Company Seven

SPECIAL-OPTICS DIVISION

THE HASSELBLAD UV-SONNAR f. 4.3/105 mm LENS

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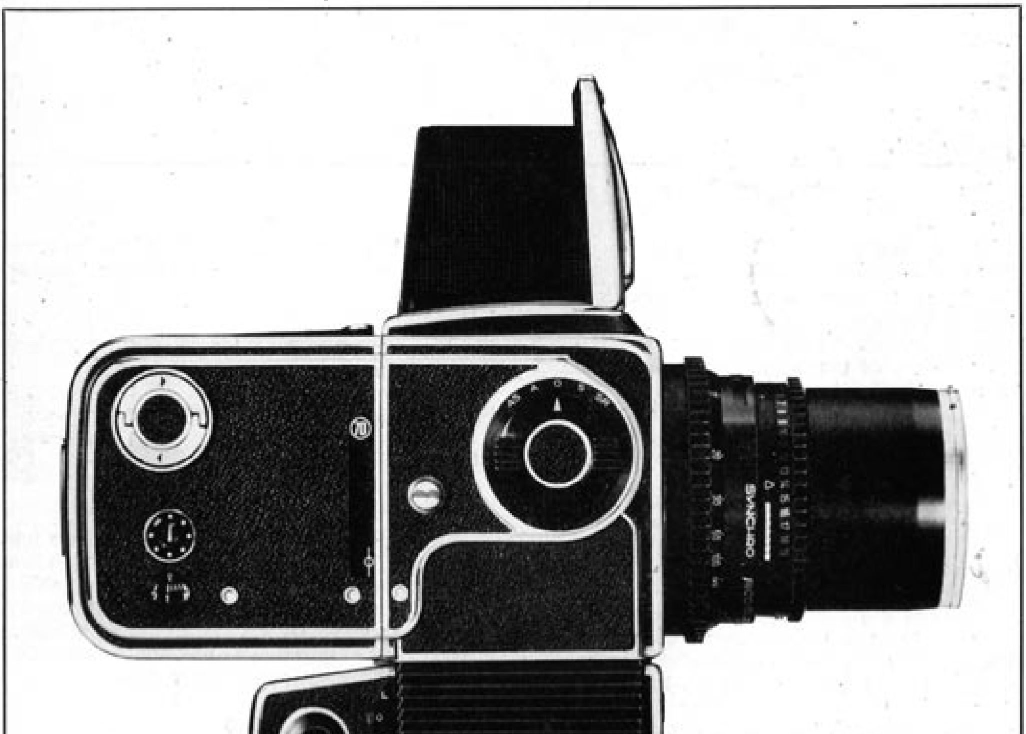
HASSELBLAD

UV-SONNAR

f.4.3/105 mm



Zeiss UV-Sonnar f. 4.3/105 mm lens for the Hasselblad 500C and 500EL

The Zeiss UV-Sonnar 105 is a special lens which is distinguished by extremely good transmission within the ultraviolet portion (215—400 millimicrons) of the electromagnetic spectrum. As a result of its exceptional chromatic correction, the lens despite its special construction for ultraviolet radiation (UV), can also be used for photography in visible light and in the infrared area of the spectrum (IR).

The manufacturer is Carl Zeiss, West Germany, one of the world's leading manufacturers of optical equipment; a guarantee of the finest optical performance. The Compur shutter has speeds from 1—1/500 sec. Like all Hasselblad lenses it automatically stops down at the moment of exposure but may be stopped down conventionally for an accurate check on depth-of-field on the ground glass; the lens also has moveable depth-of-field indicators, "M" and "X" synchronization, "V" self-timer and an exposure value scale.

The elements in the UV-Sonnar 105 are not made of glass as in the other Hasselblad lenses because the transmission of ultraviolet radiation is limited in glass. Accordingly, the f. 4.3 lens has been made of i.a. quartz, which makes for relatively high production costs.

In addition to its design for ultraviolet radiation, the UV-Sonnar 105 naturally has the same technical qualities as other Hasselblad lenses.

Technical Data

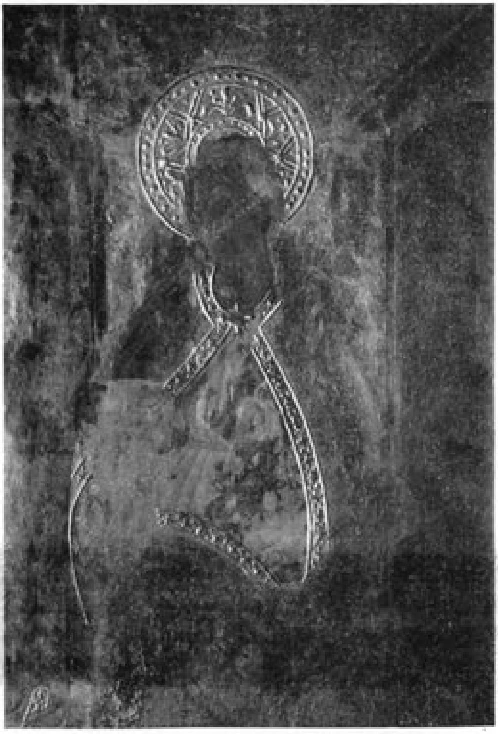
Maximum aperture/focal length	f. 4.3/105 mm
Angle of view	40°
No. of elements	7
Focusing range	6 feet—∞
	1.8 m—∞
Diaphragm	4.3—32
Synchro-Compur shutter	1—1/500 sec, B
Wavelength range	215—700 millimicrons

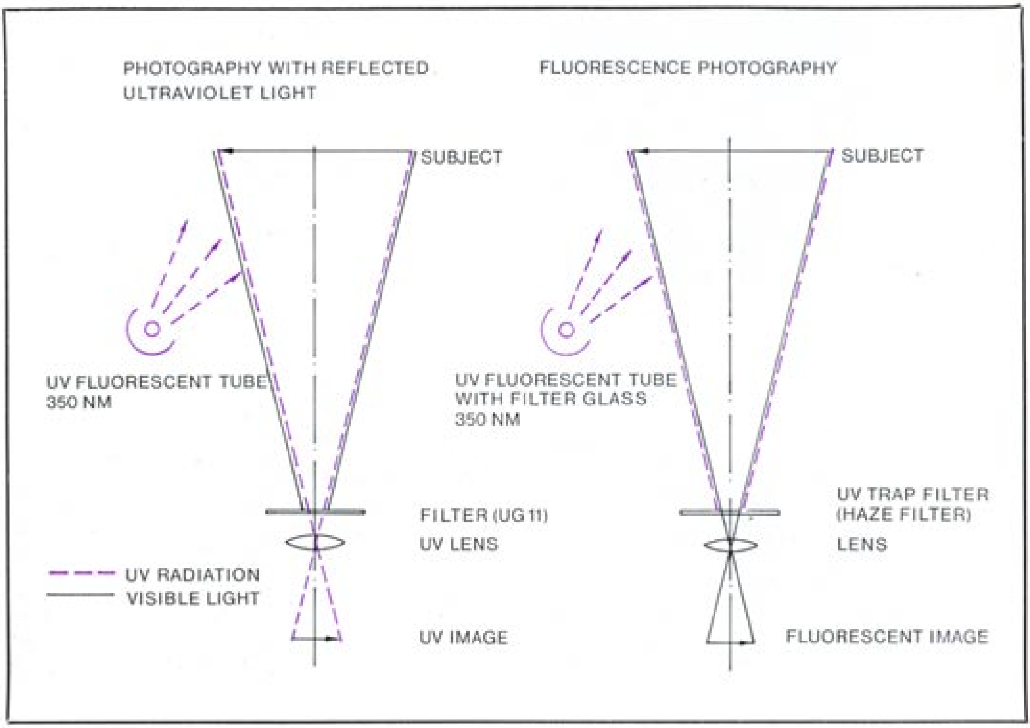
Just as the visible spectrum is divided up into color radiations (red, yellow, green etc.), ultraviolet radiation is also divided up but into shorter and longer wave ultraviolet, hence shorter and longer wave UV photography. In addition, different films, filters and sources of radiation are used at the various wavelengths.

Fluorescence Photography

Because there is often confusion about the concepts fluorescence and reflected UV photography, we'd like to try and explain briefly the difference between them since both make use of ultraviolet radiation.

By fluorescence we mean a substance's ability to emit radiation of a longer frequency than that to which it has been exposed.





Pictures at left:

This painting of Saint Agatha (Göteborg's Konstmuseum) shows how new painting and repairs can be disclosed with UV light.

The top picture was taken conventionally with photofloods. The fluorescence glow picture (right) shows how the painting fluoresces (the light parts) when exposed to invisible long-wave UV radiation from a UV fluorescent tube with filter glass. The gold colored parts (the hem of the robe and halo) do not fluoresce. This method of investigation is common in the examination of objets d'art and must be undertaken in complete darkness because of the fluorescent image's weak luminosity.

The picture (lower left) was taken with long-wave UV radiation using a UV fluorescent tube and a UG 11 filter. Repairs to the painting are clearly evident. Compare, for example, the left and right sides of the throne. The picture (right) was taken with short-wave UV radiation (253.7 millimicrons) from a germicidal lowpressure mercury tube and using a metal interference filter. This picture might provide the layman with less information than the previous one.

The film used in all cases was Kodak Tri-X, 120 roll film.

Since ultraviolet rays have a shorter wavelength than that of visible light they can, thus, produce visible fluorescence in a darkened room. The image attained can be photographed with ordinary photo equipment. However, the light source must be supplied with a UV filter which blocks visible radiation.

With direct UV photography this filter is unnecessary on the radiation source but a special filter must be used on the lens. (See diagram above).

Photographic Materials

Since the sensitivity of normal photographic emulsions extends to about 250 millimicrons, ordinary black-and-white film can be used. But shorter wave UV radiation is often reproduced better with low-gelatin high-silver content emulsions (gelatin absorbs the shorter radiations). Color film is of minor interest since only the blue-sensitive layer reacts to UV radiation.

Sources of radiation

Using the correct light source is of the greatest importance in UV photography. The simplest solution for long-wave UV is a UV fluorescent lamp with filter glass, which produces almost no visible radiation. Electronic flash units, f ash bulbs, xenon arc lamps and medicinal quartz lamps may be used if it is realized that only part of their radiation falls within the UV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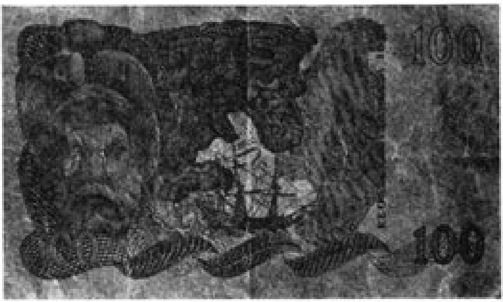
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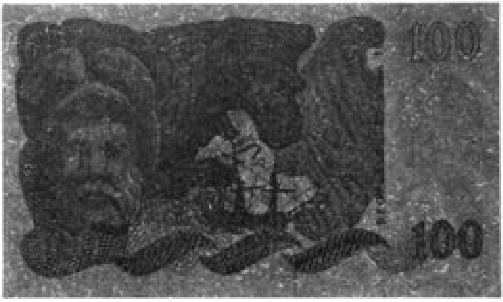
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This series of Swedish 100 kronor bills are examples of how counterfeit money can be disclosed using UV radiation. All pictures were taken with a Hasselblad 500C and a 105 mm Zeiss UV-Sonnar lens. Of course, certain differences can be discerned, albeit with great difficulty, in ordinary pictures (upper pair illuminated with photofloods and exposed for 1/30 sec.), the genuine bill to the left and the counterfeit bill to the right.
The two middle pairs are counterfeit bills. The upper pair of these were taken with long-wave UV radiation from a mercury lamp with filter glass and a UG 11 filter at 1/4 sec. Here you can clearly see that two different kinds of paper were used for the front and back, which is not the case with the genuine bill.
The bottom pair of these also supports the previous theory about different papers. These are fluorescence pictures taken with long-wave ultraviolet radiation from a mercury lamp with filter glass and a no. 8 Wratten filter (60 sec. exposure). The front fluoresces evenly across its entire surface while the back only fluoresces in spots (small dust-like areas).
The lower pair are pictures taken with transmitted long-wave UV radiation with an ultraviolet fluorescent tube and a UG 11 filter and exposed for 40 sec., the genuine bill to the left ond the counterfeit bill to the right. The bills were placed on a stretched polythene bag for the exposure.
Note the watermarks.
Kodak Tri-J, 120 roll film at f/11 was used in all cases.

The four pictures of stamps (above), photographed in different ways, shows clearly how counterfeiting can be discovered with the UV-Sonnar 105. Postal authorities overprinted the stamps with a new denomination (27 öre). But since stamps without the overprint (80 öre) are very valuable, attempts have been made to remove the overprint.
The top pair were taken conventionally with photofloods. It is quite impossible to decide whether or not the figure 80 in the right stamp had been overprinted with a 27 which was subsequently removed. However, stamps (bottom pair) exposed to long-wave UV radiation (330—370 millimicrons) from a UV fluorescent tube through a UG 11 filter show unmistakeably that the right stamp had been overprinted with a 27.
The film in both cases was Kodak Tri-X, 120 roll film.

range. The easiest way to get short-wave UV radiation is to use a germicidal lowpressure mercury tube with the greater part of its radiation at a wavelength of 253.7 millimicrons. Ordinary daylight can also be used for long-wave UV photography (more than 300 millimicrons), since daylight contains radiation of this kind. Short-wave UV is absorbed by the atmosphere.

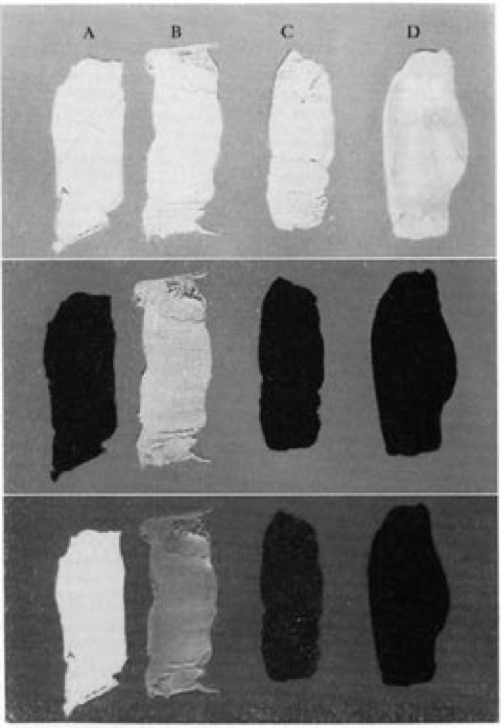
Filters

A special filter must be used in UV photography to prevent visible light from reaching the film. By using different filters you can also exploit selected parts of the lens' wavelength range of 215—700 millimicrons for special purposes. A Schott UG 11 filter, supplied with the lens as standard equipment, can be used for long-wave UV radiations; an intereference filter (see diagram) provides the easiest access to shorter wave-lengths.

Exposure

Special exposure meters have been constructed to determine exposure in UV photography since the sensitivity of conventional meters is poor in the UV range. But since these special meters are rather expensive, you can determine correct exposure by making a number of trial exposures with the light source, filter and film you intend to use. Another possibility with long-wave UV is to use an ordinary exposure meter and hold a UV filter over the photocell. You then expose e.g. at 1/10—1/100th of the time indicated by the meter; this is because exposure meters differ in their sensitivity to UV radiation and it is necessary to compensate in this way for the meter's poor sensitivity in combination with the UV filter.

Using long-wave UV radiation and the UV-Sonnar 105, it was possible to show that the picture to the left had been painted with two different white paints. The top picture was taken conventionally with photofloods. The lower picture was taken with a UG 11 filter and long-wave ultraviolet radiation from a medicinal quartz lamp. In the UV picture you can clearly see where the white parts were painted with different paints.
Compare the UV picture's left and right sides with the conventional picture's. Here the white paint partly reflected the ultraviolet rays and there was therefore no change in color; other white paint displayed no reflectivity of UV radiation.
Film: Kodak Tri-X, 120 roll film.



The four colors to the left are: zinc white (A), lead white (B) and titanium white (C) and (D). All the colors have oil-based vehicles except for (D) which has an acrylic vehicle.
The pictures were taken with a Hasselblad 500C and a UV-Sonnar 105 lens on Kodak Plus-X Pan Professional film.
The top picture was taken conventionally with photofloods with an exposure of 1/4 sec. at f/11.
The middle picture was taken with long-wave UV radiation. You can clearly see that the lead white (B) reflected the UV rays completely while the other colors displayed lower reflectivity to long-wave ultraviolet wavelengths. The picture was taken through a UG 11 filter using a HgU80W mercury lamp with a 1 sec. exposure at f/11.
The bottom picture shows the varying fluorescence of the colors when they are exposed to long-wave ultraviolet radiation from a HgU80W mercury lamp. A Schott KV 418 UV interference filter was used with an exposure of 2 min. at f/11. Here you can clearly see that the zinc white (A) fluoresced strongly while the titanium white with an acrylic vehicle (D) hardly fluoresced at all.

For UV photography in daylight with the UG 11 you use your exposure meter in the usual way. The exposure value received is then to be reduced by 3 to 7 steps.

Focusing

Focusing should really be done at the wavelength to be used for photography. This requires special attention with normal lenses used for IR and UV photography since their chromatic correction does not extend to these spectral ranges. There is no such problem with the UV-Sonnar 105. Thanks to superb chromatic correction, focusing is just as simple as with ordinary lenses. You focus via the reflex viewfinder in normal light, even when UV pictures are to be taken.
Proxars should not be used for close-ups since they are made of glass instead whose transmission of UV radiation is limited. Use a bellows extension or extension tubes.

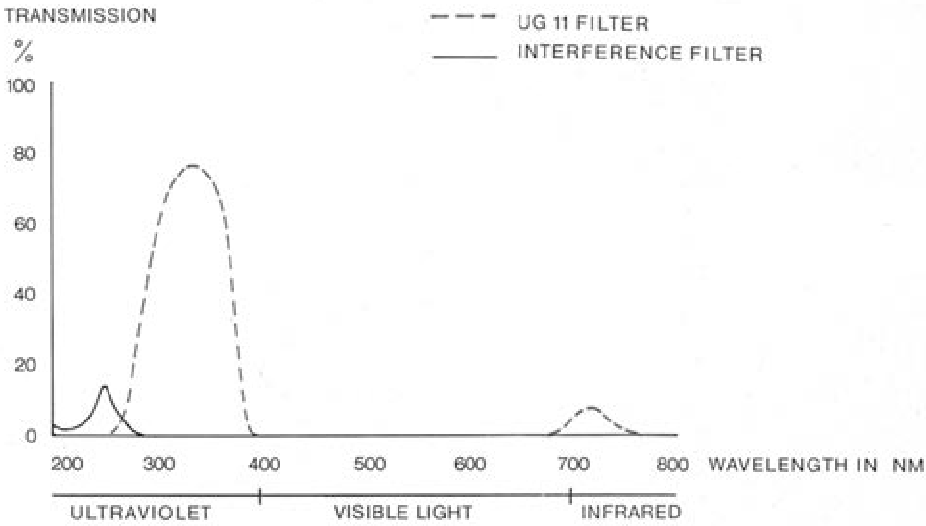
Translucent objects

Since glass cannot be used for UV photography because of its poor transmission in the UV range as mentioned above, problems can arise when photographing translucent objects. One possibility is to place the object on a tightly stretched ordinary polyethylene film, which is transparent to UV radiation.

The above pictures show how changes in skin pigmentation can be demonstrated with ultraviolet light.
Both pictures were taken in daylight with a UV-Sonnar 105. Film: Tri-X Pan Professional, 220 roll film.
It is impossible to see with the naked eye if the hand lacks pigment or not.
The picture (left) was taken conventionally and erproduces subject tones correctly. Exposure: f/11 at 1/15 sec.
The picture (right) was taken through a UG 11 filter. Exposure: f/11 at 1/4 sec. Here you can clearly see the absence of pigment (the light parts). These parts reflect UV radiation completely while the rest of the skin absorbs it.

Photography in visible light with the UV-Sonnar 105

As mentioned previously, the UV-Sonnar 105 can also be used for conventional photography. But you should put a haze filter on the lens to block UV radiation which could produce haze in black-and-white pictures and bluishness in color pictures. In conventional photography with the UV-Sonnar, filters and Proxars can be used without special problems.



Uses

The UV-Sonnar 105 has been designed to solve the most complicated photographic problems arising in conjunction with ultraviolet photography in research.

UV photography provides completely new information about the construction of many substances. The reflectivity of certain substances appears different, for example, in UV radiation as compared to visible light. This can be seen clearly in the different white tones of oil paints in which some tones are rendered darker while others retain their whiteness in UV pictures.

The UV-Sonnar 105 can not only demonstrate color changes in examinations of paintings but even over-painting, new painting, lacquering, repairs, possible forgeries etc.

Another interesting field for ultraviolet photography is criminology. Here the lens can be used for, i.a. examinations of counterfeit checks and documents, fingerprints, invisible ink etc.

UV photography is also used in many other fields of science and technology, e.g. in the examination of different laboratory samples, changes in skin pigmentation and a great many other things.

Results with UV photography in daylight are very much dependent upon the weather and position of the sun. In addition, there is a loss in contrast in the rendition of stronglylighted subjects, e.g. shadows are reproduced much lighter or disappear completely but fog and haze are strongly emphasized. Close-ups of flowers using daylight UV photography reveal the targets pointing the way to the nectar of most flowers. This mark is impossible to the naked human eye but is no problem at all to insects with their UV sensitive eyes.

WARNING! Do not forget to protect your eyes and skin when working with UV radiation and never look directly at the light source itself.

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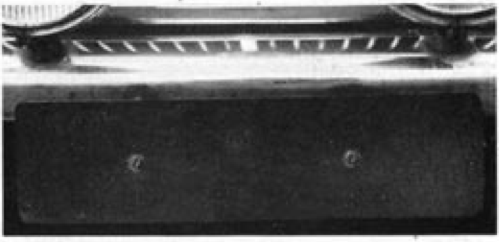

The license plates to the left display the reflectivity of different substances to UV radiation. All pictures were taken in daylight with the UV-Sonnar 105. Kodak Tri-X, 120 roll film, was used.
Both top pictures show the car's front license plate. The material is fiberglass reinforced plastic with imbedded figures.
The upper picture was taken conventionally. The second plate was photographed through a UG 11 filter and shows that the plate is almost non-reflective to ultraviolet radiation.
The car's rear license plate (the bottom pair) has figures attached with adhesive.
The third picture was exposed conventionally. The fourth picture was taken with a UG 11 filter. You can clearly see that one of the figures is made of a different material than the other figures. The former reflects UV rays while the latter absorbs them completely.

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