Voluntary Luminaire Efficacy Program: A Model for Collaboration

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ABSTRACT

In the United States, a voluntary luminaire energy-efficiency testing and information program has been established through the Energy Policy Act of 1992. This paper discusses the program development process, defines and explains the Luminaire Efficacy Rating in the National Electrical Manufacturers Association's Standard LE5, and presents results from the luminaire program's first year, including evaluation of manufacturer participation and publicity efforts.

INTRODUCTION

The U.S. Energy Policy Act of 1992 (EPAct)[1)] called for a voluntary national testing and information program for those types of luminaires that are widely used, and for which there is a potential for significant energy savings as a result of such a program. The program has been under development since 1992. This paper presents the highlights and the progress of the luminaire program.

PROGRAM DEVELOPMENT

The voluntary luminaire program represents an important new policy approach to promoting lighting efficiency. Two key elements are the voluntary aspect and the collaborative development of the program.

There has been considerable debate in the U.S. on government policy to promote energy-efficiency and the relative merits of mandatory versus voluntary approaches. For luminaires, the EPAct facilitated creation of a voluntary program by the lighting industry and interested parties. The U.S. Department of Energy (DoE) provided financial and technical assistance for development of the program. The EPAct required that DoE evaluate the program's progress, and if the voluntary program did not meet the objectives set forth in EPAct, the law prescribed government regulatory action.

There was considerable interaction between DoE and the stakeholders during the program development and evaluation process. DoE gave the new program provisional approval in March 1996 and will continue to monitor the program to ensure that its progress is consistent with the objectives of EPAct. DoE will perform a final evaluation by the end of 1998.

NATIONAL LIGHTING COLLABORATIVE

The EPAct required that DoE consult with the National Electrical Manufacturers Association (NEMA), the American Lighting Association (ALA), and other interested organizations. These groups organized the National Lighting Collaborative, which developed the luminaire program. The Collaborative covers a broad spectrum of interests in lighting policy development, and is comprised of representatives from NEMA, ALA, manufacturers, lighting designers, energy-efficiency advocacy groups, government agencies, national and university research laboratories, and electric utilities. Consensus building has been a key element in the operation of the Collaborative.

LUMINAIRE EFFICACY RATING

The goal of the voluntary luminaire program is to enable designers and specifiers to make more informed decisions about the energy-efficiency of luminaires and the relative energy costs of alternative products. The metric used to measure energy efficiency is the Luminaire Efficacy Rating, or LER.

The program is based on NEMA's standard LE5, "Procedure for Determining Luminaire Efficacy Ratings for Fluorescent Luminaires." [2] This standard specifies the calculation of the LER as well as the yearly lighting energy cost.

LER is a single number that expresses luminaire efficacy, the luminaire's light output divided by the input power.

$$LER = \frac{\textit{Luminaire Efficiency x Total Rated Lamp Lumens x Ballast Factor}}{\textit{Luminaire Input Watts}}$$

The formula is:

Note that the effects of all components of the luminaire system are included in the LER: the photometric efficiency of the luminaire, the lamp rated lumens, the effect of the ballast factor on lamp lumens, and the input wattage for the luminaire.

Product Categories

The products covered include the most common fluorescent commercial and industrial luminaires. The format of the LER begins with a two-letter designation for the product category. The first letter is an "F" identifying the luminaire as fluorescent. The second letter is a generic product category such as lensed, parabolic, wraparound, strip or industrial. The five categories are FL, FP, FW, FS, and FI.

It is very important that comparisons be made only within the same product category because the performance of different luminaires varies widely based on their application. For example, the LER values for two lensed troffers could be compared. However, comparison of the LERs of a lensed troffer and a strip luminaire would be meaningless since the two luminaire types are designed for different applications and therefore have different performance characteristics.

The product categories are shown in Table 1.

These product categories represent about 80 percent of the U.S. fluorescent commercial and industrial markets, based on an analysis of sales. NEMA will study market trends and modify and add new categories to the LE5 specifications. For example, 610 mm x 610 mm (2 foot x 2 foot) or 305 mm x 1220 mm (1 foot x 4 foot) luminaires may increase to a significant market share in the future.

Quality Metrics

Collaborative members have been concerned that the luminaire efficacy rating would be used without consideration of lighting quality. However, the lighting profession has not reached consensus on a comprehensive numerical metric that defines quality of lighting. Therefore, a placeholder has been reserved in the LER format for such a quality rating. The International Association of Lighting Designers (IALD) and Illuminating Engineering Society of North America (IESNA) are working towards the development of quality metrics that could be incorporated in the LER format.

YEARLY LIGHTING ENERGY COST

In addition to LER, the LE5 standard also contains a calculation for the relative yearly cost of the energy needed to operate each rated luminaire. This estimates the annual lighting energy cost per 1000 lumens of light output for the luminaire. The calculation uses the assumptions of 3000 burning hours per year and $0.08 per kilowatt-hour. Because application and operating conditions vary widely, this number is intended for comparison purposes rather than prediction of actual energy usage. Since the same assumptions will be used in its calculation, the yearly lighting energy cost provides a consistent relative comparison.

$$\textit{Yearly Lighting Energy Cost} = \frac{K \times 1000}{LER}$$

where K = $0.24 / Watt (based on 3000 annual burning hours and $0.08/kWh).

Figure 1 shows a sample photometric report for a 3-lamp, 2 x 4 recessed louvered (parabolic) luminaire. Note that the product category is FP, the LER is 63, and the annual energy cost is $3.81 (per 1000 lumens). Most of the inputs for the LER calculation are shown (rated lamp lumens, ballast factor, and input watts).

PRODUCT TESTING

The objective of product testing is to ensure reliable, repeatable results according to commonly accepted national testing procedures. The LE5 standard specifies the standard industry test procedures for providing the values in the LER calculation. It is recommended that luminaire testing and rating be performed with F40T12/ES lamps and energy-efficient magnetic ballasts, as well as with F32T8 lamps and electronic ballasts.

MANUFACTURER PARTICIPATION

The Collaborative decided that the most effective location for the publication of LER ratings would be on product specification sheets, technical data sheets, and other product literature. Specifiers of commercial sector products typically select them from review of this material.

Table 1. Luminaire Types and Classifications

2 x 4 Lensed T roffers	2 x 4 Parabolic T roffers	
2 lamps, 1220 mm (4 foot)	2 lamps, 1220 mm (4 foot)	
3 lamps, 1220 mm (4 foot)	3 lamps, 1220 mm (4 foot)	
4 lamps, 1220 mm (4 foot)	4 lamps, 1220 mm (4 foot)	
Wraparound	**Strip**	**Industrial**
2 lamps, 1220 mm (4 foot)	1 lamp	2 lamps
4 lamps, 1220 mm (4 foot)	2 lamps	

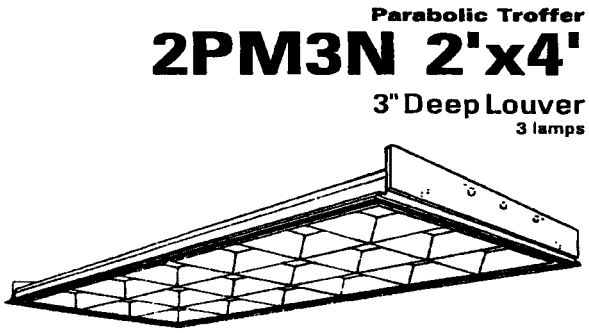

Figure 1. Sample Sections of Photometric Reports Showing LER and Yearly Lighting Energy Cost

Therefore literature was determined to be more effective than a product label, which is more appropriate for the residential consumer market.

Many manufacturers have begun to incorporate LER information in their product literature. They have stated that the rating will add competitive advantage to their products. The Collaborative agreed on program goals that reflect a reasonable cycle of product literature revision as well as test procedure schedules. The Collaborative survey performed in 1997 showed that manufacturers responding had incorporated LER ratings in product literature for 50 to 100 percent of luminaires in several product categories.

CONSUMER AWARENESS

In addition to manufacturer participation, the other key element in the success of the luminaire program is consumer awareness. To evaluate the progress of educational efforts, the Collaborative conducted a member survey in 1997. This survey showed that member organizations have promoted the program in a variety of ways, including distribution of the LE5 standard to members and to the public, articles in professional and trade journals, presentations at conferences and trade shows, press releases and briefings, and presentations to national and international audiences. Manufacturers have conducted training seminars for specifiers, sales representatives, and distributors, distributed educational literature and software, and presented seminars to lighting professionals. LER is also being incorporated in professional publications, and major lighting efficiency training programs. Information on the program appears on several Internet web sites related to lighting.

PROGRAM UPDATES

Presently the luminaire program covers only fluorescent luminaires. NEMA is preparing additional standards on high intensity discharge industrial luminaires, and on downlights. The National Lighting Collaborative has participated in the review and revision of these standards.

USE OF LER BY OTHER PROGRAMS

The LER is being used by DoE's Federal Energy Management Program (FEMP) in its procurement recommendations for fluorescent luminaires. Pursuant to a Presidential order [3] and the EPAct [4], all Federal agencies are directed to buy products that are among the 25% most energy-efficient. Products must also meet the agency's requirements and be cost-effective. FEMP recommendations have been prepared for the LE5 luminaire categories, as well as 610 mm x 610 (2 foot x 2 foot) lensed luminaires and louvered luminaires with U-tube lamps.

For luminaires designed for video display terminal (VDT) area use, it is important to address the issue of lighting quality. Luminaires appropriate for this application are designed for lower luminance ratings; the design charac-

teristics may lower the luminaire efficiency, lowering LER. Recommendations are made only for those parabolic louver (FP) luminaires that meet the IESNA Recommended Practice (RP-24 / RP-1) "recommended" maximum luminance ratings for use with VDTs. Federal buyers are advised that luminaires that meet IESNA "preferred" luminance ratings may not meet this LER level, and also that higher LERs would be recommended for non-VDT compatible parabolic luminaires.

Luminaire manufacturers have provided much input on the correct use of the LER method and on data collection to determine the appropriate LER levels for the voluntary recommendations. With NEMA's help, industry representatives have provided input to DOE/FEMP on the efficiency range of luminaire products currently on the market.

CONCLUSION

The LER rating is a comprehensive metric that categorizes the energy efficiency of the luminaire as a lighting system. The LER should be used to complement application criteria in fluorescent luminaire selection. Used in context, it is a powerful tool for bringing energy-efficiency into the complex equation of lighting purchase and specification decisions. The voluntary luminaire program continues to expand as more luminaire manufacturers test and rate their products. Consumer education efforts are reaching designers and specifiers, and the program has attracted the attention of other programs working with luminaires and energy efficiency. ●

ENDNOTES

1) *Energy Policy Act of 1992* (Public Law 102-486- Oct. 24, 1992), Section 126.

2) National Electrical Manufacturers Association. 1995. *NEMA Standards Publication LE5-1993: Procedure for Determining Luminaire Efficacy Ratings for Fluorescent Luminaires. Revision 1, January 1995.* Washington D.C., U.S.

3) Office of the President. "Energy Efficiency and Water Conservation at Federal Facilities." Executive Order #12902. March 10, 1994. (Section 507 addresses "Procurement of Energy Efficient Products by Federal Agencies.")

4) *Energy Policy Act of 1992* (Public Law 102-486- Oct. 24, 1992), Section 161.

Implementation