海纳光学 电话：0755-84870203
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100 mm F/2.8 CERCO®

UV LENSES

- LARGE APERTURE, HIGH TRANSMISSION DOWN TO 250 nm
- F-MOUNT (C-MOUNT ADAPTER IN OPTION)
- SPECIALLY SUITED FOR HIGH SPEED CAMERA AND IMAGE INTENSIFIER
- FOR COMBUSTION ANALYSIS, FORENSICS, CORONA DETECTION, BIOLOGICAL CHARACTERISATION

UV 100 mm

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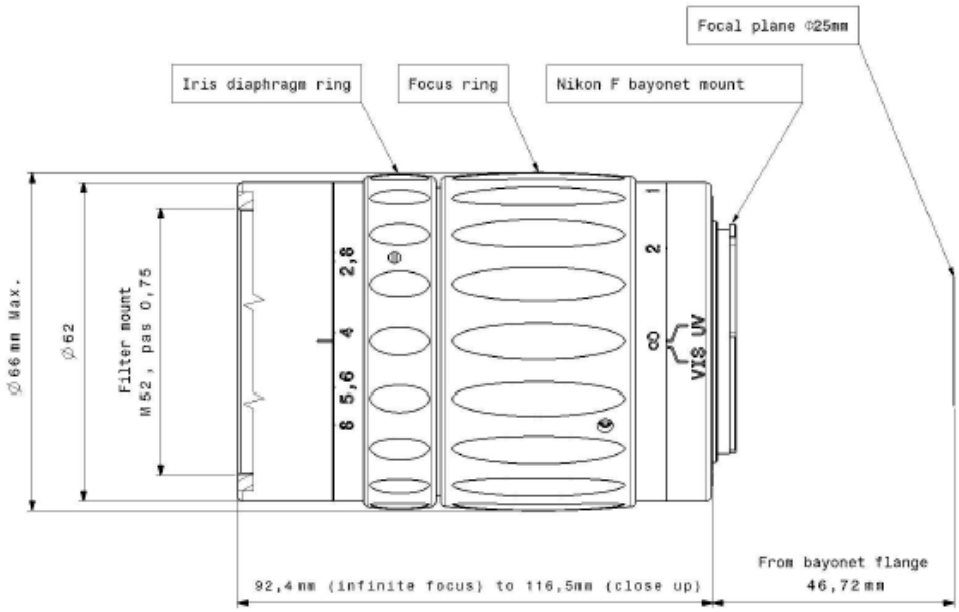
TECHNICAL SPECIFICATIONS	
Main features	
Focal lengh	98.0 mm
F stop (manual operating)	F/2,8 to F/8
Manual focus	Infinity to 45 cm
Field of view	14,5° diagonal
Picture size (mm)	Ø 25 mm
Spectral range	Optimization range: 250 nm to 410 nm Full usable range: 220 nm to 900 nm
Transmission in UV range	90% inside 250 nm to 410 nm
Standard anti reflective coating	Multi layer 220 nm to 480 nm
Optical design	6 lenses made of synthetic fused silica and UV grade mono-crystal calcium fluoride
MTF at F/2.8, UV range 240-410 nm for 30 lp/mm	20% inside Ø 18 mm, 15% Ø 25 mm
Relative radial distorsion at 1/10 magnification	<0.2% at full field
Mechanical Characteristics	
Overall Lengh (mm)	97 mm (infinite focus) to 121 mm (close focus)
Overall Diameter (mm)	Ø 66 mm
Camera mount	Nikon F type bayonet C mount adapter available upon request
Front filter thread	M 52 x 0.75



The **100F/2.8 UV lens type *CERCO® 2178*** *has been optimized for image capture in the UV range 250nm to 410 nm, with intensified high speed cameras. This UV lens is also usable on SLR camera in full manual mode from ultraviolet to near infrared wavelengths with a limited focus shift.*

UV Lens 100 F/2.8 type CERCO™ 2178
TECHNICAL DESCRIPTION

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1. INTRODUCTION

The 100 F/ 2.8 UV lens type 2178 has been first designed for intensified video cameras dedicated to the ultraviolet (UV) wavelengths and fitted with a Ø18 mm or Ø 25 mm image intensifier. Because the applications of such cameras are with very low level of UV light, the main characteristics requested for their lenses are a wide aperture and a very good transmission in the UV domain, rather than a very high resolution.
The optical design of Cerco™ UV lenses uses only UV grade synthetic fused silica and calcium fluorite single crystal which are perfectly transparent from 200 nm to infrared ; all optical surfaces are anti-reflective coated with wide band multi dielectric layers, optimised for the UV range [220 to 450 nm], which fits the largest number of the applications of our customers.
The resolution at full aperture is optimised for 30 lines pairs/mm, that exceeds most often the need of intensified cameras.

Thanks to optical properties of fused silica and calcium fluoride (index variations versus wavelengths), the lens type 2178 designed for UV range is also well corrected of optical aberrations from UV to near infrared and the defocus from UV range to visible and near infrared is quite negligible, making the lens usable from 220 nm to 900 nm.

The lens is fitted with an iris diaphragm (F/2.8 to F/8) and a focusing mechanism (infinity to 0.45 m), both manual operated.
The mounting interface is a NIKON bayonet, “F mount” type. This mount is compatible for standard accessories for Nikon F mount camera, like C mount adapter or extension rings.
The lens is fitted at front with a standard thread (M52 x 0.75) for filter screwing; an UV band-pass filter, antireflective coated, is proposed as an option.

The lens is also suitable for digital or 35 mm photography on SLR photo camera with Nikon F bayonet mount, or for back illuminated CCD adapted for UV light: because the pixels of such image detectors are below 10 µm, the lens type 2178 shall be used at intermediate F/ stops if high resolution, rather than high illumination on detector, is mandatory.
The iris diaphragm and the focus mechanism are not coupled to camera: the camera shall be operated in full manual mode.

Main applications are:

- Combustion analysis (automotive, aerospace, thermal power station, ...)
- Plasma studies, corona effects and electro-static discharge defects.
- Laser Induced Fluorescence, Particle Image Velocimetry, Molecular Tagging Velocimetry
- Detection of organic material by fluorescence: molecular contamination in the micro-electronics industry, forensic expertises, ...
- Miscellaneous: multi-spectral analysis of vegetation, observation of bioluminescent or fluorescent phenomena ...

2. OPTICAL CHARACTERISTICS

2.1 OPTICAL DESIGN

- Number of elements: 6 , no cemented parts
- Optical materials: calcium fluoride (UV grade) and synthetic fused silica; both achieve perfect optical transmission up to 200 nm, but transmission at short wavelengths is limited by anti-reflective coatings

Note : Because the optical data of CaF2 and silica are quite similar (low index of refraction, spectral dispersion), the optical design of UV lenses demands a larger number of elements than optical design of visible or infrared lenses with similar characteristics. Also, fused silica and calcium fluoride are expensive materials and request more precautions during manufacturing than optical glasses; so, the marketing compromise between cost and characteristics lead to not too large aperture and not too long focal length.

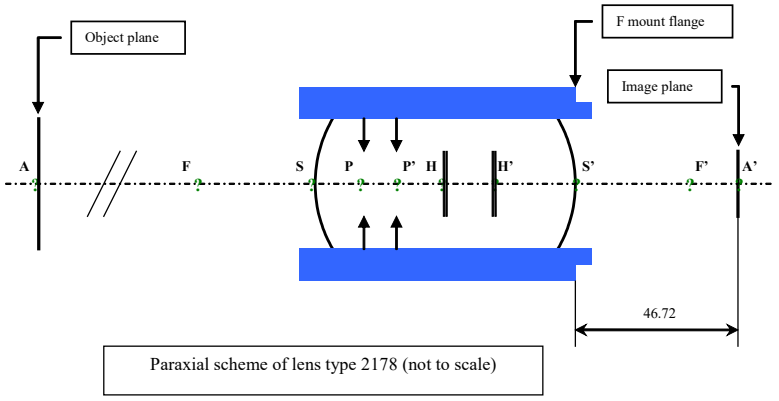
- All optical surfaces are anti-reflective coated by multi-dielectric layers, optimised for the spectral range [220 to 450 nm]; the transmission below 220 nm is altered due to absorption in the anti-reflective coatings.
- Calcium fluoride elements, which are sensitive to high thermal shocks are located internally and are protected by front and rear elements made of fused silica, which is not affected by rapid thermal variations, thanks to its zero linear expansion.
- The design does not use cemented parts, to avoid diffusion and fluorescence of lens bond caused by UV light.

2.2 OPTICAL DATA

- Focal length (wavelength 315 nm) : F = 98,0 mm (± 0.7 mm)
- Optical back focus (last optical surface to focal plane): 69.4 mm (object at infinity)
- Mechanical back focus (F mount flange to focal plane): 46.72 mm (Nikon F standard)
- F/ number: F/ 2.86 to F/ 8
- Close up focusing distance from front: ≈ 45 cm
- Magnification at close up distance: -1/ 4
- Focusing adjustment is achieved by the travel of the optical assembly inside the lens body; travel extension 24 mm.
- Image diameter: > Ø 25 mm
- Angular field of view (infinite conjugate) : > Ø 14.5 °
- Usable wavelength range: 220 – 900 nm
- Entrance pupil: diameter 34.3 mm (at full aperture); location from the front of lens mount: 23.3mm

2.3 PARAXIAL DESCRIPTION

H and H' : object and image principal planes
S and S' : first and last optical surfaces
F and F' : object and image focus
A and A' : object and image plane locations
P and P' : entrance and exit pupil locations



Paraxial scheme of lens type 2178 (not to scale)

Values in mm, positive from object to image ; wavelength 315 nm

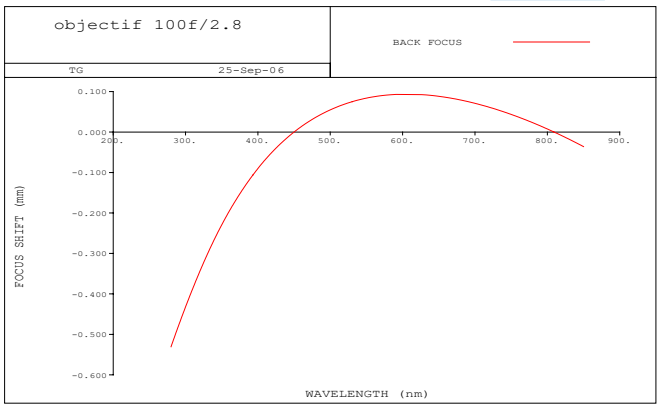
H'F' (= - HF): 98,0 (focal length)
SF = -69,7 and S'F' = 69,4
SH = 28,3 and S'H' = - 28,6
SP = 15,8 and S'P' = - 42,9
SS' =63,2 and HH' = 6,3
S to front of lens mount: 7,6
Nikon F flange to image = 46,72

Calculation of conjugates planes and magnification:

Location of object and images planes from focus: $FA \times F'A' = -F^2$
Magnification (object / image): $M = -F / FA = F / F'A'$ or $M = AH / H'A'$
Location of object and images planes from principal planes: $1/H'A' - 1/HA = 1/F$

2.4 RESIDUAL CHROMATIC ABERATIONS

• Axial focus versus wavelength; see curve



Defocus 350 µm from Visible to full UV (220 to 400 nm), corresponding to typically UV sensitivity of intensified CCD camera.

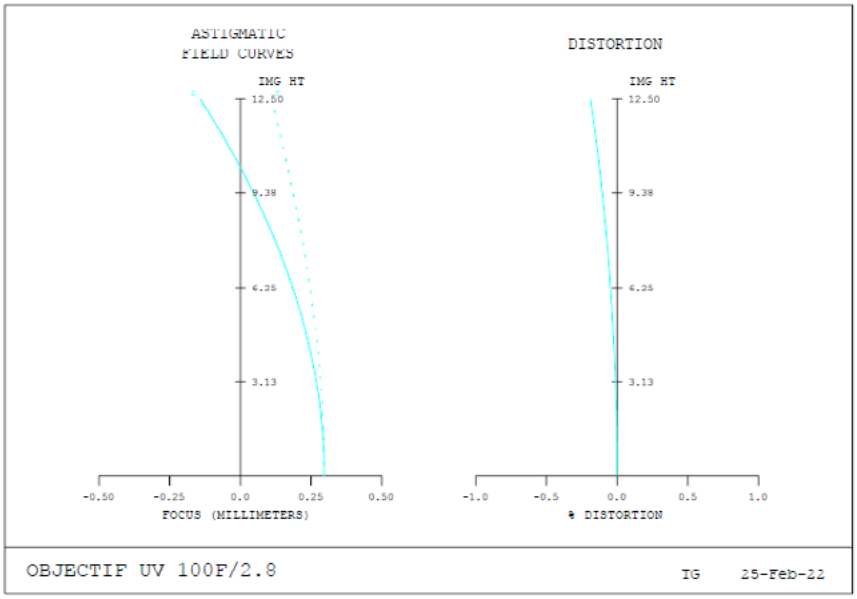
Defocus 150 µm from Visible to close UV (340 to 400nm), corresponding to typically UV sensitivity of CCD sensor without UV cut off filter ; this defocus is negligible if the iris diaphragm is closed to F/8

• Transverse chromatic residual aberration (220 to 420 nm): less than 4 µm for magnification < 1/5

2.5 FIELD CURVATURE AND DISTORTION

At magnification 1/10:
- Residual field curvature: R > 0.35 m (concave to the lens)
- Relative radial distortion: less than 0.2 %.at full field

Distorsion



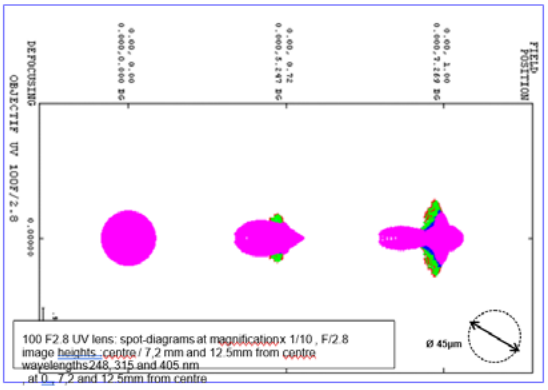
2.6 BLUR SPOTS DIMENSIONS

RMS diameter of blur spots (in µm), spectral domain 220 to 420 nm, equally weighted:

magnification	F/ number	F/2.8			F/4		
	Image height (mm)	*0*	*9*	*12.5*	*0*	*9*	*12.5*
-	Object at infinite conjugate	36	36	54	29	27	41
1/10	Object at 1.05 m	38	30	44	31	27	40
1/5	Object at 55 cm	40	38	54	33	30	42
1/ 2.5	Object at 31 cm (*)	43	54	75	36	35	49
1/1	Object at 16 cm (**)	60	97	129	37	48	65

(*): extension ring required, thickness > 15.2 mm
(**): extension ring required, thickness > 74 mm

- Spot-diagrams at magnification 1/10 and full aperture F/2.8, in UV range:



2.7 MTF

FTM curves are computed for the UV spectral range 230 to 400 nm (equally weighted); image plane is focused to optimise the resolution inside 20 mm; values are square average of tangential and radial MTF

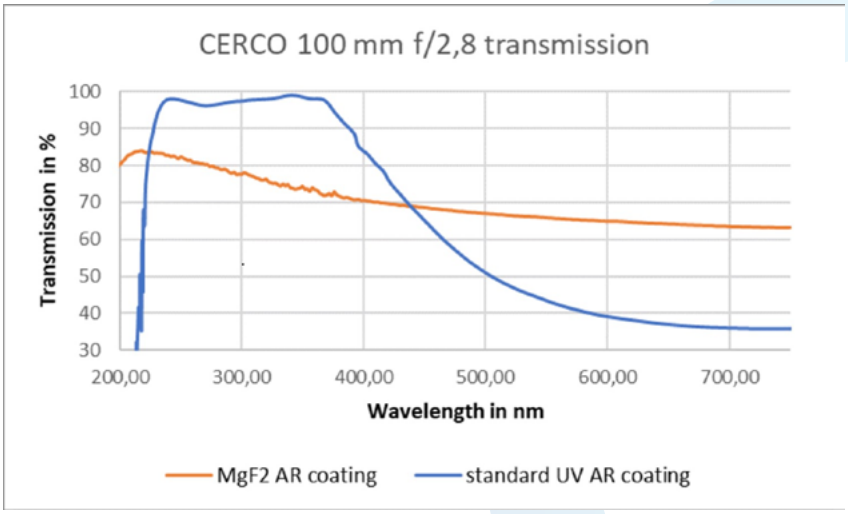
- 20 lp/mm (lines pairs / mm) correspond to 600 video lines on a 25 mm image intensifier (image 15 x 20 mm, diagonal 25 mm)
- 30 lp/mm correspond to 900 video lines on a 25 mm image intensifier (image 15 x 20 mm, diagonal 25 mm)

	Frequency & F/ number	20 pl/mm - F/2.8			30 pl/mm - F/4		
Magn.	*Image height (mm)*	*0*	*9*	*12.5*	*0*	*9*	*12.5*
/	Object at infinite conjugate	0.58	0.45	0.39	0.33	0.29	0.29
1/10	Object at 1.05 m	0.60	0.49	0.22	0.34	0.29	0.29
1/5	Object at 55 cm	0.54	0.40	0.38	0.34	0.28	0.26
1/ 2.5	Object at 31 cm (*)	0.55	0.31	0.29	0.37	0.21	0.17
1/1	Object at 16 cm (**)	0.38	0.25	0.17	0.32	0.11	0.09

(*) and (**): extension ring required

2.8 OPTICAL TRANSMISSION

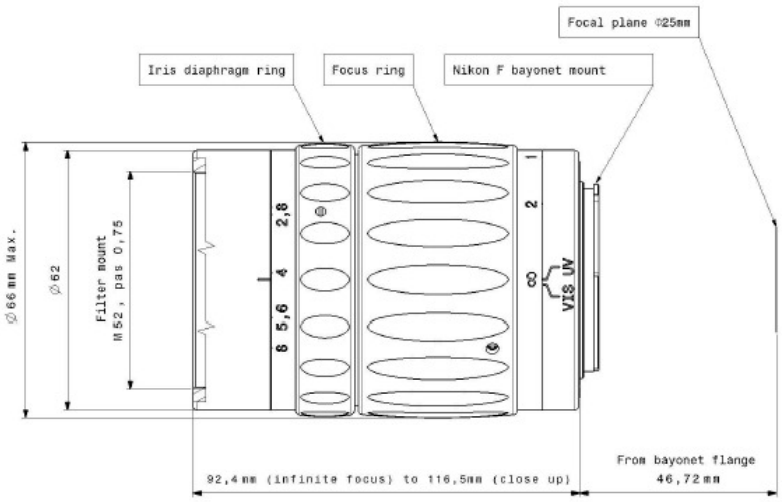
- Relative illumination over field of view at F/2.8: > 92%



- The standard AR coating offers a transmission >90% between 230 nm and 400 nm. Below 230 nm the transmission is limited by the absorption of the AR coating. Above 400 nm and up to IR the transmission goes down to 35 %, limited by the reflection of the AR coating.
- For imaging below 230 nm, a custom AR coating (MgF2) can be ordered. The usable range is broader, although the maximal transmission doesn't exceed 85%

3. MECHANICAL HOUSING

- The lens mount is made of aluminium alloy, black and light grey mate finish
- Camera interface: Nikon F type, Bayonet Mount (46.72 mm from flange); adapter for C mount interface available on request
- Dimensions according to following drawing



UV lens 100 F/ 2.8 ref Cerco 2178

- Filter mount at front: female M52 x 0.75
- Iris diaphragm: command by notched ring; unlocked positions; graduations for F/2.8, F/4, F/5.6 and F/8
- Focus: command by notched ring; graduations for focusing distance from infinity to 0.45 m to align with mark for UV spectral range or mark for visible light

4. MOUNTING / DISMOUNTING THE LENS

Lens mounting
like any lens with Nikon F bayonet

1) Present the lens in front of the camera (or adapter) bayonet: mark VIS UV shall be placed in front of red dot on camera; introduce lens into camera

2) Then lock by rotating the lens anti clockwise up to click

Lens removing

3) Unplug the lock by pressing the button near the red dot rotate clockwise the lens remove the lens

4.1 C MOUNT ADAPTER

Standard adapter from Nikon F bayonet to C mount (diameter 1», thread W 32 tpi, flange distance to image plane 17.52 mm ± 0.02 mm)