50 mm Multi-TIR Nested Lens Series
Standard Version

- **Patent pending multi-TIR innovation**
- **High efficiency**
- **Tight beam Narrow Beam, Spot Beam, and Elliptical Beam versions with minimal spilled light**
- **Medium Beam and Wide Beam versions have same diameter and fit same holders.**
- **Ideal size for MR16 applications**

Fraen Corporation's multi-TIR nested lens delivers narrow beam lighting when used with a variety of LEDs including many multi-chip and chip-on-board LEDs. The Patent Pending technology allows the optic size to be reduced significantly (when compared to reflectors or TIR collimators with similar optical performance) while delivering a tightly focused beam with reduced spill and low glare.

Fraen's nested lens design enables the luminaire designer to have more room for thermal and electrical components, thereby increasing design options.

Typical applications include:

- LED lighting applications requiring a narrow-beam and/or high center-beam candela
- Architectural Lighting and Wall-wash lighting
- Retail Lighting Fixtures
- Spot Lights
- Hospitality Lighting Fixtures
- Commercial Lighting Fixtures
- Entertainment Lighting

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General Characteristics

Materials

Lens Material	Optical Grade PMMA
Lens Holder Material	Polycarbonate
Operating Temperature range	-40° C / + 80° C
Storage Temperature range	-40° C / + 80°C

Average transmittance in visible spectrum (400 – 700nm) >90%, as measured using 3mm thick Optical Grade PMMA.

Please note that flow lines and weld lines on the external surfaces of the lenses are acceptable if the optical performance of the lens is within the specification described in the section "OPTICAL CHARACTERISTICS"

IMPORTANT NOTES – Lenses handling and cleaning*:*

- *Handling: Always use gloves to handle lenses and/or handle the lenses only by the flange. Never touch the outside surfaces of the lenses with fingers; finger oils and contamination will absorb or refract light.*
- *Cleaning: Clean lenses only if necessary. Use only soap and water to clean the surfaces and lenses. Never expose the lenses to solvents such as alcohol, as it will damage the plastic.*

CAUTION:

- *Due to the inherently high power of COB LEDs, use proper thermal management of the LED to protect the LED as well as the Fraen plastic parts. Fraen has no liability for direct, indirect or consequential damages resulting from parts being subjected to temperatures outside of the recommended operating range.*

Scope

This datasheet provides information about the mechanical features and optical performance of the 50mm diameter FNL lens series and lens holders when used with a variety of LEDs.

Optical Characteristics – On-axis Intensity, Beam Angle, Field Angle

LED		Light Emitting Surface (LES) diameter	Beam Type	On-axis Intensity (peak)	Beam Angle (FWHM)	Field Angle (FW10%)	"L" (mm) See Fig.1
bridgelux	H6	Ø 6.4 mm	Narrow	14 cd/lm	10º	21º	3.2 mm
			Spot	N/A	N/A	N/A	N/A
			Medium	3.0 cd/lm	24º	47º	3.2 mm
			Wide	1.7 cd/lm	37º	60º	3.2 mm
			Elliptical	4.0 cd/lm	11ºx28º	28ºx57º	3.2 mm
CITIZEN	CLU701	Ø 6.0 mm	Narrow	12 cd/lm	10º	22º	3.2 mm
			Spot	N/A	N/A	N/A	N/A
			Medium	2.9 cd/lm	24º	50º	3.2 mm
			Wide	1.7 cd/lm	37º	60º	3.2 mm
			Elliptical	4.3 cd/lm	10ºx39º	24ºx57º	3.2 mm
CREE	CXA1304 CXB1304	Ø 6.0 mm	Narrow	15 cd/lm	10º	20º	3.2 mm
			Spot	N/A	N/A	N/A	N/A
			Medium	2.9 cd/lm	24	50º	3.2 mm
			Wide	1.8 cd/lm	37º	60º	3.2 mm
			Elliptical	4.6 cd/lm	9.0ºx40º	25ºx57º	3.2 mm
CREE	CXB1310	Ø 6.0 mm	Narrow	13 cd/lm	10º	22º	3.2 mm
			Spot	16 cd/lm	10º	19º	3.2 mm
			Medium	2.9 cd/lm	24º	50º	3.2 mm
			Wide	1.7 cd/lm	37º	60º	3.2 mm
			Elliptical	4.3 cd/lm	10ºx39º	24ºx57º	3.2 mm
CREE	MHD-G	NOTE 2	Narrow	9.5 cd/lm	12º	27º	3.2 mm
			Spot	11 cd/lm	11º	23º	3.2 mm
			Medium	2.5 cd/lm	23º	55º	3.2 mm
			Wide	1.6 cd/lm	36º	62º	3.2 mm
			Elliptical	3.7 cd/lm	11ºx38º	29ºx59º	3.2 mm

LED		Light Emitting Surface (LES) diameter	Beam Type	On-axis Intensity (peak)	Beam Angle (FWHM)	Field Angle (FW10%)	"L" (mm) See Fig.1
CREE	CXA1520	Ø 9 mm	Narrow	7.0 cd/lm	16º	31º	3.2 mm
			Spot	N/A	N/A	N/A	N/A
			Medium	2.5 cd/lm	25º	54º	3.2 mm
			Wide	1.5 cd/lm	35º	63º	3.2 mm
			Elliptical	2.8 cd/lm	15ºx37º	36ºx64º	3.2 mm
CREE	XP-L HI	NOTE 2	Narrow	45 cd/lm 57 cd/lm	5.0º 4.0º	12º 10º	3.2 mm 3.5 mm
			Spot	84 cd/lm 91 cd/lm	3.9º 3.9º	7.8º 7.2º	3.2 mm 3.5 mm
			Medium	3.4 cd/lm	23º	36º	3.2 mm
			Wide	2.0 cd/lm	40º	57º	3.2 mm
			Elliptical	9.4 cd/lm	4ºx41º	11ºx51º	3.2 mm
CREE	XM-L2	NOTE 2	Narrow	20 cd/lm 24 cd/lm	8º 7º	17º 14º	3.2 mm 4.0 mm
			Spot	36 cd/lm 46 cd/lm	6.0º 5.3º	12º 10º	3.2 mm 3.5 mm
			Medium	3.0 cd/lm	23º	42º	3.2 mm
			Wide	2.0 cd/lm	38º	57º	3.2 mm
			Elliptical	8.3 cd/lm	6.0ºx40º	14ºx53º	3.2 mm
CREE	XHP35-HI	NOTE 2	Narrow	33 cd/lm 43 cd/lm	5.0º 5.3º	14º 12º	3.2 mm 3.8 mm
			Spot	61 cd/lm 63 cd/lm	4.8º 4.6º	9.0º 8.8º	3.2 mm 3.5 mm
			Medium	3.4 cd/lm	23º	53º	3.2 mm
			Wide	1.9 cd/lm	37º	60º	3.2 mm
			Elliptical	9.2 cd/lm	5.0ºx40º	15ºx50º	3.2 mm
CREE	XHP50	NOTE 2	Narrow	13.4 cd/lm	9.4º	21º	3.2 mm
			Spot	N/A	N/A	N/A	N/A
			Medium	2.5 cd/lm	24º	50º	3.2 mm
			Wide	1.7 cd/lm	8º	58º	3.2 mm
			Elliptical	4.7 cd/lm	8.8ºx39º	24ºx56º	3.2 mm

LED		Light Emitting Surface (LES) diameter	Beam Type	On-axis Intensity (peak)	Beam Angle (FWHM)	Field Angle (FW10%)	"L" (mm) See Fig.1
LUMILEDS	LUXEON 1203	Ø 9.0 mm	Narrow	6.5 cd/lm	15º	32º	3.2 mm
			Spot	N/A	N/A	N/A	N/A
			Medium	2.3 cd/lm	25º	55º	3.2 mm
			Wide	1.5 cd/lm	35º	65º	3.2 mm
			Elliptical	3.1 cd/lm	16ºx37º	33ºx63º	3.2 mm
LUMILEDS	LUXEON 209	Ø 6.5 mm	Narrow	12 cd/lm	11º	24º	3.2 mm
			Spot	N/A	N/A	N/A	N/A
			Medium	2.6 cd/lm	24º	53º	3.2 mm
			Wide	1.7 cd/lm	37º	60º	3.2 mm
			Elliptical	4.3 cd/lm	11ºx39º	27ºx57º	3.2 mm
NICHIA	NTCLS024B	Ø 6.7 mm	Narrow	N/A	N/A	N/A	N/A
			Spot	N/A	N/A	N/A	N/A
			Medium	2.7 cd/lm	24º	51º	3.2 mm
			Wide	1.7 cd/lm	36º	60º	3.2 mm
			Elliptical	3.7 cd/lm	12ºx39º	27ºx60º	3.2 mm
NICHIA	NFCLL036B	Ø 8.7 mm	Narrow	7.2 cd/lm	15º	30º	3.2 mm
			Spot	N/A	N/A	N/A	N/A
			Medium	2.4 cd/lm	25º	53º	3.2 mm
			Wide	1.6 cd/lm	35º	64º	3.2 mm
			Elliptical	3.2 cd/lm	15ºx37º	31ºx63º	3.2 mm
XICATO	XTM-09	Ø 9 mm	Narrow	6.8 cd/lm	14º	31º	Note 5
			Spot	7.5 cd/lm	13º	31º	Note 5
			Medium	2.2 cd/lm	25º	49º	Note 5
			Wide	1.6 cd/lm	35º	64º	Note 5
			Elliptical	3.1 cd/lm	14ºx38º	35ºx60º	Note 5

NOTE 1: The performance values listed above were produced with the bottom of the lens positioned "L" millimeters from the bottom of the LED (top of the heatsink). If using the optional Lens Holder this distance is controlled at ~3.2mm by the completed assembly. If using the lens without the optional Lens Holder Ring and Base Plate, this distance can be controlled by the LED lighting fixture, and can be optimized for beam appearance or peak intensity at the user's preference.

NOTE 2: The Light Emitting Surface (LES) diameter is not specified by the LED manufacturer.

NOTE 3: Many other LEDs are currently being evaluated and tested, and the performance results will be added to this table periodically. For performance information with specific LEDs not listed above, please contact Fraen at http://www.fraen.com/optics/contact-us/.

NOTE 4: The "Spot" lens is intended to maximize peak intensity of the beam, usually at the expense of poorer beam appearance. In instances where two "L" distances are listed, the lower cd/lm row represents the performance when the lens is positioned to produce slightly-better beam appearance. Please contact Fraen for further information.

NOTE 5: For the Xicato XTM-09 LED the dimension, "L", shown in Figure 1 of this datasheet is not applicable. The bottom of the Fraen lens should be flush with the top of the Xicato Module to obtain the optical performance shown in the table.

Example Calculations

To calculate intensity (cd): Find the central spot on-axis intensity (cd/lm) for the lens and then multiply this value by the luminous flux (lm) of the LED. Refer to the LED's datasheet for typical flux values, drive current versus flux ratios, and color temperature and binning characteristics.

Example intensity calculations:

If a Fraen lens with an on-axis intensity of 15 candela per lumen (cd/lm) is used with an LED that produces 1260 lumens of flux, the calculations are as follows:

On-axis intensity = (15 cd/lm) x (1260 lumens) = 18900 candela on-axis intensity (one LED).

An explanation of illuminance and the effect of distance

One candela at 1-meter distance produces 1 lux. In the above example, the LED + lens system produced 18900 candela. If that system is illuminating a surface one meter distant, then the *illuminance* on that surface is 18900 lux. Illuminance decreases with the square of the distance. If you move the fixture so that it is two meters from the surface, then the illuminance falls to 18900 lux/ $(2m)^2$ or 4725 lux. Moving the fixture three meters from the surface decreases the illuminance to 18900 lux/$(3m)^2$ or 2100 lux.

Beam and Field Angles

Beam and Field Angles are methods of describing the light distribution of a lens. The Beam Angle is expressed as a FWHM value (Full angular Width of the beam where it reaches Half the Maximum intensity). The Field Angle is a similar concept, sometimes expressed as FW10%, and represents the Full Width angle where the beam reaches 10% of maximum intensity.

If the lenses in our example fixture, above, have a beam angle of 10° and an on-axis intensity of 18900 cd, then at ± 5° (half of 10°) the intensity will drop to half of 18900 or 9450 cd. If the Field Angle for the fixture is 20°, then at ± 10° (half of 20°) the intensity will be 10% of 18900 or 1890 cd.

Most lenses have beam angles and field angles that are rotationally symmetrical about the center axis of the lens. Lenses with an elliptical beam profile or optics with specifically shaped beam profiles are the exception.

Intensity, illuminance, Beam and Field Angle are all important factors to be considered in a fixture design. Some applications may require specific ratios between the Beam and Field Angle values.

Mechanical Characteristics

The FNL-N1-50-R nested lens can be used with a Fraen Lens holder or the user can incorporate into their lamp housing a means of holding the lens.

Lens without Lens Holder

If using the lens alone (without the Fraen Lens-Holder System), the lens should be held by the two tabs on the perimeter of the part's 50mm top surface. The bottom of the lens should be approximately 3.0mm to 4.0mm above the bottom of the LED, as shown in Figure 1. Adjusting this distance by a few tenths of a millimeter in either direction can produce results that may favor peak intensity in exchange with beam appearance.

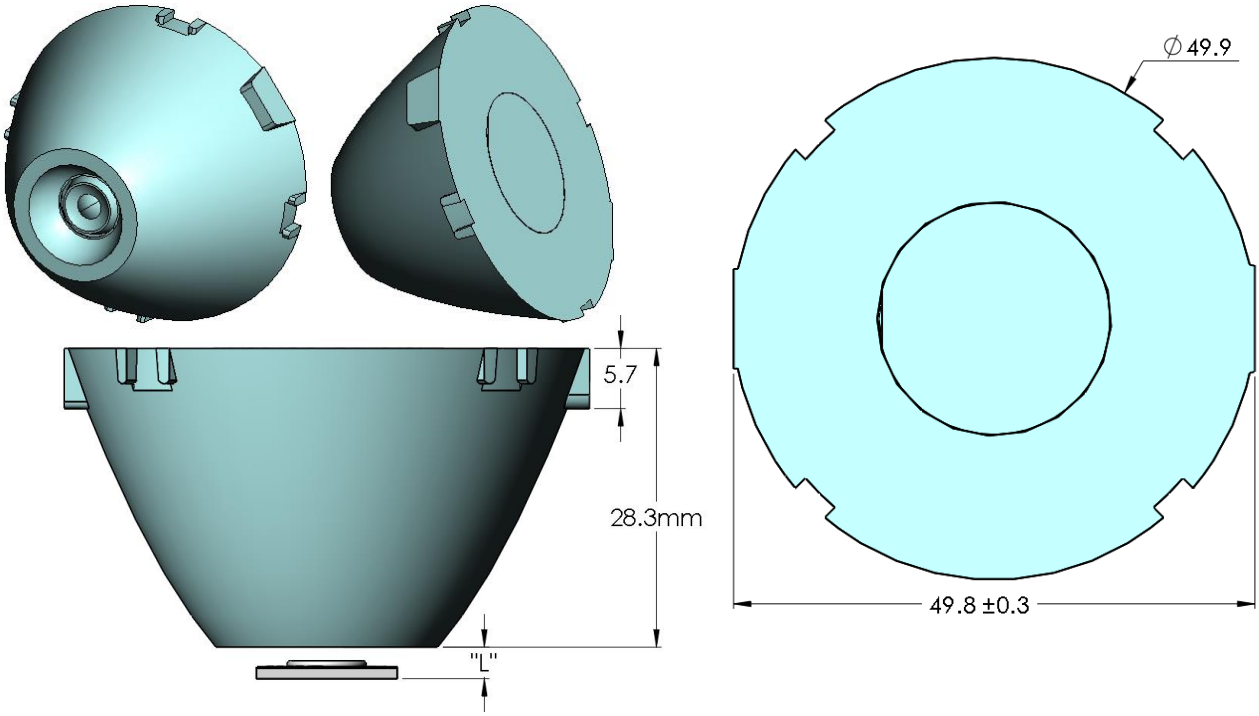

Figure 1: FNL nested lens dimensions and views (Narrow Beam version shown) and spacing distance "L" from the bottom of the lens to the bottom of the LED.

Lens with Lens Holder

There are three different Lens Holders, depending on whether an Electrical Connector is used to provide power to a Chip-on-board (COB) LED, and what type/thickness of Electrical Connector is used. As an example, Figures 2 thru 5 show the Fraen # FTS-FNL50H-A_ holder with a typical 3mm-thick x 32mm diameter Electrical Connector.

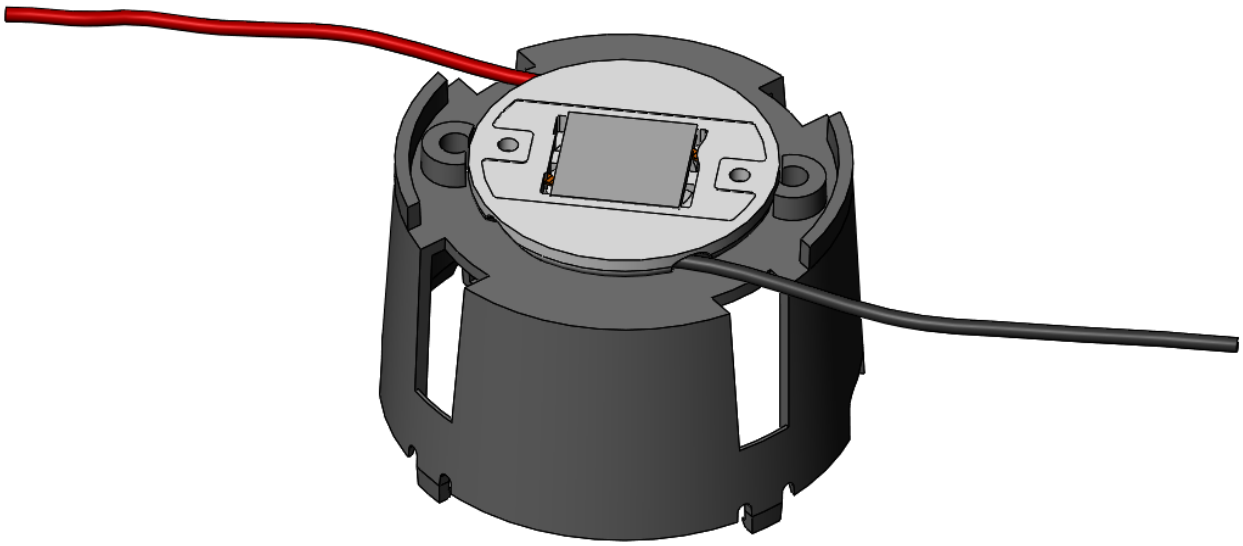

Figure 2: View from the bottom: the COB LED in the Electrical Connector, positioned inside the bottom of the Fraen Lens Holder (# FTS-FNL50H-A_ shown).

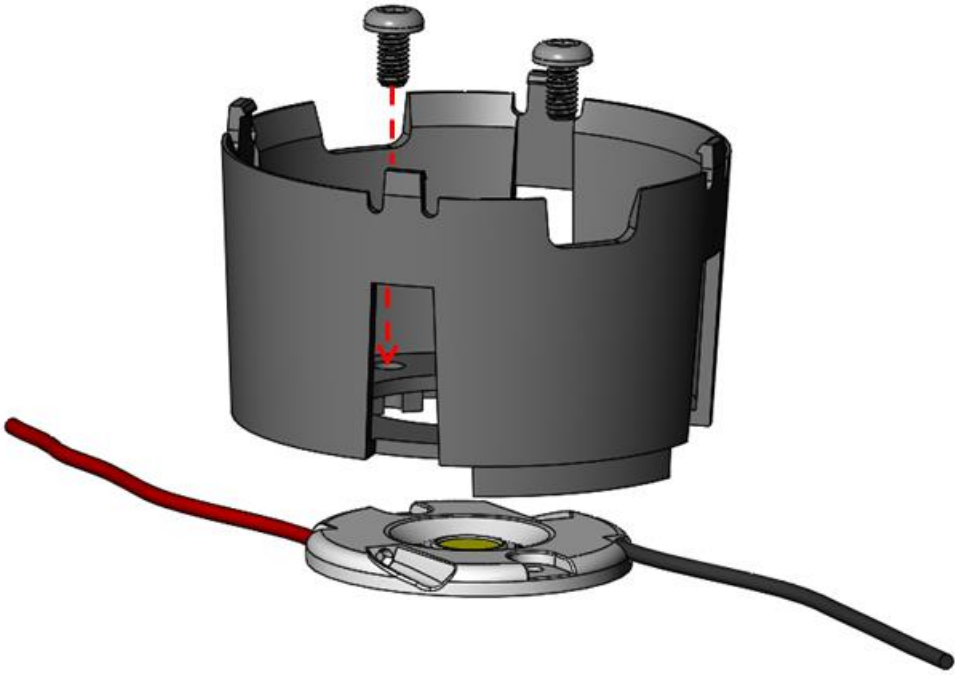

Figure 3: Two M3 screws on 35mm centers secure the Fraen Lens Holder and press the Electrical Connector and COB LED to the heatsink.

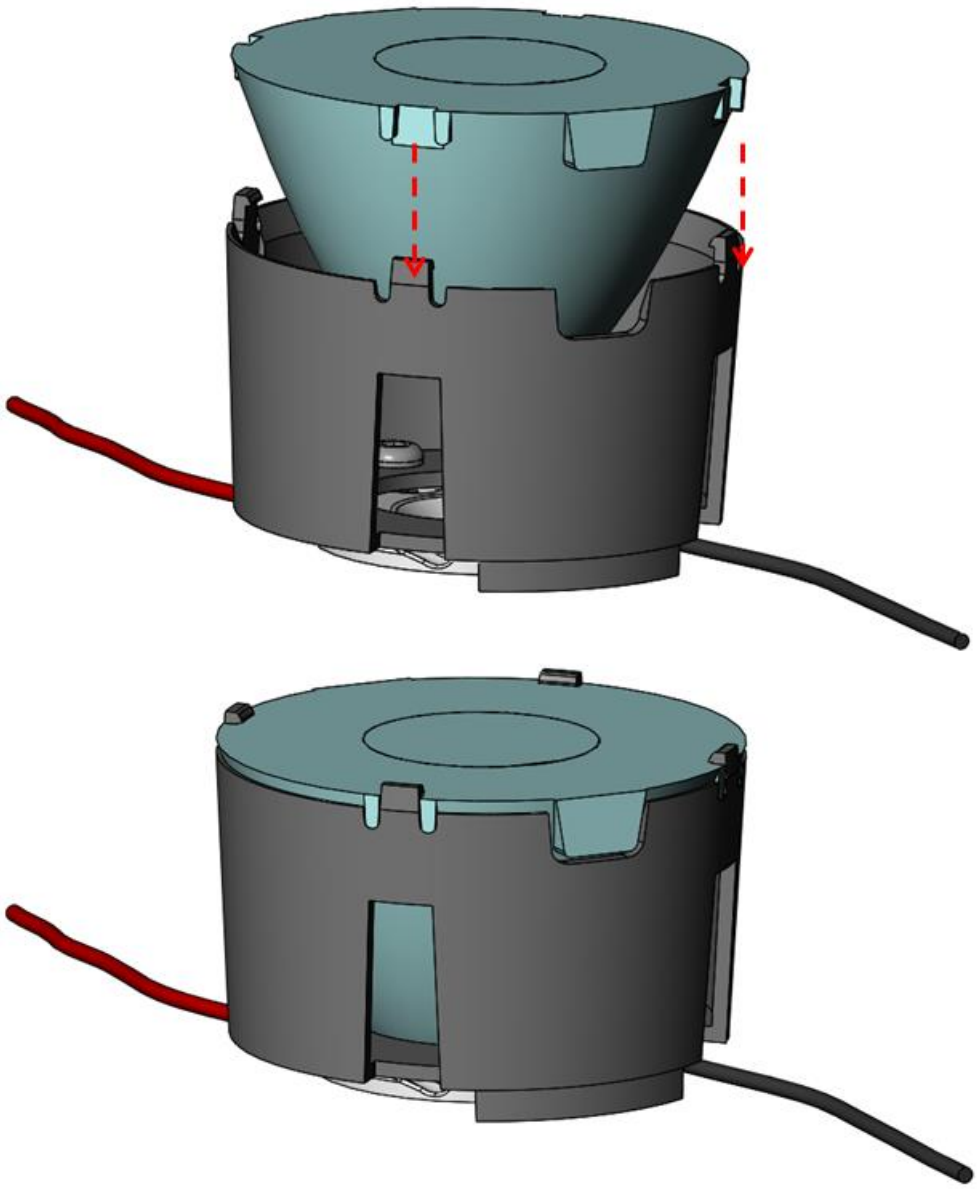

Figure 4: After the Lens Holder is secured to the heatsink with screws, the Nested Lens can be snapped into the Lens Holder.

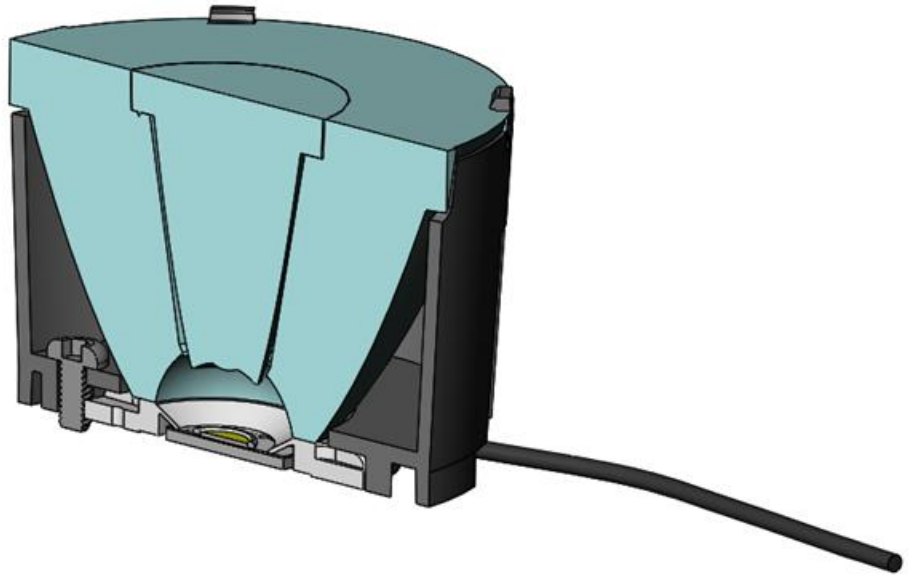

Figure 5: Sectional view showing the Nested Lens snapped into the Lens holder, which is screwed to the heatsink (not shown), thus pressing the electrical connector and LED.

Ordering Part Numbers

FNL-__-50-R

Fraen Nested Lens

S1 = Spot Beam (no texture)
N1 = Narrow Beam (texture)
M1 = Medium Beam
W1 = Wide Beam
E1 = Elliptical Beam

R = Lens only (no holder)

Diameter (mm)
Top Surface

FTS-FNL50H-_ _

Lens Holder
(Ordered separately)

A = 3.2 mm tall standoffs
B = 1.0 mm tall standoffs
C = no standoffs

B = Black Polycarbonate
W = White Polycarbonate
T = Transparent Clear

If assistance is needed, please contact Fraen http://www.fraen.com/optics/contact-us/.