Energy Efficiency Standards Subcommittee, Advisory Committee for Natural Resources and Energy

Luminaire Evaluation Standards Subcommittee

Final Report (bulb type fluorescent lamp)

For the luminaire which uses the fluorescent lamp only as the main light source (hereinafter referred to as “fluorescent lamp luminaries”), the evaluation standards of manufacturers for the fluorescent luminaire in the final report of the Fluorescent Lamp Luminaire Evaluation Standards Subcommittee, Energy Efficiency Standards Subcommittee, Advisory Committee for Natural Resources and Energy (December 17, 1998) were determined and FY2005 was the target year.
To study the new target value of luminaires including bulb type fluorescent lamps that are not currently covered, the Luminaire Evaluation Subcommittee was established, the evaluation standards of luminaire manufacturers or importers (hereinafter referred to as “manufacturers” were discussed and the final report was prepared as follows.
For fluorescent lamp luminaires, the interim report was prepared at the subcommittee (4th) held in December, 2008 and it was reported at the Energy Efficiency Standards Subcommittee held in the same month. The bulb type fluorescent lamp was continuously discussed at the subcommittee and the following final report (draft) was prepared.

1. Designated equipment [Refer to Attachment 1]

Bulb type fluorescent lamp. This excludes the reflector type, light control type, color lamp, black light, chicken house type, transparent type and separate ballast type.

2. Evaluation parameters for manufacturers, etc.

(1) Target fiscal year [Refer to Attachment 2]

FY2012

(2) Target standard values [Refer to Attachments 3 and 4]

With respect to bulb type fluorescent lamp luminaires from each manufacturer, etc. that ships within Japan during the target fiscal year, the average of the energy consumption efficiency (lm/W) measured in (3) weighted by the number of units shipped by each manufacturer, etc. for each category in the table below shall not exceed the target standard values.

Table 1 Classification of bulb type fluorescent lamps and target standard values

Category	Lamp size	Lamp light color	Lamp shape	Top runner value (lm/W)	Target standard value (lm/W)
1	10W type	Bulb color		60.6	60.6
2		Daylight white		58.1	58.1
3		Daylight		55.0	55.0
4	15W type	Bulb color		67.5	67.5
5		Daylight white		65.0	65.0
6		Daylight		60.8	60.8

7	25W type	Bulb color	D type	72.4	72.4
8			Non-D type	69.1	69.1
9		Daylight white	D type	69.5	69.5
10			Non-D type	66.4	66.4
11		Daylight	D type	65.2	65.2
12			Non-D type	62.3	62.3

(3) Measurement method for energy consumption efficiency

[Refer to Attachment 5]

The energy consumption efficiency of bulbs shall be the value obtained by dividing the total luminous flux (lm) of bulbs by the power consumption (W) of bulbs.

$$\text{Energy consumption efficiency (lm/W)} = \frac{\text{Total luminous flux of bulbs (lm)}}{\text{Power consumption (W) of bulbs}}$$

The total luminous flux and the power consumption of bulb type fluorescent lamps shall be measured by the method specified in JIS C 7801 and the method specified in the total luminous flux and lamp power consumption of JIS C 7620-2 “Self-ballasted fluorescent lamps - Part 2: Performance specifications”.

(4) Labeling related matters

1) Items for labeling shall be as follows:

a) Part name and type name
b) Category name
c) Total luminous flux
d) Power consumption
e) Energy consumption efficiency
f) Name or title of manufacturers

2) Compliance items

a) The total luminous flux shall be indicated by lumen (lm).
b) The power consumption shall be indicated by watt (W).
c) The energy consumption efficiency shall be indicated to the first decimal place by lumen for each watt (lm/W).
d) The labeling items shall be indicated on the catalogs.

4. Recommendation on energy saving

(1) Efforts by users

1) With effective use of energy saving information, users shall try to select products with high energy consumption efficiency.
2) Incandescent lamps shall be changed to products with excellent energy consumption efficiency such as bulb type fluorescent lamps.
3) When using luminaires, daylight, light control function, human sensing function Note 1, initial illumination intensity compensation function Note 2, multi-lamp distribution method Note 3, etc. shall be effectively used. Energy should be saved with efficient use including appropriate illumination.
4) Regular cleaning or replacement of lamps should be performed to reduce low illumination efficiency arising from use for a long time.

Note 1) The human sensing function is an automatic off or light control function when no one is present, which detects humans with a sensor.

Note 2) The initial illumination intensity compensation function is a function to control excessive illumination at the initial stage and to maintain constant illumination until the end of the lamp service life.

Note 3) The multi-lamp distribution method is an illumination method to improve the lighting environment and to save energy by placing multiple luminaires in one room and turning lights on only at necessary areas in order to control total power consumption.

(2) Efforts by designer for selection of luminaires

1) With effective use of energy saving information, users shall try to select products with high energy consumption efficiency.
2) Incandescent lamps shall be changed to products with excellent energy consumption efficiency such as bulb type fluorescent lamps.
3) When using luminaires, daylight, light control function, human sensing function, initial illumination intensity compensation function, multi-lamp distribution method, etc. shall be effectively used. Energy should be saved with efficient use including appropriate illumination.

(3) Efforts by sellers

1) To encourage the change of products from incandescent lamps to bulb type fluorescent lamps with better energy saving performance, users shall be educated to better understand products with excellent energy saving performance and sales shall be promoted.
2) In selection of luminaires by users, use functions effective for reduction of energy such as the light control function according to the room size, and provide information including use of the multi-lamp distribution method so that users may choose excellently efficient luminaires.

(4) Efforts by manufacturers, etc.

1) Facilitate technological development for energy saving for bulb type fluorescent lamp luminaires and try to develop products with excellent energy consumption efficiency.
2) In order to promote bulb type fluorescent lamp luminaires with excellent energy consumption efficiency, quickly adopt energy saving information on the brochures. Also, try to provide appropriate information so that users will choose bulb type fluorescent lamp luminaires with excellent energy consumption efficiency.
3) Try to facilitate understanding of users on products with excellent energy saving performance such as bulb type fluorescent lamps. Also, try to provide labeling so that users may easily select indicated bulb type fluorescent lamps instead of incandescent lamps when purchasing.
4) In order to make the change from incandescent lamps to bulb type fluorescent lamps, try to solve technical problems such as the start-up of bulb type fluorescent lamps or compatibility with luminaires for ease of operation.
5) Try to use functions effective for reduction of energy such as use of daylight, the light control function, human sensing function and initial illumination intensity compensation. Make the control system combined with these functions or multi-lamp distribution method at homes popular, and provide information to achieve energy saving with appropriate and efficient use of luminaires.

(5) Efforts by government

1) In order to make the change from incandescent lamps to bulb type fluorescent lamps with excellent energy consumption efficiency, try to utilize promotional campaigns and other necessary measures to facilitate efforts by the users and manufacturers, etc.
2) Try to use products with excellent energy consumption efficiency at office buildings.
3) Periodically and continuously monitor labeling practice by the manufacturers, etc. and try to apply appropriate laws so that users are provided with correct and easy-to-understand information regarding energy consumption efficiency.
4) The energy saving standards based on the top runner approach are very effective ways to save energy on equipment. Try to promote this approach to the world at the optimum opportunities.

Attachment 1

The scope of designated bulb type fluorescent lamps

1. Basic concept

The evaluation standards for luminaires in this report shall only apply to bulb type fluorescent lamps.

The following items are excluded because the usage is special and the shipment units are limited.

Type	Application	Remark
Reflector type	Type with mirror. It is used for special purpose such as shops.	Not applicable to JIS
For light control	Light can be controlled in the range from 100 to 10% with a dimmer control. It is mainly used for business purposes.	
Color lamp	Red, green and blue lamps are available and they are used for show illumination.	Not applicable to JIS
Black light	Visible light is hardly radiated.	Not applicable to JIS
For chicken house	Lamps used for chicken house It is a drip-proof type.	
Transparent type	G type lamp using transparent glass It is mainly used for business purposes.	
Total of items excluded		285,000 (1.3%)
Total of designated items		22,270,000 (98.7%)
Grand total		22,555,000 (100%)

For the separate ballast type, the market is small and the shipment units are limited. The test method is not specified in the JIS standard. At present, it is not included for review in this report. If it is considered appropriate to review it due to change of the shipment units, a necessary review will be performed.

Attachment 2

Target fiscal year, etc. of the bulb type fluorescent lamp

1. Since the period for development of a new product is usually 3 years, it is necessary to have at least one or two opportunities of product development for bulb type fluorescent lamps until the target fiscal year.
   Therefore, the target year of bulb type fluorescent lamps shall be FY2012.

2. The improvement ratio of the energy consumption efficiency in the target year will be approximately 3.2% assuming that the current number of shipping units (record in 2006) and the category structure are not changed.

<General description of calculation>

○ Overall bulb type fluorescent lamp

(i) Energy consumption efficiency calculated from the record values of bulb type fluorescent lamps shipped in FY2006 63.4 lm/W

(ii) Energy consumption efficiency calculated from the target standard value of bulb type fluorescent lamps shipped in the target fiscal year 65.4 lm/W

(iii) Improvement ratio of energy consumption efficiency

$$\frac{(65.4-63.4)}{63.4} \times 100 = \text{Approximately } 3.2\ \%$$

[10W type]

(i) Energy consumption efficiency calculated from the record values of bulb type fluorescent lamps shipped in FY2006 56.2 lm/W

(ii) Energy consumption efficiency calculated from the target standard value of bulb type fluorescent lamps shipped in the target fiscal year 58.4 lm/W

(iii) Improvement ratio of energy consumption efficiency

$$\frac{(58.4-56.2)}{56.2} \times 100 = \text{Approximately } 3.9\ \%$$

[15W type]

(i) Energy consumption efficiency calculated from the record values of bulb type fluorescent lamps shipped in FY2006 62.9 lm/W

(ii) Energy consumption efficiency calculated from the target standard value of bulb type fluorescent lamps shipped in the target fiscal year 65.1 lm/W

(iii) Improvement ratio of energy consumption efficiency

$$\frac{(65.1-62.9)}{62.9} \times 100 = \text{Approximately } 3.5\ \%$$

[25W type]

(i) Energy consumption efficiency calculated from the record values of bulb type fluorescent lamps shipped in FY2006 67.4 lm/W

(ii) Energy consumption efficiency calculated from the target standard value of bulb type fluorescent lamps shipped in the target fiscal year 68.6 lm/W

(iii) Improvement ratio of energy consumption efficiency

$$\frac{(68.6-67.4)}{67.4} \times 100 = \text{Approximately } 1.8\ \%$$

Attachment 3

Categories of bulb type fluorescent lamps

1. Determination of new categories for fluorescent luminaries

Since the energy consumption efficiency (lm/W) of bulb type fluorescent lamps are affected by the following factors, the categories shall be classified taking the factors into account.

(1) Lamp size

For the bulb type fluorescent lamp, the three types 10W, 15W and 25W are standardized as “lamp size” in JIS C 7651. Since each application is different, categories are determined by lamp size.

The10W type is equivalent to 40W incandescent lamps, the 15W type is equivalent to 60W lamps and the 25W is equivalent to 100W lamps.

(2) Lamp light color

Light colors of the bulb type fluorescent lamp can be classified into three types of bulb color, daylight white and daylight. Differences in light color are differences of fluorescent materials applied to the inner surface of the lamp glass. Since this difference affects the value of the total luminous flux (lm), categories are determined by the lamp light color.

(3) Lamp shape

Available shapes of the bulb type fluorescent lamps are Type A in general shape, Type T which is formed to a narrow cylinder of Type A, Type G in a ball shape and Type D which has an exposed light source without a glass globe. In particular, the lamp size of 25W has a large heat value in the lamp. Since there are differences in the energy consumption efficiency values between Type D which is good for heat radiation and Types A, T and G which are not good for heat radiation, the lamp size of 25W is categorized by the lamp shape.

Table 1 Categories of bulb type fluorescent lamps

Lamp size	Lamp light color	Lamp shape	Shipment ratio (%)
10W type	Bulb color		4.7%
	Daylight white		1.7%
	Daylight		3.0%
15W type	Bulb color		35.5%
	Daylight white		10.0%
	Daylight		19.4%
25W type	Bulb color	D type	8.9%
		Non-D type	5.6%
	Daylight white	D type	2.6%
		Non-D type	2.4%

	Daylight	D type	1.9%
		Non-D type	4.3%

(Reference) Lamp shape

Type A

Type T

Type G

Type D

Attachment 4

Target standard value of bulb type fluorescent lamps

1. Basic concept

Target standard values are set based on the top runner approach. The specific concept is stated below:

(1) A target standard value shall be set for each appropriate category of classification.

(2) If efficiency is expected to improve as a result of future technological advancement, the best effort shall be made to include such improvements in a target standard value.

(3) Target standard values shall be consistent from category to category.

2. Room to improve energy consumption efficiency through future technological advancement

Since the bulb type fluorescent lamp uses small power consumption of approximately 10 to 20W, technical innovation which will significantly reduce the power consumption will not be expected in the future. The government is now encouraging a campaign of change from incandescent lamps to bulb type fluorescent lamps. Manufacturers are focusing on the engineering development of small ballasts to improve operation of bulb type fluorescent lamps. Engineering development to improve operation of the lamps generally reduce the energy consumption efficiency. Manufacturers shall also develop a technology to compensate this low efficiency. Therefore, at present, it is difficult to improve energy saving technology that exceeds the top runner value.

Table 1 Engineering development example for improved operation of bulb type fluorescent lamps

Engineering development for improved operation	Technology example	Example of improvement	Low efficiency (Estimation)
(1) Improvement of brightness start-up	Built-in small lamp	Brightness 1 second after start Improved from 30 to 40% to 60%.	△7%
	Improvement of mercury amalgam (assumption)		△5 to 7%
(2) Improvement of color rendition	Improvement of fluorescent material (assumption)	Improvement of color rendition to be close to the color of incandescent lamps Improved from Ra* 84 to 94.	△5%

* Ra: Index to represent true reproducibility of color Incandescent lamp has Ra 100.

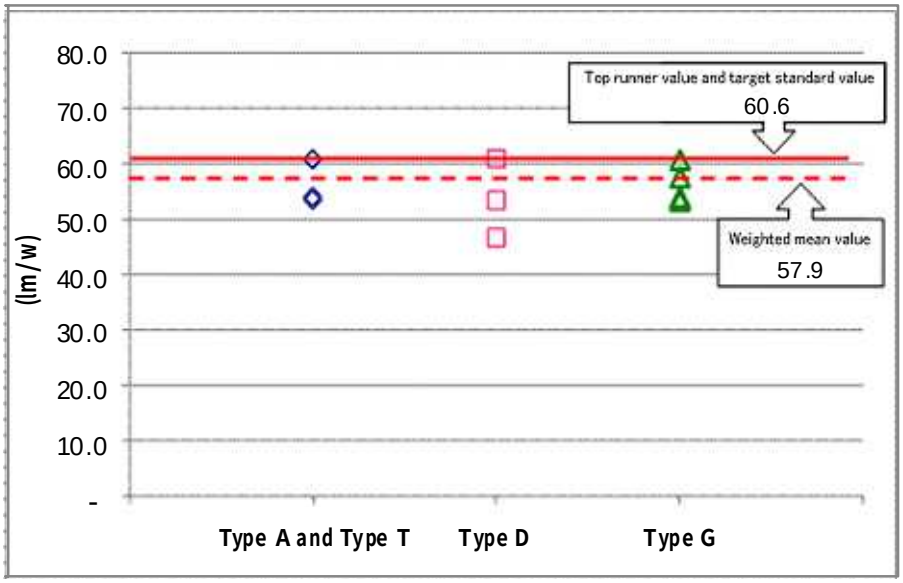
3. Determination of specific target standard values

In determination of the target standard values, as explained above, it is difficult to make an improvement that exceeds the current top runner value. The top runner value is determined as the target standard value.

Table 2 Classification of bulb type fluorescent lamps and target standard values

Category	Lamp size	Lamp light color	Lamp shape	Top runner value (lm/W)	Target standard value (lm/W)
1	10W type	Bulb color		60.6	60.6
2		Daylight white		58.1	58.1
3		Daylight		55.0	55.0
4	15W type	Bulb color		67.5	67.5
5		Daylight white		65.0	65.0
6		Daylight		60.8	60.8
7	25W type	Bulb color	D type	72.4	72.4
8			Non-D type	69.1	69.1
9		Daylight white	D type	69.5	69.5
10			Non-D type	66.4	66.4
11		Daylight	D type	65.2	65.2
12			Non-D type	62.3	62.3

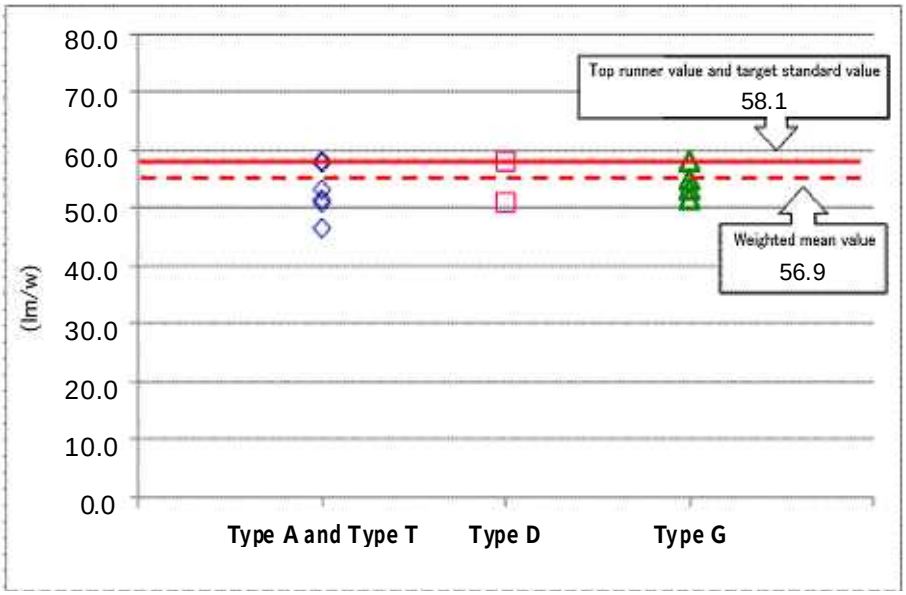
Fig. 1 (Category 1) Distribution of 10W lamp color energy consumption efficiency



Ratio of shipment units

- Type A and Type T: 50.8%
- Type D: 42.8%
- Type G: 6.3%

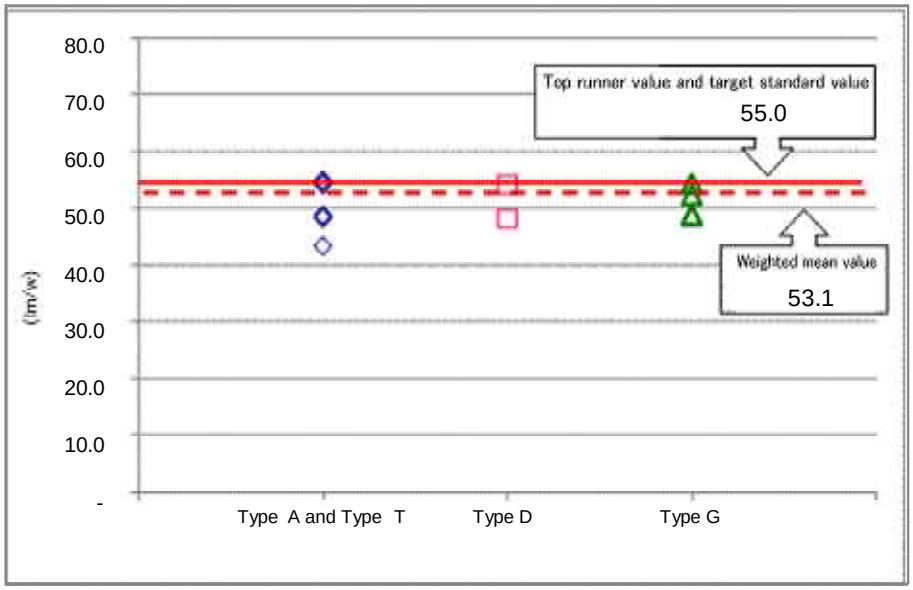
Fig. 2 (Category 2) Distribution of 10W daylight white energy consumption efficiency



Ratio of shipment units

- Type A and Type T: 60.7%
- Type D: 32.8%
- Type G: 6.5%

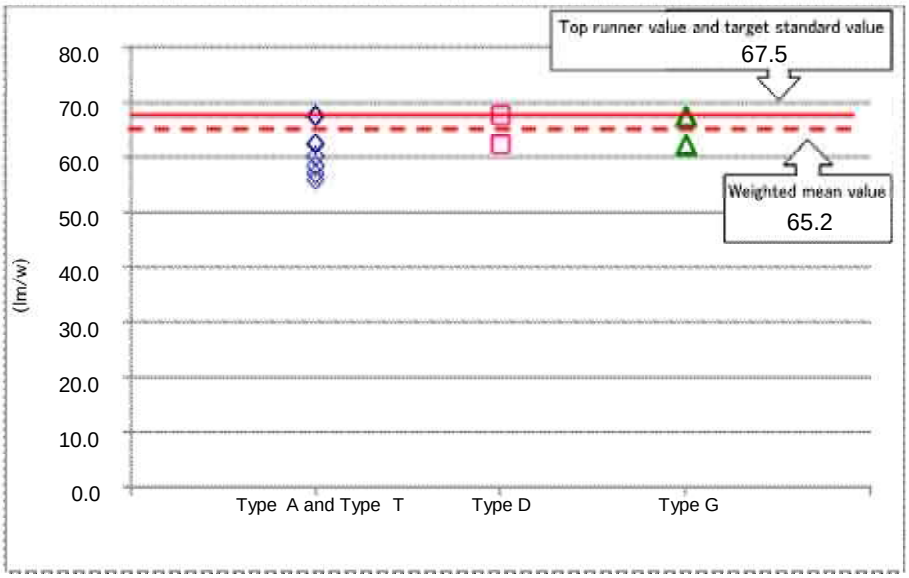
Fig. 3 (Category 3) Distribution of 10W daylight energy consumption efficiency



Ratio of shipment units

- Type A and Type T: 58.9%
- Type D: 34.9%
- Type G: 6.2%

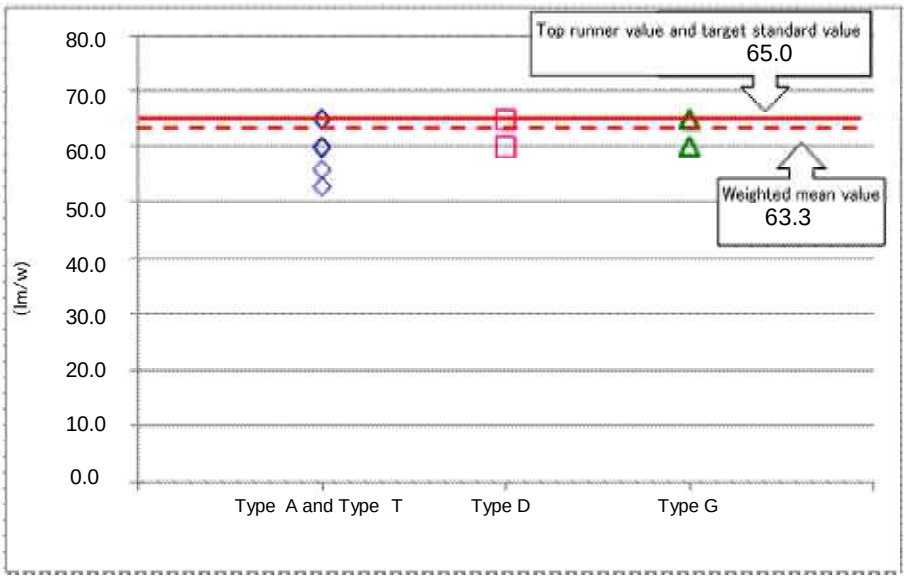
Fig. 4 (Category 4) Distribution of 10W lamp color energy consumption efficiency



Ratio of shipment units

- Type A and Type T: 53.9%
- Type D: 34.8%
- Type G: 11.2%

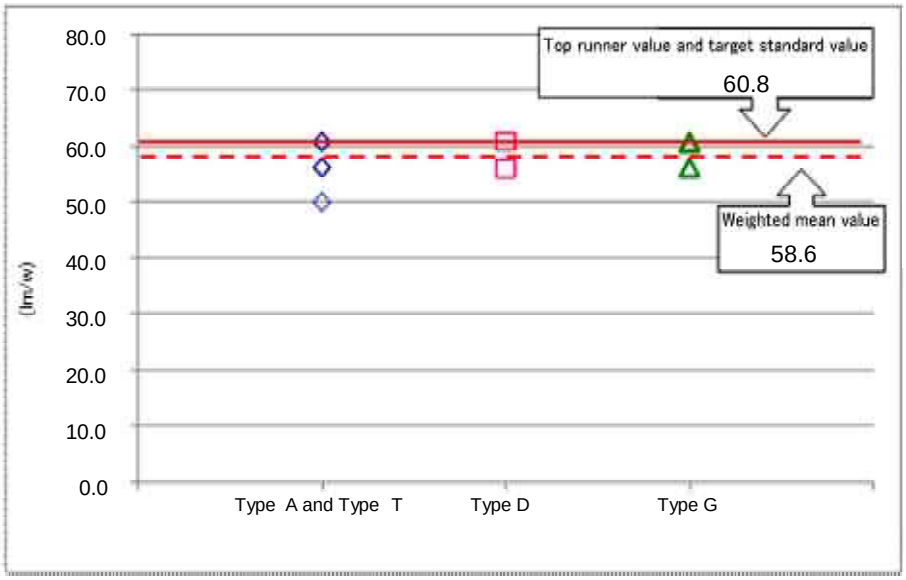
Fig. 5 (Category 5) Distribution of 10W daylight white energy consumption efficiency



Ratio of shipment units

- Type A and Type T: 51.3%
- Type D: 32.4%
- Type G: 16.3%

Fig. 6 (Category 6) Distribution of 10W daylight energy consumption efficiency



Ratio of shipment units

- Type A and Type T: 65.9%
- Type D: 16.8%
- Type G: 17.2%

Fig. 7 (Category 7) Distribution of 25W, lamp color and Type D energy consumption efficiency

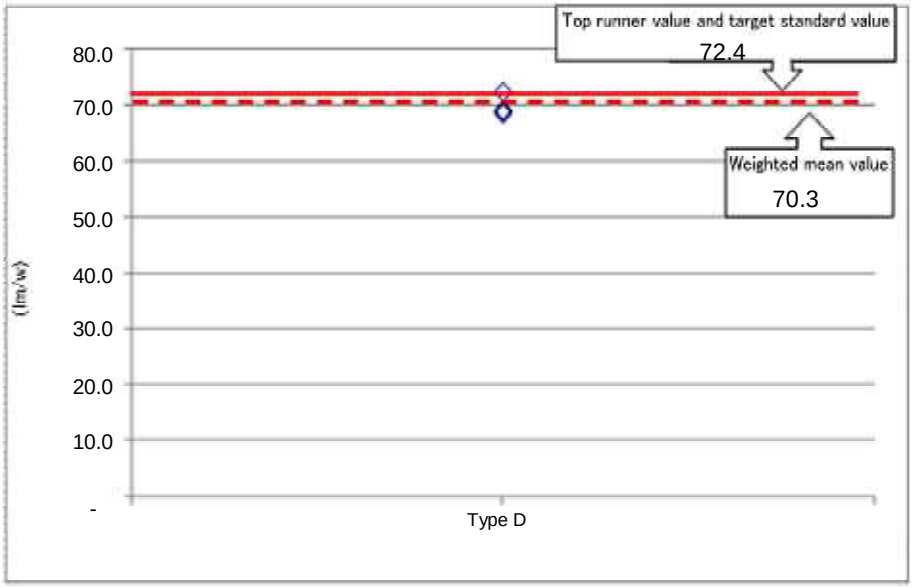
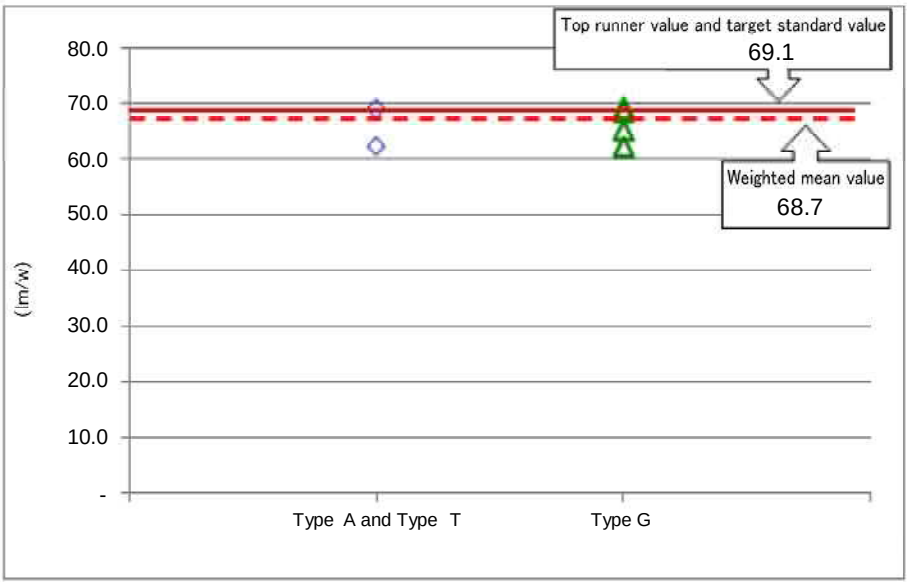


Fig. 8 (Category 8) Distribution of energy consumption efficiency other than 25W, lamp color and Type D



Ratio of shipment units

- Type A and Type T: 55.0%
- Type G: 45.0%

Fig. 9 (Category 9) Distribution of 25W, daylight white and Type D energy consumption efficiency

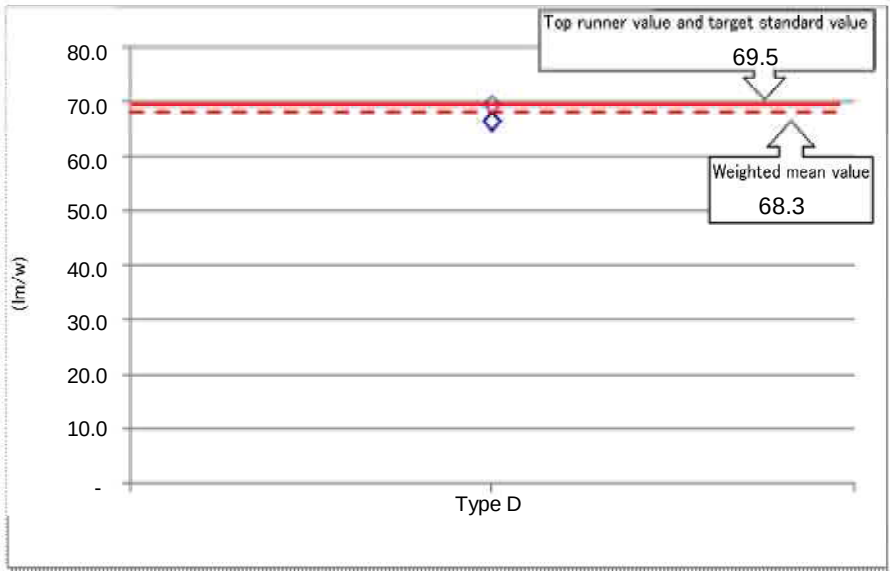
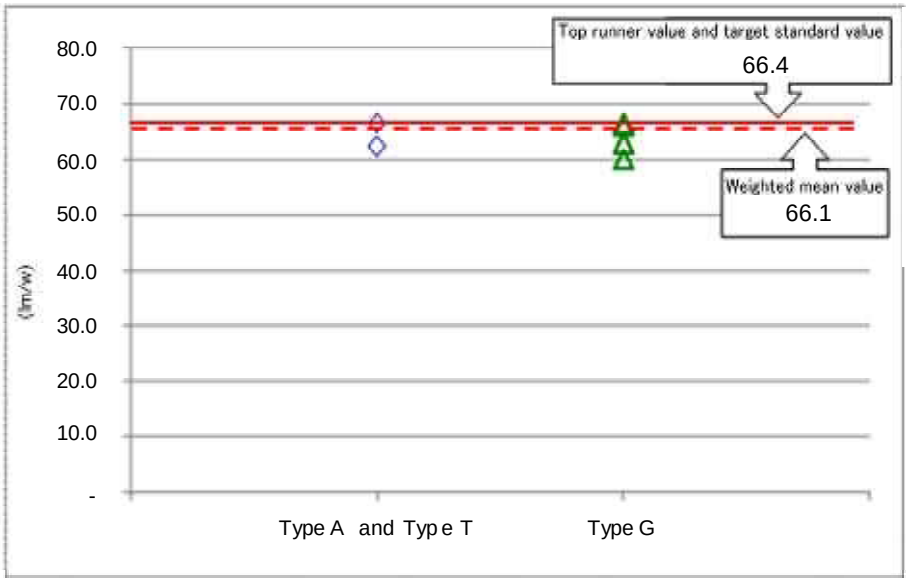


Fig. 10 (Category 10) Distribution of energy consumption efficiency other than 25W, daylight white and Type D



Ratio of shipment units

- Type A and Type T: 59.8%
- Type G: 40.2%

Fig. 11 (Category 11) Distribution of 25W, daylight and Type D energy consumption efficiency

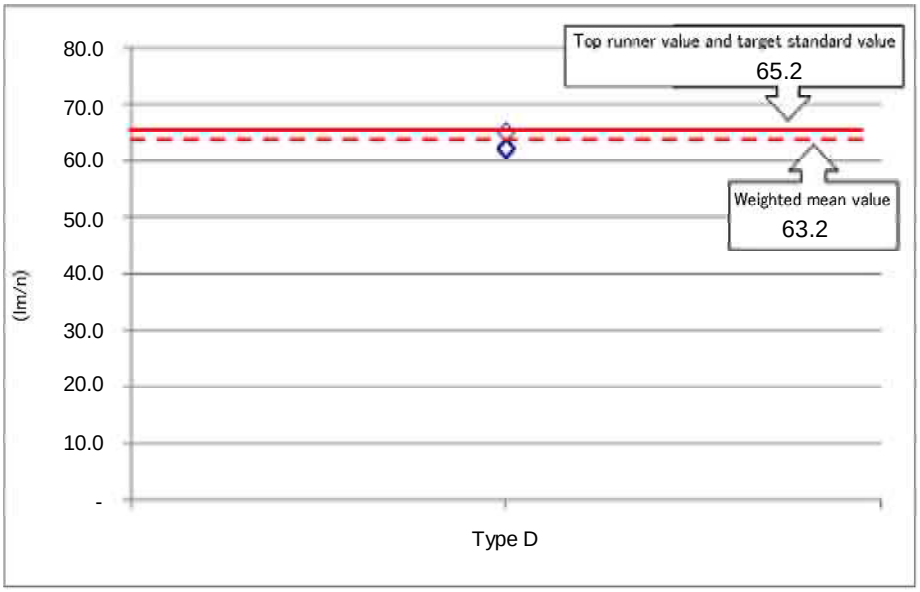
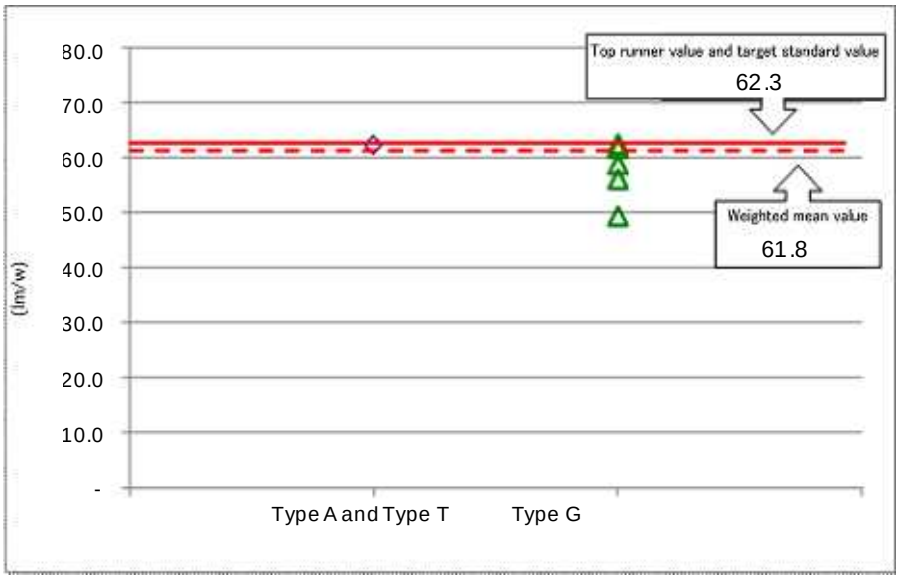


Fig. 12 (Category 12) Distribution of energy consumption efficiency other than 25W, daylight and Type D



Ratio of shipment units

- Type A and Type T: 45.4%
- Type G: 54.6%

Attachment 5

Energy consumption efficiency of bulb type fluorescent lamps and measurement methods

1. Basic concept

Since it is appropriate to use brightness of the bulb type fluorescent lamp as index for calculation of the energy consumption efficiency of the bulb type fluorescent lamp, the total luminous flux (lm/W) per power consumption shall be used.

2. Specific energy consumption efficiency of bulb type fluorescent lamps and measurement methods

(1) Energy consumption efficiency

The energy consumption efficiency of bulbs shall be the value obtained by dividing the total luminous flux (lm) of bulbs by the power consumption (W) of bulbs.

$$\text{Energy consumption efficiency (lm/W)} = \frac{\text{Total luminous flux of bulbs (lm)}}{\text{Power consumption (W) of bulbs}}$$

(2) Measurement methods of energy consumption efficiency

The total luminous flux and power consumption of the bulb type fluorescent lamp shall be measured by the method specified in JIS C 7801 and the method specified in total luminous flux and lamp power of JIS C 7620-2 “Self-ballasted fluorescent lamps - Part 2: Performance specifications”.

Attachment 6

Energy Efficiency Standards Subcommittee, Advisory Committee for Natural Resources and Energy
Luminaire Evaluation Standards Subcommittee
Meeting History

1st Subcommittee meeting (June 12, 2007)

- Making the Luminaire Evaluation Standards Subcommittee open to the public
- Achievement status of fluorescent lamp luminaires
- Current status of luminaires
- The scope of luminaire designation

2nd Subcommittee meeting (August 7, 2007)

- Additional scope of luminaire designation
- Energy consumption efficiency and measurement method

3rd Subcommittee meeting (November 14, 2008)

- Category for target of fluorescent lamp luminaires
- Concept of target standard value for fluorescent lamp luminaires

4th Subcommittee meeting (December 9, 2008)

- Interim report (fluorescent lamp luminaires)
- Review of designation for bulbs and its future study

5th Subcommittee meeting (February 26, 2009)

- Designation of bulb type fluorescent lamps
- Category for target of bulb type fluorescent lamps
- Concept of target standard value for bulb type fluorescent lamps

6th Subcommittee meeting (April 24, 2009)

- Interim report of bulb type fluorescent lamps

Attachment 7

Energy Efficiency Standards Subcommittee, Advisory Committee for Natural Resources and Energy
Luminaire Evaluation Standards Subcommittee

Chairman Kenichi Akiga, Professor/President, Setagaya Learning Center, Open University of Japan

Member Mitsuo Akatsuka, Director of Japan Luminaires Association

Akira Ishihara, Managing Director of Energy Conservation Center
(Participation from 3rd meeting)

Shoichiro Ozeki, Energy/Environment Technology General Manager of Energy Conservation Center
(Participation in 1st and 2nd meetings)

Yoshihiko Ohtani, Professor, Dept. of Electric/Electronic Engineering, College of Industrial Technology, Nihon University

Tamaki Kamata, Researcher of Product Testing Dept., National Consumer Affairs Center of Japan

Sadao Takahashi, Professor, Specializing in Architectural Engineering, Dept. of Construction Engineering, Fukui University of Technology

Yukio Nakano, Senior Researcher, System Engineering Research Laboratory, Central Research Institute of Electric Power Industry

Hiroo Hasegawa, Deputy Dept. Manager, Energy Engineering Research Dept., National Institute of Advanced Industrial Science and Technology

Tetsuji Takeuchi, Executive Vice President, Japan Electric Lamp Manufacturers Association

Atsushi Honda, Japan Building Mechanical and Electrical Engineers Association

Yoshiko Miura, Public Affairs Manager, Japan Consumer's Association

Chiharu Murakoshi, Director and Deputy Manager, Jyukankyo Research Institute Inc.

Current status of luminaires

1. Market of luminaires

1.1 Types of luminaires

Luminaires are classified into the large categories of “facilities (business purposes such as offices, shops or plants)” and “home” depending on the application. They are generally categorized into fluorescent lamp luminaires, incandescent lamp luminaires and high intensity discharge lamps (hereinafter referred to as “HID lamp”) according to the light source type.

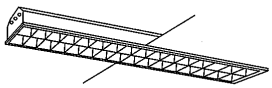
Available fluorescent lamps used for these luminaires are general fluorescent lamps and Hf (for high frequency illumination) fluorescent lamps. Available illumination devices are magnetic ballast and electronic ballast (inverter: high frequency illumination). Types of luminaires for application and their examples are shown below.

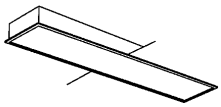
Types of luminaires for application

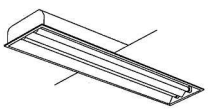
Usage	Light source type	Luminaire type
Luminaire for facilities	Fluorescent lamp	**Fluorescent (1) - Facility, Fluorescent (2) - Facility/home, Fluorescent (2) - Facility**
	Incandescent lamp	**White (1) - Home/facility**
	HID lam	**High - Facility**
Luminaire for home	Fluorescent lamp	**Fluorescent (2) - Facility/home, Fluorescent (3) - Home, Fluorescent (4) - Home**
	Incandescent lamp	**White (1) - Home/facility**
	HID lamp	**High - Home**

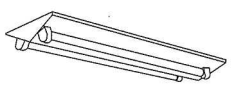
1.1.1 Fluorescent lamp luminaires

(1) Luminaires using fluorescent lamps that are 40W or larger (mainly for facilities) (Fluorescent (1) - Facility)

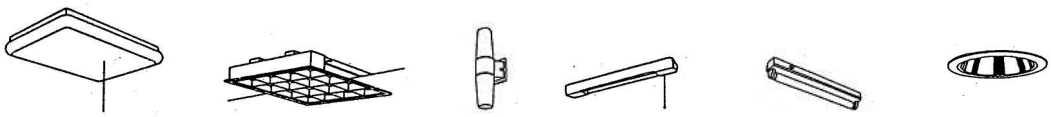

With embedded louver


With embedded cover


Open embedded lower surface


Direct mount (Mt. Fuji type)

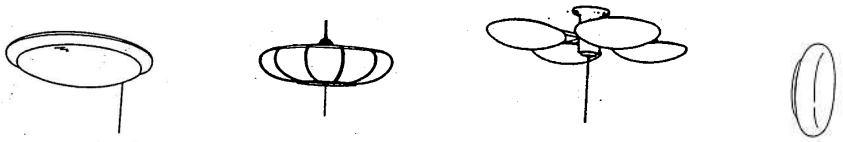
(2) Luminaires using fluorescent lamps that are less than 40W (mainly for home)



Direct mount (with cover) With embedded louver Bracket Direct mount (trough type) Down-light

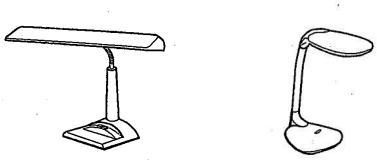
(Fluorescent (2) - Facility/home) (Fluorescent (2) - Facility) (Fluorescent (2) - Facility/Home)

(3) Ring type luminaire (mainly for home) (Fluorescent (3) - Home)



Direct mount type (with cover) Suspension type (pendant) Chandelier type Bracket

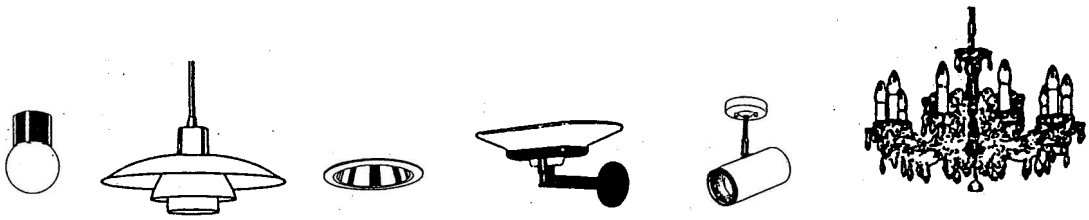
(4) Fluorescent study lamp (Fluorescent (4) - Home)



(Double capped lamp is used.) (Compact lamp is used.)

1.1.2 Incandescent lamp luminaires

(1) General type (for facilities and home) (White (1) - Home/facility)

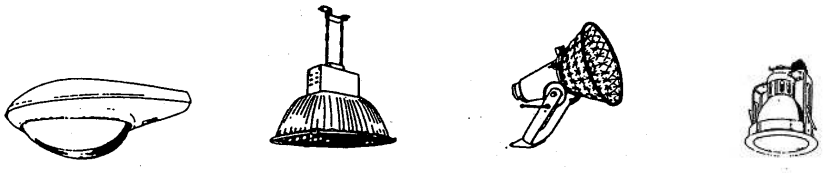


Direct mount type Suspension type Down-light Bracket Spot light Chandelier

(2) Special application (Used at plant or workplace such as explosion-proof or dust-proof) (White (2) - Facility)

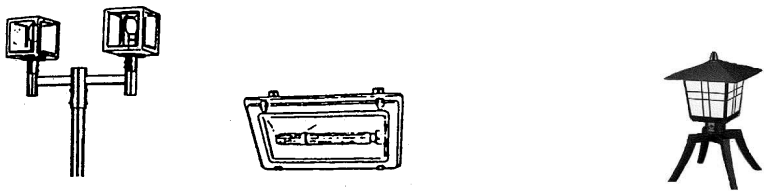
Explosion-proof and dust-proof luminaires

1.1.3 HID lamp luminaires (mainly for facilities)



Highway lamp For high ceilings Flood light Down-light

(High - Facility)



Street light luminaire Tunnel lamp Garden lamp

(High - Facility) (High - Home)

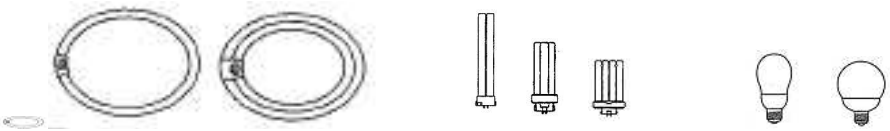
1.1.4 Main light source used for luminaires

(1) Fluorescent lamp

General type: (FL/FLR) Less than 40W General type (FL/FLR): 40W or more

Hf type: Less than 40W Hf type: 40W or more

Double-capped type



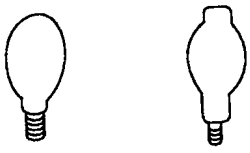
General type Hf type General type/Hf type

Ring type Compact type Bulb type

(2) Incandescent bulb

General bulb Ball bulb Mini-krypton bulb Halogen bulb

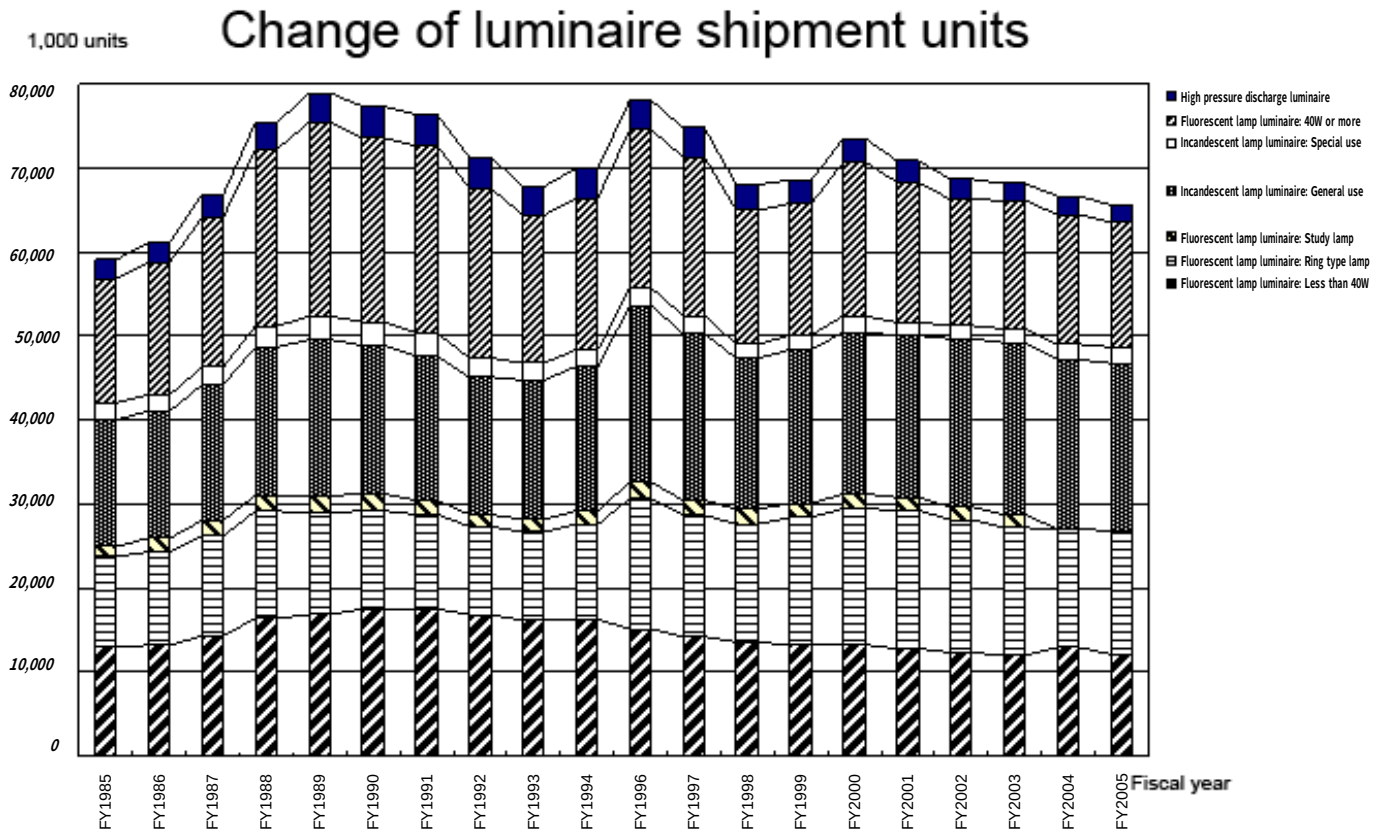
(2) HID lamp



(B type) (BT type)

1.2 Shipping movement of luminaires

The number of luminaire shipment units showed temporary recovery by last-minute demand due to the increase of consumption tax in 1996 and the revision of the Law Concerning the Measures by Large-Scale Retail Stores for Preservation of Living Environment in 2000, but it declined after 1991.



Source: Machine statistics by the Ministry of Economy, Trade and Industry

1.3 Shipping movement of luminaires for each item

1.3.1 Fluorescent lamp luminaires

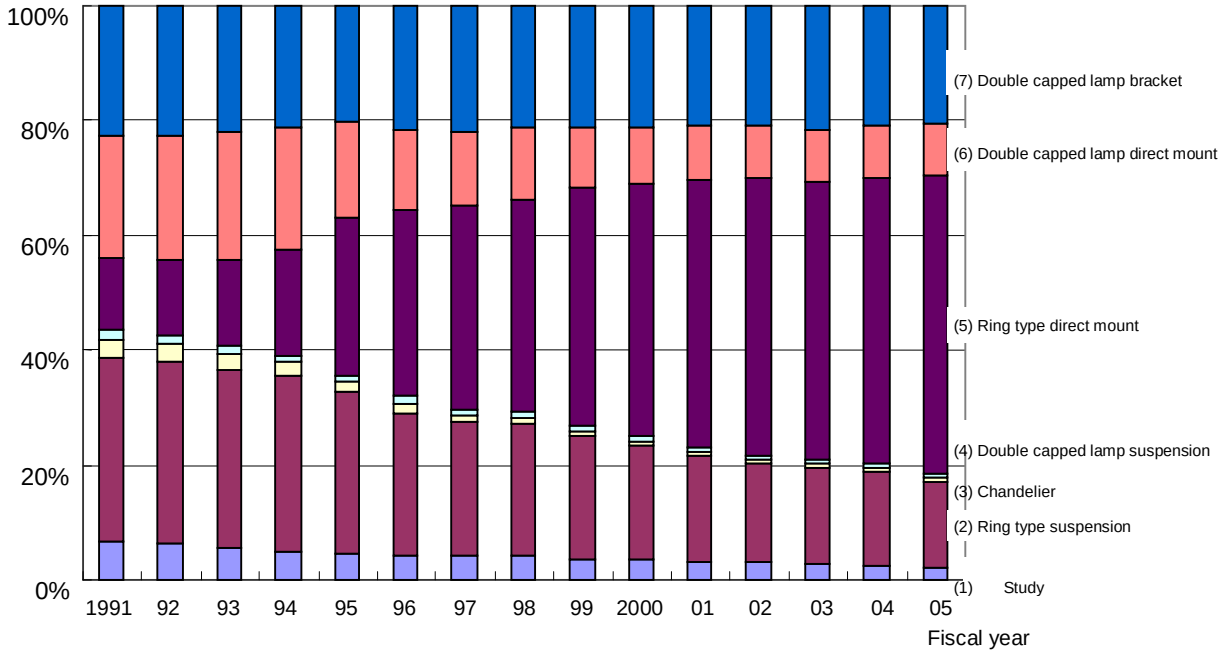
In fluorescent lamp luminaires, which are approximately 65% of luminaires, home and facilities are almost half each. The changing movement for each item is as follows.

In the home type, the employment of wide space at the ceiling surface with sufficient clearance, the lightweight and thin design by using an inverter for the illumination system, or a simple mounting method has made rapid changes from almost the same ratio (38%) of the “suspension type” and “direct mount type” to “direct mount type” in around 1994. Ring type direct mount models, which can be used for both Japanese and western styling, are mainly used (52%).

The double capped lamp bracket (including others) has been showing a constant demand of 20% or more mainly for kitchen or sink lamps. The demand for fluorescent study lamps has reduced.

(Refer to “Change of percentage for residence fluorescent lamp luminaires” by the self-statistics of the Japan Luminaires Association.)

Change of home fluorescent lamp luminaires for each type



Source: Self-statistics of the Japan Luminaires Association

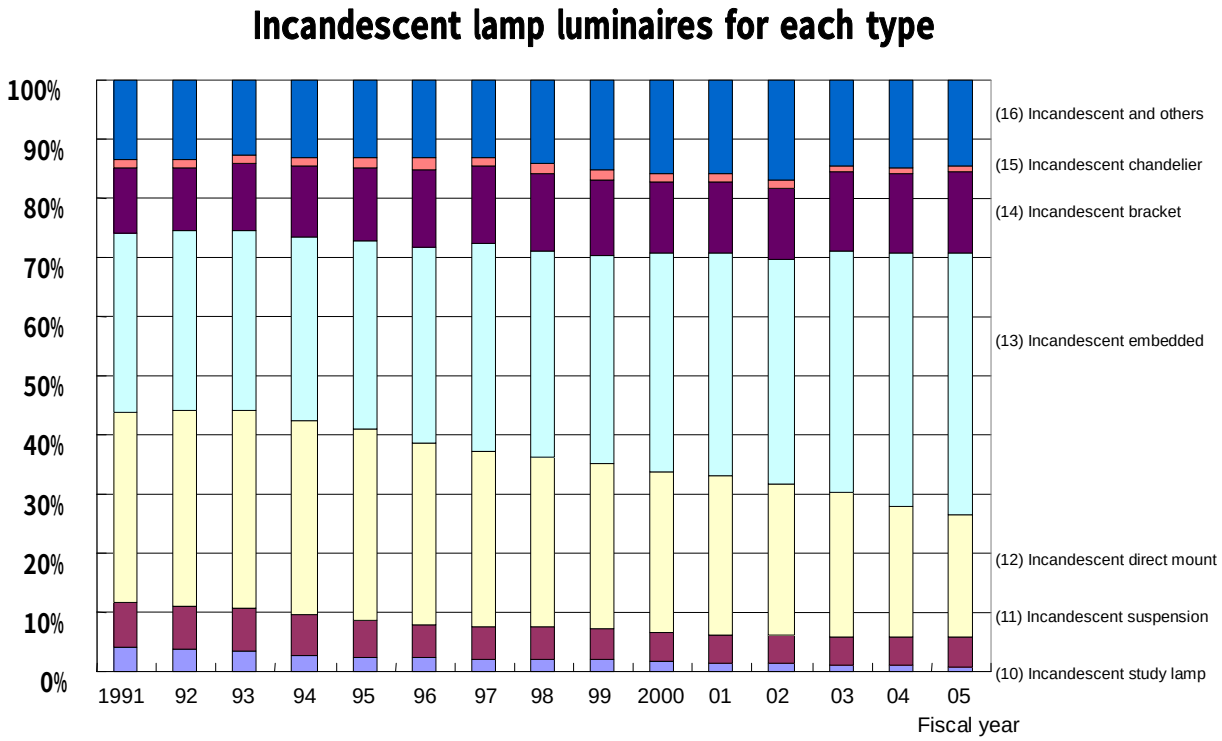
1.3.2 Incandescent lamp luminaires

Incandescent lamp luminaires are approximately 30% of the total luminaires. The percentage almost remains unchanged. It is popular because of flexibility in styling, ease of light control and warmth.

Since the application of incandescent luminaires is diversified, it is difficult to classify them into facilities and home. They are not classified in the self-statistics of the Japan Luminaires Association. Based on the item movement of the statistics, the ratio of “embedded luminaires” (mainly down-light) showed an increase. It increased from approximately 30% in 1994 to approximately 45% in 2005. In contrast, the ratio of direct mount luminaires reduced from approximately 30% to approximately 20%. The ratio of suspension luminaires also reduced by several percent.

(Refer to “Change of percentage for incandescent lamp luminaires” by the

self-statistics of the Japan Luminaires Association.)



Source: Self-statistics of the Japan Luminaires Association

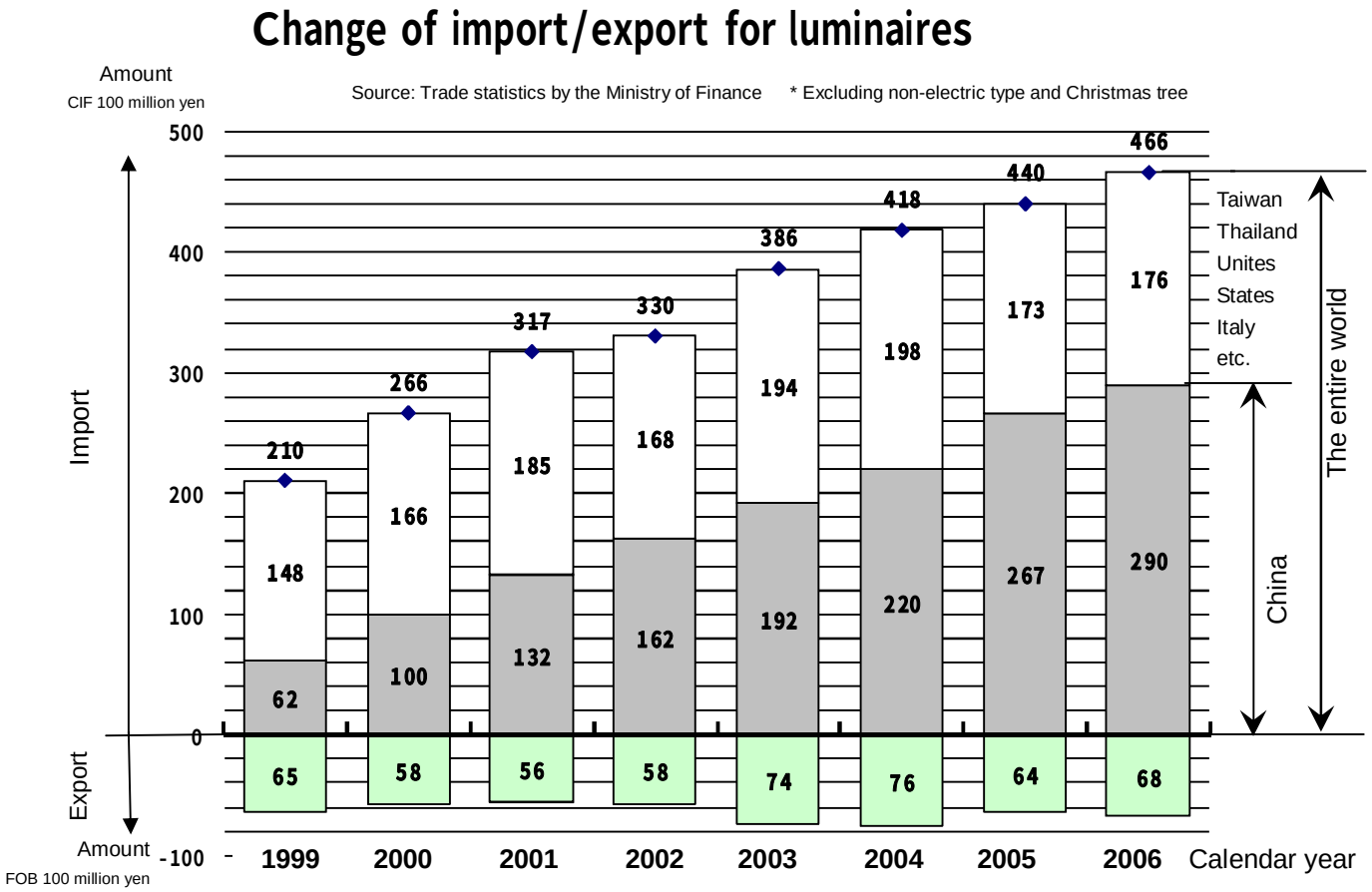
1.3.3 HID lamp luminaires

HID lamp luminaires are approximately 5% of total luminaires and the percentage almost remains unchanged. Outdoor lamps reduced due to reduction of investment in public sectors such as roads or public facilities. In contrast, investments for large shops, plants, logistic warehouses, etc. have been active, and the reduction is compensated by indoor lamps.

1.4 Import/export movement of luminaires

The item classification for import/export of luminaires is different from that in Japan and the quantity statistics is not available. Therefore, the amount (FOB/CIF) of custom statistics by the Ministry of Finance is used.

The import amount of luminaires reached 46.6 billion yen (approximately 9% of the shipment amount in Japan) in 2006 (calendar year) which is more than double the amount in 1999. In this figure, imports from China (including Hong Kong. This applies to the terms below.) are 29 billion yen, which is 62%. Most of them are reverse imports from local Japanese companies or OEM products under license agreement.



1.5 Major manufacturers and distributors in Japan

1.5.1 Fluorescent lamp luminaires for facilities

Matsushita Electric Works, Ltd. Toshiba Lighting & Technology Corporation Mitsubishi Electric Lighting Co. Hitachi Lighting, Ltd.

Odelic Co., Ltd. Koizumi Lighting Technology Corp. Daiko Electric Co., Ltd. Endo Lighting Co., Ltd.

NEC Lighting, Ltd. Iwasaki Electric Co., Ltd.

1.5.2 Fluorescent lamp luminaires for home

Matsushita Electric Works, Ltd. NEC Lighting, Ltd. Koizumi Lighting Technology Corp. Maruzen Electric Co., Ltd.

Odelic Co., Ltd. Toshiba Home Lighting Corp. Takizumi Electric Industries, Co., Ltd.

Hitachi Lighting, Ltd. Twinbird Corp. Daiko Electric Co., Ltd. Mitsubishi Electric Lighting Co.

Yamada Shomei Lighting Co., Ltd.

1.5.3 Incandescent lamp luminaires

Matsushita Electric Works, Ltd. Toshiba Lighting & Technology Corporation Koizumi Lighting Technology Corp. Daiko Electric Co., Ltd. Odelic Co., Ltd. Endo Lighting Co., Ltd. Mitsubishi Electric Lighting Co. Maxray Inc. Hitachi Lighting, Ltd.
Yamagiwa Corp. Iwasaki Electric Co., Ltd. Yamada Shomei Lighting Co., Ltd. Takizumi Electric Industries, Co., Ltd. NEC Lighting, Ltd.

1.5.4 HID lamp luminaires

Matsushita Electric Works, Ltd. Toshiba Lighting & Technology Corporation Iwasaki Electric Co., Ltd. Endo Lighting Co., Ltd. Koizumi Lighting Technology Corp.
Daiko Electric Co., Ltd. Koito Industries, Ltd. Mitsubishi Electric Lighting Co. GS Uasa Power Supply Ltd. Lighting Business Unit
Maxray Inc. Hitachi Lighting, Ltd. Maruwa Shomei Co., Ltd. Odelic Co., Ltd.
Yamada Shomei Lighting Co., Ltd. Yamagiwa Corp.

1.5.5 General lighting bulbs

Matsushita Electric Industrial Co., Ltd. Toshiba Lighting & Technology Corporation Mitsubishi Osram Co. Hitachi Lighting, Ltd.
Riken Co., Ltd. Yes Co., Ltd. Hakuyo Denkyu Co., Ltd. Kyokukou Denki Co., Ltd.
GE Consumer Products Japan, Ltd. Iwasaki Electric Co., Ltd.

1.5.6 Bulb type fluorescent lamp

Matsushita Electric Industrial Co., Ltd. Toshiba Lighting & Technology Corporation Mitsubishi Osram Co. Hitachi Lighting, Ltd.
NEC Lighting, Ltd. Iwasaki Electric Co., Ltd.

1.5.7 HID lamp

Matsushita Electric Industrial Co., Ltd. Toshiba Lighting & Technology Corporation Mitsubishi Osram Co. Hitachi Lighting, Ltd.
NEC Lighting, Ltd. Iwasaki Electric Co., Ltd. GS Uasa Power Supply Ltd. Lighting Business Unit
Philips Electronics Japan, Ltd. Koto Electric Co., Ltd. Fuji Lamp Inc.
Wako Electric Equipment Co., Ltd.

2. Current status of fluorescent lamp luminaires and future actions

2.1 Actions for current energy saving law

(1) Situation to achieve the target

A new target value with the top runner method was determined at the end of

March in 1998 and fiscal year 2005 was determined to be the target fiscal year for fluorescent lamp luminaires.

The achievement value of the target fiscal year (2005) for each category, and the achievement status of the standard value for each year are as follows:

- Fluorescent lamp luminaires for facilities

Category		(1) FLR110	(2) Hf40	(3) FLR40	(4) FL40	Total of (1) to (4)
Energy consumption efficiency (lm/W)	**Standard (2005)**	**79.0**	**86.5**	**71.0**	**60.5**	
	FY1999	77.9	87.9	68.5	64.9	72.3
	FY2000	82.3	92.3	69.3	67.0	75.8
	FY2001	84.5	92.7	69.0	66.8	77.1
	FY2002	87.3	98.0	68.9	68.3	81.8
	FY2003	89.9	100.6	71.1	67.4	84.8
	FY2004	94.7	101.5	71.9	68.0	87.5
	FY2005	98.1 (98.1)	101.6 (101.6)	72.4 (72.4)	67.7 (67.7)	89.2 (89.2)
Improvement lm/W		**20.2**	**13.7**	**3.9**	**2.8**	**16.9**

Survey by the Japan Luminaires Association. The values in ( ) are surveyed by the Ministry of Economy, Trade and Industry.

- Fluorescent lamp luminaires for home

Category		(5) FL20/ Electronic ballast	(6) FL20/ Magnetic ballast	(7) FCL Over 72	(8) FCL Over 62 to 72	(9) FCL 62 or less/ Electronic ballast	(10) FCL 62 or less/ Magnetic ballast	Subtotal of (5) to (10)
Energy consumption efficiency (lm/W)	**Standard (2005)**	**77.0**	**49.0**	**81.0**	**82.0**	**75.5**	**59.0**	
	FY1999	80.2	52.6	84.1	72.9	75.4	58.4	64.4
	FY2000	80.5	50.8	85.5	74.5	76.4	57.6	71.2
	FY2001	80.5	52.2	88.1	77.9	79.3	59.5	76.0
	FY2002	80.4	52.2	90.3	79.2	79.2	59.8	76.6
	FY2003	81.5	52.3	91.1	79.3	79.8	59.7	77.9
	FY2004	80.9	56.5	91.7	80.0	79.9	60.5	80.3

	FY2005	80.5 (80.3)	57.0 (57.0)	91.6 (91.6)	83.7 (83.8)	82.6 (82.6)	60.8 (61.4)	81.5 (81.5)
Improvement lm/W		**0.3**	**4.4**	**7.5**	**10.8**	**7.2**	**2.4**	**17.1**

Survey by the Japan Luminaires Association. The values in ( ) are surveyed by the Ministry of Economy, Trade and Industry.

- **Fluorescent table study lamps**

Category		(11) Table study compact lamp	(12) Table FL lamp	Total of (11) to (12)
Energy consump-tion effi-ciency (lm/W)	**Standard (2005)**	**62.5**	**61.5**	
	FY1999	65.1	59.3	64.8
	FY2000	63.0	60.4	62.5
	FY2001	62.5	61.0	62.3
	FY2002	64.4	61.8	64.0
	FY2003	64.7	61.6	64.2
	FY2004	67.0	66.6	67.0
	FY2005	67.7 (67.2)	68.8 (68.5)	67.7 (67.3)
Improvement lm/W		**2.6**	**9.5**	**2.9**

Survey by the Japan Luminaires Association. The values in ( ) are surveyed by the Ministry of Economy, Trade and Industry.

2.2 Actions for future energy saving

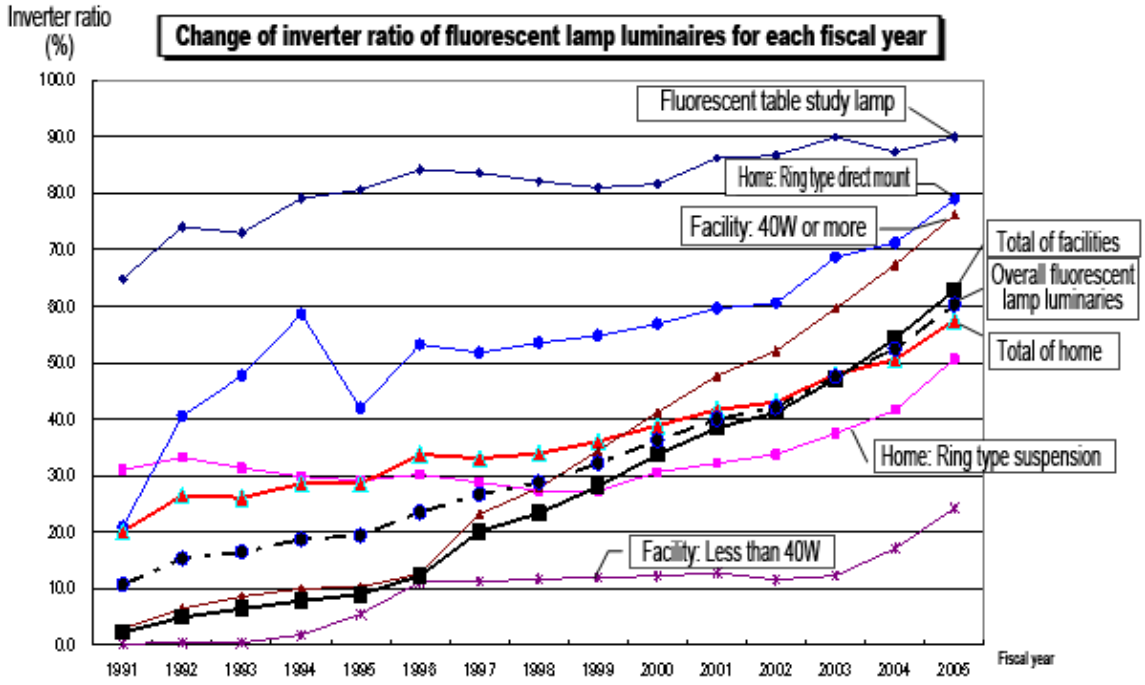
The illumination devices used for fluorescent lamp luminaires are classified into the magnetic ballast and the electronic ballast (inverter). The magnetic ballast has been used since development of the fluorescent lamp and various improvements have been made until now. It is completed from engineering point of view.

Therefore, to further promote energy saving of fluorescent lamp luminaires, it is necessary to shift to the electronic ballast (inverter) with higher energy saving performance. In particular, it is important to shift to the luminaires for high frequency illumination, which is called the Hf method.

Based on the change to use of inverters, which is directly linked to energy saving, the ratio has been consistently increasing. The records in FY2005 were 78.9% (41.9% in FY1995) for the ring type direct mount which is the major product for home fluorescent lamp luminaires, 76.2% (10.3% in FY1995) for

40W (32W) or more which is the major product for facility fluorescent lamp luminaires, 57.5% (28.6% in FY1995) for overall home fluorescent lamp luminaires, 62.8% (9.0% in FY1995) for overall facility fluorescent lamp luminaires and 60.2% (19.4% in FY1995) for overall fluorescent lamp luminaires.

An engineering issue for fluorescent lamps is the improvement of lamp illumination efficiency. However, a significant technical innovation cannot be expected. To further propel energy saving in the future, improvement of the inverter ratio is the largest issue.



Statistical survey by the Japan Luminaires Association

3. Current status of incandescent lamp luminaires and future actions

Incandescent lamps have features of warm light color, glittering, small shape, etc. which are not seen in other light sources. In addition, it has an advantage of not requiring a ballast. The design freedom as luminaires is high and it is widely used at general homes and facility buildings.

In contrast, the lamp efficiency of incandescent bulbs is 13.5 lm/W (JIS C 7501-2000) for the most popular rated power consumption of 60W, which is low in view of the illumination principle. At present, the rated power consumption of 54W which has achieved approximately 10% energy saving is popular. Still, the lamp efficiency is only 15 lm/W. Further technical improvements have almost reached their limit and improvements may not be expected in the future.

(1) Improvement by change of filament design

Filament has a coil-wound design. The denser a coil is wound, the better efficiency is. This accuracy is almost at its limit, and further improvement will cause disadvantages such as shortened product life or less durability against vibration.

(2) Improvement by change of sealing gas and sealing pressure

A change from current argon gas is expected, but there is no alternative with better efficiency than argon gas based on the evaluation including costs. The sealing pressure has also reached the upper limit of glass processing. In this process, the sealing gas and sealing pressure were changed for improvement, although the cost is high. Mini-krypton bulbs and halogen bulbs were developed, but improvement of the energy consumption efficiency was still remaining at approximately 16 to 21 lm/W.

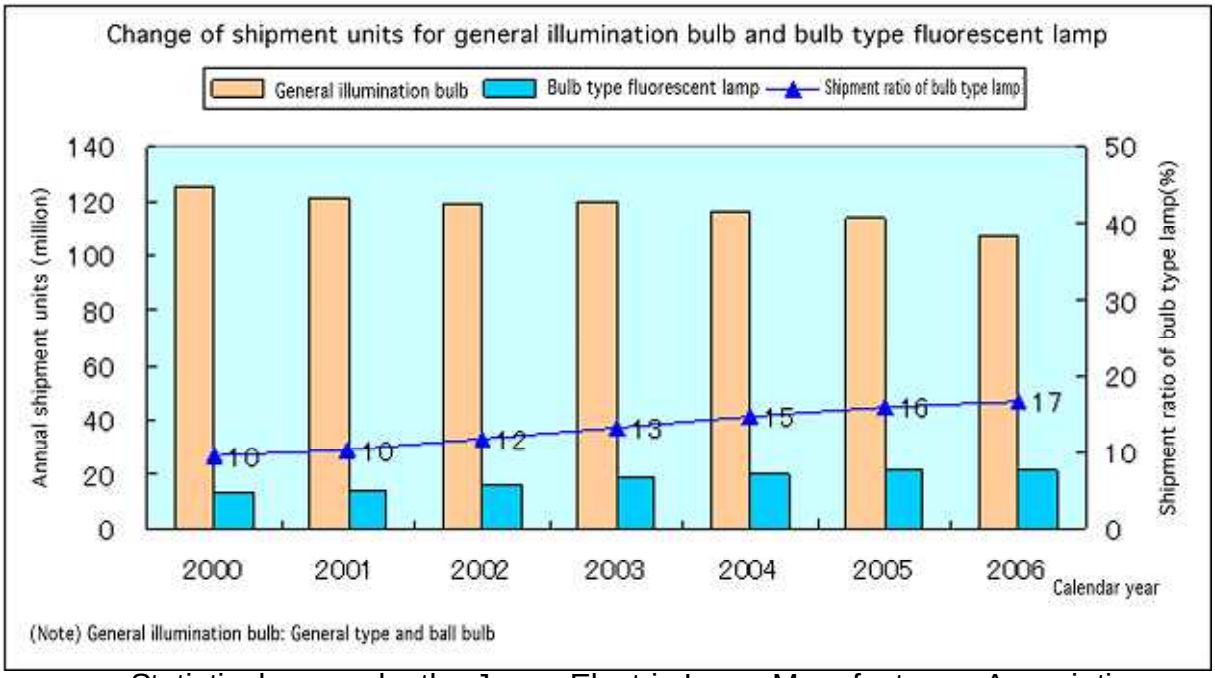
(3) Improvement by change of filament material

By using a material with a higher melting point, improvement of the filament temperature and an increase of visible light radiation are expected. In view of service life, mechanical strength and costs, development of a new material cannot be expected with the present technology.

In the future, to make further progress of energy saving in this field, it is important to change incandescent lamps to bulb type fluorescent lamps, considering the use of incandescent lamp features. The power consumption of a bulb type fluorescent lamp equivalent to incandescent lamps with the general rated power consumption of 54W is only approximately 12W. Replacement can reduce the power consumption to less than 1/4, which leads to definite energy saving.

The figure shows the change of shipment units for general illumination bulbs to be replaced and bulb type fluorescent lamps, and the shipment ratio of bulb type fluorescent lamps. The shipment unit ratio of the bulb type fluorescent lamp in 2006 was approximately 17%.

In the future, it is important to increase this ratio for progress in energy saving.

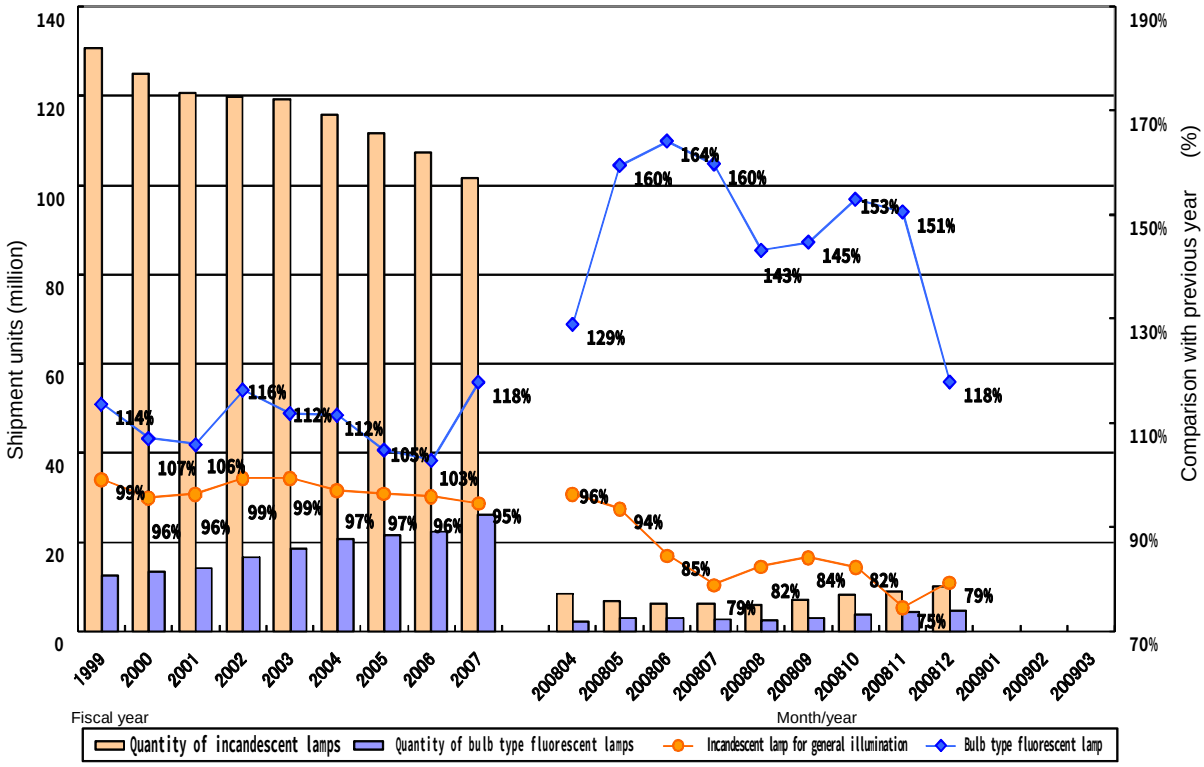


Statistical survey by the Japan Electric Lamp Manufacturers Association

○Action of incandescent lamps in Japan

In May, 2008, the government requested the “Energy Saving Home Appliance Promotion Forum” to be formed by home appliance manufacturers, distributors and consumer organizations to basically take actions for change to products with excellent energy saving performance such as bulb type fluorescent lamps for production, and shipment of general incandescent bulbs aiming at 2012. In response, luminaire manufactures, distributors, consumer organizations, etc. established the “Energy Saving Light Forum” and are taking actions for the spread of products with excellent energy saving performance including bulb type fluorescent lamps as one of several nationwide activities.

Shipment units of incandescent lamps and bulb type fluorescent lamps and comparison with previous year



Statistical survey by the Japan Electric Lamp Manufacturers Association

○ Major action of incandescent lamps overseas

(1) EU

i) Characteristics of market

Incandescent lamps are frequently used. The shipment ratio for each lamp is approximately 67% for incandescent lamps and approximately 20% for fluorescent lamps. The ratio of luminaires in the total power consumption is approximately 39% for fluorescent lamps and 23% for incandescent lamps.

ii) Action details

- From 2009, application of the standard for the power consumption level of incandescent lamps is reviewed step by step.

[Standard on incandescent lamps]

	Obscure lamp	Transparent lamp	
After September, 2009	51.6 lm/W or more	Lamps of 100W or more 15.2 lm/W or more	Lamps less than 100W 11.1 lm/W or more
After September, 2010	Ditto	Lamps of 75W or more 15.2 lm/W or more	

After September, 2011	Ditto	Lamps of 75W or more 15.2 lm/W or more
After September, 2012	Ditto	All lamps 15.2 lm/W or more

(2) Unites States

i) Action details

- From 2012, the standard for the total luminous flux (lm) of incandescent lamps is applied step by step.
- 45 lm/W or more for the standard after 2020 is reviewed. It will be determined by January, 2017.

[Standard on incandescent lamps]

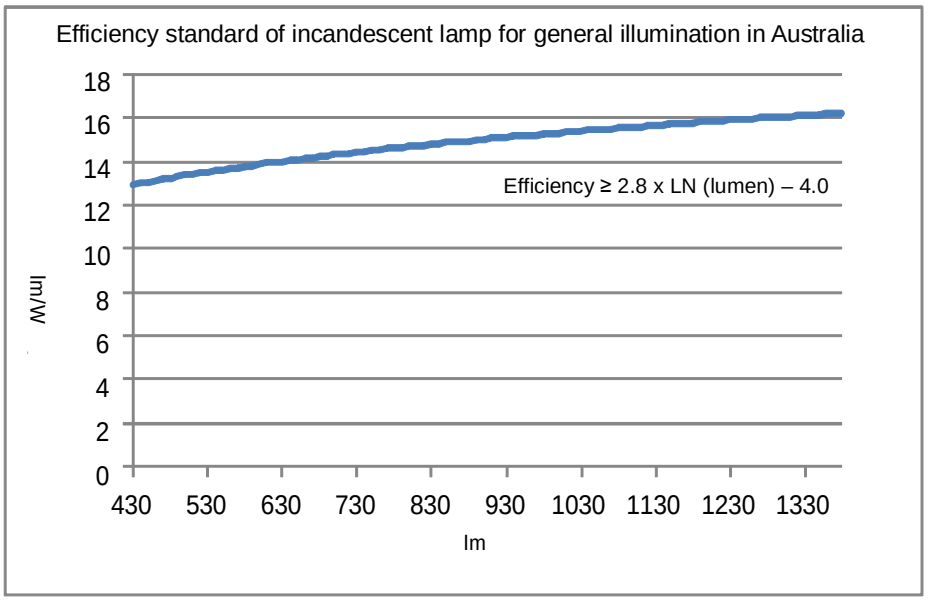
	Total luminous flux (lm)	Power consumption (W)	Minimum efficiency (lm/W)
After 01.01.1	1,490 to 2,600	72W or less	36 lm/W or more
After 01.01.12	1,050 to 1,489	72W or less	28 lm/W
After 01.01.12	750 to 1,049	43W or less	24.4 lm/W
	310 to 749	29W or less	25.8 lm/W

(3) Australia

i) Restriction details

- It is determined that incandescent lamps which have low efficiency are banned for import from February, 2009 and their sale is prohibited from November, 2009.
- The efficiency standard of incandescent lamps for general illumination is calculated from the formula below for all lamps.

Efficiency ≥ 2.8 x LN (lumen) – 4.0



(4) China

i) Restriction details

In April, 2008, the plan to make efficient lighting products popular was announced. The government will provide aids for 150 million fluorescent lamps including bulb type fluorescent lamps.

4. Current status of HID lamp luminaires and future actions

The HID lamps for general illumination are classified into three large categories of high pressure mercury lamps, metal halide lamps and high pressure sodium lamps. In the light sources for general illumination, they are used for outdoor illumination in large-scale spaces such as squares, shopping streets, roads and sports facilities, and also for indoor illumination such as plants and shop facilities, with the features of relatively high luminous flux, high efficiency, high luminance and long life.

To explain the history of the HID lamp, the high pressure mercury lamp appeared for the first time in 1901. Approximately 60 years later, the high pressure sodium lamp which sought after lamp efficiency and the metal halide lamp which sought after color rendition (Ra) were developed one after another. Recently, combining the technologies of the high pressure sodium lamp and the metal halide lamp, the metal halide lamp (ceramic metal halide lamp) with high efficiency, and using the ceramic illumination tube which greatly improved high color rendition, has been rapidly becoming popular.

Lamp efficiency and color rendition (Ra) of representative models for various HID lamps are as shown in the table below. The high pressure mercury lamp is the most inexpensive but the lamp efficiency is the lowest. This lamp uses the illumination principle of fluorescent lamps. Higher pressure and temperature than those of a fluorescent lamp achieve high luminous flux per beam, using illumination of the

mercury itself. Since the illumination wavelength (including illumination with low efficiency that can feel brightness) is fixed, in principle, the lamp efficiency limit is approximately 55 lm/W. To obtain better lamp efficiency, the lamp service life needs to be sacrificed. The technical limit is almost reached.

Various HID lamps	Shipment efficiency[2] (%)	Representative models	Lamp efficiency (lm/W)	Color rendition Ra
High pressure mercury lamp	37	400W	55	60
Metal halide lamp [1]	54	360W	115	80
High pressure sodium lamp	9	360W	125	25

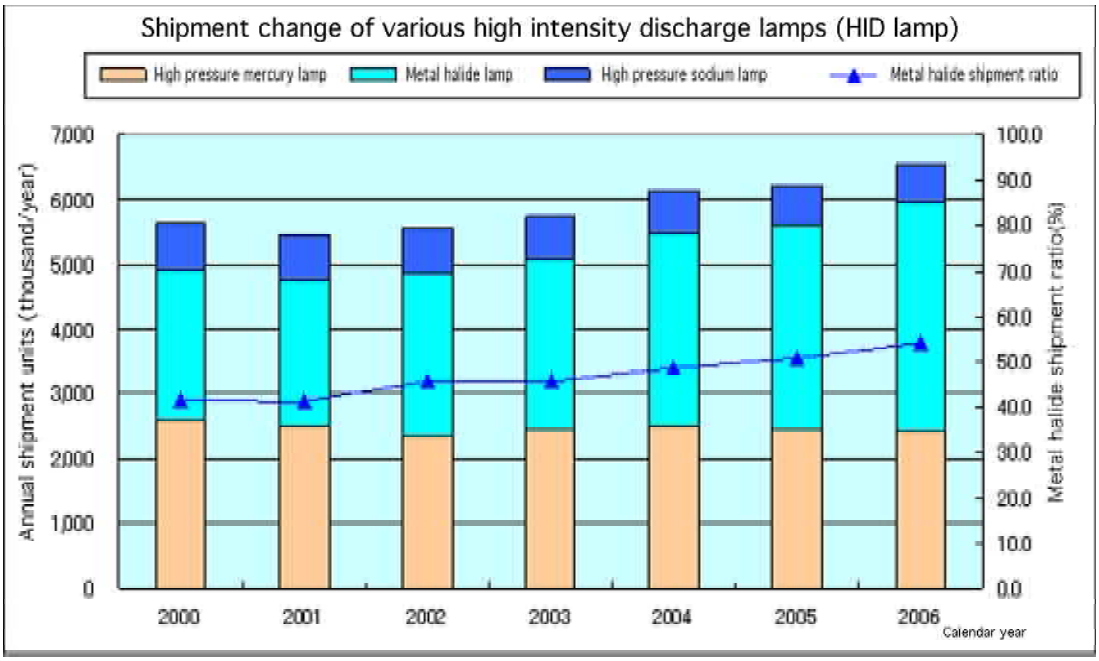
(Note 1) The representative model of the metal halide lamp is the ceramic metal halide lamp.
(Note 2) Ratio of annual shipment units in 2006

Survey by the Japan Electric Lamp Manufacturers Association

The lamps that compensated defects in this principle and achieved high efficiency were the high pressure sodium lamp and the metal halide lamp, which were introduced dozens of years later. By sealing sodium or metal halide in addition to mercury, highly efficient and wide range illumination that can feel brightness are achieved, resulting in a great improvement of lamp efficiency. Both lamps require high voltage at the start in comparison with the high pressure mercury lamp. Many of the features are not compatible. Ballast and, in a case, luminaire, have to be replaced. Smooth replacement is not in progress.

Although there are issues like the above, it is effective to replace high pressure mercury lamps with high pressure sodium lamps and metal halide lamps for achievement of energy saving in this field.

The figure shows a change in shipment units of various HID lamps after 2000. In view of energy saving, replacement with metal halide lamps has recently been in progress. In the future, it will be important to increase this ratio.



Statistical survey by the Japan Electric Lamp Manufacturers Association