

LIGHT “LOSS” FOR ANY LENS¹ WHEN USED AT CLOSE FOCUS

¹ Except lenses with internal focussing

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- (1) For any object distance L (measured from the film plane) a lens will work at a magnification M, which we will define as being negative and numerically less than 1. A typical value might be -0.1.

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

- (2) 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

$$(2 / \log 2) \times 0.09691 = 0.64386$$

- (3) 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 of 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 $(2 / \log 2) \times (\log 6.33015 - \log 5.6) = 0.3536$

- (4) For the Cooke S4 135mm lens NN' = - 65.575 and f = 135mm

NOTE: 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.