Final Report by Microwave Oven Evaluation Standard Subcommittee, Energy Efficiency Standards Subcommittee of the Advisory Committee for Natural Resources and Energy

The Microwave Oven Evaluation Subcommittee had deliberations on judgment standards for the manufacturers and importers (hereafter referred to as "manufacturers") concerning performance improvements of microwave ovens, and prepared a final summary report as below.

1. Target Scope [See Attachment 1]

The report shall cover microwave ovens. However, microwave ovens for business use, those dedicated to rated input voltage of 200V, those of embedded type, those having a gas oven, and those whose interior height is less than 135 mm shall be excluded.

2. Items to be Judgment Standards for Manufacturers

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

It shall be the fiscal year 2008.

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

With regard to microwave ovens that manufactures ship within Japan for the target fiscal year, the weighted average of energy consumption efficiency (annual energy consumption) calculated in (3) by the volume of shipments for each manufacturer per category in the table below shall not exceed the target standard values.

Category	Function	Heating Method	Inner Volume	Target Standard Value [kWh/year]
A	Without oven function (single-function microwave oven)	−	−	60.1
B	With oven function (oven-microwave oven)	With an exposed heater (except for those of hot air circulation heating method)	Less than 30 L	73.4
C			30 L or greater	78.2
D		Without an exposed heater (except for those of hot air circulation heating method)	Less than 30 L	70.4
E			30 L or greater	79.6
F		Hot air circulation heating method	−	73.5

Note: "Inner Volume" refers to a numeric value computed from usable dimensions of a heating chamber defined by Electrical Machinery and Appliance Quality Labeling Regulations based on Household Goods Quality Labeling Law (Law No.104 of 1962).

(3) Measurement method of energy consumption efficiency [See Attachment 5]

The energy consumption efficiency of microwave ovens shall be the annual energy consumption, and it is a numeric value [kWh/year] calculated by the following expression.

$$E = [(580.8*A_{V285} + 66*A_{V245} + 571.1*A_{V125} + 205*A_{V185}) + 31*B + 6400*C]/ 1000$$

In this equation, E, A_{V285}, A_{V245}, A_{V125}, A_{V185}, B, and C shall represent the following numeric values.

E: Energy consumption efficiency [kWh/year]

A_{V285}: Energy consumption per use of microwave function to heat dummy-load of 285[g] [Wh/time]

A_{V245}: Energy consumption per use of microwave function to heat dummy-load of 245 [g] [Wh/time]

A_{V125}: Energy consumption per use of microwave function to heat dummy-load of 125 [g] [Wh/time]

A_{V185}: Energy consumption per use of microwave function to heat dummy-load of 185 [g] [Wh/time]

B: Energy consumption per use of oven function [Wh/time]

C: Standby energy consumption per hour [Wh/time]

(4) Display items and others

Items to be displayed shall follow the provisions in the Household Good Quality Labeling Law. The items concerning energy-saving shall be as follows.

1) Display items shall be as follows:

a) Category
b) Annual energy consumption of microwave function
c) Annual energy consumption of oven function (limited to those with oven function.)
d) Annual standby energy consumption
e) Energy consumption efficiency (annual energy consumption)
f) Manufacturer's name

(Note) Regarding the display of a) to e) in the above, revision of the Electric Machinery and Appliance Quality Labeling Regulation is required.

2) Compliance items

a) The energy consumption efficiency shall be in kWh/year displayed to one place of decimals. In this case, the energy consumption efficiency shall be

106% or below of the displayed value.

b) The annual energy consumption of microwave function shall be a numeric value calculated by the following expression, and in kWh/year displayed to one place of decimals:

Annual energy consumption of microwave function = (580.8*A_{V285} + 66* A_{V245} + 571.1*A_{V125} + 205*A_{V185}) / 1,000

c) The annual energy consumption of oven function shall be a numeric value calculated by the following expression, and in kWh/year displayed to one place of decimals:

Annual energy consumption of oven function = 31*B / 1,000

d) The annual standby energy consumption shall be a numeric value calculated by the following expression, and in kWh/year displayed to one place of decimals:

Annual standby energy consumption = 6400*C / 1,000

e) The display items shown in 1) above shall be put in a prominent place in catalogues or instruction manuals explaining products' performance, when consumers select appliances.

3. Proposals for Energy-saving

(1) Actions of users

1) Utilizing information such as "energy-saving label", efforts shall be made to select microwave ovens with excellent energy consumption efficiency; and on occasions when using microwave ovens, efforts shall be made to reduce the energy consumption by appropriate and efficient use.

(2) Action of retailers

1) Microwave ovens with excellent energy consumption efficiency shall be promoted, and by use of "energy-saving label", appropriate information shall be provided for users to select a microwave oven with excellent energy consumption efficiency. Also, in using the energy-saving label, its display shall be easy to see for users, so as not to misconceive.

(3) Actions of manufacturers

1) Technical development for energy-saving of microwave ovens shall be promoted by, for example, carrying out an efficiency analysis of microwave heating, and the products with excellent energy consumption efficiency shall be developed.
2) From viewpoint of promoting the spread of microwave ovens with excellent energy consumption efficiency, "energy-saving label" shall be swiftly introduced, and appropriate information shall be provided for users to select them. Also, in using the energy-saving label, its display shall be easy to see for users, so as not to misconceive.

(4) Actions of Government

1) From viewpoint of promoting spread of microwave ovens with excellent energy consumption efficiency, efforts shall be made to take necessary measures such as spread and enlightenment activities, so as to promote actions of users and manufacturers.
2) Implementation of the display items by manufacturers shall be checked periodically and continuously, and appropriate law management shall be made so as for correct and easy-to-understand information concerning energy consumption efficiency to be provided for users.
3) The energy-saving standard based on the Top Runner Program is a very effective method for energy-savings of products; therefore, efforts shall be made to spread it internationally by catching appropriate opportunities.

Attachment 1

Target Scope

The criteria shall be applied to all microwave ovens. However, the followings shall be excluded from the scope:

- Microwave ovens for business use

  The measurement method for household microwave ovens cannot be applied to microwave ovens for commercial use such as in convenience stores, restaurants, etc., because the number of use times is different between those for household use and for commercial use. Since not only the measurement method for the latter has not yet been established, but also the number is extremely small (fiscal year 2003: approximately 25,000 units), they shall be excluded from the scope.

- Microwave ovens dedicated to rated input voltage of 200V

  They shall be excluded from the scope, because engineering works for 200V are necessary to use, because the usage is generally different from those for household use, and because the number is extremely small (fiscal year 2003: approximately 10,000 units).

- Microwave ovens of embedded type

  They are used in a built-in kitchen, and thus their adiabatic efficiency, etc. varies depending on design, materials, etc. of the built-in kitchen which they are embedded in. Because a measurement method concerning such factors has not yet been established and because the number is extremely small (fiscal year 2003: approximately 23,000 units), they shall be excluded from the scope.

- Microwave ovens having a gas oven

  They shall be excluded from the scope because gas ovens have already been designated as specified equipment of Top Runner Program.

- Microwave ovens whose interior height of less than 135 mm

  Because measurement by using a tall beaker, which has been defined in the

measurement method of energy consumption efficiency, is not possible for them, it is difficult to set a target standard value. Also, they are the particular kind of products whose main function is oven (referred to as so-called toaster ovens), and their number is extremely small (fiscal year 2003: approximately 10,000 units); thus, they shall be excluded from the scope.

Shipment volumes of the equipment listed above are little, in general, and consumer needs for them have not yet been defined. Depending on future developments, however, we shall conduct a necessary review when it is considered appropriate to include them in the scope.

Note) The scope shall not cover microwave ovens for industrial use, such as high frequency thawing equipment, high frequency dielectric heater, etc. that utilize generation of high frequency by magnetron.

Attachment 2

Target Fiscal Year, etc. for Microwave Ovens

1. In general, a considerable improvement in energy consumption efficiency of microwave ovens is made when a model change takes place, and a typical development period of these new products is approximately 1 year. For this reason, consideration should be given so that the manufacturers can take at least two opportunities of bringing out new models before the next target fiscal year.

On the other hand, in light of measures against global warning, in order to ensure that products that achieved the target standard value become widely used among consumers during the first commitment period of Kyoto Protocol (2008 to 2012), it would be desirable to achieve the target in as short time as possible, assuming that the tenure of use of microwave ovens would be approximately 10 years.

With the above in mind, the target year of microwave ovens shall be set to fiscal year 2008, three years after establishment of the criteria.

2. In addition, the improvement rate of energy consumption efficiency in the target fiscal year is expected to be approximately 8.5%, on the assumption that there will be no change from the current volume of shipments (results of fiscal year 2004) and composition by each category.

<Overview of Estimation>

(1)Energy consumption efficiency estimated from values of actual achievements of microwave ovens shipped in fiscal year 2004: 77.2 kWh/year

(2)Energy consumption efficiency estimated from target standard values of microwave ovens to be shipped in the target fiscal year: 70.6 kWh/year

(3) Improvement rate of energy consumption efficiency

$$\frac{(77.2 - 70.6)}{77.2} * 100 =$$

Attachment 3

Classification of Microwave Ovens

1. Basic Idea

In the case of microwave ovens, functions, heating systems and inner volume have a large impact on energy consumption efficiency (annual energy consumption). Hence, microwave ovens shall be classified based on them.

2. Specific Classification Method

(1) Classification by function

Two types of microwave ovens exist; namely, microwave ovens that have oven function (oven-microwave oven) and that do not have oven function (single-function microwave oven). It is reasonable to classify them by the function because the difference influences energy consumption efficiency and development of energy saving technologies in the future.

1) Microwave ovens without oven function (single-function microwave oven)
2) Microwave ovens with oven function (oven-microwave oven)

(2) Classification by heating method

As for microwave ovens having oven function, they can be divided by heating method of oven function into the followings: those of direct heating method (those with an exposed heater inside of a microwave oven), those of radiation heating method (other than those with an exposed heater inside of a microwave oven), and those of hot air circulation heating method. Because the differences in the heating methods influence energy consumption efficiency, it would be reasonable to classify them by the heating method. In addition, for microwave ovens of hot air circulation heating method with a heater, as the heater is supplementary, they shall be classified into the category of hot air circulation heating method, which is the main heating method (See Figure 1).

1) Microwave ovens with an exposed heater (excluding those of hot air circulation heating method)
2) Microwave ovens without an exposed heater (excluding those of hot air circulation heating method)
3) Microwave ovens of hot air circulation heating method

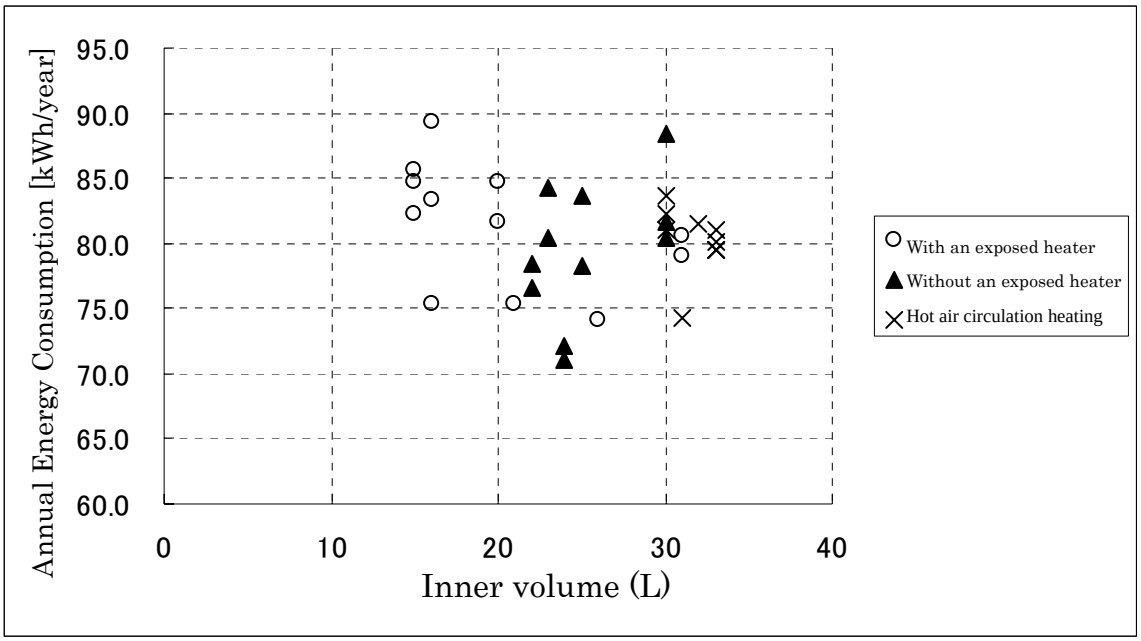


Figure 1　Relationship of Heating Method and Annual Energy Consumption

(3)　Classification by inner volume

The products having oven function can be divided at around the inner volume of 30L into the followings: products that enable multifunctional cooking such as cooking using two square plates (two-level cooking) and those used for simple cooking.　As the difference can influence energy consumption efficiency, it is reasonable to classify them into those having the inner volume of less than 30 L and those having the inner volume of 30L or greater (See Figure 2).

"Inner volume" refers to a numeric value computed from usable dimensions of a heating chamber defined by Electrical Machinery and Appliance Quality Labeling Regulations based on Household Goods Quality Labeling Law (Law No.104 of 1962).

1) Microwave ovens having the inner volume of less than 30L
2) Microwave ovens having the inner volume of 30L or greater

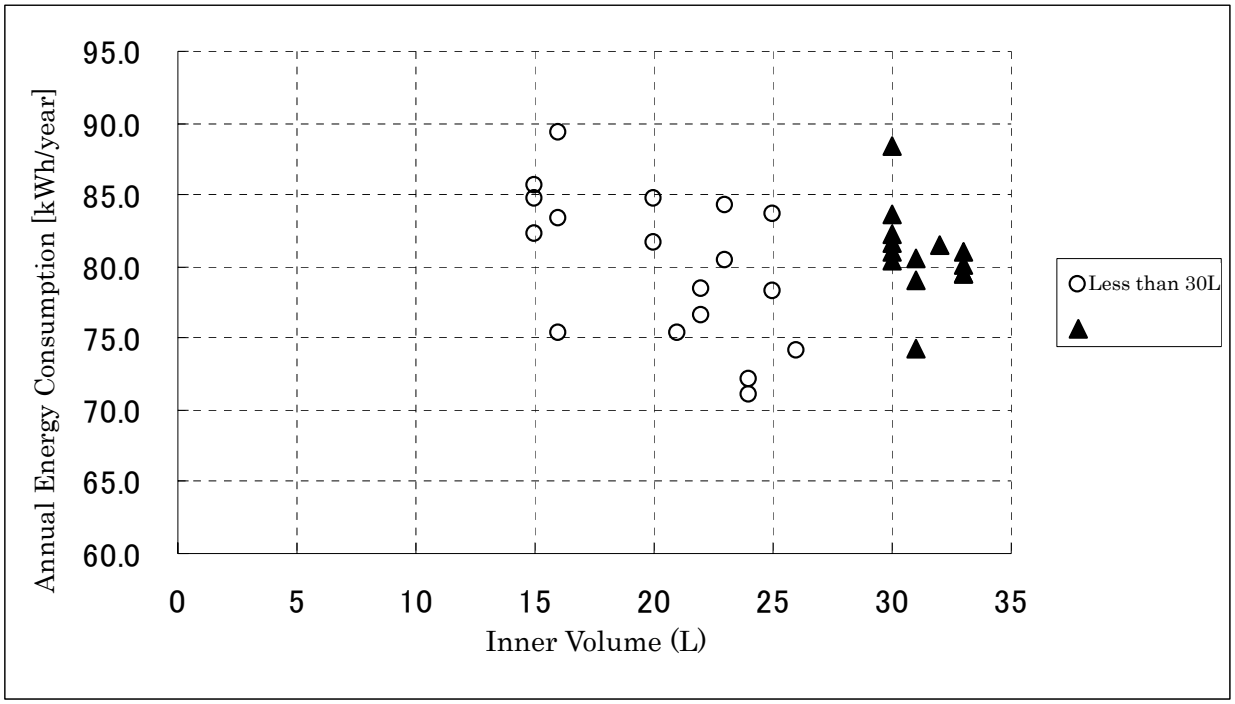


Figure 2　Relationship of Inner Volume and Annual Energy Consumption

3.　Proposal for Basic Classification

Based on the above, we shall set the proposal for basic classification, as shown in the following table:

Temporary Category	Function	Heating Method	Inner Volume
a	Without oven function (single-function microwave oven)	–	–
b	With oven function (oven – microwave oven)	With an exposed heater (excluding those of hot air circulation heating method)	Less than 30 L
c			30L or greater
d		Without an exposed heater (excluding those of hot air circulation heating method)	Less than 30 L
e			30L or greater
f		Hot air circulation heating method	Less than 30 L
g			30L or greater

Attachment 4

Target Standard Values of Microwave Ovens

1. Idea on Establishment of Target Standard Values

(1)Basic idea

We shall set target standard values based on the idea of Top Runner Method. The specific policy shall be as follows:

1) Target standard values shall be set for every category that has been appropriately defined.
2) As for the categories where future technological advances are expected to improve efficiency, the target standard value shall allow for the improvement as much as possible.
3) Target standard values shall not conflict among categories.

(2)Room for improvement in energy consumption efficiency through technological advances in the future

Engineering developments of microwave ovens have been carried out mainly with the objective of improving taste quality. In addition, although engineering developments have also been taken place for improving energy consumption efficiency such as reduction of standby power consumption, it can be said that there is still some room for improvement in efficiency of microwave ovens.

Although efficiency of magnetron that comprises a large percentage of power consumption of microwave function is saturated, the efficiency is expected to increase by changing a radiating method of microwave and by improving thermal insulation performance, etc. Taking into consideration that these factors might contribute to higher efficiency, we set the target standard value by 1% up from the current Top Runner Value.

2. Specific Target Standard Values

Target standard values of microwave ovens shall be represented in real numbers.

To be specific, for each category, the best value of energy consumption efficiency shall be a Top Runner Value, and the value obtained by adding improvement of efficiency to the Top Runner Value shall be a target standard value (See Figure 1 to 6).

The category of less than 30 L of hot air circulation heating method in which no products exist (temporary category f) shall be integrated into a category of 30L or greater of hot air circulation heating method (temporary category g).

Table 1 Top Runner Values of Microwave Ovens

Temporary Category	Function	Heating Method	Inner Volume	Top Runner Value [kWh/year]
a	Without oven function (single-function microwave oven)	−	−	60.7
b	With oven function (oven-microwave oven)	With an exposed heater (except for those of hot air circulation heating method)	Less than 30 L	74.1
c			30 L or greater	79.0
d		Without a exposed heater (except for those of hot air circulation heating method)	Less than 30 L	71.1
e			30 L or greater	80.4
f		Hot air circulation heating method	Less than 30 L	−
g			30 L or greater	74.2

Table 2 Target Standard Values of Microwave Ovens

Category	Function	Heating Method	Inner Volume	Top Runner Value [kWh/year]	Improved Efficiency [%]	Target Standard Values [kWh/year]
A	Without oven function (single-function microwave oven)	−	−	60.7	1.0	60.1
B	With oven function (oven-microwave oven)	With an exposed heater (except for those of hot air circulation heating method)	Less than 30 L	74.1	1.0	73.4
C			30 L or greater	79.0	1.0	78.2
D		Without an exposed heater (except for those of hot air circulation heating method)	Less than 30 L	71.1	1.0	70.4
E			30 L or greater	80.4	1.0	79.6
F		Hot air circulation heating method	−	74.2	1.0	73.5

(Reference)

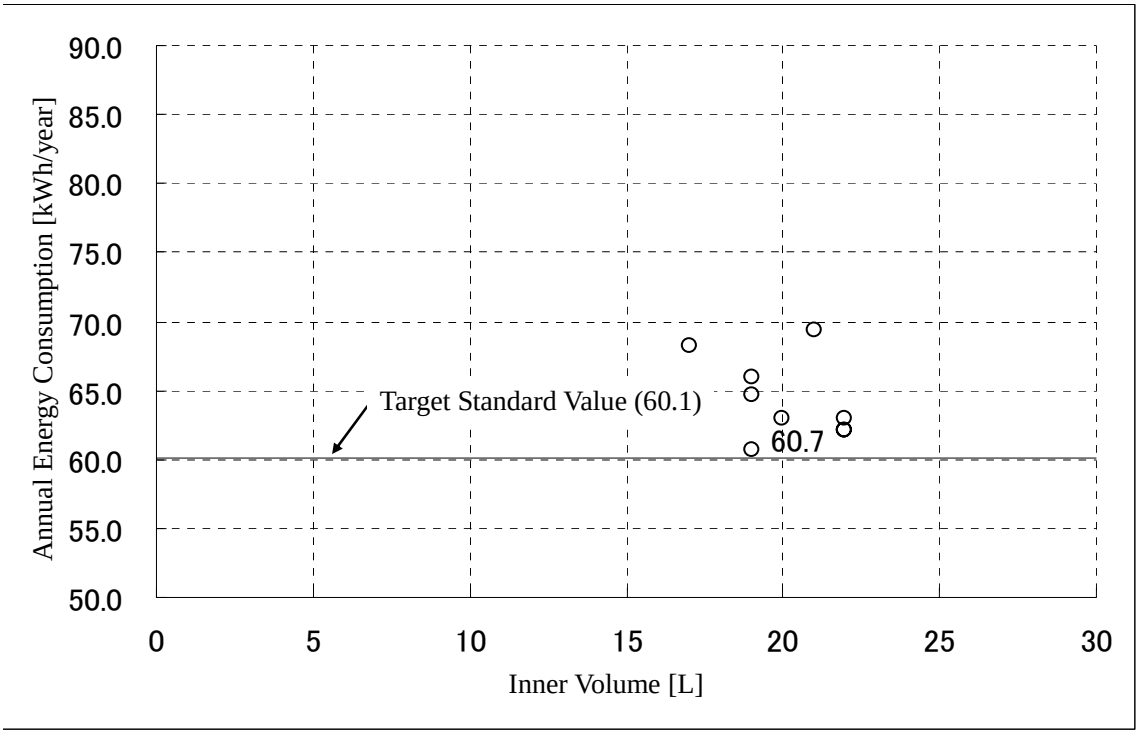


Figure 1 Top Runner Value and Target Standard Value of Category A

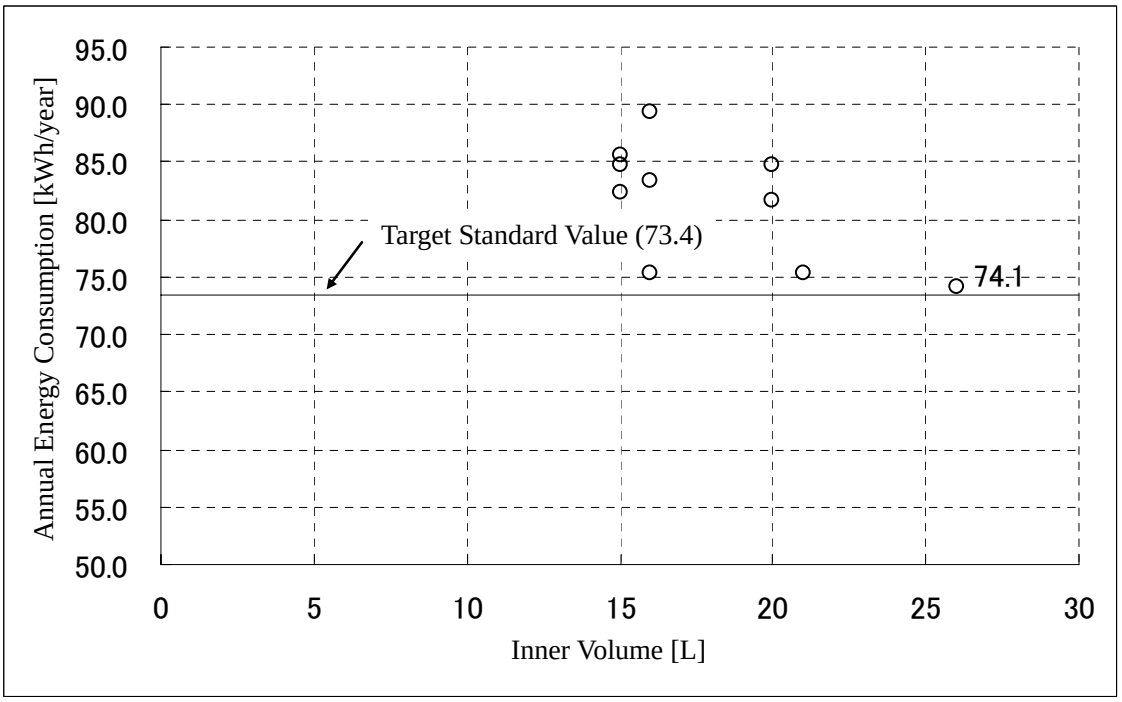


Figure 2 Top Runner Value and Target Standard Value of Category B

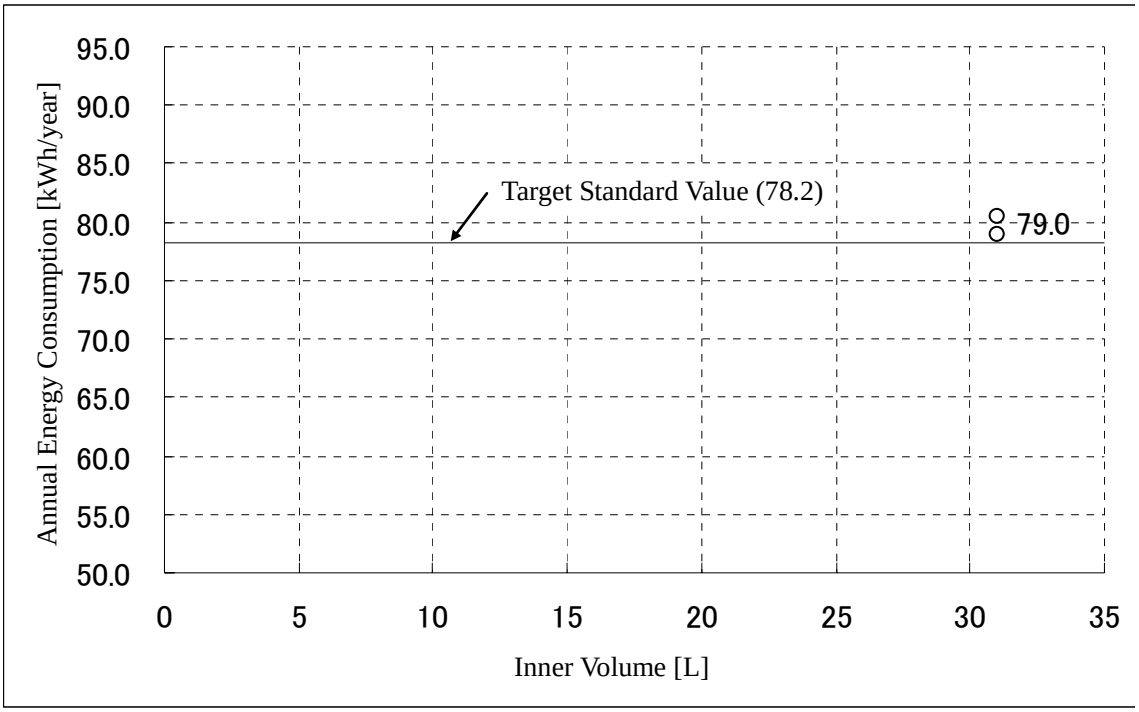


Figure 3　Top Runner Value and Target Standard Value of Category C

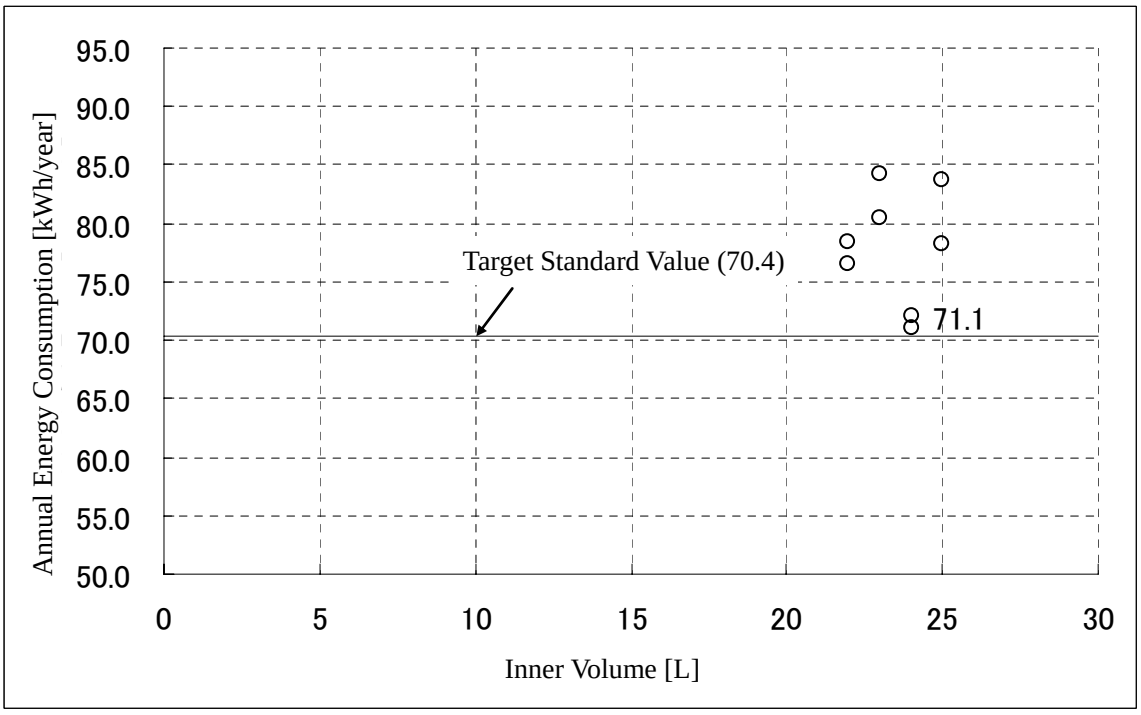


Figure 4　Top Runner Value and Target Standard Value of Category D

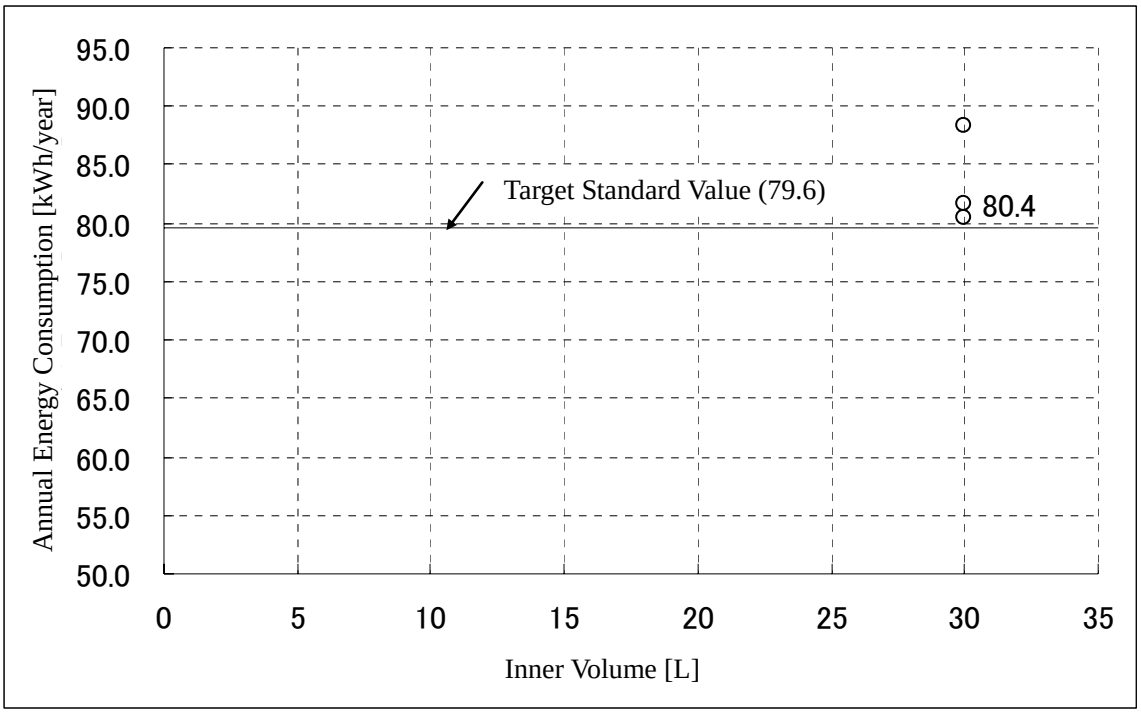


Figure 5　Top Runner Value and Target Standard Value of Category E

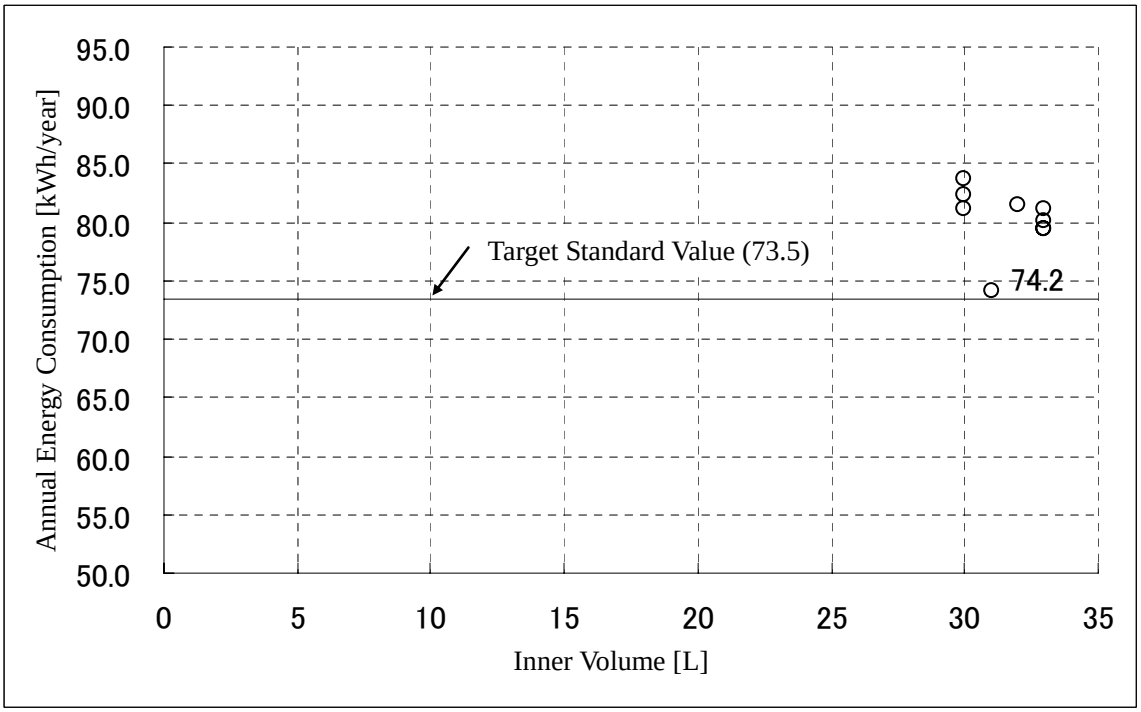


Figure 6　Top Runner Value and Target Standard Value of Category F

Attachment 5

Energy Consumption Efficiency of Microwave Ovens and Method of Measurement

I. Basic Idea

We studied energy consumption efficiency of microwave ovens and a measurement method thereof based on result of the study conducted by "Microwave Oven Energy Consumption Study Panel" (Chaired by: Makoto Ando, Professor of Tokyo Institute of Technology) of the Energy Conservation Center, Japan.

Microwave ovens are products that consume power mainly in three states: namely, microwave function, oven function, and standby state. Thus, the energy consumption efficiency thereof shall be defined as annual energy consumption to be obtained by computing the power consumption in these three states based on the status of use by general households. Specifically, the energy consumption of microwave function, oven function, and standby state is individually measured. Then, the energy consumption efficiency of microwave oven is obtained by summing all the values calculated by means of multiplying those measured power consumption values by respective utilization coefficients (such as number of annual heating times by microwave function) that are determined from a questionnaire survey ("Questionnaire Survey of Microwave Utilization" conducted by the Energy Conservation Center, Japan).

In addition, the measuring method described above is to evaluate energy saving performance of equipment in actual operating state, so that the cooking performance such as taste quality or finished state, etc. is not necessarily considered.

II. Specific Measurement Method

The energy consumption efficiency of microwave oven shall be annual energy consumption, and it is a numeric value [kWh/year] computed with the following expression:

$$E = \{ [(N_{A1} + K_1 * N_{A2}) * A_{V285} + K_2 * N_{A3} * A_{V245} + (N_{A4} + K_3 * N_{A5} + K_4 * N_{A6}) * A_{V125} + N_{A7} * A_{V185}] + [N_B * B] + [H_C * C] \} / 1000$$

Wherein E, A_{V285}, A_{V245}, A_{V125}, A_{V185}, N_{A1}, N_{A2}, N_{A3}, N_{A4}, N_{A5}, N_{A6}, N_{A7}, B, N_B, C, and H_C

shall represent numeric values listed below:

E: Energy consumption efficiency [kWh/year]

Av_{285}: Energy consumption per use of microwave function to heat dummy-load of 285[g] [Wh/time]

Av_{245}: Energy consumption per use of microwave function to heat dummy-load of 245 [g] [Wh/time]

Av_{125}: Energy consumption per use of microwave function to heat dummy-load of 125 [g] [Wh/time]

Av_{185}: Energy consumption per use of microwave function to heat dummy-load of 185 [g] [Wh/time]

N_{A1}: Annual heating time [time/year] of refrigerated food of 285 [g] by microwave function = 363

N_{A2}: Annual heating time [time/year] of frozen food of 285 [g] by microwave function = 99

N_{A3}: Annual thawing time [time/year] of perishable food of 245 [g] by microwave function = 55

N_{A4}: Annual heating time [time/year] of refrigerated food of 125 [g] by microwave function = 314

N_{A5}: Annual heating time [time/year] of frozen food of 125 [g] by microwave function = 115

N_{A6}: Annual thawing time [time/year] of perishable food of 125 [g] by microwave function = 13

N_{A7}: Annual heating time [time/year] of drink of 185 [g] by microwave function = 205

K_1: Heating coefficient of frozen food of 285 [g] = 2.2

K_2: Heating coefficient of thawing perishable food of 245 [g] = 1.2

K_3: Heating coefficient of frozen food of 125 [g] = 2.1

K_4: Heating coefficient of thawing perishable food of 125 [g] = 1.2

B: Energy consumption per use of oven function [Wh/time]

N_B: Annual heating time [time/year] by oven function = 31

C: Standby energy consumption per hour [Wh/h]

H_C: Annual standby hour [h/year] = 6400

1. Energy consumption per use of microwave function [Wh/time]

Energy consumption per use of microwave function shall be power consumption required for heating from 4 to 70 degrees using a real container with the following method, and it is the mean value of two measurements. However, if a divergence between the

mean of 2 computed values and each of the 2 computed values is ± 1.5% and greater, two more measurements shall be conducted, and the mean of the four measurements shall be taken.

(1) The energy consumption required for heating from 4 to 70 degrees using a real container shall be a numeric value to be computed by the following expression for each dummy-load mass (See (2) below).

Numeric values of m_J and C_P shall be from Table 1:

$$A = A_{1070} * \left\{ (1 - \frac{2257 * (M_{10} - M_{70})}{(4.187 * M + 0.55 * m) * (T_{70} - T_{10}) + 2257 * (M_{10} - M_{70})}) \right.$$

$$\left. * \frac{66}{T_{70} - T_{10}} * \frac{4.187 * M + C_p * m_J}{4.187 * M + 0.55 * m} + \frac{2257 * (M_{10} - M_{70})}{(4.187 * M + 0.55 * m) * (T_{70} - T_{10}) + 2257 * (M_{10} - M_{70})} \right\}$$

In the expression shown above, A, A_{1070}, T_{10}, T_{70}, M_{10}, M_{70}, M, m and m_J shall represent the following values, respectively:

A: Energy consumption required for heating from 4 to 70 degrees using a real container [Wh/time]

A_{1070}: Energy consumption required to heat to T_{70}℃

T_{10}: Temperature of dummy-load before heating [℃]

T_{70}: Temperature of dummy-load after heating [℃]

M_{10}: Mass [g] of dummy-load and test container at T_{10} [℃]

M_{70}: Mass [g] of dummy-load and test container at T_{70} [℃]

M: Mass of dummy-load [g]

m: Mass of test container [g]

m_J: Mass of real container [g]

C_P: Specific heat of real container [J/g･K]

Table 1: Coefficients of a Calculation Formula of Energy Consumption

Mass of Dummy-Load, M [g]	m_J	C_P
285	400	1.07
245		
125	200	1.07
185	250	0.55

(2) Dummy-load shall be water and have the mass listed in the left column of Table 2 below:

Table 2 Mass of Dummy-Load and Specification of Test Container

Mass of Dummy-load, M [g]	Specification of Test Container
285	A crystallizing plate having outside diameter of 150 mm and height of 75 mm specified in JIS R 3503
245	
125	A crystallizing plate having outside diameter of 90 mm and height of 45 mm specified in JIS R 3503
185	A tall beaker having outside drum diameter of 66 mm and height of 135 mm specified in JIS R 3503

(3) A test container listed in the right column of Table 2 shall be used, according to the mass of dummy-load shown in the left column. Also, its mass m[g] shall be measured.

(4) If equipment is provided with an additive function for improving taste quality that can be turned ON/OFF by a user, measurement may take place with the additive function turned OFF.

(5) Temperature inside of a microwave oven before starting a test shall be 23±2 ℃.

(6) In case of conducting 2 tests continuously, the second test shall be performed after a forced cooling period of at least 15 minutes, following the termination of the first test.

(7) Mass of dummy-load and test container, M_{10} [g], shall be measured.

(8) Temperature of dummy-load and container before starting a test shall be 10±1℃, and the container shall be placed at the geometric center of a plate inside of a microwave oven.

(9) Using microwave function, heat to raise temperature of dummy-load up to 70±2 ºC.

(10) Measurement shall be made at the maximum output setting, which is manually settable, of a microwave oven.

(11) After heating, the dummy-load shall be promptly stirred, and the temperature of dummy-load, T_{70} ℃, shall be measured. Also, the mass of dummy-load and container, M_{70} [g], and the required energy consumption, A_{1070} [Wh], shall be measured.

2. Energy consumption per use of oven function [Wh/time]

Energy consumption per use of oven function shall be energy consumption measured with the following method, and it is the mean of two measurements. However, if a divergence between the mean of 2 computed values and each of the 2 computed values is ± 1.5% and greater, two more measurements shall be conducted, and the mean of the four measurements shall be taken.

(1) Temperature inside a microwave oven before starting a test shall be 23±2 ℃.
(2) Nothing shall be inside the microwave oven; neither load nor tray shall be placed inside. However, for a microwave oven with a rotary stand on which the tray is placed; measurement shall take place with the rotary stand installed.
(3) Mounting location of a thermocouple shall be the center of the inside of a microwave oven, which is at one-half of width, depth and height respectively, according to the second appendix (related to article 2) of Electric Machinery and Appliance Quality Labeling Regulation, fourteen (two) (See Figure 1).
(4) Power consumption for increasing inside temperature of a microwave oven from the initial temperature by 177 [K] shall be B1 [Wh], and power consumption for subsequently and continuously maintaining the state for 20 minutes shall be B2. Then, a combined value of B1 and B2 shall be taken.
(5) Note, however, that, depending on a model, it may be difficult to keep a certain temperature due to its temperature setting mechanism. In such a case, in principle, retention temperatures and power consumptions at 2 points under and over the temperature that has risen by 177 [K] from the initial temperature shall be measured. Then, the power consumption at the temperature that has risen by 177 [K] from the initial temperature shall be computed with a linear interpolation (See Figure 3 (1)). In the case of a model for which those 2 points cannot be taken, 2 points which are closest to the temperature that has risen by 177K and also which can be selected with the model shall be taken (See Figure 3(2)). In either case, energy consumption at the temperature that has risen by 177 [K] from the initial temperature shall be calculated with the following expression:

$$B = B_L + (B_H - B_L) \times \frac{T - T_L}{T_H - T_L}$$

Wherein,

B: Energy consumption at temperature that has risen by 177 [K] from the initial temperature [Wh]

B_L: Energy consumption at lower retention temperature [Wh]

B_H: Energy consumption at higher retention temperature [Wh]

T_L: Lower retention temperature [℃]

T_H: Higher retention temperature [℃]

T: Temperature that has risen by 177 [K] from the initial temperature

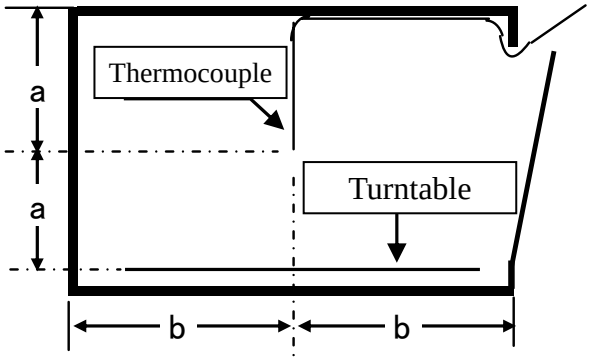


Figure 1 Mounting Diagram of Thermocouple

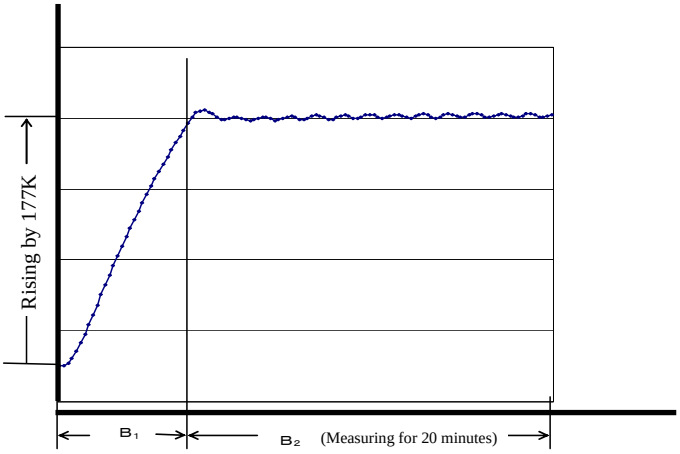
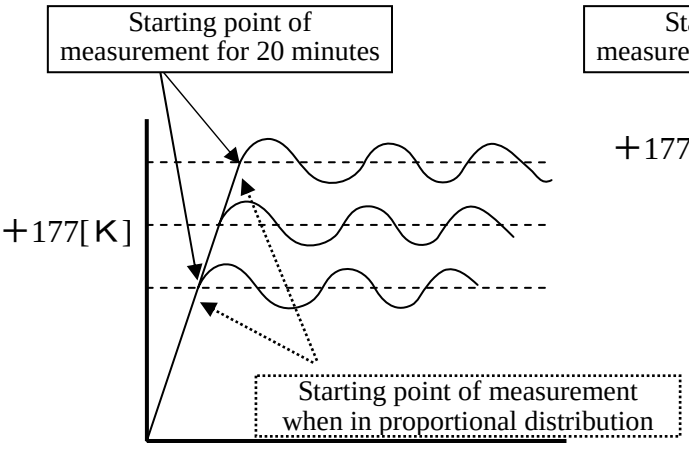
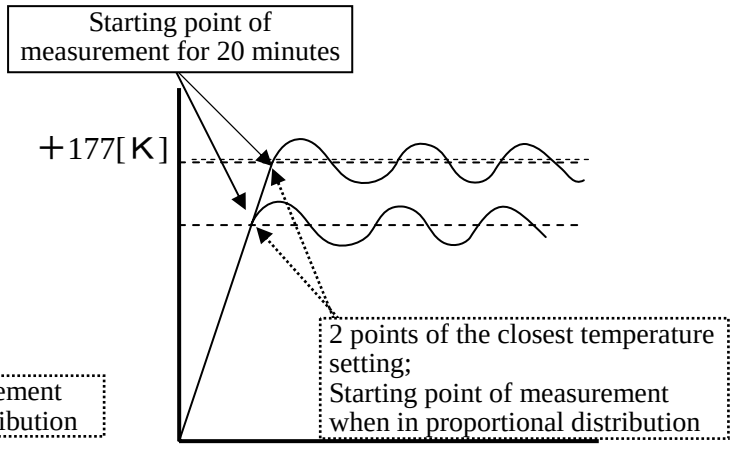


Figure 2 Measuring Method of Energy Consumption of Oven



(1) In the case of a model for which the temperature that has risen by 177 [K] cannot be retained for 20 minutes.



(2) In the case of a model for which the temperature of 177 [K] or greater cannot be retained for 20 minutes.

Figure 3: Measurement Method in Cases with Linear Interpolation

3. Standby energy consumption per hour [Wh/h]

Standby power consumption per hour shall be a numeric value of energy consumption measured for one hour, under the condition where the microwave oven is supplied with alternating current power, not used for cooking, and in a stable condition without subsequent changes.

4. Measurement of energy consumption efficiency of a microwave oven shall take place under the following conditions:

(1) Ambient temperatures shall be 23±2 ℃.

(2) The equipment shall be installed in a normal condition on a flat wooden stand having thickness of 10mm or greater.

(3) The power supply voltage shall be 100±1V, and the power supply frequency shall be 50±0.1 Hz or 60±0.1 Hz.

(4) A scale shall be able to measure up to 0.1 g, and magnitude of relative error to measurements shall be maintained within ±0.5%.

(5) A watt-hour meter shall ensure the magnitude of relative error to measurements within ±2%.

(6) A thermometer shall be a bar thermometer specified in JIS B 7411 (Glass bar thermometer for general use), appendix table 2, M, or its equivalent.

(7) A thermocouple shall be “Type K, Class 1” specified in JIS C 1602 (Thermocouple).

Attachment 6

Microwave Oven Evaluation Standard Subcommittee,
Energy Efficiency Standards Subcommittee of the Advisory Committee
for Natural Resources and Energy
Background of Holding

First Subcommittee Meeting (January 31, 2005)

- Disclosure of the Microwave Ovens Evaluation Standard Subcommittee
- Current situation of microwave ovens
- Scope of microwave ovens to be covered
- Energy consumption efficiency and its measurement method

Second Subcommittee Meeting (July 12, 2005)

- Scope of microwave ovens to be covered
- Classification of microwave ovens for target setting
- Target standard values and target fiscal years of microwave ovens

Third Subcommittee Meeting (September 2, 2005)

- Interim summary report

Fourth Subcommittee Meeting (October 26, 2005)

- Comments on the interim summary report; and final summary report

Attachment 7

Microwave Oven Evaluation Standard Subcommittee,
Energy Efficiency Standards Subcommittee of the Advisory Committee
for Natural Resources and Energy
List of Members

Chairman:	TETSUJI ODA	Professor in Department of Electrical Engineering, Graduate School of Engineering, The University of Tokyo
Members:	MAKOTO ANDO	Professor in Electrical and Electronic Engineering Department, Graduate School of Science and Engineering, Tokyo Institute of Technology
	MARIKO ICHIKAWA	Consultant for Consumers' Affairs, Japan Consumer's Association
	SHOICHIRO OHZEKI	Senior General Manager of Energy Environment Technology Division, The Energy Conservation Center, Japan
	TAKAHIRO KANAI	Chairman of Microwave Oven Technology Expert Committee, The Japan Electrical Manufacturers' Association
	KIKUKO TATSUMI	Managing Director of Nippon Association of Consumer Specialists
	OSAMU HASHIMOTO	Professor in Department of Electrical Engineering and Electronics, College of Science and Engineering, Aoyama Gakuin University
	CHIHARU MURAKOSHI	Director and General Manager of Laboratory, Jyukankyo Research Institute Inc.
	HIROSHI HARUHARA	Managing Director of Japan Machinery Importers' Association (Resigned as of March 31, 2005, due to dissolution of the association)

Reference Material 1

Current Situation of Microwave Ovens

1. Market Trend

1.1 History of Microwave Ovens

- Appearance of first domestically-produced microwave oven (in 1962)

  Microwave ovens for business use were released. Fast cooking which was never imaginable before was realized by entirely new cooking equipment that heats without fire.

  Initially, these microwave ovens were used in restaurants, etc. as equipment for business use. At that time, they were also used in dining cars of JR (Japan Railways) or private railways. In 1964 when Shinkansen bullet trains started service, it got into the news that their dining cars were equipped with microwave ovens. It let the speedy heating of microwaves become publicly known.

- Release of microwave ovens for household use (in 1965)

  Microwave ovens for household use appeared for the first time.

- Release of oven-microwave oven (in 1977)

  Oven-microwave ovens that are microwave ovens equipped with oven function were released in 1977. Combined operations of microwave function and oven function expanded the variations of cooking. In addition, for users who need both microwave oven and oven, it resulted in reduced space, as they could have only one device, not two.

- Release of hot air circulation type oven-microwave oven (in 1978)

  Hot air circulation type oven-microwave oven were released. As for oven function, not only top-bottom heating method but also hot air circulation method that bakes with hot air have appeared, and the new function has been added to a microwave oven, the compound cooker.

*Table 1-1 shows a relationship of microwave oven types and heating methods.

Table 1-1 Relationship of Nominal Designations of Microwave Ovens and Heating Methods

<table>
<tr><td></td><td colspan="2">Single-function microwave ovens</td><td colspan="2" rowspan="2">Oven-microwave ovens</td></tr>
<tr><td></td><td>Mechanical type</td><td>Microcomputer type</td></tr>
<tr><td>Control Method</td><td><u>Control by a mechanical timer switch</u>
A timer switch turns ON/OFF electricity.</td><td><u>Electronic control by a microcomputer</u>
A sensor senses finishing state, and a microcomputer controls the amount of electricity based on the information from the sensor.
An electronic timer of the microcomputer turns ON/OFF electricity.</td><td colspan="2"><u>Electronic control by a microcomputer</u>
- Microwave
A sensor senses finishing state, and a microcomputer controls the amount of electricity based on the information from the sensor.
An electronic timer of the microcomputer turns ON/OFF electricity.
- Oven
A sensor senses the inside temperature and finishing state. Based on the information from the sensor, a microcomputer controls the inside temperature and the amount of electricity.
An electronic timer of the microcomputer turns ON/OFF electricity.</td></tr>
<tr><td rowspan="3">Heating Method</td><td colspan="2" rowspan="3"><u>Microwave heating</u>
Heating takes place by conversion of electric energy of microwave into vibrational energy of water molecules.</td><td rowspan="3"><u>Microwave heating</u>
Heating takes place by conversion of electric energy of microwave into vibrational energy of water molecules.</td><td><u>Hot air circulation heating</u>
Heating takes place by circulating heat of a heater by fan.</td></tr>
<tr><td><u>Top-bottom heating (radiation type)</u>
Heating takes place by radiant heat.</td></tr>
<tr><td><u>Top-bottom heating (direct projection type)</u>
Heating takes place by direct projection of heat of a heater.</td></tr>
</table>

1.2 Volume of Domestic Shipments

Since the first domestic microwave oven was released for household use in 1965, microwave ovens have become widely used as multifunctional cooking equipment without fire for warming, baking, boiling, steaming, etc.

Table 1-2 and Figure 1-1 show transitions in domestic shipment volume since 1990, in domestic production output including products for export, in overseas production output (quantity of overseas production by Japanese-affiliated firms), and in the number of imported units. As shown in Figure 1-1, a volume of domestic shipments have remained unchanged on the level of 3.5 million units. As Japanese manufacturers shift production base from Japan to overseas, domestic production output is on a downward trend, and the number of imports is growing.

Table 1-2 Transitions in Domestic Shipment Volume, in Domestic and Overseas Production Outputs, and in Number of Imports of Microwave Ovens

Unit: 1,000 units

	1. Domestic Shipment Volume (JEMA, voluntary statistics)	2. Domestic Production Output (METI, current survey of industrial production)	3. Overseas Production Output (JEMA, voluntary statistics)	4. Number of Imports (Ministry of Finance, customs statistics)
Fiscal year (FY)1990	3,145	4,666	3,869	115
FY 1991	3,108	4,185	5,384	53
FY 1992	2,791	3,714	6,786	99
FY 1993	2,757	3,393	5,959	200
FY 1994	2,808	3,117	6,770	634
FY 1995	3,079	3,273	8,233	981
FY 1996	3,582	3,513	10,103	994
FY 1997	3,524	3,442	10,168	845
FY 1998	3,494	2,964	11,164	1,033
FY 1999	3,518	2,858	10,694	1,289
FY 2000	3,770	2,951	10,708	1,721
FY 2001	3,614	2,416	10,361	1,736
FY 2002	3,533	1,956	9,284	1,865
FY 2003	3,547	1,589	9,764	2,394

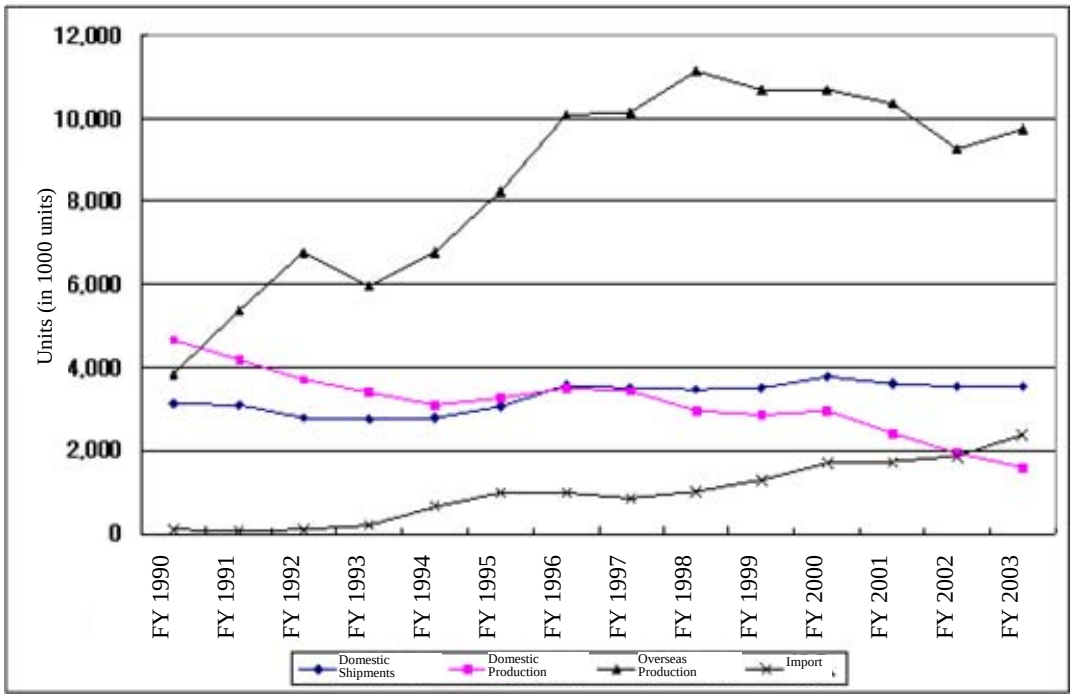


Figure 1-1: Transitions in Domestic Shipment Volume, in Domestic and Overseas Production Outputs, and in Number of Imports of Microwave Ovens

Source: Domestic Production Statistics: METI current survey of industrial production.

Import Statistics: Ministry of Finance, Customs Statistics.

Domestic Shipment Statistics and Overseas Shipment Statistics: Japan Electrical Manufacturers' Association (JEMA).

1.3 Domestic Shipment Volume of Microwave Ovens by Type

Table 1-3 shows domestic shipment volume of single-function microwave ovens and oven-microwave ovens. In addition, Figure 1-2 shows proportions of each type of microwave ovens based on the volume of shipments. Although in 1990 the single-function microwave ovens and the oven-microwave ovens accounted for almost the same percentages in the total domestic shipment volume, recently the latter constitutes about 75%.

Table 1-4 shows the domestic shipment volume of microwave ovens of 1000W or greater for business use and its proportion to the total domestic shipment volume of microwave ovens.

Table 1-3 Domestic Shipment Volume of Single-Function Microwave Oven and Oven-Microwave Oven

Unit: 1,000 units

Fiscal Year (FY)	Single-Function Microwave Oven	Oven-Microwave Oven	Total
FY 1990	1,586	1,559	3,145
FY 1991	1,403	1,705	3,108
FY 1992	1,166	1,625	2,791
FY 1993	1,014	1,743	2,757
FY 1994	821	1,987	2,808
FY 1995	652	2,426	3,079
FY 1996	758	2,825	3,582
FY 1997	831	2,693	3,524
FY 1998	780	2,713	3,494
FY 1999	801	2,717	3,518
FY 2000	865	2,905	3,770
FY 2001	836	2,778	3,614
FY 2002	898	2,635	3,533
FY 2003	912	2,634	3,547

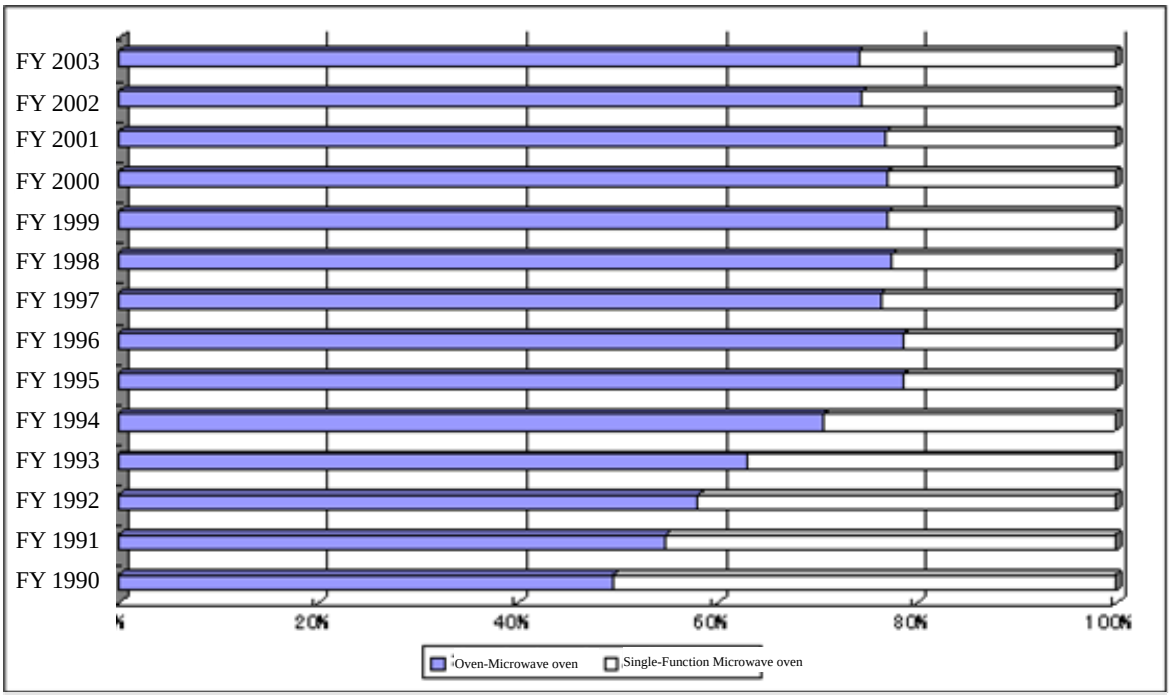


Figure 1-2　Percentage of Each Type of Microwave Ovens
Based on Domestic Shipment Volume

Source: Japan Electrical Manufacturers' Association (JEMA)

Table 1-4　Domestic Shipment Volume of Microwaves for Business Use and its Percentage to Total Domestic Shipment Volume

Fiscal year (FY)	Domestic Shipment Volume of Microwaves oven (in 1,000 units)	Domestic Shipment Volume of Microwave Ovens for Business Use (in 1,000 units)	Percentage of Microwave Oven for Business Use (%)
FY 1993	2,757	18	0.65%
FY 1994	2,808	20	0.71%
FY 1995	3,079	22	0.71%
FY 1996	3,582	29	0.81%
FY 1997	3,524	23	0.65%
FY 1998	3,494	19	0.54%
FY 1999	3,518	18	0.51%
FY 2000	3,770	21	0.56%
FY 2001	3,614	24	0.66%
FY 2002	3,533	25	0.71%
FY 2003	3,547	25	0.70%

Source: Japan Electrical Manufacturers' Association (JEMA)

1.4 Domestic Shipment Volume of Oven-Microwave Ovens by Price

Table 1-5 shows domestic shipment volume of oven-microwave ovens by price. In addition, Figure 1-3 shows percentage of oven-microwave ovens by price based on the domestic shipment volume.

Table 1-5 Domestic Shipment Volume of Oven-Microwave Ovens by Price

Unit: 1,000 units

Fiscal year (FY)	Below 40,000 yen	40,000 to below 50,000 yen	50,000 to below 60,000 yen	60,000 to below 80,000 yen	80,000 to below 100,000 yen	100,000 yen or more	Total
FY 1997	730	778	499	407	189	89	2,693
FY 1998	1,069	575	467	361	137	105	2,713
FY 1999	1,115	556	459	381	112	95	2,717
FY 2000	1,275	598	458	318	195	62	2,905
FY 2001	1,377	383	448	352	162	57	2,778
FY 2002	1,374	263	414	376	158	50	2,635
FY 2003	1,373	409	342	316	164	30	2,634

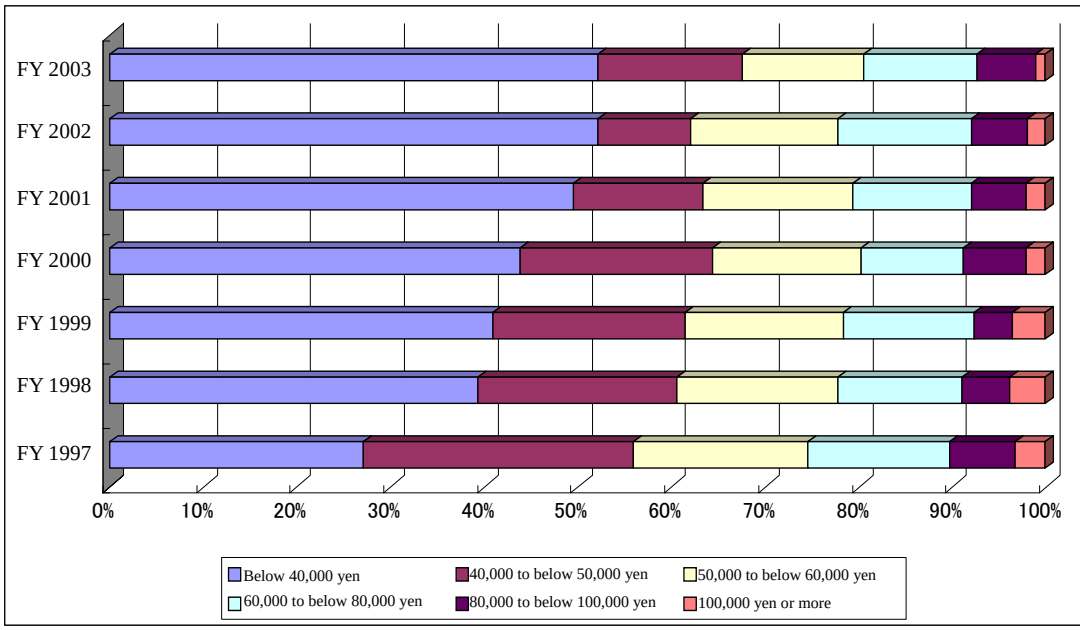


Figure 1-3 Percentages by Price Based on Domestic Shipment Volume

Source: Japan Electrical Manufacturers' Association (JEMA)

1.5 Major Manufacturers and Distributors of Microwave Ovens in Japan

The following are domestic major manufacturers and distributors of microwave ovens (in random order):

[Domestic Businesses]

SANYO Electric Co., Ltd., Sharp Corporation, ZOJIRUSHI CORPORATION, Tiger Corporation., TOSHIBA Corporation, Hitachi Home & Life Solutions, Inc., Matsushita Electric Industrial Co., Ltd., Mitsubishi Electric Corporation, YOSHII ELECTRIC Co., Ltd.(Abitelax), KOIZUMI SEIKI CORP., MITSUBOSHI BOEKI LTD., Iwatani International Corporation, Kyushu Takemura Electric (SKJ), etc.

There are some brands of microwave ovens imported from overseas. Overseas businesses are as follows:

[Overseas Businesses]

LG, Samsung, Daewoo, Haier Japan, Electrolux, EUPA, GE, etc.

2. Users' Requests for Microwave Ovens

2.1 Attention-grabbing Features of Microwave Ovens at the Time of Purchase

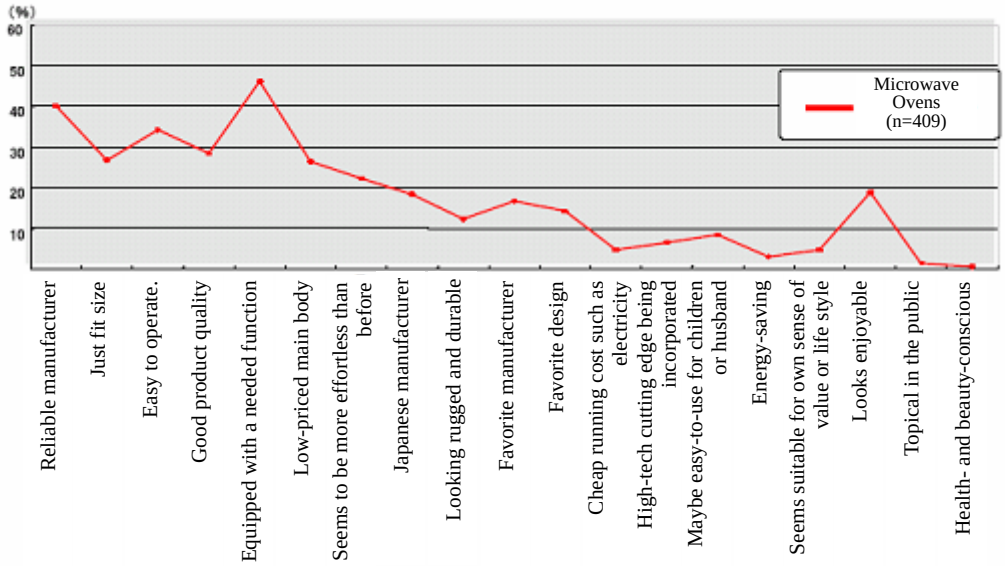
Table 2-1 shows the result of a survey on "Attention-grabbing Features of Microwave Ovens at the Time of Purchase" conducted by a manufacturer:

Table 2-1: Attention-grabbing Features of Microwave Ovens at the Time of Purchase

(The Number of Samples: 409)

Reasons for Selection	The Number of Answers
Equipped with a needed function	192
Reliable manufacturer	163
Easy to operate	143
Good product quality	118
Just fit size	114
Low-priced main body	106
Japanese manufacturer	77
Favorite manufacturer	73

Reasons for Selection of Currently Using Product "Why did you choose the product you are now using?"



Source: Survey by manufacturers

As can be seen from this survey result, user's request for microwave ovens mostly include the reasons for selection, such as "function", "quality", and "brand", which represent reliability, a sense of reassurance, and multifunctionality of cooking. On the other hand, the percentage of users who answered "Cheap running cost such as electricity" and "Energy-saving" is not so high. The result seems to reflect the fact that operating time of microwave ovens is usually not so long that consumers' awareness about energy saving is low.

3. Energy Saving in Microwave Ovens – Efforts Up to Now

3.1 Energy Saving in Microwave Ovens

So far efforts to promote energy saving in microwave ovens have focused on increase of efficiency of magnetrons, which is a major component of the appliance. Figure 3-1 shows a transition in increase of efficiency of magnetrons. Although the efficiency of magnetrons increased from 63.8% to 70% in the period of 1960 to about 1970, it only rose about 3% in the following 30 years. The efficiency in recent few years has been flat. In addition, Figure 3-2 shows one example of outline of energy balance. When we look at breakdown of power loss of microwave ovens, it can be divided into "power consumption of accompanying electrical components", "loss in high-voltage transformer", and "feeding loss". Energy-saving efforts for the accompanying components have been made till now. Moreover, a voluntary declaration about standby energy consumption has been made, and energy-saving efforts are proceeding.

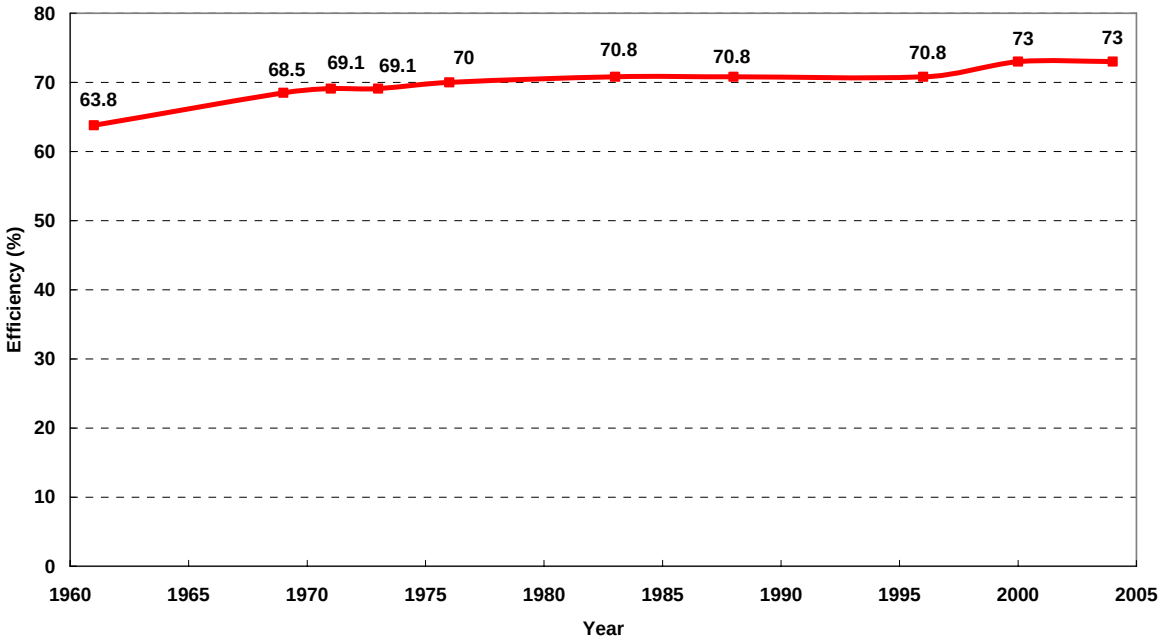


Figure 3-1　Transition in Magnetron Efficiency

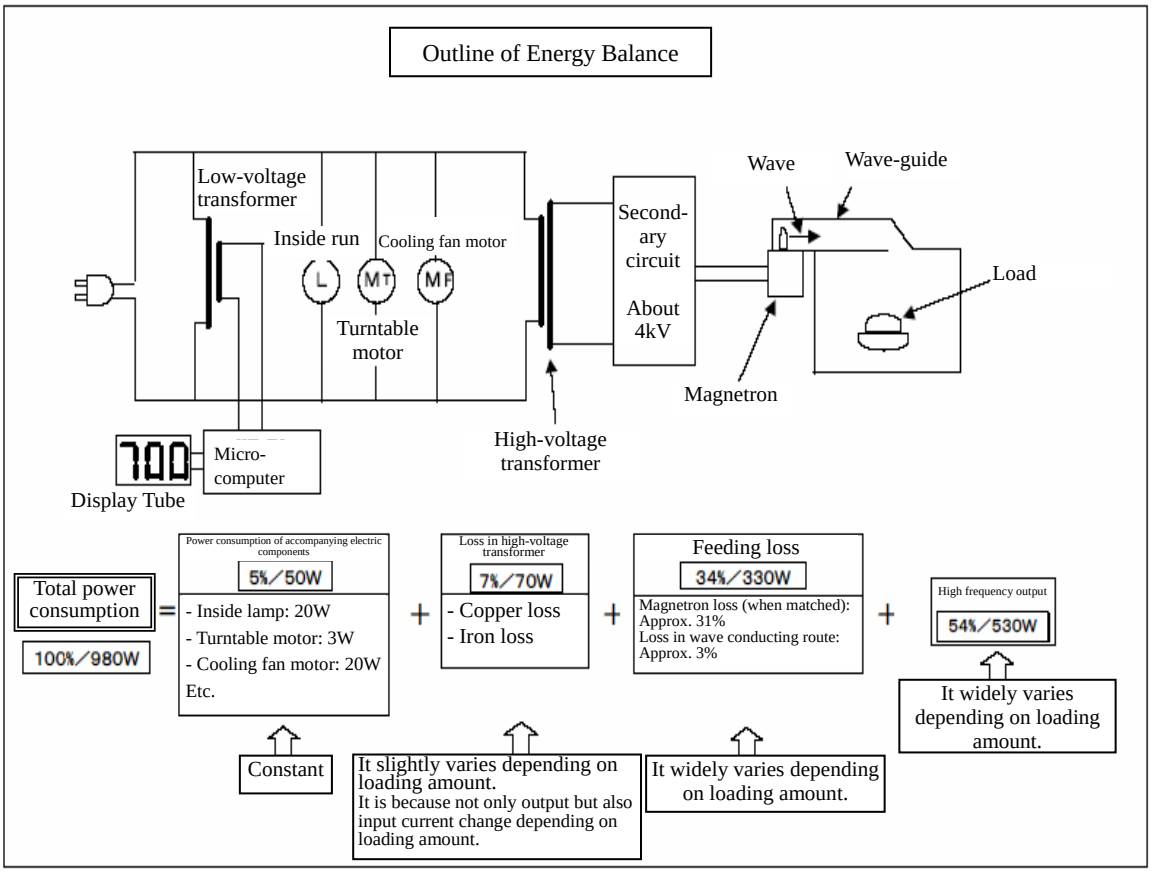


Figure 3-2　Outline of Energy Balance

3.2 Energy Saving During Standby

Standby power consumption of appliances holds a place that cannot be ignored from the standpoint of energy saving. Hence, Japan Electronics and Information Technology Industries Association, the Japan Refrigeration and Air Conditioning Industry Association, and the Japan Electrical Manufacturers' Association made a voluntary declaration in their joint names that, by the end of fiscal year 2003 (September, 2004 in the case of air conditioners), they would reduce the standby power consumption of products without a timer as close to zero as possible and that of those with a timer to 1W or lower. In order to adhere to the declaration, each manufacturer improved control circuits and attained the goal 100% as far as microwave ovens are concerned.

Table 3-3 Transitions in Standby Power Consumption

Standby Power Consumption in Fiscal Year 2003*1	Standby Power Consumption in April 2004*2
0.9 W	0.0W

Sources *1: Survey on Standby Power Consumption in fiscal year 2003: The Energy Conservation Center, Japan

*2: The Japan Electrical Manufacturers' Association