"LIGHT LOSS" FOR LENSES USED AT CLOSE FOCUS

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(1) When a lens is focussed on a close object there is usually a slight "light loss". This term light loss is in inverted commas because it is jargon. What we mean is that the effective f/number or T number will be slightly larger than when the lens is focussed on infinity. Normally this light loss can be safely ignored.

(2) However in the case of macro lenses, including the semi-macro 135mm S4 cine prime lens, the light loss at macro focussing distances will be more significant than a "slight" light loss. For example, when a whole lens is moved forwards to give a 1:1 magnification, the f/number, or T number, will be multiplied by 2, so a T2 lens will be working at T4, which is two stops dimmer. This is a slightly artificial example because many macro lenses that focus that close will have moving components, or components that don't move along with the rest of the lens, and that will modify this light loss effect, but not usually by very much.

(3) In the case of the Cooke 135mm S4 close-focussing cine prime lens, the maximum macro light loss is about 2/3 of a stop. This light loss effect is indicated by the engraving on the barrel of the lens.

(4) In the case of most of the Cooke S4 cine prime lenses, where the whole lens moves forward for focussing, the light loss is negligible, but you can if necessary calculate the exact light loss figure using the formulae given below in the appendix to this document.

(5) There is a further category of Cooke S4 cine prime lenses, where the focussing is achieved using the movement of optical components within the lens. Cooke have used this focussing mechanism to achieve semi-macro close-focussing with our longer focal length lenses (150mm and 180mm), and also with our extreme wide angle (short focal length) 12mm lens. In doing so we have been able to exploit the extra functionality of the focussing components within the lens to eliminate any close focussing light loss.

Appendix
Close focus "Light Loss" for lenses where the whole lens moves forward for focussing

(a) For any object distance L (measured from the film plane) a lens will work at a magnification M. The image will be upside down, and to express this mathematically we will give the quantity M a minus sign. The size of the image will also usually (but not always) be less than the object. So a typical value for M might be –0.1, indicating that the image on the film is upside down and $1/10^{th}$ of the size of the object

To get the effective Tno, which we will call Tno*, we multiply the engraved Tno by (1-M).

For example, if M = -1 (a macro situation) and we are using a lens which is set at an engraved Tno of 2.0, then Tno* = 2.0 x (1+1) = 4.0

(b) The number of stops "lost" is given by:

$$\text{Number of stops lost} = (2 / \log 2) \times (\log Tno^* - \log Tno)$$

For example, if Tno* = 4.0 and Tno = 2.0, then the number of stops "lost" is

$$(2 / \log 2) \times (0.60206 – 0.30103) = 2$$

Or if Tno* = 3.5 and Tno = 2.8, then the number of stops “lost” is

$$(2 / \log 2) \times (0.54407-0.44716) = 0.64386$$

(c) We needed the value of M to do this calculation. But how do we know what M is for any given value of L? We have to calculate this, and to do so we need to know the nodal point separation for the lens, and its focal length. The nodal point separation may be positive or negative, and we will denote its value by NN’. We will use f for focal length, where “focal length” means effective focal length.

Then: $$M = 1 – Q/2 + ((Q – 2)^2 / 4 –1)^{0.5}$$

Where the quantity Q is (L – NN’) / f

For example, if we have a 50mm lens with a nodal separation of 10mm, working at an object distance of 500mm:

$Q = (500 – 10) / 50 = 9.8$
$M = 1 – 4.9 + (7.8^2 / 4 –1)^{0.5} = -0.130385$

If the lens is set at Tno = 5.6, then Tno* will be 5.6 x 1.130385 = 6.33015
In this case the number of stops “lost” will be (2 / log2) x (log6.33015 – log5.6) = 0.3536

(d) For the Cooke S4 Prime lenses which move forward as an integral assembly, here are the magnitudes of the separation between the nodal points

fmm	14	16	18	21	25	27	32	35	40	50	65	75	100	135
NN’ mm	103.5	99.8	77.5	67.5	57.1	49.9	47.9	38.6	22.1	-23.5	-41.2	-49.8	-63.6	-65.4

NOTES

(i)In these notes, where examples of apertures like Tno = 5.6 have been used, it should be understood that all the standard apertures are the square roots of a series of natural integers, and in the case of Tno = 5.6 the natural integer involved is 32. The square root of 32 is 5.6568. The error involved in using 5.6 instead of 5.6568 is negligible in this context.

(ii) For the 135mm, 150mmm and 180mm S4 lenses Cooke recommend that the lens is stopped down when they are being used at focussing distances less than (approximately)10x their focal length. The engraving on the lens barrel shows this recommendation. This closing down of the aperture is separate from the issue of close focus light loss.