

Optical Surfaces Ltd specialises in the design and manufacture of off-axis paraboloids. The company has developed manufacturing techniques over its 40 years history blending modern methods with a high degree of craftsmanship. With this combination we are able to offer a reliable service tailored to individual customer needs. Whether the requirement is for custom optics or off the shelf mirrors, we work to the highest specifications possible.

A cost effective solution

The solution to many problems in optical design may be found by using off-axis parabolas (OAPs). They can often provide the most cost effective answer with no compromise in performance.

OAP's offer the advantage of an unobstructed aperture, giving access to the focal plane in system designs. This ensures pure diffraction patterns on axis with no spikes caused by "spiders" or other obstructions. This is particularly important if MTF and similar measurements are being made. Off-axis parabolic mirrors are especially suitable for broadband and multiple wavelength applications due to their completely achromatic characteristics.

Applications include:

- Collimators
- Beam Expanders
- FLIR testing
- High power laser beam focusing
- Target projection
- MTF reference surfaces
- MRTD test systems
- Spectrograph mirrors

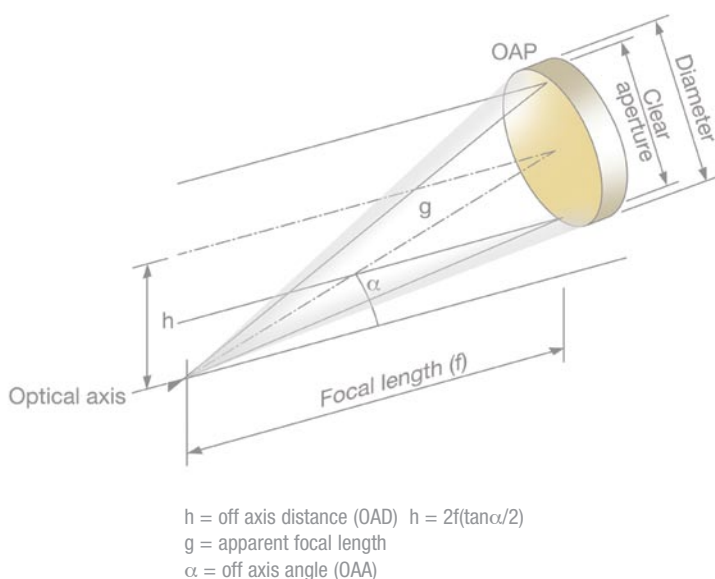
Quality and value

Optical Surfaces Ltd pioneered a technique of making OAPs from single blanks, reducing the need to invest in a number of fixed focal length "parent paraboloids" from which segments are cut to make the required mirror. This gives us greater adaptability in providing a specification to suit you at almost no cost penalty. Only our smaller standard mirrors (generally <152mm diameter) are made from parents; above this size we make them as stand alones.

Mounted mirrors

Accuracy and stability are essential to the use of high precision mirrors, and Optical Surfaces Ltd offers a range of gimbal mounts suitable for most table or bench use. Correct fitting is necessary to avoid distortion, and all mounted mirrors ordered from us have interferograms and OPD maps after coating and mounting.

See also our *Tube Collimator data sheet*.



Notes:

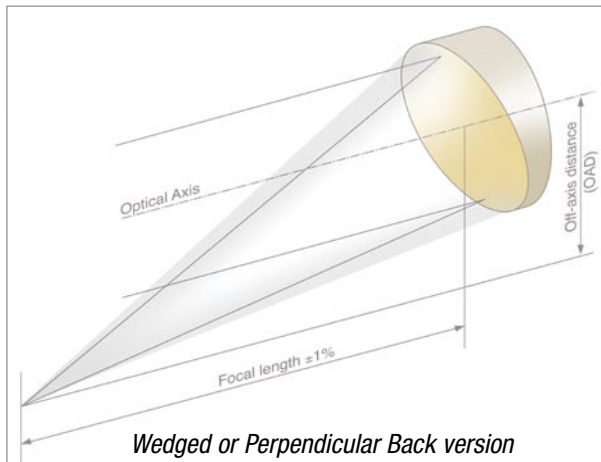
Smaller mechanical and optical tolerances can be quoted on request. Mirrors of 125mm diameter or larger are usually made with the back "parallel" to the front as drawn above. If required a wedge can be applied to the back so that it is perpendicular to the optical axis. We will also quote for various custom made notches, slots, flats or other machined shapes in the mirror blank. We strongly recommend that all mirrors are ordered in mounts - details on request. You will then have confidence that the mirror is held in a stress free manner. Interferograms are provided after coating and mounting.

Diameter:	60	75	100	125	152	203	254	305	356	406	457	500	550	600
Aperture:	50	65	90	110	140	190	230	290	330	380	430	450	500	550
Edge Thickness*:	17	20	20	20	25	33	42	50	62	75	75	84	90	100
* When supplied as parallel backed														
Focal length														
150	53/20.0	65/24.4												
200	70/19.8	65/18.4												
300	60/11.4	105/19.8	95/18.0	80/15.2										
400	60/8.6	105/14.9	95/13.5	80/11.4										
500	60/6.8	120/13.6	120/13.7	115/13.1	100/11.4									
600	60/5.7	130/12.4	120/10.5	115/10.9	125/9.5									
750	60/4.6	130/9.9	140/10.6	125/9.5	125/7.1									
1000	60/3.4	150/8.6	140/8.0	125/7.1	125/5.7	150/8.6	175/10.0							
1250	60/2.7	150/3.7	140/6.4	125/5.7	125/4.8	150/6.9	175/8.0	200/9.2						
1500	60/2.3	150/5.7	140/5.3	125/4.7	125/4.1	150/5.7	175/6.7	200/7.6	225/8.6	250/9.5				
1750			100/3.3	105/3.4	125/3.6	150/4.9	175/5.7	200/6.5	225/7.3	250/8.2	270/9.2			
2000			100/2.9	105/3.0	125/2.9	150/4.3	175/5.0	200/5.7	225/6.4	250/7.1	270/8.0	280/8.0	300/8.6	
2250														325/8.3
2500				105/2.4	125/2.4	150/3.4	175/4.0	200/4.6	225/5.2	250/5.7	270/6.4	280/6.4	300/6.9	325/7.4
3000						150/2.9	175/3.3	200/3.8	225/4.3	250/4.8	270/5.3	280/5.3	300/5.7	325/6.2
4000						150/2.1	175/2.5	200/2.9	225/3.2	250/3.4	270/4.0	280/4.0	300/4.3	325/4.6
5000								200/2.3	225/2.6	250/2.9	270/3.2	280/3.2	300/3.4	325/3.7

Example

 $53/20.0 = \text{Off-axis distance}$
 $= \text{OAA degrees}$

Diameter tolerance:	+0/-1mm
Thickness tolerance:	+0/-2mm
Focal length:	+/-1%
Off-axis distance:	+6mm -0mm (mirrors above 100mm diameter) +/- 1mm (mirrors =<100mm diameter)
Surface accuracy:	$\lambda/10$ p-v@633nm across entire clear aperture. Slope errors $<\lambda/10$ per cm Interferograms and analysis showing surface accuracy are supplied with all mirrors using industry standard software
Micro-roughness:	1.2nm rms. Measurements of roughness are not included in price
Surface quality:	60/40 to MIL-O-13830 Rev H in which 60=60microns and 40=0.40mm
Materials:	Zerodur is standard for mirrors of 125mm diameter or less. Mirrors above 125mm are made from fine-annealed low expansion glass unless otherwise requested
Coating:	Al+MgF is included in our standard list price. Spectral scans free if requested at the time of order. Silver, gold high-power laser, and Femto-second laser coatings quoted for on request



Wedged or Parallel Back?

We make off axis paraboloids by two distinct methods, giving rise to a choice of physical form shown at left.

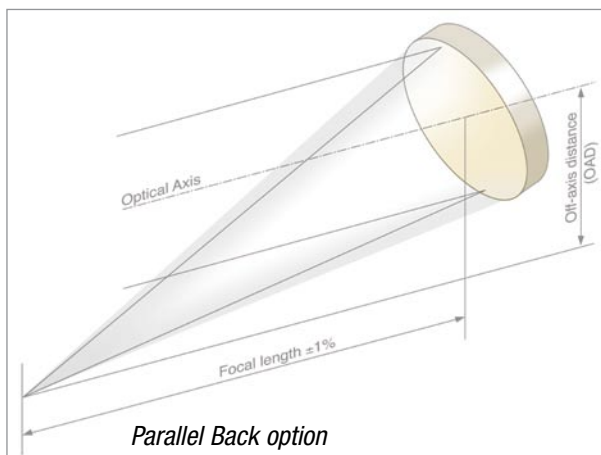
Parent method

Generally, OAPs up to 152mm diameter are manufactured in a “parent” or “mother” paraboloid – an on-axis paraboloid. The customer’s require off-axis segment is then drilled from this parent. Standard parents are stocked in 356mm diameter or 406mm diameter (dependent on focal length) although specials can be made to >600mm diameter. We can trade off diameter and off axis distances anywhere within the clear aperture of the parent.

The result of this production method is that the “wedged back” form is the natural choice since the OAP can be directly cut out with a core-drill axis perpendicular to the back.

This form has some advantages: since our parents are made accurately centred, the back can be polished and used to define the optical axis direction. This helps with alignment, and the front of the mirror is already tilted in the correct direction when the back is running square to the customer’s optical table. A mounting groove can be generated in the edge which is often useful to mechanical designers solving the problems of mirror mounting.

However, to put the mirror into an optical mount, it is often preferable to have a parallel back, mounting the mirror like a normal on axis optic. This requires a rotation on the optical table to make the mirror point in the correct direction.



Stand alone method

Mirrors above 152mm diameter are generally made as single items- “stand alone” OAPs.

This has the advantage of flexibility of focal length beyond the choice of stock parents. This method naturally results in the parallel back form of mirror, nominally equal in thickness round its perimeter. We do make large mirrors in a wedged back form, but this is an additional cost due to the amount of machining required.

Summary: mirrors up to 152mm diameter can generally be supplied wedged or parallel back at the same price. This option should be discussed and clarified prior to order. Above this size, the standard form is parallel back, with wedged back available only at an extra cost.