

Light Guides and Acrylic Plastic



Numerous light guides have been fabricated by Eljen Technology to meet a wide variety of light collection applications for scintillators. Light guides are always custom made for each customer's needs. One general rule to remember when considering using light guides: they usually improve the uniformity of light collection but often reduce the average signal amplitude. Light guide types fabricated by Eljen include, but are not limited to, the following general types:

- **Adiabatic Light Guides:** Consists of an array of strips adapting the edges of scintillator plates to a single phototube. These generally apply best on wide scintillators and are the most expensive.
- **Fishtail Light Guides:** Consists of a single solid element providing a smooth adaption of a rectangular cross section to a round PMT face.
- **Flat Trapezoid Light Guides:** Consists of a flat triangular PMMA sheet terminated at the PMT end by a cylindrical rod or disc for effective PMT mounting.

Light guides are fabricated from cast acrylic materials. Cast acrylic generally has good optical clarity, good mechanical properties, and very little natural scintillation response to ionizing radiation.

Cast acrylic is also known as PMMA (polymethylmethacrylate) and is often referred to in a generic sense by the many commercial product names under which it is manufactured. Some of these names include: Lucite®, Plexiglas®, Perspex®, and Rohaglas®. It is normally made as cast sheet stock with UV absorbing additives for general purpose commercial applications. When the UV absorbers are omitted to obtain optical transmission into the ultraviolet regions, the product is often referred to as UVT. Sheet stock up to about 6 mm (0.25") thick are also made by extrusion processes. However, the best optical properties are obtained with the cast material. Acrylic sheets are occasionally used in fabricating tanks for selected liquid scintillators. In this case, the cast materials provide superior resistance to chemical attack.

The plot below demonstrates typical properties of these two classes of plastics.

ACRYLIC PLASTIC MATERIALS

Material	Description/Application	Commercial Equivalents	
		NE	S-G
PMMA	Clear acrylic plastic, Light guides	-	BC-802
UVT	UV transmitting acrylic plastic, Light guides	-	BC-800

PROPERTIES	CAST PMMA
Specific Gravity at 20°C	1.190
Refractive Index, n_D (589nm)	1.492
Refractive Index (436nm)	1.502
No. of H Atoms per cm^3 ($\times 10^{22}$)	5.73
No. of C Atoms per cm^3 ($\times 10^{22}$)	3.58
No. of O Atoms per cm^3 ($\times 10^{22}$)	1.43

**CAST ACRYLIC SHEET OPTICAL TRANSMISSION
COMMERCIAL GRADE vs. UVT GRADE
REFERENCE: AIR**

