

PRECISION OPTICS

Let it be light ZRAK

OVER 60 YEARS EXPERIENCE IN OPTICS



2015

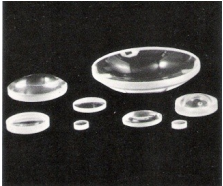
PRECISION OPTICS

Production range:

- Making of technological documentation
- Measuring of optical parameters
- Manufacturing of optical elements

Optical elements

Top grade optical elements, with or without optical layers, made of optical glass, to the client's specifications



LENSES

PLANO-CONVEX, BICONVEX, PLANO-CONCAVE, BICONCAVE, MENISCUS

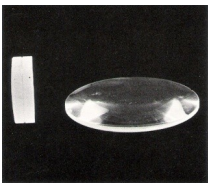
Our selection of lenses is very broad. We offer plano-convex, biconvex, plano-concave, biconcave, meniscus, achromats made of two or three lenses.

Lenses are made of optical glass or optical crystals according to a producer's specification.

Different materials and coatings are used as appropriate.

We also have capability to design and prototype special systems for you.

- Dimensions of lenses in diameters are from 5 to 300 mm with a tolerance between 0,1 and 1mm
- Focal length is in tolerance of 1%. focal lengths of lenses are from 10 to 3000 mm
- Centering i.e. bringing of mechanical axis in a coincidence with optical axis is in a tolerance from 0,002 to 0,05 mm.
- Thickness of a lens is made in tolerance of $\pm 0,2$ mm.
- Curvatures are made in a specified tolerance, which can be from $1/20 \lambda$ to $n\lambda$ according to specified standard.
- Quality of a surface is in tolerance according to specified standard
- Surface of a lens is protected with an antireflection coating.
- Lenses are made of optical glass or optical crystals according to a producer's specification.

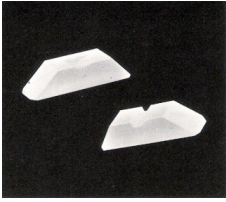


ACHROMATS MADE OF TWO OR THREE LENSES

- Lenses are cemented with a glue transparent for the wavelength of light from 0,3 to 2,5 μm . Glue is resistant under temperature -50°C to $+70^\circ\text{C}$.
- Doublets or triplets are in diameter from 10 to 150 mm.
- Achromats are corrected for visible light or IR light up to 2,5 μm .
- Outer surface are protected with antireflection coating.
- Centering achromat is within a tolerance which is from 0,005 to 0,05.
- Curvatures are made in a tolerance from $1/20\lambda$ to $n\lambda$ according to a specified standard.
- Optical glass according to a producers specification.

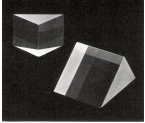
Achromats are produced according to documentation for required lenses or according to technical data which are taken as the input data in the optimization program.

PRISMS



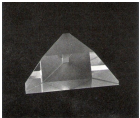
Dove prisms

Material:	optical glass
Dimensional tolerance:	$\pm 0,15$ mm
Surface accuracy(λ):	1 - 3/2
Angle tolerance:	± 5 arcseconds to ± 1 arcminute
Surface quality:	From 0,01 to 0,25 according to DIN 3140



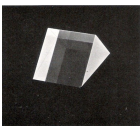
Right angle prisms

Material:	optical glass
Dimensional tolerance:	$\pm 0,15$ mm
Surface accuracy(λ):	1 - 3/2
Angle tolerance:	± 30 arcseconds to ± 5 arcminutes
Surface quality:	From 0,01 to 0,25 according to DIN 3140



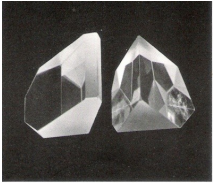
Roof prisms

Material:	optical glass
Dimensional tolerance:	$\pm 0,15$ mm
Surface accuracy(λ):	1/10 on roof surface and up to 1 on other surface
Angle tolerance:	± 3 arcseconds for roof angle, ± 30 arcseconds for other angles
Surface quality:	From 0,01 to 0,25 according to DIN 3140



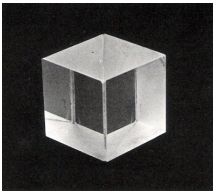
Wedge prisms

Material:	optical glass
Dimensional tolerance:	$\pm 0,15$ mm
Surface accuracy(λ):	1/2 - 3/2
Angle tolerance:	± 30 arcseconds
Surface quality:	From 0,01 to 0,25 according to DIN 3140
Coating:	Reflexion $< 1\%$ spectral range from 450 to 750nm



Pechan prisms

Material:	optical glass
Dimensional tolerance:	$\pm 0,15$ mm
Surface accuracy(λ):	1 - 3/2
Angle tolerance:	± 1 arcseconds to ± 3 arcminutes
Surface quality:	From 0,01 to 0,25 according to DIN 3140
Coating:	Reflexion $< 1\%$ spectral range from 450 to 750nm
Deviation:	0° with a tolerance of ± 30 arcseconds
Distance between prism:	Less than 0,1 mm



Cube beam prisms

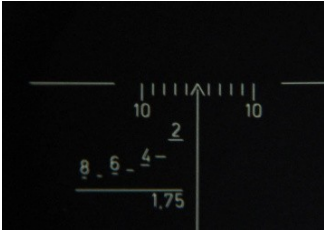
Material:	optical glass
Dimensional tolerance:	$\pm 0,15$ mm
Surface accuracy(λ):	1 - 3/2
Roof angle tolerance:	± 5 arcseconds
Surface quality:	From 0,01 to 0,25 according to DIN 3140
Coating on orthogonal surface:	AR coating with a reflexion $< 0,5\%$ for a given spectral range
Coating on a hypotenuse surface:	<ul style="list-style-type: none">- intensity beam splitter with R:T=1:1; 2:1; and 1- spectral beam splitter with R:T=4:1 or 1:4 for two given spectral range.



Optical windows

Material:	optical glass
Dimensional tolerance:	$\pm 0,15$ mm
Wedge angle tolerance:	± 5 arcseconds to ± 5 arcminutes
Surface accuracy(λ):	1/10 - 1/50 for the wavelength 623 nm
Roof angle tolerance:	± 5 arcseconds
Surface quality:	From 0,01 to 0,25 according to DIN 3140
Coating:	Reflexion $< 0,5\%$ for a given spectral range deposited on the elements made of optical glass

RETICLES

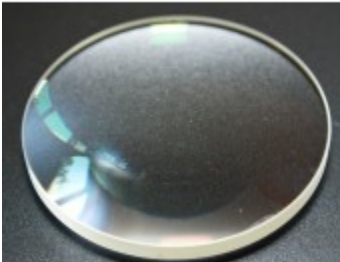


For over 5 decades Zrak d.d. Sarajevo has been manufacturing high quality reticles for military applications.

For binoculars, telescopes, rifle sights, sighting systems and calibration systems Zrak d.d. Sarajevo has the capability to produce quality components.

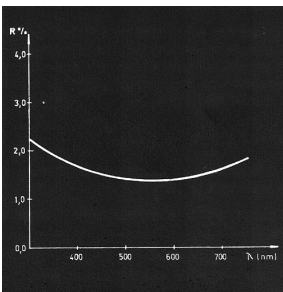
From simple crosslines to complex sighting patterns; from vacuum chrome deposited images to etch and fill doublet assemblies, Zrak d.d. Sarajevo has the experience to supply your exact requirements. If you need anti-reflective coatings we can do those too.

THIN FILM COATING



ANTIREFLECTION COATING

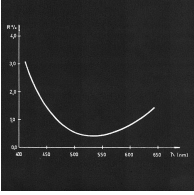
Antireflection coatings are deposited on polished surfaces of all optical elements according to the requirements. Spectral characteristic of antireflection coatings are controlled with spectrophotometric method in reflected and transmitted light.



Single layer AR coating

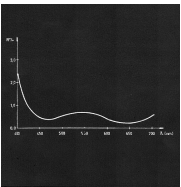
- Reflection of this coating is less than 1,5%;
- Coating is resistant under durability tests according MIL-C-675 C;

- It is available for any wavelength between 400 and 2500 nm with the width of low reflection zone from 200 to 300 nm.



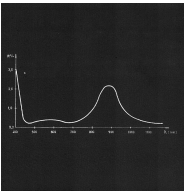
Two-layer AR coating

- Reflection of this coating on the base material with the index of refraction from 1,43 to 1,7 is less than 0,5% in the spectral range of $\lambda_0 \pm 50$ nm;
- Coating is resistant under durability tests according MIL-C-675 C;
- It is available for any wavelength between 400 and 2500 nm.



Wide range AR coating

- Reflection of this coating on the base material with the index of refraction from 1,43 to 1,7 is less than 0,5% in the spectral range of $\lambda_0 \pm 100$ nm;
- Coating is resistant under durability tests according MIL-C-675 C;
- It is available for any wavelength between 400 and 2500 nm.



Dual AR coating

- Reflection of this coating is less than 0,5% in the spectral range from 500 to 700 nm and at the same time for 1060 nm \pm 50 nm;
- This coating has the given reflection for all the base material with the index of refraction from 1,43 to 1,75;
- Coating is resistant under durability tests according MIL-C-675 C;

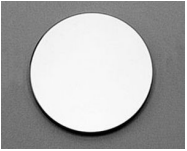
Three-layer AR coating

- Reflection of this coating is less than 0,5% in the spectral range of between 420 and 700 nm
- Coating is resistant under durability tests according MIL-C-675 C;

Multilayer

- Reflection of this coating is less than 1% in the spectral range of between 420 and 1100 nm

- Coating is resistant under durability tests according MIL-C-675 C;



MIRRORS

Spherical and flat surface shapes of mirrors for UV, V and IR spectral range are available. Reflection coating can be deposited upon the front surface or upon the rear side surface. Front face mirrors are formed by vacuum deposition of Ag and Al which are overcoated with dielectric films. Rear surface mirrors are formed by chemical deposition of Ag and Cu and protected with black mat lacquer.

mettalic coating can be enhanced overcoating with dielectric films to increase the reflectance over a desired range of wavelenght or angle of incidence.

Mirror for V spectrum AL + SiO

- reflection for wavelenght 550 ± 50 nm is greater than 87%;
- Mirror is moisture and abrasion resistant.

Mirror Al + MgF₂

- Reflection higher than 90% in the spectral range from 550 to 650 nm;
- Mirror is moisture and abrasion resistant.

Mirror Al + D₁ + D₂

- Reflection higher than 92% in the spectral range from 500 to 700 nm;
- Mirror is moisture and abrasion resistant.

Mirror Ag + D

- Reflection higher than 90% in the spectral range from 450 to 700 nm;
- Mirror is moisture and abrasion resistant.

Mirror for UV spectrum

- Reflection higher than 92% in the spectral range from 200 to 380 nm. In the region $\lambda_0 \pm 20$ nm where the reflection is maximum, it is higher than 94% ;
- Mirror is moisture and abrasion resistant.

Mirror for IR spectrum

- Reflection higher than 98% for the wavelenght greater than 1000 nm;
- Mirror is moisture and abrasion resistant.

BEAM SPLITTERS

Beam splitters are available in two main types: cube and plate one. Cube beam splitter is the one withthe coating deposited upon the hypotenuse of the right angle prism, and the plate one with the coating on one surface of the plane parallel plate.

Beam splitter can be spectral and intensity beam splitters.

Intensity beam splitters are available for the visible spectral range. Beam splitters are characterised with the multi layer structure consisting of more dielectric films with low and high index refraction.

Intensity beam splitter

- Intensity beam splitters are available for the normal incidence of light and for the angle of incidence of $45^\circ \pm 15^\circ$;
- Spectral characteristics of the coating change inside $\pm 5\%$ with the change of angle of incidence for $\pm 15^\circ$;
- Plate-type beam splitter is resistant under durability tests according to MIL-C-675 C;
- Absorption of the coating is less than 2%, but for the beam splitter it is higher because of the additional absorption in the optical glass.
- Intensity beam splitters with the similar spectral characteristics are available for the IR spectrum up to 2,5 μm .

Spectral beam splitters

Beam splitter V-V

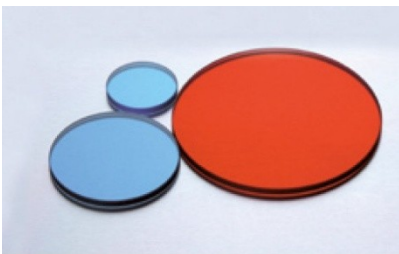
- This is a cube-type beam splitter;
- Reflection is greater than 80% for the wavelength greater than 610 nm;
- For the wavelengths shorter than 570 nm reflection is lower than 20%;
- Absorption is less than 2% for the whole visible range;
- Value of reflection in the deflection point of the curve changes for $\pm 10\%$ when the angle of incidence of 45° changes $\pm 15^\circ$;
- Position of the deflection point moves for ± 20 nm for the ends of angle range.

Beam splitter for V-IR region

- Reflection for the wavelength 1064 nm is higher than 80% for the incidence angle of $45^\circ \pm 12^\circ$. In the spectral range from 500 to 700 nm reflection is less than 25%
- Absorption in both spectral regions is not greater than 2%;
- Beam splitter does not change characteristics while changing temperature from -50°C to $+70^\circ\text{C}$.

Beam splitter for IR-V region

- Reflection for the spectral range 1060 ± 50 nm is lower than 20% for the angle of incidence of $45^\circ \pm 12^\circ$. In the spectral range from 500 to 700 nm reflection is higher than 80%;
- Absorption in both spectral regions is not greater than 2%.



FILTERS

Zrak manufactures standard and custom filters in all standard filter types on substrates of optical glass or colored filters

- bandpass,
- longpass,
- shortpass,
- neutral density filters.
- laser protection filters: KG-3 SCHOTT, from 420-694 nm $T \geq 80\%$, for $\lambda_0 = 694$ nm $OD \geq 3,4$, for $\lambda_0 = 1064$ nm $OD \geq 2$

