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

Luminaire Evaluation Standards Subcommittee

Final Report (fluorescent luminaire)

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.
The discussions in this final report are for fluorescent lamp luminaires, and bulbs are continuously discussed in this subcommittee.

1. Evaluation of existing standards

The weighted average value of energy efficiency for the fluorescent luminaire that was the target fiscal year in 2005 was 85.6 lm/W, and it was improved by 35.7% from the weighted average value (63.1 lm/W) of energy consumption efficiency before the introduction of the top runner standards (product shipped in 1997). The level of improvement was greater than the estimated value (73.6 lm/W) and the estimated improvement ratio (16.6%) set at the time of the top runner standards.

In view of the above, it can be evaluated that energy conservation in fluorescent lamp luminaires has made progress through the efforts of manufacturers, etc. and that the existing standards based on the top runner approach are effectively working.

2. Designated equipment [Refer to Attachment 1]

Fluorescent luminaire. This excludes the explosion-proof type, heat resistance type, dust-proof type, corrosion resistance type and luminaires designed for vehicles and other transportation means, and recently excludes luminaires intended for assembly in machines, furniture, etc.

Regarding luminaires that use fluorescent lamps (excluding home suspension type, direct mount type and table study luminaires) that are less than 40W, which had previsouly been excluded from the designation, the embedded type luminaires specified in Japanese Industrial Standard C8106 “Fluorescent lamp luminaires for commercial, industrial and public lighting” were newly included in the designation.

3. 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 fluorescent lamp luminaires that each manufacturer, etc. ships within Japan during the target fiscal year, the average of the energy consumption efficiency (lm/W) measured in (3) and 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 Category of fluorescent luminaire and target standards

Category	Application	Lamp shape	Lamp size	Target standard value (lm/W)
I	For facilities	Double-capped type or compact double tube type	Equipment with the lamp size of 86 or larger	100.8
II			Equipment with the lamp size less than 86	100.5
III		Compact type other than double lamp type		61.6
IV	Home use	Ring type or double-capped type	Equipment with the total sum of the lamp size of 70 or more (excluding the double-capped fluorescent lamp with the size of 20)	91.6
V			Equipment with the total sum of the lamp size less than 70 and equipment with the total sum of the lamp size of 70 or more using double-capped fluorescent lamps with the size of 20	78.1
VI	Fluorescent table study lamps	Double-capped type or compact type		70.8

Note 1 “Lamp size” refers to the “value of size category” of fluorescent lamps specified in Japanese Industrial Standard C7601 “Fluorescent lamps for general lighting service” or in Japan Electric Lamp Manufacturers Association Standard 211 “Fluorescent lamps (general lighting service) for high frequency illumination”. However, in the case of fluorescent lamps that do not specify the “value of size category”, the value of the “rated lamp power” specified in Japanese Industrial Standard C7617-2 “Double-capped fluorescent lamps - Part2 : Performance specifications” shall be used for double-capped fluorescent lamps and the value of the “rated lamp power” specified in Japanese Industrial Standard C7618-2 “Single - capped fluorescent lamps - Part 2: Performance specifications” shall be used for

ring type and compact type fluorescent lamps.

Note 2 In ring type fluorescent lamps, the lamp output value shall be used for the lamp size of the fixture which uses fluorescent lamps for high frequency illumination.

(3) Measurement method for energy consumption efficiency

[Refer to Attachment 5]

The energy consumption efficiency of fluorescent luminaires shall be the value obtained by dividing the total luminous flux (lm) of the fluorescent lamp mounted on the fluorescent luminaire by the power consumption (W) of the florescent luminaire.

$$\text{Energy consumption efficiency (lm/W)} = \frac{\text{Total luminous flux (lm) of the fluorescent lamp mounted on the fluorescent luminaire}}{\text{Power consumption (W) of fluorescent luminaire}}$$

The total luminous flux and the power consumption of fluorescent luminaires shall be measured as follows:

1) Measurement method of total luminous flux

The total luminous flux of fluorescent luminaires shall be the value by multiplying the ballast output coefficient and the temperature compensation coefficient by the total luminous flux value of the individual fluorescent lamp (hereinafter referred to as the “rated total luminous flux value of lamp”) measured with the method specified in optical characteristics of Japanese Industrial Standard C7617-2 “Double-capped fluorescent lamps - Part2 : Performance specifications” and Japanese Industrial Standard C7618-2 “Single - capped fluorescent lamps - Part 2: Performance specifications”.

* Total luminous flux means the total sum of luminous flux emitted in all directions from the light source.

Total luminous flux = (Rated total luminous flux value of lamp) x (Ballast light output coefficient) x (Temperature compensation coefficient)

i) Calculation of ballast light output coefficient

The ballast light output coefficient shall be the value obtained from the calculation method specified in the measurement of optical output coefficient by the sample ballast of Japanese Industrial Standard C 8020 “Method of

calculation on fluorescent luminaire efficacy index".

ii) Calculation of temperature compensation coefficient

The temperature compensation coefficient shall be the coefficient specified in Appendix 2 of Japanese Industrial Standard C 8020.

2) Measurement method of power consumption

The power consumption of fluorescent lamp luminaires shall be measured with the method specified via Japanese Industrial Standard C 8105-3 "Luminaires - Part 3 : General requirements for performance". After measuring the tube wall temperature to calculate the temperature compensation coefficient, measurement shall be performed under the same conditions.

(4) Labeling related matters

1) Items for labeling shall be as follows:

a) Part name and type name
b) Type of fluorescent lamp
c) Class name
d) Total luminous flux
e) Power consumption
f) Energy consumption efficiency
g) Name or title of manufacturers

Items related to identification of the table study lamp shall be as specified in the Household Goods Labeling Law. For identification of (c) above, Electric Appliance Quality Labeling Rules need to be revised.

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. The table study lamp shall be identified according to the Household Goods Labeling Law.

4. Recommendation on energy saving

(1) Efforts by users

1) With effective use of information such as “energy saving label”, users shall try to select fluorescent luminaires with high energy consumption efficiency.
2) Users shall try to change incandescent lamps to energy saving type luminaires using new light sources such as fluorescent luminaires or LED as much as possible, and try to save energy by introducing luminaires that have inverters with excellent energy consumption efficiency or have illumination with special high frequency, when selecting fluorescent luminaires.
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) Luminaires should be frequently turned on and off (reduced illumination or reduced light). Unnecessary illumination should be reduced by effective use of daylight or use of the control function including a human sensor.
5) 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 information such as “energy saving label”, users shall try to select fluorescent luminaires with high energy consumption efficiency.
2) Users shall try to change incandescent lamps to energy saving type luminaires using new light sources such as fluorescent luminaires or LED as much as possible, and try to save energy by introducing luminaires that have inverters with excellent energy consumption efficiency or have illumination with special high frequency, when selecting fluorescent luminaires.
3) When using luminaires, daylight, light control function, human sensing func-

tion, 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) Try to sell fluorescent lamp luminaires with excellent energy consumption efficiency. Also, use “Energy Saving Labels” and try to provide appropriate information so that users will choose fluorescent lamp luminaires with excellent energy consumption efficiency.
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 luminaires and try to develop products with excellent energy consumption efficiency.
2) In order to promote fluorescent lamp luminaires with excellent energy consumption efficiency, quickly adopt “Energy Saving Labels” on brochures. Also, try to provide appropriate information so that users will choose fluorescent lamp luminaires with excellent energy consumption efficiency. Try to provide data for the database of energy saving labels identified by distributors so that distributors may appropriately provide information.
3) Try to provide information on additional functions such as reflectors which improves illumination intensity or cover, louvers, etc. which reduce the light volume so that consumers may understand and make appropriate selections.
4) 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 promote fluorescent lamp luminaires with excellent energy consumption efficiency, try to use promotional campaigns and other necessary measures to facilitate efforts by users and manufacturers, etc.
2) 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.
3) Try to prepare a database of energy saving labels so that distributors may provide the labels.
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 fluorescent lamp luminaires

1. Basic concept

The evaluation standards in this report shall only apply to luminaires that only use fluorescent lamps as the main light source.

The designated range shall be enlarged or reduced as follows by changes in the number of shipping units, launch of new product, etc.

2. Enlargement of designated equipment

In fluorescent luminaires that use fluorescent lamps with less than 40W, the embedded type luminaires specified in Japanese Industrial Standard C 8106 “Fluorescent lamp luminaires for commercial, industrial and public lighting” are not included in the current designation, but the number of shipping units has recently been increasing. They shall be included in the designation.

This enlargement of the range will add approximately 1,296,000 units.

3. Exclusion from designation

In the top runner method, (1) Models used for special applications, (2) models of which the technical measurement method and evaluation method are not established and it is difficult to determine the target standard, and (3) models that have an extremely low share of the market shall be excluded from the designation. Based on this principle, the following products are excluded from the designation. Luminaires designed for assembly into machines, furniture, etc. shall also be excluded.

(1) Explosion-proof type

Luminaries that are used at a location where flammable gas is generated. Since the structure is special and the number of production units is very limited, they are excluded.

(2) Heat resistance type

Luminaries that are used at a location (boiler room, freezing room, etc.) where the ambient temperature is (always) very high or low. Since the structure is special and the number of production units is very limited, they are excluded.

(3) Dust-proof type

Luminaries that are used at a location where much dust is generated. Since the structure is special and the number of production units is very limited, they are excluded.

(4) Corrosion resistance type

Luminaries that are used at a location where corrosive gas is generated. Since the structure is special and the number of production units is very limited, they are excluded.

(5) Type designed for vehicles or other transportation means

Luminaries with a special power source and structure for vehicles. Since the number of production units is very limited, they are excluded.

(6) Type designed for assembly into machines, furniture, etc.

The structure is special because luminaires are assembled into machines, furniture, etc. Since the number of production units is very limited, they are excluded.

(7) Fluorescent luminaires using fluorescent lamps with less than 40W (excluding the fluorescent lamp luminaires specified in Japanese Industrial Standard C 8115 “Fluorescent lamp luminaires for residential lighting”, Japanese Industrial Standard C8112 “Fluorescent table study lamps” and the embedded type luminaires specified in Japanese Industrial Standard C 8106 “Fluorescent lamp luminaires for commercial, industrial and public lighting”)

These fluorescent lamps are used for auxiliary purposes (dimensional fitting) at a location where conventional 40W luminaires cannot be mounted, and are used in kitchens, bath rooms, outdoor areas, etc. Since they are often used as illumination at a location where lamps are not used full time and the power consumption ratio is low, they are excluded.

(8) Compact type fluorescent lamp with built-in ballast at cap

The measurement method for fluorescent lamp luminaires that use the compact type fluorescent lamp with built-in ballast at the cap has not yet been determined. Since the number of production units is very limited, they are excluded.

Attachment 2

Target year of fluorescent lamp luminaires

1. Since the energy consumption efficiency of fluorescent lamp luminaires will be greatly improved by the development and spread of luminaires using highly efficient ballast (inverters), the time necessary for the development of luminaires with inverters is allowed. Development time of inverters for fluorescent lamp luminaires is usually 1 or 2 years. For this purpose, it is necessary to have opportunities for one or two model changes until the target year.
   The target year of fluorescent lamp luminaires shall be FY2012.

2. The improvement ratio of the energy consumption efficiency in the target year will be approximately 7.7% assuming that the current number of shipping units (record in 2006) and the category structure are not changed.

<General description of calculation>

○ Overall fluorescent lamp luminaires

(i) Energy consumption efficiency calculated from the record value of fluorescent lamp luminaires shipped in FY2006 84.7 lm/W

In calculation of the values above, of the fluorescent lamp luminaires that use tfluorescent lamps with less than 40W that are included in the designation, the embedded type luminaires specified in Japanese Industrial Standard C 8106 “Fluorescent lamp luminaires for commercial, industrial and public lighting” were included in the calculation items. In this way, it is different from the value of the energy consumption efficiency in FY2005.

(ii) Energy consumption efficiency calculated from the target standard value of fluorescent lamp luminaires shipped in the target fiscal year 91.2 lm/W

(iii) Improvement ratio of energy consumption efficiency

$$\frac{(91.2-84.7)}{84.7} \times 100 = \text{Approximately } 7.7\ \%$$

[For facilities]

(i) Energy consumption efficiency calculated from the record value of fluorescent lamp luminaires shipped in FY2006 87.0 lm/W

(ii) Energy consumption efficiency calculated from the target standard value of

fluorescent lamp luminaires shipped in the target fiscal year 94.0 lm/W

(iii) Improvement ratio of energy consumption efficiency

$$\frac{(94.0-87.0)}{87.0} \times 100 = \text{Approximately } 8.0\ \%$$

[Home use]

(i) Energy consumption efficiency calculated from the record value of fluorescent lamp luminaires shipped in FY2006 81.9 lm/W

(ii) Energy consumption efficiency calculated from the target standard value of fluorescent lamp luminaires shipped in the target fiscal year 87.7 lm/W

(iii) Improvement ratio of energy consumption efficiency

$$\frac{(87.7-81.9)}{81.9} \times 100 = \text{Approximately } 7.1\ \%$$

[Table top lamp]

(i) Energy consumption efficiency calculated from the record value of fluorescent lamp luminaires shipped in FY2006 68.0 lm/W

(ii) Energy consumption efficiency calculated from the target standard value of fluorescent lamp luminaires shipped in the target fiscal year 70.8 lm/W

(iii) Improvement ratio of energy consumption efficiency

$$\frac{(70.8-68.0)}{68.0} \times 100 = \text{Approximately } 4.1\ \%$$

Attachment 3

Classification of fluorescent lamp luminaires

1. Category of current fluorescent lamp luminaires

Since the following three requirements affect the energy consumption efficiency, the current fluorescent lamp luminaires are classified based on these requirements and the standard is determined for each class.

(1) Lamp shape
(2) Lamp output
(3) Lamp illumination method and ballast

Table 1 Category of fluorescent lamp luminaires

Category	Lamp shape, output, illumination method and ballast type
Equipment using double-capped 110W rapid start type fluorescent lamps	• Luminaires using 110W rapid start type fluorescent lamps • Luminaires using 96W compact type fluorescent lamps • Luminaires using 105W compact type fluorescent lamps for high frequency illumination
Equipment using double-capped 40W fluorescent lamps for high frequency illumination	• Luminaires using 40W and 65W fluorescent lamps for high frequency illumination
Equipment using double-capped 40W rapid start type fluorescent lamps	• Luminaires using 40W rapid start type fluorescent lamps • Luminaires using 36W and 55W compact type fluorescent lamps • Luminaires using 32W, 42W and 45W compact type fluorescent lamps for high frequency illumination
Equipment using double-capped 40W starter type fluorescent lamps	• Luminaires using 40W starter type fluorescent lamps

<table>
<tr><td>Equipment using double-capped 20W starter type fluorescent lamps with electronic ballast</td><td>• Luminaires using 20W starter type fluorescent lamps and luminaires with electronic ballast</td></tr>
<tr><td>Equipment using double-capped 20W starter type fluorescent lamps with magnetic ballast</td><td>• Luminaires using 20W starter type fluorescent lamps and luminaires with magnetic ballast</td></tr>
<tr><td>Equipment with the total sum of ring type fluorescent lamp size category of over 72</td><td rowspan="4">(Note)
“Category of lamp size” refers to the size category specified in JIS C 7601 Section 4 (Model and type).

<table><tr><td>Size classification</td><td>Lamp type</td></tr><tr><td>20</td><td>FCL20/18</td></tr><tr><td>30</td><td>FCL30/28</td></tr><tr><td>32</td><td>FCL32/30</td></tr><tr><td>40</td><td>FCL40/38</td></tr></table>(FCL refers to the ring starter type fluorescent lamp.
• The size category of ring type fluorescent lamps for high frequency illumination shall be the value of the rated lamp power. For equipment with high output illumination, the value shall be the lamp power at illumination with high output.</td></tr>
<tr><td>Equipment with the total sum of ring type fluorescent lamp size category of over 62 up to 72</td></tr>
<tr><td>Equipment with the total sum of ring type fluorescent lamp size category of 62 or less with electronic ballast</td></tr>
<tr><td>Equipment with the total sum of ring type fluorescent lamp size category of 62 or less with magnetic ballast</td></tr>
<tr><td>Table top lamps using compact type fluorescent lamps</td><td>• Luminaires using 27W, 18W and 13W compact type fluorescent lamps</td></tr>
<tr><td>Table top lamps using double-capped fluorescent lamps</td><td>• Luminaires using 20W and 15W starter type fluorescent lamps</td></tr>
</table>

2. Determination of new categories for fluorescent luminaries

(1) Basic concept

In the current category of fluorescent lamp luminaires, the categories are classified by the lamp shape, lamp size, lamp illumination method and ballast type.

Since luminaires with high frequency illumination ballast showing excellent energy consumption efficiency have been popular, the categories for illumination method and ballast type are abolished and categories are determined by application, lamp shape and lamp size.

(i) Application

Since fluorescent lamp luminaires are classified into large categories of application in Japanese Industrial Standard, they are classified into facilities, home fluorescent lamp luminaires and table study lamps according to Japanese Industrial Standard.

Luminaires for facilities refer to equipment requiring connection to wires at the power source, not the connector. Luminaires for home refer to equipment that can be easily connected with connectors such as attachment plugs, twist locking rosettes, etc., and they do not refer to application in actual use.

- Fluorescent lamp luminaires for commercial, industrial and public lighting (Japanese Industrial Standard C 8106: 2008)

  Scope: Fluorescent lamp luminaires for general lighting in facilities that are connected to wires at the power source without using connectors such as an attachment plug, twist locking rosette, etc. and that have an input voltage of AC 300V or less using the fluorescent lamp as the light source.

- Fluorescent lamp luminaires for home (Japanese Industrial Standard C 8115: 2008)

  Scope: Fluorescent lamp luminaires for residential lighting that can be easily connected to the input voltage of AC100V using the fluorescent lamp as the light source with an attachment plug, twist lock rosette, etc.

- Fluorescent table study lamps (Japanese Industrial Standard C 8112: 2008)

  Scope: Fluorescent table study lamps with the rated voltage of 100V or less and the secondary rated voltage of 150V or less, considering supply of necessary light to improve efficiency in visual work for studying or reading using a fluorescent lamp conforming to the rules of Japanese Industrial Standard C 7601 “Fluorescent

lamps for general lighting service".

(ii) Shape and size of lamp

(1) Double-capped fluorescent lamp for facilities or double lamp compact type fluorescent lamp

The lamps are categorized into the size of 86 or more used for facilities with large floors and high ceilings such as plants, warehouses, etc. and into the size less than 86 for facilities with moderate height ceiling such as offices, schools, etc.

The current categories are classified by the lamp illumination method and ballast type. Since the application is the same, the categories are integrated.

(2) Compact type fluorescent lamp other than the double lamp type for facilities

Since compact type fluorescent lamps other than the double lamp type are often used for a narrow area like down-lights in facilities. They are independently categorized.

This excludes the double lamp compact type fluorescent lamp used for facilities similar to the double capped fluorescent lamp.

(3) Fluorescent lamp for home

For the fluorescent lamps for home, the room size for both the ring type and the double capped type varies depending on the lamp size. They are classified into two categories: general size room (usually less than 8-joh (8-tatami mat size)) and larger room (usually 8-joh or more).

The current categories are classified by the lamp shape (ring type, double capped type), lamp illumination method and ballast type. Since the application is the same, the categories are integrated.

* Fluorescent table study lamps

Since the lamps are sued for studying or reading on tables, they are independently categorized.

The current categories are classified by the lamp shape (double capped type, compact type). Since the application is the same, the categories are integrated.

Table 2 Category of fluorescent lamp luminaires

Application	Lamp shape	Lamp size	Places mainly used (example)
For facilities	Double-capped type or compact double tube type	Equipment with the lamp size of 86 or larger	Plants, warehouses, supermarkets, etc. (Installation height is generally approximately 3 m or more.)
		Equipment with the lamp size less than 86	Offices, schools, shops, plants, warehouses, etc. (Installation height is generally less than 3 m.)
	Compact type other than double lamp type		Shops, offices (hallways, toilets, etc.), houses (rooms, hallways, etc.), etc.
Home use	Ring type or double-capped type	Equipment with the total sum of the lamp size of 70 or more (excluding the double capped type with the lamp size of 20)	Larger room (generally 8-joh or more)
		Equipment with the total sum of the lamp size less than 70 and equipment with the total sum of 70 or more using the double capped type with the lamp size of 20	General size room (usually less than 8-joh)
Fluorescent table study lamps	Double-capped type or compact type		Table top

Note 1 “Lamp size” refers to the “value of size category” of fluorescent lamps specified in Japanese Industrial Standard C7601 “Fluorescent lamps for general lighting service” or in Japan Electric Lamp Manufacturers Association Standard 211 “Fluorescent lamps (general light-

ing service) for high frequency illumination". However, in the case of fluorescent lamps that do not specify "value of size category", the value of "rated lamp power" specified in Japanese Industrial Standard C7617-2 "Double-capped fluorescent lamps - Part2 : Performance specifications" shall be used for double-capped fluorescent lamps and the value of "rated lamp power" specified in Japanese Industrial Standard C7618-2 "Single - capped fluorescent lamps - Part 2: Performance specifications" shall be used for ring type and compact type fluorescent lamps.

Note 2 In the ring type fluorescent lamps, the lamp output value shall be used for the lamp size of the luminaires which use the fluorescent lamp for high frequency illumination.

Attachment 4

Target standard value of fluorescent lamp luminaires

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. Products treated as a special part

In determination of the target standard value with the top runner method, if a product uses special technology, the share of the product concerned is considerably low in all products, the uncertainty element of the product is considered large in the future and the energy consumption efficiency of the product using the technology concerned is determined to be the target standard value, it is highly probable that products using the technology that is widely used cannot be present, that the market is extremely narrowed or that improvement or innovation of other technologies may be disturbed. In this case, the product is treated as a special part, and it shall be excluded from the study in selection of the top runner value.

In this study, the following products are determined as a special part for each category.

(1) Equipment for facilities using double capped fluorescent lamps or double lamp compact type fluorescent lamps with the lamp size of 86 or more

- Equipment using FHP105 (double fluorescent lamp (105W) for high frequency illumination)

Equipment using FHP105 is being converted to FHF86. It is currently manufactured by only one company in the market. The number of the shipment ratio is only 5.5% of the category concerned. Thus, this shall be treated as a special part.

* “Lamp size” refers to “value of size category” of the fluorescent lamp specified in Japa-

nese Industrial Standard C7601 “Fluorescent lamps for general lighting service” or Japan Electric Lamp Manufacturers Association Standard 211 “Fluorescent lamps (general lighting service) for high frequency illumination”. However, in the case of fluorescent lamps that do not specify “value of size category”, the value of “rated lamp power” specified in Japanese Industrial Standard C7617-2 “Double-capped fluorescent lamps - Part2 : Performance specifications” shall be used for double-capped fluorescent lamps and the value of “rated lamp power” specified in Japanese Industrial Standard C7618-2 “Single - capped fluorescent lamps - Part 2: Performance specifications” shall be used for ring type and compact type fluorescent lamps. The same applies to paragraphs below.

(2) Equipment for facilities using double capped fluorescent lamps or double lamp compact type fluorescent lamps with the lamp size less than 86

- FPL32 (compact type double fluorescent lamp (32W) and FPL45 (compact type double fluorescent lamp (45W))

Equipment using FPL32 and FPL45 is being converted to compact type fluorescent lamp FHP32 and FHP45 for high frequency illumination. It is currently manufactured by only one company in the market. The number of the shipment ratio is only 3.9% of the category concerned. Thus, this shall be treated as a special part.

(3) Equipment for facilities using compact type fluorescent lamp other than double lamp type

- FHH62 (8 fluorescent lamps for high frequency illumination (62W) and FHH82 (8 fluorescent lamps for high frequency illumination (82W))

Applications of equipment using FHH62 and FHH82 are limited to down-light, etc. for ceilings of 3 m or higher. It is currently manufactured by only one company in the market. The number of the shipment ratio is less than 1% of the category concerned. Thus, this shall be treated as a special part.

(4) Equipment for home with the total sum of the lamp size of 70 or more using the ring type or double capped type lamp (excluding the double capped fluorescent lamp with the lamp size of 20)

- FHG90 (square fluorescent lamp for high frequency illumination (90W) and FHG110 (square fluorescent lamp for high frequency illumination (110W))

Equipment using FHG90 and FHG110 is not a standard lamp like the ones in Japanese Industrial Standard. It is currently manufactured by only one company

in the market. The number of the shipment ratio is less than 1% of the category concerned. Thus, this shall be treated as a special part.

(5) Home use lamps with the total sum of the lamp size less than 70 using a ring type or double capped type lamp and lamps with the total sum of the lamp size of 70 or more using double capped fluorescent lamps with the size of 20

- FHF24S (double capped type fluorescent lamp for high frequency illumination (24W))

Demand for equipment using FHF24S is very limited in the market. It is manufactured by only one company. The number of the shipment ratio is only 0.4% of the category concerned. In addition, although the luminaire is efficient in double capped fluorescent lamps, it is inferior to the ring type luminaire in the aspect of cost and efficiency. In the future, the number of shipment units will be reduced. Thus, this shall be treated as a special part.

(6) Other very limited shipment number luminaires

Although the efficiency is good, the shipment number of units is very limited in luminaires with the same fluorescent lamp type or number of lamps mounted due to use of a special type lamp. If it is difficult to have the efficiency of the concerned product equivalent with other products, this shall be treated as a special part.

3. Room to improve energy consumption efficiency through the introduction of highly efficient technology

The energy saving performance of fluorescent lamp luminaires can be enhanced by improving the illumination efficiency and ballast (illumination circuit) efficiency of the lamp used. Since the technology development for illumination efficiency is almost at its limit, large technological innovation is not expected in the future. There is still a large difference between the equipment using highly efficient ballast (inverters) and the equipment not using them (magnetic type). There are still items for the improvement of efficiency.

4. Specific target standard value

(1) Basic concept

Luminaires are required to have an appropriate visual environment such as il-

lumination intensity or illumination distribution depending on the purpose or location. To develop styling or light distribution, a variety of lamp shapes, lamp colors and luminaire shapes are available, and there are many types of luminaires.

Even if the lamp used is the same, there is difference in the luminaire temperature (lamp wall temperature) between luminaires with an exposed lamp and luminaires with a cover or louver for reduction of glare. Therefore, the power consumption changes. (In general, the input power is reduced along with increase of the lamp temperature.)

Luminaires with the light control function have a complicated ballast circuit. The power consumption is larger than luminaires without the light control function, and the efficiency is low.

As described above, the values of energy consumption efficiency vary for each product depending on availability or combinations of luminaire shapes such as covers or louvers, or functions including light control, even if the fluorescent lamp luminaire belongs to the same category. It is difficult to use the highest energy consumption value uniformly as the target standard value in the same category.

In contrast, determination of a target standard value for each lamp or function type makes the categories detailed. A large energy saving effect may not be achieved.

In this way, considering the performance of many types of luminaires, the target standard value that can encourage efficiency improvement is the use of a highly efficient ballast (inverter) like the type (Hf) for high frequency illumination with excellent energy consumption efficiency.

(2) Determination of target standard value

Considering performance of many types of luminaires, to encourage improvement of efficiency with a highly efficient ballast (inverter), based on Principle 5 of "Basic concept on planning and revision of manufacturers' evaluation standards for performance improvement related to specific equipment", the top runner value is determined by putting fluorescent lamps for high frequency illumination that give a large difference in energy consumption efficiency, fluorescent lamp luminaires using dedicated inverters, and fluorescent lamp luminaires using magnetic ballasts that provide illumination in commercial frequency in the same category.

In specific, attention was paid to the elements that affect the energy consump-

tion efficiency from differencees in technology of each category, such as shape, size and the number of lamps, illumination method (Hf, inverter or magnetic type), output type (high output or rated output), lower surface condition (with/without cover), with/without light control function, light color, and they were detailed and classified into product groups. In each group, the product showing the most excellent performance was determined to be the top runner value of the product group concerned. Then, the weighted mean value of the top runner value of each product group is determined to be the top runner value of the whole category according to the shipment ratio of each product, and it shall be used as the value that represents the degree of improvement of energy consumption efficiency for the whole category.

Based on the top runner value determined as above, the target standard value shall be the value by adding the improvement of energy consumption efficiency, assuming further progress of the inverter until the target fiscal year, in view of the current shipment ratio of fluorescent lamp luminaires with excellent efficiency using an inverter as in fluorescent lamps for high frequency illumination. (Refer to Figs. 1 to 6.)

(Reference) Principle 5 of "Basic concept on preparation and revision of evaluation standard for manufacturers related to improvement of performance of specific equipment"

Since highly advanced energy saving technology is used, equipment with expensive and high energy consumption efficiency may be classified into categories. It is desirable to handle them in the same category so that manufacturers may sell products with excellent energy consumption efficiency in a positive manner.

Table 1 Category of fluorescent luminaire and target standards

Application	Lamp shape	Category	Lamp size	Top runner value (lm/W)	Efficiency improvement (%)	Target standard value (lm/W)
For facilities	Double-capped type or compact double tube type	I	Equipment with the lamp size of 86 or larger	100.2	0.6%	100.8
		II	Equipment with the lamp	96.1	4.6%	100.5

			size less than 86			
	Compact type other than double lamp type	III		58.7	4.9%	61.6
Home use	Ring type or double-capped type	IV	Equipment with the total sum of the lamp size of 70 or more (excluding the double capped type with the lamp size of 20)	90.3	1.4%	91.6
		V	Equipment with the total sum of the lamp size less than 70 and equipment with the total sum of 70 or more using the double capped type with the lamp size of 20	69.3	12.7%	78.1
Fluorescent table study lamps	Double-capped type or compact type	VI		70.8	0%	70.8

Note 1 “Lamp size” refers to the “value of size category” of fluorescent lamps specified in Japanese Industrial Standard C7601 “Fluorescent lamps for general lighting service” or in Japan Electric Lamp Manufacturers Association Standard 211 “Fluorescent lamps (general lighting service) for high frequency illumination”. However, in the case of fluorescent lamps that do not specify “value of size category”, the value of “rated lamp power” specified in Japanese Industrial Standard C7617-2 “Double-capped fluorescent lamps - Part2 : Performance specifications” shall be used for double-capped fluorescent lamps and the val-

ue of “rated lamp power” specified in Japanese Industrial Standard C7618-2 “Single - capped fluorescent lamps - Part 2: Performance specifications” shall be used for ring type and compact type fluorescent lamps.

Note 2 In ring type fluorescent lamps, the lamp output value shall be used for the lamp size of the fixture which uses fluorescent lamps for high frequency illumination.

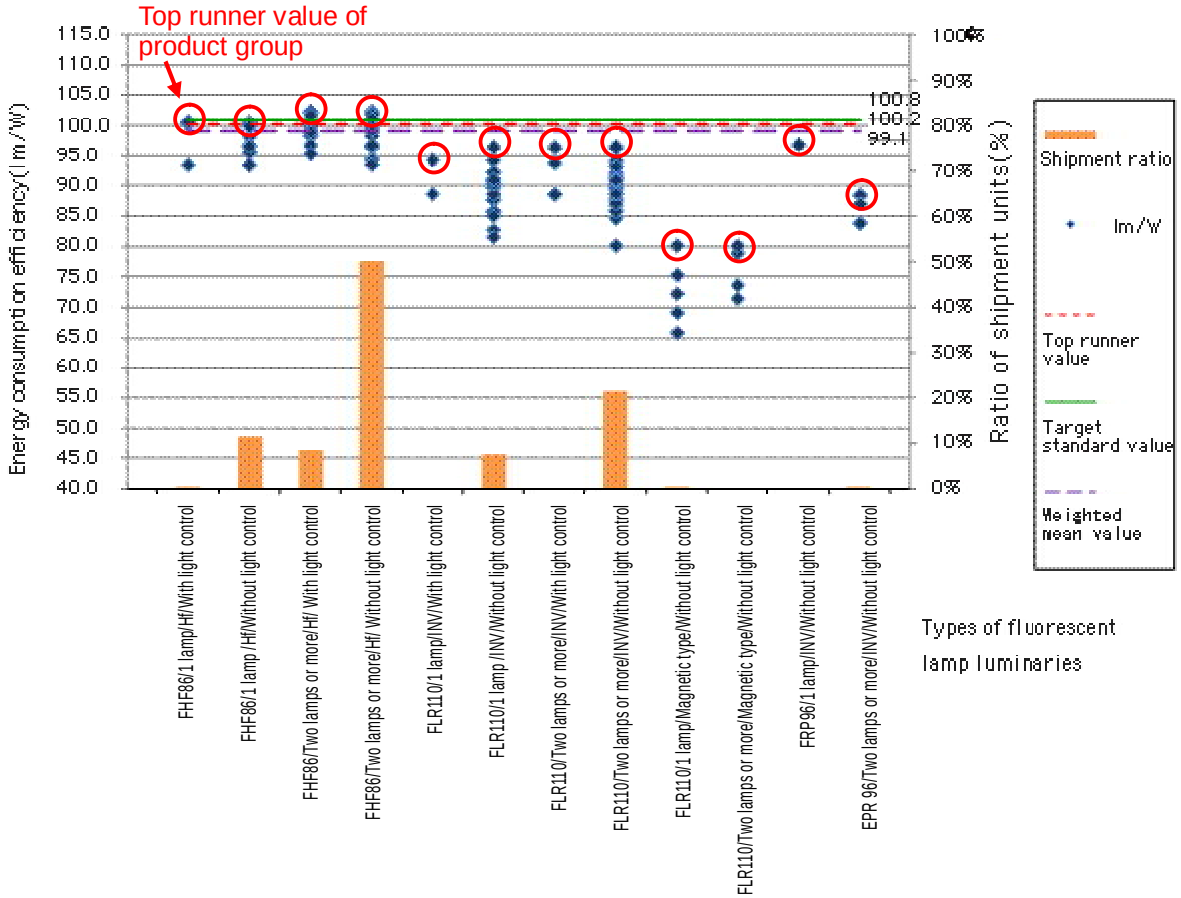


Fig. 1 Target standard value of Category I (equipment for facilities using double capped fluorescent lamps or double lamp compact type fluorescent lamps with the lamp size of 86 or more)

* To determine the top runner value, the top runner value (level of ○) of each product group (e.g. FHF86/2 lamps or more/Hf/with light control) was multiplied for calculation by the shipment ratio (approximately 50%) of the product group concerned.

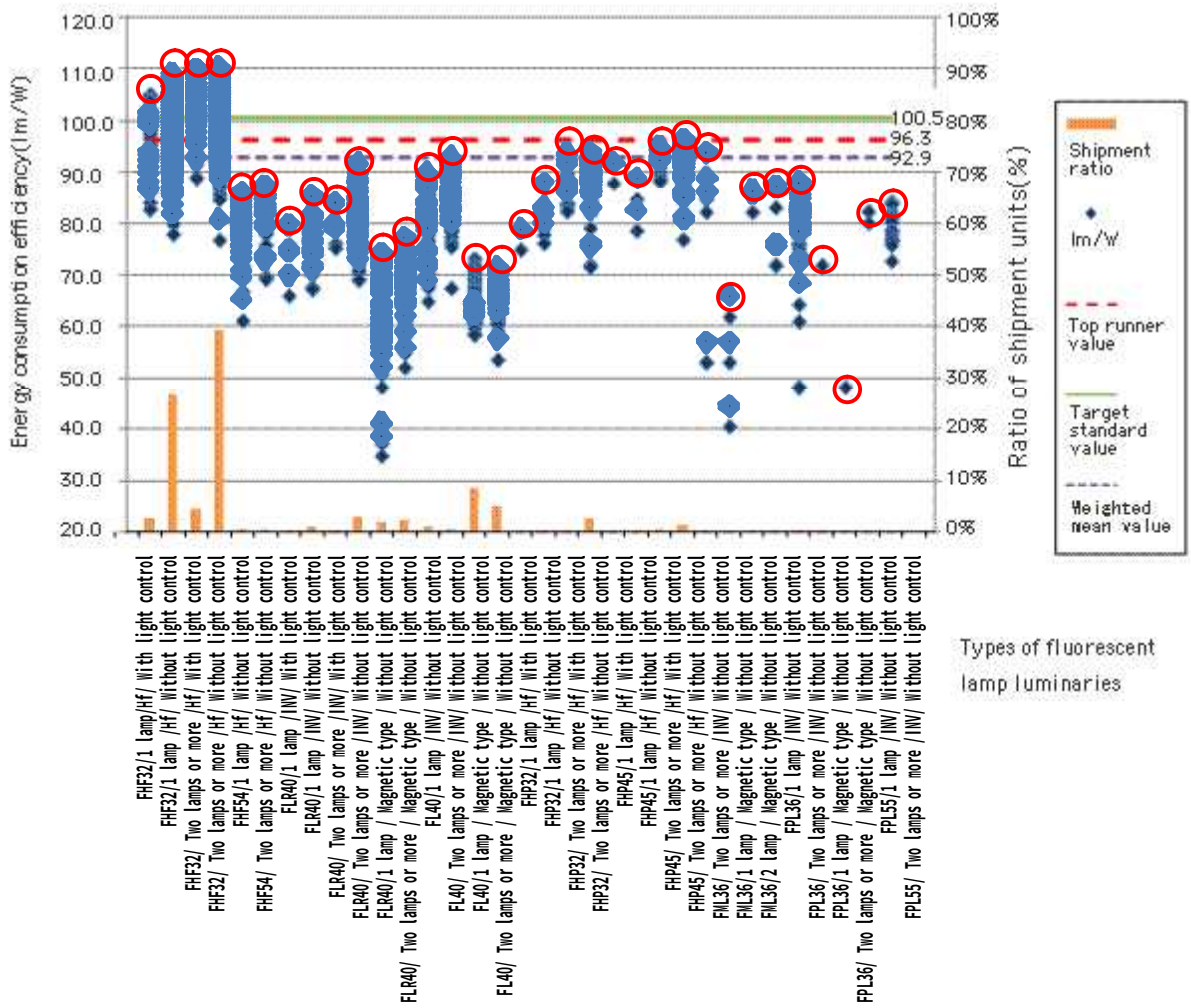


Fig. 2 Target standard value of Category II (equipment for facilities using double capped fluorescent lamps or double lamp compact type fluorescent lamps with the lamp size less than 86)

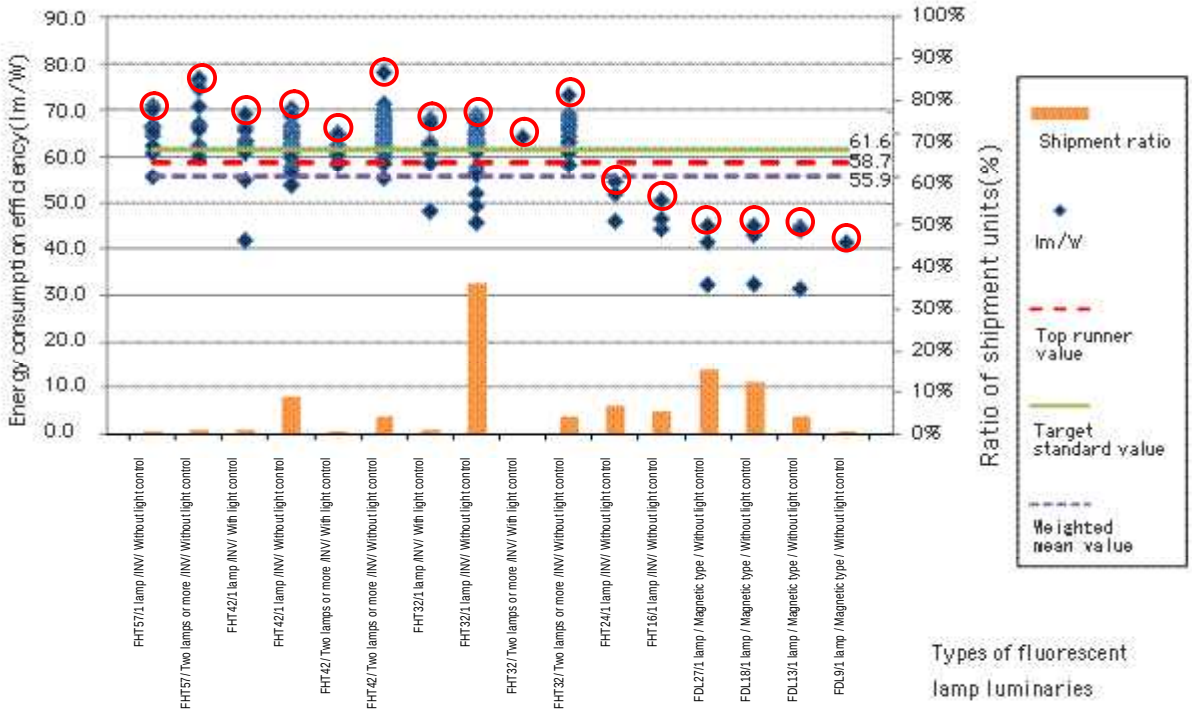


Fig. 3 Target standard value of Category III (equipment for facilities using compact type fluorescent lamps other than the double lamp type)

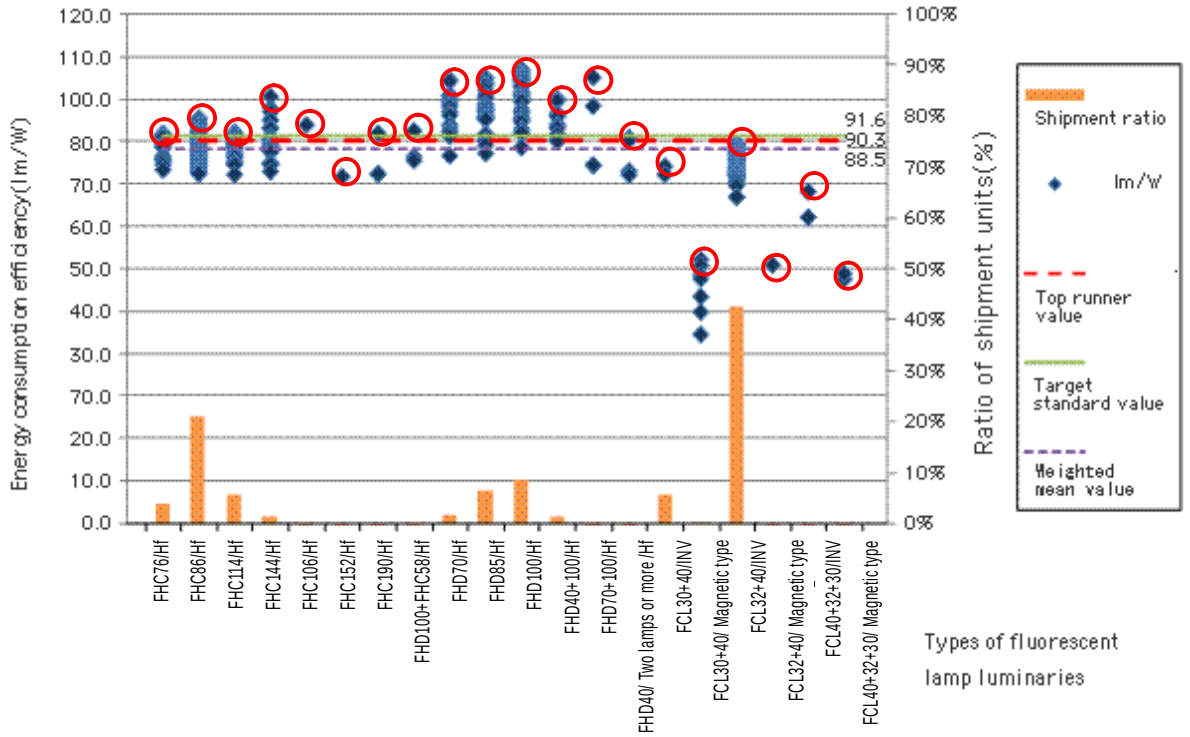


Fig. 4 Target standard value of Category IV (equipment for home with the total sum of the lamp size of 70 or more using the ring type or double capped type lamps (excluding double capped fluorescent lamps with the lamp size of 20)

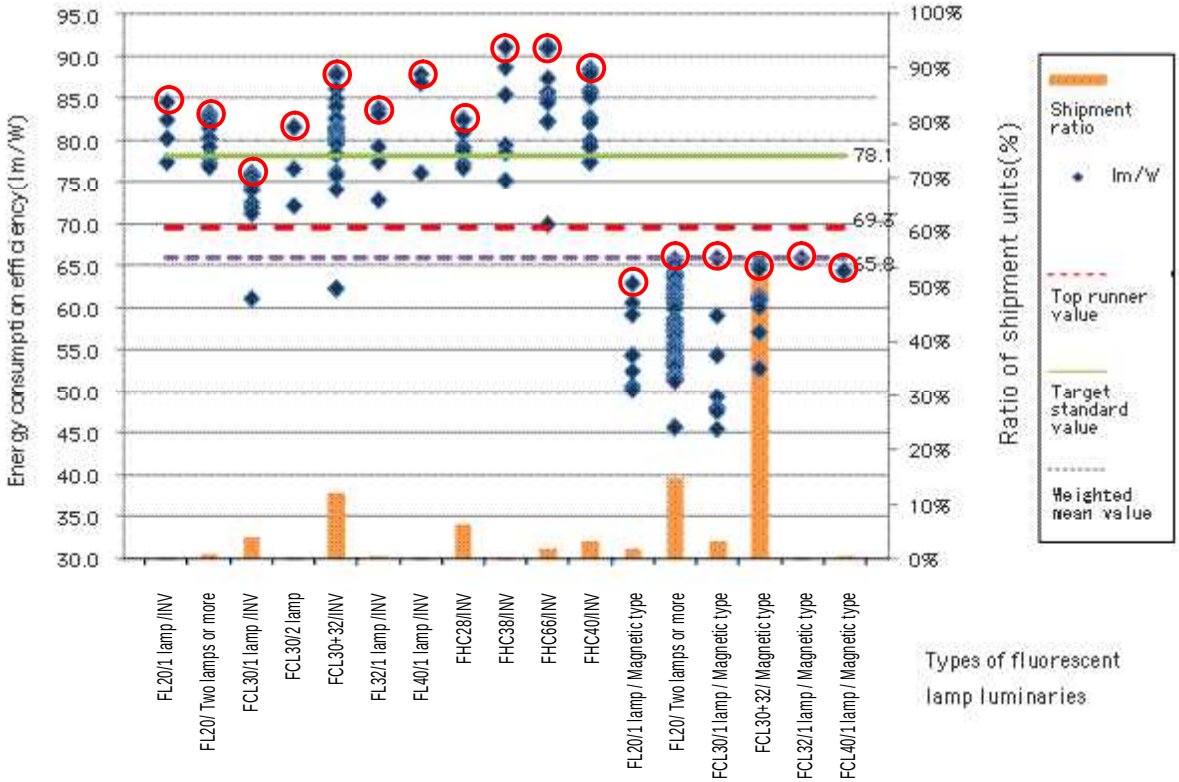


Fig. 5 Target standard value of Category V (equipment for home with the total sum of the lamp size less than 70 using the ring type or double capped type lamps and lamps with the total sum of the lamp size of 70 or more using the double capped fluorescent lamps with the size of 20)

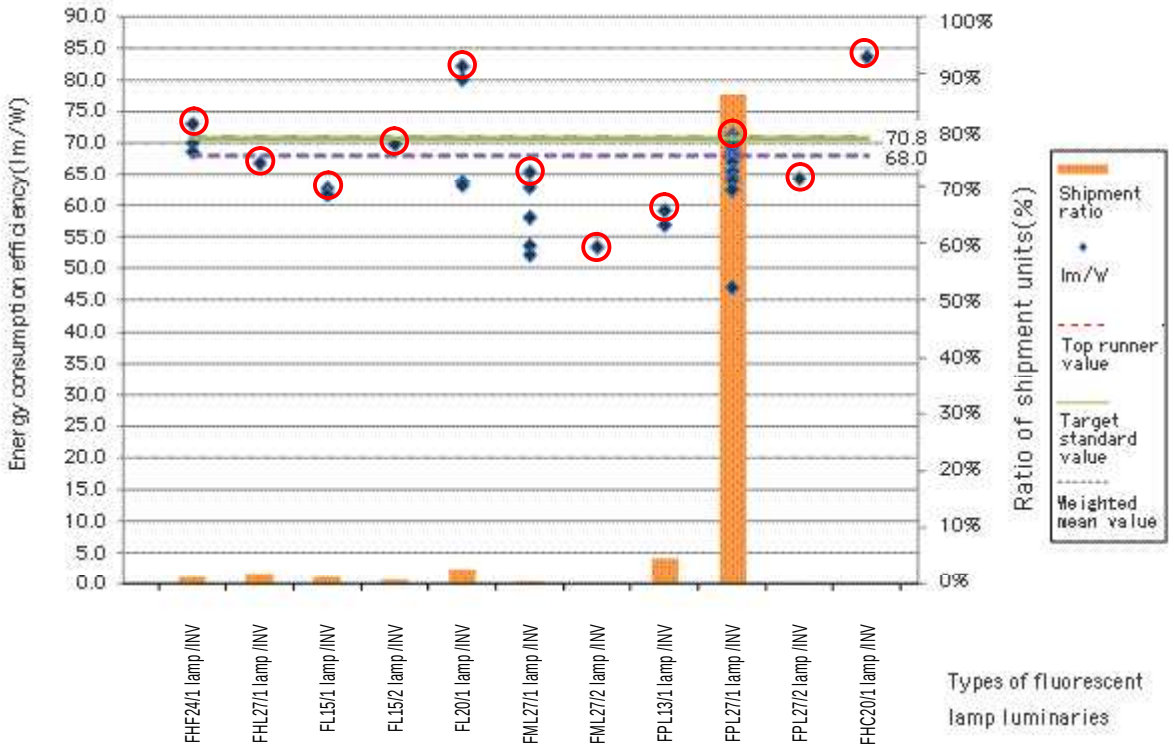


Fig. 6 Target standard value of Category VI (equipment for table study lamps using the double capped type or compact type fluorescent lamps)

Attachment 5

Energy consumption efficiency of luminaires and measurement methods

1. Basic concept

The current energy consumption efficiency of fluorescent lamp luminaires specified in Energy Saving Law is the total luminous flux (lm/W) per power consumption. It shall be obtained by dividing the total luminous flux (lm) of fluorescent lamps mounted on the fluorescent luminaires by the power consumption of the fluorescent luminaires.

In measuring the current energy consumption efficiency of fluorescent lamp luminaires, it is reasonable to use brightness of fluorescent lamp luminaires continuously as an index. The current measurement method shall be basically used.

For the measurement method of the energy consumption efficiency for fluorescent lamp luminaires, the Japanese Industrial Standard C 8020 “Method of calculation on fluorescent luminaire efficacy index” was determined in 2005. Since an element not directly related to energy consumption like effect of light intensity with/without a cover affects the value of consumption efficiency, the definition of the energy consumption efficiency in the standard is not employed as is to determine the measurement method of the current energy consumption. The provision of a coefficient necessary for calculation is partially quoted from the standard. (Refer to the attachment.)

2. Specific measurement methods for energy consumption efficiency of fluorescent lamp luminaires

(1) Energy consumption efficiency

The energy consumption efficiency of fluorescent luminaires shall be the value obtained by dividing the total luminous flux (lm) of the fluorescent lamp mounted on the fluorescent luminaire by the power consumption (W) of the florescent luminaire.

$$\text{Energy consumption efficiency (lm/W)} = \frac{\text{Total luminous flux (lm) of the fluorescent lamp mounted on the fluorescent luminaire}}{\text{Power consumption (W) of fluorescent luminaire}}$$

(2) Measurement methods of energy consumption efficiency

The total luminous flux and the power consumption of fluorescent luminaires shall be measured as follows:

1) Measurement method of total luminous flux

The total luminous flux of fluorescent luminaires shall be the value by multiplying the ballast output coefficient and the temperature compensation coefficient by the total luminous flux value of the individual fluorescent lamp (hereinafter referred to as the “rated total luminous flux value of lamp”) measured with the method specified in optical characteristics of Japanese Industrial Standard C7617-2 “Double-capped fluorescent lamps - Part2 : Performance specifications” and Japanese Industrial Standard C7618-2 “Single - capped fluorescent lamps - Part 2: Performance specifications”.

* Total luminous flux means the total sum of luminous flux emitted in all directions from the light source.

Total luminous flux = (Rated total luminous flux value of lamp) x (Ballast light output coefficient) x (Temperature compensation coefficient)

i) Calculation of ballast light output coefficient

The ballast light output coefficient shall be the value obtained from the calculation method specified in the measurement of optical output coefficient by the sample ballast of Japanese Industrial Standard C 8020 “Method of calculation on fluorescent luminaire efficacy index”.

ii) Calculation of temperature compensation coefficient

The temperature compensation coefficient shall be the coefficient specified in Appendix 2 of Japanese Industrial Standard C 8020.

2) Measurement method of power consumption

The power consumption of fluorescent lamp luminaires shall be measured with the method specified via Japanese Industrial Standard C 8105-3 “Luminaires - Part 3 : General requirements for performance”. After measuring the tube wall temperature to calculate the temperature compensation coefficient, measurement shall be performed under the same conditions.

Attachment

Preparation of Japanese Industrial Standard C 8020 “Method of calculation on fluorescent luminaire efficacy index”

Japan Luminaires Association

1. Establishment history of Japanese Industrial Standard C 8020

(1) On December 17, 1998, the “final report of Fluorescent Lamp Luminaire Evaluation Standards Subcommittee, Energy Efficiency Standards Subcommittee, Advisory Committee for Natural Resources and Energy” was submitted. Based on the reasons below, the Japanese Industrial Standard C 8020 “Method of calculation on fluorescent luminaire efficacy index” was determined.

“No matter how large the energy consumption efficiency is, luminaires cannot be good due to glare or lamp color rendition. Because a good illumination environment from luminaires can be basically achieved only with appropriate supply of both light intensity and quality from luminaires. It is important to select luminaires effective for energy saving without impairing illumination quality. (Excerpt from explanation in Japanese Industrial Standard C 8020)

(2) Method of calculation on fluorescent luminaire efficacy index

For example, the energy consumption efficiency index of home fluorescent lamp luminaires can be calculated from the formula below.

$LEI=LER\times K_1\times K_2$

- LEI : Energy consumption efficiency index of sample fluorescent luminaire
- LER : Characteristic energy consumption efficiency (lm/W) of sample fluorescent luminaire
- K_1 : Color rendition coefficient of sample fluorescent lamp
- K_2 : Combination coefficient of sensor function and light control function

$LER=\eta\times F\times BF/P$

- η : Equipment efficiency of sample fluorescent lamp luminaire (%)

- ΦF : Rated total luminous flux of sample fluorescent lamp (lm)
- BF : Light output coefficient of sample ballast
- P : Input power of fluorescent lamp luminaire (W)

2. Issues of Japanese Industrial Standard C 8020 calculation method

JIS C 8020 provides the energy consumption efficiency index of fluorescent lamp luminaires considering “both aspects of light intensity and quality from luminaires”. For adoption in the Energy Saving Law, the following issues are present.

(1) By applying the luminaire efficiency introduced in Japanese Industrial Standard C 8020, the total energy consumption efficiency of luminaires can be known. An extreme example shows that a luminaire without a cover or louver on the lower surface rather than a luminaire with a cover or louver which provides quality light gives higher equipment efficiency. The simple introduction of an index considering “both aspects of light intensity and quality from luminaires” may adversely deteriorate light quality, which is contradictory.

(2) To cope with this, there are methods to divide categories into details for the purpose and application. Luminaires for facilities and houses are basically designed for the purpose and application. It is no exaggeration to say that each model has own its category. Therefore, if corresponding categories are provided, the classifications are too detailed. It may be complex for users and it is not preferred.

(3) A light distribution device is required to measure the luminaire efficiency. There are several methods for measurement and the manufacturers are selecting the methods to introduce the device. Some companies do not possess light distribution devices and variation of measurement values shall also be considered. At present, there is no public institution that can measure luminaire efficiency. Certainty of the measurement value cannot be currently assured.

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

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 Manu-

facturers 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.

References

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.

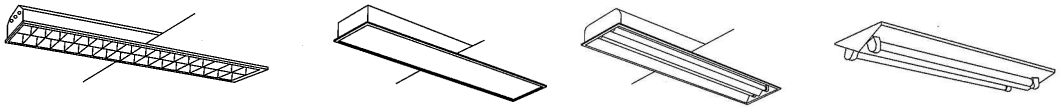
Available fluorescent lamps used for these luminaires are general fluorescent lamps and Hf (for high frequency illumination) fluorescent lamps. Available illumination devices are magnetic ballast and electronic ballast (inverter: high frequency illumination). Types of luminaires for application and their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

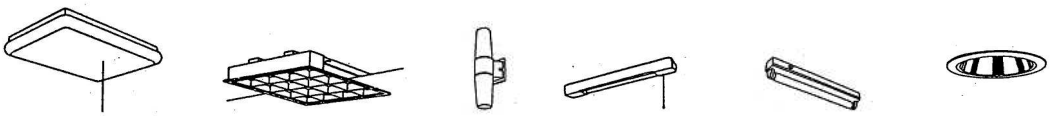
1.1.1 Fluorescent lamp luminaires

(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)

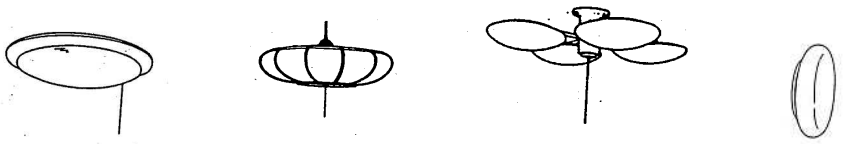
(2) Luminaires using fluorescent lamps that are less than 40W (mainly for home)



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

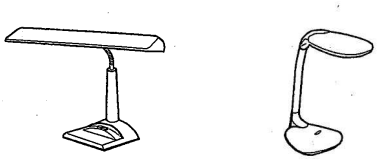
(Fluorescent (2) - Facility/home) (Fluorescent (2) - Facility) (Fluorescent (2) - Facility/Home)

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



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

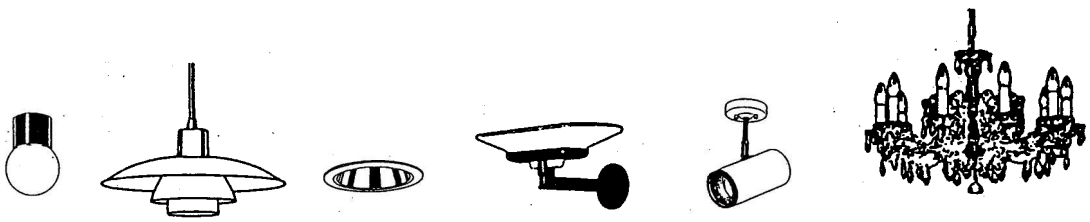
(4) Fluorescent study lamp (Fluorescent (4) - Home)



(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)



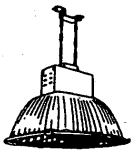
Direct mount type Suspension type Down-light Bracket Spot light Chandelier

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

Explosion-proof and dust-proof luminaires

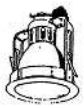
1.1.3 HID lamp luminaires (mainly for facilities)

Highway lamp



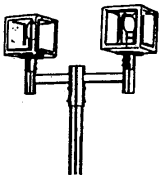
For high ceilings

Flood light

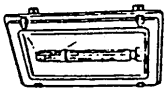


Down-light

(High - Facility)



Street light luminaire



Tunnel lamp

(High - Facility)

Garden lamp

(High - Home)

1.1.4 Main light source used for luminaires

(1) Fluorescent lamp

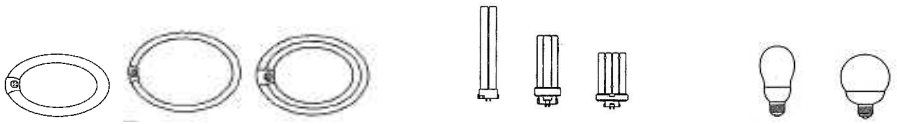
General type: (FL/FLR) Less than 40W

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

Hf type: Less than 40W

Hf type: 40W or more

Double-capped type



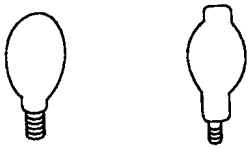
General type Hf type General type/Hf type

Ring type Compact type Bulb type

(2) Incandescent bulb

General bulb Ball bulb Mini-krypton bulb Halogen bulb

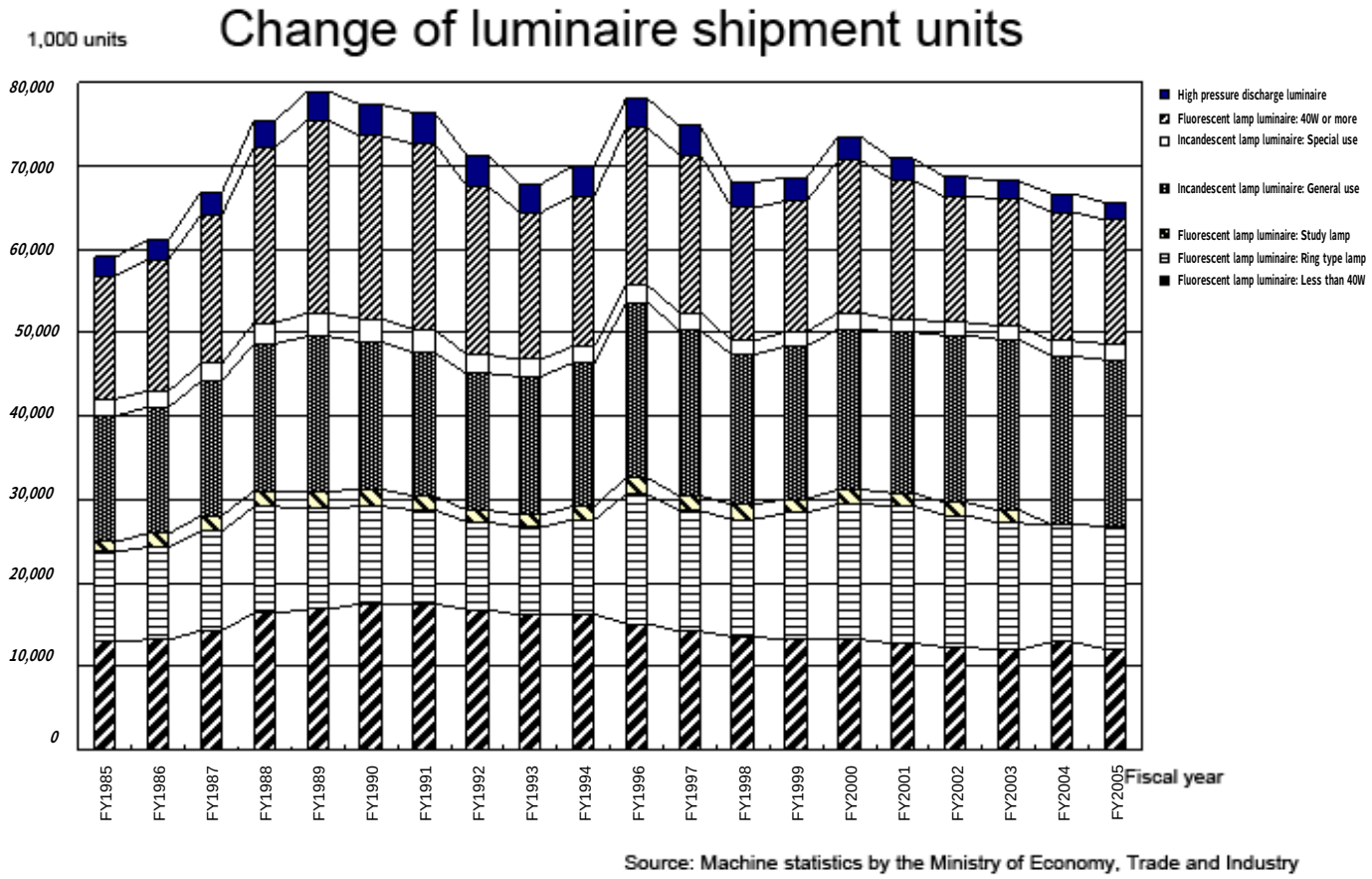
(2) HID lamp



(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

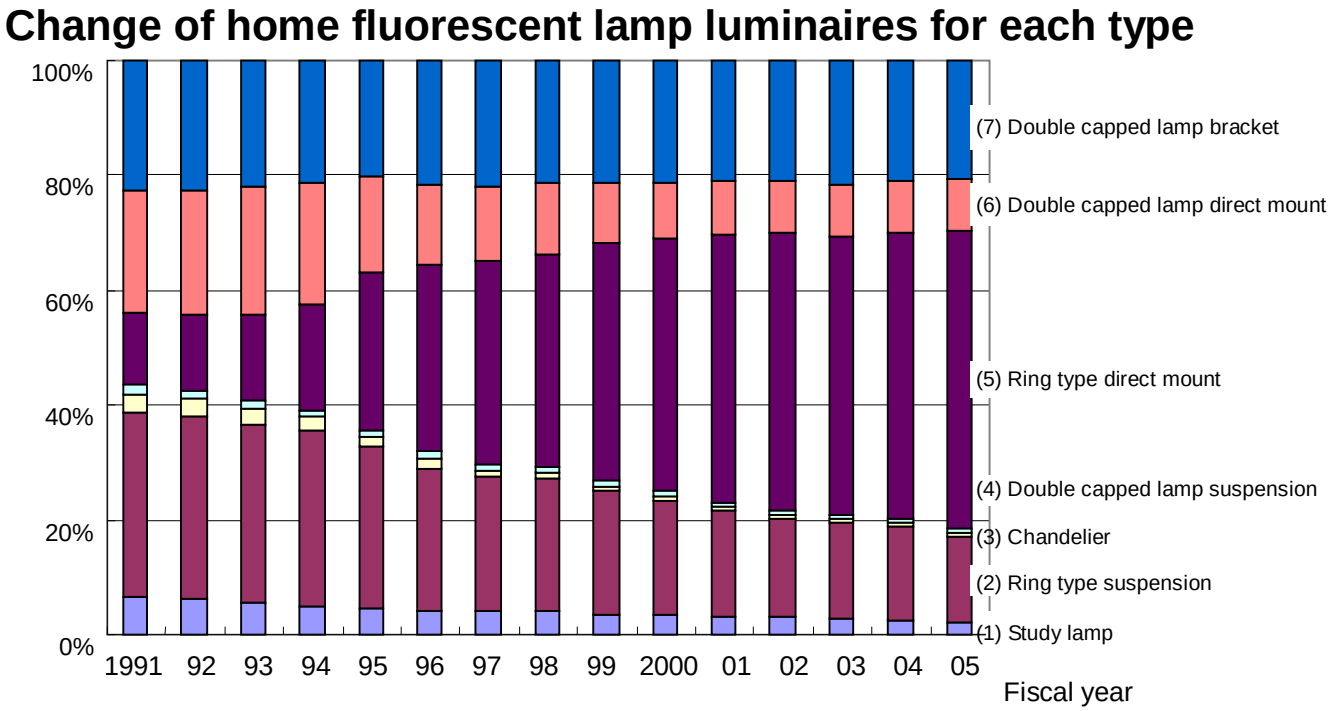
1.3.1 Fluorescent lamp luminaires

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.)



Source: Self-statistics of the Japan Luminaires Association

1.3.2 Incandescent lamp luminaires

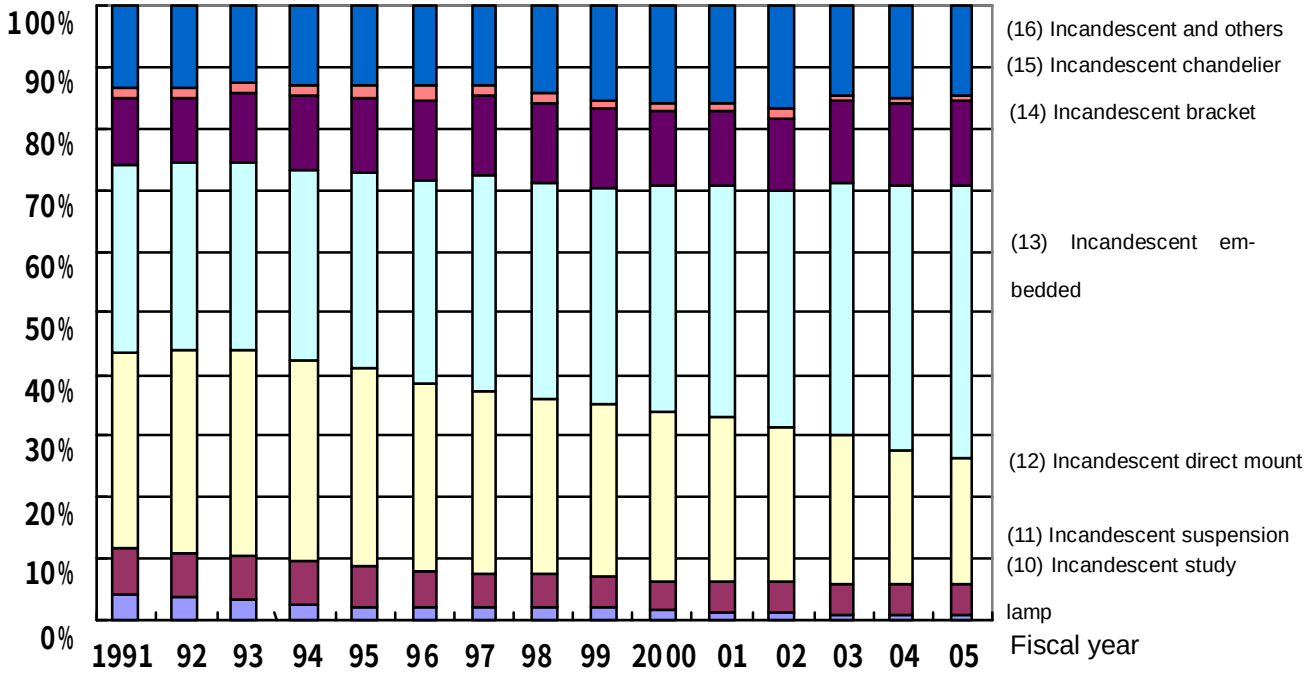
Incandescent lamp luminaires are approximately 30% of the total luminaires. The percentage almost remains unchanged. It is popular because of flexibility in styling, ease of light control and warmth.

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 suspen-

sion luminaires also reduced by several percent.

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

Incandescent lamp luminaires for each type



Source: Self-statistics of the Japan Luminaires Association

Source: Self-statistics of the Japan Luminaires Association

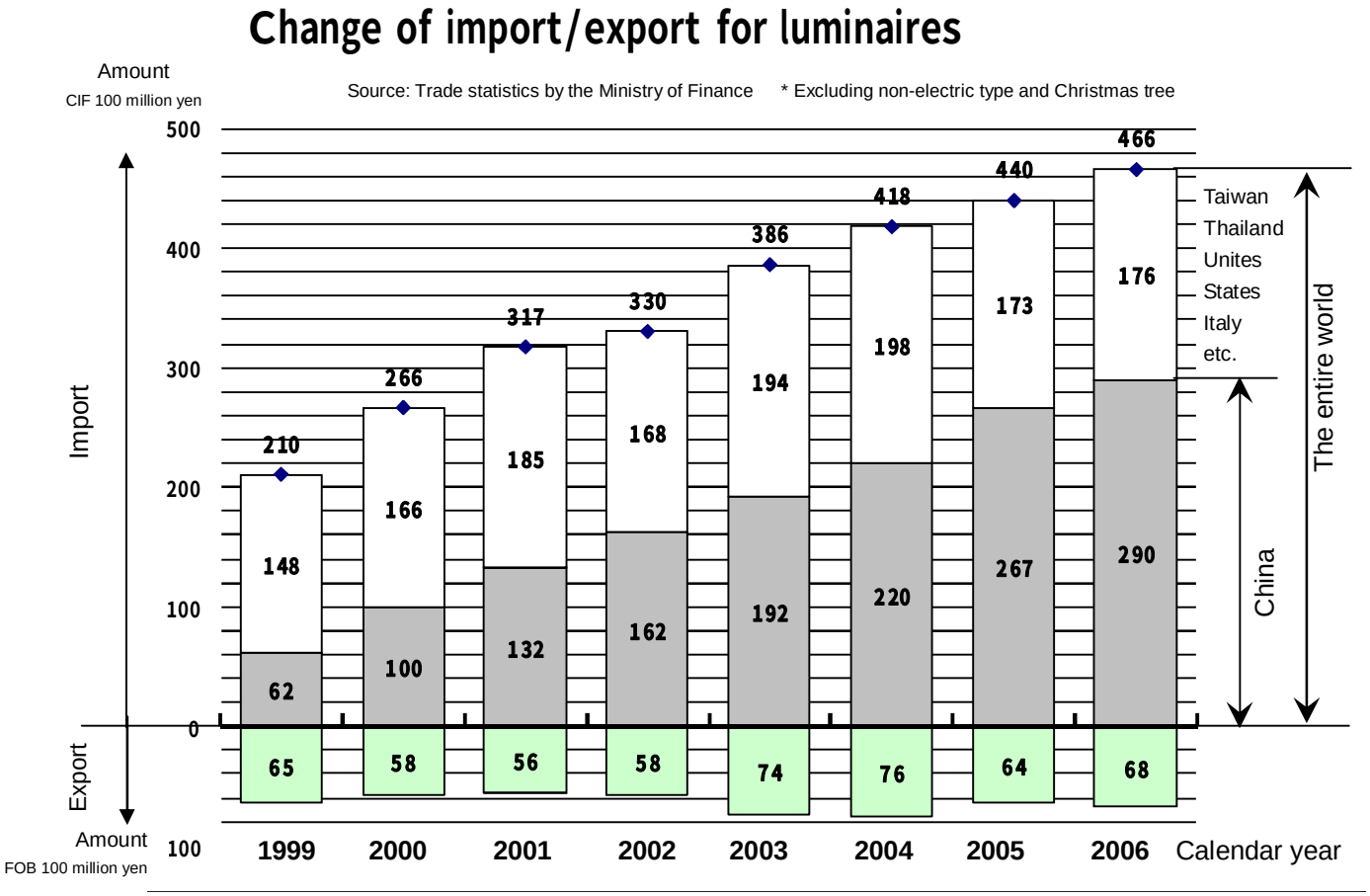
1.3.3 HID lamp luminaires

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)		**77.0**	**49.0**	**81.0**	**82.0**	**75.5**	**59.0**	
		80.2	52.6	84.1	72.9	75.4	58.4	64.4
		80.5	50.8	85.5	74.5	76.4	57.6	71.2
		80.5	52.2	88.1	77.9	79.3	59.5	76.0
		80.4	52.2	90.3	79.2	79.2	59.8	76.6
		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 consumption efficiency (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.

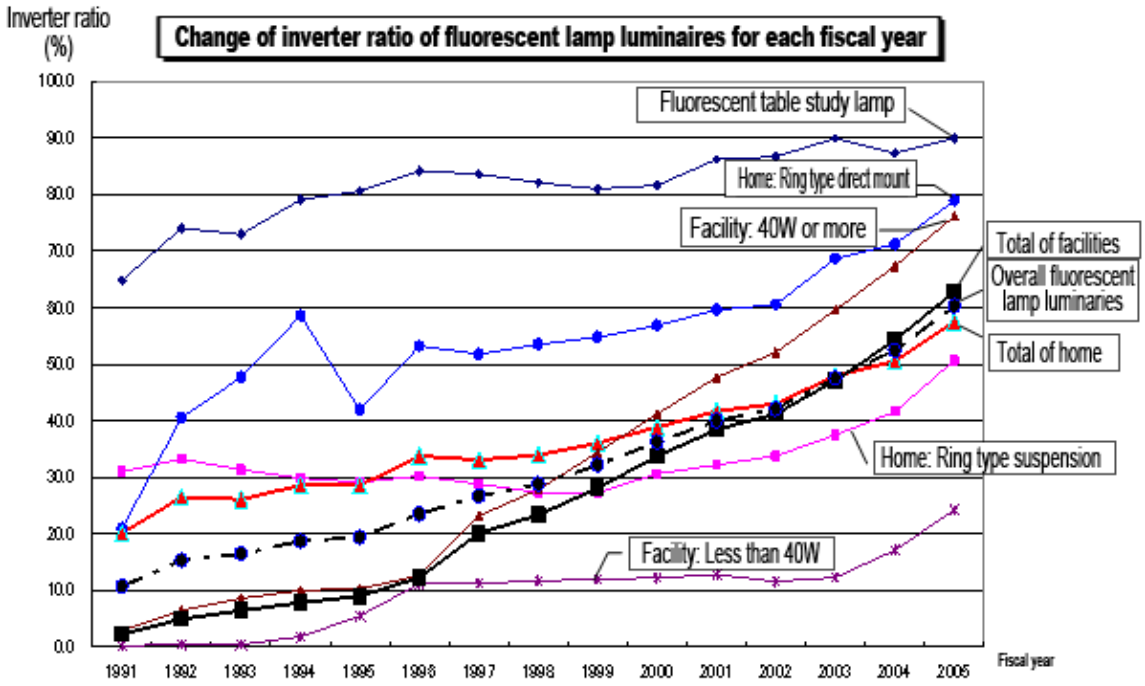
2.2 Actions for future energy saving

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.

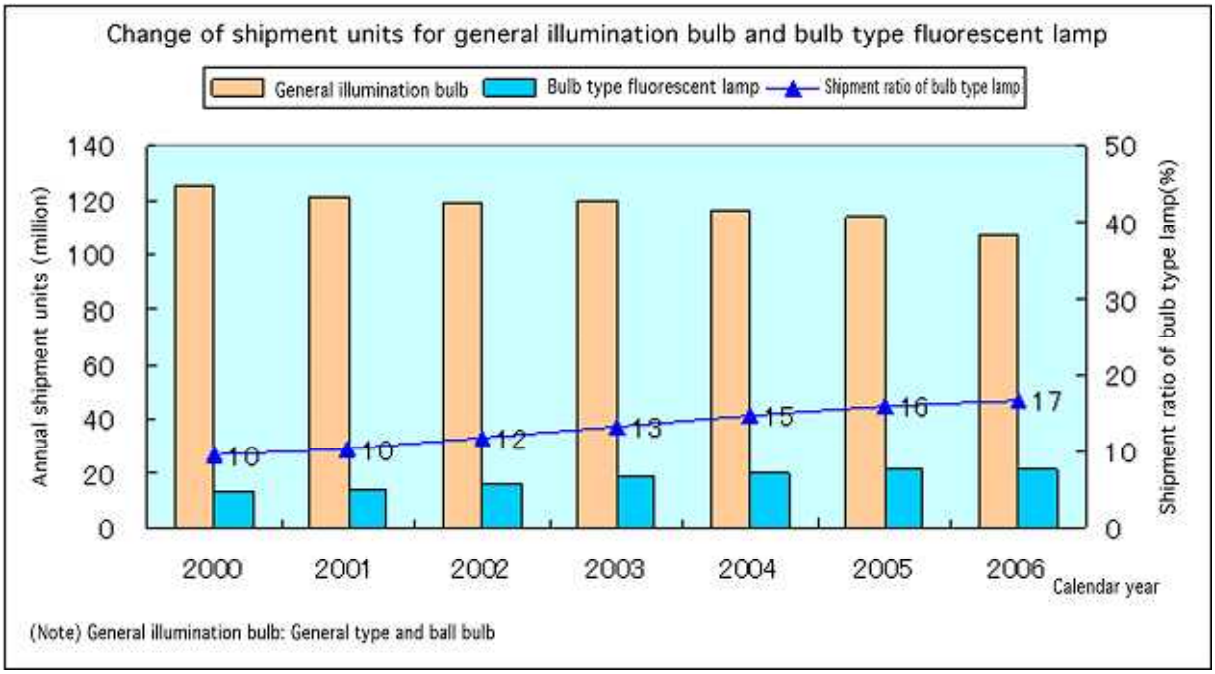
(3) Improvement by change of filament material

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

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

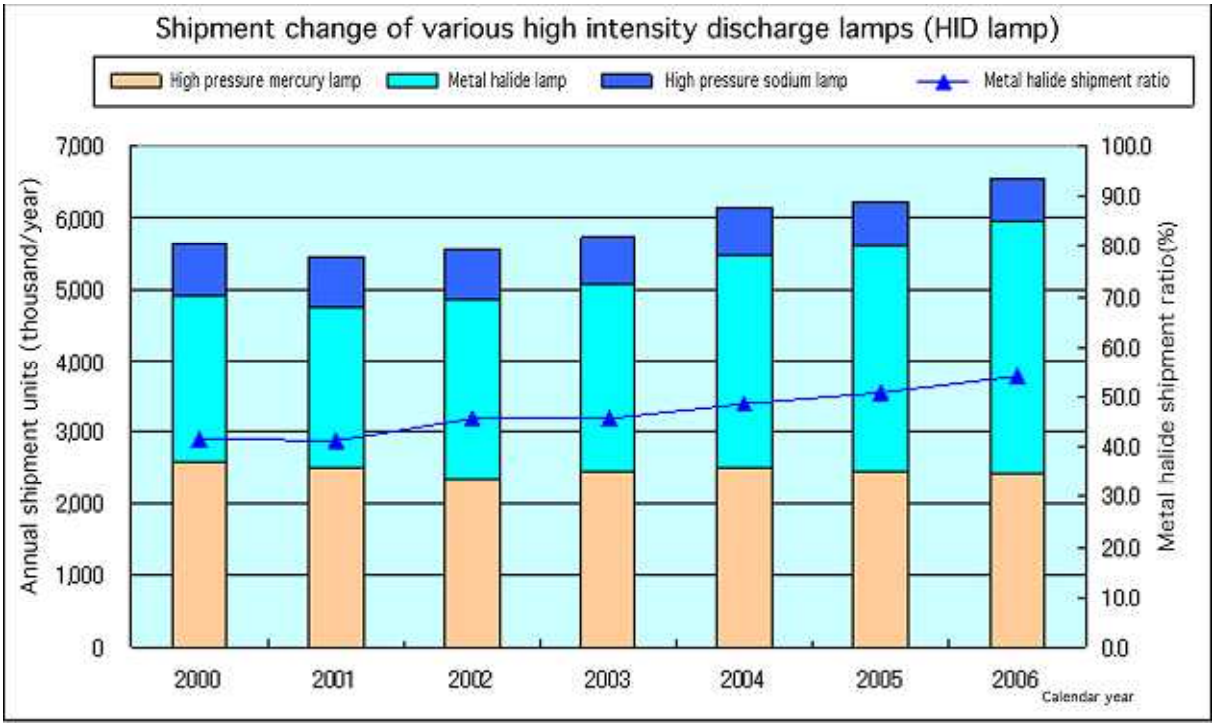
(Note 1) The representative model of the metal halide lamp is the ceramic metal halide lamp.
(Note 2) Ratio of annual shipment units in 2006

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 a wide range of illumination that can feel brightness are achieved, resulting in great improvement in 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