performed on the reference.

Art.-No.	Reflectivity	Dimensions
SG 3151	≈ 95 %	200x200x12 mm (approx. 8x8 inch)
SG 3152	≈ 90 %	200x200x11 mm (approx. 8x8 inch)
SG 3153	≈ 50 %	200x200x11 mm (approx. 8x8 inch)
SG 3154	≈ 20 %	200x200x11 mm (approx. 8x8 inch)
SG 3171	≈ 10 %	200x200x11 mm (approx. 8x8 inch)
SG 3155	≈ 5 %	200x200x11 mm (approx. 8x8 inch)
SG 3166	≈ 95 %	300x300x12 mm (approx. 12x12 inch)
SG 3167	≈ 90 %	300x300x11 mm (approx. 12x12 inch)
SG 3168	≈ 50 %	300x300x11 mm (approx. 12x12 inch)
SG 3169	≈ 20 %	300x300x11 mm (approx. 12x12 inch)
SG 3172	≈ 10 %	300x300x11 mm (approx. 12x12 inch)
SG 3170	≈ 5 %	300x300x11 mm (approx. 12x12 inch)
SG 3156	≈ 95 %	500x500x12 mm (approx. 20x20 inch)
SG 3157	≈ 90 %	500x500x11 mm (approx. 20x20 inch)
SG 3158	≈ 50 %	500x500x11 mm (approx. 20x20 inch)
SG 3159	≈ 20 %	500x500x11 mm (approx. 20x20 inch)
SG 3173	≈ 10 %	500x500x11 mm (approx. 20x20 inch)
SG 3160	≈ 5 %	500x500x11 mm (approx. 20x20 inch)
SG 3161	≈ 95 %	1000x1000x12 mm (approx. 40x40 inch)
SG 3162	≈ 90 %	1000x1000x11 mm (approx. 40x40 inch)
SG 3163	≈ 50 %	1000x1000x11 mm (approx. 40x40 inch)
SG 3164	≈ 20 %	1000x1000x11 mm (approx. 40x40 inch)
SG 3174	≈ 10 %	1000x1000x11 mm (approx. 40x40 inch)
SG 3165	≈ 5 %	1000x1000x11 mm (approx. 40x40 inch)

Calibration will be performed on a Perkin Elmer Lambda 950, data will be supplied electronically in 1 nm steps, 50 nm step printed documentation with NIST/PTB traceability with certificate for the 250 nm – 2450 nm range.





Zenith Polymer® Full Material Targets

Although the Zenith Lite™ diffuse targets cover a wide range of applications, in some cases, the purity of the material and volume reflection (bulk scattering) is required. For vacuum applications or use under space conditions, only pure optical PTFE can be used. There is also the option to vacuum bake the raw PTFE material before production. We offer a restricted choice of standard sizes, so for custom sizes, please contact us directly.

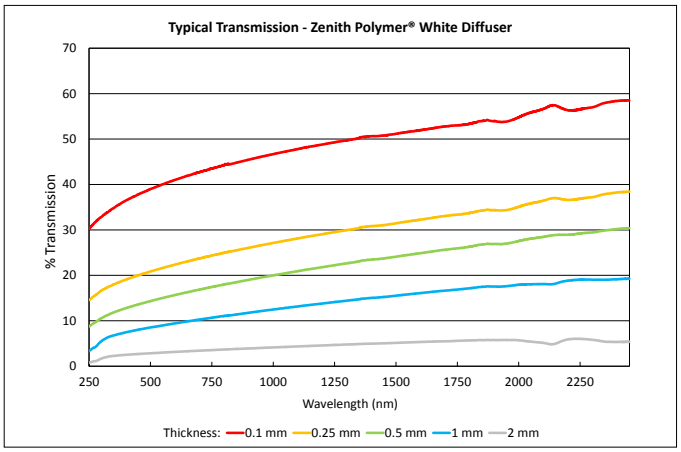
Art.-No.	Reflectivity	Dimensions
SG 3105	≈ 99 %	50x50x10 mm (approx. 2x2 inch)
SG 3110	≈ 99 %	100x100x10 mm (approx. 4x4 inch)
SG 3120	≈ 99 %	200x200x10 mm (approx. 8x8 inch)
SG 3150	≈ 99 %	500x500x10 mm (approx. 20x20 inch)

Calibration will be performed on a Perkin Elmer Lambda 950, data will be supplied electronically in 1 nm steps, 50 nm step printed documentation with NIST/PTB traceability with certificate for the 250 nm – 2450 nm range.

APPLICATIONS:
Remote Sensing Calibration • Field Testing of Imaging Systems • Environmental Test Targets • Optical Reflectors • Contrast Measurement for Camera Applications • Illuminator Panels for QC of Projectors and Projector Lamps • Reflectance Standard for Illumination Measurements and Calibration

Zenith Polymer® White Diffuser
Lambertian transmission sheets

Our Zenith Polymer® diffusers are made of the same material as our reflectance standards with its unique, highly lambertian optical properties. Thin section Zenith Polymer® sheets are used as cosine diffusers minimise angular dependency of the light reaching a photodetector or to create more even illumination from a light source. With a constant, lambertian throughput over the entire wavelength range of 250 nm to 2450 nm, the Zenith Polymer® diffuser finds application in a variety of light scattering measurements and calibration set ups.

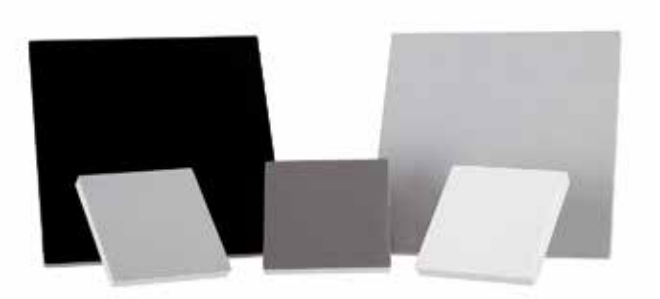


Art.-No.	Transmission	Description
SG 3201	≈ 50 %	Diffuser 100 µm thickness 200x200 mm (approx. 8x8 inch)
SG 3202	≈ 50 %	Diffuser 100 µm thickness 500x500 mm (approx. 20x20 inch)
SG 3203	≈ 25 %	Diffuser 250 µm thickness 200x200 mm (approx. 8x8 inch)
SG 3204	≈ 25 %	Diffuser 250 µm thickness 500x500 mm (approx. 20x20 inch)
SG 3205	≈ 16 %	Diffuser 500 µm thickness 200x200 mm (approx. 8x8 inch)
SG 3206	≈ 16 %	Diffuser 500 µm thickness 500x500 mm (approx. 20x20 inch)
SG 3210	≈ 8 %	Diffuser 1mm thickness 200x200 mm (approx. 8x8 inch)
SG 3211	≈ 8 %	Diffuser 1mm thickness 500x500 mm (approx. 20x20 inch)
SG 3212	≈ 8 %	Diffuser 1mm thickness 1000x1000 mm (approx. 40x40 inch)
SG 3213	≈ 4 %	Diffuser, 2 mm thickness 200x200 mm (approx. 8x8 inch)
SG 3214	≈ 4 %	Diffuser, 2 mm thickness 500x500 mm (approx. 20x20 inch)
SG 3215	≈ 4 %	Diffuser, 2 mm thickness 1000x1000 mm (approx. 40x40 inch)

Only general transmission data available!

Zenith Polymer® Greyscale Diffuser
Lambertian reflectance sheets

For some applications in quality control or production processes, the flat surface of the reflectance targets and standards are not usable and custom curvature or shape is required. To realise optical and process stability, often Zenith Polymer® greyscale diffuser sheets are used as an optical baseline reference. To enable the customer to adapt the optical standard to his or her needs, we offer the greyscale Zenith Polymer® as 1 mm thick sheets, optionally with the proper gluing agent applied, so engineers and quality control personnel can fit the standard to their needs.



Art.-No.	Reflectivity	Description
SG 3224	≈ 50 %	Diffuser, 1 mm thickness 1000x1000 mm (approx. 40x40 inch)
SG 3223	≈ 50 %	Diffuser, 1 mm thickness 500x500 mm (approx. 20x20 inch)
SG 3222	≈ 50 %	Diffuser, 1 mm thickness 200x200 mm (approx. 8x8 inch)
SG 3221	≈ 20 %	Diffuser, 1 mm thickness 1000x1000 mm (approx. 40x40 inch)
SG 3200	≈ 20 %	Diffuser, 1 mm thickness 500x500 mm (approx. 20x20 inch)
SG 3219	≈ 20 %	Diffuser, 1 mm thickness 200x200 mm (approx. 8x8 inch)
SG 3225	≈ 10 %	Diffuser, 1 mm thickness 1000x1000 mm (approx. 40x40 inch)
SG 3226	≈ 10 %	Diffuser, 1 mm thickness 500x500 mm (approx. 20x20 inch)
SG 3227	≈ 10 %	Diffuser, 1 mm thickness 200x200 mm (approx. 8x8 inch)
SG 3218	≈ 5 %	Diffuser 1mm thickness 1000x1000 mm (approx. 40x40 inch)
SG 3217	≈ 5 %	Diffuser 1mm thickness 500x500 mm (approx. 20x20 inch)
SG 3216	≈ 5 %	Diffuser 1mm thickness 200x200 mm (approx. 8x8 inch)

APPLICATIONS:
Industry Quality Control • Refinement of Detectors • Custom Research Applications • Remote Sensing Calibration

Calibration Service

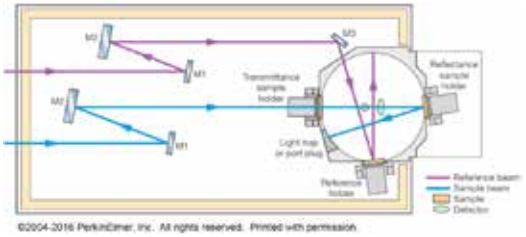
SphereOptics can provide a service for the measurement for our standards and targets, as well as for samples, that are provided by the customer. The reflectance and transmittance measurements in the range from 250 nm to 2450 nm are performed by using a high end spectrometer, Perkin Elmer Lambda 950 or Lambda 19, which are both equipped with an integrating sphere. Following applications are possible:

- (Re)calibration of optical standards and reflecting materials
- Verification of wavelength standards
- Deviation of color values
- Determination of transmission properties of glass
- Customer specific measurement service on request

The measurement of reflectance is done in the 8° geometry. Using this setup, the sample is mounted at the port of the sphere with an angle of 8°, which shifts the specular reflection of the sample toward the spheres wall. Optional, it is possible to have a light trap at this 8° position of the Sphere, to get also the diffuse and specular parts of the total reflection.
To obtain the right reflectance values a reference standard is used, which was certified by the Physikalisch-Technische Bundesanstalt (PTB). The wavelength accuracy of the spectrometer is checked periodically by using a SRM-2036 standard of the National Institute of Standards & Technology (NIST).
In cooperation with Labsphere Inc.; SphereOptics provides ISO 17025 (NVLAP) accredited calibrations.

Art.-No.	Description
SG 3401	One-point-calibration (Ø 10 mm measurement surface): 1-2 piece
SG 3401-3	One-point-calibration (Ø 10 mm measurement surface): Quantity discount from 3 to 5 pieces
SG 3401-6	One-point-calibration (Ø 10 mm measurement surface): Quantity discount from 6 - 10 pieces
SG 3401-xx	One-point-calibration (Ø 10 mm measurement surface): Quantity discount for 11 and more pieces – on request
SG 3411	One-point-calibration (Ø 10 mm measurement surface), wavelength standards or non-standard measurement range / resolution: 1 piece

Recalibration will be performed on a Perkin Elmer Lambda 19, data will be supplied electronically in 1 nm steps, 50 nm step printed documentation with NIST/PTB traceability with certificate for the 250 nm - 2450 nm range.



Handling & Care Instructions for Zenith Polymer® Materials

Characteristics, handling, storage & transport, cleaning, disposal

Zenith Polymer® (Polytetrafluorethylen) is a thermoplastic material used in a variety of different shapes as diffuse reflection material in optical systems. However, during treatment it shows many characteristics similar to a Duroplast. The material has a hardness comparable to polyethylene.
The thermic carrying capacity of Zenith Polymer® ranges from - 260 °C to + 260 °C even up to 300 °C in short term use. The long-run-treatment temperatures however depend on the prevailing strain. It is chemically inert to all but the most powerful bases such as sodium or lithium compounds.
The porous network of thermoplastic produces multiple reflections in the first few tenths of a millimeter. This “open structure” readily absorbs nonpolar solvents, greases and oils. Also intensive contact with cigarette smoke affect the optical properties. Zenith Polymer® is nonpolar and hydrophobic.

General Handling

Zenith Polymer® as an optical reference material should be stored and handled like other optical components and reflectance standards. To avoid impact on optical characteristics it is recommended to wear unpowdered latex or vinyl gloves while handling.

Storage and Transport

Zenith Polymer® products should be stored such as other high quality optical components in a clean laboratory environment. We recommend to store the highly pure optical PTFE dry, covered, dust free and at room temperature. After exposure to extreme temperature and humidity conditions for instance during transport, the reflection material should be allowed to adapt to the laboratory environment for 2 hours, before it is used for measurements. Storage necessarily has to be hydrocarbon-free.
Recommended max. longterm temperature range: - 50 °C to + 150 °C
Recommended max. longterm moisture range: 5 % to 95 %

Disposal

If the Zenith Polymer® material still does not show the required reflectivity, even after the appropriate rework has been made, we recommend to replace them. For correct exploitation of the old, contaminated materials either send them back to your supplier or depose them according to the respective government regulations for organic polymer.

APPLICATIONS:
Satelite Calibration Targets • Space Based Platforms • Radiance Calibration Standards • Uniform Light Source Spheres

Cleaning Service -
Rework and cleaning of optical PTFE material

In case your standard or target become contaminated, dirty or mechanically damaged we offer a cleaning and repair service.

Gladly you can send your standards to us and our experienced laboratory stuff will give advices regarding the need or in extreme cases the general possibility of cleaning.

If the Zenith Polymer® material still does not show the required reflectivity, even after the appropriate rework has been made, we recommend to replace them. For correct exploitation of the old, contaminated materials either send them back to your supplier or depose them according to the respective government regulations for organic polymer.

Art.-No.	*Description*
SG CLEAN-ST	Mechanical rework and cleaning of optical PTFE material Area sizes: Ø 30 - 90 mm / 50 x 50 mm - 90 x 90 mm (or similar size)
SG CLEAN-TA1	Mechanical rework and cleaning of optical PTFE material Area sizes: Ø 100 - 190 mm / 100 x 100 mm - 190 x 190 mm (or similar size)
SG CLEAN-TA2	Mechanical rework and cleaning of optical PTFE material Area sizes: Ø 200 - 290 mm / 200 x 200 mm - 290 x 290 mm (or similar size)
SG CLEAN-TA3	Mechanical rework and cleaning of optical PTFE material Area sizes: Ø 300 - 390 mm / 300 x 300 mm - 390 x 390 mm (or similar size)

Custom and OEM Parts made out of Zenith Polymer®

We welcome enquiries for the custom fabrication of Zenith Polymer® parts such as small OEM integrating spheres, laser cavities, lamp housings, illumination or diffuser panels and custom calibration targets. Our engineers can work directly from your print or drawing.

With Zenith Polymer® 99 % reflectance standards or Zenith Polymer® optical greyscale standards, you obtain an optical standard which withstands harsh environments, is chemically inert, stable against most acids, resists temperatures up to 250 °C and offers you a constant, high diffuse reflectivity over the broad range of UV-VIS and NIR.

Zenith Polymer® Space Grade Material

Zenith Polymer® space grade is the material of choice for vacuum applications and space based platforms or satellites. Our customers are the main European space agencies.
Our space qualified material is produced using highly advanced manufacturing processes that virtually eliminate potential contamination that can lead to UV degradation under space conditions. Zenith Polymer® material and manufacturing processes have been qualified by ESA contractors for several satellite space projects.
The material exhibits reflectance values of more than 98 % over the wavelength range of 300 nm to 1800 nm. It is resistant to heat, humidity and exposure to high levels of radiation, making it the optimal material for use in space.

NOTE:
We advise to get the mechanical rework and cleaning done by experts.

SphereOptics GmbH
Gewerbestrasse 13 | 82211 Herrsching | Germany
Fon +49 8152 983 78-90 | Fax +49 8152 983 78-91
info@sphereoptics.de | www.sphereoptics.de

Images: Defense Ministry | Norsk Elektro Optikk AS | PerkinElmer | SphereOptics