Application Note 121

(12 Feb. 2007)

Acceptance angles of beam attenuation meters

The acceptance angle of a beam attenuation meter is defined by the detector aperture and the focal length of the lens. See Jerlov (1976, p.48). If the diameter of the aperture is given by D, and the focal length of the lens by f, then the acceptance angle in air, θ_a, is given by:

$$\tan(\theta_a) = 0.5 \ D/f.$$

$$\theta_a = \text{atan}(0.5 \ D/f).$$

This needs to be adjusted for water using Snell's law, where θ_w is the acceptance angle in water. Interestingly, Jerlov does not make this adjustment.

$$\theta_w = \text{asin}\{ \ \sin[\theta_a/1.33] \ \}, \quad \text{where 1.33 is the index of refraction of water.}$$

$$\theta_w = \text{asin}\{\sin[\text{atan}(0.5 \ D/f)/1.33] \ \}.$$

The maximum error estimate comes from the maximum tolerance for the focal length of the lens, which practice has shown to be 5%. The tolerance for the diameter of the aperture is 1 mil which is about 0.025mm. The overall maximum error in the acceptance angle is thus ~ 8%.

Table I. Receiver acceptance angles and other parameters for various WET Labs beam attenuation meters.

Instrument	Lens aperture (mm)	Lens focal length (mm)	Detector aperture (mm)	acceptance angle (degrees)
ac-9, 25 cm	10	30	1.3	0.93
ac-9, 10 cm	10	30	1.3	0.93
ac-s, 25 cm	10	30	1.3	0.93
ac-s, 10 cm	10	30	1.3	0.93
C-Star, 25 cm	15	36	2.0	1.2
C-Star, 10 cm	15	36	2.0	1.2

Reference

Jerlov, N.G., Marine Optics, Elsevier Amsterdam, 1976, p. 48.