



*Light Diffuser Lens With Less
Smoke and Fire Risk than Acrylic*

Fire-Safe Light Diffusers

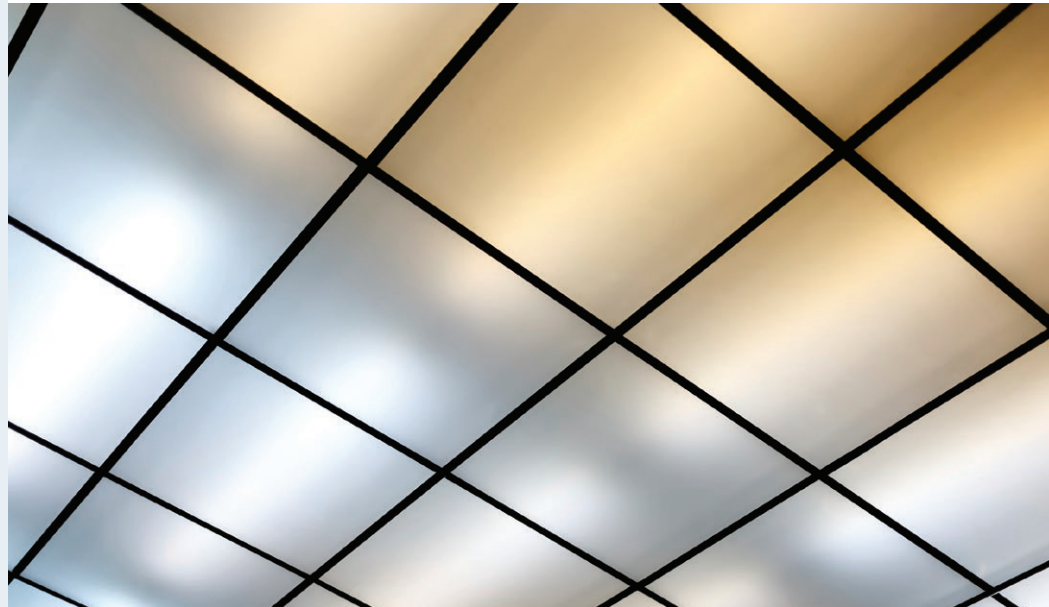
*Made from 100%
biobased materials,
SafeLens™ virtually
eliminates the hidden
fire-risk problems present
with acrylic-based light
diffusers.*

APPLICATIONS

SafeLens can be used to fabricate diffuser lenses for any size or shape of linear fluorescent light fixture.

SafeLens can also be used to develop new diffuser designs for other lighting platforms including:

- ▶ Incandescent lamps
- ▶ Compact fluorescent lamps
- ▶ Halogen lamps
- ▶ High-intensity discharge
- ▶ Light emitting diodes



The U.S. demand for lighting fixtures will rise nearly 8% annually to nearly \$34 billion in 2018 (Freedonia 2014). Globally, about 3 billion linear fluorescent lamps are made each year, which produce around 58% of the world's artificial light (IEA 2006). Most fluorescent lamps are covered by a plastic lens which diffuses the light more evenly and enhances lighting aesthetics. Acrylic diffusers constitute about 80% of the market. Unknown to most consumers, acrylic exhibits many unsafe characteristics in the event of a fire:

- As a petroleum-based plastic, acrylic readily burns when exposed to a flame
- Melted acrylic “drops” continue to burn, thus spreading a fire to the floor below
- Burning acrylic emits toxic black smoke containing formaldehyde, carbon monoxide, and other harmful materials

Alternatives to acrylic exist (e.g., polycarbonate and polystyrene), but none that readily meet cost and performance specifications for the mass market.

Biovation's SafeLens technology can cost-effectively replace acrylic with corn-based polylactic acid (PLA) or other bioplastic variants to eliminate all of the aforementioned problems and more.



Montgomery, MN | Broadway, NC
Wilmington, DE

BENEFITS

- ▶ **Decreased fire spreading:** **SafeLens** will cease to burn once removed from a flame. **SafeLens** will melt, but the flame-free drops will not ignite the floor below.
- ▶ **Better across key fire-safe factors:** Compared to acrylic diffusers, **SafeLens** is less likely to burn, generates less smoke that is less harmful, more quickly extinguishes, and contributes less to fire propagation.
- ▶ **Environmentally sustainable technology:** **SafeLens** is made from 100% bio-based materials which are free from petroleum, VOCs, formaldehyde, PVC, and other red-list materials decreasingly used in building and plastic products.
- ▶ **Improved diffuser formability:** **SafeLens** is robust in practice, but can be easily formed during manufacturing—allowing for a host of novel diffuser designs.
- ▶ **Material flexibility encourages design innovation:** **SafeLens** allows for a variety of fillers to be added to the bioplastic which can further reduce costs and add functionality and aesthetics to differentiate products in a commodity market.
- ▶ **Lower process energy costs:** **SafeLens** material can be extruded at lower temperatures and using less energy inputs compared to alternatives like acrylic.
- ▶ **Lower cost material:** PLA raw material pellets cost less than acrylic and many other petrochemical-based plastic pellets.

IP PROTECTION STATUS

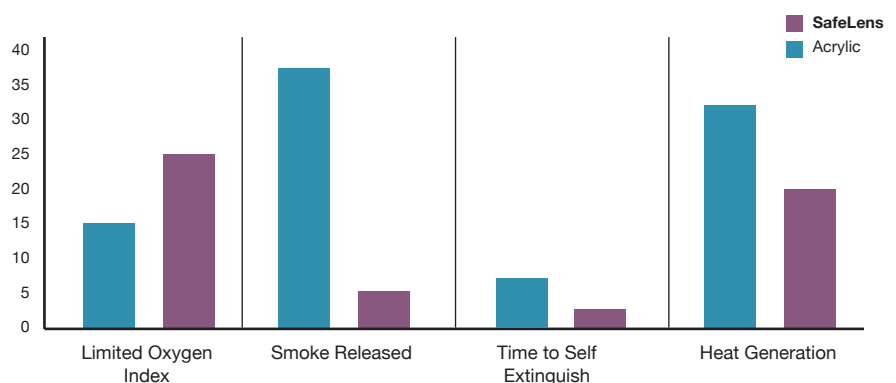
SafeLens and related technologies are protected by patents, pending applications, and trade secrets.

HOW IT WORKS

To what extent do materials impact safety when a fire breaks out in a building? Various ASTM standards are used to determine how materials behave during combustion. Key parameters for evaluating combustion behavior include Limited Oxygen Index, Smoke Released (aka Smoke Index), Time to Self Extinguish, and Heat Generation. Bio-based plastics like polylactic acid (the

core material in **SafeLens**) are superior to petrochemical-based plastics like acrylic that is the standard material used in light diffusers. The table and graphic below illustrate how **SafeLens** is superior to acrylic across each of these key fire-safe dimensions. In the event of a fire, which material would you want in your building?

	Limited Oxygen Index	Smoke Released	Time to Self Extinguish	Heat Generation
Definition	% of oxygen required to support combustion	Amount of smoke generated by material during combustion	Time for a material removed from a flame to cease burning	Peak heat release during combustion
ASTM Standard	2863	E1354	E1354	E1354
Safety Implications	Values <21=fire accelerators	Low values are desired	Low values are desired	Low values are desired
Units	%	m2/kg (*10 to fit scale)	Minutes	kW/m2
Acrylic	16	37.5	4.0	31
SafeLens	24	4	2.0	21
Is SafeLens Superior	Yes	Yes	Yes	Yes



See table above for unit definitions per factor

SAFELENS IN ACTION

Biovation has utilized two ISO 9001 plastic processors to fabricate **SafeLens** diffusers. **SafeLens** technology was shown to substantially outperform acrylic across

factors including limited oxygen index, smoke release, time to self extinguish, and heat generation.