POLARIZATION MODULATION TECHNOLOGIES

USEFUL APERTURE

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The useful apertures for Hinds Instruments PEM 100™ photoelastic modulators are specified in our product data bulletin for Head Assemblies. In Table 2, Optical Head Specifications, the useful aperture is specified to indicate the aperture for which any point in the aperture field will have >90% of the maximum retardation.

However, a "useful aperture" for a particular photoelastic modulator (PEM) model may better be defined according to a specific application. Certain experiments can tolerate a relatively large non-uniformity of retardation over an aperture field while other experiments may require a high uniformity of retardation over the useful aperture.

In the PEM, the modulation efficiency has its maximum value (unity) in the center of the optical element. This efficiency decreases as the light beam is moved away from the center, as illustrated in the Figure 1 for both bar-shape and octagonal-shape PEMs.

For a bar-shape PEM, the height of the bar is normally the limiting factor for the useful aperture that is specified in our data bulletin. For an octagonal-shape PEM, the modulation efficiency has an approximately circular distribution over the useful aperture. The average modulation efficiencies for different PEM models over certain given apertures are listed in Table 1.

Hinds PEMs can be used for applications requiring either high or low uniformity of retardation over the useful aperture. For a circular dichroism experiment, for example, since a calibration procedure is generally needed, the variation of the modulation efficiency over the PEM aperture cancels out. As a result, apertures as large as several centimeters have been successfully used for CD measurements.

Hinds' PEMs also have a large acceptance angle (> +/- 20°). The combination of a large aperture and a large acceptance angle makes Hinds PEMs particularly useful in polarization modulation applications where a large diameter and focusing beam are needed. On the other hand, a uniformity as high as 99% average modulation efficiency can be obtained for beam sizes ranging from several millimeters to several centimeters with different Hinds PEM models, as shown in Table 1.

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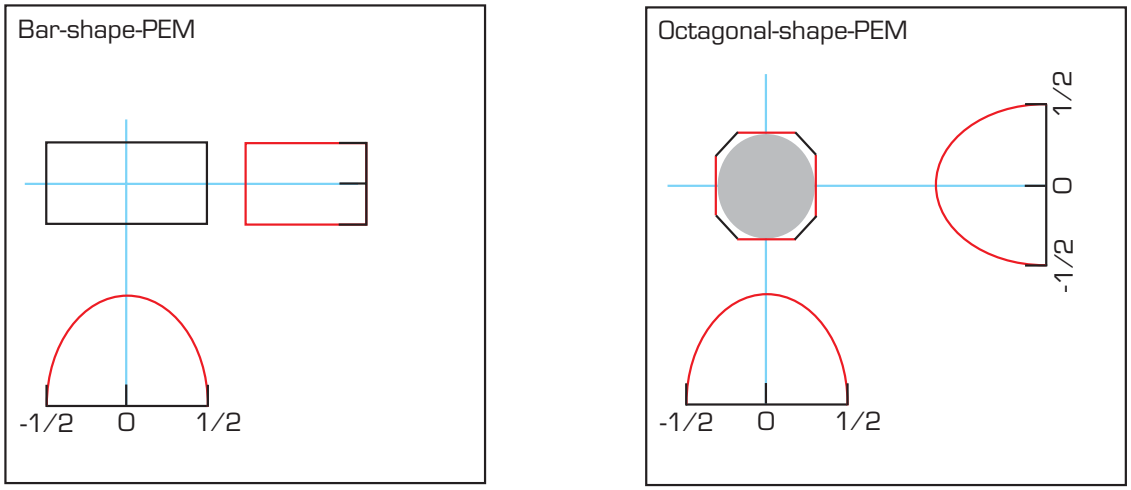

The modualtion efficiency of the bar-shaped PEM is uniform in the vertical direction, but varies as a cosine function in the horzonal direction.

The modulation efficiency of the octangonal-shaped PEM varies as a cosine function along all directions from the center of the optical element.

Figure 1. The PEM modulation efficiency variation

Table 1. PEM Useful Aperture

	Aperture ≥90% of max. retardation (diameter)	Aperture 90% average effiency (diameter)	Aperture 75% average effiency (diameter)	Aperture 99% average effiency (diameter)
I/FS50	16 mm	16 mm	16 mm	9 mm
I/FS20	22 mm	22 mm	22 mm	21 mm
I/CF50	16 mm	16 mm	16 mm	10 mm
II/FS42	18 mm	25 mm	42 mm	8 mm
II/IS42	18 mm	25 mm	42 mm	8 mm
II/FS20	37 mm	52 mm	88 mm	16 mm
II/FS47	16 mm	23 mm	37 mm	7 mm
II/FS84	9 mm	13 mm	21 mm	4 mm
II/IS84	9 mm	13 mm	21 mm	4 mm
II/ZS50	10 mm	13 mm	22 mm	4 mm
II/CF57	16 mm	22 mm	36 mm	7 mm
II/ZS37	13 mm	18 mm	30 mm	6 mm

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