THE NIKON ZOOM-PHOTO BIOMICROSCOPE:

A study of light and camera controls for proper slide film exposures

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The importance of photographs in ocular diagnosis is obvious. Not only do photographs provide a document of the appearance of the lesion or a condition, but they also provide a valuable means for comparison with the previous or subsequent photograph so that extension, progression, or regression can be recognized and observed.

The purpose of this guide is to provide the user of the slit lamp with a concise description of how to take good slit lamp photographs of the ocular structures. Let's review some of the light and camera controls responsible for proper exposure.

LIGHT CONTROLS

The voltage of the slit lamp bulb can be varied from five to eight volts using the on-off switch. The brightness control, however, does not affect photography because the electronic flash has a much greater intensity and overrides the existing light.

The power unit for the electronic flash contains a capacitor which yields power of from fifty to two-hundred watt-seconds. There are five intensity selection, as shown in Figure 1 and Table E. The recycling time for the flash is usually less than ten seconds, and the flash is ready when the indicator light on the front panel is lit. It is generally a good idea to turn the power unit on a few minutes before using the flash in order to permit maximum buildup of charge.

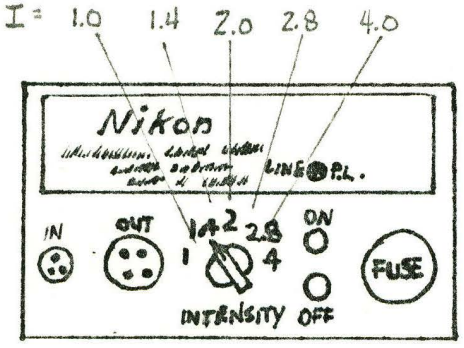

Figure 1.

The aperture diaphragm adjustment also provides a significant aid in controlling light. Decreasing the aperture size does not significantly increase the depth of focus, but it does reduce peripheral light and light scatter. Light intensity is affected for both observation and photography because the diaphragm is located directly in the path of both light sources.

CAMERA CONTROLS

Each eyepiece of the slit lamp is focused independently. One eyepiece is associated with the camera and that eyepiece should be focused sharply before taking photographs. The other eyepiece is used for observation; it does not affect photography, but focusing is desired for optimum binocular viewing.

The electronic flash is synchronized with the shutter which is of the focal plane type consisiting of a blind of rubberized fabric or metal slats which move at a controllable speed close to the film plane. The shutter should be set at 1/30 second for Nikon f and 1/60 for Nikkormat camera bodies.

Although the viewer observes the eye at magnifications of 7X to 35X, remember that photographs are actually being made at magnifications of 0.7X to 3.5X since they are made without the 10X ocular.

Tables A, B, and C show the suggested flash settings for each ASA and type film used in the study. The magnification used refers to the click-stop setting on the zoom-lens turret of the instrument,

the actual magnification which is photographed is 1/10 that amount.

These standards are based on healthy eyes. Fro some photographs there is more than one possible flash intensity and the decision to use either one may be based on the occurence of any opacity which reflects back better, therefore taking the lesser intensity is suggested. These should be duplicated and be made available in the photodocumentation clinic for easy referral to correct exposure control.

Table D is a duplication of a table appearing in the Nikon Instruction Manual. A translation of what these numbers mean and how the exposure is derived for each ASA is offered at the bottom. It appears that this is a conservative estimation of the camera's capabilities and exposure requirements for various films when compared to my actual observations and own tables of flash intensities. In general, when magnification increases, so does light requirements. In some cases, e.g. narrow slit, high magnifation photographs may lack sufficient light. For that reason, and also because of the loss of depth of focus with greater magnification, I recommend 16X as a useful and sufficient magnification for most photographs. When larger magnifications are needed for closer evaluation, enlargements may be useful.

Based on the reliability of satisfactory results, I suggest the use of Ektachrome films of ASA 64 or 200. The Ektachrome 64 film shows a slightly tighter grain pattern and lower contrast(better shadow detail) than the 200 ASA. However, the new 200's have a finer grain, similar to the 64 ASA. The density of colors is good, but

not quite equal to the slower Ektachromes. The Ektachromes do have a bluer cast to them than a Kodachrome of the same ASA, but the possibilities of self-processing and quicker analysis outweigh any differences. (Kodachrome has a patented developing process only performed at Kodak labs, at Kodak prices!)

RECOMMENDATIONS

1) There are many glass surfaces throughout the slit lamp, and obtaining good photographs require that they be clean and free of dust. A dust cover should be kept over the lamp when it is not in use and the exposed surfaces should be cleaned periodically with a glass cleaner. In addition, air in pressurized cans (available at photography stores) can be used to blow dust from hard to reach places.

2) A battery operated motor drive unit is a definite advantage so photography can be done single-handed. The addition of the auto-wind unit simplifies and frees up an extra hand to change the camera and light controls for a proper exposure. The extra cost, approximately $100, is worth the incresed speed and efficiency.

3) A bulk film loader and reusable film cartridges are a cost cutter and provide for quicker development and analysis of photo-documentation. Once the bulk loader is filled one-hundred foot rolls of color film in the darkroom, any number or length of exposures can be wound into plastic or metal film cartridges in daylight. Costs here include $16.95 for the loader and $6.00 for ten Kodak reusable film cassettes. Film in hundred foot rolls cost $47.55 for Ektachrome 64 and $51.20 for Ektachrome 200. Approximately thirty rolls of 36-exposures each can be wound from a hundred foot roll. The cost of single rolls of 36-exposures is $3.81 and $4.56 for E64 and E200, respectively. This represents a significant savings when a large number of rolls can be wound by the clinic. Plus, any length exposure can be wound when shorter rolls are necessary.

4) With the loader and cartridges recommended above, it would be beneficial to be able to process and mount these slides. Equipment and costs to begin developing and mounting our own slide film should include the following:

a. Daylight film tank-holds three reels of film to be developed = $12.50.

b. Stainless steel film reels = $3.95 ea.
(or autoload plastic reels = $4.25 ea.)

c. Thermometer = $7.95 to $9.00

d. Timer - by Gra-lab = $39.95

e. Changing bag = $9.50 (or total darkness, to load film into bulk loader or onto developing reels)

f. E-6 Chemistry by Unicolor processes the new Ektachrome series film = $19.95 for one gallon quantity

g. Brown (light absorbing) bottles - available from some pharmacies = usually no charge

h. Cardboard mounts - iron to seal = $4.05 per 100

Several reels can be developed together to increase cost efficiency of the chemicals. A typical mix of chemicals (one quart) can develop ten to twelve 36-exposure rolls of film. Cardboard mounts that can be ironed together make getting that finished slide into the patient's file faster.

Please consult the enclosed "propoganda" on processing chemistry manufacturers for a summary of their processes. It should be noted that the new E-6 process (versus the old E-3 and E-4 processes, still available) has cut the processing time from 47 minutes down to 37¼ minutes, wash down to 6¼ minutes, decreased the number of wet steps, and drying time has been reduced. The temperature has been increased to 100.4°F however. These changes have made it even more simple to begin processing slide films than ever before.

The previous summary offers some viable suggestions and recommendations to improve and simplify the photodocumentation clinic at the College of Optometry. These somewhat personal observations are offered for implementation at the Clinic's own pace and willingness to provide greater responsibility for better and more diversified services to patients and instruction to students in the area of photodocumentation.

TABLE A

EXPOSURE GUIDE FOR NIKON PHOTO BIOMICROSCOPE
FILM: KODACHROME ASA 25

	7x	10x	16x	25x	35x
CORNEA - OPTIC SECTION SLIT LESS THAN 1mm	-	-	-	4	4
CORNEA - PARALLELOPIPED	1.4 2	2 2.8	2 2.8	2 2.8	4
CONJUNCTIVA	1*	1*	1	1.4 2	1.4 2
SCLEROTIC SCATTER	2 2.8	2.8 4	-	-	-
LENS	-	-	2.8	4	4
BLUE IRIS	1.4	1.4	2 2.8	2 2.8	2 2.8
BROWN IRIS	1	1.4	2	2 2.8	2.8 4
CHAMBER ANGLE	1.4	1.4	2	2	2 2.8
FUNDUS - NARROW SLIT	-	-	-	-	-
FUNDUS - WIDE SLIT	-	-	1	1	-
FUNDUS - PERIPHERAL	1.4	2	2 2.8	2.8	-

(-) indicates values not obtained or unsatisfactory
(*) use aperature diaphragm to additionally control light

TABLE B

EXPOSURE GUIDE FOR NIKON PHOTO BIOMICROSCOPE

FILM: EKTACHROME ASA 64

	7x	10x	16x	25x	35x
CORNEA - OPTIC SECTION SLIT LESS THAN 1mm	1.4 2	2 2.8	2.8	2.8 4	-
CORNEA - PARALLELOPIPED	1.4 2	2 2.8	2.8	2.8 4	4
CONJUNCTIVA	1*	1*	1	1.4	1.4
SCLEROTIC SCATTER	1 1.4	2.8 4	-	-	-
LENS	1.4 2	2	2	2.8	2.8 4
BLUE IRIS	1 1.4	1.4	1.4 2	2 2.8	2.8
BROWN IRIS	1 1.4	1 1.4	1.4	2 2.8	2.8 4
CHAMBER ANGLE	1 1.4	1.4	1.4 2	2	2 2.8
FUNDUS - NARROW SLIT	1	1.4	2	2	2 2.8
FUNDUS - WIDE SLIT	1.4	2	2	2 2.8	2 2.8
FUNDUS - PERIPHERAL	-	-	-	-	-

(-) indicates values not obtained or unsatisfactory
(*) use aperature diaphragm to additionally control light

TABLE C

EXPOSURE GUIDE FOR NIKON PHOTO BIOMICROSCOPE
FILM: EKTACHROME ASA 200

	7x	10x	16x	25x	35x
CORNEA - OPTIC SECTION SLIT LESS THAN 1mm	1	1 1.4	1.4 2	2 2.8	2.8 4
CORNEA - PARALLELOPIPED	1	1.4 2	2 2.8	2.8	2.8 4
CONJUNCTIVA	1*	1*	1*	1	1.4 2
SCLEROTIC SCATTER	2	2.8	2.8	-	-
LENS	1	1 1.4	2 2.8	2 2.8	2.8 4
BLUE IRIS	1	1.4	1.4	2	2 2.8
BROWN IRIS	1	1	1 1.4	1 1.4	1.4 2
CHAMBER ANGLE	1 1.4	1.4	1.4 2	2	2.8
FUNDUS - NARROW SLIT	1	1	1 1.4	1.4 2	2 2.8
FUNDUS - WIDE SLIT	1	1	1 1.4	2 2.8	2.8 4
FUNDUS - PERIPHERAL	1 1.4	1.4 2	2 2.8	2.8	2.8 4

(-) indicates values not obtained or unsatisfactory
(*) use aperature diaphragm to additionally control light

TABLE D

NIKON SUGGESTS THIS TABLE FOR COMPUTATIONS:

	7-10x	16x	25x	35x
CONJUNCTIVA	35	70	140	280
IRIS	50	100	200	400
FUNDUS	200	400	800	1600
CORNEA-WIDE	150	300	600	1200
CORNEA-NARROW	200	400	800	1600
LENS-WIDE	200	400	800	1600
LENS-NARROW	400	800	1600	3200

THESE FIGURES REPRESENT FLASH OUTPUT TIMES (X) FILM SPEED (ASA)

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FOR THE FILM SPEEDS TESTED IN THIS STUDY, THE CHART WOULD TRANSLATE LIKE THIS:

	7-10x			16x			25x			35x		
	25	64	200	25	64	200	25	64	200	25	64	200
CONJUNCTIVA	1	1*	1*	2.8	1*	1*	4	2	1	-	4	1.4
IRIS	2	1	1*	4	1.4	1*	-	2.8	1	-	4	2
FUNDUS	4	2.8	1	-	4	2	-	-	4	-	-	-
CORNEA-WIDE	4	2	1*	-	4	1.4	-	-	2.8	-	-	4
CORNEA-NARROW	-	2.8	1	-	4	2	-	-	4	-	-	-
LENS-WIDE	-	2.8	1	-	4	2	-	-	4	-	-	-
LENS-NARROW	-	4	2	-	-	4	-	-	-	-	-	-

(-) EXPOSURE OUTSIDE OF COMPUTATIONS LIMITS
(*) APERATURE DIAPHRAGM MUST BE USED TO FURTHER CONTROL LIGHT

TABLE E

FLASH INTENSITY EQUIVALENTS FOR THE

NIKON PHOTO BIOMICROSCOPE

INTENSITY SETTING	*FLASH OUTPUT*
1.0	50 watt-seconds
1.4	*70*
2.0	*100*
2.8	*140*
4.0	*200*

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-----, The New E-6 Films From Kodak, Popular Photography, November 1976, pp.8+.

-----, Personal interview with proprietor of Mind's Eye Photo Shop, 210 Maple Street, Big Rapids, MI, phone 796-8737.

Rengstorff, O.D., M.S., Roy H., and Krause Jr., Charles C., Guide for Slit Lamp Photography of the Cornea, Journal of the American Optometric Association, December 1971, pp. 1250-1255.

Zuckerman, Joshua, Diagnostic Exam of the Eye. J. B. Lippincott, Philadelphia, 1964, p. 437.

Various manufacturer's advertising and informational pamphlets were also examined for inclusion in this paper.

315 slides photographed with the clinic camera were the basis of my exposure guides contained herein, found in Tables A, B, and C. The slides are included for the use of the advisor as he wishes to.