Upgrading from Fluorescent to LED Troffers: **Avoiding Excessive Brightness**

Introduction

When replacing fluorescent troffers with light-emitting diodes (LEDs) it is important to specify the new troffers effectively. In some cases, the new lighting system can create a space that is too bright, resulting in wasted energy and complaints from occupants.

Why does this happen?

The Lighting Research Center (LRC) at Rensselaer Polytechnic Institute examined potential mechanisms for why some LED replacement troffers make a space too bright. New LED troffers may produce more luminous flux (lumens) than needed for the space.

New LED troffers may also make a space appear brighter for the following reasons:

- When changing from a louvered fluorescent troffer to a typical lensed or "volumetric" LED troffer, more light may shine outward toward the walls; brighter walls can increase the perceived brightness of a space, even if the total luminous flux is the same.
- When changing from a low-CCT source (e.g. 3000K) to a high-CCT source (e.g. 5000K), the room will appear brighter, even if the total luminous flux is the same.

Specifying new LED troffers

This guide details four steps that will provide adequate brightness without wasting energy, when specifying new LED troffers.

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Step 1 Determine target illuminance

If occupants are satisfied with the current light levels, the best way to determine target illuminance is to use a calibrated illuminance meter on several unobstructed desktops (after dark or with the blinds closed). Note whether the illuminance meter uses units of lux vs. footcandles. Calculate average horizontal illuminances on typical desktops.

Note the height of typical desktops and height of existing troffers. Use scaled plan drawings to note locations of the existing troffers.

If occupants find the existing lighting to be too dark or too bright, adjust target illuminance accordingly.

If field measurements are not possible, use the *IES Lighting Handbook* to determine recommended light levels for that type of space.

Step 2 Identify troffer light output needed to achieve target illuminance

Once you determine the target illuminance level (in lux or footcandles) on the workplane, and luminaire locations, perform a photometric simulation to identify the light output (in lumens) needed from the troffer. In order to perform a photometric simulation, here are three options you may want to consider:

- Request the assistance of a lighting manufacturer's application engineers.
- Use free online tools provided by lighting manufacturers (several examples are listed in the Resources section of this guide).
- Hire a lighting specifier or lighting engineer.

All light sources experience reduced light output over time; to account for eventual reductions in light output, increase target light output by at least 10%. For example, if target illuminance can be achieved with a 3000-lumen troffer, select a product with 3300 to 3500 lumen output.

Step 3 Identify troffer with lowest power that provides target light output

LED troffer data sheets will include the lumen output for various configurations including different wattages. Select the product that meets the target lumen output with the lowest power demand.

Step 4 Consider controls

If possible, provide dimming controls that either the occupant can access (such as a slider on a wall switch) or the building manager can access (called "high-end" trim). However, such strategies may not allow financial incentives or rebates for all of the energy savings because the full connected load is not reduced. To maximize incentives, it would be better to specify the LED retrofit lighting system with lower lumen output to ensure adequate brightness before the system is dimmed. Programmable drivers are becoming very common, and many have a CLO (constant light output) mode where the driver is programmed to the current needed to meet the target illuminance when the system is new and then automatically increases the light output at a predetermined rate, such as by 1% per year.

Consider installing LED troffers with integral luminaire level lighting controls (LLLCs) for greater energy savings opportunities.

Resources

For further information about specifying LED troffers for retrofits, see:

- Guidance document "LED Troffer Installations: A guide for contractors and specifiers to replacing fluorescent troffers with new LED troffers or retrofit kits" available at https://www.lrc.rpi.edu/programs/energy/pdf/LEDTroffers.pdf
- Free online tools provided by lighting manufacturers. Examples include:
  - » https://products.gecurrent.com/lighting-tools/lighting-layout-estimator
  - » https://www.sylvania.com/en-us/tools-and-resources/Pages/Lighting-Layout-Tool.aspx
  - » https://www.visual-3d.com/tools/interior

How much light is being emitted by my old fluorescent troffers?

It is difficult to accurately estimate light output from installed fluorescent luminaires without documentation of its internal components. Factors that can result in wide variation in light output include:

- *Lamp type*. 4-foot T8 and T12 lamps ranging from 30 to 40 watts, for example, typically produce approximately 3000 lumens.
- *Age of the lamps*. Lumen depreciation can reduce light output from a fluorescent lamp by up to 10% over its typical operating life.
- *Optical efficiency of the reflector.* Fluorescent troffers have optical efficiencies ranging from 33% to 91%, resulting in up to a 140% variation in the troffer light output. For more information, visit https://www1.eere.energy.gov/buildings/publications/pdfs/alliances/20111025_webinar_trofferspec.pdf
- *Ballast factor.* Conventional fluorescent lamp ballasts have ballast factors ranging from 0.7 to 1.2, resulting in up to 70% variation in the luminaire light output.