4-Foot T-8 Fluorescent Lamp Upgrading

ENERGY SAVING – FACT SHEET

Background

Electric lighting accounts for 20 to 29 percent of all energy used in buildings and about 5 percent of all energy used in the U.S. In buildings, lighting has a secondary impact on cooling and indirectly accounts for some portion of building heating requirements.

History of 4-foot Fluorescent Systems

Timeline

1960	The current 4-foot T-12 (1.5 inch diameter) technology emerges. Lamps rated at 80 lumens/watt, "rapid start" electromagnet ballasts,40-watt lamps dominate.
1973	Following the 1973 energy crisis, 34-watt "reduced wattage" T-12 lamps offered as direct replacements for F40-T12 lamps
1978	Post –1978 ballasts are labeled as "PCB free."
1980	More efficient T-8 (1-inch diameter) lamp technology released. "Rare earth" phosphor improves both light output and quality of color (improved color rendering). High frequency electronic ballast systems introduced. Energy Service Companies (ESCO) gain popularity.
1992	Energy Policy Act of 1992 (EPACT) establishes the 34-watt lamp for existing T-12, magnetic ballast as principal lamp. T-8, electronic ballasted systems easily meet EPACT. EPA "Green Lights" promote T-8 system conversions. Low-mercury containing lamps introduced in mid-1990's.
2000	New federal energy efficiency standard rules out production of magnetic ballasts after 3/21/2005 for new applications. Replacement magnetic ballasts can still be manufactured until 6/30/2010.

Lighting Level Issues

One of the lighting system's functions is to support productive activity. For this reason it is important to retain appropriate lighting levels. For most offices this is in a range of 30 to 70 foot-candles (fc), depending on the quality of the reading material encountered. If the current lighting level is satisfactory, it shouldn't be changed. Conference room lighting should average 30 foot-candles. Hallways are usually lighted to a range from 5 to 10 foot-candles.

During the past 15 years, illumination level design standards in offices have been dramatically reduced, mostly due to the use of computers. These changes have allowed many facilities to de-lamp fixtures to achieve 30-50 fc levels in offices. Always verify appropriate foot-candle levels before considering retrofitting.

Understanding for Informed Choices

The words "T-12" and "T-8 refer to the lamp tube diameter in "eighths of an inch," hence a T-12 lamp has a diameter of 12/8's inch or 1-1/2 inches. The narrower the lamp, the more efficient it is.

Basically, a fluorescent system involves a tubular lamp with a chemical phosphor coating on its inside surface. The phosphor produces the useable light from the system. A specialized transformer provides a needed range of power in order to start an arc discharge through a mix of vaporized mercury and other inert gases in a partial vacuum inside the glass tube. A correct power level is needed to keep the arc from "running away" after starting (hence the term ballast) and destroying the lamp.

New technology in ballasts that uses "electronic" instead of "magnetic" electrical components provides for ballasts that run lamps more efficiently. Electronic ballasts are typically available in "low," "normal," or "high" ballast factors, which allow for the fine tuning of lamp light output.

A particular tube length and diameter can be operated over a range of stabilized wattages. For instance, 4-foot, T-8 lamps are now available in 28- and 25-watt ratings.

Light producing phosphors, inside the lamp are described using such terms as "color temperature" (degrees Kelvin or "k") and "color rendering index" (CRI).

Color temperature is a description of the "whiteness" of lamp light. The usual fluorescent range is from a "yellowish" 3000 °k to a "bluish" 4100 °k for normal applications, but can go higher for special application lamps. In comparison, incandescent lamps have a color temperature of 2700°k.

Color rendering index refers to how close the effect of a particular lamp light on object colors compares to that of an "ideal lamp light" at a particular color temperature. Older 40-watt lamps had a low CRI of 62. *New T-8 lamps have an improved CRI of 82 and 86.*

High Performance T-8

CEE (Consortium for Energy Efficiency, Inc.) has developed a High-Performance T-8 Specification based on performance characteristics relating to 4 foot T-8 lamp and ballast combinations with a not-to-exceed lamp nominal wattage of 32 watts. This specification provides information to allow the most efficient lighting lamp and ballast combinations for your application. More information is available at the CEE website: www.cee1.org/com/com-lt/com-lt-specs.pdf

Successes in T-8 Upgrades

Warren Wilson College (WWC), located in Swannanoa, NC, is a four-year college that focuses on liberal arts, the environment, and community service. Based on energy efficiency recommendations in an assessment report by Waste Reduction Partners, WWC facility management let a contract to upgrade older T-12 lighting systems to new T-8 lamps with electronic ballasts in 28 of the campus' buildings. This $200,000 upgrade project had an annual savings of $70,100 and a simple payback of 2.8 years. Total project savings included A/C energy savings and material savings. All old lamps were managed through a recycling service. For more information, contact Paul Braese, Director, ,Facility Management and Technical Services. e-mail: pbraese@warren-wilson.edu

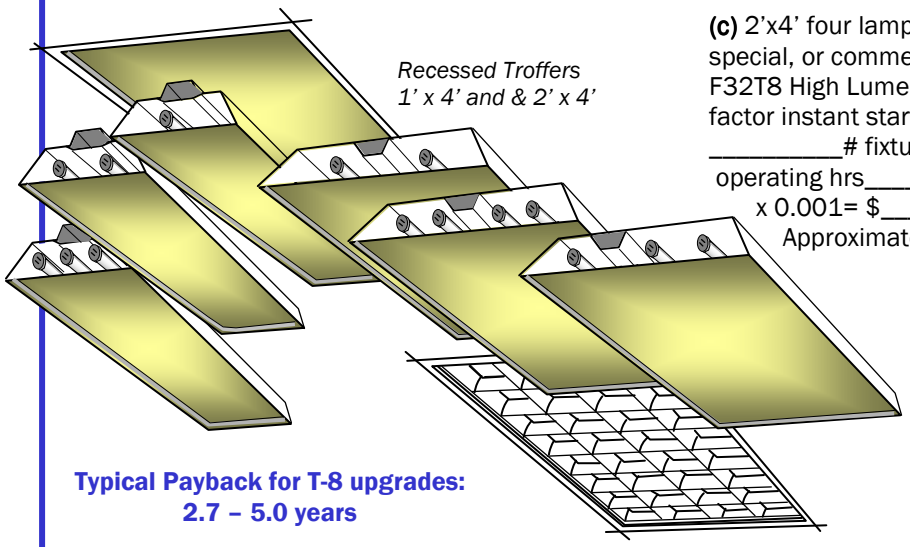
Estimating Potential Savings from T-12 to T-8 Conversions

Lighting Fixture Basis: Only the most likely examples and solutions out of all potential field situations are shown. These are based on a specific fixture count in a particular room or site. *It is assumed that a correct or acceptable lighting level is present and that the goal is to obtain a similar level with the T-8 system.*

(a) 2'x4' fixture with four lamps de-lamped to two F34 T-12 lamps replaced with two F32 T-8 lamps and a 2-lamp "LOW" * ballast factor instant start electronic ballast.
_____# of fixtures x 34 watts/fixture x annual operating hrs_____ (usually 3000) x $0.086/kWh** x 0.001 = $_____savings per year.

(b1) 2'x4' four lamp with four F34 T-12 lamps replaced with four F32 T-8 lamps and a 4-lamp "LOW"* ballast factor instant start ballast .
_____# of fixtures x 69 watts/fixture x annual operating hrs_____ (usually 3000) x $0.086/kWh** x 0.001 = $_____savings per year.

OR **(b2)** Replace with two F32T8 High Lumen" lamps & 2-lamp "HIGH"* ballast factor Inst. start ballast.
_____# of fixtures x 86 watts/fixture x annual operating hrs_____ (usually 3000) x $0.086/kWh** x 0.001 = $_____savings per year. Approximately 14% light reduction.



Recessed Troffers 1' x 4' and & 2' x 4'

(c) 2'x4' four lamp with four F40 (CRI=80+) T-12 lamps for special, or commercial, applications, replace with three F32T8 High Lumen" lamps and 3-lamp "High"* ballast factor instant start ballast.
_____# fixtures x 78 watts/fixture x annual operating hrs_____ (usually 3000) x $.086/kWh x 0.001= $_____savings per year. Approximately 8% light reduction.

Typical Payback for T-8 upgrades: 2.7 – 5.0 years

* Ballasts can be purchased to operate the lamp below (L-low 77-79%), Close to (N-normal 88-90%), or above (H-high 115-120%) the lamp's wattage rating
** Typical NC power rate
*** Premium high lumen lamp with high color rendering index

A characteristic of premium T-8 lamps is that they function with a reduced amount of mercury so as to pass the "TCLP" test specified in the RCRA Hazardous Waste regulations. This is an indicator of the suitability of waste lamps for land filling. Recycling is the recommended mode of waste management for lamps. For a directory of lamp recyclers serving North Carolina facilities, go to www.p2pays.org/DMRM.

Alternative Stepwise Approaches

When capital budgets do not allow for "group" upgrading, "spot" ballast and lamp upgrading can be conducted at the time of an older T-12 lamp replacement. This stepwise approach spreads upgrading costs over a 2—8 year period depending on use. Upgrade costs are shifted from capital to operation and maintenance (O&M) budgets.
Whatever the plan, fixtures should be thoroughly cleaned on a regular basis.

References & Resources:

General Electric Lighting, www.ge.com/lighting
Osram Sylvania, www.sylvania.com
Phillips Lighting, www.advance.philips.com/default.aspx
IESNA Handbook, ninth edition, 2000
CEE (Consortium for Energy Efficiency, Inc.) Commercial Lighting www.cee1.org/com/com-lt/com-lt-main.php3

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