

Third Edition

Pilot project for the environmental technology verification  
In the field of heat island control technology

Protocol for the verification tests on  
heat island control technology  
(Technology for controlling sensible heat  
produced from outdoor air-cooling units)

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Ministry of the Environment

# Table of Contents

<b>Main section .....</b>	<b>1</b>
I. Introduction.....	1
1. <i>Target technologies</i> .....	1
2. <i>Types and outline for verification tests</i> .....	1
(1) <i>Types of verification tests</i> .....	1
(2) <i>Verification testing process</i> .....	1
3. <i>Definitions of terms and phrases</i> .....	2
II. Verification test system .....	4
1. <i>Ministry of the Environment</i> .....	4
2. <i>The committee on the pilot project for the environmental technology verification</i> .....	4
3. <i>Verification Management Organization</i> .....	4
4. <i>Working group on the heat island control technology</i> .....	4
5. <i>Verification Organizations</i> .....	4
6. <i>Technology Panels</i> .....	5
7. <i>Environmental Technology Developers</i> .....	5
III. Selection of target verification technologies .....	6
1. <i>Application</i> .....	6
2. <i>Selection of target verification technologies</i> .....	6
IV. Preparation for the verification tests.....	7
1. <i>Determination of verification items</i> .....	7
(1) <i>Verification items regarding sensible heat control performance</i> .....	7
(2) <i>Verification items regarding operations and maintenance</i> .....	8
2. <i>Establishment of the Test Plan</i> .....	9
V. Verification test methods .....	10
1. <i>Operations and maintenance</i> .....	10
(1) <i>Regular operations and maintenance</i> .....	10
(2) <i>Actions in the event of abnormal conditions</i> .....	10
(3) <i>Cost estimation</i> .....	10
2. <i>Test conditions</i> .....	10
(1) <i>Setting for test conditions</i> .....	10
(2) <i>Test conditions to be recorded</i> .....	12
3. <i>Measurement methods</i> .....	13
(1) <i>Measurement methods for verification items regarding sensible heat control performance</i> .....	13
(2) <i>Measurement methods for verification items regarding operations and maintenance</i> .....	17
4. <i>Management of analytical accuracy</i> .....	19
(1) <i>Evaluation of performance and maintenance of instruments and equipment</i> .....	19
(2) <i>Evaluation of reliability of measurement</i> .....	19
(3) <i>Data management and evaluation</i> .....	21

VI. Preparation of the Verification Report.....	22
VII. Remarks in conducting the verification test.....	23
1. <i>Quality control of data</i> .....	23
(1) <i>The method for quality control of data</i> .....	23
(2) <i>Measurement and data acquisition</i> .....	23
2. <i>Management, analysis, and presentation of data</i> .....	23
(1) <i>Data management</i> .....	23
(2) <i>Data analysis and presentation</i> .....	23
3. <i>Environment, health and safety</i> .....	24
4. <i>Fees</i> .....	24
(1) <i>Setting up and collection of fees</i> .....	24
(2) <i>Fee items</i> .....	25
5. <i>Change and cancellation of verification tests</i> .....	25
(1)..... <i>Addition of verification items by request of the environmental technology developer</i>	25
(2)..... <i>Cancellation (declining) of test by request of the environmental technology developer</i>	26
(3)..... <i>Addition of test items by judgment of the Verification organization</i>	26
Appendix 0: Quality management system to be constructed at the Verification Organizations.....	27
<i>Introduction</i> .....	27
Appendix 1: Application form for verification.....	31
Appendix 2: Test Plan.....	36
Appendix 3: Form of Verification Report (Provisional version).....	38

<b>Reference</b> .....	<b>i</b>
I. Brief overview of the pilot project for the environmental technology verification.....	i
II. System for promotion of the “pilot project for the environmental technology verification” .....	iii
III. Flow of the pilot project for the environmental technology verification .....	iv
IV. Prospectus for organizing the working group on the heat island control technology in the committee on the pilot project for the environmental technology verification for 2005.....	v
V. Particulars discussed in the working group on the heat island control technology .....	viii

# Main section

## I. Introduction

### 1. Target technologies

Heat island control technologies covered by this protocol for the verification are those (equipment, etc.) that can be installed later in a unitary air conditioner (industrial air conditioner) for controlling sensible air produced from the outdoor air-cooling unit by spraying water on the unit to make use of latent heat when the water evaporates, or by using other mechanisms.

### 2. Types and outline for verification tests

#### (1) Types of verification tests

This verification test verifies the following items by performing a series of operations of a target verification apparatus installed in an outside air-cooling unit, including startup, running, and stopping:

- Environmental protective effect under practical operational conditions in the range specified by an environmental technology developer
- Energy, materials and cost required for operation
- Operational environment allowing normal operations
- Labor for operations and maintenance (hereinafter referred to as the “O&M”)

A verification test conducted under regulated conditions is inadequate to give a full picture of the performance of a target verification technology, but is believed to provide adequate information to determine its applicability to controlling of the heat island effect in summer.

#### (2) Verification testing process

The verification test will be mainly conducted in accordance with the steps specified below. The Verification Organization may, if necessary, subcontract part of the verification test to external test organizations.

##### **i Planning**

The plan for the verification test (hereinafter referred to as the “Test Plan”) will be prepared before the test is conducted. The Test Plan will be prepared by a Verification Organization in cooperation with an environmental technology developer.

The main activities in the planning stage are as follows:

- Specifying the individuals and organizations involved in the test
- Specifying the general and technology-specific objectives of the test
- Specifying verification items
- Determining analytical and data measurement methods and the test period
- Establishing a Test Plan that includes specific procedures, a schedule, and the individuals in charge, based on the results of the above items

##### **ii Verification test**

In this stage, a verification test will be conducted in accordance with the Test Plan described above. The verification test verifies the conformity of a target verification apparatus with its objectives specified in the planning stage.

##### **iii Data assessment and reporting**

In the final stage, all data collected will be analyzed for verification, and a report on the verification test (hereinafter referred to as the “Verification Report”) will be compiled. A Verification Organization is responsible for analysis of the data and reporting.

The Verification Report will be submitted to the Ministry of the Environment, which will give an approval based on the results of the examination as to whether the verification has been conducted in a suitable manner. The examination is carried out by the working group on the heat island control technology of the committee on the pilot project for the environmental technology verification (hereinafter referred to as “working group”). The approved Verification Report will be disclosed to the public through a database on environmental technology managed by the Ministry of the Environment.

### 3. Definitions of terms and phrases

The definitions of the major terms and phrases are in accordance with those of the Japanese Industrial Standards (hereinafter referred to as “JIS”). The standards in JIS particularly relevant to this protocol for the verification (hereinafter referred to as “this Protocol”) are as follows:

JIS B 8615-1 “Non-ducted air conditioners and heat pumps – Testing and rating for performance”

JIS B 8615-2 “Ducted air-conditioners and air-to-air heat pumps – Testing and rating for performance”

JIS B 8616 “Unitary air conditioners”

In addition, the terms and phrases used in this Protocol are defined as set forth in Table 1.

**Table 1 Definitions of terms and phrases used in this Protocol**

<b>Term/Phrase</b>	<b>Definition</b>
Target verification technology	Method for controlling sensible heat produced from outdoor air-cooling units to be verified in the verification test. The target verification technology should have a clear scientific basis.
Target verification apparatus	An apparatus to be actually used in the verification test among the apparatuses/equipment representing the embodiments of the target verification technology.
Verification items	Items to be analyzed for determination of the performance of a target verification apparatus.
Test Site	An establishment where a target verification apparatus is to be installed and the verification test is to be conducted.
Verification applicant	A person wishing to have his/her own technology verified. If the applied technology is selected as a target verification technology, the verification applicant will be referred to as an “environmental technology developer.”
Environmental technology developer	A person who possesses a target verification technology. Until the applied technology is selected as a target verification technology, the person is referred to as a “verification applicant.”

## II. Verification test system

### 1. Ministry of the Environment

- Comprehensively administer the entire pilot project for the environmental technology verification
- Comprehensively discuss the verification test system
- Establish and administer the committee on the pilot project for the environmental technology verification
- Select a target verification technology field
- Select a Verification Management Organization
- Subcontract operation of verification tests to the Verification Management Organization and bear the costs
- Approve a protocol for verification tests
- Approve a Verification Organization
- Subcontract operation of verification tests to the Verification Organization and bear the costs
- Approve a Verification Report
- Create an Environmental Technologies Verification database for dissemination
- Provide the logo for the verified technology.

### 2. The committee on the pilot project for the environmental technology verification

- Offer advice on the management of the entire pilot project for the environmental technology verification
- Offer advice on selection of a Verification Management Organization
- Offer advice on the comprehensive evaluation of verification test results

### 3. Verification Management Organization

- Prepare a protocol for the verification test and obtain approval of the Ministry of the Environment.
- Select Verification Organizations and obtain approval of the Ministry of the Environment.
- Approve target verification technologies
- Determine the items of the fee associated with the verification test and collect the fee
- Subcontract operation of verification tests to the Verification Organization

### 4. Working group on the heat island control technology

- Offer advice on the management of the pilot project for the environmental technology verification in the field of heat island control technology
- Offer advice on creating a protocol for the verification
- Offer advice on the selection of Verification Organizations
- Offer advice on approval of the Verification Report

### 5. Verification Organizations

- Administer the verification test under the auspices of the Ministry of the Environment or Verification Management Organizations
- Construct the quality management system shown in Appendix 0
- Collect and assess target verification technologies
- Establish and administer respective Technology Panels
- Establish a Test Plan in cooperation with environmental technology developers

- Calculate the fee required in a verification test
- Conduct and manage the target verification tests based on the Test Plan
- Ensure the health and safety of all persons relevant to the verification tests at the Test Sites
- Set and adjust the test schedule by assuring the means of communication among all participants in the verification test, and providing transportation assistance and technical advice as necessary
- When the verification test is subcontracted to an external organization, ensure that the quality management system which is required in the Protocol is indeed functioning properly at the subcontractor
- Audit the procedures for the verification test
- Perform monitoring, measurement, and analysis under the auspices of the Ministry of the Environment
- Manage the data/information obtained in the verification tests
- Prepare the Verification Report based on analysis of the data on the verification test

## 6. Technology Panels

- Offer advice on the selection of target verification technologies
- Offer advice on the preparation of the Test Plan
- Offer advice on the problems that may occur during the verification tests
- Offer advice on the issuance of the Verification Report
- Offer advice on dissemination of the technologies verified in the verification test

## 7. Environmental Technology Developers

- Cooperate with Verification Organizations in establishment of the Test Plan, such as by providing information required for the verification test
- Provide as many target verification apparatuses that can be used at the Test Site as required. In addition, provide the Verification Organization with its “O&M manual”
- Bear the costs and responsibility for the transportation, installation, removal, and others of the target verification apparatus
- Bear, in principle, the costs for O&M of the target verification apparatus. In addition, bear the costs for chemicals, supplies, and utilities that may be additionally required
- Provide technical support to the Verification Organization by assisting in the operation and measurement of the target verification apparatus during the verification test period, if necessary
- Provide engineers for O&M of the target verification apparatus, if necessary. The engineers should be properly qualified or experienced and have received adequate training
- Provide existing relevant performance data for the target verification technology if it has been tested at other sites
- Cooperate with the Verification Organization in preparing the Verification Report



### III. Selection of target verification technologies

#### 1. Application

A verification applicant may apply to a Verification Organization for verification of the applicant's proprietary technology/product. Items to be specified in the application form are described below. The verification applicant should fill in the necessary information in the "Application form for verification" set forth in Appendix 1, and submit the application form together with the designated documents to the Verification Organization.

- a. Company name, address, division of person in charge, name of person in charge, etc.
- b. Outline of a technology
- c. In-house test results
- d. Product data
- e. Developmental status and past delivery record
- f. Technological novelty
- g. Other relevant or unique features (if any)
- h. Technical specification for the target verification apparatus (the design purpose should be included)\*
  - i. O&M manual (Management contents should be included)\*(Note) The documents designated with \* should be attached to the application form for verification.

#### 2. Selection of target verification technologies

Based on the description of the application and the advice from the Technology Panel, a Verification Organization selects target verification technologies and obtains approval from the Ministry of the Environment. The selection criteria are as follows:

- a. Technological requirements:
  - Does the applied technology fall under the target verification technology field described in "1. Target technologies" on page 1?
  - Is the application form properly filled in?
- Is the technology at a commercialization stage?
- b. Possibility of verification
  - Is it possible to complete the verification from cost and organizational standpoints?
  - Is it possible to establish a suitable Test Plan?
  - Is it possible that a verification applicant bear the cost for a verification test?
- c. Environmental protective effect, etc.
  - Is it possible to scientifically explain the principle and mechanism of the technology?
  - Is there any possibility of the technology causing side environmental issues?
  - Does it provide a high environmental protective effect?

At the selection stage, a verification applicant can confer with the Verification Organization concerning the specific methods of verification, including the period and date of tests. In addition, the selection result of each applied technology shall not be opened, in principle.

#### IV. Preparation for the verification tests

##### 1. Determination of verification items

###### (1) Verification items regarding sensible heat control performance

The possible verification items regarding sensible heat control performance to be examined in the verification test are summarized in Table 2. Test items listed in Table 3 shall also be measured for reference items. In addition to the test items specified above, the Verification Organization examines the necessity for other verification items and describes all of the verification items regarding sensible heat control performance in the Test Plan.

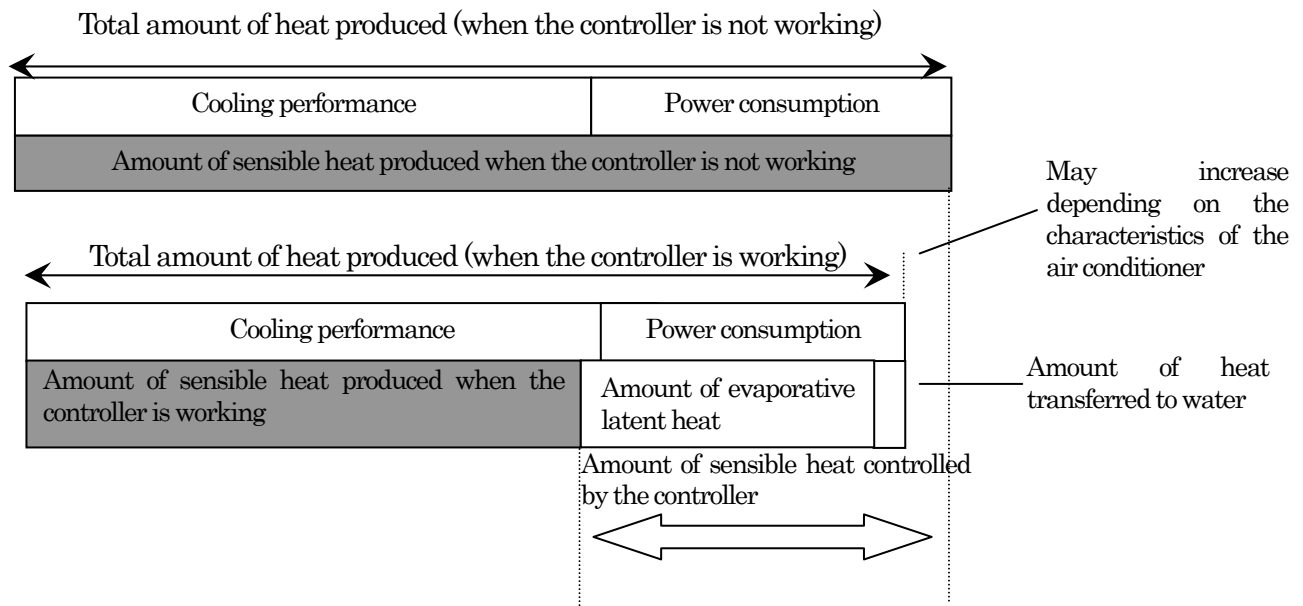
**Table 2 Verification items regarding sensible heat control performance**

Test item	Description
Sensible heat control rate	Rate of sensible heat controlled by the installation of the sensible heat controller. Calculated from the amount of sensible heat controlled and the amount of sensible heat produced when the controller is not working (%).
Cooling performance improvement rate	Rate of improvement in cooling performance caused by the sensible heat controller (%)
Cooling COP improvement rate	Rate of improvement in cooling COP caused by the sensible heat controller (%)

**Table 3 Reference data to be collected**

Test item	Description
Power consumption reduction rate	Rate of reduction in power consumption caused by the sensible heat controller (%)
Rate of latent heat release	Rate of the amount of heat converted into latent heat due to the vaporization of sprayed water. Calculated from the amount of evaporative latent heat and the amount of sensible heat produced when the controller is not working (%).
Rate of heat transfer to water	Rate of the amount of heat transferred to water left in the drain without being evaporated. Calculated from the amount of heat transferred to water and the amount of sensible heat produced when the controller is not working (%).

**Fig. 1 Image of sensible heat control performance**



**(2) Verification items regarding operations and maintenance**

The verification items presumably required for quantitative and qualitative evaluation of the performance in and cost for O&M are summarized in Table 4. In addition to the test items specified above, the Verification Organization examines the necessity for other verification items and describes all of the verification items regarding O&M determined in the Test Plan.

**Table 4 Verification items regarding operations and maintenance**

Category	Verification item	Description	Major relevant cost
Environmental impact	Amount of environmentally-unfriendly substances discharged	Amount of environmentally-unfriendly substances, such as antirusts and scale removers, discharged per unit hour or season	Cost for consumables
	Measures against destructive fungi	Check for measures to prevent reproduction of Legionella bacteria or other destructive fungi that may emerge following the use of standing water, recycling of water, or retention of drain water.	—
Electricity use and material consumption	Electricity consumption	Electricity consumption per unit time (kWh/h)	Cost for electricity
	Water consumption	Water consumption per unit time (amount of sprayed water if water is not collected after being sprayed)	Cost for water
	Other chemical consumption such as reactant	Amount of chemicals, such as antirusts and scale removers, consumed per unit hour or season	Cost for consumables
O&M performance	Number of operators, and the level of operator skill required for O&M of the target verification apparatus	Maximum number of operators and working days (man-day) for each operational item The technicality and difficulty of O&M shall be described.	—

	Effect and ease of maintenance	Details and effect of maintenance required for maintaining the performance of the target verification apparatus and air conditioners with which the apparatus is used (frequency of replacement of nozzles, valves, and other parts, scale removal, application of agents, etc.)	Maintenance cost
	Evaluation of O&M manual	Readability, understandability, and problems	—

(Items to be described as reference data in the report)

O&M performance	Possibility of having an impact on the cooling performance or life of air conditioners	Possibility of causing fin decay, scale adhesion, reduced performance of the fan, and other adverse effects after long-term use, and measures against those adverse effects	—
	Reliability of the target verification apparatus	Check whether the target verification apparatus has obtained certification from the Japan Water Works Association for its quality.	—
	Method of restoring from problems	Ease of and problems in resumption	—

## 2. Establishment of the Test Plan

The Verification Organizations establish the Test Plan based on information provided by the environmental technology developers and the advice of the Technology Panel. If the environmental technology developers do not approve the Test Plans, the Verification Organizations will consult as required with the Ministry of the Environment to determine the necessary actions.

The items to be included in the Test Plan are listed in Appendix 2.

## V. Verification test methods

### 1. Operations and maintenance

The target verification apparatus should be inspected periodically and kept in a suitable condition in order to maintain stable operation and thereby ensure proper operation and increase the efficiency of operation throughout the test period. All procedures involving inspection and O&M should be adjusted in advance by the Verification Organization, described in the Test Plan, and confirmed by the parties concerned.

#### (1) Regular operations and maintenance

- O&M to ensure proper operation of the target verification apparatus during the test period should be performed in accordance with the O&M manual.
- Calibration should be performed in accordance with the O&M manual. Calibration should also be performed at least as frequently as specified in the O&M manual.
- In selecting the verification items regarding O&M, the problems that may arise when an operator is not sufficiently capable of conducting O&M should also be considered.

#### (2) Actions in the event of abnormal conditions

The Verification Organization will inform the environmental technology developer as soon as possible in the event of abnormal conditions. The Verification Organization should take the actions for restoring the apparatus to stable operation specified by the environmental technology developer. In the event of unforeseen circumstances, the Verification Organization will take the actions together with the environmental technology developer.

The data obtained under the abnormal conditions will not be used in the statistical analysis for the Verification Report, but shall be described and analyzed in the Verification Report. As soon as stable operation is resumed, alternative measurements will be made.

The conditions, cause and result, and method for resumption under abnormal conditions shall be described in the Verification Report. When the cause is unclear or it is not possible to judge whether the conditions are indeed unusual, the measurement results obtained during the period are used in the statistical analysis for the Verification Report.

The Verification Organizations should install experimental apparatuses that are modified to ensure the safety of the experimental environment and the operators, even if such modifications may lead to inadequate operation or inadequate performance of the target verification apparatuses.

#### (3) Cost estimation

The Verification Organizations will collect and sort the data required for cost estimation for O&M, such as power and water consumption and the prices of consumables, in cooperation with the environmental technology developers.

### 2. Test conditions

#### (1) Setting for test conditions

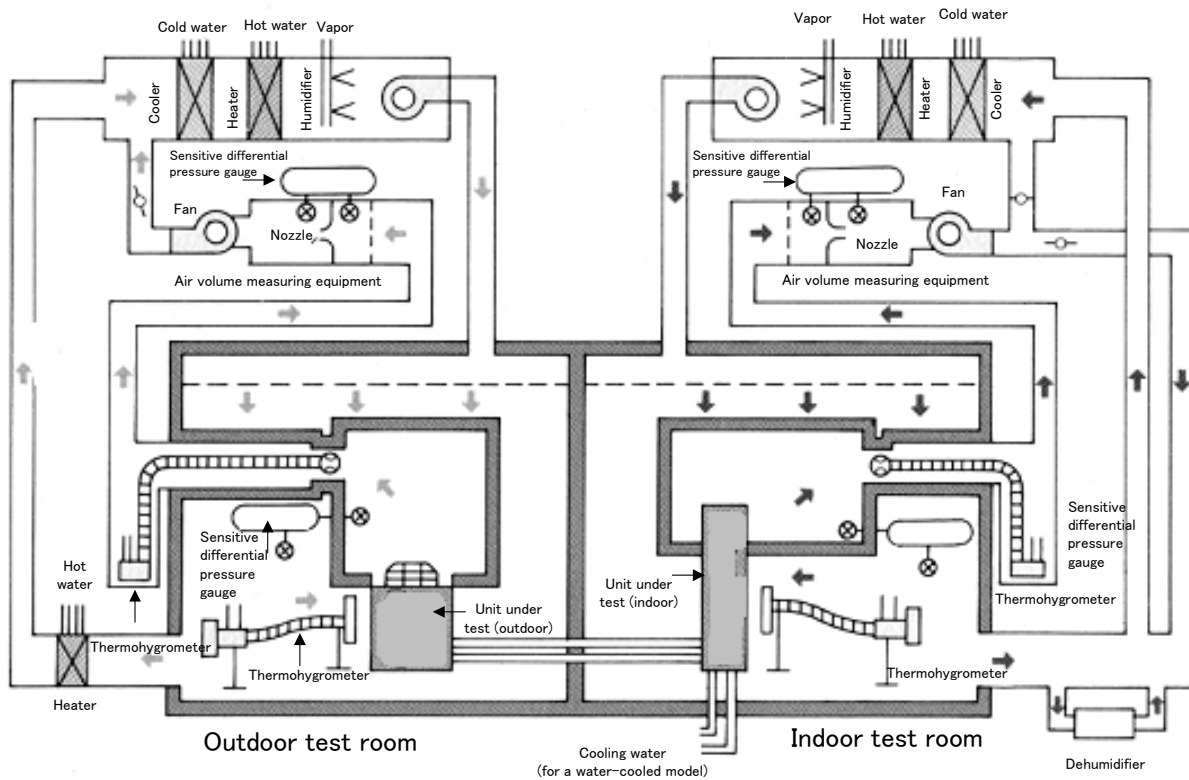
A verification test of a heat island control technology shall be conducted under the following conditions. The Verification Organization shall consider test conditions that comply with relevant JIS standards in preparing a Test Plan.

- Determine the conditions of a test room and installation with reference to “4. Cooling Test” and “Appendix F: Outdoor Air Enthalpy Test Method” of JIS B 8615-1 (Non-ducted air conditioners and heat pumps – Testing and rating for performance).
- Outdoor and indoor temperature conditions are listed in Table 5. Test condition 1 is based on T1 specified in JIS B8615-1 (test conditions assuming mild climate areas), and test condition 2 assumes general summer temperatures and humidity in large cities and is based on past data obtained from the Japan Meteorological Agency. However, if a verification test cannot be conducted under test condition 2 in Table 5 due to the characteristics of the target verification apparatus, the Verification Organization may change the test condition 2 to some extent. Test condition 3 is determined by consultation between Verification

Organizations and the environmental technology developer in order to allow for the characteristics of each target technology to be sufficiently evaluated. Verification Organizations shall detail the types of situations assumed for testing conditions in the Verification Report. The Verification Organization shall assemble the equipment under test in such a way that a test can be conducted under the conditions shown in Table 5 unless the operation of the sensible heat controller makes it difficult to maintain the conditions.

- The Verification Organization shall keep temperature, humidity, water pressure, water temperature, the air conditioner to be used, and other test environments as constant as possible so that test conditions are not influenced by the timing of the verification test and the Test Site.
- An air conditioner in which the sensible heat controller is installed shall have a rated power consumption of 5 horsepower (3.73 kW) for cooling and a coefficient of performance (COP) of 2.5 or greater. The air conditioner should be chosen by consultation between Verification Organizations air conditioner and the environmental technology developer. If the controller is installed in an inverter air conditioner, it shall be operated at a fixed frequency.
- Amounts of water to be sprayed, spray pressures, and other operational conditions of the target verification apparatus shall be set appropriately by the environmental technology developer.
- Adjust the position of the dry bulb in the outdoor vent so that water mist does not affect the reading of the dry bulb when the sensible heat controller is working.

**Figure 2 Measuring equipment based on the air enthalpy method**



Source: Brochure of the Japan Refrigeration and Air Conditioning Industry Association

**Table 5 Air humidity and temperature conditions for testing (for reference)**

Item	Test condition 1 (T1 specified in JIS B8615-1*)	Test condition 2 (General summer temperature)**	Test condition 3 (Optimum conditions for use of apparatus)***
Temperature of suctioned air in the outside			(Verification Organizations shall determine by consultation with the environmental technology developer)
Dry bulb temperature	35°C	30°C	
Wet bulb temperature	24°C	25°C	
Temperature of suctioned air in the inside	27°C		
Dry bulb temperature	19°C		
Wet bulb temperature			

Note 1: \* Test condition assuming mild climate areas

Note 2: \*\* Based on the average summer (August) temperature and humidity (converted from relative humidity) in large cities (Tokyo and Osaka) calculated from statistical data compiled by the Japan Meteorological Agency for the period of 1999 to 2003.

Note 3: \*\*\* Verification Organizations shall detail the types of situations assumed for testing conditions in the Verification Report.

**(2) Test conditions to be recorded**

The Verification Organizations shall record the following parameters and describe them in the Verification Report.

- Temperature and pressure of water sprayed or dropped
- Dry and wet bulb temperatures of air suctioned from inside or outside of the room

### 3. Measurement methods

#### (1) Measurement methods for verification items regarding sensible heat control performance

Measurement methods for verification items regarding sensible heat control performance from the outdoor air-cooling unit and data to be collected for reference are listed in Tables 6 and 7, respectively.

Measurement methods for items other than the test items specified below shall be specified in the Test Plan with reference to the relevant JIS standard (JIS B 8615-1 [Appendix A “Test Procedures,” Appendix D “Measuring Equipment,” and Appendix E “Air Volume Measurement”]) and relevant regulations.

Measurement shall be repeated 7 times at intervals of 5 minutes after the apparatus is stabilized. For intermittent operation (spray water intermittently, for example), which may cause fluctuations in measurements, the measurement time shall be adjusted to count the fluctuations.

**Table 6 Measurement methods for verification items regarding sensible heat control performance**

Measurement item	Description
Sensible heat control rate	<p>Measure the amounts of sensible heat produced from air discharged from the outdoor unit when the sensible heat controller is working and not working. Determine the amount of sensible heat controlled from the balance between the amounts measured.</p> <p>Measure the amounts of sensible heat produced from air discharged with reference to the outdoor air enthalpy test method specified in JIS B 8615-1. Determine the sensible heat control rate by dividing the amount of sensible heat controlled by the amount of sensible heat produced from the outdoor air-cooling unit when the controller is not working. The calculation method is shown in Table 8.</p>
Cooling performance improvement rate	<p>Determine the cooling performance when the sensible heat controller is working and not working according to the indoor air enthalpy test method with reference to JIS B 8615-1. Determine the cooling performance improvement rate by dividing the cooling performance when the controller is working by that when the controller is not working. The calculation method is shown in Table 8.</p>
Cooling COP improvement rate	<p>Measure the cooling COP of the sensible heat controller when the sensible heat controller is working and not working. Determine the improvement rate by dividing the COP when the controller is working by that when the controller is not working. The calculation method is shown in Table 8.</p>



**Table 7 Measurement methods for reference items**

Reference item	Description
Power consumption reduction rate	Use an integrating wattmeter to measure power consumption when the sensible heat controller is working and not working. Divide the power consumption when the controller is working by that when the controller is not working to determine the power consumption reduction rate. The calculation method is shown in Table 9.
Rate of latent heat release	Determine the temperature and amount of evaporation of water sprayed, and find the amount of heat that the evaporated water captured from air (sum of the heat required for evaporation and sensible heat of water due to a difference between air and water temperatures). Divide the result by the amount of sensible water produced from the outdoor air-cooling unit when the controller is not working to determine the rate of latent heat release. The calculation method is shown in Table 9.
Rate of heat transfer to water	Calculate the amount of heat required for the temperature rise of water left without being evaporated from the temperatures of sprayed water and water in the drain, and the amount of water in the drain. Divide the result by the amount of sensible heat produced from the outdoor air-cooling unit when the controller is not working. The calculation method is shown in Table 9.

**Table 8 Calculation methods for verification items regarding sensible heat control performance**

Verification item	Calculation method	
Sensible heat control rate	<p>The amount of dry air contained in the air discharged from the outdoor unit is equal to the amount of dry air contained in the air taken into the unit; therefore, the amount of air is calculated as the amount of dry air which is passed through, using the following equation.</p> $G_d = \frac{60q}{u_o(1+\chi_o)} \quad (1)$ <p>where, <math>G_d</math>: amount of dry air passed through [kg/Hr]  <math>q</math>: amount of air discharged (measured value) [m<sup>3</sup>/min]  <math>u_o</math>: specific volume of the air discharged [m<sup>3</sup>/kg]  <math>\chi_o</math>: absolute humidity of the air discharged [kg/kg (DA)]</p> <p>Using the following equation, calculate the sensible heat of the air flowing into the outdoor unit.</p> $H_i = \frac{G_d(a t_i + b t_i \chi_i)}{3600} \quad (2)$ <p>where, <math>H_i</math>: sensible heat of the air flowing into the unit [kW]  <math>a</math>: specific heat of dry air [1.006 (kJ/kg·°C)]  <math>b</math>: specific heat of water vapor [1.805 (kJ/kg·°C)]  <math>t_i</math>: dry bulb temperature of the air taken in (measured value) [°C]  <math>\chi_i</math>: absolute humidity of the air taken in [kg/kg (DA)]</p> <p>Using the following equation, calculate the sensible heat discharged from the outdoor unit.</p> $H_o = \frac{G_d(a t_o + b t_o \chi_o)}{3600} \quad (3)$ <p>where, <math>H_o</math>: sensible heat of the air discharged from the unit [kW]  <math>t_o</math>: dry bulb temperature of the air discharged (measured value) [°C]  <math>\chi_o</math>: absolute humidity of the air discharged [kg/kg (DA)]</p> <p>Using the following equation, calculate the sensible heat produced by the outdoor unit due to the operation of the air conditioner.</p> $H = H_o - H_i \quad (4)$ <p>where, <math>H</math>: sensible heat produced by operation of the air conditioner [kW]</p> <p>Using the following equation, calculate the sensible heat control rate due to operation of the sensible heat controller.</p> $E = \frac{H_{off} - H_{on}}{H_{off}} \cdot 100 \quad (5)$ <p>where, <math>E</math>: sensible heat control rate [%]  <math>H_{off}</math>: sensible heat produced when the sensible heat controller is not working [kW]  <math>H_{on}</math>: sensible heat produced when the sensible heat controller is working [kW]</p>	
	Cooling performance improvement rate	<p>Using the following equation, calculate the cooling performance improvement rate due to operation of the sensible heat controller.</p> $A = \frac{\phi_{on} - \phi_{off}}{\phi_{off}} \cdot 100 \quad (6)$ <p>where, <math>A</math>: cooling performance improvement rate [%]  <math>\phi_{off}</math>: cooling performance when the sensible heat controller is not working (measured value) [kW]  <math>\phi_{on}</math>: cooling performance when the sensible heat controller is working (measured value) [kW]</p>
		<p>Using the following equation, calculate the cooling COP improvement rate due to operation of the sensible heat controller.</p> $C = \frac{(\phi_{on}/P_{on}) - (\phi_{off}/P_{off})}{(\phi_{off}/P_{off})} \cdot 100 \quad (8)$ <p>where, <math>C</math>: cooling COP improvement rate [%]</p>

**Table 9 Calculation methods for reference measurement data**

Reference item	Calculation method
<p>Power consumption reduction rate</p>	<p>Using the following equation, calculate the power consumption reduction rate due to operation of the sensible heat controller:</p> $B = \frac{P_{off} - P_{on}}{P_{off}} \cdot 100 \quad (7)$ <p>where, B: power consumption reduction rate [%]  P<sub>off</sub>: power consumption when the sensible heat controller is not working (measured value) [kW]  P<sub>on</sub>: power consumption when the sensible heat controller is working (measured value) [kW]</p>
<p>Rate of latent heat release</p>	<p>Using the following equation, calculate the amount evaporated of all the water used for the sensible heat controller operation.</p> $W1 = Gd(\chi_{oon} - \chi_{ion}) \quad (9)$ <p>where, W1: amount of water evaporated [kg/Hr]  χ<sub>oon</sub>: absolute humidity of the air discharged when the sensible heat controller is working [kg/kg (DA)]  χ<sub>ion</sub>: absolute humidity of the air taken in when the sensible heat controller is working [kg/kg (DA)]</p> <p>Using the following equation, calculate the rate of latent heat release due to operation of the sensible heat controller:</p> $D = \frac{[c(\text{toon} - \text{tw}) + d]W1}{3600H_{off}} \cdot 100 \quad (10)$ <p>where, D: rate of latent heat release [%]  c: specific heat of water [4.184 (kJ/kg·°C)]  d: latent heat of water evaporation [2501 (kJ/kg·°C)]  toon: dry bulb temperature of the air discharged when the sensible heat controller is working (measured value) [°C]  tw: temperature of the water used for operation of the sensible heat controller (measured value) [°C]</p>
<p>Rate of heat transfer to water</p>	<p>Using the following equation, calculate the rate of heat transferred to water discharged as excess without evaporating when the sensible heat controller is working.</p> $F = \frac{c(\text{tx} - \text{tw})W2}{3600H_{off}} \cdot 100 \quad (11)$ <p>where, F: rate of heat transfer to water [%]  tx: temperature of excess water (measured value) [°C]  W2: amount of excess water generated by operation of the sensible heat controller (measured value) [kg/Hr]</p>

(2) Measurement methods for verification items regarding operations and maintenance

The test methods for verification items regarding operations and maintenance are summarized in Table 10.

The unit prices for estimation of the cost of electricity, water, and others shall be set appropriately by the Verification Organizations.

Measurement methods for items other than the test items specified below shall be specified in the Test Plan with reference to the relevant JIS standards and regulations. The Verification Organizations should describe the test items and test methods in the Verification Report.

**Table 10 Measurement methods for verification items regarding operations and maintenance**

Category	Verification item	Description
Environmental impact	Amount of environmentally-unfriendly substances discharged	(Determine the amounts of environmentally-unfriendly substances such as antirusts or scale removers added to sprayed water or consumed regularly in other ways.) Appropriately set by the Verification Organization.
	Measures against destructive fungi	Evaluate measures to prevent reproduction of destructive fungi in the O&M manual.
Electricity use and material consumption	Electricity consumption	Determine from the value of the current integrators in all apparatuses (kW).
	Water consumption	Appropriately set by the Verification Organization.
	Other chemical consumption such as reactant	Appropriately set by the Verification Organization.
O&M performance	Number of operators, and the level of operator skill required for O&M of the target verification apparatus	Evaluate based on the results of actual operation.
	Effect and ease of maintenance	Evaluate the duration of control performance, fin decay protection performance, etc. in technical specifications or maintenance procedures provided by the environmental technology developer and recommended use conditions specified by them. If required, check the effects of maintenance in pictures of the outdoor air-cooling unit taken before and after the maintenance.
	Evaluation of O&M manual	Evaluate based on the results of actual use.

(Items to be described as reference data in the report)

O&M performance	Possibility of having an impact on the cooling performance or life of air conditioners	Evaluate based on technical specifications provided by the environmental technology developer and recommended use conditions specified by them. Examine past case data on decay, scale adhesion, reduced performance of the fan, and other adverse effects, if submitted.
	Reliability of the target verification apparatus	Evaluate measures to ensure the startability and operability, such as intermittent operation and spraying of water, in technical specifications provided by the environmental technology developer. Check whether the target verification apparatus has obtained certification from the Japan Water Works Association for its quality.
	Method of restoring from problems	Check ease of restoring from problems in the O&M manual and the results of actual operation.

#### 4. Management of analytical accuracy

In order to ensure accuracy at a certain level in measurement of the effects of the target apparatus, the data should be managed properly during the entire test period, from operation to measurement. Conduct management to ensure analytical accuracy with reference to “JIS B 8615-1.”

##### (1) Evaluation of performance and maintenance of instruments and equipment

###### 1) Operation

A cooling performance test shall be conducted according to the conditions specified in JIS B 8615-1.

- Adjust the positions of the grill and the damper and the fan rotation speed so that the maximum cooling performance can be exploited unless they are specified by the manufacturer. If these conditions are set in a way that the maximum performance cannot be exploited, describe these conditions with the performance.
- Wait for one hour or longer until the apparatus is stabilized before starting measurement.

###### 2) Instrumental measurement

A cooling performance test shall be conducted according to the conditions specified in JIS B 8615-1.

###### 1. Flow volume measurement conditions

Refer to the conditions specified in Appendix E of JIS B 8615-1.

Maintain the static pressure of the vent of the air conditioner equipped with the target verification apparatus at 0 Pa when determining the air volume for the verification test after the operation (amount of flocculated water) is stabilized. The air volume shall be measured in cubic meters of standard air defined in Table 11 per second (m<sup>3</sup>/s) (or cubic meters of standard air per minute [m<sup>3</sup>/min]).

**Table 11 Definition of standard air (excerpt from JIS B 8615-1) (for reference)**

Definition of standard air	Dry air with a density of 1.204 kg/m <sup>3</sup> at a temperature of 20.0°C and at a standard atmospheric pressure of 101.325 kPa.
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###### 2. Measurement conditions of temperature, pressure, electricity, and water volume

Refer to the conditions specified in Appendix D of JIS B 8615-1.

##### (2) Evaluation of reliability of measurement

###### 1) Measurement errors

For measurement error tolerances in a cooling performance test, refer to the conditions specified in JIS B 8615-1.

**Table 12 Measurement error tolerances (excerpt from JIS B 8615-1): for reference**

Measurement item	Measurement error tolerance (uncertainty)*
Water	
Temperature	±0.1°C
Temperature difference	±0.1°C
Volume flow rate	±5%
Static pressure difference	±5 Pa
Air	
Dry bulb temperature	±0.2°C
Wet bulb temperature	±0.2°C
Volume flow rate	±5%
Static pressure difference	Pressure ≤ 100 Pa: ±5 Pa Pressure > 100 Pa: ±5%
Electric quantity	±0.5%
Time	±0.2%
Mass	±1.0%
Speed	±1.0%

Note\*: A measurement error tolerance (uncertainty) refers to an estimated range in which the true value of an amount to be measured lies.

Reference: Generally, measurement errors consist of many elements. Some of these elements can be estimated based on the statistical distribution of a series of measurements, and expressed as standard deviations. Other elements can be estimated based on experience and other information.

## 2) Tolerances of variations in measurements

For maximum tolerances of variations in measurements in a cooling performance test, refer to the conditions specified in JIS B 8615-1.

A maximum tolerance of variations in measurements refers to a tolerance from a target test condition within which the maximum and minimum measurements observed in a test must fall. A maximum tolerance of variations expressed as a percentage is a tolerance from the average of test conditions or measurements expressed as a percentage.

If the intermittent operation of the target verification apparatus prevents the air conditioner in the test room from functioning normally (unsteady operation), triple the values in the following table.

**Table 13 Tolerances of variations in measurements (excerpt from JIS B 8615-1): for reference**

Measurement item	Average tolerance of variations	Maximum tolerance of variations
Temperature of suctioned air in the inside of the room		
Dry bulb temperature	$\pm 0.3^{\circ}\text{C}$	$\pm 1.0^{\circ}\text{C}$
Wet bulb temperature	$\pm 0.3^{\circ}\text{C}$	$\pm 0.5^{\circ}\text{C}$
Temperature of suctioned air in the outside of the room		
Dry bulb temperature	$\pm 0.3^{\circ}\text{C}$	$\pm 1.0^{\circ}\text{C}$
Wet bulb temperature	$\pm 0.3^{\circ}\text{C}$	$\pm 0.5^{\circ}\text{C}$
Temperature of air discharged in the outside		
Dry bulb temperature		$\pm 1.0^{\circ}\text{C}$
Air volume flow rate	$\pm 5^{\circ}\text{C}$	$\pm 10^{\circ}\text{C}$
Voltage	$\pm 1\%$	$\pm 2\%$
Static pressure outside the unit to air flow	$\pm 5\text{ Pa}$	$\pm 10\text{ Pa}$

### (3) Data management and evaluation

#### 1) Points to remember when evaluating data

The use conditions of the target verification apparatus, work processes, measurement timing, and other conditions shall be carefully considered in evaluating data obtained in a test.

#### 2) Handling of outliers and missing values

If there are wide variations in measurements, they are considered as not reliable. Thus, perform measurements again or handle them as missing values and conduct a test again. These problems require an enormous amount of labor, time and cost, and an increased number of outliers or missing values influence the evaluation of the entire test result. Thus, carefully check in advance for factors that may affect measurements, or take other measures to minimize the number of outliers or missing values. Careful consideration shall be given to how outliers or missing values, if any, were caused. They should be recorded to help to prevent the reoccurrence of similar problems.



## VI. Preparation of the Verification Report

The results obtained in the verification test shall be reported in the Verification Report. All data, including the results of the verification test for the period from startup to the end of operation, all actions taken for O&M, and any changes during the test period, shall be described in the Verification Report.

The Verification Report shall contain the following:

- Executive summary (Refer to Appendix 3.)
- Overview and purpose of the verification test
- Overview of the target verification technology and apparatus
  - Principle and configuration of the target verification apparatus
  - Target verification technology specifications and capabilities for suppressing sensible heat
- Manufacturer of product (Name, address, TEL)
- Serial number
- Method and conditions of the verification test
  - Schedule of the entire verification test
  - Conditions and test equipment of the verification test
  - Verification items regarding sensible heat control performance (method and date)
  - Verification items regarding O&M (method and date)
- Results and discussions of the verification test (The measurement and analytical results shall be shown in tables and graphs.)
  - Verification items regarding sensible heat control performance
  - Verification items regarding O&M
  - Record of measurement processes (settings of the conditions of measuring equipment and results, variations in measurements in performance tests, etc.)
- Appendix
  - Quality control of data
  - Auditing of the quality management system

The Verification Organization prepares a draft of the Verification Report and, after obtaining the consent of the environmental technology developer concerning mistakes and the like in the description and discussions, and then reviewed by the Technology Panel, finalizes the Verification Report. The Verification Report submitted to the Verification Management Organization shall be discussed by the working group and approved by the Ministry of the Environment.

## VII. Remarks in conducting the verification test

### 1. Quality control of data

#### (1) The method for quality control of data

The quality of data obtained on the verification items should be managed in accordance with the method specified in Section V. Verification test methods, 4. Management of analytical accuracy.

#### (2) Measurement and data acquisition

For quality control of data, the following requirements should be given during measurement and data acquisition:

- Any assumptions on which the Test Plan is based as well as data on the air conditioner in which the target verification apparatus is installed should be reported to and approved by the Technological Panel during design of the Test Plan.
- Any non-standard air conditioner or analytical methods and instruments that may affect the representativeness of data should be validated and documented.
- All analytical methods and instruments used should be documented.
- The requirements for the calibration of all analytical instruments and procedures, including the calibration standards, should be specified in the Test Plan.
- Any type of data not obtained by measurement, such as that obtained through interviews and the like, should be examined to determine the limits of its use.

### 2. Management, analysis, and presentation of data

The data obtained in the verification test includes quantitative data such as amounts of sensible heat produced, cooling performance, and amounts of water evaporated as well as qualitative data such as that on the reliability and operability of the system and operators demands. The methods for management, analysis, and presentation of these data are as follows:

#### (1) Data management

Data should be managed securely, as described in “Appendix 0: Quality management system to be constructed at the Verification Organizations, 3 Quality management system, (3) Control of documents and records.”

#### (2) Data analysis and presentation

The data obtained in the verification test should be analyzed statistically and presented. All mathematical expressions used for statistical analysis shall be given in the Verification Report. The data not subjected to the statistical analysis (including that obtained under abnormal conditions) shall be included in the Verification Report as an appendix.

##### **i Analysis and presentation of verification items regarding sensible heat control performance**

- Data showing changes in volume, and recordings of dry and wet bulb temperature of the air discharged from the outdoor unit when the sensible heat controller is working and not working
- Data showing changes in the readings of the wet and dry bulbs in the inlet of the outdoor unit when the sensible heat controller is working and not working
- Data showing changes in the sensible heat control rate
- Data showing changes in cooling performance when the sensible heat controller is working and not working (Use data observed inside the test room.)
- Data showing changes in the cooling performance improvement rate
- Data showing changes in the power consumption when the sensible heat controller is working and not working
- Data showing changes in power consumption

## ii Analysis and presentation of verification items regarding O&M

- Findings on the number of operators and the level of operator skill required for O&M of the target verification apparatus
- Findings on target verification apparatus safety
- Findings on the emergency response
- Findings on consistency of treatment performance
- Findings on failure recovery method
- Findings on evaluation of O&M manual
- Other findings

### 3. Environment, health and safety

The Verification Organization should take strict environment, health, and safety measures with respect to the verification test. In establishing a Test Plan, relevant environmental problems and potential hazards regarding the verification test and Test Site should be identified, and countermeasures against them should be specified. The Verification Organization should inform the personnel at the Test Site, including employers and employees who are not involved in the verification test, of the potential hazards and the countermeasures against them. The following, among others, are to be discussed in establishing a Test Plan:

- Precaution regarding the operation of the target verification apparatus and emission of processed wastewater
- Biological, chemical and electrical hazards
- Material Safety Data Sheet
- Compliance with local regulations regarding electricity and plumbing
- Prevention of fires
- Confirmation of emergency contacts (emergency medical, fire fighting, etc.)
- Ensuring of occupational health and safety
- Others

### 4. Fees

#### (1) Setting up and collection of fees

Among all the expenses for the verification test, the environmental technology developer shall bear the fees for three of the expense items: "measurement, analysis, and the like," "expendables associated with testing," and "travel expenses (i.e., of the Verification Organization)."

When announcing a call for the submissions of target verification technologies, the Verification Organization shall determine the estimation of these three items, register the estimated fee at the Verification Management Organization, and show the amount of the estimated fee explicitly at the time of the announcement. The major contents of the fee items that need to be calculated are shown in (2), and the Verification Organization shall determine the estimated fees in consultation with the Verification Management Organization as necessary. In this field, the ratio of fixed cost (equipment cost) is large among the costs related to a verification test and the fee fluctuates significantly by the number of applications because simulation equipment is used in the test. It is desirable that the Verification Organization publicly disclose the fact that the fee will fluctuate by the number of application or the content of an applied technology when collecting target technologies. In addition, the Verification Organization desirably reduces the ratio of the fixed cost, which causes fluctuation of the cost to as much an extent as possible.

After developing the Test Plan, but before starting the verification test, the Verification Organization shall finalize the amount of the test fee and the due date of the payment, on which an adjustment has been made with the Verification Management Organization, and notify the above information to the environmental technology developer. The amount of fee shall be determined in consultation with the Verification Management

Organization and the environmental technology developer, as necessary. In principle, the payment due date shall be before the starting date of the verification test. The environmental technology developer shall receive the above notification, and make a payment for the fee to the Verification Organization by the due date.

When presenting the finalized test fee, the Verification Organization shall ensure the environmental technology developer be informed that verification items and incurred fees may be added in the course of the verification test; and when the addition of a test item and fee is made, the Verification Organization shall discuss with the Verification management Organization and the environmental technology developer.

If a verification test was not completed for any reason, the Verification Organization shall explain the circumstances for the incompleteness to the Ministry of the Environment and Verification Management Organization to obtain an approval from them, and then discuss with the environmental technology developer, calculate the expenses involved in the portion of the test carried out, and determine the revised amount of fee which needs to be paid by the environmental technology developer.

## (2) Fee items

- Measurement, analysis, etc.

This fee item is the expenses, such as measurement associated with verification items of waste gas treatment performance and environmental load, analysis, and the O&M item survey. Mainly the following expenses are included:

- Labor costs (for arrangement of external institutions, monitoring test status and others)
- Wages for assistant personnel (for arrangement of external institutions, monitoring test status and others)
- Measurement and analysis costs (measurement of temperature and others, commission of analysis and operation of simulation devices, etc.)
- Rental fees of testing air-conditioning equipment and others

- Expendables associated with the test

This fee item is the expenses for the expendables accompanying the implementation of the test. Mainly the following expenses are included:

- Insulation board
- Mending tape
- Distilled water
- Salt
- Recording paper

- Travel expenses (i.e., of the Verification Organization)

This item is the expenses for travel to the Test Site, which are made by the Verification Organization, and the typical expenses are as follows:

- Expenses of public transportation (e.g., fare, express fare)
- Expenses of vehicle use (e.g., vehicle use fee, fuel fee, highway toll)
- Daily travel allowances
- Accommodation fees

- Other

The Verification Organization can include general administrative costs in the fee as necessary.

## 5. Change and cancellation of verification tests

### (1) Addition of verification items by request of the environmental technology developer

When addition of verification items is requested by the environmental technology during the verification test, the Verification Organization shall make an assessment whether the addition is an appropriate revision in light of the purpose of the project, which is the objective verification by the third party, in consideration of the opinions of the Technology Panel, and may make revisions of the Test Plan in consultation with the Verification Management Organization and the environmental technology developer.

If that revision of the test fee arises due to the change, the Verification Organization shall determine a new amount of the test fee, which should be paid by the environmental technology developer in consultation with the Verification Management Organization and the environmental technology developer. Once the new fee is set, the Verification Management Organization shall promptly prepare the paperwork for collecting supplemental fee from the environmental technology developer.

## (2) Cancellation (declining) of test by request of the environmental technology developer

When cancellation (declining) of the verification test is requested by the environmental technology developer during the course of the verification test, the Verification Organization shall report the request of cancellation to the Ministry of the Environment and the Verification Management Organization to obtain an approval, and cancel the test.

If the revision of the test fee arises due to the change, the Verification Organization shall determine a new amount of the test fee, which should be paid by the environmental technology developer in consultation with the Verification Management Organization and the environmental technology developer. (※) Once the new fee is set, the Verification Management Organization shall promptly prepare paperwork for the refund of the test fee to the environmental technology developer.

Note (※): The environmental technology developer shall bear the portions of cost, which were required up to the point of cancellation. For the remaining portion of the paid-fee that has not been used by the time of cancellation, the Verification Organization shall determine whether or not to refund and use it for the research of technological improvement, etc. in consultation with the Verification Management Organization and the environmental technology developer. The Verification Organization shall provide the environmental technology developer the portion of the test data, which was obtained by the costs borne by the environmental technology developer.

## (3) Addition of test items by judgment of the Verification organization

When the Verification Organization has judged that addition of test item(s) is necessary in light of the purpose of the project, which is the objective verification by the third party, <sup>Note (\*)</sup> the Verification Organization shall revise the Test Plan in consultation with the Verification Management Organization and the environmental technology developer. <sup>Note (\*2)</sup>

If the revision of the test fee arises due to the change, the Verification Organization shall determine a new amount of the test fee, which should be paid by the environmental technology developer in consultation with the Verification Management Organization and the environmental technology developer. Once the new fee is set, the Verification Management Organization shall promptly prepare paperwork for collecting the supplemental fee from the environmental technology developer.

Note (\*): The situations include the cases in which some secondary impact that was not expected at the time of planning has been observed, and therefore it is judged that the verification item(s) should be added.

Note (\*2): If an agreement was not reached with the environmental technology developer regarding the revision of the test, the Verification Organization shall obtain an agreement from the environmental technology developer regarding the entry of description to the Test Report stating that the portion of data for the items, which should be measured based on the judgment of the Verification Organization, has not been obtained.

## Appendix 0: Quality management system to be constructed at the Verification Organizations

### Introduction

The Verification Organizations participating in the pilot project for the environmental technology verification should desirably construct the quality management system in accordance with JIS Q 9001:2000 (ISO9001:2000) “Quality management systems - Requirements,” JIS Q 17025:2000 (ISO/IEC 17025:1999) “General requirements for the competence of testing and calibration laboratories.” In this Appendix, some elements of the quality management system that are required to be constructed at Verification Organizations that do not have such a quality management system in accordance with the above standard will be described.

### 1. Scope

The quality management system specified in this Appendix is applicable to all departments or procedures relevant to the verification test in the Verification Organization. In addition, if part of the verification test is subcontracted to an external organization, that organization is also included in the scope of application.

The Verification Organization in which all departments relevant to the verification test have already received the following certification, JIS Q 17025:2000 (General requirements for the competence of testing and calibration laboratories) or JIS Q 9001:2000 (Quality management systems - Requirements), will be regarded as satisfying the requirements specified in this Appendix.

### 2. References

JIS Q 17025:2000 (ISO/IEC 17025:1999) General requirements for the competence of testing and calibration laboratories

JIS Q 9001:2000 (ISO 9001: 2000) Quality management systems – Requirements

### 3. Quality management system

#### (1) Organization and responsibility

The organization concerned shall be an entity that can be held legally responsible.

The responsibilities of key personnel in the organization relevant to the verification tests shall be clearly defined.

Appoint a member of the staff as a quality manager (however named) who, irrespective of his or her other duties and responsibilities, shall have defined responsibility and authority for ensuring that the quality system is implemented and followed at all times.

#### (2) Quality system

The organization concerned shall establish, implement, and maintain a quality management system appropriate to the scope of its activities regarding the verification test.

In the quality management system, the quality policy regarding the verification test and the procedures for the quality management system shall be documented. These documents shall be communicated to and understood by the appropriate personnel.

The policy shall include the following:

- a) The organization’s commitment to ensuring the quality of verification tests
- b) The organization’s statement on the quality standard of the verification tests
- c) The objectives of the quality system
- d) A description of the construction and implementation of the quality management system

In addition, the system for promoting verification tests, as well as the role, responsibility, and authority of the personnel concerned, shall be documented.

#### (3) Control of documents and records

The organization concerned shall control documents such as the standards regarding the verification tests (protocol for the verification and relevant standards) and the Test Plan, as well as drawings, software,

specifications, written directives, and manuals.

With respect to document control, the following shall be ensured:

- a) All documents shall be reviewed and approved for use by authorized personnel prior to their issuance.
- b) All documents shall contain a description of the relevant documents to ensure that appropriate documents can be found easily and are available at any time at all Test Sites.
- c) Invalid and/or obsolete documents shall be promptly removed or be assuredly prevented from unintended use.
- d) The management method for documents as data shall be specified and maintained.
- e) The form for records and the location of documents, as well as the inspection method, shall be specified and maintained.

In addition, records regarding the verification tests shall be identified, properly collected, indexed, specified for usage, filed for applications, maintained, and adequately discharged, and the storage period for them shall be decided. In particular, records in the original copy of the test data, data and information that enable trace audits, records of calibrations, records of the persons involved, each individual report published, and copies of calibration certificates shall be stored for a predetermined period.

#### (4) Subcontracting of the tests

If the organization concerned subcontracts to perform the verification test, the organization shall select a competent external organization, and demand the same quality management as that of the Verification Organization.

#### (5) Purchase of goods and services

The organization concerned shall examine, by appropriate measures such as inspection, whether the goods and services purchased from external sources that may affect the quality of verification tests satisfy the requirements specified in the protocol for the verification, and shall not use them for the verification tests until this examination is completed.

In addition, the organization shall evaluate the suppliers of goods and services, and make a list of the approved suppliers.

#### (6) Control of complaints and nonconforming tests

The organization concerned shall have a system and method that shall be implemented when any of its verification tests or the results of these tests do not conform to the protocol for the verification or other specifications for any reason. The organization shall have a system and method for handling contingencies such as complaints from environmental technology developers, the inhibition of impartiality, information leaks, and others. These systems shall include the person in charge and personnel required for the handling of such cases.

#### (7) Corrective and preventive actions

When any of its verification tests or the results of these tests do not or may not conform to the protocol for the verification or other specifications, the organization concerned shall investigate the reasons and take corrective or preventive actions.

#### (8) Audit

The organization concerned shall conduct audits to judge whether the verification test has been properly conducted. When the verification test is subcontracted to an external organization, the operations of the subcontracted organization shall be audited.

The audit shall be conducted at least once during the test period. If the verification test lasts for 2 years or more, the audit shall be conducted periodically, and the frequency of the audit shall desirably be more than once per year.

In addition, the audit shall be conducted by personnel who are independent of the verification test to as great an extent as possible. The results of the audit shall be reported to the superintendent of the organization concerned.

### 4. Technical requirements

### (1) Personnel

The organization concerned shall ensure the competence of all who operate specific equipment for the verification test, perform tests, evaluate results, and sign test reports. The personnel performing specific tasks shall be qualified on the basis of appropriate education, training, and/or demonstrated skills, as required.

### (2) Accommodation and environmental conditions

The facilities for the verification test, including but not limited to energy sources, lighting, and environmental conditions, shall be such as to facilitate correct performance of the tests. The organization concerned shall ensure that the environmental conditions do not invalidate the results or adversely affect the required quality of any measurement. Particular care shall be taken when the verification test is undertaken at sites other than a permanent laboratory facility.

The organization concerned shall monitor, control, and record environmental conditions of the test in accordance with the protocol for the verification, the Test Plan, and other standards. Tests shall be stopped when the environmental conditions jeopardize the results of the tests.

### (3) Test methods and method validation

The organization concerned shall use appropriate methods and procedures for all tests within its scope and determine the test methods in accordance with the protocol for the verification.

When the method to be used is not specified in the protocol for the verification, the organization concerned shall select either an appropriate method disclosed in international standards, regional or national standards, scientific texts, or the like, or a method specified by the manufacturer of the equipment. When it is necessary to use methods not covered by standard methods, these shall be subject to agreement with the verification applicant, and their validity shall be appropriately examined prior to use. Validation is the confirmation by examination that the requirements for a specific intended use are fulfilled. The validation shall be conducted based on discussion and subsequent approval by the Technology Panel.

When computers or automated equipment are used for data management, the organization concerned shall provide suitable environmental and operational conditions for the purpose of managing the computers and automated equipment properly, to ensure that there is no loss or improper conversion of data as a result of accidental erasure.

### (4) Equipment

The organization concerned shall be furnished with (or leased) all items of the equipment required for the execution of verification tests. If a piece of equipment can only be operated by authorized personnel, the organization concerned shall specify the equipment. Equipment that has been subjected to overloading or mishandling, gives suspect results, or has been shown to be defective or outside specified limits, shall be taken out of service until it has been repaired and confirmed to perform correctly.

### (5) Measurement traceability

All equipment used for tests that has a significant effect on the accuracy or validity of the result of the verification test shall be calibrated before being put into service.

### (6) Sampling

The organization concerned shall take samples of reagents, materials, or products in accordance with the protocol for the verification.

### (7) Handling of test and calibration items

If necessary, the organization concerned shall transport, receive, handle, protect, store, retain, and/or dispose of test items in accordance with the protocol for the verification.

### (8) Verification of data and assurance of test result quality

The data resulting from the verification test shall be recorded in such a way that trends are detectable and, where practicable, statistical techniques shall be applied to the review of the results. This verification shall be conducted by a person other than the one who conducts the verification test.

### (9) Reporting the results



The organization concerned shall report the results of the test conducted accurately, clearly, unambiguously, and objectively in accordance with the protocol of the verification tests.

## Appendix 1: Application form for verification

A verification applicant should submit the application form specified below. If apparatuses of the same series that are different in capacity are available, the target apparatus shall be described.

[Applicant]

Company name	
Address	
Division and name of person in charge	
Contact address	TEL: _____ FAX: _____
	e-mail: _____
Name of technology/product	

### 1. Overview of the technology

Configuration of apparatus and diagram of sensible heat control system
Principle
Features / advantages / selling points

## 2. In-house test results

		Item	Unit	Measurement value, etc.	
Test conditions	Indoor	Dry bulb temperature for inlet air	°C		
		Wet bulb temperature for inlet air	°C		
	Outdoor	Dry bulb temperature for inlet air	°C		
		Wet bulb temperature for inlet air	°C		
	Water temperature		°C		
	Water pressure		MPa		
	Operation mode		—		
	Air conditioner used with the target apparatus	Manufacturer/model name		—	
		Rated cooling performance (value in the catalog)		W	
COP for cooling (value in the catalog)		—			
Test results	Amount of evaporated water	Water usage	L/h		
		Amount of water evaporated	L/h		
	Reduction of power use	Power consumption when the apparatus is not	W		
		Power consumption when the apparatus is	W		

\* Give temperatures and the amount of water evaporated per unit time when operation is kept steady.

\* Specify the operation mode of the sensible heat controller, such as intermittent operation or automatic control.

3. Product data (Submit a technical specification as an attached document.)

Item		Description
Name of the target verification apparatus		
Model number		
Capacity of compatible air conditioners (W)		
Name of the manufacturer		
Contact address	TEL	( ) —
	Website	http//
	E-mail	@
	FAX	( ) —
Dimensions	W (mm)	
	D (mm)	
	H (mm)	
Weight (kg)		
Power source (phase, V, Hz)		
Details about control functions (temperature sensor, microcomputer control, mode setting, etc.)		
Requirements for installation	Requirements of air conditioners	(Possibility to install in gas heat pump air conditioners, freezers, etc., forms of outdoor units, and others)
	Water pressure requirements	
	Recommended use conditions, water quality and air environment requirements, and other points to consider	
	Other requirements such as installation site requirements	
Necessity of maintenance		Not necessary Necessary Describe in detail: • Measures against fin decay: (• Measures against scale adhesion: • Others: )
Possibility of causing the reproduction of destructive fungi and measures to combat them		
Possibility of causing fin decay, scale adhesion, and other adverse effects and measures to combat them (Can be omitted if these measures are described in the Necessity of Maintenance field.)		

Items	Description			
Additional equipment*	Not available - Available Specify the equipment in detail: <div style="border: 1px solid black; width: 100%; height: 40px; margin-top: 5px;"></div>			
Life of the target verification apparatus				
Approximate cost  Examples of expense items of the initial cost: Price of the apparatus, construction cost, etc.  Examples of expense items of the running cost: Water, electricity, consumables, etc.	Expense item	Unit cost	Quantity	Total
	Initial cost			
	Running cost (per hour)			
Others (possibility of rainwater use*)				

\* If rain water is used, the “Standard on Planning of Systems Using Wastewater or Rain Water” established by the Ministry of Land, Infrastructure and Transport shall be followed.

#### 4. Developmental status and past delivery record

Check the number that best describes the current situation.

1. The apparatus is only available as a pilot unit and is not commercialized.
2. The apparatus has already been commercialized and is available as a product.
3. The apparatus has past delivery records.

↓

Specify the past records in detail:

#### 5. Technological novelty, etc.

Describe the novelty of the technology, status of application/acquisition of patents, utility model rights, etc., presence or absence of published papers on the technology, awards, and the verification test by official organizations.

6. Other relevant or unique features (if any)

[Documents to be attached to this application form]

- Basic technical specification for the target verification apparatus
- Results of in-house performance tests
- O&M Manual

An O&M manual is a document that describes methods for operating and maintaining a target verification apparatus. An O&M manual shall contain the following information:

- Method for installing the target verification apparatus
- Method for operating the target verification apparatus (standard operational pattern, automatic control of operation mode, etc.)
- Maintenance (maintenance procedure manual)
- Troubleshooting
- Optimization of operation and environmental protection
- Ability to handle variations in test conditions (Attach past case data on fin decay, scale adhesion, reduced performance of the fan, and other adverse effects, if available.)

## Appendix 2: Test Plan

The Test Plan provides a general description of the objectives and procedures of verification tests, such as the design of verification tests and the various procedures in the verification tests.

The content of the Test Plan may vary according to circumstances, but should include at least the following:

### 1. Cover sheet/approval of the verification test participants/table of contents

A cover sheet for the Test Plan, signatures of the pilot project participants (responsible official of the Verification Organization, the environmental technology developer, etc.) who approved the Test Plan, and the table of contents shall be given.

### 2. Participating organizations and personnel responsibilities

The organizations participating in the verification tests and the responsibilities of the representatives shall be described.

### 3. The target verification technology and apparatus description

- Principle of the target verification apparatus, system configuration including pre- and post-processing
- Dimensions and weight of the target verification apparatus
- Required consumables, power consumption, and water consumption
- Work items required for the O&M of the target verification apparatus
- The level of operator skill required to successfully operate the target verification apparatus
- Noise and foul odor control, housing requirement

### 4. Details of the verification test

#### (1) Test period

- Test period and general schedule

#### (2) Verification test for verification items regarding sensible heat control performance

- Verification items regarding sensible heat control performance
- Measurement/analytical methods, instruments and schedule
- Calibration methods and calibration schedule

#### (3) Verification test for verification items regarding operations and maintenance

- Verification items regarding operations and maintenance
- Operational schedule, person in charge, and documentation formats
- Methods of evaluating the data provided by the environmental technology developer
- Other verification items, evaluation methods, and information collection schedule

### 5. Quality control of data

- Methods of documenting measurement procedures
- Information on accuracy control
- Necessity for supplying additional quality management information (All unprocessed data shall be stored as the Appendix of the Verification Report.)

### 6. Management, analysis and presentation of data

#### (1) Data management

Data that are produced in the verification test and are to be managed and forms in which the data should be

managed shall be specified.

## (2) Analysis and presentation

Methods of data analysis and presentation format of data shall be specified in the Test Plan.

## 7. Audits

An audit schedule, audit procedures, and information on the audit group shall be specified in the Test Plan.

## 8. Appendix

The following should be described in the Test Plan as an Appendix:

- O&M manual provided by the environmental technology developer
- Other literature and data for reference



### Appendix 3: Form of Verification Report (Provisional version)

Target verification technology / environmental technology developer	
Verification Organization	
Verification test period	

#### 1. Overview of the target verification technology

Method	Principle

#### 2. Overview of the verification test

##### ○ Specifications of the target verification apparatus

Item	Specifications and capability
Type	
Dimensions and weight	W mm × D mm × H mm, kg —
Compatible air conditioner capability	(Cooling capability) ~ (kW)
Description of control function	(Thermal sensor / microcomputer-controlled / mode selection, etc.)

##### ○ Settings for verification test conditions

		Test conditions		
		Test condition 1 (T1 specified in JIS B8615-1)	Test condition 2 (General summer temperature)	Test condition 3 (Optimum conditions for use of apparatus)
Indoor inlet air	Dry bulb temperature	°C	°C	°C
	Wet bulb temperature	°C	°C	°C
Outdoor inlet air	Dry bulb temperature	°C	°C	°C
	Wet bulb temperature	°C	°C	°C
Water temperature		°C	°C	°C
Water pressure		Mpa	MPa	MPa
Operation mode of target verification apparatus				

##### ○ Situations assumed for Test condition 3 ←

Assumed situations	
--------------------	--

##### ○ Air conditioner used for Verification Test

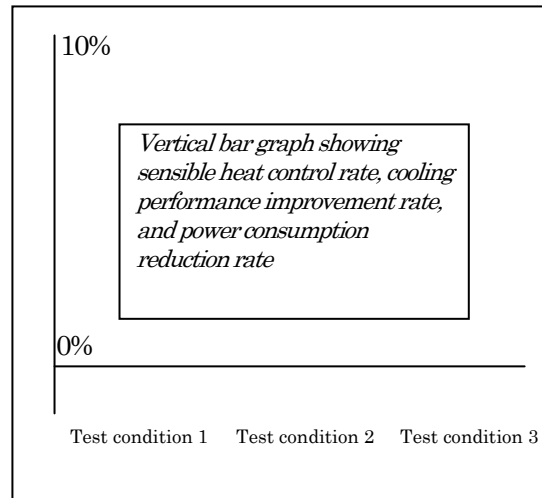
Item	Specifications and process capabilities
Rated cooling capability	kW (60/50 Hz)
Rated electricity consumption	kW (60/50 Hz)
Rated COP	(60/50 Hz)
Operation control type	Non-inverter type/ inverter type (to be operated at a fixed frequency)

### 3. Results of the verification test

○ Verification items regarding sensible heat control performance

[Effects]

Operation conditions	Test conditions		
	1	2	3
Sensible heat control rate	%	%	%
Cooling performance improvement rate	%	%	%
Cooling COP improvement rate	%	%	%

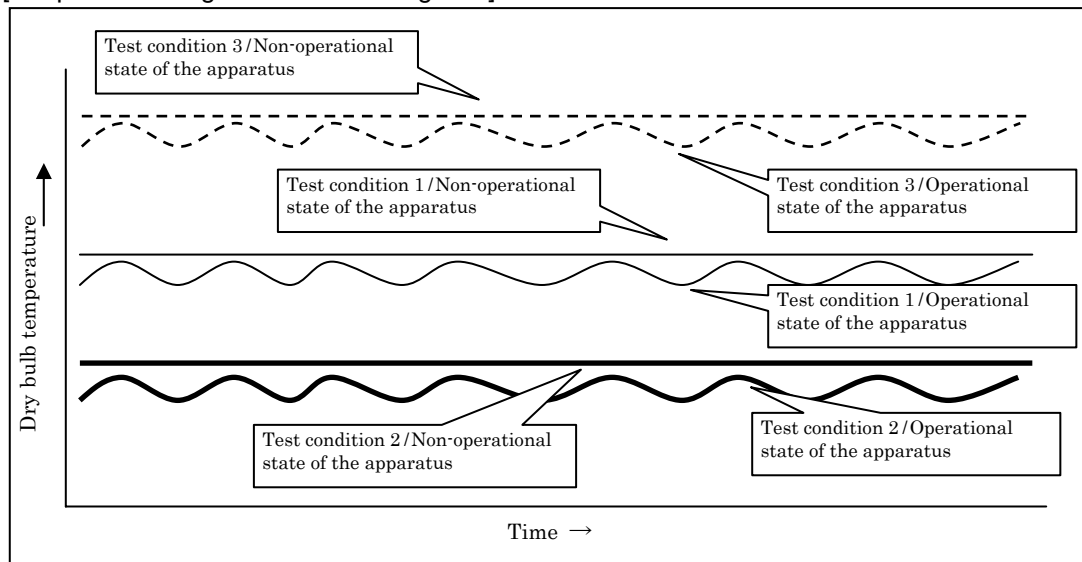


[Reference values]

Operation conditions	Test conditions		
	1	2	3
Power consumption reduction rate	%	%	%
Rate of latent heat release	%	%	%
Rate of heat transfer to water	%	%	%

\* Cooling COP: Values obtained by dividing cooling performance by cooling power consumption. Higher cooling COP values indicate higher energy efficiency.

[Temperature change of outdoor discharged air]



○ Verification items regarding O&M

Item	Test condition 1		Test condition 2		Test condition 3	
	Non-operational state of the apparatus	Operational state of the apparatus	Non-operational state of the apparatus	Operational state of the apparatus	Non-operational state of the apparatus	Operational state of the apparatus
Amount of environmental load discharged						
Electricity consumption	Wh/h	Wh/h	Wh/h	Wh/h	Wh/h	Wh/h
Water consumption	L/h	L/h	L/h	L/h	L/h	L/h
Other chemical consumption such as reactant						
Power consumption reduction rate of air conditioner	Wh/h	Wh/h	Wh/h	Wh/h	Wh/h	Wh/h

\* Water consumption amount includes newly supplied water use such as tap water, and drained water (condensed water, a byproduct of air conditioner operation, is not included)

(Qualitative findings)

Item	Findings
Precautions against harmful bacteria	
Number of operators and the level of operator expertise required for O&M of the apparatus	
Effects and ease of maintenance	
Evaluation of O&M manual	
Others	

○ Running cost under test conditions (average of test conditions 1 and 2)

A rough estimate using the average value of test conditions 1 and 2	Running cost per hour		
	Electricity cost (@ yen/Wh)	Wh/h	yen
	Water cost (@ yen/L; including sewer cost)	L/h	yen
	Total		yen
	Reduced cost due to power consumption reduction		
	Electricity cost (@ yen/Wh)	Wh/h	yen
A rough estimate using test condition 3 (optimal conditions for apparatus use)	Running cost per hour		
	Electricity cost (@ yen/Wh)	Wh/h	yen
	Water cost (@ yen/L; including sewer cost)	L/h	yen
	Total		yen
	Reduced cost due to power consumption reduction		
	Electricity cost (@ yen/Wh)	Wh/h	yen

\* Attention must be given to the fact that unit prices for electricity and water vary depending on the installation location. The basic fee discount due to contractual power consumption reduction cannot be included in the amount of reduced cost. For the assumed situations of test condition 3, please refer to the description on the previous pages.

(Reference information)

All information in this page is provided by the environmental technology developer in an application for a verification test at its own responsibility. The Ministry of the Environment and the Verification Organization assume no responsibility for the information.

○ Product data

Item		Description (to be filled in by the environmental technology developer)
Name / type		
Name of manufacturer (distributing agent)		
Capability of compatible air conditioner		kW
Contact address	TEL/FAX	( ) - / ( ) -
	Website	http://
	E-mail	@
Dimensions / weight		× × (mm) kg
Power source		
Requirements for installation	Types/ forms of compatible air conditioners	(Possibility to install in gas heat pump air conditioners, freezers, and forms of outdoor units, and others)
	Required water pressure	MPa
	Recommended use conditions, etc.	
	Installation site requirements	
Effects on cooling performance and service life of the air conditioner		(Effects based on self-assessment by the environmental technology developer, e.g., effects of antirust coating)
Reliability of apparatus		
Failure recovery methods		
Other		
Life of the target verification apparatus		
Approximate cost  Running cost is shown in the previous page	Initial cost	
		×
		×
		×
	Total	×

○ Other information provided by the manufacturer

# Reference

## I. Brief overview of the pilot project for the environmental technology verification

### 1. Objectives

Many innovative environmental technologies that are already at a practically applicable stage and seem to be useful have not come into wide use because end users, including local municipal entities, companies, consumers, and the like, cannot use the technologies with confidence due to the lack of objective evaluation of the environmental protective effect and the like.

Accordingly, in this pilot project for the environmental technology verification, with respect to the innovative environmental technologies that have not been widely accepted as described above, the environment protective effect and others will be objectively verified by an independent organization on an experimental basis.

It is hoped that the pilot project for the environmental technology verification will accelerate the dissemination of the environmental technologies developed by venture companies and the like, and contribute to the activation of economic activity through environmental protection and the advancement of regional environmental industries.

### 2. What the “verification” means

In the pilot project for the environmental technology verification, the environmental protective effect and the like of particular environmental technologies will be verified through the collection of objective data based on various tests and others. There is a similar term, “certification,” in which the suitability to the standard of an environmental technology is judged in terms of the performance that a technology should provide. The present project does not conduct such “certification.”

### 3. System for promoting the project

The pilot project for the environmental technology verification will be conducted by the Ministry of the Environment in cooperation with Verification Management Organizations, which prepare a protocol, solicit and select Verification Organizations, and set up and collect fees and with Verification Organizations, which conduct verification tests.

### 4. Procedures of the project

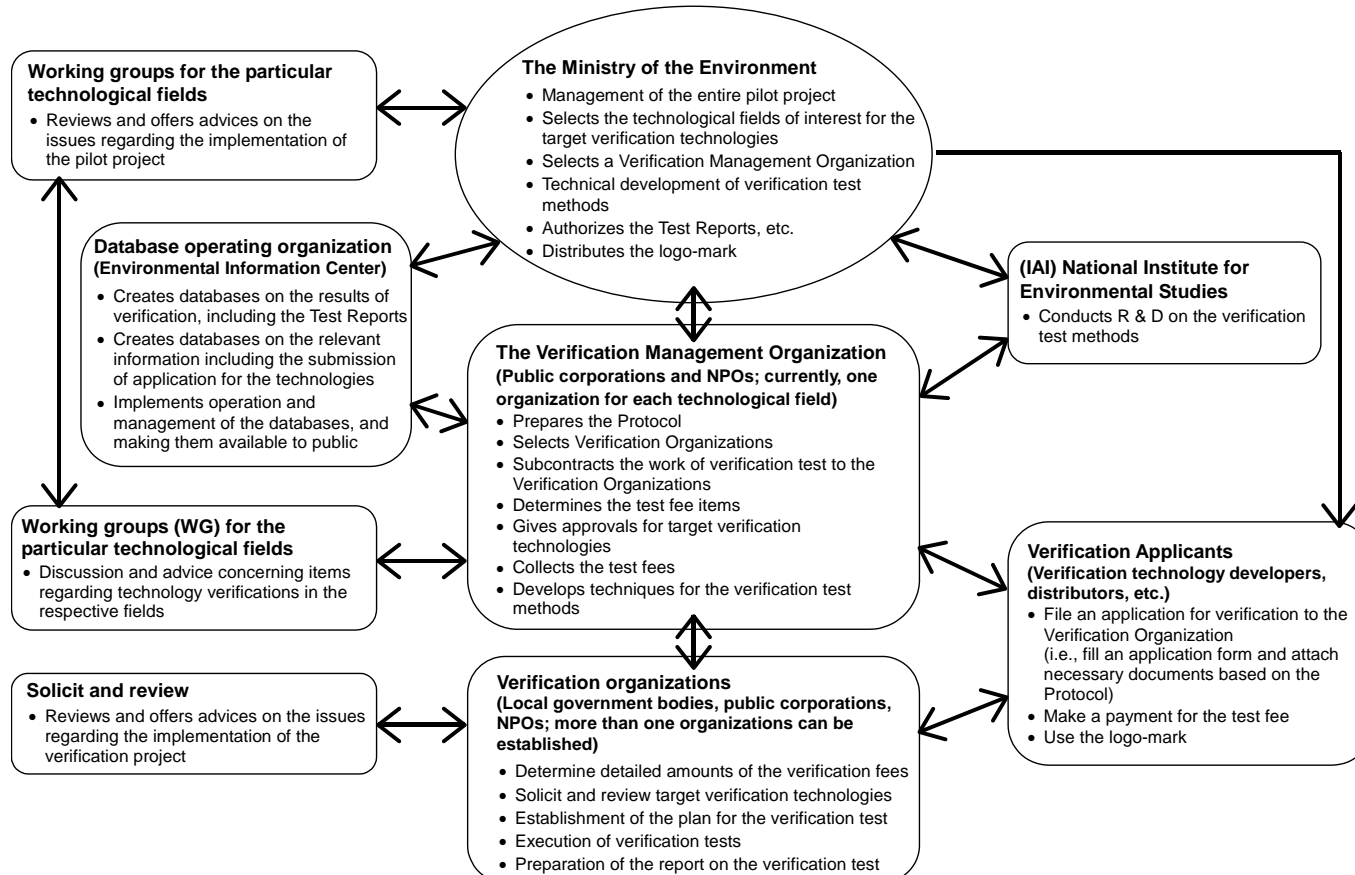
The pilot project for the environmental technology verification will generally be conducted in accordance with the following procedures:

- (1) The Ministry of the Environment will identify the needs of the technology developers / distributing agents, users, and others, through the use of questionnaires or the like.
- (2) The Ministry of the Environment will select target verification technology fields based on discussions in the committee on the pilot project for the environmental technology verification.
- (3) The Ministry of the Environment shall select a "Verification Management Organization," which is in charge of the preparation of the Protocol, solicitation and selection of Verification Organizations, determination of the test fee items and collection of the fees.
- (4) The Verification Management Organizations will prepare a “protocol for the verification,” which establishes the specific methods of technology verification regarding the selected target verification technology fields.
- (5) The Verification Management Organizations will select the “Verification Organizations,” which are the independent organizations that conduct the verification tests.
- (6) The Verification Organizations will invite applications from companies and the like for the technology to be verified.
- (7) The Verification Organization shall discuss and review the submitted technologies in its expert committee to select technologies that are the subject of verification.
- (8) The Verification Organizations will conduct verification tests on the selected technologies in accordance with

the protocol for the verification.

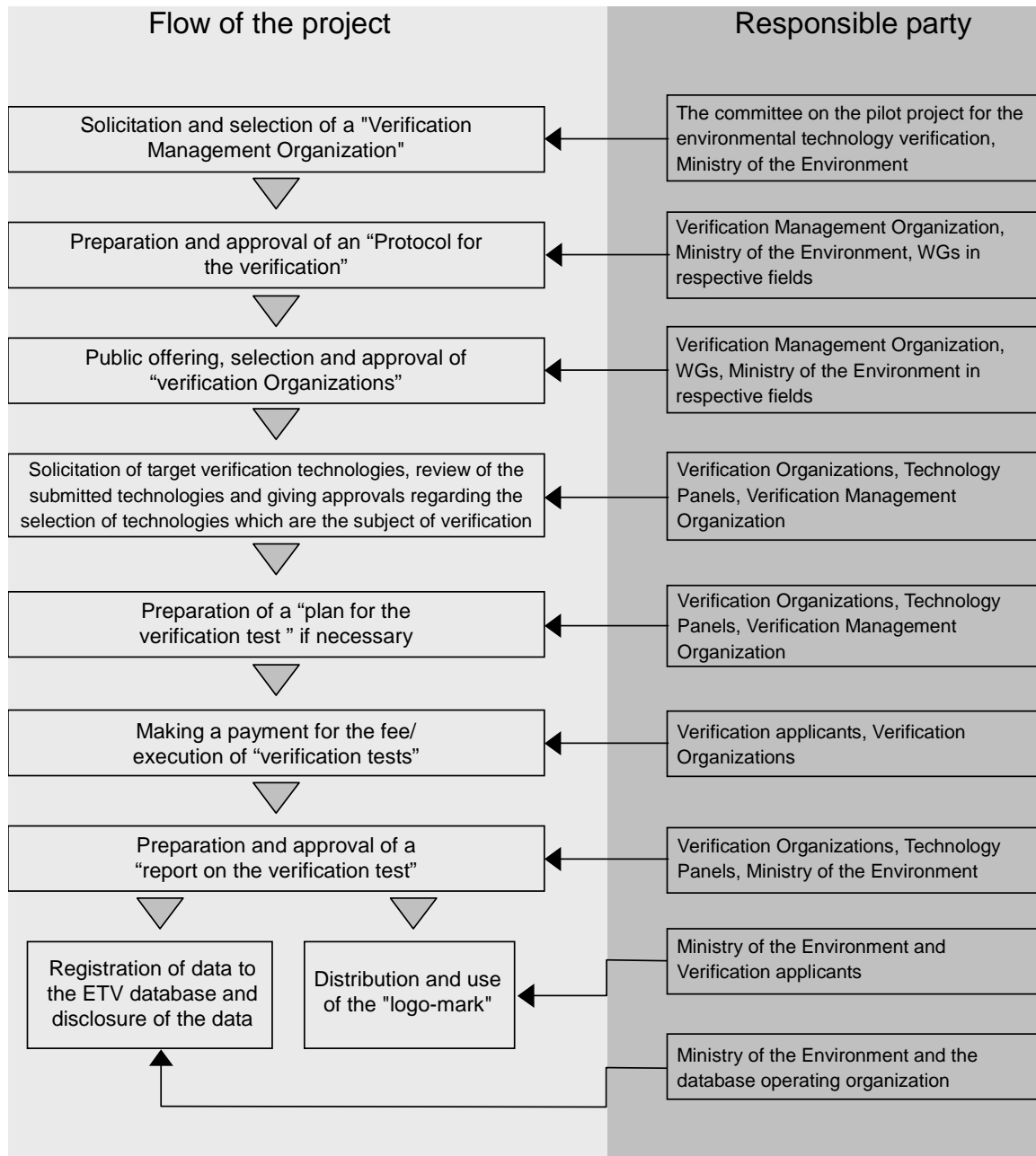
- (9) The Verification Organization shall organize the test results into a report, which will be given to the Verification Management Organization and the Ministry of the Environment. In addition, the report will be registered in a database on the Internet and made available to the public.
- (10) The Ministry of the Environment will distribute logo marks to the verified technologies.

## II. System for promotion of the “pilot project for the environmental technology verification”



(Note) In the implementation of the project, a part of the implementation system may be monitored after receiving an approval from the Ministry of the Environment.

### III. Flow of the pilot project for the environmental technology verification





#### IV. Prospectus for organizing the working group on the heat island control technology in the committee on the pilot project for the environmental technology verification for 2005

##### 1. Objective of the working group

The working group on the heat island control technology (hereinafter referred to as “working group”) is established for the purpose of discussing based on specialized knowledge heat island control technology, a technology field in which technology verification is scheduled to be conducted in 2004, in the pilot project for the environmental technology verification and thus promoting the project smoothly and efficiently.

##### 2. Items to be investigated and discussed

###### (1) Field of heat island control technology

- (i) Preparation of a protocol for the verification
- (ii) Selection of Verification Organizations
- (iii) Confirmation of Verification Reports
- (iv) Other items relevant to execution of the project

###### (2) How future verification tests shall be conducted, and the selection of candidate technology fields

- (i) Items related to implement projects in the collecting fee system
- (ii) Other items related to implement future projects

##### 3. Organization and others

- (1) The working group consists of 10 or fewer members.
- (2) The working group has a chairperson.
- (3) The chairperson will supervise the working group.
- (4) The members will be appointed by UFJ Institute Ltd., from among academic experts, well-informed individuals, and the like relevant to verification tests on heat island control technology, with the approval of the Environmental Management Bureau of the Ministry of the Environment.
- (5) The members will be under commission for the period from the date of appointment by UFJ Institute Ltd. to the end of the same fiscal year.
- (6) In addition, participants and interested parties in the pilot project for the environmental technology verification may also attend the meetings of the working group as observers and the like, if necessary.

##### 4. Disclosure of the discussion and others, etc.

Meetings of the working group will, in principle, be held in public. However, the chairperson may hold a closed meeting of the working group if a public meeting may cause significant obstacles to fair and neutral discussion, and provide particular individuals with unfair benefit or detriment.

##### 5. Secretariat

The general affairs of the working group will be processed by UFJ Institute Ltd., with the consent of the Environmental Management Bureau of the Ministry of the Environment.

The committee on the pilot project for the environmental technology  
verification for FY 2005

List of the members of the working group  
on the heat island control technology

Yasunobu Ashie	Senior Researcher, Department of Environmental Engineering, Building Research Institute
Toshiaki Kiuchi	Professor, School of Science and Engineering, Kokushikan University
Satoshi Sadohara	Professor, Graduate School of Environmental and Information Sciences, Yokohama National University
Yoshiyuki Shimoda	Assistant Professor, Graduate School of Engineering, Osaka University
Tadayoshi Kubo	Counselor, Division of Administration of Agriculture, Forestry and Fishery, Dept. of Agriculture, Forestry and Fishery, Osaka Prefecture
Yasunari Morikawa	Head, New Frontier Technology Development Office, Construction Technology Research Laboratory, Taisei Corporation

< Secretariat (Ministry of the Environment) >

Izumi Tokunaga	Director, Environmental Control Technology Office, Environmental Management Bureau
Masataka Segawa	Deputy Director, Environmental Control Technology Office, Environmental Management Bureau
Yuko Tanaka	Planning manager, Environmental Control Technology Office, Environmental Management Bureau
Miyoshi Negishi	Noise Control Manager, Environmental Control Technology Office, Environmental Management Bureau
Masanori Fujimoto Yosuke Takahara	Deputy Director, Office of Odor, Noise and Vibration, Environmental Management Bureau Coordinate Manager, Office of Odor, Noise and Vibration, Environmental Management Bureau

Kenji Ueda	Deputy Director, Office of Environmental Research and Technology, Environmental Policy Bureau
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< Secretariat (Mitsubishi UFJ Research & Consulting Institute Ltd.) >

Eiko Saito	Chief researcher, Environmental Policy Consulting Department
Naoki Yoshizawa	Researcher, Environmental Policy Consulting Department
Toshiya Kayama	Researcher, Environmental Policy Consulting Department (since second meeting)
Kotaro Shimizu	Researcher, Environmental Policy Consulting Department

As of March 2007

## V. Particulars discussed in the working group on the heat island control technology

(2003)

First meeting: 15:00 to 17:00, February 18, 2004

- Pilot project for the environmental technology verification
- Heat island control technologies
- Protocol for the verification (first draft)

February 18, 2004 to March 2, 2004

- Invite public opinion on the protocol for the verification (second draft)

Second meeting: 10:00 to 12:00, March 11, 2004

- Protocol for the verification (third draft)
- Public offering and selection of Verification Organizations

(2004)

First meeting: 15:00 to 17:00, May 12, 2004

- Protocol for the verification
- Public offering of Verification Organization
- Hearing from organizations that have applied for a Verification Organization
- Selection of Verification Organizations

Second meeting: 10:00 to 12:00, February 16, 2005

- Review of Verification Reports
- Review of the protocol for the verification tests
- Public offering and selection of Verification Organizations

(2005)

First meeting: 16:00 to 17:30, May 25, 2005

- Protocol for the verification
- Solicitation of Verification Organizations
- Interviews with organizations that have applied for a Verification Organization
- Selection of Verification Organizations

Second meeting: 13:00 to 15:00, February 17, 2006

- Review of Verification Reports
- Review of the protocol for the verification tests
- New target technologies in the verification technology field

## Revision histories of protocol for the verification test on heat island control technologies

First edition Published on March 24, 2004

Second edition Published on April 20, 2005

<Major revisions from the first edition>

- Some test conditions were added
- Cooling COP improvement rate was added as a reference item to verification items of sensible heat control performance
- Inconsistent descriptions of the project system were corrected, and redundant descriptions were reorganized.
- The “Environment, health, and safety plan” was deleted because it should be portrayed in the Test Plan.
- Items in the Verification Report and Test Plan were reorganized
- The application form for verification and general overview form for the Verification Report were revised as a provisional version.

Third edition Published on March 31, 2006

<Major revisions from the second edition>

- Project implementation system in accordance with transfer to the fee collecting system and the description about fee items were added.
- Items related to change and cancellation of verification tests were added.
- The definition of reference item was revised.
- “Power consumption reduction rate,” which had categorized in verification items regarding sensible heat control performance, was changed to a reference item.
- “Cooling COP importance rate,” which had been categorized in reference items, was changed to a verification item regarding sensible heat control performance.