FRB Application Guide for LED Luminaires

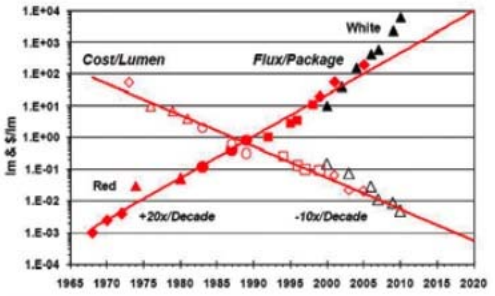
Introduction

This application guide describes how 3M Flame Barrier FRB Series products can be used in integrated LED (Light Emitting Diodes) light modules, based on work with a world-class LED manufacturer.

Background

The $100 billion global lighting industry is being transformed by the technical breakthroughs in Light Emitting Diodes. The main drivers for this transformation to LEDs are improved luminous efficacy (efficiency of visible light from electricity), longer life, increased functionality and shrinking price. It has been observed that every 10 years, the cost per lumen (unit of useful light emitted) falls by a factor of 10, and the amount of light generated per LED package increases by a factor of 20. (This relationship is called Haitz's law, which is analogous to Moore's law describing the number of transistors on an integrated circuit over time.)

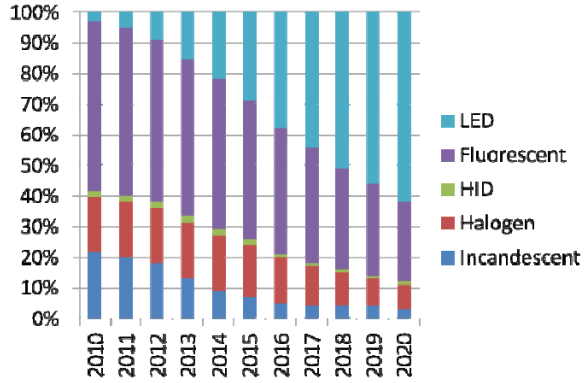
Haitz's Law, 2010 version



Source:
http://www.globalledoled.com/index.php?option=com_content&view=article&id=96:printed-electronics-for-flexible-solid-state-lighting&catid=39:led&Itemid=57

LED technology is expected to gain a larger share of lighting, as result of anticipated performance and cost improvements (see chart below). Architectural lighting manufacturers are the early LED adopters, but others lighting applications are following. LED light manufacturers are going beyond lamps to integrated luminaires (light fixtures with source) get the best efficiency at the lowest cost. 3M flame barrier FRB Series are enabling materials for use in various integrated LED light applications.

Global Lighting Technology Mix



Source: "Lighting the Way" by McKinsey & Company

Efficient Integrated LED Luminaire Design

LEDs technology with their unique characteristics require special design consideration for thermal management (see below table). The extremely long life of LEDs (12 to 30 times incandescent) gives luminaire designers the flexibility to optimize performance and cost with an integrated design.

Relative Power Conversion for "White" Light Sources

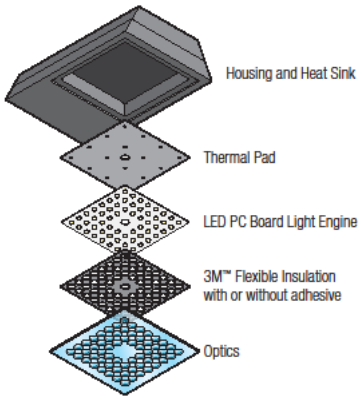
	Incandescent† (60W)	Fluorescent† (Typical linear CW)	Metal Halide‡	LED*
Visible Light	8%	21%	27%	20-30%
IR	73%	37%	17%	~ 0%
UV	0%	0%	19%	0%
Total Radiant Energy	81%	58%	63%	20-30%
Heat (Conduction + Convection)	19%	42%	37%	70-80%
Total	100%	100%	100%	100%

† IESNA Handbook ‡ OSRAM SYLVANIA

* Varies depending on LED efficacy. This range represents best currently available technology in color termperatures from warm to cool. DOE's SSL Multi-Year Program Plan (Mar 2009) calls for increasing extraction efficiency to more than 50% by 2025.

Source:
http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/thermal_mgt_white_leds.pdf

The heat sink can be incorporated into the light fixture housing. A thermal pad helps conduct the heat from PC board to the housing. Direct connected (UL 8750 Class 1 Type) LED arrays offer better efficiency than Class 2 types. Class 1 luminaire requires UL94 5VA rated housing materials to safely contain these higher voltages. Creating a 5VA enclosure with flexible insulation and LED with 5VA primary lenses eliminates the need for flame retardants in the optics that would otherwise reduce the light efficiency. An optical sheet with array of lenses simplifies the sealing and assembly of the luminaire. This concept can be made into a modular design with common footprint to give designers the versatility and flexibility for incorporating in other similar light fixtures.



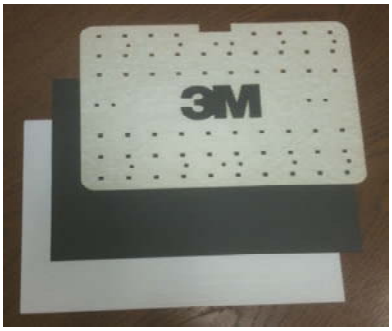
Electrical Flame Barrier Requirements

The applicable safety standard is UL 8750 "Light Emitting Diode (LED) Equipment for Use in Lighting Products" with supporting UL 746 standards for "Polymeric Materials". Some of the key polymer enclosure requirements are 5VA flammability resistance, PLC ≤ 4 for comparative tracking index, either PLC ≤ 3 for Hot Wire Ignition or pass glow wire ignition system test, and PLC ≤ 2 for High Ampere Arc. In addition, the electrical

flame barrier must be able to be easily die-cut with holes for LEDs. Good dimensional stability is also needed for assembly and long-term reliability.

3M™ Flame Barrier FRB Series Products

3M™ Flame Barrier FRB Series is a thin flexible insulation made primarily of inorganic materials for electrical insulating flame



barrier applications. This series of products is intended for applications as either an electrical flame barrier in electrical equipment or as part of a polymeric enclosure for electrical equipment. The target barrier applications include: general purpose lighting luminaires (including LED type), electric and electric hybrid vehicles (e.g. between batteries, battery charger, power converter, etc.), appliances (e.g. vacuum cleaner, crock pot, rice cooker, etc.) and electrical devices (e.g. timers, actuators, switches, etc.). The FRB Series provides the very high flammability and ignitability resistance, excellent arc and track resistance, good dielectric strength and good convertibility to safely contain electrical hazards.

3M™ Flame Barrier FRB-NT Series properties:

Property	Typical Results
UL 94 flame rating	V-0 & 5VA
High Voltage Arc Tracking Rate (HVTR)	0
Comparative Tracking Index (CTI)	0
Hot Wire Ignition (HWI)	4*
High Current Arc to Ignition (HAI)	2
Glow Wire Ignition Temperature (GWIT)	990°C
Glow Wire Flammability Index (GWFI)	960°C
High Volt, Low Current Arc Resistance	4
Thermal & Moisture Stability	Excellent

** Materials that do not comply with the minimum hot-wire ignition levels may be evaluated by an abnormal overload test or the glow-wire end-product test, per UL 746C*

FRB series products are available in three colors: beige/white marbled, white or black. The white is used to maximize efficacy and black is used to minimize light pollution.

Conclusion

LED technology is transforming the lighting industry with its high efficiency, long life, and improving costs. Integrated direct connected LED luminaire designs are the best way to maximize luminous efficacy in cost effective manner. FRB Series products can and have been successfully deployed into these integrated LED luminaire designs.

Important Notice

Before using this product, you must evaluate it and determine if it is suitable for your intended application. You assume all risks and liability associated with such use.

Warranty; Limited Remedy; Limited Liability

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3M Electrical Markets Division
1 Paper Trail
Tilton, NH 03276-5250
866 357 2737
FAX: 603 286 4859
www.3M.com/flexibleinsulation

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