



IFC/GEF Efficient Lighting Initiative Voluntary Technical Specification Lamp Ballast Circuits for Linear Fluorescent Lighting

Background

Developing countries often share common market barriers to the use of energy-efficient lighting. Barriers include inadequate information about the energy, economic and environmental benefits of efficient lighting, and a lack of credible sources of such information.

To address these barriers, ELI develops and promotes voluntary technical specifications that include rigorous technical and quality criteria. ELI has a labeling system that helps consumers identify energy efficient lighting products that meet the ELI specifications. ELI programs include marketing, educational, market building, and financing activities. Each participating country tailors its activities to meet the needs of the local market. These activities are supported by US\$15 million in Global Environment Facility funding, and by additional local and international funding. Lighting manufacturers whose products meet the ELI specifications are invited to launch product promotions and advertising campaigns in cooperation with ELI's local marketing programs.

Manufacturers interested in ELI should review the ELI voluntary technical specifications to determine whether or not their products could comply. They should then review the ELI qualification protocol for guidance on how their lighting products could receive the ELI label.

Linear Fluorescent Systems

Fluorescent lamps and ballasts are interdependent components of a complete lighting system. Different lamps and ballasts are combined to create systems that generate light at different levels of efficiency. High frequency electronic ballasts paired with triphosphor T8 lamps can reach efficiencies approaching 100 lumens per watt, as compared to older fluorescent technologies that may yield less than 65 lumens per watt.

The diversity of lighting customers and markets in ELI countries poses a challenge to the design of a common specification for linear fluorescent lighting that is relevant across all ELI countries. As a result, this specification recognizes that different technologies may be appropriate for market transformation activities in different sectors. For new commercial and industrial applications, this specification requires high frequency electronic ballasts and triphosphor T8 or T5 lamps. New residential installations may use low-loss electromagnetic ballasts, due to their relatively lower costs. Low-loss electromagnetic ballasts may also be used to replace failed ballasts in existing luminaires. ELI offers no general specification for lamps; ELI country program managers must decide what is appropriate for lamps in each country.

The specifications do not address the issue of product reliability because linear fluorescent lighting systems are familiar and have well-established markets in each ELI country. The one exception is for linear fluorescent electronic ballasts which are relatively new and which have had problems with high failure rates in some countries. This specification relies on broadly accepted technical parameters for electronic ballasts. These parameters are further supported by a requirement that manufacturer product warranties cover not only the material costs of replacing faulty electronic ballasts, but also labor costs.

ELI assumes that high quality electronic ballasts will be available at cost-effective prices in all ELI country commercial and industrial new construction markets by the end of ELI (in the year 2002). In fact, in many ELI countries this goal has already been reached. The market transformation task for ELI in the commercial and industrial new construction market is to help the penetration of electronic ballast technology by increasing product quality and driving down prices through competition and higher sales volumes.

The residential market for linear fluorescent lighting in most countries is very price-sensitive, and in ELI countries tends to be dominated by low-efficiency, electromagnetic ballasts. Therefore, low-loss electromagnetic ballasts represent a significant improvement over the status quo.

The replacement ballast specification allows ELI to promote low-loss electromagnetic replacement ballasts that compete in the same general price category as inefficient electromagnetic ballasts that are the current market leaders in ELI countries. Of course, ELI encourages electronic replacement ballasts where possible.

Definitions

Electronic Fluorescent Ballast

A device used with a linear fluorescent lamp to obtain the necessary circuit conditions (voltage, current and waveform) for starting and operating. Electronic ballasts are made of solid-state electronic components and operate at higher frequencies than AC mains.

Electromagnetic Fluorescent Ballast

A device used with a linear fluorescent lamp to obtain the necessary circuit conditions (voltage, current and waveform) for starting and operating. Electromagnetic ballasts operate at the same frequency as AC mains (50 or 60 Hz).

Linear Fluorescent Lamp

A linear fluorescent lamp is an electric discharge lamp that generates light from a phosphor-coated tube. Linear fluorescent lamps come in a wide range of lengths and a number of different diameters. The older "T12", or 1.5 inch (38 mm) diameter tube is being globally supplanted by the "T8", or 1 inch (26 mm) diameter tube or the even thinner "T5" tube. Halo-phosphor technology is also being replaced by more efficient triphosphors. In some countries, the use of halo-phosphor lamps has been restricted as an energy efficiency measure.

Linear Fluorescent Lighting System

For the purposes of this specification, the linear fluorescent lighting system consists of a fluorescent ballast or ballasts and a linear fluorescent lamp or lamps that are designed to operate together in a luminaire. This specification considers only the efficiency of the lamp-ballast circuit, and not the efficiency of the luminaire.

Luminous flux

Luminous flux is the generated by the linear fluorescent system after an initial burn-in period of 100 hours. Luminous flux shall be the lumens generated by the specific linear fluorescent lighting system in question under stable operation at maximum power.

Input Power

Power drawn by the linear fluorescent system after an initial burn-in period of 100 hours. Input Power shall be the power drawn measured in watts (W) by the specific linear fluorescent lighting system in question under stable operation at maximum power.

System Efficiency

Luminous flux generated by a linear fluorescent lighting system divided by Input Power in units of lumens per watt lm/W.

Ballast Factor

The ratio of a fluorescent lamp's light output on a specific ballast compared to the fluorescent lamp's output as measured on a reference ballast.

Residential

For the purposes of this specification, residential linear fluorescent products are sold through retail shops to consumers and may be installed in dwellings, small commercial and other buildings.

Commercial/Industrial/Institutional (C/I/I)

For the purpose of this specification, C/I/I linear fluorescent ballasts and lamps are sold in bulk through commercial distributors to builders or electrical contractors.

New Construction & Significant Renovation

For the purpose of this specification, new construction or significant renovation applications for linear fluorescent lighting are applications involving the total replacement of the linear fluorescent luminaire and possibly the rewiring of a building's lighting.

Replacement

For the purpose of this specification, replacement applications for linear fluorescent lighting are applications involving the replacement of only the linear fluorescent lamp and or ballast.

Standard References

- IEC - International Electrotechnical Commission
- CIE - Commission International d'Eclairage (International Illumination Commission)
- ISO - International Standards Organization

Linear fluorescent Lighting Systems sold for new applications in commercial, institutional and industrial buildings should use electronic ballasts that meet the following efficiency criteria for ELI:

Table 1: New C/I/I – Linear Fluorescent Systems	
Lamp Power (High Frequency)	Max. Circuit Power Draw
13.5 W	≤18 W
16 W	≤21 W
24 W	≤33 W
32 W	≤38 W
50 W	≤59 W
60 W	≤72 W
Fluorescent lamps shall have a color rendering index (CRI) ≥ 70.	
These maximum power draw limits shall be measured as defined by the Association of European Luminaire Manufacturers (CELMA) and are equivalent to the CELMA "A3" level classification for fluorescent ballasts.	

Electronic Ballasts that are promoted through ELI should meet the following requirements.

Table 2: Electronic Ballasts	
Frequency	> 20 kHz
Power Factor	≥ 0.90
Total Harmonic Distortion	≤ 32 %
In-rush Current	≤ 20 A for < 3 ms
Current Crest Factor	≤ 1.7
Voltage variation	Must operate within specified parameters at a range of nominal voltages up to 15% higher or lower than rated operating voltage without reduction in rated life (as by IEC 60929)
Safety	Ballast shall comply with applicable parts of IEC – 60920, 61547, 60928 and all local requirements.
Warranty	Minimum 3-year replacement warranty including a labor allowance for electronic ballasts that fail early due to manufacturer defect. Manufacturer shall apply a label with basic warranty terms and a local telephone number to each ballast, written in at least one applicable local language.

Linear fluorescent Lighting Systems for new applications in residential buildings should meet the following efficiency criteria for ELI:

Table 3: New Residential Linear Fluorescent Systems	
Lamp Power (50- 60 Hz)	Max. Circuit Power Draw
15 W	≤21 W
18W	≤24 W
30 W	≤36 W
36 W	≤41 W
38 W	≤43 W
58 W	≤64 W
70 W	≤77 W

These maximum power draw limits shall be measured as defined by the Association of European Luminaire Manufacturers (C.E.L.M.A) and are equivalent to the CELMA “B1” level classification for fluorescent ballasts.

Note: These efficiency levels should allow new residential linear fluorescent systems to use low-loss electromagnetic ballasts. Electronic ballasts used for new residential applications should meet the same criteria specified for electronic ballasts in C/I linear fluorescent systems (Table 2 above).

Linear Fluorescent Ballasts for Replacement Applications sold separately from fluorescent lamps and luminaires must meet the following performance specifications for ELI:

Table 4: Linear Fluorescent Ballasts for Replacement Applications
At a minimum, linear fluorescent ballasts intended for replacement applications must meet the efficiency criteria described in Table 3 above, corresponding to CELMA classification B1. All electronic ballasts used in replacement applications must meet the performance criteria further described in Table 2.

Note: The specification allows ELI qualified low-loss electromagnetic ballasts to compete in the local ballast replacement markets against the inefficient electromagnetic ballasts that currently dominate those markets. The specification also ensures that purchasers who make the cost and efficiency leap to an ELI-qualified electronic ballast will get the savings and reliability that they expect.

Linear Fluorescent Lamps for Replacement Applications that are sold separately from ballasts and luminaires for installation in retrofit applications must meet the following performance specifications for ELI:

Table 5: Linear Fluorescent Lamps for Replacement Applications
Due to the different levels of penetration of different linear fluorescent tube and ballast technologies into the different ELI country markets, individual specifications will be determined on a country by country basis by IFC in concert with country implementation staff.

Reference Specifications

- IEC – 60920 Linear fluorescent ballast safety
- IEC – 61547 Equipment for general lighting purposes - EMC immunity requirements
- IEC – 60928 High frequency ballast safety
- IEC – 60929 High frequency ballast performance
- National Lighting Product Information Program, *Guide to Fluorescent Lamp-Ballast Compatibility*, Lighting Research Center, Rensselaer Polytechnic Institute, Troy, NY USA
- National Lighting Product Information Program, *Guide to Specifying High Frequency Electronic Ballasts*, Lighting Research Center, Rensselaer Polytechnic Institute, Troy, NY USA
- Classification of Lamp-Ballast Circuits for Energy Efficiency in Lighting, C.E.L.M.A.

Inquiries

Please address all questions or comments regarding this specification to:

Ms. Kathryn Conway
Technical Consultant, Efficient Lighting Initiative
P.O. Box 510
Nassau, NY 12123-0510 USA
email eli@kateconway.cc