

## ASPHERE EQUATIONS

### EVEN ASPHERE

$$z = \frac{cr^2}{(1 + \sqrt{1 - (k+1)c^2r^2})} + \sum_{i=1}^{20} a_i |r|^i$$

### FORBES Q POLYNOMIAL

$$z(r) = \frac{cr^2}{1 + \sqrt{1 - c^2r^2}} + \frac{1}{\sqrt{1 - c^2r^2}} \left\{ u^2 (1 - u^2) \sum_{m=0}^M a_m Q_m(u^2) \right\}$$

$z$  = sag  $c$  = curvature at vertex  $k$  = conic constant  $r$  = radial coordinate  $u = r/r_{max} = r/(CA/2)$

## ASPHERE METROLOGY

METHOD	COST OF TEST SETUP <sup>1</sup>	SETUP TIME <sup>2</sup>	TEST TIME <sup>3</sup>	TOLERANCE LIMIT	MAXIMUM DEPARTURE	COMMENTS
<b>SURFACE CONTACT MEASUREMENT</b>						
CMM	Low	Minutes	~10 Min	±5 μm	mm	No required symmetry; requires datum and fixturing
PROFILOMETRY	Low	Minutes	~5 Min	±0.5 μm	<25 mm	Most common method; only provides 2D data
<b>SURFACE TESTING IN REFLECTION</b>						
SPHERICAL WAVEFRONTS	Low	Minutes	~10 Min	0.1 Fringes	<10 μm	Zernike subtraction; fringe density limited
CGH	High	Months	~20 Min	0.25 Fringes	mm	No required symmetry; part specific
SPHERICAL NULL REFLECTION	High	Weeks	~10 Min	0.1 Fringes	100 μm	Part specific
PARABOLA/ELLIPSE	Average	Hours	~30 Min	0.1 Fringes	mm	-1 ≤ k < 0
SUBAPERTURE STITCHING	Average	Minutes	~30 Min	0.1 Fringes	<650 μm	Absolute test
ANNULAR RING STITCHING	Average	Minutes	~15 Min	0.1 Fringes	<800 μm	Discontinuous at sagittal zero curvature
<b>LENS TESTING IN TRANSMISSION</b>						
TWE	Average	Hours	~10 Min	0.1 Fringes	<50 μm	Must be well-behaved aspheric lens
CGH	High	Months	~20 Min	0.25 Fringes	mm	No required symmetry; part specific
SPHERICAL NULL TWE	High	Weeks	~10 Min	0.1 Fringes	~100 μm	Part specific

▲ 1. Relative cost of tooling & labor for each test ▲ 2. Includes time to obtain needed components & alignment of system ▲ 3. Includes time for alignment of unit under test, data collection & analysis

