

# Transmission Spheres

A complete offering of high quality transmission spheres (TS) designed to provide optimum interferometer performance. ZYGO's optics are specified and fully qualified to ensure accurate metrology for applications ranging from testing conventionally polished ultra smooth surfaces, to providing critical metrology feedback for small tool polishing processes. Each TS comes in a protective storage case with quality certification.

## OVERVIEW

Measurement Capability	Used in conjunction with a laser Fizeau interferometer for the measurement of the surface form or transmitted wavefront of spherical optics and assemblies. Can also be utilized in the measurement of conic and aspheric shapes <sup>(1)</sup> .
Diameters	25 mm, 4 inch, 6 inch
Wavelength	633 nm
Specifications	Apply to advertised TS f/#
Design	Low expansion reference element. Field coverage and residual axial ghosts are suitable for use with ZYGO Ring-of-Fire illumination. Controlled mid-spatial frequency content (PSD). Suitable for use in closed-loop feedback processes in work cells utilizing small pad polishing technologies.

## STANDARD PERFORMANCE ( $\lambda/10$ ) TS

Best for metrology of test optics with  $\leq 40\%$  reflectivity.

Entrance Beam Diameter	25 mm 4 inch (101.6 mm) 6 inch (152.4 mm)
f/# (25 mm)	f/0.58, f/0.7, f/1.0
f/# (4 inch)	f/0.65, f/0.75, f/1.5, f/3.3, f/7.1, f/10.7
f/# (6 inch)	f/0.8, f/1.1, f/2.2, f/3.5, f/5.4, f/7.2
Reference Surface	4% reflectivity $\lambda/10$ PV ( $\lambda = 633$ nm)

## STANDARD PERFORMANCE DYNAFLECT™ ( $\lambda/10$ ) TS

Best for metrology of test optics with  $> 40\%$  reflectivity.

Entrance Beam Diameter	4 inch (101.6 mm)
f/# (4 inch)	f/0.75, f/1.5, f/3.3, f/7.1, f/10.7
Reference Surface	Dynaflect coating $\lambda/10$ PV ( $\lambda = 633$ nm)

## HIGH PERFORMANCE ( $\lambda/20$ ) TS

Best for metrology of test optics with  $\leq 40\%$  reflectivity.

Entrance Beam Diameter	4 inch (101.6 mm)
f/# (4 inch)	f/0.65, f/0.75, f/1.5, f/3.3, f/7.1, f/10.7
Reference Surface	4% reflectivity $\lambda/20$ PV ( $\lambda = 633$ nm)



## ULTRASPHERE ( $\lambda/50$ ) TS

The NEW ZYGO Ultrasphere product is designed to enable surface form metrology with an uncertainty in the RMS<sup>(2)</sup> of  $\leq 3.2$  nm ( $\lambda/200$  at 633nm) when used with a ZYGO interferometer. Best for metrology of test optics with  $\leq 40\%$  reflectivity.

Entrance Beam Diameter	4 inch (101.6 mm)
f/# (4 inch)	f/0.75, f/1.5, f/3.3
Reference Surface	4% reflectivity $\lambda/50$ PVR <sup>(3)</sup> ( $\lambda = 633$ nm) $< 2.5$ nm RMSi <sup>(4)</sup>
Reference Surface Power Spectral Density (PSD) <sup>(5)</sup>	Mean Radial Profiles: $< 5 \times 10^4 \cdot \text{freq}^{-1.55} \text{ A}^2/\mu\text{m}$ Azimuthal Profiles: $< 1 \times 10^5 \cdot \text{freq}^{-1.55} \text{ A}^2/\mu\text{m}$
Transmitted Wavefront Slope	Supports $< 2$ nm RMS cavity induced error <sup>(6)</sup>

The Ultrasphere TS products include absolute calibration of the reference surface and are shipped with the resulting MetroPro \*.dat file and 37 term Zernike fit on a USB memory stick.

## ADDITIONAL INFORMATION

To dynamically determine the recommended TS for an application use the *Transmission Sphere Selection Tool*, OMP-0495 or the *VeriFire Asphere Calculator Tool*, OMP-0525.

Reference Drawings 6024-0034-02 and 6024-0048-02 provide mechanical dimensions of 4 inch and 6 inch TS's, respectively.

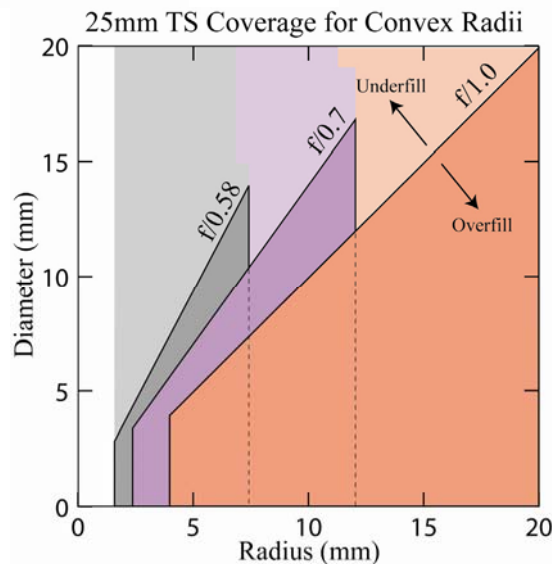
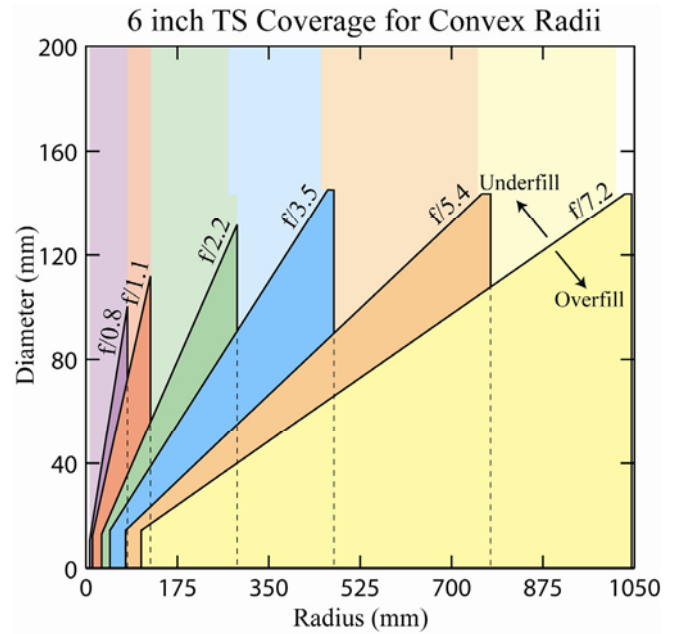
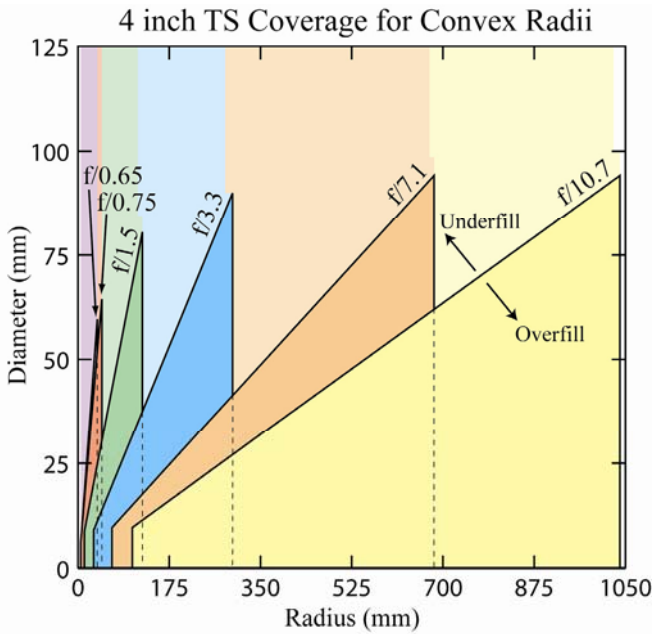
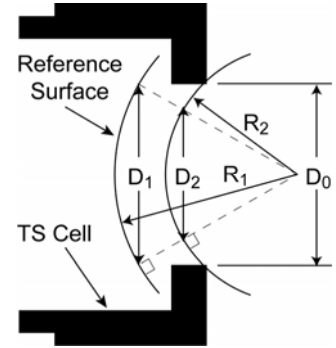
## Notations

1. Direct measurement of an asphere with a spherical reference wavefront will introduce retrace errors. A ZYGO VeriFire Asphere interferometer minimizes retrace by measuring null zones of the asphere that match the f/# of the transmission sphere.
2. Assumes form metrology of smooth spherical surfaces, a well-nulled cavity, data averaging to minimize systematic noise, a suitably stable environment, and uncertainty estimation following ISO's "Guide to the Expression of Uncertainty in Measurement" (1995) with  $k=1$ .
3. PVR is defined as the 36 term Zernike fit plus 3 times the rms residual of the Zernike fit ( $\text{PVR} = \text{PV}_{36 \text{ Zernike}} + 3 \times \sigma_{36 \text{ Zernike Residual}}$ ).
4. RMSi is the irregularity after removing the best fit spherical surface per ISO 10110 part 5 (1996)/ISO 14999 Part 4 (2007) standards.
5. Spatial frequency band: 3/Clear Aperture to 0.2/Lateral Scale. PSD limits defined by the power law model of ISO 10110-8.
6. As-built TS wavefront slope is controlled to insure that the peak cavity induced retrace errors will contribute less than the specified RMS value up to reference-to-part radius ratios of 5:1. As an example, a 5:1 ratio for an f/0.75 TS corresponds to a reference surface of radius 48.2 mm and a test sphere of radius 9.64 mm. Cavities that yield ratios of  $> 5:1$  may induce error that exceed the specified RMS.

# Transmission Spheres

Part Number	Aperture	f/#	R <sub>1</sub> (mm)	D <sub>1</sub> (mm)	D <sub>0</sub> (mm)	R <sub>2</sub> (mm)	D <sub>2</sub> (mm)
6024-0472-01	25 mm	0.58	8	14	14	7	12
6024-0474-01	25 mm	0.7	12	17	19	11	16
6024-0476-01	25 mm	1.0	20	20	24	17	17
6024-0454-XX	4 inch	0.65	39	60	61	36	56
6024-0444-XX	4 inch	0.75	48	64	65	45	60
6024-0430-XX	4 inch	1.5	121	81	93	115	76
6024-0399-XX	4 inch	3.3	298	90	89	282	85
6024-0404-XX	4 inch	7.1	682	96	98	674	95
6024-0410-XX	4 inch	10.7	1040	97	100	1030	96
6024-0458-XX	6 inch	0.8	80	100	104	77	97
6024-0455-XX	6 inch	1.1	123	112	128	118	107
6024-0414-XX	6 inch	2.2	290	132	164	274	125
6024-0413-XX	6 inch	3.5	476	149	164	458	130
6024-0417-XX	6 inch	5.4	776	147	164	761	141
6024-0405-XX	6 inch	7.2	1045	145	164	1022	142

-XX Key: -11 =  $\lambda/10$  PV, -13 =  $\lambda/20$  PV, -14 =  $\lambda/10$  PV Dynaflect, -15 =  $\lambda/50$  PVr



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