**APPLICATION GUIDANCE FOR FLUORESCENT LIGHTING PROJECTS**

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This application guidance is intended to help activity personnel retrofit fluorescent lighting. With this guide, an energy manager can determine if replacing T-12 lamp and magnetic ballast fixtures is cost effective.

Fluorescent lighting, Energy Conservation Investment Program/Electrical Circuit Analysis Program (ECIP/ECAP), total harmonic distortion (THD)

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Application Guidance for Fluorescent Lighting Projects

This application guide is intended to help activity personnel retrofit fluorescent lighting. With this guide, an energy manager can determine if replacing T-12 lamp and magnetic ballast fixtures is cost effective. Also included are assumptions to make for ECIP/ECAP (Energy Conservation Investment Program/Electrical Circuit Analysis Program) life cycle cost calculations.

TECHNICAL BACKGROUND

Although the standard 48-inch, 40-watt T-12 lamp is the most commonly used fluorescent fixture, it is not the most efficient fluorescent light source. Since it will no longer be manufactured after October 1995, as a result of the National Energy Policy Act of 1992, now is the time to consider alternatives. The T-8 lamp with an electronic ballast is the most common retrofit. Table 1 compares T-12 systems to T-8 systems.

The T-8 fixture is generally more efficient. However, there is a 250-lumen (a lumen is a measure of light output, a footcandle is one lumen per square foot) light output difference between the two options. This is about an 8-percent difference. These values assume that both lamps and ballasts are new. With an

Table 1
Comparison of T-12 to T-8 Lamp Systems

<table>
<thead>
<tr>
<th>Lamp</th>
<th>Rated Initial Lumens</th>
<th>Ballast</th>
<th>2-Lamp Fixture (watts)</th>
<th>Lumens/Watt</th>
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<tbody>
<tr>
<td>F40 CW</td>
<td>3,150</td>
<td>Standard Magnetic</td>
<td>96</td>
<td>62.3</td>
</tr>
<tr>
<td>F40 CW</td>
<td>3,150</td>
<td>Energy Efficient</td>
<td>86</td>
<td>69.9</td>
</tr>
<tr>
<td>F40 CW</td>
<td>3,150</td>
<td>Electronic</td>
<td>71</td>
<td>76.3</td>
</tr>
<tr>
<td>F032 T8</td>
<td>2,900</td>
<td>High Efficiency Magnetic</td>
<td>72</td>
<td>76.5</td>
</tr>
<tr>
<td>F032 T8</td>
<td>2,900</td>
<td>Electronic</td>
<td>52</td>
<td>104</td>
</tr>
</tbody>
</table>

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older magnetic ballast changing to a T-8 lamp and an
electronic ballast can reduce noise levels and provide
better color.

When electronic ballasts first became available,
in the early eighties, the technology was not regu-
lated. Several manufacturers were selling ballasts that
cause power quality problems in other electrical ap-
pliances on the same circuit. Ballasts sold today must
meet minimum requirements established by ASHRAE
(American Society of Heating, Refrigerating and Air-
Conditioning Engineers) and ANSI (American Na-
tional Standards Institute).

No ballast can have a total harmonic distortion
(THD) level over 20 percent. THD is a measure of
distortion in power wave forms. This distortion can
disrupt the normal operation of AC appliances. There
are many ballasts available now with THD levels
below 15 percent.

Using a current specification is the best way of
ensuring that the ballast is of the highest quality. The
Department of Energy has a current specification for
electronic ballasts, as do the engineering field divi-
sions in San Diego and Norfolk. When purchasing
electronic ballasts, consult these sources to ensure
that minimum requirements are met. Ordering from
the Defense Logistics Agency (DLA) catalog is an-
other way of ensuring you have the best equipment.
To obtain a catalog, call 800-DLA-BULB. It is im-
portant to order only those ballasts that offer a 5-year
manufacturer’s warranty. This will protect you from
inferior products.

A word of caution for those considering elec-
tronic ballasts in dimmable fluorescent circuits. Make
sure that you order appropriate ballasts when upgrad-
ing a fluorescent fixture that is currently on a dimer.
The normal electronic ballast will not operate in
such a configuration.

Recently, several manufacturers of specular ref-
ectors have made claims that a retrofit with their
product allows for removal of half the lamps in a
fixture because of the increased light levels. Unfortu-
nately, most of this increased light output is due to
cleaning of the luminaire and the installation of new
lamps, and is not a permanent improvement. The
reflectivity of the luminaire is increased by 5 to 15
percent, at best, with a reflector retrofit. Often a
similar light gain can be realized, at less cost, by
delamping, cleaning the lens and existing reflector,
and installing new lamps. The Naval Facilities Engi-
eering Service Center does not recommend using
reflectors as a lighting retrofit.

RETROFIT ECONOMICS

To determine the cost-effectiveness of a retrofit,
you must know six things:

1. Number of fixtures and lamps
2. Operational hours per year
3. Local energy charge in $/kWh
4. Local demand charge in $/kW
5. Existing fixture’s electrical load
6. Replacement fixture’s electrical load

The following four charts were developed by as-
suming common values for this data (assumptions are
included in the following section).

Chart 1 shows the payback versus energy charge
for replacing a 2-lamp T-12 fixture and standard mag-
etic ballasts with a T-8 fixture with electronic bal-
lasts. If you have 2-lamp fixtures in a space that has
about 2,500 operational hours per year, this chart can
be used to determine the cost-effectiveness of a retro-
fit. Any ballasts installed before 1990 are standard
magnetic ballasts.

Chart 2 shows the payback versus energy charge
for replacing a 4-lamp T-12 fixture and standard mag-
etic ballasts with a T-8 fixture with electronic bal-
lasts. If you have 4-lamp fixtures in a space that has
about 2,500 operational hours per year, this chart can
be used to estimate the cost-effectiveness of a retro-
fit. Standard magnetic ballasts are any ballasts in-
stalled before 1990.

Magnetic ballasts installed after 1990 are more
energy efficient. Energy legislation made this change
mandatory for manufacturers. The load of a T-12
fixture with these energy-efficient ballasts is lower
than for standard ballasts and the payback is longer.

Chart 3 shows the simple payback for various
kWh charges and demand rates when retrofitting a 2-
lamp T-12 and energy-efficient magnetic ballast fix-
ture with a T-8 and electronic ballast fixture.

Chart 4 shows the simple payback for various
kWh charges and demand rates when retrofitting a 4-
lamp, T-12 and energy-efficient magnetic ballast fix-
ture with a T-8 and electronic ballast fixture.
Simple Payback for 2-Lamp T-12 to T-8 Retrofit with Standard Magnetic Ballasts

Chart 1
No Demand Charge
$5/kW Demand
$7/kW Demand
$10/kW Demand

Simple Payback in Years
Energy Charge in $/kWh

Simple Payback for 4-Lamp T-12 to T-8 Retrofit with Standard Magnetic Ballasts

Chart 2
No Demand Charge
$5/kW Demand
$7/kW Demand
$10/kW Demand

Simple Payback in Years
Energy Charge in $/kWh
Simple Payback for 2 Lamp T-12 to T-8 Retrofit with Energy Efficient Magnetic Ballasts

Simple Payback for 4 Lamp T-12 to T-8 Retrofit with Energy Efficient Magnetic Ballasts
These charts were generated using common values for electrical load and installation and maintenance costs; your particular situation may be different. If your utility rates yield a payback less than 10 years on the appropriate chart, then further investigation is warranted.

PROJECT SUBMISSION ASSUMPTIONS

In the interest of standardization, as well as, easing the prioritization for funding process, we offer the following assumptions for lighting retrofit calculations on ECIP/ECAP project submittals.

Existing T-12 Fixture Load

- 2-lamp, 40-watt T-12 fixtures with standard magnetic ballast (pre-1990)
  
  Fixture load = 95 watts

- 4-lamp, 40-watt T-12 fixtures with standard magnetic ballast (pre-1990)

  Fixture load = 190 watts

- 2-lamp, 40-watt T-12 fixtures with energy-efficient magnetic ballasts (post-1990)

  Fixture load = 88 watts

- 4-lamp, 40-watt T-12 fixtures with energy-efficient magnetic ballasts (post-1990)

  Fixture load = 176 watts

T-8 Fixture and Retrofit Costs

- 2-lamp, 32-watt T-8 with electronic ballasts

  Fixture load = 62 watts
  
  Energy savings per fixture = 33 watts (Std T-12)
  
  Energy savings per fixture = 26 watts (EEF T-12)
  
  Retrofit labor cost = $10.00
  
  Lamp cost = $4.00
  
  Ballast cost = $25.00

- 4-lamp, 32-watt T-8 with electronic ballasts

  Fixture load = 95 watts
  
  Energy savings per fixture = 62 watts
  
  Retrofit labor cost = $10.00
  
  Lamp cost = $8.00
  
  Ballast cost = $30.00

WHAT TO DO NOW

If, after examining the charts, you think you may have a cost-effective project, submit the necessary documentation. If you need help, contact your local EFD for information on ECIP/ECAP documentation. If you have further questions about fluorescent lighting or ballasts, contact:

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