Document 3-5

Final Report by Air Conditioner Criteria Standard Subcommittee, Energy Efficiency Standards Subcommittee of the Advisory Committee on Energy

This subcommittee deliberated on the criteria of air conditioner with respect to energy efficiency to be used by manufacturers or importers (manufacturers) of them, and summarized as follows.

1. Scope of Application

   Air conditioners (including types that can be used for heating); excluding ones exceeding the cooling capacity of 28 kW, ones with water-cooling system, ones without motor for compression, ones having energies other than electricity as heat source, ones with the temperature control or dust-proof function for the purpose of air-conditioning to maintain the performance of machine or to control the sanitation of foods/drinks, ones mainly designed to send cooled outside air into room, spot air conditioners, ones designed for the transport means like vehicle, ones with ducts at the suction/exhaust ports of outdoor heat exchanger, ones with heat storage, ones specially designed for highly air-sealing/heat-insulating housing duct air-conditioning system, and solar air conditioner. (See Attachment 1.)

2. Items of Standard Criteria for Manufacturers. (See Attachments 2-4.)

   (1) Target Fiscal Year

   1) Cooling & heating/direct-blowoff type/separate/wall-hung type products with cooling capacity of 4 kW or less
      - 2004 Freezing Fiscal Year (starting in Oct. 2003 and ending in Sept. 2004)
   2) Products other than 1)
      - 2007 Freezing Fiscal Year (starting in Oct. 2006 and ending in Sept. 2007)

   (2) Target standard values

   Concerning the air conditioners to be shipped domestically in the target fiscal year by the manufacturers, the energy efficiency measured in (3) shall be weighed by the shipped quantity of each manufacturer in each segment in the following table, so that the harmonic average values may not fall below the target standard values.

[Target standard values of energy efficiency]

Segmentation by cooling capacity				
～ 2.5 kW	～ 3.2 kW	～ 4.0 kW	～ 7.1 kW	～ 28.0 kW

1) Cooling & heating

1) Direct-blowoff type /window type・wall-hung type

2.85				

2) Direct-blowoff type/separate/wall-hung type

5.27	4.90	3.65	3.17	3.10

3) Direct-blowoff type /others

3.96	3.96	3.20	3.12	3.06

4) Duct connected type

3.02			3.02	3.02

5) Multi-type

4.12			3.23	3.07

2) Cooling only

1) Direct-blowoff type/window type・wall-hung type

2.67				

2) Direct-blowoff type/separate/wall-hung type

3.64	3.64	3.08	2.91	2.81

3) Direct-blowoff type/others

2.88			2.85	2.85

4) Duct connected type

2.72			2.71	2.71

5) Multi-type

3.23			3.23	2.47

(3) Measuring Method (See Attachment 5.)

1) Energy efficiency shall be "COP (Coefficient of performance)," and shall be the value (hereinafter shown as "Cooling COP") obtained from dividing the cooling capacity (W) by the cooling power consumption (W) or the value (hereinafter shown as "Heating COP") obtained from dividing the heating capacity (W) by the heating power consumption (W).

$$\text{Cooling COP} = \frac{\text{Cooling capacity (W)}}{\text{Cooling power consumption (W)}}$$

$$\text{Heating COP} = \frac{\text{Heating capacity (W)}}{\text{Heating power consumption (W)}}$$

For ones designed for both cooling and heating, the average of cooling COP and heating COP shall be taken.

(4) Display method (See Attachment 6.)

1) The following items shall be displayed.

(Ones applicable to announcement based on Household Goods Labeling Law.)

- Product name and model name
- Cooling capacity
- Cooling power consumption
- Cooling energy efficiency
- Heating capacity (limited to type capable of heating)
- Heating power consumption (limited to type capable of heating)
- Heating energy efficiency (limited to type capable of heating)
- Average of cooling/heating energy efficiency (limited to type capable of heating)
- Name of manufacturer, etc.

(Note) In the display of the above "Product name and model name," "Cooling power consumption", "Heating power consumption (limited to type capable to heating)," "Average of cooling/heating energy efficiency (limited to type capable of heating)" and "Name of manufacturer, etc.," the Electric Equipment & Device Quality Labeling Codes should be revised.

(Type applicable to announcement based on Law concerning the Rational Use of Energy)

- Product name and model name
- Cooling capacity
- Cooling power consumption
- Cooling energy efficiency
- Heating capacity (limited to type capable of heating)
- Heating power consumption (limited to type capable of heating)
- Heating energy efficiency (limited to type capable of heating)
- Average of cooling/heating energy efficiency (limited to type capable of heating)
- Name of manufacturer, etc.

(Note) "Cooling capacity" and "Cooling power consumption" mean the values obtained from the measuring methods for the cooling capacity test and cooling power consumption test specified in JIS B8616 or C9612.
"Heating capacity" and "Heating power consumption" mean the values obtained from the measuring methods for the standard heating capacity test and standard heating power consumption test specified in JIS B8616 or C9612.

2) Items shall be displayed at a place on the product body, where they can be seen easily.

3. Recommendations for Energy Saving

(1) Efforts to be made by Users

When purchasing air conditioner, the user shall try to select product of high energy efficiency, and try to save energy by using air conditioner appropriately and efficiently.

(2) Efforts to be made by Manufacturers

1) Manufacturer shall encourage technical development to save energy in air conditioner, and try to develop high energy efficient products.
2) Manufacturers shall try to examine policies contributing to reduce power consumption in standby mode, including the installation of power switch on the air conditioner which can be operated easily.
3) Manufacturers shall try to enhance the understanding by users in order to disseminate the high energy efficiency air conditioners.

(3) Efforts to be made by the Government

In order to disseminate the high energy efficient air conditioners, the Government shall try to take necessary measures including governmental assistance and enlightenment for dissemination, which enhance the understanding of users and encourage the manufacturers to take actions.

4. History of Examination

(1) History of holding subcommittee meetings (See Attachment 7.)
(2) Name list of committee members (See Attachment 8.)

[Attachment 1]

Scope of Application for Air conditioners

1. Regulation of Scope of Application in Current Law

(1) Regulations in Law concerning the Rational Use of Energy

In Law concerning the Rational Use of Energy, the scope of application for air conditioners is specified as shown below.

[Law concerning the Rational Use of Energy, Enforcement Order]
(Special equipment)

Article 7 Equipments specified in the government ordinance in Article 18, Item 1 are as shown below.

2. Air conditioner (including ones which can be used for heating, but excluding ones with the cooling capacity of 27 kW or more, ones with water-cooling system and others specified by Ordinance of the Ministry of International Trade and Industry.)

[Law concerning the Rational Use of Energy, Enforcement Rules]
(Exception of special equipment and devices)

Article 12 Air conditioners specified in Article 7 Item 2 in Ordinance of the Ministry of International Trade and Industry shall be as quoted below.

1. Ones without motor for compression
2. Ones having energies other than electricity as heat source
3. Ones with the temperature control or dust-proof function for the purpose of air-conditioning to maintain the performance of machine or to control the sanitation of foods/drinks
4. Ones mainly designed to send cooled outside air into room
5. Spot air conditioners
6. Ones designed for the transport means like vehicle
7. Ones with ducts at the suction/exhaust ports of outdoor heat exchanger
8. Ones connected with two or more indoor units per outdoor unit as a separate type

2. Scope of Exclusion

Shown below are the products which are excluded from current Law concerning the Rational Use of Energy and which should also be excluded from application in the future, and the products which should be excluded from application because they are merchandized so lately that the evaluating method is not established yet.

(1) Common air conditioners driven electrically

1) Air conditioners with cooling capacity exceeding 28 kW

The air conditioners with cooling capacity exceeding 28 kW are ordered as special items to be installed mainly at plants, which are of various specifications.

The test methods for these products are not specified in JIS Standards, and are not always established.

* Estimated shipped quantity: 97 Freezing Fiscal Year: approx 33,000 units

2) Water-cooling air conditioner

Water-cooling air conditioners are used under the special conditions such as an existence of cooling water system, and are the specific products requiring additional heat source for heating. Number of shipment tends to decrease in the long run.

* Estimated shipped quantity: 97 Freezing Fiscal Year: approx 21,000 units

3) Ones with energies other than electricity as heat source for heating

These are the composite products using the combustion heat by gas or oil as the heat source for heating while cooling is driven electrically, and are used limitedly in cold regions where the heating load cannot be dealt with by heat pump alone.

Currently, there is no international standard on the measurement method, and no method is established in the country, either.

* Estimated shipped quantity: 97 Freezing Fiscal Year: approx 47,000 units

4) Ones used to maintain the performance of machine or device and to control the sanitation of foods/drinks

Unlike the common ones, these are the air conditioners to maintain air purity, temperature and humidity, including Package air conditioner for computer room, Package air conditioner for clean room, and Package air conditioner for low-temperature. They are ordered specifically in most cases.

* Estimated shipped quantity: 97 Freezing Fiscal Year: approx 8,000 units

5) Ones mainly sending cooled outside air into room

These are called All-Fresh Type, and used for special purposes such as in the operating room in hospitals, outside air treatment at plants and explosion-proof facilities.

Due to a number of restrictions in buildings, very limited number of units is available.

* Estimated shipped quantity: 97 Freezing Fiscal Year: approx 600 units

6) Spot air conditioners

Spot air conditioners are of special shape which sends cool air to workers in order to improve work environment mainly at plants. The evaluation method for them is not established.

* Estimated shipped quantity: 97 Freezing Fiscal Year: approx 65,000 units

7) Ones with ducts at the suction/exhaust ports of outdoor heat exchanger

Though belonging to wall type air conditioner, these take in or out the air through duct for outdoor heat exchanger by way of slits, in which the wall of building is not directly perforated.

Due to a number restriction in buildings, very limited number of units is available.

* Estimated shipped quantity: 97 Freezing Fiscal Year: approx 5,000 units

(2) Ones not driven electrically, which is used for transport means

The drive source and construction are widely different between ones without motor for compression and ones designed for transport means including vehicle.

1) Ones without motor for compression

· Gas-engine driven heat pump air conditioner

* Estimated shipped quantity: 97 Freezing Fiscal Year: approx 40,000 units

2) Ones designed for transport means

· Air conditioner for car

* Estimated shipped quantity: 97 Freezing Fiscal Year: approx 5,915,000 units

· Air conditioner for bus

* Estimated shipped quantity: 97 Freezing Fiscal Year: approx 15,000 units

· Air conditioner for railway vehicle

* Estimated shipped quantity: 97 Freezing Fiscal Year: approx 4,300 units

(3) Additional exceptions

It is considered to be appropriate that following newly merchandized products shall be exclude from the application, because they are shipped in small numbers and the evaluation method is not established at present.

1) Heat storage type air conditioner

This is an air conditioner to cool by means of obtaining cold energy at daytime from the stored it at night in the heat storage tank. Heat storage air conditioner has been developed newly to equalize the power demand, and expected to be distributed widely. However, very few are shipped at present.

There is no international standard, and establishing the measurement method is a future task.

* Estimated shipped quantity: 97 Freezing Fiscal Year: approx 2,500 units

2) Duct air-conditioning system for highly air-sealing/heat-insulating housing

This is a product developed specially for the recent highly air-sealing/heat-insulating housing, and is to be distributed. They may equip heat exchanger for exhaust and suction. It is necessary to study the evaluation method.

* Estimated shipped quantity: 97 Freezing Fiscal Year: approx 5,000 units

3) Solar air conditioner

Solar air conditioner has a specially designed power supply unit. A problem is how to evaluate the consumption of the power produced by solar system. Evaluation method is not established. Very few are distributed at present.

* Estimated shipped quantity: 97 Freezing Fiscal Year: approx 40 units

3. Enlarging the Scope of Application

(1) Enlargement of the scope to cooling capacity of 28 kW

After reviewing the standards in Law concerning the Rational Use of Energy, the package air conditioner of JIS B 8616-1993 has been revised, and the scope of JIS has been extended from max cooling capacity 27 kW to max 28 kW. Taking these changes into account, additional air conditioners are included in the scope of application.

As a result of this enlargement, another 35,000 units or so will be added.

(2) Multi-type

Multi-type air conditioner is a separate type which controls indoor units individually by connecting the two or more indoor units to an outdoor unit. It continues to increase its number. After reviewing the standards in Law concerning the Rational Use of Energy, the package air conditioner of JIS B 8616-1993 has been revised, and the scope of application has been extended upto multi-type.

Based on these situations, basic items of required evaluation method shall be specified, and the multi-type shall be included in the scope of application.

As a result of this enlargement, another 148,000 units or so will be added.

4. Estimation of quantities

If exclusion and addition in the above 2 and 3 are taken into account, the quantities of applicable air conditioners are as shown below.

Quantities of the Applicables in the Domestic Shipment of Air Conditioners
in 1997 Freezing Fiscal Year

(Unit: 1000 units, % in ( ))

	Cooling/heating	Cooling only	Total
Products applicable to current Law concerning the Rational Use of Energy	7,070	448	7,518 (95)
Total of “28 kW” class and multi-type	179	4	183 (2)
Total	7,249	452	7,701 (98)
Total of air conditioners excluded	-	-	187 (2)
Total	-	-	7,888 (100)

(Note) Above table excludes the ones not driven electrically and ones designed for transport means.

5. Ones designed for transport means

About 6 million units of air conditioners designed for transport means have been shipped in the ‘97 Freezing Fiscal Year. Efforts are being made currently to identify the operating condition and energy efficiencies. Based on the study results, another discussion will be made to determine whether they should be included to the scope of application.

[Attachment 2]

Basic Segments to Set Target Value for Air Conditioners

1. Basic Concept in Segmentation

Air conditioners are segmented to set target values, and it is according to the basic function, unit form and cooling capacity.

(1) Segmentation by basic function

To be segmented according to the cooling/heating unit with heating pump for heating and the cooling unit having cooling function only:

1) Cooling/heating
2) Cooling only

(2) Segmentation by unit form

To be segmented as shown below according to unit form:

1) Direct-blowoff type/window・wall types
2) Direct-blowoff type/separate/wall-hung types
3) Direct-blowoff type/others
4) Duct-connected type
5) Multi-type

(3) Segmentation by cooling capacity

Cooling capacity is segmented into 5 classes according to the cooling capacity based on the area of the room to be installed.

[References for applicable area (wooden - reinforced concrete)]

1) - 2.5 kW or less [for housing (equivalent to 7-10 tatami mats or less)]
2) Over 2.5 kW - 3.2 kW or less [for housing (equivalent to 9-13 tatami mats or less)]
3) Over 3.2 kW - 4.0 kW or less [for housing (equivalent to 11-17 tatami mats or less)]
4) Over 4.0 kW - 7.1 kW or less [for housing/store (equivalent to 12-38 tatami mats or less)]
5) Over 7.1 kW - 28.0 kW or less [for large-scale store/building air-conditioning]

2. Segmentation per unit form

As for the segmentation per unit form, air conditioners are classified into each segment by types of basic constructions due to the restrictions by sizes in the installation at housing or building. Room air conditioners, except the common direct-blowoff/wall-hung types, are as shown below.

(1) Window・wall types

The window type is mainly designed for small rooms. Since it is mostly installed directly to the window, weight and dimensions are controlled strictly. The wall type is also controlled very strictly by architectural designs.

(2) Direct-blowoff, but not wall-hung type

They are mostly the cassette types installed by means of burying the main unit in the ceiling while leaving grille on the ceiling surface. They are restricted by the height of space behind the ceiling and by the width according to methods of constructing houses.

(3) Duct-connected type

Many of them are installed in the space behind ceiling, with ducts connected to the blow-out and/or suction ports. They are controlled more strictly than the cassette types by the height of space behind the ceiling. Also since the static pressure out of machine is required, power of blower should be larger than other types.

(4) Multi-type

The multi-type is connected with two or more indoor units to one outdoor unit, and its basic construction is different from above machines.

3. Segmentation by cooling capacity

Though three segments ～4.0 kW, ～7.1 kW and ～27 kW (extended to -28 kW this time) were specified by the conventional standard in the cooling capacity, the range up to 4.0 kW has been sub-divided this time for the following reasons.

(1) As for the air conditioners up to cooling capacity 4 kW, seven types such as 2.0, 2.2, 2.5, 2.8, 3.2, 3.6 and 4.0 kW are available currently according to the size of a room.

(2) As for these air conditioners up to cooling capacity 4 kW, especially for the wall-hung type, energy-saving technologies have been rapidly innovated these years. Top value of COP has reached very high levels in each capacity.

(3) The COP top value for each capacity is at a very high level, and therefore, it fairly reflects the restriction of room size. Concerning the air conditioners of cooling capacity 4 kW or less, therefore, it is necessary to classify according to the actual status of these technologies.

(4) Taking into these situations above, it seems appropriate for air conditioners up to cooling capacity 4 kW or less to classify into three segments of -2.5 kW, -3.2 kW and -4.0 kW. This is obtained from at most rational consideration while reflecting the actual conditions including the restrictions in the corresponding room areas and sizes.

Thus, as for the segmentation to set target values, the standard shall be 50 segments in total by means of including newly established three segments as above. Segments will be further summarized based on the status quo of shipment of products and of technologies. (See Attachment 3).

(Reference 1)

Proposed Basic Segmentation for Air Conditioners

1. Air conditioners for both Cooling/Heating

(1) Direct-blowoff/window・wall types

～2.5 kW	～3.2 kW	～4.0 kW	～7.1 kW	～28.0 kW

(2) Direct-blowoff/separate/wall-hung types

～2.5 kW	～3.2 kW	～4.0 kW	～7.1 kW	～28.0 kW

(3) Direct-blowoff /others

～2.5 kW	～3.2 kW	～4.0 kW	～7.1 kW	～28.0 kW

(4) Duct-connected type

～2.5 kW	～3.2 kW	～4.0 kW	～7.1 kW	～28.0 kW

(5) Multi-type

～2.5 kW	～3.2 kW	～4.0 kW	～7.1 kW	～28.0 kW

2. Air conditioners for cooling only

(1) Direct-blowoff/window・wall types

～2.5 kW	～3.2 kW	～4.0 kW	～7.1 kW	～28.0 kW

(2) Direct-blowoff/separate/wall-hung types

～2.5 kW	～3.2 kW	～4.0 kW	～7.1 kW	～28.0 kW

(3) Direct-blowoff /others

～2.5 kW	～3.2 kW	～4.0 kW	～7.1 kW	～28.0 kW

(4) Duct-connected type

～2.5 kW	～3.2 kW	～4.0 kW	～7.1 kW	～28.0 kW

(5) Multi-type

～2.5 kW	～3.2 kW	～4.0 kW	～7.1 kW	～28.0 kW

(Reference 2)

Number of Shipped Units per Segment in Proposed Basic Segmentation
(97 Freezing Fiscal Year, unit: 1,000 units)

1. Air conditioners for both cooling/heating

(1) Direct-blowoff/window・wall types

29	0.4	0.2	—	—

(2) Direct-blowoff/separate/wall-hung types

4172	1687	474	115	22

(3) Direct-blowoff /others

6	74	56	130	306

(4) Duct-connected type

—	4	2	4	21

(5) Multi-type

—	—	12	80	54

2. Air conditioners for cooling only

(1) Direct-blowoff/window・wall types

121	—	0.4	0.5	—

(2) Direct-blowoff/separate/wall-hung types

177	47	22	15	4

(3) Direct-blowoff/others

—	—	2	15	43

(4) Duct-connected type

—	—	0.0	0.4	2

(5) Multi-type

—	0.1	0.4	—	1

(Reference 3)

Number of Models per Segment in Proposed Basic Segmentation
(98 Freezing Fiscal Year)

1. Air conditioners for both cooling/heating

(1) Direct-blowoff/window・wall types

13	3	2	—	—

(2) Direct-blowoff/separate/wall-hung types

249	243	137	278	166

(3) Direct-blowoff/others

11	76	172	849	1383

(4) Duct-connected type

2	17	37	110	259

(5) Multi-type

—	—	18	89	187

2. Air conditioners for cooling only

(1) Direct-blowoff/window・wall types

25	—	1	2	—

(2) Direct-blowoff/separate/wall-hung types

38	28	40	99	40

(3) Direct-blowoff/others

—	—	37	179	263

(4) Duct-connected type

—	—	1	13	54

(5) Multi-type

—	1	1	—	9

[Attachment 3]

Summary of Air Conditioner Segmentation and Target Values

1. COP max value per basic segment

The COP max values of products in October 1998 for each basic segment (described in Attachment 2) is shown below.

Both products announced to be sold by the time of October 1998 and products sold up to recently are included.

Segmentation by cooling capacity				
～2.5 kW	～3.2 kW	～4.0 kW	～7.1 kW	～28.0 kW

1. Air conditioners for both cooling/heating (average of cooling/heating COP)

(1) Direct-blowoff/window・wall types

2.57	2.85	2.46	—	—

(2) Direct-blowoff/separate/wall-hung types

5.27	4.90	3.65	3.17	3.10

(3) Direct-blowoff/others

2.97	3.96	3.20	3.12	3.06

(4) Duct-connected type

2.28	2.96	2.58	2.87	3.02

(5) Multi-type

—	—	4.12	3.23	3.07

2. Air conditioners for cooling only (cooling COP)

(1) Direct-blowoff/window・wall types

2.67	—	2.19	2.25	—

(2) Direct-blowoff/separate/wall-hung types

3.64	3.64	3.08	2.91	2.81

(3) Direct-blowoff/others

—	—	2.88	2.85	2.85

(4) Duct-connected type

—	—	2.72	2.51	2.71

(5) Multi-type

—	3.23	2.58	—	2.47

2. Concept in Summarizing Segments

(1) Concept in summarizing Segments

Segments are summarized by reflecting the following view points in the proposed basic segmentation consisted of 50 segments. (As for the segment per form, the small to large sequence with respect to cooling capacity starts from the left: 1st segment, 2nd segment, 3rd segment, 4th segment and 5th segment.)

A. Type of cooling capacity from 1st to 3rd segments, and types of 4th and 5th segments are mainly for household use, household & business use and for business use, respectively. There are also technical differences among them. Therefore, these three basic classes shall be maintained.

B. Concerning the segments in which products are hardly shipped, there will be very little possibility to ship these products in the future either. Therefore, these may be handled the same way as the neighboring segments without a problem. By considering the target values of the nearest one or two segment(s), employ the max COP value out of them, and integrate aforementioned products into the segment of the relevant max COP value (excluding the case of A.

C. Summaries of exceptions for A. and B.

1) In the cooling/heating type, direct-blowoff type, window type・wall type, the max COP value is the 2nd segment, even exceeding the max COP value in the 1st segment. Since, however, the value of cooling capacity and the value of COP are correlated positively to each other, the 1st segment of smaller cooling capacity than one in the 2nd segment may be treated the same way as the 2nd segment technically. Therefore, the 1st segment is integrated into the 2nd segment by considering the technical development, and the same target value is employed.

In the segments subsequent to the 3rd segment, there will be very little chance of shipment in the future. Therefore, the segments shall be integrated as the same value of the 2nd segment likewise.

Thus, as for this type of air conditioners, only one segment shall be employed.

2) In the 1st and 2nd segments of the cooling/heating type, direct-blowoff type and other types, the COP value of the 2nd segment is larger. The 1st segment of smaller cooling capacity than one in the 2nd segment may be treated the same way as the 2nd segment technically. Therefore, the same target value as the 2nd segment shall be employed by considering technical development. As for this type of air conditioner, certain number of products already is shipped, and certain number of models already exists. Therefore, there is no integration of these segments.

3) In the cooling/heating type and duct-connected type, the COP value of the 5th segment is the largest. The 4th segments and lower segments with smaller cooling capacity than the 5th segment may be treated the same way as the 5th segment technically. Therefore, the same target value as 5th segment shall be employed by considering technical development. As for the 3rd segment and lower segments, there shall be very little chance of shipment in the future. Therefore, the three segments are integrated.

4) In the cooling type, direct-blowoff type, window type・wall type, there will be very little chance of shipment in the future in the segments except the 1st. Therefore, these shall be integrated into one segment as a whole, and the max COP value among them shall be

employed.

5) In the 4th and 5th segments of cooling type and duct-connected type, the COP value is larger in the 5th. The 4th class of smaller cooling capacity than 5th class may be treated the same way as the 5th segment technically. Therefore, the same target value as 5th segment shall be employed by considering technical development.
6) In the cooling type and multi-type, there will be very little chance of shipment in the future in the 3rd segment and lower. Therefore, the three segments shall be integrated, and the max COP value of the integrated segment shall be employed.

   The target value of the 3rd segment changes, when the 3rd segments and the lowers are integrated. At the same time, the same target COP value as for the 3rd segment shall be employed for the 4th segment, because it has little shipment of products at present (it is according to the concept in 2).

Proposed Summarization for Segmentation of Air Conditioners

1. Air conditioners for both cooling/heating

(1) Direct-blowoff type/window type/wall type

				～28.0 kW

(2) Direct-blowoff type/separate/wall-hung type

～2.5 kW	～3.2 kW	～4.0 kW	～7.1 kW	～28.0 kW

(3) Direct-blowoff type/others

～2.5 kW	～3.2 kW	～4.0 kW	～7.1 kW	～28.0 kW

(4) Duct-connected type

			～7.1 kW	～28.0 kW

(5) Multi-type

			～7.1 kW	～28.0 kW

2. Air conditioners for cooling only

				～28.0 kW

(2) Direct-blowoff type/separate/wall-hung type

～2.5 kW	～3.2 kW	～4.0 kW	～7.1 kW	～28.0 kW

(3) Direct-blowoff type/others

			～7.1 kW	～28.0 kW

(4) Duct-connected type

			～7.1 kW	～28.0 kW

(5) Multi-type

			～7.1 kW	～28.0 kW

Target Values of Air Conditioners

I. Target values

Target value for each segment, which is discussed in the previous section, is as shown below.

Segmentation by cooling capacity				
～2.5 kW	～3.2 kW	～4.0 kW	～7.1 kW	～28.0 kW

1. Air conditioners for cooling/heating type (average of cooling/heating COP)

(1) Direct-blowoff type/window type・wall type

2.85				

(2) Direct-blowoff type/separate/wall-hung type

5.27	4.90	3.65	3.17	3.10

(3) Direct-blowoff type/others

3.96	3.96	3.20	3.12	3.06

(4) Duct-connected type

3.02			3.02	3.02

(5) Multi-type

4.12			3.23	3.07

2. Air conditioners for cooling only (cooling COP)

(1) Direct-blowoff type/window type・wall type

2.67				

(2) Direct-blowoff type/separate/wall-hung type

3.64	3.64	3.08	2.91	2.81

(3) Direct-blowoff type/others

2.88			2.85	2.85

(4) Duct-connected type

2.72			2.71	2.71

(5) Multi-type

3.23			3.23	2.47

II. Improvement of Energy Efficiency

If the energy efficiencies of air conditioners based on the above “Target values” in the target fiscal year are compared with the actual values in 1997 Freezing Fiscal Year under a certain condition, it is estimated that the energy efficiencies are improved by about 63% for the cooling/heating type and by about 14% for the cooling type (See Reference 5).

(Reference 4)

Future Perspective of Energy-Saving Technology in Air Conditioners,
and Expected Improvement of Energy Efficiency

1. Trends in technical development and future perspective

Energy-saving technology related to air conditioners is basically an improvement of technology for component units such as heat exchanger, blower and compressor, and a variety of modifications like the substitution of materials, improvement of shape and change of drive method have been attempted.

However, the development of these element technologies has almost reached its limit, and innovative technical development cannot be expected to happen in the future, though slight improvements may be made.

It should be noted that the air conditioners, which reflect these achievements in various energy-saving technologies which have almost reached their limits, realize the top energy efficiency at present.

In the future, therefore, important problem is how to reflect these energy-saving technologies in as many products as possible while considering the trends of demand and manufacturing cost.

Improvement of element technologies and future perspective are as shown below.

(1) Heat exchanger

Heat exchanger is designed for heat exchange between room air and refrigerant in the indoor unit and for heat exchange between outside air and refrigerant in outdoor unit. It is one of the most important components in an air conditioner.

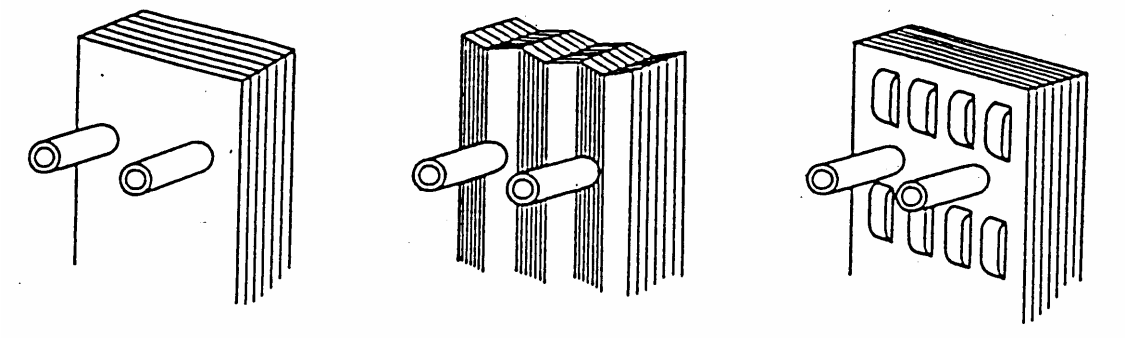
In this heat exchanger, the fin tube type heat exchanger, which the copper tube of refrigerant side passes through an aluminum plate fin for air side.

1) Fin for heat exchanger

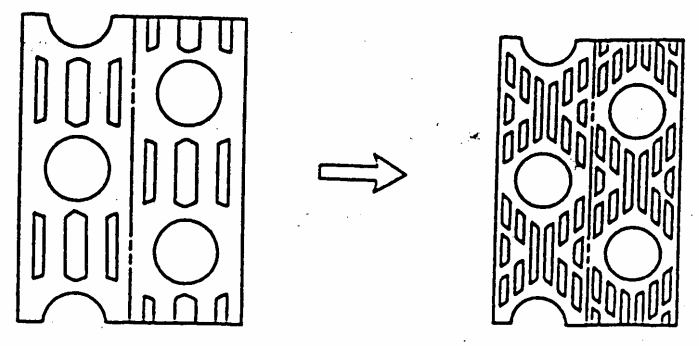
Flat aluminum plate (plate fin) was used for the fin in initial heat exchangers. However, the corrugate fin processed in waves and the slit fin with cutouts were to be employed. Efforts are also made to modify the shape of slit.

Currently, further improvement of the shape of slit has reached a stage where it is very hard to modify better.

<Plate fin> <Corrugate fine> <Slit fin>



<Modification of the shape of slit>

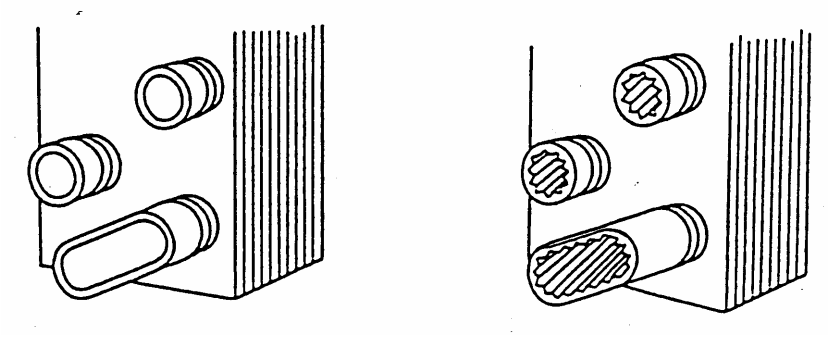


2) Copper tube for heat exchanger

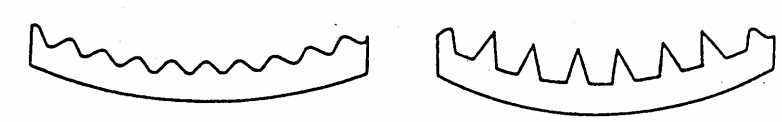
In the initial heat exchangers, smooth tubes, which were not given an internal process like normal copper tubes, were used. For energy saving, however, tube with internal groove has been developed, and efforts were made to optimize the shape of groove further.

If the current technology for internal grooving is taken into account, a stage has already arrived where it is very hard to make further improvement.

<Smooth tube> <Tube with internal grooves>



<Optimizing groove shape>



Efforts were also made to reduce the diameter of tube in order to improve heat conductivity between refrigerant and copper tube. Due to the resistance by flow rate, it is now thought to be very hard to further reduce the diameter of tube.

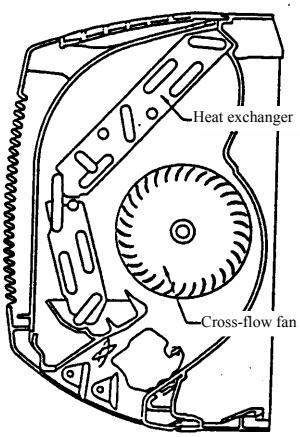
[Example] Tube diameter 9.5 mm → 7.0 mm → 6.3 mm

3) Form of heat exchanger

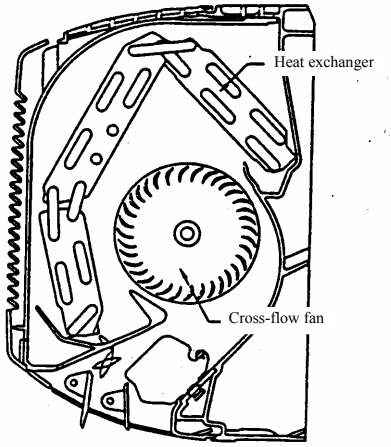
In the indoor unit of separate wall-hung type which is the most common as room air conditioners, the cross section of the conventional heat exchanger was formed flat. In order to enlarge heat exchanger area in the limited space, however, the bent type and the curved type by forming have been developed.

As a future perspective, it is now very hard to further expand within the current dimensions.

<2-stage bending>



<Multi-stage bending>



(2) Blower

1) Indoor blower

For the blower used in indoor unit, fans of different shapes are used according to the form of unit. Typical types are “Cross-flow fan” used for wall-hung type and “Turbo fan” used for the cassette type for business use.

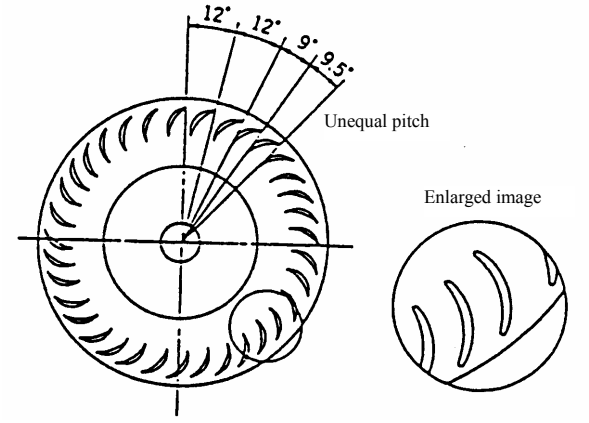
[Cross-flow fan]

Though having been assembled with metal plate worked blades, currently cross-flow fan is made of plastic, and efforts were made to increase air volume while suppressing noises by employing blade shape for cross section and increasing the diameter of fan.

Also in the layout and forming of fan and blade, improvements have been made by employing random layout of blades and tilting the fan shaft.

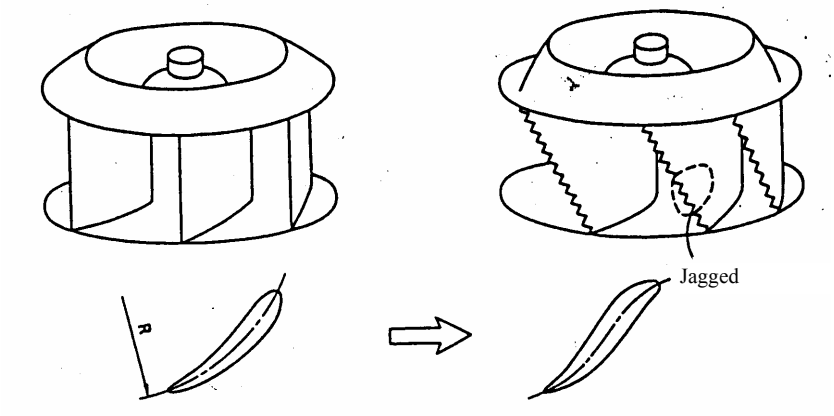
A stage has now arrived where it is very hard to further improve.

<Random pitch>



[Turbo fan]

Also in the turbo fan, improvements were made including the 3D processing of blade. Due to the restrictions in product size, however, there seems to be very little room for further improvement.



2) Outdoor blower

For the outdoor unit of air conditioner, the propeller fan is used generally. By changing the conventional metal plate to plastic, efforts were made to increase air volume while suppressing noises by modifying the shape of blade.

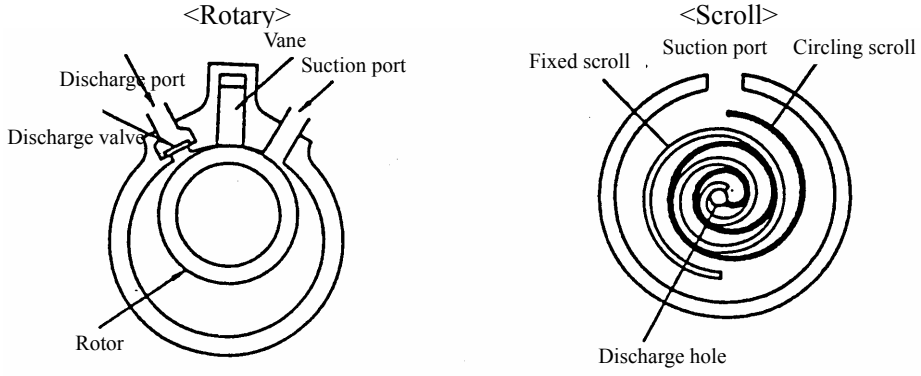
There seems to be very little chance for further improvement.

(3) Compressor

1) Conversion of compressor method

Compressor is the heart of air conditioner, and its core component as well which requires highly accurate processing technology. The reciprocal type (reciprocal movement type) compressor has been conventionally used. However, the rotary compressor was employed in the field of compact type, and the scroll compressor was developed for the medium/large types, and now they become used widely.

In these methods, high processing accuracy is required. The improvement of efficiency per volume comes close to limit as this technology improves. It is thought now very hard to establish any fundamentally and technically possible compression method which realizes the energy efficiency higher than the current level.



2) Employment of inverter and DC brush-less motor

For the motor to drive compressor, AC induction motor has been used. However, the inverter to control the revolution has been employed, and it is rapidly popularized mainly in

the air conditioners for household use.

Inverter is to convert current like AC → DC → AC. Then, the method to directly drive DC brush-less motor by the converted DC has been developed.

Also in the magnetic body used in the rotor, ones using the rare-earth metal, neodymium, instead of ferrite have been developed.

As far as practicability is concerned, it is thought very hard to develop at present any motor of higher efficiency than the current level.

2. Efficiency dropped as HFC refrigerant is changed

For the purpose of protecting ozone layer (See Attachment 4), new refrigerants have been developed and evaluated, and the products with new refrigerants have been developed and evaluated for a few years so far.

Consequently, the HFC line refrigerants (such as HFC410A for household use and HFC407C for business use) are introduced prevalently. According to the performance evaluation data of substitute refrigerants carried out by Japan Refrigeration and Air Conditioning Industry Association, energy efficiency is said to drop inevitably by about 3 - 10% as the refrigerant is changed from HCFC to HFC in the air conditioners for household use and business use.

3. Improved efficiency of energy consumption

As has been described above, the development of the element technologies for air conditioners is thought to have already reached its supreme level. If, at this stage, these energy-saving technologies can be applied to products smoothly, COP is expected to improve even in the products of low COP.

In the meantime, most of these technologies are realized by using effective materials. As a result, the use of such expensive materials could contribute to raise the prices of products, and using materials hard to process may cause problems in installation due to large-size products. In further utilization of these technologies, therefore, there seems to be very difficult problems to come across ahead.

Also as the conversion of refrigerant to HFC is further promoted in the future as shown in 2 above, energy efficiency is expected to drop more or less. If all these things are taken into account generally, it seems very hard to improve COP further.

In air conditioners, therefore, it seems appropriate to set max COP as the target values for each segment, and make efforts toward achievement.

(Reference 5)

Estimation Related to Improvement of Energy Efficiency

1. Calculated from the actual values of air conditioners shipped in 1997 Freezing Fiscal Year:

Energy Efficiency:	Cooling/heating type	2.96
	Cooling type	2.80

2. Calculated from the actual values of air conditioners shipped in the target fiscal year:

Energy Efficiency:	Cooling/heating type	4.82
	Cooling type	3.21

* As preconditions, number of shipped units and composition of the units were specified as the same as 1997 Freezing Fiscal Year.

3. Improvement rates of energy efficiency

(1) Cooling/heating type

$$\frac{(4.82 - 2.96) \times 100}{2.96} = \text{Approximate } 63\ \%$$

(2) Cooling type

$$\frac{(3.21 - 2.80) \times 100}{2.80} = \text{Approximate } 14\%$$

[Attachment 4]

Target Fiscal Years of Air Conditioners

1. Basic concept in setting target fiscal year
   Feasibility of target fiscal year shall be evaluated based on the factors such as 1) Necessity to convert to substitute refrigerant (from HCF to HFC), 2) Implementation of energy-saving technologies and 3) Development cycle of product, and a target fiscal year shall be set for each of the following two product categories as shown in Item 2.

2. Target fiscal year
   (1) Products shown below, which are produced in mass as air conditioners for household use, and in which the energy-saving technologies are most advanced, and whose the product development including the introduction of HFC refrigerant is expected to advance readily.

   Cooling/heating type/direct-blowoff type/separate wall-hung type of cooling capacity 4 kW or less
   - 2004 Freezing Fiscal Year
   (Applicable to products shipped in Oct. 2003 and later. Lead time is about 4 years.)

   (2) Products other than (1), which have features like varied model composition and length of product cycle
   - 2007 Freezing Fiscal Year
   (Applicable to products shipped in Oct. 2006 and later. Lead time is about 7 years.)

(Reference) Measures to protect ozone layer

1. Montreal Protocol to protect ozone layer newly controls HCFC (hydro-chlorofluorocarbon) which has been a substitute CFC, in addition to the abolition of CFC (chlorofluorocarbon) production in 1995. In real terms, HCFC should be abolished totally in substance by the year 2020.

2. In this event, domestic manufacturers of air conditioners set down the objectives to convert to other refrigerants by the year 2010 for the products using HCFC as refrigerant. As for the air conditioners for household use which use more of HCFC refrigerant, above all, measures are planned to realize the conversion to products with substitute refrigerants in main models by the year 2004 when 35% reduction of HCFC starts.

<HCFC reduction plan in the current Montreal Protocol>
- ·After 2004: 65% or less of the year 1996
- ·After 2010: 35% or less of the year 1996
- ·After 2015: 10% or less of the year 1996
- ·After 2020: Abolished totally in substance

[Attachment 5]

Basic Measure, Energy Efficiency, and Measurement Method for Air Conditioner

1. Concepts in basic measure, energy efficiency and measurement method

Basic measure for air conditioner shall be the cooling capacity (W).

Similar to conventional standards, the energy efficiency shall use the value obtained from dividing cooling capacity (W) by cooling power consumption (W) (hereinafter shown as "Cooling COP") and the value obtained from of dividing heating capacity (W) by heating power consumption (W) (hereinafter shown as "Heating COP")(Reference 6).

Measurement methods shall be according to the cooling capacity test and heating capacity test specified in JIS B 8616 Package Air conditioner and JIS C 9612 Room Air conditioner (Reference 7).

(1) Energy Efficiency and measurement method for cooling/heating type air conditioner

For the cooling/heating type, it is necessary to evaluate the two functions such as cooling and heating totally. Therefore, the average COPs of cooling and heating shall be used respectively (average value of the cooling COP based on the cooling capacity test and the heating COP based on the heating capacity test specified in JIS)

(2) Energy Efficiency and measurement method for cooling type air conditioner

For the cooling type, the cooling COP shall be used (cooling COP based on the cooling capacity test specified in JIS).

2. Measurement method for multi-type

Multi-type to be added this time is applicable in JIS B 8616 Package Air conditioner as the revision of JIS. Basics contents including temperature conditions are specified there, but there are no details of conditions to measure energy efficiency. Therefore, the measurement methods need to be decided as the type comes to be applicable to this standard.

The multi-type uses more than one indoor unit for an outdoor unit. Therefore, the capacity, type and quantity of indoor unit connected to an outdoor unit are combined in various ways. It seems unrealistic, therefore, to evaluate the energy efficiency for all of them.

Thus, standard combination of indoor units for an outdoor unit shall be set down, and the energy efficiency shall be evaluated according to the following method.

(Note) Multi-type in this context shall be separate type air-conditioners in which the two or more indoor units are connected to an outdoor unit, and which can control the indoor units individually.

(1) Measurement methods

For the multi-type, the cooling capacity test and standard heating capacity test specified in JIS shall be carried out in case the indoor units are operated simultaneously in the standard combination of indoor units for an outdoor unit as shown below. Energy efficiency shall be calculated by such measured values.

(2) Standard combination

1) If only one combination of indoor units for an outdoor unit is available, such combination shall be the standard combination.
2) If two or more combinations of indoor units for an outdoor unit are available, the following combinations shall be the standard combinations.
   (a) Form of the indoor units shall be the optimum one for the use of multi-type. The wall-hung type and 4-way cassette type shall be employed basically.
   (b) Number of indoor units to be connected shall be the number of ports if the outdoor unit has a port for each indoor unit. Otherwise, it shall basically be two units.
   (c) Capacity of indoor unit shall be so selected that the ratio of total cooling capacities of indoor units and cooling capacity of the outdoor unit is 1. If, however, no combination to make the ratio 1 is available, any combination near "1" will be selected.

3. Measurement method for duct-connected type

(1) Concerning the duct-connected type air conditioner, the measurement method is specified currently only by the package air conditioner of JIS B 8616-1993. However, "Duct-connected Type Air conditioner and Air-to-air Heat Pump Rated Performance and Operating Performance Test" is being reviewed as a draft plan for JIS, conforming to ISO13253.

(2) Main points of the measurement method for duct-connected type in the current JIS B 8616-1993 are shown below.

1) Adjust the damper of tester to obtain the external static pressure (rated external static pressure) specified by the manufacturer, and measure the rated air volume by carrying out the air volume test when air is being sent.
2) Carry out the cooling test and heating test when damper adjustment, etc. are maintained, and determine the capacity and power consumption.

(3) Main points of the measurement method for duct-connected type in the draft plan for JIS conforming to ISO13253 are shown below.

1) By setting the indoor side air volume at the lowest external static pressure specified by the manufacturer as the rated air volume, carry out cooling test and heating test based on this rated air volume.
2) Correct the cooling capacity and power consumption in order to set external static pressure of "0"(zero) as standard in the calculations of cooling capacity and cooling power consumption.
   · Add the blower's power consumption (W) required, because of external static pressure being larger than zero, to the cooling capacity (W).
   · Subtract the blower's power consumption (W) required, because of external static pressure being larger than zero, in the blower input.

If these situations are taken into account, two ways such as “Value of the capacity/power consumption measured by giving external static pressure” and “Value of the capacity/power consumption corrected by converting the given external static pressure into power consumption” are available as the measurement methods for duct-connected type.
As shown above, the measurement methods are different partially between the current JIS and the draft plan for JIS conforming ISO. In consideration of the user convenience by showing actual cooling capacities and of the possibility to revise ISO Standard, however, the standard shall be “Value of the capacity/power consumption measured by giving external static pressure”(current JIS) for the time being.

(Note) Currently, ISO Standard is being revised extensively.

(Reference 6)

Definition in current Law concerning the Rational Use of Energy

In the standard by the current Law concerning the Rational Use of Energy (Ministry of International Trade and Industry Announcement No. 650, 10 Dec. 1993), the energy efficiency of air conditioners is defined as shown below.

In 1 and 2 (Note: "1" means air conditioners for cooling and heating, and "2" means air conditioners for cooling only), energy efficiencies of cooling and heating shall be as specified in the following items (1) and (2) respectively.

(1) Energy efficiency of cooling shall be the value obtained from dividing cooling capacity (W) measured by cooling capacity test in JIS B 8616 or C9612 by cooling power consumption (W) measured by cooling power consumption test in the same JIS B 8616 or C9612 (as for the products for rated frequencies of both 50 Hz and 60 Hz, smaller one of the values calculated from the values measured in each frequency is employed).

(2) Energy efficiency of heating shall be the value obtained from dividing the heating capacity (W) measured by the standard heat pump heating capacity test in JIS B 8616 or the standard heating capacity test in JIS C 9612 by the heating power consumption (W) measured by the standard heat pump power consumption test in JIS B 8616 or the standard heating power consumption test in JIS C 9612 (as for the products for rated frequencies of both 50 Hz and 60 Hz, smaller one of the values calculated from the values measured in each frequency is employed).

(Reference 7)

Table 1. JIS C9612-1994 Test Conditions for Room Air Conditioners

Unit: °C

Test conditions			Indoor side air condition		Outdoor side condition			
					Air-cooling		Water-cooling	
			Dry-bulb temperature	Wet-bulb temperature	Dry-bulb temperature	Wet-bulb temperature	Inlet water temperature	Outlet water temperature
Cooling	Capacity		27	19	35	24(2)	30	35
	Overload		32	23	43	26(2)	34	—
	Frozen		21	15	21	15(2)	—	21
	Frosted		27	24	27	24(2)	—	27
Heating	Capacity	Standard	20	—	7	6	15	—
		Low temperature	20	15 or less(2)	2	1	—	—
	Overload		27	—	21	15	21	—
	Defrosted		20	15 or less(2)	2	1	—	—

Notes (1) Applicable to the type in which the wet bulb temperature affects the indoor side heat exchanger
(2) Applicable to the type in which the wet bulb temperature affects the outdoor side heat exchanger (type of using latent heat of water, etc. as the heat source for outdoor side heat exchanger)

Table 2. JIS B8616-1993 Test Conditions for Package Air Conditioners

Unit: °C

Test conditions			Indoor side air condition		Outdoor side condition					
					Air-cooling type package air conditioner		Water-cooling type cooling package air conditioner		Water-cooling heat pump type package air conditioner	
			Dry-bulb temperature	Wet-bulb temperature	Dry-bulb temperature	Wet-bulb temperature	Inlet water temperature	Outlet water temperature	Inlet water temperature	Outlet water temperature
Cooling	Capacity		27	19	35	24(2)	30	35	18	29
	Overload		32	23	43	26(2)	34	-(3)	24	—(3)
	Frosted		27	24	27	24(2)	_	27	—	27
	Frozen		21	15	21	15(2)	_	21	—	21
Heating by heat pump	Capacity	Standard	20	—	7	_	-	—	15	—(3)
		Low temperature	20	15 or less(1)	2	—	-	—	—	—
	Overload		27	—	21	15	_	—	21	—(3)
	Defrosted		20	15 or less(1)	2	1	_	—	—	—
Heating by electric heater			20(4)	—	—	—	—	_	—	—
Air volume static pressure (5)			20	15.8	—	—	—	_	—	—

Notes (1) Applicable to the type in which the wet bulb temperature affects the indoor side heat exchanger.
(2) Applicable to the type in which the wet bulb temperature affects the indoor side heat exchanger (type of using latent heat of water, etc. as the heat source for outdoor side heat exchanger).
(3) Water volume determined in the cooling capacity test conditions is applied.
(4) This means the standard ambient temperature.
(5) Changes in external static pressure shall be contained within ±10% of rated static pressure in the period of measurement. If, however, the rated static pressure is 98 Pa or less, the rate static pressure shall be within ±9.8 Pa.

[Attachment 6]

Display of Energy Efficiency of Air Conditioners

1. Current regulations for display

Display of energy efficiency of air conditioners is specified by the following two regulations.

(1) Announcement based on Household Goods Labeling Law (Codes for Electric Equipment and Device Quality Labeling) (See Reference 8); applicable to air conditioners of 3 kW or less in the total of motor rated power consumption.

(2) Announcement based on Law concerning the Rational Use of Energy (display items by manufacturer as related to energy efficiency of air conditioner) (See Reference 9); applicable to air conditioners other than (1)

(Note) Concerning the display for special equipment, Article 20 of Law concerning the Rational Use of Energy arranges the announcement of Law concerning the Rational Use of Energy in a way that it may not overlap the Codes for Electric Equipment and Device Quality Indication. Therefore, the announcement of Ministry of International Trade and Industry based on Law concerning the Rational Use of Energy shall be applicable to products excluded from Codes for Electric Equipment and Device Quality Indication.

2. Display items

As for the display of energy efficiency of air conditioner, it shall be appropriate to basically inherit the above two current standards and display the following items.

(1) Display items by the announcement based on Household Goods Labeling Law

- Product name and model name
- Cooling capacity
- Cooling power consumption
- Energy efficiency of cooling
- Heating capacity (limited to ones capable of heating)
- Heating power consumption (limited to ones capable of heating)
- Energy efficiency of heating (limited to ones capable of heating)
- Average of energy efficiency of cooling/heating (limited to ones capable of heating)
- Name of manufacturer

(Note) In the display of the above items “Product name and model name,” “Cooling power consumption”, “Heating power consumption (limited to ones capable of heating),” “Average energy efficiency of cooling/heating (limited to ones capable of heating)” and “Name of manufacturer,” Codes for Electric Equipment and Device Quality Labeling needs to be revised.

(2) Display items by announcement based on Law concerning the Rational Use of Energy

- Product name and model name
- Cooling capacity
- Cooling power consumption

- Energy efficiency of cooling
- Heating capacity (limited to ones capable of heating)
- Heating power consumption (limited to ones capable of heating)
- Energy efficiency of heating (limited to ones capable of heating)
- Average of energy efficiency of cooling/heating (limited to ones capable of heating)
- Name of manufacturer

(Note) Items “Cooling capacity” and “Cooling power consumption” shall be the values measured by the cooling capacity test and cooling power consumption test in JIS B8616 or C9612. Items “Heating capacity” and “Heating power consumption” shall be the values measured by the standard heating capacity test and standard heating power consumption test in JIS B8616 or C9612.

3. Items to be complied (main points)

(1) Cooling capacity shall be displayed in kilo watt values measured by the cooling capacity test in JIS B8616 or C9612.

(2) Energy efficiency of cooling shall be displayed as the value obtained from dividing the value (W) of the cooling capacity in (1) by the value (W) measured by the cooling power consumption in JIS B8616 or C9612. It shall be shown until the 2nd decimal place.

(3) Heating capacity shall be displayed in kilo watt values measured by the standard heating capacity test in JIS B8616 or C9612.

(4) Energy efficiency of heating shall be displayed as the value obtained from dividing the value (W) of heating capacity in (3) by the value (W) measured by the standard heating power consumption test in JIS B8616 or C9612. It shall be shown until the 2nd decimal place.

(5) Items shall be displayed at part of the product body where such display items can be seen easily.

(Reference 8)

Codes for Electric Equipment and Device Quality Indication (excerpt)

(Announcement No. 673, 1 Dec. 1997, Ministry of International Trade and Industry)

(Display items)

Article 1: Items to be displayed on the quality of electric equipment and devices shall be those quoted in the right column of Attached Table 1 for the electric equipment and devices quoted in the left column of the same table.

(Items to be complied)

Article 2: In the display of the items specified in the above article, the items to be complied by the manufacturers, sellers or labeling companies shall be as shown in Attached Table 2.

Attached Table 1 (related to Article 1)

Electric equipment and devices	Items to be displayed on quality
Item 3 (13) Air conditioners (If total of motor's rated power consumption is 3 kW or less, or if electric heater is provided, the types using electric cool air blower or electric heating element shall be excluded so far as the rated power consumption of the electric heater is 5 kW or less.)	1. Cooling capacity 2. Energy efficiency in cooling operation 3. Heating capacity (limited to ones capable of heating) 4. Energy efficiency in heating operation (limited to ones capable of heating) 5. Cautions in operation

Attached Table 2 (related to Article 2)

7. Air conditioners

(1) Cooling capacity or heating capacity shall be displayed as the value shown in kilo watt obtained by the test method of cooling capacity or heating capacity specified in JIS C9612 (room air conditioner) at standard voltage (100 V or 200 V; hereinafter shown the same way) in the rated frequency of each air conditioner, or the value shown in kilo watt obtained by the test method of cooling capacity or heat pump standard capacity specified in JIS B8616 (package air conditioner). However, the display of cooling capacity or heating capacity may be omitted for the water evaporation type. Also, the display of heating capacity may be omitted for the heating type of other than heat pump heating or electric heater only. In such cases, the allowable ranges shall be from +15% to –8% of the displayed value (In the display of heating capacity for the ones heating by electric heater only, the range will be ±10% of the displayed value if it is 1 kW or less. In case that the displayed value exceeds 1 kW, the rage will be ±5% of the value).

(2) Efficiency of energy consumption in cooling or heating operation shall be indicated as the value shown in watt obtained by dividing the value of cooling or heating capacity given in the test method specified in Regulation (1) for rated frequency of each air conditioner by the value shown in watt obtained by the measurement according to the test method of cooling or heating power consumption specified in JIS C9612 (room air conditioner) or the value shown in watt obtained by the measurement according to the test method of cooling power consumption or heat pump standard heating power consumption specified in JIS B8616 (package air conditioner), which is shown to the 2nd digit after decimal point. However, the indication of the efficiency of energy consumption in cooling or heating operation may be omitted in the steam type, heat pump heating, heating by methods other than those by electric heater only, or in the type in which two or more indoor units can be operated in cooling or heating operation simultaneously by one refrigerant circuit. In such cases, the allowable range shall be –15% of the indicated value.

(3) As the cautions in operation, the following items shall be indicated appropriately according to the shape and quality of product. Followings are included into the display items related to cautions in operation, but not limited to. I

a. Cautions related to operation
b. Cautions related to check/maintenance
c. Cautions related to installation

(4) The name of person or appellation in charge of the display items shall be included in the display.

(5) Display items shall be clearly described at places readily seen by consumer for each air conditioner. Cautions in operation shall be displayed on the product body and in the operation manual.

(Reference 9)

(2)-2) Items to be Displayed and Complied by Manufacturers on Energy Efficiency of Air Conditioners

(Announcement No. 356, 30 May 1994, Ministry of International Trade and Industry)
(Announcement No. 6 partially revised on 9 Jan. 1995, Ministry of International Trade and Industry)

1. Display items

Manufacturer or importer (hereinafter shown as "Manufacturers") of air conditioners shall display the following items on energy efficiency of air conditioners quoted in Article 7 Item 2 of Law concerning the Rational Use of Energy Enforcement Order (Government Ordinance No. 267, 1979) (excluding air conditioners in Attached Table 1 Item 3 (13) of Household Goods Labeling Law Enforcement Order (Government Ordinance No. 390, 1962); hereinafter shown as "Air conditioner").

a. Product name and model name
b. Cooling capacity
c. Cooling power consumption
d. Energy efficiency of cooling
e. Heating capacity (limited to ones capable of heating)
f. Heating power consumption (limited to ones capable of heating)
g. Energy efficiency of heating (limited to ones capable of heating)
f. Name of manufacturer or appellation

2. Items to be complied

(1) Cooling capacity shall be displayed as the value shown in kilo watt measured in each rated frequency by the cooling capacity test in JIS B8616 or C9612. In this case, displayed value shall be 100/95 or less of cooling capacity.
(2) Heating capacity shall be displayed as the value shown in kilo watt measured in each rated frequency by the standard heat pump heating capacity test in JIS B8616 or the standard heating capacity test in JIS C9612. In this case, displayed value shall be 100/95 or less of heating capacity.
(3) Cooling power consumption shall be displayed as the value shown in kilo watt measured in each rated frequency by the cooling power consumption test in JIS B8616 or C9612. In this case, displayed value shall be 100/110 or more of cooling power consumption.
(4) Heating power consumption shall be displayed as the value shown in kilo watt measured in each rated frequency by the standard heat pump heating power consumption test in JIS B8616 or the standard heating power consumption test in JIS C9612. In this case, displayed value shall be 100/110 or more of heating power consumption.

(5) Energy efficiency shall be the values according to the lower column in Attached Table 3 of Law concerning the Rational Use of Energy (Ministry of International Trade and Industry Ordinance No. 74, 1979). They shall be displayed up to the 2nd decimal place for each rated frequency.

(Ministry of International Trade and Industry Announcement No. 6, 1995, partially revised)

(6) Display items in 1 above shall be displayed on each air conditioner in ways hard to be erased at part of the product body, or in the metal or synthetic resin label firmly fixed to the part easy to be seen of the product body.

Supplementary provisions

1. This announcement shall be applied on and after the date of promulgation.
2. Air conditioners which displayed the items specified in Announcement No. 192, 8 May 1980, Ministry of International Trade and Industry, by 30 September 1995 before its abolition may be according to the prior and existing examples despite this announcement.

[Attachment 7]

History of Air Conditioner Criteria Subcommittee

1st Meeting (11, Aug. 1998)

- Status quo of air conditioners
- Target area
- Measurement of energy efficiency of air conditioners
- Segmentations to set target values

2nd Meeting (4, Sept. 1998)

- Scope of application
- Basic measures and measurement methods for energy efficiency
- Segmentations to set target values
- Summarizing segments
- Target values and target fiscal years

3rd Meeting (25 Sept. 1998)

- Perspective of technical development and improvement of energy efficiency
- Display items
- Interim report

4th Meeting (4, Dec. 1998)

- Comments to the interim report
- Final report

[Attachment 8]

Air Conditioner Criteria Standard Subcommittee, Energy Efficiency Standards Subcommittee of the Advisory Committee on Energy: List of members

Chairman:	Takamoto Saito	Professor of Faculty of Physical Sciences and Engineering, Meisei University
	Hiroshi Asano	Senior Researcher of Socio-Economic Research Center, Central Research Institute of Electric Power Industry
	Yakuhiro Amano	Executive Director of the Japan Refrigeration and Conditioning Industry Association
	Masako Ariyama	Consulting room of Japan Consumers' Association
	Shogo Ogasawara	Honorary member of Japan Building Mechanical and Electrical Engineers Association
	Takao Kashiwagi	Professor of Department of Mechanical Systems Engineering, Faculty of Technology, Tokyo University of Agriculture & Technology
	Atsumi Kimura	General Manager of Research Department, the Energy Conservation Center, Japan
	Kazuko Sato	Director of Nippon Association of Consumer Specialists
	Yasumasa Tsutsui	General Manager of Energy Department, Mechanical Engineering Laboratory, Agency of Industrial Science and Technology
	Hidetoshi Nakagami	President of Jyunkankyo Research Institute Inc.
	Yasuhiko Nakane	Executive Director of Japan Machinery Importers' Association
	Eiji Hihara	Assistant Professor of Department of Mechanical Engineering, Graduate School of Engineering, the University of Tokyo
	Takashi Fudo	Project General Manager of Air Conditioner and Energy-saving Joint Working Group, Japan Refrigeration and Air Conditioning Industry Association

Yoichi Hori Assistant Professor of Institute of Engineering Innovation, Faculty of Engineering, the University of Tokyo

[Reference]

Status quo of air conditioners

I. Types and Classification

1. Idea of "Air Conditioning"

Air Conditioning is to maintain the air condition at a favorable condition in a specified space (indoor generally), and is thought to comprise the following elements.

1) Temperature (cooling and heating)
2) Humidity (dehumidification and humidification)
3) Cleanliness (removal of dust and ventilation)
4) Air flow (sending air)

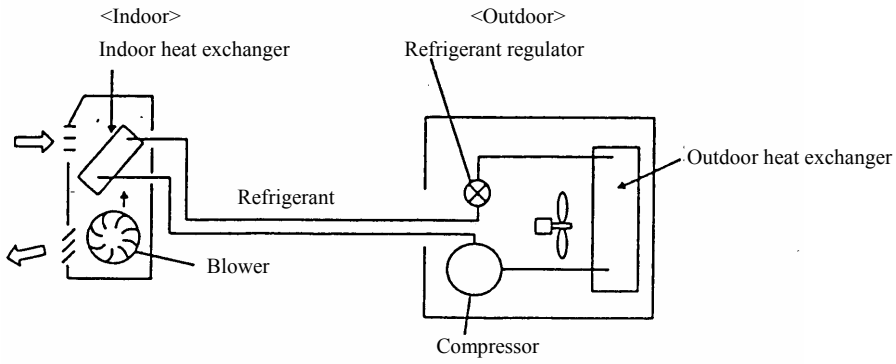
Air conditioning equipment is a unit with the function to control these elements. These controls are realized only by "Freezing" applied cooling. Any unit with cooling function, therefore, is called air conditioning equipment.

2. Method of Air Conditioning and Air Conditioners

Method of air conditioning can be classified from various viewpoints. According to the relation between the unit of freezing cycle and air conditioning, two methods are available generally; one of cooling air directly by the cooling unit in the freezing cycle and the other of once making cool water in the freezing cycle, then exchanging heat with air at the place to be cooled by using such cool water.

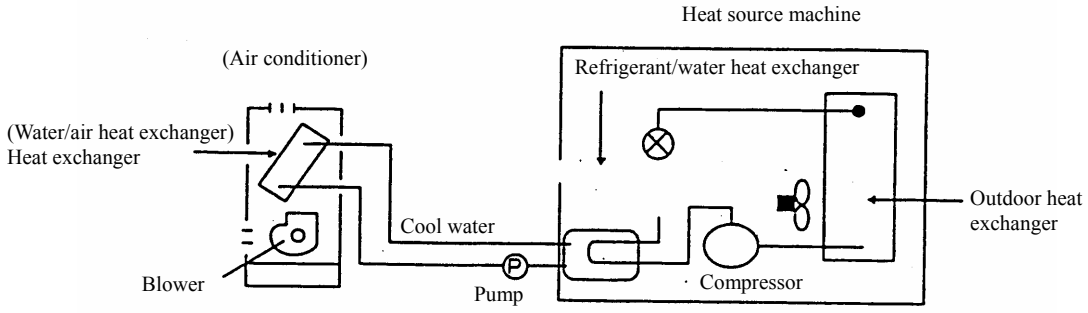
The former method is called Direct Expansion System. This method is meant generally when air conditioners are quoted. The latter method is called Cooling (Hot) Water System.

1) Air conditioner (method of cooling air directly in freezing cycle)
(also called direct expansion system or unit type air conditioner)



The direct expansion system is applied in a variety of fields because it can be used more easily than cool/hot water system, thus accounting for a dominant percentage in terms of quantity.

2) Cool/hot water system (method of once making cool water by freezer, then cooling by cool water) (also called cool (hot) water system, chiller/fan coil type or indirect expansion system)



Cool/hot water system is generally used in air conditioning of the large-scale facilities.

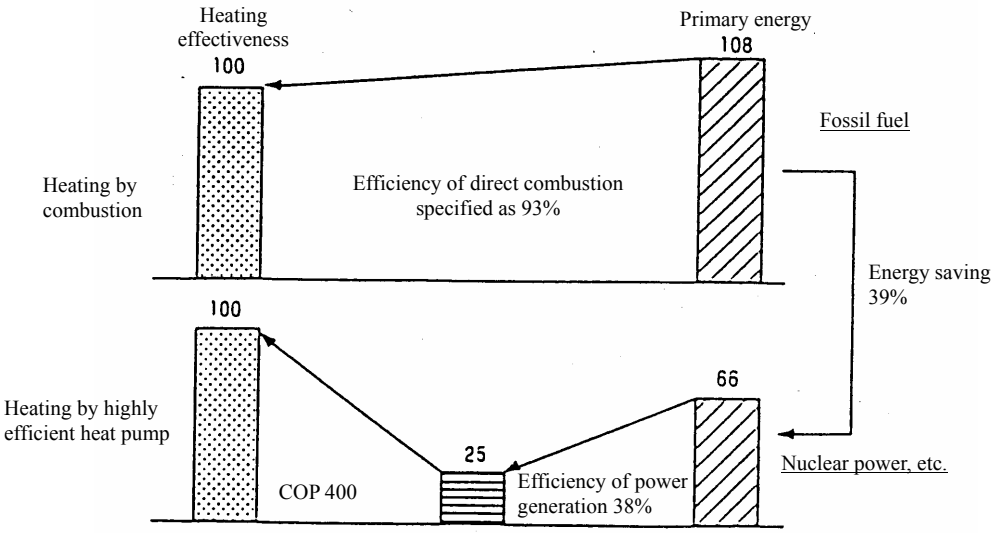
According to the classification of products (See Attachment 1), 1) Direct Expansion System is called "Air conditioner," and called in more details according to the place it is installed (common applications such as car, railway vehicle and housing: building). 2) Cool/Hot Water System is air conditioning equipment which is classified as "Air conditioning component" in terms of equipment.

3. Air Conditioner Heating/Heat Pump

· Air conditioner is capable of heating the room by taking heat from outside by reversing the freezing cycle. This is called "Heat pump," and most of the cooling/heating air conditioners for household use and business use maintain the heating performance by this heat pump alone at present.

· Heat pump does not convert energy to heat straightly, but use it as a power. In comparison with the heating by burning fossil fuels as they are, this is a heating method saving more energy. If technical innovation is realized, a drastic energy saving is realized in the primary energy conversion.

<Comparison of primary energies to attain heating effectiveness 100>



4. Categories of unit type air conditioner (compressive type)

For the unit type air conditioners (one of the direct expansion system of cooling rooms directly in freezing cycle, which excludes air conditioner for transport machines), the following categories are available.

(1) Categories by function (in terms of freezing cycle)

- Cooling type
- Cooling/heating type (heat pump type)

} Type capable of dehumidifying operation

(2) Categories by freezing method

1) Type by steam compression type freezing cycle
(Most of the current air conditioners belong to this type.)

2) Type by absorption type freezing cycle
(Absorption type chiller for cool/hot water system is widely distributed, but the type of directly cooling air is rare, and produces as prototypes.)

3) Type using Peltier element, etc.
(Not merchandized)

(3) Categories by compressor drive method

(Type by compressor drive method, using steam compression type freezing cycle)

1) Electrically driven

2) Engine driven
Gas engine driven heat pump air conditioner
Oil engine driven heat pump air conditioner, etc.

(4) Categories by purpose of air conditioning

1) Type to maintain the health/comfort of residents
(Comfortable air conditioning, common air conditioning, air conditioning for human being)

2) Type for machine, device and foods, not for comfort of residents
(Special air conditioning, air conditioning for objects, etc.)

(5) Categories by application

·For household use (room air conditioner)
·For business (package air conditioner)

} Commonly known as Room or Package

(Various air conditioners for special applications are available for business use.)

(6) Categories by unit configuration (See Attachment 3.)

- Window type, through-the-wall type and single package type are available as one-block type.
- Split type (separate type) and remote condenser type are available as the separate type.
- Separate type has a compressor in the outdoor unit.
  Many depends on the shape of indoor unit, while others are the multi-type having more than one indoor unit. (See Attachment 2.)
- Remote condenser type has compressor in the indoor unit.

(7) Categories by the heat (cooling) source of outdoor heat exchanger

- Water-cooling type (water heat source type)
- Air-cooling type (air hear source type)

(Attachment 1)

Classification of air conditioning equipment by product classes

According to the Japanese standard product classification, air conditioning equipment is included in "Medium Category 55 Freezer applied products and equipment," and positioned in the classification as a whole as shown below.

55. Freezer, freezer applied products and equipment

- 55.1 Freezer
- 55.2 Air conditioning equipment
- 55.3 Freezing/refrigerating equipment
- 55.4 Freezer applied products
- 55.5 Freezer applied equipment
- 55.6 Cooling tower and heating tower
- 55.8 Parts and accessories for freezer and freezer applied products and equipment

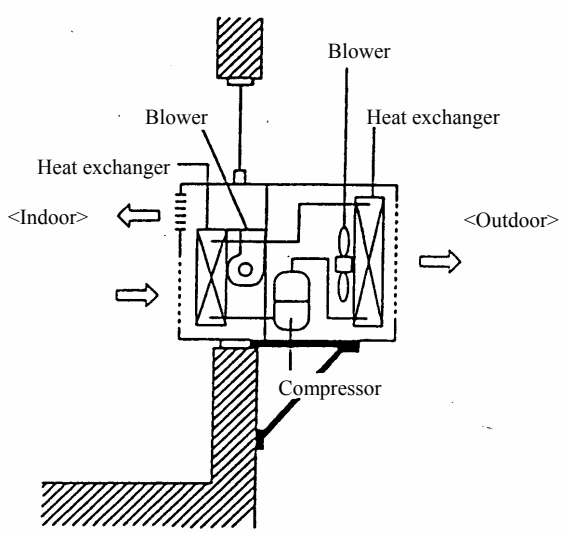
55 2	Air conditioning equipment (limited to complete set)
55 21	Air conditioner for transport machine
55 211	Air conditioner for car
55 2111	Air conditioner for passenger car
55 2112	Air conditioner for bus
55 2119	Air conditioner for other cars
55 212	Air conditioner for railway vehicle
55 213	Air conditioner for aircraft
55 219	Air conditioner for other transport machines
55 22	Unit type air conditioner for
55 221	Window type and wall type air conditioners
55 2211	Cooling/heating type
55 22111	Heat pump type
55 22119	Others
55 2212	Cooling type
55 222	Package type air conditioner
55 2221	Cooling/heating type
55 22211	Heat pump type
55 22219	Others
55 2222	Cooling type
55 223	Separate type air conditioner
55 2231	Cooling/heating type
55 22311	Heat pump type
55 22319	Others
55 2232	Cooling type
55 23	Dehumidifier
55 24	Air conditioning equipment components
55 241	Air conditioning liquid chilling unit (including heat pump type)
55 2411	Compressive type
55 24111	Volume compressive type
55 24112	Centrifugal type
55 2412	Absorption type
55 2419	Others
55 242	Air conditioning equipment and related units
55 2421	Fan coil unit
55 2422	Induction unit
55 2423	Air handling unit
55 2424	Total heat exchanger and total heat exchange ventilation unit
55 2425	VAV terminal unit
55 2426	Air purification system and air filter
… …..	Humidifier
55 2429	Others

(Attachment 2)

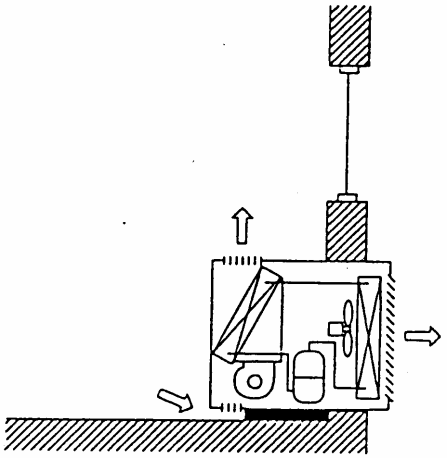
Categories by unit configuration

As a unit type air conditioner of electric compressive type, the "Window type" mounted by using a window of housing was initially merchandized. As the larger scale type mounted on the floor in the room, on the other hand, "Package type" using water-cooling condenser was put to practical use. In Japan, too, these two types were merchandized, the window type of which was called "Room cooler," and the water-cooling one-block type was called "Package cooler". These names persist up to now, but the forms of units have changed. The type for housing is called "Room air conditioner," and the type for business use is called "Package air conditioner". These names are also used in the standards, though coverage varies. Basic types by unit configuration are shown below.

1) Window type
   Type mounted on window
   · Small capacity because unit is mounted in each room
   · Mostly for household use (decreased in quantity lately)

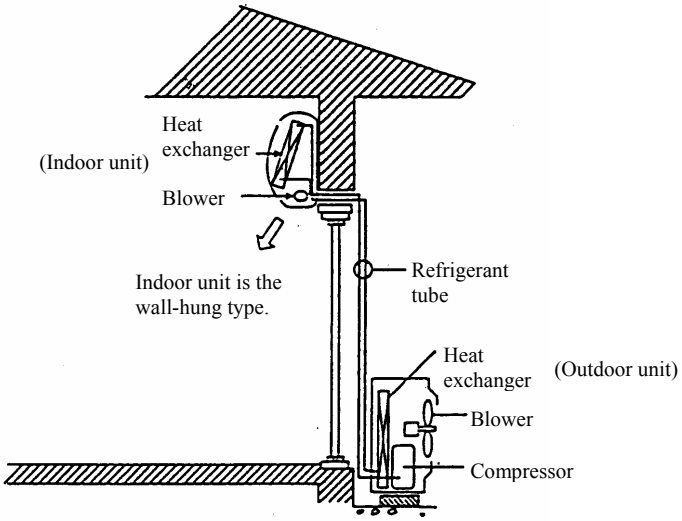


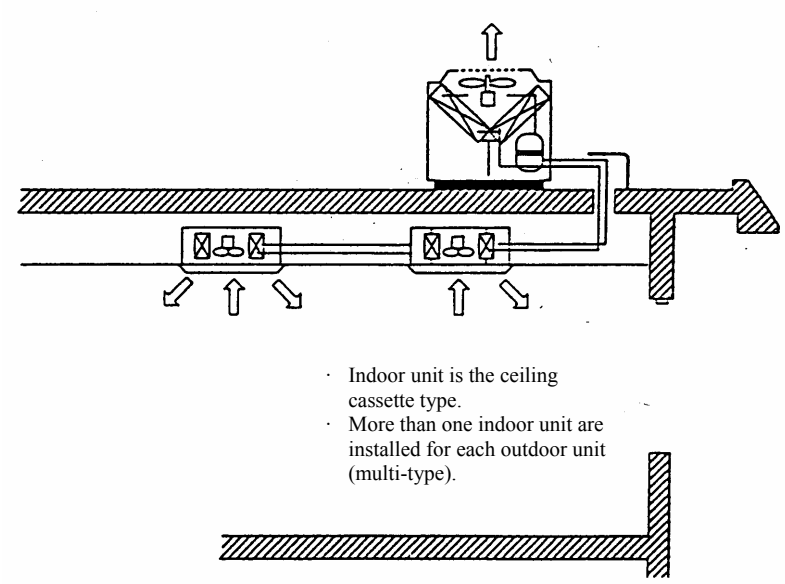
2) Wall type
   Also called "Through" or "Through-the-wall".
   Though similar to the window type basically, wall type is mounted on the floor, and the wall is perforated.
   · Small capacity because unit is mounted in each room
   · Specially ordered items normally to be installed in hotel, office, etc.



3) Split type (separate type)

- Split type is divided into the indoor unit containing heat exchanger and blower and outdoor unit containing compressor, heat exchanger and blower.
- Split type finds various applications in housing and building because it can be installed at various places flexibly, scale being small to large. Multi-type, above all, is the type having more than one indoor unit, in which each indoor unit can be controlled individually.





Separate type has many merits including light weight with lower noises and the flexible design conforming to the room size and installing space, because it has no compressor in the room. Most of the domestic air conditioners for household use and business use are the products of this type at this moment.

4) Single package type

(a) Water-cooling one-block type
Type of radiating heat outside via cool water, used in buildings like office in scales medium to large. Number of used units tends to decrease because of the necessities of maintenance of cooling water and of heating source.

(b) Air-cooling one-block type
(Example of roof-top type)
Accounts for smaller percentage because there are few flat buildings in Japan, but is used mainly in buildings like large store and office.

5) Remote condenser type
Remote condenser type is designed for outside use by replacing the heat exchanger with water in the water-cooling one-block type with an outdoor heat exchanger.
Capacity and application are almost similar to the water-cooling one-block type.

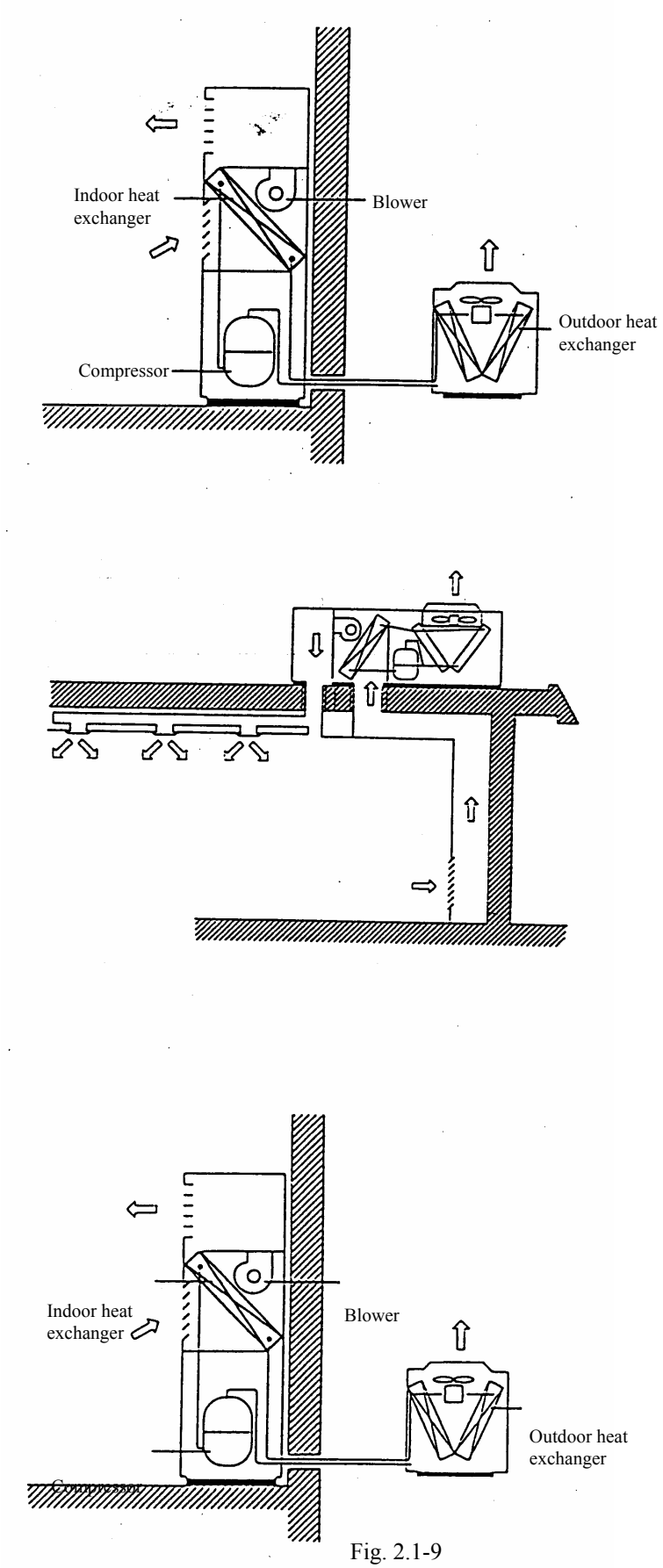
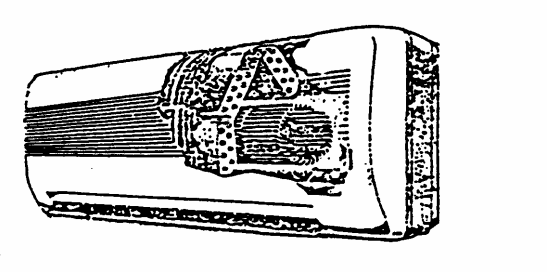


Fig. 2.1-9

(Attachment 3)

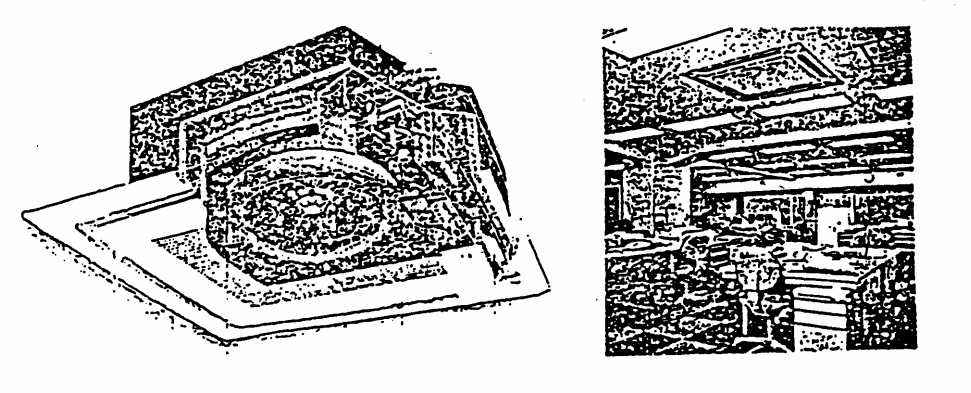
Categories by separate type indoor unit

1) Wall-hung type

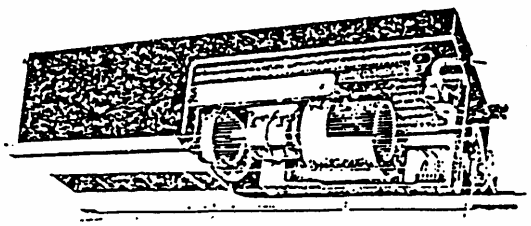


2) Cassette type

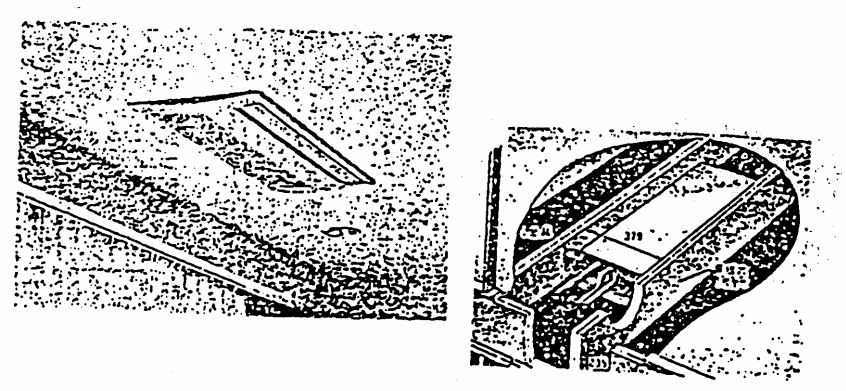
(i) 4-way cassette type



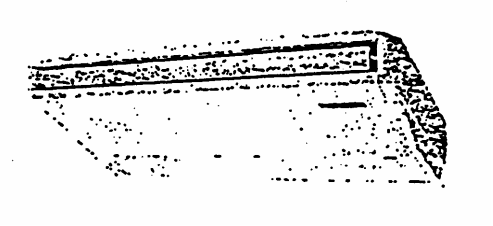
(ii) 2-way cassette type



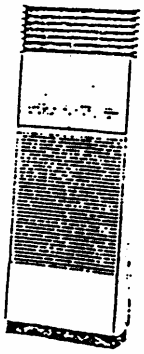
(iii) 1-way cassette type



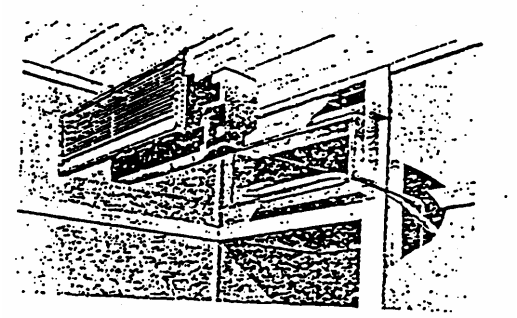
3) Ceiling-hung type



4) Floor type

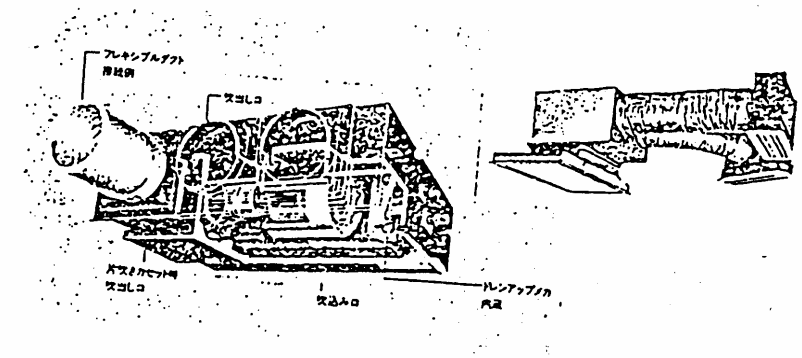


5) Wall-buried type

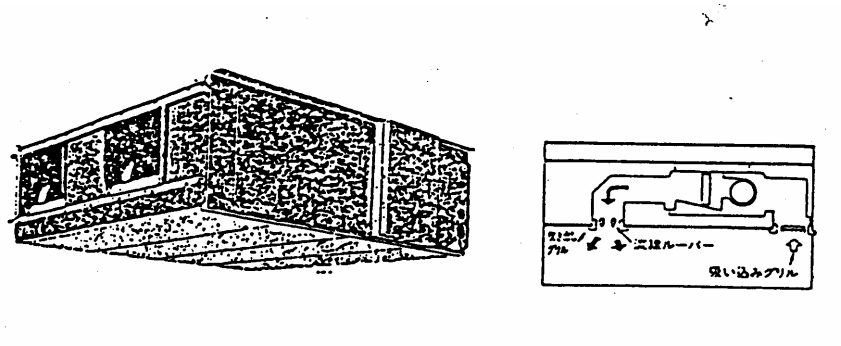


6) Duct type

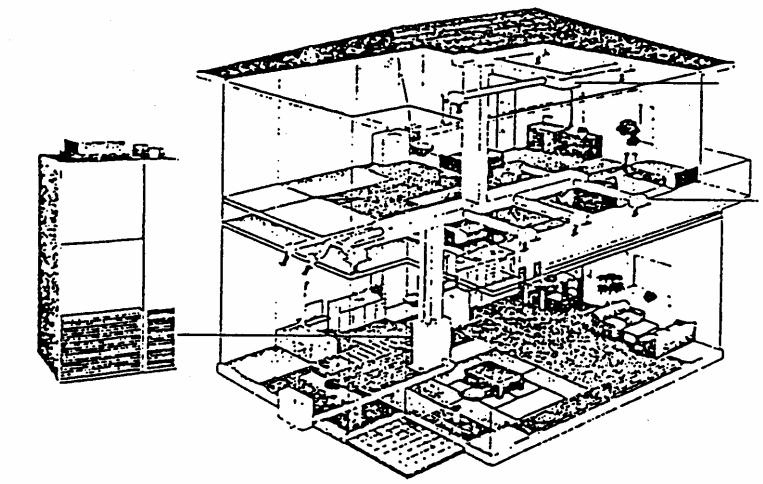
(i) Ceiling built-in type



(ii) Ceiling-concealed type



(iii) Duct system for highly air-tight/heat-insulating housing



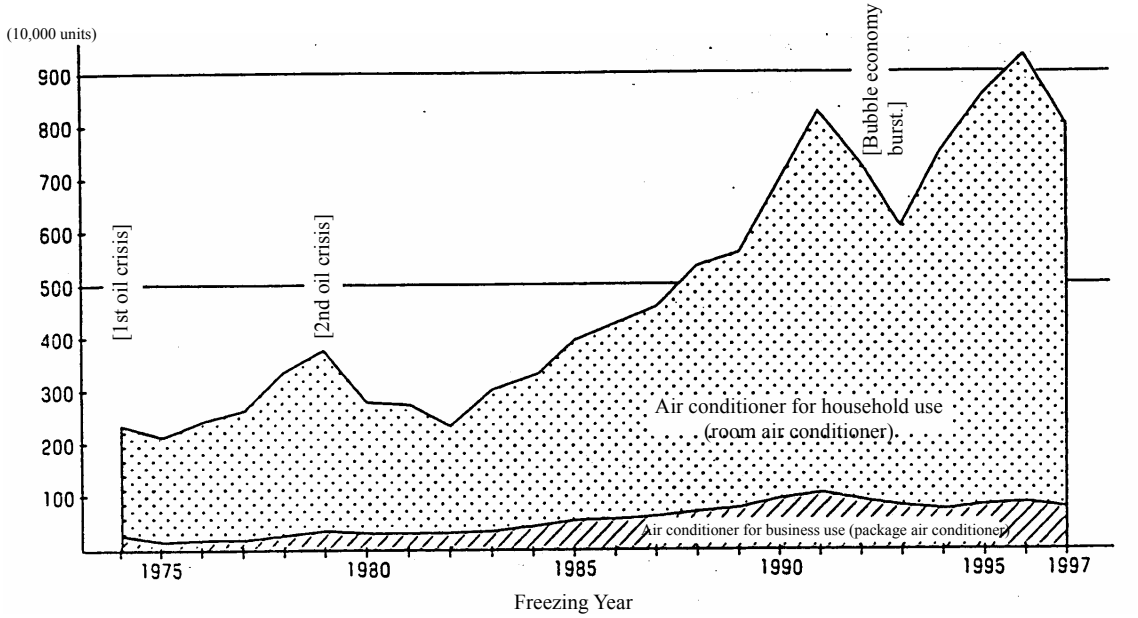
II. Domestic Delivery

1. Changes in Domestic Delivery

This section introduces the domestic delivery based on the periodical research paper issued by Japan Refrigeration and Air Conditioning Industry Association.

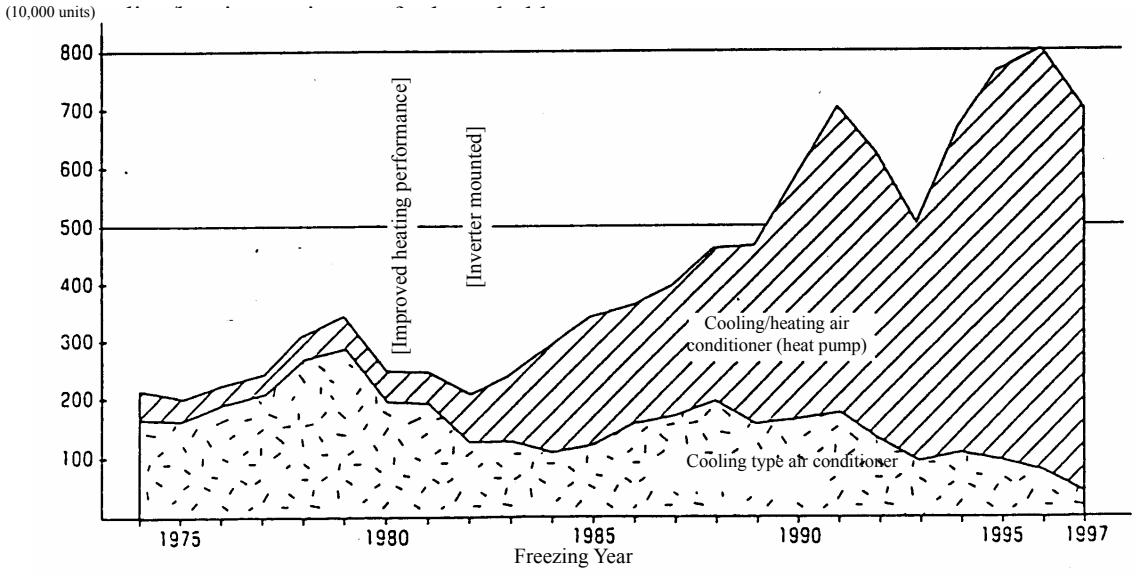
(1) General

Both air conditioners for household use and business use continue to increase popularity steadily as the equipments to maintain the comfortable housing/business environment even through the increasing/decreasing stages under the effects by cool summer or burning hot summer, or associated with changes in economy.



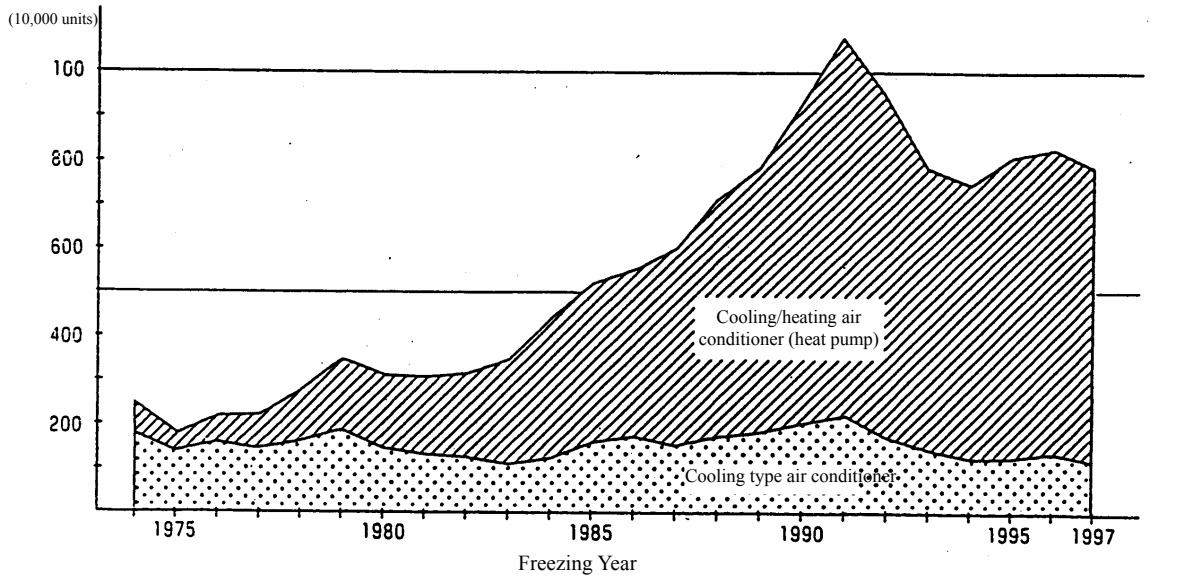
(2) Air conditioner for household use

Though the air conditioners for household use were for cooling only initially, the cooling/heating type was rapidly popularized as the heating performance by inverter improved since the beginning of the 1980s, and came to play the main role as the



(3) Air conditioners for business use

In the air conditioners for business use, the initial cooling-only type was replaced with heat pump rather early, and the shift to heat pump continues steadily still now.



Domestic delivery of air conditioners for household use and business use
(Freezing Years 1974 - 1996)

Unit: 1,000 units

Freezing Year	Household use (room air conditioner)			Business use (package air conditioner)		
	Total	Cooling type	Heat pump	Total	Cooling type	Heat pump
1974	2,091	1,597	494	251	-	-
1975	1,980	1,633	347	175	140	35
1976	2,222	1,879	343	221	160	61
1977	2,443	2,082	361	229	152	77
1978	3,116	2,709	407	280	167	113
1979	3,411	2,871	540	350	191	159
1980	2,462	1,948	514	312	147	170
1981	2,434	1,881	553	307	134	173
1982	2,021	1,253	768	316	126	190
1983	2,427	1,268	1,159	350	118	232
1984	2,877	1,073	1,804	440	132	309
1985	3,409	1,239	2,170	523	150	373
1986	3,673	1,559	2,113	557	153	404
1987	3,982	1,744	2,238	600	156	444
1988	4,605	1,910	2,695	707	171	536
1989	4,736	1,570	3,164	786	186	600
1990	5,932	1,689	4,243	930	205	725
1991	7,092	1,750	5,343	1,081	222	859
1992	6,249	1,337	4,912	928	181	747
1993	5,048	868	4,180	785	140	645
1994	6,724	1,120	5,604	745	131	614
1995	7,697	934	6,763	805	143	662
1996	8,116	761	7,356	830	138	692
1997	7,154	428	6,724	786	122	664

2. Delivery per Capacity and Form

Detail results of the survey per capacity and form carried out this time are outlined. The delivery by manufacturers was mainly surveyed, and the air conditioners for household use and business use as well as multi-type of max rated cooling capacity 28 kW were included. Types mentioned for special uses in government and ministry ordinance were excluded.

(1) Delivery per cooling capacity

Delivery per rated cooling capacity is as shown below.

Delivery per cooling capacity in 1997 Freezing Year

(Unit: 1,000 units)

Cooling capacity (kW)	Cooling/ heating type	Cooling type	Total
- 1.6	0	86.4	86.4
- 1.8	28.6	35.9	64.5
- 2.0	18.7	113.2	131.9
- 2.2	2,246.3	2.0	2,248.3
- 2.5	1,913.6	60.7	1,974.3
- 2.8	1,560.4	31.2	1,591.5
- 3.2	204.6	16.3	220.9
- 3.6	1.9	2.2	4.1
- 4.0	543.3	23.3	566.7
- 4.5	42.0	3.3	45.3
- 5.0	127.2	13.9	141.1
- 5.6	68.8	5.8	74.6
- 6.3	39.9	4.0	43.8
- 7.1	50.4	3.9	54.3
- 8.0	82.1	13.4	95.4
- 9.0	24.5	0.2	24.7
- 10.0	13.2	0.4	13.6
- 11.2	62.9	11.7	74.6
- 12.5	11.2	0	11.2
- 14.0	74.9	12.3	87.2
- 16.0	45.4	5.9	51.4
- 18.0	3.4	0	3.4
- 20.0	7.3	1.1	8.5
- 22.4	30.4	2.1	32.5
- 25.0	0	0	0
- 28.0	47.8	3.0	50.8
Total	7,248.8	452.2	7,701.0

(2) Delivery per unit form

Delivery per unit form is as shown below.

Delivery per unit form in 1997 Freezing Year

(Unit: 1,000 units)

	Cooling/heating type	Cooling type	Total
1. Direct-blowoff/window/wall type	29.8	122.1	151.8
2.1 Direct-blowoff/separate wall-hung type	6,469.7	265.5	6,735.2
2.2 Direct-blowoff/separate/4-way cassette	232.0	31.2	263.1
2.3 Direct-blowoff/separate/1- and 2-way cassette	122.5	0.6	123.1
2.4 Direct-blowoff/separate/ceiling-hung type	121.7	20.9	142.6
2.5 Direct-blowoff/floor type	70.7	7.2	77.9
2.6 Direct-blowoff/others	24.5	0.3	24.7
3. Duct type	31.6	2.7	34.3
4. Multi-type	146.4	1.9	148.2
	7,248.8	452.2	7,701.0

(3) Matrix per capacity/form

Details of above items (1) and (2) are shown in Page 46. Here, the mark (*) means that the data is not disclosed possibly because only one manufacturer supplies the item.

3. Number of Models per Capacity and Form

On the matrix per capacity and form similar to item 2, the results of surveying the models by Jun. 1998 are shown in Page 48.

1998 Freezing Year: Number of models per capacity and form

Rated cooling capacity (kW)

	-1.6	-1.8	-2.0	-2.2	-2.5	-2.8	-3.2	-3.6	-4.0	-4.5	-5.0	-5.6	-6.3	-7.1	-8.0	-9.0	-10.0	-11.2	-12.5	-14.0	-16.0	-18.0	-20.0	-22.4	-25.0	-28.0
1. Cooling/heating type																										
1.1 Direct-blowoff type/window type/wall type		9			4	1	2	2																		
1.2.1 Direct-blowoff type/separate/wall-hung type			1	114	134	175	68		137	57	96	63	35	27	40	26	19	29	10	11	14			15		2
1.2.2 Direct-blowoff type/separate/cassette type [4-way]									50	57	68	72	47	32	54	45	34	57	40	54	53	10	2	41		41
1.2.3 Direct-blowoff type/separate//cassette type [1-way/2-way]				3	4	16	19		58	42	69	66	40	31	55	37	20	46	25	46	56	8		40		35
1.2.4 Direct-blowoff type/separate/ceiling-hung type									41	48	55	56	39	28	53	36	30	49	33	53	51	6	4	31		34
1.2.5 Direct-blowoff type/floor type (including remote condenser type)						17	8		16	5	38	22	22	11	26	12	7	22	11	28	28		8	21	1	28
1.2.6 Direct-blowoff type/others (wall-buries type, etc.)				3	1	8	8		7		1				1					5			1			5
1.3 Duct-connected type (separate type ceiling built-in/floor type, roof-top, etc.)		1			1	8	9		37	10	24	27	25	24	26	18	11	37	16	42	35	2	12	22	4	34
1.4 Multi-type								2	16	20	18	29	5	17	24	3	3	24	2	35	30			34		32
2. Cooling type																										
2.1 Direct-blowoff type/window type/wall type	12	12			1				1		2															
2.2.1 Direct-blowoff type/separate/wall-hung type		2	16	3	17	13	15	2	38	20	38	20	12	9	15		1	12		4	4			4		
2.2.2 Direct-blowoff type/separate/cassette type [4-way]									20	14	23	18	14	11	13	1	2	19		18	15		1	11		13
2.2.3 Direct-blowoff type/separate/cassette type [1-way/2-way]									2		6		3		4	1		1		1	2					
2.2.4 Direct-blowoff type/separate/ceiling-hung type									15	12	19	12	12	7	15	1	2	18		17	15		1	12		9
2.2.5 Direct-blowoff type/floor type (including remote condenser type)											12	7	5	4	13	1	1	10		14	6		6	4	1	9
2.2.6 Direct-blowoff type/others (wall-buried type, etc.)															1					1			2			2
2.3 Duct-connected type (separate type ceiling built-in/floor type, roof-top, etc.)									1		8		5		7	2		7		13	3		6	4	2	10
2.4 Multi-type							1		1											1	2			3		3

1997 Freezing Year: Delivery per capacity and form

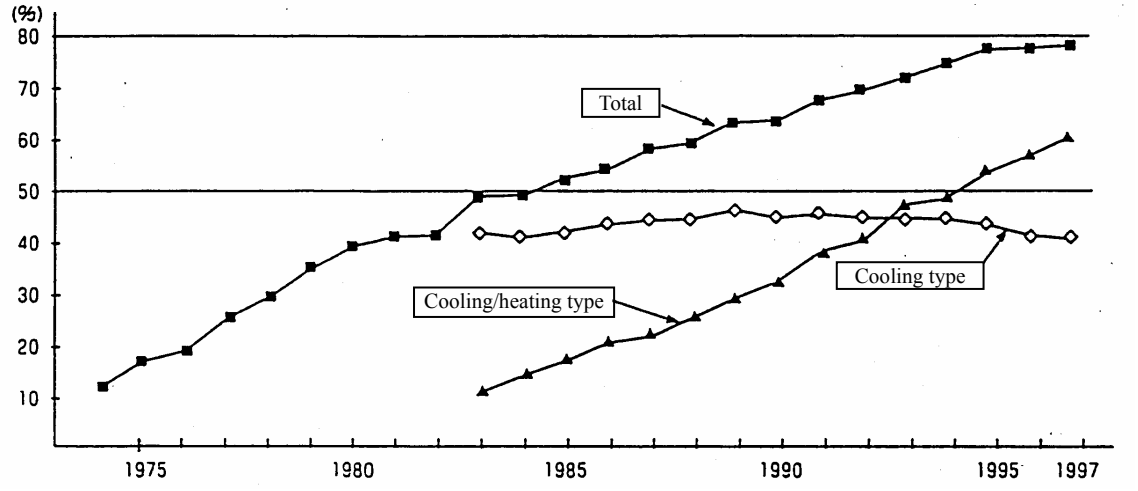
(Unit: 1,000 units)

Rated cooling capacity (kW)	-1.6	-1.8	-2.0	-2.2	-2.5	-2.8	-3.2	-3.6	-4.0	-4.5	-5.0	-5.6	-6.3	-7.1	-8.0	-9.0	-10.0	-11.2	-12.5	-14.0	-16.0	-18.0	-20.0	-22.4	-25.0	-28.0
1. Cooling/heating type																										
1.1 Direct-blowoff type/window type/wall type	-	28.6	(*)	-	0.6	(*)	(*)	(*)	-	-	-															
1.2.1 Direct-blowoff type/separate/wall-hung type	-	(*)	18.7	2,245.4	1908.3	1,501.6	185.0	(*)	473.4	12.0	76.9	13.9	7.4	4.8	11.8	1.7	0.8	5.4	0.2	0.5	0.6	-	-	0.9	-	(*)
1.2.2 Direct-blowoff type/separate/cassette type [4-way]	-	-	-	-	-	-	-	(*)	10.9	6.4	15.0	17.5	10.2	13.9	28.7	12.7	6.2	27.1	6.2	33.8	18.1	(*)	-	9.5	-	13.0
1.2.3 Direct-blowoff type/separate//cassette type [1-way/2-way]	-	-	-	(*)	(*)	28.5	12.7	-	30.1	3.0	15.0	6.0	3.1	3.1	5.9	1.6	0.5	2.8	0.3	3.1	1.3	(*)	-	0.8	-	0.9
1.2.4 Direct-blowoff type/separate/ceiling-hung type	-	-	-	-	-	-	-	(*)	3.6	2.9	6.6	6.7	5.5	6.0	17.6	5.7	4.2	15.7	3.7	17.2	12.5	(*)	2.6	4.3	-	6.3
1.2.5 Direct-blowoff type/floor type (including remote condenser type)	-	-	-	-	(*)	13.1	1.8	-	7.8	0.2	4.6	1.3	1.5	0.9	6.7	1.3	0.2	5.3	0.3	9.1	4.9	-	2.4	2.6	(*)	6.2
1.2.6 Direct-blowoff type/others (wall-buries type, etc.)	-	-	-	(*)	(*)	14.2	3.5	-	3.9	-	(*)	-	-	-	(*)	-	-	-	-	(*)	-	-	(*)	-	-	(*)
1.3 Duct-connected type (separate type ceiling built-in/floor type, roof-top, etc.)	-	-	-	-	-	3.0	1.2	-	2.2	0.3	1.0	0.8	0.9	0.7	2.7	0.5	0.3	2.7	0.1	4.1	1.9	0.0	2.1	1.3	(*)	5.7
1.4 Multi-type							-	(*)	11.5	17.2	7.5	22.7	11.3	21.2	8.8	0.9	1.0	3.8	0.3	7.0	6.1	-	-	11.0	-	15.3
2. Cooling type																										
2.1 Direct-blowoff type/window type/wall type	86.4	34.1	-	-	(*)	-	-	-	(*)	-	0.5															
2.2.1 Direct-blowoff type/separate/wall-hung type	-	(*)	113.2	(*)	60.1	31.2	16.2	(*)	20.1	1.9	9.1	2.2	1.3	0.9	2.4	-	(*)	1.1	-	0.0	0.0	-	-	0.0	-	-
2.2.2 Direct-blowoff type/separate/cassette type [4-way]	-	-	-	-	-	-	-	-	1.6	0.9	2.1	2.3	1.4	1.9	5.2	(*)	(*)	5.4	-	6.0	2.8	-	-	0.8	-	0.5
2.2.3 Direct-blowoff type/separate/cassette type [1-way/2-way]	-	-	-	-	-	-	-	-	(*)	-	(*)	-	(*)	-	(*)	-	-	(*)	-	(*)	(*)	-	-	(*)	-	(*)
2.2.4 Direct-blowoff type/separate/ceiling-hung type	-	-	-	-	-	-	-	-	0.7	0.5	1.4	1.1	1.0	1.0	4.0	(*)	(*)	4.0	-	3.7	2.3	-	(*)	0.4	-	0.3
2.2.5 Direct-blowoff type/floor type (including remote condenser type)	-	-	-	-	-	-	-	-	(*)	(*)	0.3	0.2	0.2	0.1	1.3	(*)	(*)	0.9	-	1.9	0.5	-	0.4	0.3	(*)	1.0
2.2.6 Direct-blowoff type/others (wall-buried type, etc.)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(*)	-	-	-	-	(*)	-	-	(*)	-	-	(*)
2.3 Duct-connected type (separate type ceiling built-in/floor type, roof-top, etc.)	-	-	-	-	-	-	-	-	(*)	-	0.4	-	0.1	-	0.2	-	-	0.3	-	0.6	(*)	-	0.4	(*)	(*)	0.6
2.4 Multi-type							(*)	-	(*)	-	-	-	-	-	-	-	-	-	-	(*)	(*)	-	-	0.4	-	0.6

4. Distribution

Common household having air conditioners reaches 80% or so of all. The cooling/heating type air conditioner increases rapidly, while the cooling type starts to decrease.

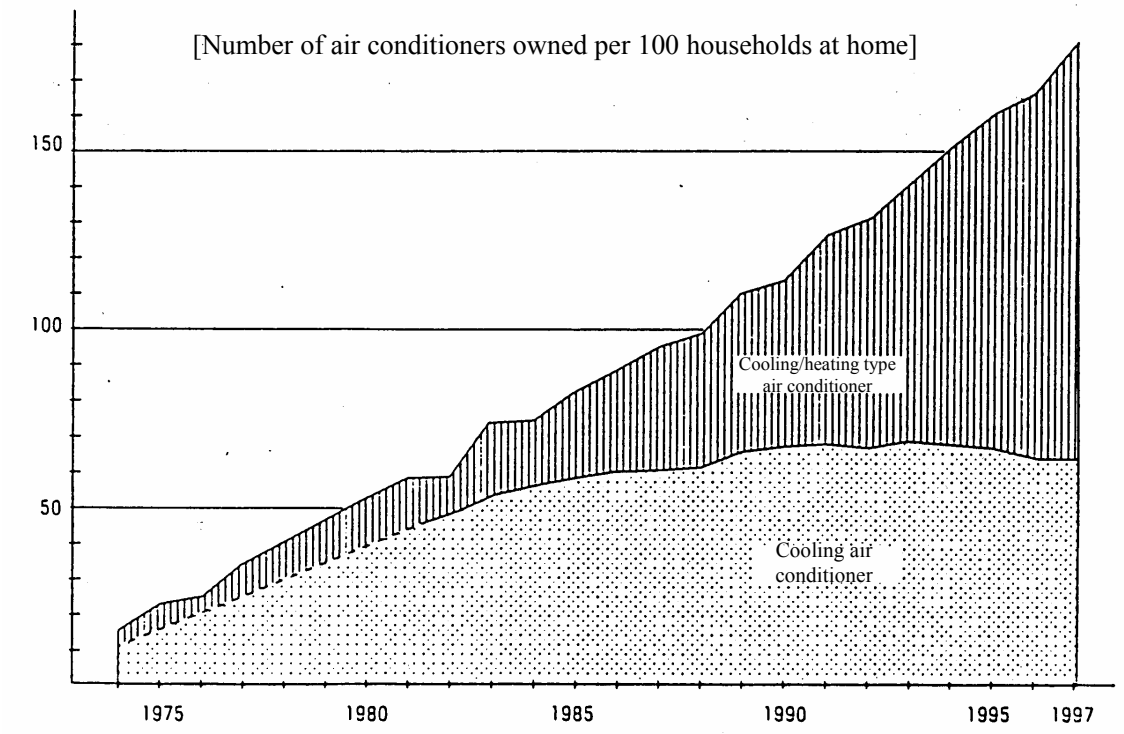
[Distribution rate of air conditioners at home]



Economic Planning Agency "Consumer's Behavior Survey"

Number of units owned per 100 households expands rapidly mainly in the cooling/heating type air conditioner, finally reaching 180 units. Number of units per household reaches average 2.3 units or so.

[Number of air conditioners owned per 100 households at home]



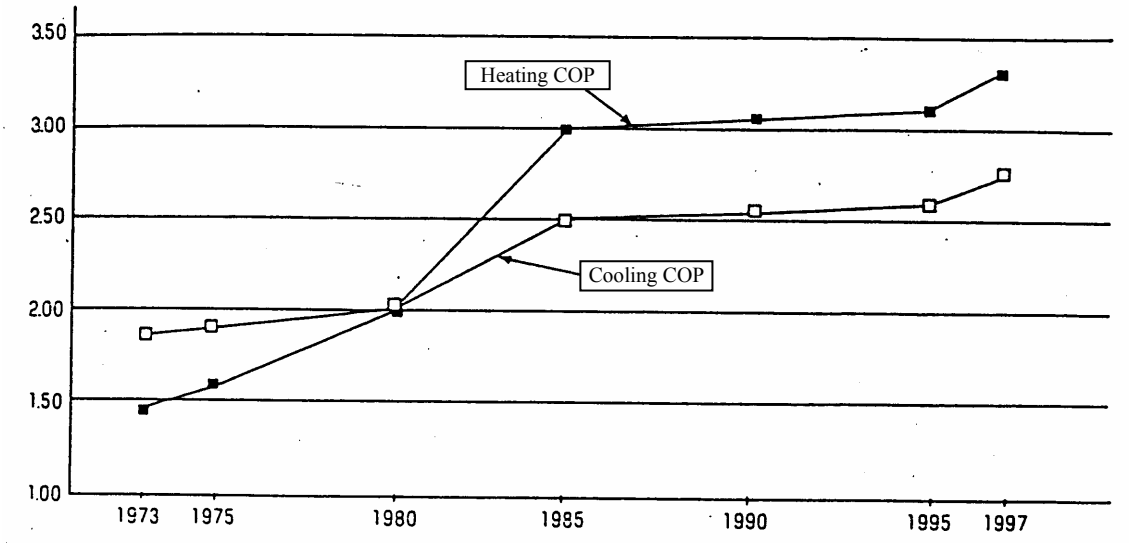
Economic Planning Agency "Consumer's Behavior Survey"

III. Changes in Efficiency of Energy Consumption

/ Efficiency of energy consumption in air conditioners is shown by the value "COP" given by dividing the cooling or heating capacity by each power consumption. This means how effective cooling or heating can be in power consumption 1 W.

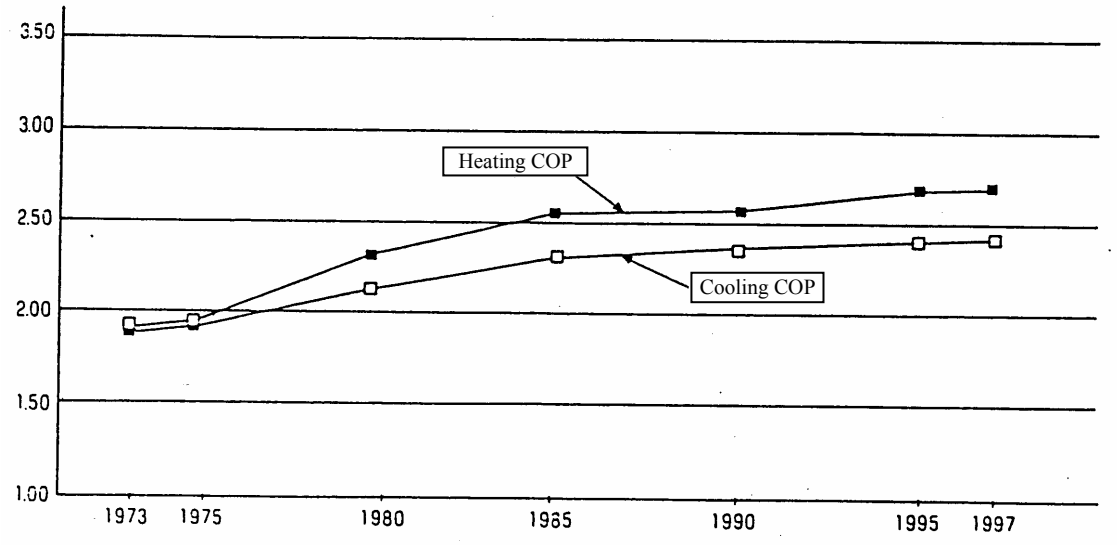
/ Cooling/heating air conditioner has two aspects such as cooling COP and heating COP.

COP changes in household air conditioners
(cooling/heating type)



Japan Refrigeration and Air Conditioning Industry Association

COP changes in business air conditioners
(cooling/heating type)



Japan Refrigeration and Air Conditioning Industry Association

Item 6295 containing the U. S. energy saving standard sets down the energy saving standard as the federal government, which is applied to products. The standard related to air conditioners is set down as shown below, and the value of cooling capacity divided by power consumption is specified as a rule.

(A) Standard for room air conditioner (window type)

(1) The energy efficiency ratio of room air conditioners manufactured since 1 Jan. 1990 must not be the following values or less.

Product type

·With both-side suction and without turnaround cycle

6,000 Btu or less	8.0 Btu/Wh
6,000 – 7,999 Btu	8.5 Btu/Wh
8,000 – 13,999 Btu	9.0 Btu/Wh
14,000 – 19,999 Btu	8.8 Btu/Wh
20,000 Btu or more	8.2 Btu/Wh

·Without both-side suction and without turnaround cycle

6,000 Btu or less	8.0 Btu/Wh
6,000 – 7,999 Btu	8.5 Btu/Wh
8,000 – 13,999 Btu	8.5 Btu/Wh
14,000 – 19,999 Btu	8.5 Btu/Wh
20,000 Btu or more	8.2 Btu/Wh

·With both-side suction and with turnaround cycle	8.5 Btu/Wh
·Without both-side suction and with turnaround cycle	8.0 Btu/Wh

(B) Standard for central air conditioner and heat pump

(1) Seasonal energy efficiency ratio for central air conditioner and heat pump must not be the following values or less.

·Split system	
(products manufactured since 1 Jan. 1992)	10.0 Btu/Wh
·Single package system	
(products manufactured since 1 Jan. 1993)	9.7 Btu/Wh

(2) Heating seasonal performance factor for central air conditioner and heat pump must not be the following values or less.

·Split system	
(products manufactured since 1 Jan. 1992)	6.8 Btu/Wh
·Single package system	
(products manufactured since 1 Jan. 1993)	6.8 Btu/Wh

(Note) Btu/hW is a British unit of calorie, and converted as shown below.

	(Conventional unit)	(SI unit)
·8.0 Btu/Wh	2.02 kcal/Wh	2.34 (kW/kW)
·10.0 Btu/Wh	2.52 kcal/Wh	2.93 (kW/kW)
·6.8 Btu/Wh	1.71 kcal/Wh	1.99 (kW/kW)

Reference

Law related to rationalization of energy use
Currently applicable government/ministry ordinances (excerpts)

(Special equipment & devices)

Government Ordinance Article 7　Equipment and devices specified in the Government Ordinance Article 18, Item 1 are as shown below.

1. Passenger car (Limited to the type if it uses volatile oil for fuel, with 10 or less passengers, and if the type is specified in Article 75 Item 1 of Road Transport Vehicle Law (Law No. 185, 1951) and excluding 2-wheel type (including type with side cars) and caterpillar track)
2. Air conditioner (Including types capable of heating and excluding those of cooling capacity of 27 kilo watt or more, water-cooling type or others which are specified in the Ministry of International Trade and Industry Ordinances)
3. Lighting equipment having fluorescent lamp alone for main light source (excluding types specified as explosion-proof or others in the Ministry of International Trade and Industry Ordinances)
4. Television receiver (Limited to the types which have cathode ray tube and are used in AC circuit and excluding types for industrial use)
5. Copier (Limited to the types which is of dry indirect electrostatic type and excluding the color copier or others specified in the Ministry of International Trade and Industry Ordinances)
6. Computer (excluding types having enhanced processing capability specified in the Ministry of International Trade and Industry Ordinances)
7. Magnetic disc unit (excluding types having memory of 200 MB or less)
8. Cargo vehicle (Limited to the types which uses volatile oil for fuel, gross vehicle weight specified 2.5 tons or less in Article 40 Item 3 of Road Transport Vehicle Law, the type of which is designated in Article 75 Item 1 of the same law and excluding 2-wheel type (including type with side cars) and caterpillar track type)
9. Video tape recorder (Limited to the types which are used in AC circuit and excluding types for industrial use or others specified in the Ministry of International Trade and Industry Ordinances)

(Exception of special equipment and devices)

Ministry Ordinance Article 12 Air conditioners specified in Article 7 Item 2 of the Ministry of International Trade and Industry Ordinances shall be as mentioned below.

1. Type without motor for compression
2. Type having energies other than electricity as heat source for heating
3. Type with the temperature control function for the purpose of air-conditioning to maintain the performance of machine or device or control the sanitation of foods/drinks or with the dust-proof performance
4. Type mainly designed to send air into room after cooling air outside
5. Spot air conditioners
6. Type designed for the transport means like vehicle
7. Type with ducts at the suction/exhaust ports of outdoor heat exchanger
8. Type connected with two or more indoor units per outdoor unit as a separate type

2. Lighting devices having fluorescent lamp alone for main light source as specified in Article 7 Item 3 of the Ministry of International Trade and Industry Ordinances shall be as mentioned below.
   1. Heat-resistant type
   2. Designed as dust-proof
   3. Anti-corrosive type
   4. Type designed for the transport means like vehicle
   5. Type using the fluorescent lamp less than 40 type (excluding handing type for household use and the fluorescent lamp tool used on the desk)
3. Copiers specified in Article 7 Item 5 of the Ministry of International Trade and Industry Ordinances shall be as mentioned below.
   1. Designed to copy forms of A2 or larger
   2. Designed to copy 86 sheets or more per minute
   3. Designed as one block with printer
   4. Designed as one block with facsimile
4. Computers specified in Article 7 Item 6 of the Ministry of International Trade and Industry Ordinances shall have a composite theoretical performance of 3,000 mega or more operations per second (shown in the lower column for the computers mentioned in the upper column of Attached Table 2).
5. Video tape recorders specified in Article 7 Item 9 of the Ministry of International Trade and Industry Ordinances shall be as mentioned below.
   1. Designed to process the electric signals related to sound and image in digital method
   2. Designed to process the electric signals related to images of 1,125 or more scanning lines
   3. Designed to process the electric signals related to images of 400 or more scanning lines in horizontal resolution, without broadcast-by-satellite receiving function
   4. Designed to have more than one driver for video tape
   5. Designed to have player function only

1)Manufacturer's criteria related to improvement of air conditioner performance

(Ministry of International Trade and Industry Announcement No. 650, 10 Dec. 1993)

Manufacturer or importer (hereinafter shown as "Manufacturer") of the air conditioners (hereinafter shown as "Air conditioner") quoted in Article 7 Item 2 of law enforcement order (Government Ordinance No. 267, 1979) related to the rationalization of energy use shall meet the following standards in the performance of the air conditioners delivered domestically in 1998 Freezing Year (from 1 Oct. 1997 to 30 Sept. 1998).

1. In the cooling/heating type air conditioner, measures shall be taken so that the values of the efficiency of cooling energy consumption and efficiency of heating energy consumption weighed and harmonic-averaged by the delivered quantities per classes mentioned to the left of Table 1 respectively may not fall below the values shown in the middle column of the same table, or that the total of the values of the efficiency of cooling energy consumption and efficiency of heating energy consumption weighed and harmonic-averaged by the delivered quantities per classes mentioned to the left of Table 1 respectively divided by 2 may not fall below the values shown to the right of the same table.
2. In the cooling type air conditioner, measures shall be taken so that the values of the efficiency of cooling energy consumption weighed and harmonic-averaged by the delivered quantities per classes mentioned to the left of Table 2 respectively may not fall below the values shown to the right of the same table, or that the values of the efficiency of cooling energy consumption of the air conditioners belonging to two classes or more mentioned to the left of the same table weighed and harmonic-averaged by the total quantities delivered may not fall below 2.93.
3. In the items 1 and 2, the efficiency of cooling energy consumption and efficiency of heating energy consumption shall be as specified in the following items (1) and (2) respectively.
   (1) Efficiency of cooling energy consumption shall be the value obtained by dividing the value shown in watt of the cooling capacity measured by the method specified for cooling capacity test in JIS B8616 or C9612 by the value shown in watt of the cooling power consumption measured by the method specified for cooling power consumption test in the same standard B8616 or C9612 (smaller one of the values calculated by the values measured in each frequency if 50 Hz and 60 Hz are shared as rated frequency).
   (2) Efficiency of heating energy consumption shall be the value obtained by dividing the value shown in watt of the heating capacity measured by the method specified for the heat pump standard heating capacity test in JIS B8616 or the standard heating capacity test in C9612 by the value shown in watt of the heating power consumption measured respectively by the method specified for heat pump standard heating power consumption test in the same standard B8616 or the standard heating power consumption test in the same standard C9612 (smaller one of the values calculated by the values measured in each frequency if 50 Hz and 60 Hz are shared as rated frequency).

Supplementary Regulations

This announcement shall be enforced on and after the date of promulgation.

Table 1 (Cooling/heating type air conditioner)

Classification	Standard efficiency of cooling energy consumption / Standard efficiency of heating energy consumption	Standard efficiency of cooling/heating average energy consumption
1. One-block type of cooling capacity of 4.0 kW or less	2.19 / 2.38	2.33
2. Separate type of cooling capacity of 4.0 kW or less	2.67 / 3.20	2.97
3. Type of cooling capacity over 4.0 kW through 7.1 kW or less	2.34 / 2.56	2.50
4. Type of cooling capacity over 7.1 kW	2.45 / 2.62	2.59

Table 2 (Cooling type air conditioner)

Classification	Standard efficiency of cooling energy consumption
1. One-block type of cooling capacity of 4.0 kW or less	2.45
2. One-block type of cooling capacity over 4.0 kW through 7.1 kW or less	2.20
3. Separate type of cooling capacity of 4.0 kW or less	3.09
4. Separate type of cooling capacity over 4.0 kW through 7.1 kW or less	2.42
5. Type of cooling capacity over 7.1 kW	2.45

2) Items to be indicated by manufacturer related to the efficiency of energy consumption for air conditioners

(Ministry of International Trade and Industry Announcement No. 356, 30 May 1994)
(Ministry of International Trade and Industry Announcement No. 6; partially revised on 9 Jan. 1995)

1. Indicated items

Manufacturer or importer (hereinafter shown as "Manufacturer") of air conditioners (hereinafter shown as "Air conditioner") shall indicate the following items for the efficiency of energy consumption of the air conditioners (excluding air conditioner in Attached Table 1 Item 3 (13) of household goods labelling law Enforcement Order (Government Ordinance No. 390, 1962); hereinafter shown as "Air conditioner") quoted in Article 7 Item 2 of the law enforcement order (Government Ordinance No. 267, 1979) related to the rationalization of energy use.

a. Product name and type
b. Cooling capacity
c. Cooling power consumption
d. Efficiency of cooling energy consumption
e. Heating capacity (limited to type capable of heating)
f. Heating power consumption (limited to type capable of heating)
g. Efficiency of heating energy consumption (limited to type capable of heating)
h. Name of manufacturer or names

2. Items to meet

(1) Cooling capacity shall be indicated as the value shown in kilo watt measured by the method specified for the cooling capacity test in each rated frequency in JIS B8616 or C9612. In this case, indicated value shall be 100/95 or less of cooling capacity.

(2) Heating capacity shall be indicated as the value shown in kilo watt measured by the method specified for the heat pump standard heating capacity test in JIS B8616 or the standard heating capacity test in the same standard C9612 in each rated frequency. In this case, indicated value shall be 100/95 or less of heating capacity.

(3) Cooling power consumption shall be indicated as the value shown in kilo watt measured by the method specified for the cooling power consumption test in each rated frequency in JIS B8616 or C9612. In this case, indicated value shall be 100/110 or more of cooling power consumption.

(4) Heating power consumption shall be indicated as the value shown in kilo watt measured by the method specified for the heat pump standard heating power consumption test in JIS B8616 or the standard heating power consumption test in the same standard C9612 in each rated frequency. In this case, indicated value shall be 100/110 or more of heating power consumption.

(5) Efficiency of energy consumption shall be indicated as the value quoted in the lower column in Attached Table 3 of law enforcement rules (Ministry of International Trade and Industry Ordinance No. 74, 1979) related to the rationalized use of energy in each rated frequency, which shall be shown to the 2nd digit after decimal point.
(Ministry of International Trade and Industry Announcement No. 6, 1995, partially revised)

(6) Items to be indicated in Item 1 shall be described in ways hard to erase, in each air conditioner, at part of the main unit of air conditioner, or in the metal or synthetic resin label firmly fixed to the part easy to see of the main unit.

Supplementary provisions

1. This announcement shall be applied on and after the date of promulgation.
2. Air conditioners so indicated as specified by Ministry of International Trade and Industry Announcement No. 192, 8 May 1980 before its abolition on 30 Sept. 1995 may be based on the conventional examples despite this announcement.

(Reference)

Japanese Industrial Standard **JIS**

Room air conditioners

C9612-1994

1. Scope of application – This standard sets down the room air conditioners (hereinafter shown as "Room air conditioner") to cool (including type used for heating), circulate air and remove dust for the purpose of comfortable air conditioning in the room, which are one-block type (containing compressive type freezer, blower, etc. in a cabinet) or separate type (containing compressive type freezer, blower, etc. in two cabinets) of rated cooling capacity of 10 kW or less and rated cooling power consumption of 3 kW or less.

2. Definition of terms – Main terms used in this standard shall be defined as shown below.

(1) Cooling capacity: Calorie that can be removed from the room in unit time when cooled by air conditioner, which is shown in kW

(2) Cooling power consumption: Total of electric power consumed by room air conditioner when cooled by air conditioner

(3) Heat pump: Freezing system for absorbing heat from air or water at low temperature by switching the refrigerant circuits in cooling operation, radiating heat into the room, then heating air to high temperature

(4) Heating capacity: Calorie that can be added to the room in unit time when heated by air conditioner, which is shown in kW. Heating capacity comprises the standard heating capacity and low-temperature heating capacity.

Remark – If only the heating by heat pump is available, it is called Heat pump heating capacity.

(5) Heating power consumption: Total of electric power consumed by room air conditioner when heated by room air conditioner. Heating power consumption comprises the standard heating power consumption and low-temperature heating power consumption.

Remark – If only the heating by heat pump is available, it is called Heat pump heating power consumption.

8. Tests

8.1 Test conditions – When ay test is carried out, the following items shall be met.

(1) Type and accuracy of instruments: The type and accuracy of the instruments used in tests shall be equivalent to or more than those shown in Table 10.

Table 10 Type and accuracy of instruments

Classification	Type	Accuracy
Thermometer	Rod thermometer	±0.1 K
	Resistance thermometer	±0.1 K
	Thermoelectric thermometer	±1.0 K
Dew point meter	-	±0.5 K
Air pressure gauge	Manometer	Picot tube dynamic pressure and nozzle, office output pressure ±2.0%
		Duct static pressure ±2.45 Pa
Electrical instrument	Indicator type	±0.5%
	Accumulation type	±1.0%

(2) Temperature conditions shall be as in Table 11. The outdoor unit of separated and water-cooling types shall be so installed that the temperature conditions for outdoor unit may be those for the air-cooling type in the outdoor side condition.
(3) Allowable differences in the temperature and humidity in the cooling capacity and heating capacity tests for air-cooling type under the temperature conditions in Table 11 shall be as shown in Tables 12 and 13.

Table 11 Temperature conditions

Unit: °C

Test conditions			Indoor side air condition		Outdoor side condition			
					Air-cooling		Water-cooling	
			Dry-bulb temperature	Wet-bulb temperature	Dry-bulb temperature	Wet-bulb temperature	Inlet water temperature	Outlet water temperature
Cooling	Capacity		27	19	35	24(4)	30±0.3	35±0.3
	Overload		32±1.0	23±0.5	43±1.0	26±0.5 (4)	34±0.5	-
	Frozen		21±1.0	15±0.5	21±1.0	15±0.5 (4)	-	21±0.5
	Condensation		27±1.0	24±0.5	27±1.0	24±0.5 (4)	-	27±0.5
Heating	Capacity	Standard	20	-	7	6	15±0.3	-
		Low temperature		15 or less(3)	2	1	-	-
	Overload		27±1.0	-	21±1.0	15±0.5	21±0.5	-
	Defrost		20±1.0	15 or less(3)	2±1.0	1±0.5	-	-

Notes(3) Applicable to type in which the wet-bulb temperature affects the heat exchange in the indoor side
(4) Applicable to type in which the wet-bulb temperature affects the heat exchange in the outdoor side (type of using the latent heat of water, etc. for heat source for outdoor side heat exchanger)

Table 12 Allowable differences in cooling capacity test and standard heating capacity test

Unit: K

Item	Indoor side air condition		Outdoor side condition	
	Dry-bulb temperature	Wet-bulb temperature(5)	Dry-bulb temperature	Wet-bulb temperature
Max deviation width	±1.0	±0.5	±1.0	±0.5
Average deviation width	±0.3	±0.2	±0.3	±0.2

Note (5) Not applicable to standard heating capacity test

Table 13 Allowable differences in low-temperature heating capacity test

Unit: K

Item	Indoor side air condition		Outdoor side condition			
	Dry-bulb temperature		Dry-bulb temperature		Wet-bulb temperature	
	Heating	Defrost	Heating	Defrost	Heating	Defrost
Max deviation width	±2.0	±2.5	±2.0	±5.0	±1.0	±2.5
Average deviation width	±0.5	±1.5	±0.5	±1.5	±0.3	±1.0

Remark: "Defrost" means the duration of defrost operation and 5 minutes following its completion.

(4) In the separate type, the length of tube connecting the indoor unit with outdoor unit shall be 5±0.3 m, and the indoor unit, outdoor unit and tubes shall be installed in a way that the capacities may be maximized. If, however, any specific lengths of tube less than 5 m is specified, the max size shall be applied.
(5) Excluding the load changes in start or stop, the change in power voltage shall be ±2% of the rated voltage, and the change in frequency shall be ±1% of the rated frequency.

(6) Temperatures shall be measured by bar thermometer, resistance thermometer or thermoelectric thermometer.
In the cooling capacity test or heating capacity test, the temperatures of indoor or outdoor air condition shall be measured by bar thermometer or resistance thermometer.
(7) Ambient temperatures shall be measured at places not affected directly by heat source or room air conditioner.

8.4 Cooling capacity test – In the cooling capacity test, install room air conditioner based on Attachment 1, set the operating switch, exhaust door, ventilating door and wind direction grille (hereinafter shown as "Operating switch") of room air conditioner in a way that the cooling capacity may be maximized, operate under the conditions for cooling capacity test shown in Table 11 at the rated voltage and frequency, then calculate the cooling capacity by the measurement method and calculation formula specified in Attachment 1.

8.5 Cooling power consumption test – In the cooling power consumption test, the electric power and current consumed by room air conditioner are measured when the measured values of cooling capacity stabilize in the test in 8.4. If two types or more of power supply are provided, measure values in each power supply. For the three-phase room air conditioner, power factor shall be calculated.

8.6 Heating capacity test

8.6.1 Standard heating capacity test – In the standard heating capacity test, install the room air conditioner based on Attachment 1, set the operating switch, etc. in a way that the heating capacity may be maximized, operate under the conditions for heating capacity test shown in Table 11 at the rated voltage and frequency, then calculate the standard heating capacity by the measurement method and calculation formula specified in Attachment 1. If, however, any auxiliary electric heater is provided and if such an auxiliary electric heater cannot be operated under the conditions for standard heating capacity test specified in Table 11 because of temperature switch, etc., measurement shall be carried out under the conditions closest to those for standard heating capacity test in Table 11, which allow the auxiliary electric heater to be operated.

8.6.2 Low-temperature heating capacity test – In the low-temperature heating capacity test, install the air-cooling room air conditioner in the test room of indirect method shown in Attachment 1, set the operating switch, etc. in a way that the heating capacity may be maximized, continue to operate for 1 hour or more under the conditions for low-temperature heating capacity test shown in Table 11 at the rated voltage and frequency, and then calculate the heating capacity by the measurement method and calculation formula specified the indirect method in Attachment 1 under the conditions in either of the following items.

Measurement interval of heating capacity shall be within 10 sec in the case of (1) and within 10 min in the case of (2), and the value of heating capacity shall be converted to equivalent value per hour.

(1) Measure 3 defrost-cycles continuously. If 1 defrost cycle exceeds 3 hours, however, measure 1 defrost cycle.
(2) If defrost function is not provided, measure for 6 hours.

Remark: 1 defrost-cycle shall be from the moment of starting the heating operation till the moment of starting the next heating operation after stopping defrosting.

8.7 Heating power consumption test

8.7.1 Standard heating power consumption test – In the standard heating consumption test, the electric power and current consumed by room air conditioner are measured when the measured values of standard heating capacity stabilize in the test in 8.6.1. If two types or more of power supply are provided, measure values in each power supply.

For the three-phase room air conditioner, power factor shall be calculated.

8.7.2 Low-temperature heating power consumption test – In the low-temperature heating power consumption test, the electric power consumed by room air conditioner is measured when measuring the low-temperature heating capacity in the test in 8.6.2.

If two types or more of power supply are provided, measure values in each power supply.

(2) Scope of application – This attachment sets down the cooling and heat pump heating capacity measurement methods for room air conditioners.

2. Types of measurement method – Cooling capacity and heat pump heating capacity measurement method comprises the followings.

(2) Direct method: Method of calculating the capacity by measuring the heat input by balancing the cooling and dehumidifying capacities in the indoor side of sample in cooling with the heat input of measuring system or balancing the heating capacity in the indoor side of sample in heating with the heat input of measuring system

(2) Indirect method: Method of calculating the capacity by measuring the suction and blow-out air temperatures, and the air volume at the time in the indoor side of sample

Remark: Measuring system by the indirect method in (2) shall be calibrated by the measuring system by (1) Direct method.

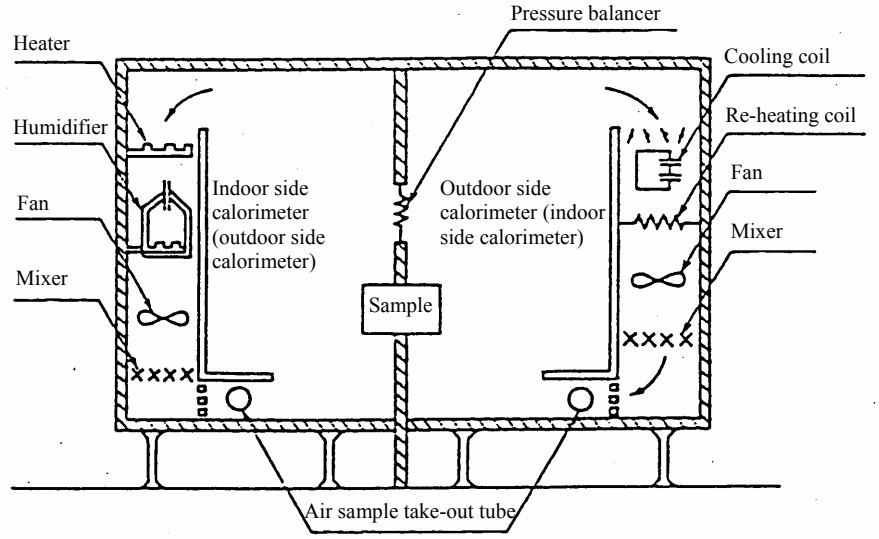
3. Measurement of calorie

3.1 Direct method

3.1.1 Measuring system – Measuring system by the direct method shall be either of the followings.

(2) Room type calorie measuring system (Fig. 1 in Attachment 1)

Fig. 1 in Attachment 1 Room type calorie measuring system



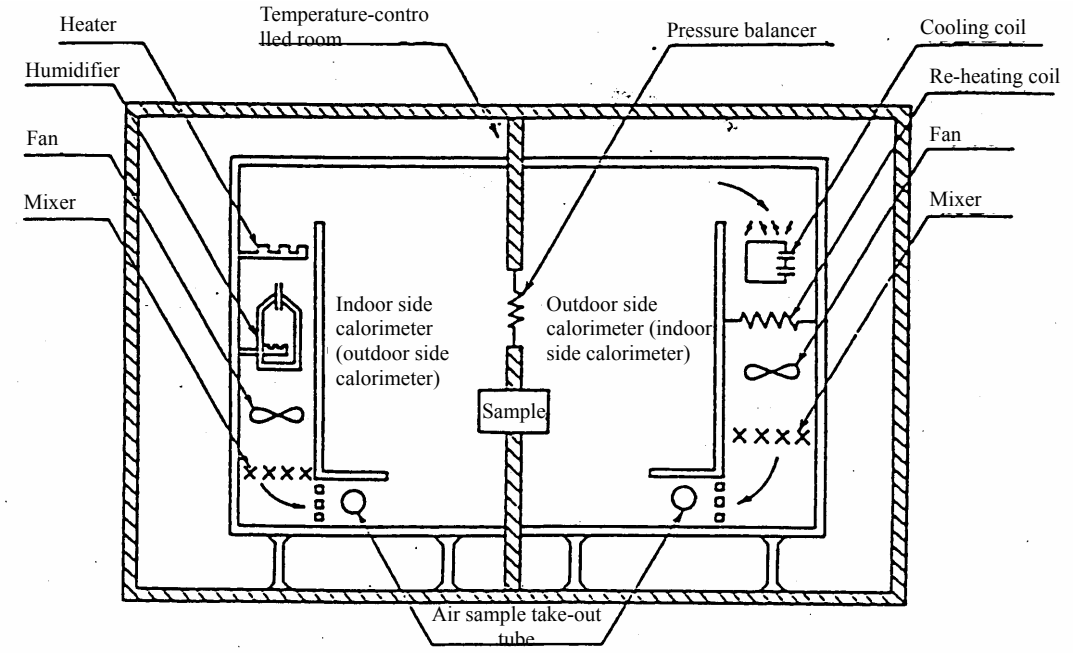
Remark: ( ) means the case of measuring heat pump heating capacity.

(2) Balance type & room type calorie measuring system (Fig. 2 in Attachment 1)

Remark: Room air conditioner shall be installed in normal way, and must not be modified or connected in any special way.

Size of calorimeter shall be increased to reduce resistance as far as possible when room air conditioner takes in or blows out the air. Air conditioning equipment shall have a porous plate or appropriate grille at the outlet to maintain the discharge air of 0.5 m/s or more, and appropriate spaces shall be provided in front of the grilles at inlet and outlet so that air flow may not be interfered.

Fig. 2 in Attachment 1 Balance type & room type calorie measuring system



Remarks: ( ) means the case of measuring heat pump heating capacity

3.1.2 Measurement method – Measurement methods are as shown below.

(1) Cooling capacity and heat pump heating capacity shall be determined from the tests in the indoor side. However, the cooling capacity and heat pump heating capacity from outdoor side shall be calculated, and such values shall conform to the values obtained from the tests in indoor side within 4%.

(2) By installing the sample in the calorimeter, operate under the conditions in Table 11 at the rated frequency and voltage, continue such an operation for 1 hour or more after reaching the state of balance, and then measure in each 5 min 7 times in all.

(Reference)

Japanese Industrial Standard **JIS**

Package air conditioners

B8616-1993

1. Scope of application – This standard sets down the one-block type (containing electric compressor, blower, etc. in a cabinet) or separate type (containing electric compressor, blower, etc. in two or more cabinets) of the air conditioner (hereinafter shown as "Package air conditioner") for business use for comfortable air conditioning in the room which cools by air circulation (including type co-used for heating), and which has the rated cooling power consumption over 3 kW and rated cooling capacity of 28 kW or less.
However, the followings are excluded.

(1) Temperature conditions of suction air, etc. are specified in special ways ([1]).
(2) Designed mainly for the air conditioning for machine/equipment or foods
(3) Designed mainly for the air conditioning by introducing only outside air into room
(4) Designed mainly to supply cool air to specified workers in a specified partition at plant or work place
(5) Designed mainly for the air conditioning in the vehicle
(6) Designed for any other special use conforming to those mentioned in items (1) - (5)
Note ([1]) Package air conditioner for computer, All Fresh type (オールフレッシュ形), etc.

2. Definition of terms – Terms used in this standard are defined as shown below.

(1) Rated cooling capacity: Calorie, which is removed by package air conditioner from room under the conditions for cooling capacity test specified in 4.1 (2) of Attachment 1,shown in kW on main unit
(2) Rated cooling power consumption: Total of electric power, which is consumed by package air conditioner under the conditions for cooling capacity test specified in 4.1 (2) of Attachment 1, shown on main unit
(3) Rated heat pump heating capacity: Calorie (excluding calorie by auxiliary electric heater for heating), which is added by package air conditioner to air in the room under the conditions for heat pump heating capacity test specified in 4.1 (2) of Attachment 1, shown in kW on main unit
(4) Rated heat pump heating power consumption: Total of electric power (excluding power consumption by auxiliary electric heater for heating), which is consumed by package air conditioner under the conditions for heat pump heating capacity test specified in 4.1 (2) of Attachment 1, show on main unit

Attachment 1 General test methods

1. Scope of application – This attachment sets down the performance test methods for the package air conditioners specified in the main body of standard.

4. Tests

4.1 General conditions – Unless specified otherwise, tests shall be carried out under the following conditions specified in (2) by using the following measuring instruments specified in (1).

(1) Type & accuracy of measuring instruments – Measuring instruments used in the tests shall be of the type and accuracy equivalent to or more than those specified in Attachment 1 Table 1.

Attachment 1 Table 1 Type & accuracy of measuring instruments

Classification	Type	Accuracy
Thermometer	Liquid sealed glass bar thermometer, thermocouple, resistance thermometer, temperature difference meter	Air temperature ±0.1°C Water temperature and water temperature difference ±0.1°C Refrigerant temperature ±1.0°C
Flow meter	Recording type, indicator type, accumulation type	±2%
Refrigerant pressure gauge	Bourdon tube	±2%
Air pressure gauge	Manometer	Picot tube dynamic pressure and nozzle, orifice dynamic pressure ±2%, duct static pressure ±2.45 Pa
Electric measuring instrument	Indicator type	±0.5%
	Accumulation type	±1%

(2) Test conditions – In addition to the regulations in 4.2, the test conditions shall conform to the following items.

(a) Air temperature and water temperature shall conform to the conditions in Attachment 1 Table 2. The cooling capacity of air-cooling type and the allowable differences in dry-bulb temperature and wet-bulb temperature in heat pump standard heating capacity test shall be as specified in Attachment 1 Table 3.
The allowable differences in dry-bulb temperature and wet-bulb temperature in heat pump low-temperature heating capacity test and defrost test shall be as specified in Attachment 1 Table 4.

(b) Sample machine shall be installed by the method specified by manufacturer including the amount of refrigerant charged, and must not be modified or connected in any way affecting the capacities.

(c) Connecting tubes of 5 m or more specified by manufacturer shall be used. If nothing is specified in particular, the length of tube shall be 5 m, and the length of tube in the outdoor side shall be 2 m or more.

(d) The air volume and static pressure of the sample machine shall conform to 2 in Attachment 3

(e) Sample machine shall be operated by the rated frequency and voltage (value within ±2% of each rating).

Attachment 1 Table 2 Temperature conditions

Unit: °C

Test conditions			Indoor side air condition		Outdoor side condition					
					Air-cooling package air conditioner		Package air conditioner only for cooling by water		Water-cooling heat pump type package air conditioner	
			Dry-bulb temperature	Wet-bulb temperature	Dry-bulb temperature	Wet-bulb temperature	Inlet water temperature	Outlet water temperature	Inlet water temperature	Outlet water temperature
Cooling	Capacity		27	19	35	24(2)	30±0.3	35±0.3	18±0.3	29±0.3
	Overload		32±1.0	23±0.5	43±1.0	26±0.5(2)	34±0.5	-(3)	24±0.5	-(3)
	Frosted		27±1.0	24±0.5	27±1.0	24±0.5(2)	-	27±0.5	-	27±0.5
	Frozen		21±1.0	15±0.5	21±1.0	15±0.5(2)	-	21±0.5	-	21±0.5
Heat pump heating	Capacity	Standard	20	-	7	6	-	-	15±0.3	-(3)
		Low temperature	20	15 or less(1)	2	1	-	-	-	-
	Overload		27±1.0	-	21±1.0	15±0.5	-	-	21±0.3	-(3)
	Defrost		20	15 or less(1)	2	1	-	-	-	-
Heating by electric heater			20(4)	-	-	-	-	-	-	-
Air volume static pressure (5)			20±2.0	15.8±1.0	-	-	-	-	-	-

Notes(1) Applicable to type in which the wet-bulb temperature affects indoor side heat exchange
(2) Applicable to type in which the wet-bulb temperature affects outdoor side heat exchange (type of using the latent heat of water, etc. for the heat source of outdoor side heat exchanger)
(3) Water amount determined under the conditions for cooling capacity test shall be applied.
(4) Means the standard ambient temperature.
(5) Change in external static pressure shall be contained within ±10% of the rated static pressure in the period of measurement. If, however, the rated static pressure is 98 Pa or lower, the range shall be within the rated static pressure ± 9.8 pa.

Attachment 1 Table 3 Allowable differences in dry-bulb temperature/wet-bulb temperature in cooling capacity and heat pump standard heating capacity test

Unit: °C

Item	Indoor side air condition		Outdoor side condition	
	Dry-bulb temperature	Wet-bulb temperature(6)	Dry-bulb temperature	Wet-bulb temperature(7)
Max deviation width	±1.0	±0.5	±1.0	±0.5
Average deviation width	±0.3	±0.2	±0.3	±0.2

Notes (6) Not applicable to heat pump standard heating capacity test
(7) Applicable to type in which the wet-bulb temperature affects the outdoor side heat exchange

Attachment 1 Table 4 Allowable differences in dry-bulb temperature/wet-bulb temperature in heat pump low-temperature heating capacity test and defrost test

Unit: °C

Item	Indoor side air condition		Outdoor side condition			
	Dry-bulb temperature		Dry-bulb temperature		Wet-bulb temperature	
	Heating	Defrost	Heating	Defrost	Heating	Defrost
Max deviation width	±2.0	±2.5	±2.0	±5.0	±1.0	±2.5
Average deviation width	±0.5	±1.5	±0.5	±1.5	±0.3	±1.0

Remark: "Defrost" means the duration of defrost operation and 5 minutes following its completion.

4.2 Test methods

4.2.3 Cooling capacity test – Cooling capacity shall be tested based on Attachment 2 after making adjustments so that the cooling capacity of sample machine may be maximized under the conditions of cooling capacity test specified in Attachment 1 Table 2.

4.2.4 Cooling power consumption & operating current tests – In the cooling power consumption and operating current tests, electric power consumed by sample machine shall be measured after the sample machine reaches steady condition in the cooling capacity test in 4.2.3. Also measure the operating current at the time, and calculate the power factor. If two types or more of power supply are provided, measure values in each power supply.

4.2.5 Heat pump heating capacity test – Heat pump heating capacity test shall conform to the following items.

(1) Heat pump standard heating capacity test

Heat pump standard heating capacity shall be tested based on Attachment 2 after making adjustments so that the heating capacity of sample machine may be maximized under the conditions for heat pump standard heating capacity test specified in Attachment 1 Table 2. If, however, any auxiliary electric heater for heating is provided and if it is operated and measured under the conditions for heat pump standard heating capacity test, the heat pump standard heating capacity shall be calculated by the following formula

$$H = H_1 - H_2$$

Here, H: Heat pump standard heating capacity (kW)
H_1: Measured heating capacity (kW)
H_2: Measured power consumption of electric heater (kW)

(2) Heat pump low-temperature heating capacity test

Heat pump low-temperature heating capacity test shall be carried out based on Attachment 2 after making adjustments so that the heating capacity of sample machine may be maximized under the conditions for heat pump low-temperature heating capacity test specified in Attachment 1 Table 2. If, however, any auxiliary electric heater for heating is provided and if it is operated and measured under the conditions for heat pump low-temperature heating capacity test, the heat pump low-temperature heating capacity shall be calculated by the following formula

$$H = H_1 - H_2$$

Here, H: Heat pump low-temperature heating capacity (kW)
H_1: Measured heating capacity (kW)
H_2: Measured power consumption of electric heater (kW)

4.2.6 Heat pump heating power consumption and operating current test - Heat pump heating power consumption and operating current test shall conform to the followings.

(1) Heat pump heating power consumption and operating current test – In the heat pump heating power consumption and operating current test, the electric power consumed by sample machine (excluding the power consumption of auxiliary electric heater for heating if any) shall be measured after the sample machine reaches steady condition in the test specified in 4.2.5 (1). Also measure the operating current at the time, and calculate the power factor. If two types or more of power supply are provided, measure values in each power supply.

(2) Heat pump low-temperature heating capacity test – In the heat pump low-temperature heating capacity test, the electric power consumed by sample machine in 4.2.5 (2) shall be measured, and the average value shall be calculated. If two types or more of power supply are provided, measure values in each power supply.

Attachment 2 Cooling capacity, heat pump standard heating capacity and heat pump low-temperature heating capacity test methods

1. Scope of application – This attachment sets down the test methods for the package air conditioner's cooling capacity, heat pump standard heating capacity and heat pump low-temperature heating capacity.

2. Types of test method – Test method for cooling capacity and heat pump standard heating capacity shall be by the following direct methods and indirect methods, and the test method for heat pump low-temperature heating capacity shall be by the air enthalpy method in the following direct methods.

(1) Direct methods

(a) Air enthalpy method: Method to obtain the capacity by measuring the suction and blow-out air temperatures (dry-bulb temperature and wet-bulb temperature) in the indoor side of sample machine, or by measuring the temperature difference between suction and blow-out air and the air volume at the time in the heat pump low-temperature heating capacity test

(b) Room type calorimeter method: Method to obtain the capacity by balancing the cooling and dehumidifying capacities in the indoor side of sample machine in cooling or balancing the heating capacity in the indoor side of sample machine and the heat input of calorimeter in heating, then by measuring the heat input

(2) Indirect methods

(a) Outdoor air enthalpy method: Method to obtain the capacity by measuring the suction and blow-out air temperatures (dry-bulb temperature and wet-bulb temperature) in the outdoor side of sample machine, air volume at the time and the electric input of sample machine

(b) Water side calorimeter method: Method to obtain the capacity by measuring the water temperatures at inlet and outlet of water side heat exchanger of sample machine, water amount at the time and the electric input of sample machine

(c) Refrigerant flow meter method: Method to obtain the capacity by measuring the characteristic values of refrigerant at indoor side inlet/outlet of sample machine, refrigerant flow at the time and the electric input to the sample machine indoor side

(d) Calibration compressor method: Method to obtain the capacity by measuring the data of compressor itself operated under the same conditions as sample machine and the electric input to the sample machine indoor side

(e) Outdoor room type calorimeter method: Method to obtain the capacity by balancing the cooling capacity and dehumidifying capacity or heating capacity in the outdoor side of sample machine with the heat input of calorimeter and by measuring the heat input and the electric input to sample machine

3. Test methods

3.1 Direct methods

3.1.1 Air enthalpy method – Air enthalpy method shall conform to the followings.

(1) Test system: Test system shall be by either of the followings.

(a) Tunnel type air enthalpy method test system (example shown in Fig. 1 of Attachment 2)

(b) Loop type air enthalpy method test system (example shown in Fig. 2 of Attachment 2)

(c) Calorimeter type air enthalpy method test system (example shown in Fig. 3 of Attachment 2)

(d) Room type air enthalpy method test system (example shown in Fig. 4 of Attachment 2)
Size of test room shall be enough for the air velocity around sample machine not to affect its performance, and the air volume measuring unit and air conditioning unit shall be arranged in a way that the measurements of air volume, room temperature and external static pressure may not be affected adversely.

(2) Test methods: Test method shall be as shown below.

(2.1) Cooling capacity and heat pump standard heating capacity test: Measurement shall be continued 7 times for 30 min every 5 min and in all following an hour operation after the air conditioning unit and sample machine have reached steady condition under the test

conditions in Attachment 1 Table 2. The method for the air volume static pressure test at the time shall be as shown in Attachment 3. If defrost operation is performed in the heat pump standard heating capacity test, however, the measurement shall conform to the following heat pump low-temperature heating capacity test.

(2.2) Heat pump low-temperature heating capacity test: Measurement shall be carried out under the conditions in either of the following items after operating the air conditioning unit and sample machine for 1 hour or more under the test conditions in Attachment 1 Table 2. The method for air volume static pressure test at the time shall be as shown in Attachment 3.
Interval of heating capacity measurement shall be a specified period of time within 10 sec in the case of (a) and within 10 min in the case of (b).

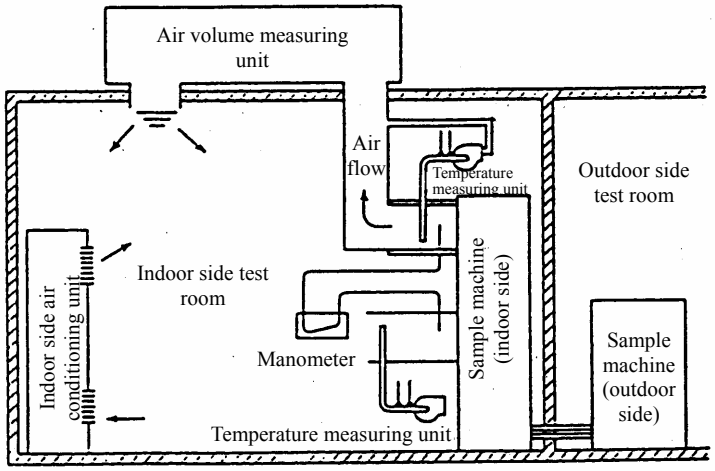
(a) Measure 3 defrost-cycles continuously. If 1 defrost cycle exceeds 3 hours, however, measure 1 defrost cycle.

(b) If defrost function is not provided, measure for 6 hours.

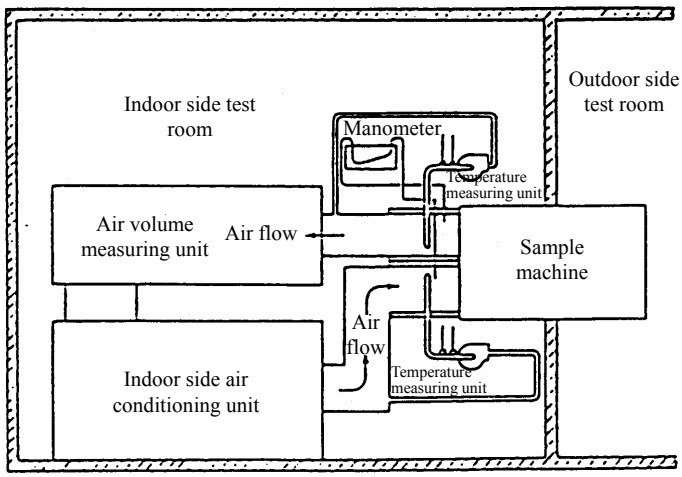
Remarks 1: 1 defrost cycle shall be from the moment of starting the heating operation till the moment of starting the next heating operation after stopping defrosting.

2: If defrost operation is not started for 6 hours or more after the start of measurement, take the same actions as in the case no defrost function is provided.

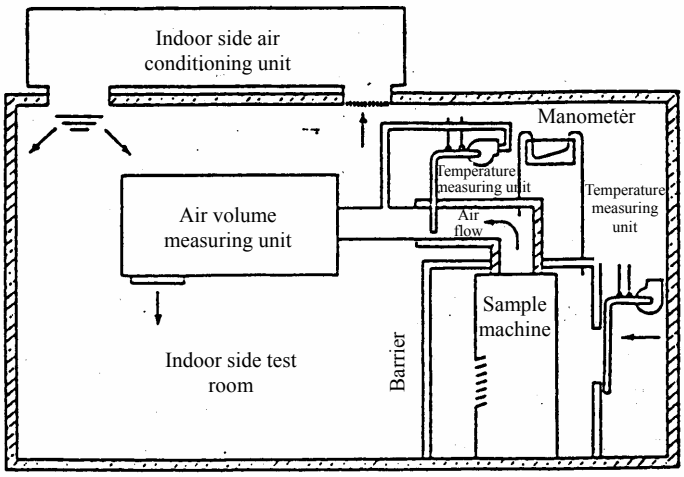
Attachment 2 Fig. 1 Tunnel type air enthalpy method test system (example)



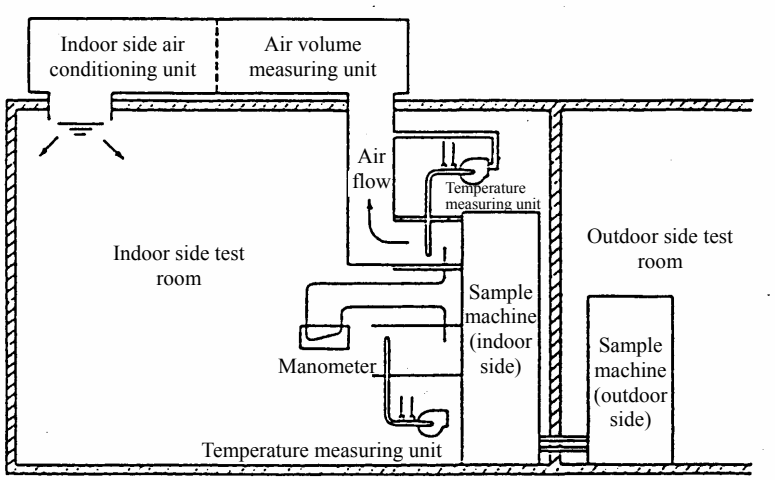
Attachment 2 Fig. 2 Loop type air enthalpy method test system (example)



Attachment 2 Fig. 3 Calorimeter type air enthalpy method test system (example)



Attachment 2 Fig. 4 Room type air enthalpy method test system (example)

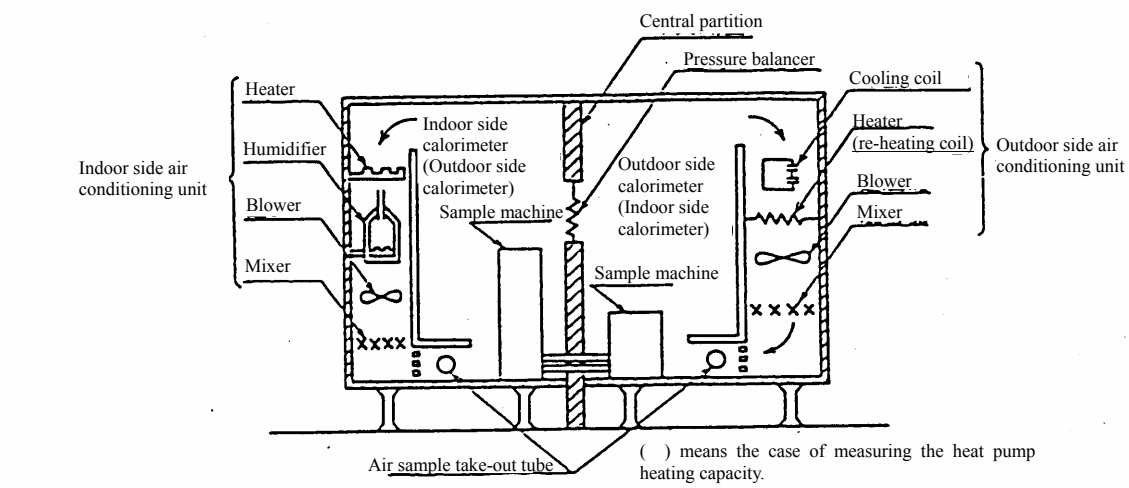


3.1.2 Room type calorimeter method – Room type calorimeter method shall be as shown below.

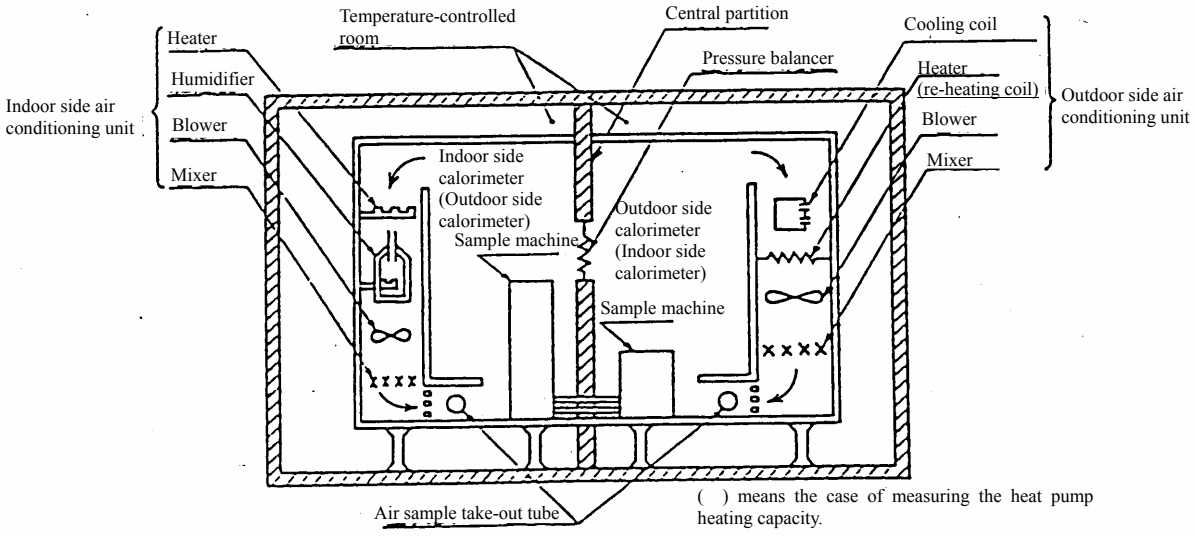
(1) Test system: Test system shall be a calibration type room type calorimeter (example shown in Attachment 2 Fig. 5) or balance type room type calorimeter (example shown in Attachment 2 Fig. 6).

Size of calorimeter shall be increased to reduce resistance as far as possible when sample machine takes in or blows out the air. Air conditioning equipment shall have a grille or porous plate at the outlet, and appropriate spaces shall be provided in front of the grilles at inlet and outlet so that air flow may not be interfered.

Attachment 2 Fig. 5 Calibration type room type calorimeter test system (example)



Attachment 2 Fig. 6 Balance type room type calorimeter test system (example)



Japanese Industrial Standards

JIS
CXXXX: 199X

Direct-blowoff air conditioners and heat pumps Testing and rating for performance

(Preface)
This standard is the Japanese Industrial Standards prepared by translating the relevant international standards based on ISO 5151 Direct-blowoff air conditioners and heat pumps – Testing and rating for performance issued as 1st version in 1994, without changing the technical description. However, regulations not specified in the relevant international standards are added as Japanese Industrial Standards.
Sections underlined by dotted line or siding are not contained in the relevant international standards.

1. Scope of application

1.1 This standard sets down the test methods under the test conditions to determine various rated performances for the one-block type and separated type of direct-blowoff air conditioner using air-cooling or water-cooling condenser and of direct-blowoff heat pump using air-cooling condenser. This standard shall be applied only to the system consisted of one evaporator and one condenser in single freezing cycle.

Remark: The terms "Equipment" and "Sample machine" used in this standard mean the direct-blowoff air conditioner and/or direct-blowoff heat pump.

1.2 This standard sets down the test conditions and test procedure to determine the operating performances of direct-blowoff air conditioner and heat pump.

1.3 This standard shall not be applied to the determination of the tests and ratings for the following equipments.

a) Water heat source heat pump
b) Multi-type air conditioner (1) and heat pump
c) Equipment designed to use ducts
d) Movable type equipment (not window type) having exhaust duct for condenser

Note (1) Equipment having two or more indoor units for one outdoor unit
However, this standard may be applied to the performance in case indoor units are operated simultaneously.

Remarks: This standard shall not be applied to the following equipments.

(1) Type not using the freezing cycle by electric compressor
(2) Type designed for vehicles
(3) Type designed for use under the following special temperature conditions
(i) Mainly used to control the quality of machine, device and foods
(ii) Introducing only outside air into room
(iii) Supplying cool air to workers at hot work place, etc.

4. Cooling Test

4.1 Determination of rated cooling capacity

4.1.1 General conditions

For all the equipments in the scope of application of this standard, the cooling capacity and the efficiency of energy consumption shall be determined by the cooling conditions specified in Table 1 according to the regulations in this standard.

4.1.2 Temperature conditions

4.1.2.1 The test conditions specified in Table 1, T1, T2 and T3 shall be used as the standard rating conditions.

Remark: Unless specified in the manufacturer specification, T1 shall be the standard rating condition for those used domestically.

Table 1 Conditions for cooling capacity test

Item	Standard test conditions		
	T1	T2	T3
Indoor side suction air temperature (°C)			
Dry-bulb temperature	27	21	29
Wet-bulb temperature	19	15	19
Outdoor side suction air temperature (°C)			
Dry-bulb temperature	35	27	46
Wet-bulb temperature (1)	24	19	24
Condenser water temperature (2) (°C)			
Inlet	30	22	30
Outlet	35	27	35
Test frequency (Hz)	Rated frequency (3)		
Test voltage	Rated voltage (4)		

T1 = Standard cooling capacity rating conditions for warm climate zone
T2 = Standard cooling capacity rating conditions for cold climate zone
T3 = Standard cooling capacity rating conditions for hot climate zone

Notes) (1) In the case of air-cooling condenser not evaporating condensed water, the wet-bulb temperature conditions are not required.
(2) Typical values of equipment using cooling tower. In equipments by other methods, the manufacturer shall clarify the inlet and outlet temperatures of condenser before testing, or clearly specify the water amount and inlet temperature.
(3) In equipment having double rated frequencies, each frequency shall be tested.
(4) In equipment having double rated voltages, both voltages shall be tested. If, however, only one rated value is to be indicated, the lower value of voltage shall be tested.

4.1.3 Conditions for air volume

If the air volume for cooling capacity test is to be determined, it shall be obtained in the test carried out after the amount of condensed water stabilizes in the freezing cycle under the conditions for cooling capacity test (See Table 1), in a way that the sample machine static pressure at blow-out port may be maintained at 0 Pa. The air volume shall be shown in cubic meter/second (m^3/sec) of standard air defined in Item 3.3.

4.1.4 Test conditions

4.1.4.1 Required conditions

a) When using room type calorimeter method, two methods shall be used to determine the capacities. One is the method to determine the capacities from indoor side, and the other is the method to determine the capacities from outdoor side. Values obtained by these two methods at the same time shall conform to the values obtained from indoor side within 4%. In the case of direct-blowoff air conditioner using water-cooling condenser, the heat emitted into cooling water shall be measured as a substitute for the value of outdoor side.
b) Tested value of cooling capacity shall contain the sensible heat, latent heat and all cooling capacities obtained from indoor side.
c) Tests shall be carried out without adding the changes in fan speed or system resistance for correcting the deviations from standard atmospheric pressure (See 3.3).
e) Unless the manufacture instructions for grille position, damper position or fan speed are ignored, such positions shall be set in a way that the cooling capacity may be maximized. When tested in any different settings, such things shall be described with capacities.
e) Data of capacity test shall be recorded after 1 hour or more of stabilization time.

4.1.4.2 Duration of tests

In the tests, measurement shall be repeated 7 times in interval of 5 min in operation of 30 min after stabilization. Max allowable differences in the values measured in cooling capacity test shall be as shown in Table 12.

5. Heating Test

5.1 Determination of rated heating capacity

5.1.1 General conditions
In all the equipments in the scope of application of this standard, the ratings in the heating capacity and the efficiency of heating power consumption shall be determined by the conditions specified in Table 6 according to the regulations in this standard. In the heating power consumption, the rating measured in the heating capacity test shall be determined.

5.1.2 Temperature conditions

5.1.2.1 Test conditions described in Table 6 shall be used as the rating conditions.

5.1.2.2 If manufacturer specifies that the equipment is not suitable for use under extreme low-temperature test condition, the tests shall be carried out under the standard and low-temperature conditions specified in Table 6.

Table 6 Conditions for heating capacity test

Item	Standard test conditions
Indoor side suction air temperature (°C)	
Dry-bulb temperature	20
Wet-bulb temperature	15
Outdoor side suction air temperature (standard)(1)(°C)	
Dry-bulb temperature	7
Wet-bulb temperature	6
Outdoor side suction air temperature (low temperature)(1)(°C)	
Dry-bulb temperature	2
Wet-bulb temperature	1
Outdoor side suction air temperature (extreme low temperature)(1)(2)(°C)	
Dry-bulb temperature	-7
Wet-bulb temperature	-8(5)
Test frequency (Hz)	Rated frequency (3)
Test voltage (V)	Rated voltage (4)

Notes) (1) If defrosting occurs during the standard, low-temperature or extreme low-temperature heating capacity test, the indoor air enthalpy method (See Attachments B.2 and C.3.3) shall be used.
(2) Test shall be carried out only in case the manufacturer clearly specifies “Operable” for this condition in the specification.
(3) In equipment having double rated frequencies, each frequency shall be tested.
(4) In equipment having double rated voltages, both voltages shall be tested.
If, however, only one rated value is to be indicated, the lower value of voltage shall be used.
(5) Wet-bulb temperature below zero may be measured by absorption hygrometer or dew point thermometer.

5.1.3 Conditions for air volume

5.1.3.1 In the equipment for heating only, the air volume shall be specified by the manufacturer.

5.1.3.2 In the equipment of cooling/heating type, the air volume shall be set to the same position as in the rated cooling capacity test.

5.1.3.3 If air volume is determined for the rated heating capacity test, heating operation shall be carried out under the standard test conditions (See Table 6), and the static pressure at the blow-out port of machine shall be maintained at 0 Pa in the test.

5.1.4 Test conditions

5.1.4.1 Required conditions

5.1.4.1.1 When using the room type calorimeter method, two methods must be used at the same time to determine the heating capacity. One is to determine the heating capacity from indoor side, and the other is to determine the heating capacity from outdoor side. The value obtained by these two methods shall conform to the value obtained from indoor side within 4%.

5.1.4.1.2 Tests shall be carried out without changing the fan speed or system resistance for correcting the deviations from standard atmospheric pressure (See 3.3).

5.1.4.1.3 The air conditioning equipment and sample machine in the test room shall be kept in the state of balance for 1 hour or more before measuring the data of heating capacity test.

5.1.4.2 Test hours

Following stabilization, the test shall be carried out in a 30-minute operation within the max allowable differences specified in Table 12, and the measurement should be repeated 7 times in all in an interval of 5 min.

5.1.4.3 Conditions for frosting

5.1.4.3.1 If any slight frost is found on the outdoor heat exchanger under the heating conditions, it is necessary to identify whether frosting occurs generally or not. If the temperature of blow-out air in the outdoor side is within the max allowable difference in Table 12, it is interpreted as No Frosting in this standard. In case the temperature of blow-out air in the outdoor side exceeds the max allowable difference due to frosting, the heating capacity test to defrost shall be based on A4 in Attachment A.

5.1.4.3.2 If defrosting starts within 3 hours during test, or if the max allowable difference in Table 12 is exceeded, the transitional heating capacity test method (See B1.2 in Attachment B) shall be used.

Japanese Industrial Standards

JIS

Duct-connected air conditioners and air-to-air heat pumps Testing and rating for performance

(Preface)
This standard is the Japanese Industrial Standards prepared by translating the relevant international standards based on ISO 5151 Duct-connected air conditioners and air-to-air heat pumps – Testing and rating for performance issued as 1st version in 1995, without changing the technical description. However, regulations not specified in the relevant international standards are added as Japanese Industrial Standards.
Sections underlined by dotted line or siding are not contained in the relevant international standards.

1. Scope of application

1.1 This standard sets down the performance tests and rating standards for the duct-connected air conditioner and air-to-air heat pumps equipped with electric air-cooling or water-cooling condenser for housing, commercial or industrial use, which are manufactured at plants. Requirements for the tests and rated values specified in this standard are determined based on an appropriate combination of products.
This standard uses a single freezing circuit, and is applied to the system equipped with an evaporator and a condenser respectively.

1.2 This standard shall not be applied to the determination of tests and ratings for the following equipments.

a) Each unit in separated type
b) Unit using absorption type freezing cycle
c) Direct-blowoff air conditioner or direct-blowoff heat pump
d) Heat pump with water as heat source

Remarks 1: This standard shall not be applied to the following equipments.
(1) Designed for vehicles
(2) Designed for use under special temperature conditions as show below
(i) Mainly used to control the quality of machine, device and foods
(ii) Introducing only outside air into room
(iii) Supplying cool air to workers at hot work place, etc.
2: In the multi-type air conditioner and heat pump, this standard may be applied to the performance in the case of operating the indoor units simultaneously.

4. Cooling Test

4.1 Determination of rated cooling capacity

4.1.1 General conditions – In all the equipments in the scope of application of this standard, the ratings in the cooling capacity and the efficiency of heating power consumption shall be determined by the cooling conditions specified in Table 1 according to the regulations in this standard.

4.1.2 Temperature conditions

4.1.2.1 The test conditions specified in the columns of T1, T2 and T3 in Table 1 shall be used as the standard rating conditions.

Remark: Unless the specification of equipment is shown by manufacturer, products used domestically shall use T1 as the standard rating condition.

Table 1 Conditions for cooling capacity test

Item	Standard test conditions		
	T1	T2	T3
Indoor side suction air temperature (°C)			
Dry-bulb temperature	27	21	29
Wet-bulb temperature	19	15	19
Outdoor side suction air temperature (°C)			
Dry-bulb temperature	35	27	46
Wet-bulb temperature (1)	24	19	24
Condenser water temperature (2) (°C)			
Inlet	30	22	30
Outlet	35	27	35
Test frequency	Rated frequency (3)		
Test voltage	Rated voltage (4)		
T1 = Standard cooling capacity rating conditions for warm climate zone T2 = Standard cooling capacity rating conditions for cold climate zone T3 = Standard cooling capacity rating conditions for hot climate zone			

Notes) (1) In the case of air-cooling condenser not evaporating condensed water, the wet-bulb temperature conditions are not required.

(2) Typical values of equipment using cooling tower. In equipments by other methods, the manufacturer shall clarify the inlet and outlet temperatures of condenser before testing, or clearly specify the water amount and inlet temperature.

(3) In equipment having double rated frequencies, each frequency shall be tested.

(4) In equipment having double rated voltages, both voltages shall be tested.
If, however, only one rated value is to be indicated, the lower value of voltage shall be tested.

4.1.3 Conditions for air volume

4.1.3.1 Indoor air volume

4.1.3.1.1 All the standard ratings shall be determined based on the indoor air volume described below. All the air volumes shall be shown in cubic meter/sect (m^3/sec) of standard air defined in Item 3.1, and determined by the measurement in the test method described in Attachment E.

4.1.3.1.2 If any equipment has an indoor blower used in combination with dust systems installed locally, the indoor side air volume in the minimum external static pressure specified by the manufacturer shall be the rated air volume.

4.1.3.1.3 If equipment has no indoor blower used as assembled in the heating unit, the indoor air volume shall be specified by the standard rating specified by the manufacturer. However, the pressure loss of indoor coil assembly, recommended indoor unit system or any accessory must not exceed 75 Pa.

4.1.3.1.4 The indoor air volume and pressure are related to the air volume obtained when the equipment is cooling and dehumidifying under the conditions specified in this item.
Excluding the cases described in items 4.3.3 and 4.4.3, this air volume must be used in all the other tests described here regardless of external static pressure.
4.1.3.2 Outdoor air volume – If operation of blower can be adjusted, all the standard ratings should be determined by the outdoor air volume by manufacturer specification. If unable to adjust, operate equipment when all the resistance elements related to the suction port or louver and attachments to duct are mounted in normal installation as the manufacturer thinks, and specify the outdoor air volume unique to the equipment as the rated value. Once set, the outdoor side air circuit of sample machine must not be changed during any test described here.
4.1.4 Test conditions
4.1.4.1 Required conditions - The air conditioning equipment and sample machine in the test room shall be operated for at least 1 hour or more until reaching the state of balance before recording the data of capacity test.
4.1.4.2 Duration of test – Data shall be recorded in every 5 min for 30 min totally, and continue testing until the seven consecutive readings are contained within the allowable limit shown in Item 6.5.

5. Heating Test

5.1 Rated heating capacity
5.1.1 General conditions – In all the equipments in the scope of application in this standard, the ratings of heating capacity and efficiency of heating energy consumption shall be determined by the conditions specified in Table 5 according to the regulations in this standard. The heating power consumption shall also be measured in the heating capacity test, and the rating shall be determined.
5.1.2 Temperature conditions
5.1.2.1 The test conditions shown in Table 5 shall be used as the standard rating conditions.
5.1.2.2 If the manufacture regards the equipment as the specification which is not suitable to operation under the extreme low-temperature test conditions, the test shall be carried out under the standard and low-temperature conditions specified in Table 5.
5.1.3 Conditions for air volume
5.1.3.1 In the equipment for heating only, the air volume should be as specified by the manufacturer.
5.1.3.2 In the equipment for cooling/heating type, air volume shall be set to the same position as in the rated cooling capacity test.
5.1.4 Test conditions
5.1.4.1 Required conditions
5.1.4.1.1 The air conditioning equipment and sample machine in the test room shall be kept in the state of balance for 1 hour or more before measuring the data of heating capacity test.
5.1.4.1.2 Under certain heating conditions, the outdoor coil could be frosted slightly. It is necessary, therefore, to identify whether frosting occurs generally or not. If the temperatures of blow-out air in the indoor side and outdoor side are within the max allowable values for operation without frosting specified in Table 10, the test is interpreted as No Frosting in this standard. In case the allowable difference of blow-out air temperature exceeds the allowable range due to frosting, the heating capacity test method in the area of defrosting shall be used.

Table 5 Conditions for heating capacity test

Item	Standard test conditions
Indoor side suction air temperature (°C)	
Dry-bulb temperature	20
Wet-bulb temperature	15
Outdoor side suction air temperature (standard)[(1)](°C)	
Dry-bulb temperature	7
Wet-bulb temperature	6
Outdoor side suction air temperature (low temperature)[(1)](°C)	
Dry-bulb temperature	2
Wet-bulb temperature	1
Outdoor side suction air temperature (extreme low temperature)[(1)(2)](°C)	
Dry-bulb temperature	-7
Wet-bulb temperature	-8[(5)]
Test frequency (Hz)	Rated frequency [(3)]
Test voltage (V)	Rated voltage [(4)]

Notes) ([1]) If defrosting occurs during the standard, low-temperature or extreme low-temperature heating capacity test, the indoor air enthalpy method (See Attachments B) shall be used.
([2]) Test shall be carried out only in case the manufacturer clearly specifies "Operable" for this condition in the specification.
([3]) In equipment having double rated frequencies, each frequency shall be tested.
([4]) In equipment having double rated voltages, both voltages shall be tested.
If, however, only one rated value is to be indicated, the lower value of voltage shall be used.
([5]) Wet-bulb temperature below zero may be measured by absorption hygrometer or dew point thermometer.

5.1.4.1.3 During the defrosting test, any equipment should not be connected, which could disturb the normal flow of outdoor air over sample machine. In the air flow in the indoor side, the values of air flow set for the sample machine or related testing equipment should not be changed during test. If the defrost controller is designed to stop the indoor blower, however, there must be a method of cutting off the air flow passing through the indoor coil from testing equipment when the blower stops.
Watt-hour meter shall be used to measure the electric inputs of sample machine.
Remark: Momentary wattmeter may be used to measure the electric inputs.

5.1.4.1.4 Excluding normal deviation occurring due to the defrost control by sample machine, the air conditioning equipment in the test room and the sample machine during test shall be operated for at least 1 hour until the state of balance is attained. Under some defrosting conditions, the normal function of the air conditioning equipment in the test room could be disturbed. In such a case, the max allowable difference for the reading of air temperature shall be 3 times of the value specified in Table 10.
5.1.4.2 Test hours – Data should be recorded for 30 min in an interval of 5 min until the seven consecutive readings are contained within the allowable limit specified in Item 6.5. Sample machine shall be operated for 3 hours. If sample machine has already started defrosting operation by the time the test ends, such a defrosting operation should be completed. Data are normally recorded in every 5 min. During the defrosting operation, however, the data should be recorded in at least 10 sec in order to accurately identify the start/completion of defrosting, time of indoor air, temperature change (in case indoor blower is operated) and the electric input to sample machine.
Remark: When using the momentary type wattmeter, it is recommended to read data in every 10 sec.