

LESSONS LEARNED IN LIGHTING EQUIPMENT TESTING IN THE PHILIPPINES

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INTRODUCTION

The primary goal of the Philippine Department of Energy (DOE) energy efficiency program is to increase awareness among users of energy in the commercial, industrial, transport and household sectors, on how to use energy efficiently and to promote increased levels of efficiency of energy utilization among these sectors.

DOE has recognized the important role of energy efficiency and energy conservation in achieving its goals of cutting down on energy consumption with the added benefit of reducing environmental emissions. It has implemented and coordinated energy conservation programs, promoted the efficient use of energy, and set energy standards and labelling program for energy intensive devices and equipment.

To conduct performance testing and implement energy standards and labelling programs for energy intensive devices and equipment, the government has set up the first Fuel and Appliance Testing Laboratory (FATL), a neutral test house that can competently verify claims for energy performance and identify energy intensive equipment that will be subject of improvement for energy efficiency.

This report will discuss FATL's experiences, findings, and results obtained in testing lighting systems such as, compact fluorescent lamps (CFLs), incandescent lamps (ILs), linear fluorescent lamps (FLs), and fluorescent lamp ballasts.

I. FUELS AND APPLIANCE TESTING LABORATORY (FATL)

In June 1991, the first Fuel and Appliance Testing Laboratory (FATL) in the Philippines was inaugurated. FATL presently exists as a government testing laboratory managed and operated by the Department of Energy, the government agency mandated to formulate, plan, monitor, implement, and coordinate policies and programs in the field of energy.

The FATL was established to conduct energy performance tests on electrical household appliances and lighting systems as well as to serve the energy testing requirements of the industry sector. The establishment of FATL served as the key to the institutionalization of energy standards and labeling in the country.

In addition, FATL aims to contribute to the national objective of ensuring adequate energy and power supply for sustaining the country's economic growth. At the same time it aims to be recognized as a full-fledged laboratory authorized to issue test certificates for industrial fuels, equipment, and appliances from the point of view of energy consumption and efficiency.

II. PHILIPPINE HOUSEHOLD ENERGY CONSUMPTION SURVEY (HECS)

In 1995, a household energy consumption survey (HECS) was conducted by the National Statistics Office (NSO) and Department of Energy. It served to update the first survey conducted in 1989. The survey

provided a comprehensive overview of electricity use of households nationwide including those utilizing electricity from non-conventional energy.

The total number of household in 1995 was 12.8 million of which 83.90% had electricity. The number of household was 14.6 percent higher than the 1989 figure of 11.2 million.

The 1995 survey showed a rising level of households energy demand from 1989. This could have been driven by population increase, economic performance, urbanization and rural to urban migration.

HECS end-use data disclosed most Filipino households (80%) used electricity to light homes and the average household spends up to 25% of its monthly electric bill on lighting.

III. THE PHILIPPINE APPLIANCE ENERGY STANDARDS AND LABELING PROGRAM

The Philippine appliance energy efficiency certification and labeling program is a government driven initiative. It is a joint program of the Philippine Department of Energy and the Department of Trade and Industry – Bureau of Product Standards (BPS).

The appliance energy standard and labelling program is a combination of regulatory efficiency standards and energy labelling. Some products like “Aircon” are covered by both efficiency standard and labelling. Others like refrigerators and freezers are covered just by the energy label requirement.

The program uses the comparison type of labelling which allows the consumers to compare the energy cost of competing brands and models of similar size, capacity or rating and other features.

The program aims to reduce monthly electricity bills for end users, eliminate the least efficient products in the local market and encourages manufacturers to improve product efficiency to make their product more competitive in the world market. This in turn results in significant benefits to the country in achieving energy self-sufficiency, and contributes to the reduction of greenhouse gas emission.

Under the Appliance Energy Standards and Labeling Program, priority was given to room air-conditioners (non-ducted), household refrigerators and freezers, fluorescent lamp ballasts and compact fluorescent lamps because of the magnitude of potential energy savings in these equipment and because their use coincides with peak demand.

A. NON-DUCTED ROOM AIRCONDITIONERS.

The room air conditioner “Aircon” was the first product to be covered by the program. Started in 1993, the Aircon program requires all models imported or locally-manufactured to pass a minimum efficiency level and to carry the prescribed energy guide label before they can be sold in the market.

The Aircon program motivated the manufacturers to improve their product by using more energy efficient components (compressors, evaporators, condensers etc.). As a result, the energy efficiency level of aircon models sold in the country increased by up to 100% during the last ten years.

The program covers split and non-ducted window-wall type units with maximum cooling capacity of 36,000 kJ/h.

B. HOUSEHOLD REFRIGERATORS AND FREEZERS

DOE initiated in 1995 the development of certification and labeling program for household refrigerators and freezers. The refrigerator/freezer program was launched in 1999 and became mandatory toward the end of 2000. The program covered household refrigerators with storage volume capacity (total volume of refrigerator and freezer compartments) of 142 to 267 litres (5-8 cubic feet).

C. LABORATORY STUDY ON PERFORMANCE OF LIGHTING SYSTEMS

1. *Electromagnetic Ballast¹*

Fluorescent lamp and ballast operate as a unit to produce light. The ballast is an integral and important control gear for the operation of a fluorescent lamp lighting system. The electromagnetic type is the predominantly used ballast in the country. Based on FATL estimates, there were more than 2.5 million ballast sold, hence annually installed in new buildings, residential houses, and industrial and commercial establishments. Ballasts actually consumed about 30% (or more in some inefficient ballasts) of the lighting fixture energy consumption.

With the new ballast production technology by the use of more energy efficient materials such as high grade silicon steel wrapped with copper windings, ballast energy consumption could be reduced by 50% from the normal consumption of 10 watts and above. The so called “low loss ballasts” which are currently introduced, consume only about 6 watts for 20 and 40-watt rated lamps.

In 1997, DOE-FATL completed the testing and evaluation of 90 various brands and models of electromagnetic ballast sold in the local market. Based on the test results the power consumed by the ballasts ranged from 10 to 12 watts for 20-watt ballasts and 12 to 20 watts for 40-watt ballasts.

With the above findings, FATL initiated the formulation of an energy standard rating for electromagnetic ballast based on the data gathered. After a series of consultative meetings with the stakeholders, a standard for energy labelling of ballasts has been agreed upon.

2. *Linear/Tubular Fluorescent Lamps*

In 1996, a private organization requested DOE to conduct a study to determine if the 18 watt and 36 watt, T8 linear fluorescent lamps are more efficient than the 20 watt and 40 watt, T12 lamps, respectively. The study focused on performance testing of these lamps.

The main objective of the study is to promote on a large scale the use of 18 watt and 36 watt to residential and commercial sectors and total phasing out of 20 and 40 watt lamps.

DOE-FATL and two (2) major manufacturers of lamps in the Philippines utilized their testing laboratories for the study. A total of 140 lamps of well known brands were tested.

Based on test results, the 40 watt lamp produced 10% to 12% higher light output compared with the 36 watt lamps. The test result also showed that the 36 watt lamps have no efficiency advantage over the 40 watt.

The same results were observed for the 20 watt and 18 watt lamps. Due to these findings, the move to propose the phasing out of the 20 and 40 watts lamps did not gain support.

3. *DOE-World Bank Study on Lighting Systems*

In 1994, with technical and financial assistance from World Bank Alternative Energy Unit (ASTAE), ASIA Technical Department, DOE through its Fuels and Appliance Testing Laboratory conducted performance testing of various brands and wattages of incandescent lamps and compact fluorescent lamps sold in the local market. The research and testing procedure were designed to determine the lumens output (light output) and operating hours, and to model the demand of these types of lamps on electricity supply system in the Philippines and to assess benefits to end users of improving their efficiency.

The following tests were carried out in accordance with internationally known standard:

¹ Electromagnetic ballast is also known as “core and coil ballast”, “choke ballast”, “conventional ballast”, and “ferromagnetic ballast”.

- Life-testing of incandescent lamps and CFLs at pre-determined supply voltages and pre-determined on/off switching cycles.
- Measurement of CFL and incandescent lumens output, power consumption, and power factor at different time intervals.

The test results were used to develop data for direct comparisons between compact fluorescent lamps and incandescent lamps.

3.1 COMPACT FLUORESCENT LAMPS

The main objective of testing compact fluorescent lamps (CFLs) was to develop a lighting strategy to promote on a large scale the use of efficient CFLs instead of incandescent lamps to the residential and commercial sectors. A total of more than 350 compact fluorescent lamps from 6 manufacturers were tested.

Based on claims, CFL' are designed or rated to last from 6,000 to 8,000 hours, meaning that for a given batch (samples to be tested at one time), 50% should survive up to 6,000 to 8,000 hours and the other 50% may fail before reaching their rated life and give off light 4 to 5 times more than an incandescent lamps.

The results of the tests showed that most of the "integral"² type CFLs lived up to their rated life when subjected to 230 volts nominal voltage supply. Some brands even reached beyond 8,000 hours before posting 50 percent failure. The "modular"³ type CFLs are even more enduring, all reached 10,000 hours before registering failure.

The results showed majority of "integral type" of CFLs fail prematurely under low voltage supply (207 volts). Among the seven major brands that were tested, only two brands had models that lasted beyond 8,000 hours of burning life. At the same input voltage , the "modular type" of CFLs exceed their rated life.

3.2 INCANDESCENT LAMPS

On the same study, a total of 75 incandescent lamps were tested from 3 major brands. Based on the test results all incandescent lamps failed to reach the 1,000 operating hours under a switching cycle of 2 hours and 45 minutes "on" and 15 minutes "off" at a test voltage of 230 volts.

Incandescent lamps are expected to last 1,000 operating hours at rated voltage. The average operating hours of the tested lamps was 640 hours. This indicate that the incandescent lamps being sold in the Philippines are of poor quality or designed for a low operating voltage.

4. CFL In-House Testing of Compact Fluorescent Lamps

Because of reported early failures and proliferation of uncertified CFLs, the Department of Energy's-Energy Utilization Management Bureau 120 samples of 2U bare lamp electronic type of CFLs offered for sale in sidewalks and retail shops for verification testing to determine their electrical characteristics as well as the level of lumen maintenance. These compact fluorescent lamps are being sold in the market at approximately 3 pcs. for Php 100.00 (3 pcs. for US\$ 2.00)

In June 2000 the tests on electrical characteristics and lumen maintenance were completed. Based on the test results, 76 out of 120 of the test samples failed to reach 2,000 operating hours when subjected to a switching cycle of 2 hours and 45 minutes "on" and 15 minutes "off" at a test voltage of 230 volts.

² a unit that cannot be dismantled without being permanently damaged, provided with the lamp cap and incorporating a light source and any additional element necessary for starting and stable operation of the light source.

³ a separate lamp tube and medium screw base ballast operating together as a unit. Lamp can be replace without replacing the ballast

All test samples failed in the power input test. The average difference between the initial average measured power input and rated wattage of the test samples is -50.25% way below the standard requirement of +/- 15%. The average lumen maintenance of the twenty samples is 65.53%.

5. Compact Fluorescent Lamp Certification Testing

Since 1998 DOE and DTI have been implementing a certification program for CFLs with DOE-FATL conducting the performance requirements (photometric and electrical characteristics) and DTI-BPS for safety requirements. For the period January to December 2000, FATL completed the electrical characteristics and lumen maintenance tests on 44 various models of CFLs.

IV. DEVELOPMENT/REVIEW OF PHILIPPINE NATIONAL STANDARDS ON LAMPS AND RELATED PRODUCTS

DOE actively participated in the development, formulation and review of energy labelling program for fluorescent lamp ballasts, compact fluorescent lamps and other lamp accessories.

The implementation of the energy labelling program in lighting system is based largely on Philippine National Standards which were formulated and developed by the BPS-Technical Committee Lamps and Related Equipment (TC-4) composed of representatives from industry organizations, manufacturers, academe, government, trade, industry, professional organizations, and consumer group and other concerned parties.

The standards for lighting systems have been developed in support of the DOE’s objective of promoting energy efficient products as a strategy for achieving energy self-sufficiency, contributing to the reduction of greenhouse gas emission and serving as guide to consumers in determining which products is less costly to operate.

A. FLUORESCENT LAMP BALLAST

In November 2000, the Bureau of Product Standards approved and endorsed the implementation of PNS 12-3:1999 “Lamps and related equipment-Electromagnetic ballast-Energy standards and labelling requirements”

This standard prescribes the maximum power loss and labelling requirements of electromagnetic ballasts. Suppliers and importers are required to label the individual fluorescent lamp ballast the power consumed by the ballast or the power loss. (Power loss is defined as the power consumed by the ballast when operating fluorescent lamps at standard test conditions). Implementing guidelines or the written agreement with the stakeholders have been completed.

Classification of Maximum Ballast Power Loss

Table 1 – Preheat ballast power loss

Ballast rating	Class A	Class B	Class C	Class D
1 x 18/20 W 1 x 36/40 W	≤ 7 W	> 7 W ≤ 8 W	> 8 W ≤ 10 W	> 10 W ≤ 12 W

Table 2 – Rapid-Start Ballast Power Loss

Ballast rating	Class A	Class B	Class C	Class D
1 x 18/20 W 1 x 36/40 W	≤ 12 W	> 12 W ≤ 13 W	> 13 W ≤ 15 W	> 15 W ≤ 18 W
2 x 36/40 W	≤ 17 W ≤ 20 W	> 17 W ≤ 30 W	> 18 W	> 20 W

The implementation of Energy Labelling and Certification Program for Electromagnetic Ballast will commence on February 01, 2001 and the market monitoring to verify compliance of manufacturers and retailers on the labelling program will start February 01, 2002.

The program requires the display of an energy label sticker that will allow the buying public to compare electromagnetic ballast offer for sale based on maximum ballast loss.

The maximum ballast power loss is subject to periodic review of the BPS Technical Committee on Lamps and Related Equipment (TC-4).

B. COMPACT FLUORESCENT LAMPS

On December 5, 2000, TC-4 approved the amendment to PNS 603 Part 2: 1993 Amd. 1:2000 (identical to IEC 969:1988) "Amendment 1 to Lamps Self-Ballasted Lamps for General Lighting Services Part 2: Performance Requirements".

When implemented, all manufacturers, suppliers and importers will be required to label the individual lamp with mark of origin which may take the form of trademark of the manufacturer's name, rated supply voltage, power input to the lamps and supply frequency. In addition to lamp markings, other information such as rated average life, % lumen maintenance, line current and other electrical characteristics shall be made available in the lamp packaging or in manufacturer's catalogue. Hence, consumers will benefit in terms of improved product quality and better product information.

The mandatory implementation of Energy Labelling and Certification Program for compact fluorescent lamps is currently being considered by the technical committee.

VI. CONCLUSION AND RECOMMENDATION

In view of the laboratory tests conducted and results gathered by FATL, it is recommended that claimed performance of various lighting systems particularly new lighting technologies be verified through laboratory tests before adoption.

Policy recommendations should be based not only on the technical aspect, but also on the social and economic impact.

The government should put in place an effective monitoring scheme to ensure compliance of manufacturers, importers and retailers to the energy labelling program.

VII. REFERENCES

Department of Energy-Energy Planning and Monitoring Bureau. "*Philippine Energy Plan 2000-2009*".

Department of Energy and National Statistics Office, "*1995 Household Energy Consumption Survey*", July 1999

Divinagracia, Iryzhar M. "*Report on the Performance Study of Linear Fluorescent Lamps*", April 1997 (unpublished report)

Fuels and Appliance Testing Laboratory (FATL) brochure, undated

The World Bank-The Asia Alternative Unit, "*Compact Fluorescent Lamps in the Philippines: A Technical Performance and Market Assessment*" October 1996.

Zabala, Arturo M. "*Certification and Labelling Program for Lamp Ballast-A Philippine Experience*". Technical paper presented at Asia-Pacific Economic Cooperation-Steering Group on Energy Standards' APEC Workshop on Setting-up and Running an Energy Performance Testing Laboratory, Manila, Philippines, 6-8 July 1999.

He attended fellowship trainings on electrical appliance and lighting systems testing, standard formulation and implementation sponsored and organized by UNDP/UNIDO, USAID, World Bank, and International Institute for Energy Conservation (IIEC).