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Minimum Allowable Values of the Energy Efficiency and Energy Efficiency Grades for Room Air Conditioners

房间空气调节器能效限定值及能效等级

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Minimum Allowable Values of the Energy Efficiency and Energy Efficiency Grades for Room Air Conditioners

1 Scope

This Standard specifies the energy efficiency grades, the minimum allowable values of energy efficiency and test methods for room air conditioners.

This Standard is applicable to room air conditioners which adopt air-cooled condensers and fully enclosed electric compressors, and with a rated cooling capacity not greater than 14,000 W and with a climate type T1, as well as low ambient temperature air source heat pump air heaters with a nominal heating capacity not greater than 14,000 W.

This Standard is not applicable to mobile air conditioners, multi-connected air conditioning units and air-duct air conditioners.

2 Normative References

The following documents are indispensable to the application of this document. In terms of references with a specified date, only versions with a specified date are applicable to this document. In terms of references without a specified date, the latest version (including all the modifications) is applicable to this document.

GB/T 7725-2004 *Room Air Conditioners*

GB/T 35758-2017 *Household Electrical Appliances - Measurement of Standby Power*

JB/T 13573-2018 *Low Ambient Temperature Air Source Heat Pump Air Heaters*

3 Terms and Definitions

What is defined in GB/T 7725-2004 and JB/T 13573-2018, and the following terms and definitions are applicable to this document.

3.1 Minimum Allowable Values of Energy Efficiency for Room Air-conditioners

Minimum allowable values of energy efficiency for room air-conditioners refers to the minimum allowable values of energy consumption efficiency during the cooling and heating operation under specified operating conditions.

efficiency.

In terms of the heat pump room air conditioners with adjustable revolution speed compressor, the annual performance factor (APF) and single-cooling seasonal energy efficiency ratio (SEER) shall be greater than or equal to the index value of Grade-3 energy efficiency.

In terms of the single-cooling room air conditioners, the seasonal energy efficiency ratio (SEER) shall merely by evaluated.

5.1.2 In terms of the low ambient temperature air source heat pump air heaters, the heating seasonal performance factor (HSPF) shall be greater than or equal to the index value of Grade-3 energy efficiency. Its nominal heating coefficient of performance ($COP_{-12°C}$) shall not be lower than 2.20; the low temperature heating coefficient of performance ($COP_{-20°C}$) shall not be lower than 1.80; for models with an auxiliary electric heating device, when the auxiliary electric heating device is turned on at -25 °C outdoors, the comprehensive COP value shall be not lower than 1.80.

5.2 Electric Auxiliary Heating

5.2.1 Products that use electric auxiliary heating shall be able to implement manual turn-on and turn-off of the electric auxiliary heating system. Meanwhile, a display showing the operating state of the electric auxiliary heating system shall be installed in an obvious position.

5.2.2 For room air conditioner products, under the circumstance where the outdoor-side dry-bulb temperature is lower than 0 °C, it is allowed to use electric auxiliary heating to directly heat the indoor air as part of the indoor heating capacity.

5.2.3 In terms of low ambient temperature air source heat pump air heaters, under the circumstance where the outdoor-side dry-bulb temperature is lower than -20 °C, when the electric auxiliary heating is turned on, it is allowed to actuate the electric auxiliary heating system; for electric auxiliary heating selected by the user, but the controller reserves the interface, the turn-on and turn-off of the electric auxiliary heating system are controlled by the unit, then, the turn-on and turn-off method of the electric auxiliary heating shall be explained in the instruction (or operation manual).

5.3 Energy Consumption in Standby Mode

5.3.1 In terms of products with a rated cooling capacity of 4,500 W and below, and products without communication protocols, such as: sensors, WIFI and Bluetooth (or these functions can be turned off during the test, and the products are tested after these functions are turned off), the energy consumption in standby mode is not greater than 3 W.

5.3.2 In terms of products with a rated cooling capacity of 4,500 W and below, and products equipped with communication protocols, such as: sensors, WIFI and

the low temperature heating test method of air conditioners, expressed in (W).

ϕ_e---electric heating capacity under the minimum operating heating condition of the low temperature heating test method of air conditioners, expressed in (W).

P_{heat}---heat pump heating power consumption under the minimum operating heating condition of the low temperature heating test method of air conditioners, expressed in (W).

P_e---electric heating power consumption under the minimum operating heating condition of the low temperature heating test method of air conditioners, expressed in (W).

6.2.2 Detection methods for electric auxiliary heating control opening

For units with built-in electric auxiliary heating system, set the electric auxiliary heating to the on-state. When the product is in heating mode, comply with the default setting of the remote control, maintain the indoor-side air inlet temperature unchanged at 16 °C; set to the highest wind gear; set the indoor air outlet temperature to the rated air outlet temperature of the unit; respectively adjust the outdoor dry-bulb temperature to: -18 °C → -20 °C → -19 °C → -15 °C. Each time it is adjusted to a temperature point and becomes stable, respectively run for at least 10 min or the time provided by the manufacturer. During this period, record the passing current of the electric auxiliary heating system. With the change with the rise and fall of the outdoor dry-bulb temperature, observe whether the electric auxiliary heating system is actuated.

6.2.3 Test and calculation methods for energy consumption in standby mode

Energy consumption in standby mode shall be tested in accordance with the stipulations of GB/T 35758-2017. During the test, the ambient temperature of the laboratory shall be maintained at (23 ± 5) °C. The expanded uncertainty of the measurement by the power measuring instrument shall be not greater than 0.02 W (95% confidence interval); the division value of the instrument shall be able to read at least 0.01 W. After the air conditioner is connected to the power supply and turned on for heating operation for at least 10 min, turn off the air conditioner, so that it enters the standby mode. After the air conditioner is turned off for at least 30 min, conduct the test of the energy consumption in standby mode; the duration of the test is 30 min; the average interval of data collection shall be every 10 s or less. Read the average power value in the measurement period, which shall be expressed in (W). The test result shall retain 1 decimal place.

NOTE: the power value may be obtained by dividing the measured power consumption by the measuring time.

Appendix A

(normative)

Test and Calculation Methods for Seasonal Energy Efficiency Ratio (SEER) and Heating Seasonal Performance Factor (HSPF) of Room Air Conditioners

A.1 Terms and Definitions

A.1.1 Cooling capacity

When an air conditioner is in a long-term stable cooling operation under specified operating status and conditions, the total amount of heat removed from a confined space, room or area in a unit of time, expressed in (W).

Cooling capacity is divided into rated cooling capacity, rated intermediate cooling capacity, rated maximum cooling capacity and rated minimum cooling capacity.

NOTE 1: rated intermediate cooling capacity is the capacity for the compressor motor to continuously and stably operate at the current speed when the air conditioner reaches the range of “1/2 of the rated cooling capacity” ± 100 W, expressed in (W).

NOTE 2: when the machine’s minimum cooling capacity is greater than 55% of the rated cooling capacity, the minimum cooling capacity is the intermediate cooling capacity.

A.1.2 Cooling power input

The total power consumed by the air conditioner during the cooling capacity operation, expressed in (W).

The power input during the cooling capacity operation is divided into rated cooling power input, rated intermediate cooling power input, rated minimum cooling power input and rated maximum cooling power input.

A.1.3 Heating capacity

When an air conditioner is in a long-term stable heating operation under specified operating status and conditions, the total amount of heat sent into a confined space, room or area in a unit of time, expressed in (W).

Heating capacity is divided into rated high temperature heating capacity, rated intermediate heating capacity, rated low temperature heating capacity, rated minimum heating capacity and rated maximum heating capacity.

NOTE 1: rated intermediate heating capacity is the capacity for the compressor motor to

A.1.8 Degradation coefficient

C_D

The coefficient of an air conditioner's efficiency degradation due to intermittent operation.

A.1.9 Seasonal energy efficiency ratio; SEER

During the cooling season, the ratio of the total amount of heat removed from the indoor in the cooling operation of an air conditioner to the total power consumption.

A.1.10 Heating seasonal performance factor; HSPF

During the heating season, when an air conditioner is in heating operation, the ratio of the total amount of heat sent into indoor to the total power consumption.

A.1.11 Annual performance factor; APF

During the cooling season and heating season of an air conditioner, the ratio of the amount of cold removed from the indoor air and the total amount of heat sent into indoor to the total power consumption in the same period.

A.1.12 Cooling seasonal total energy; CSTE

During the cooling season, the total amount of power input of an air conditioner during the cooling operation.

A.1.13 Heating seasonal total energy; HSTE

During the heating season, the total amount of power input of an air conditioner during the heating operation.

A.1.14 Annual power consumption; APC

The sum of the cooling seasonal total energy during the cooling season and the heating seasonal total energy during the heating season.

A.1.15 Maximum capacity of revolution-adjustable

The maximum capacity of an air conditioner with adjustable revolution speed:

a) Test under the rated operating conditions of cooling shown in Table A.1, when it is in continuous and stable operation (not less than 1 h) at the maximum allowable speed of the compressor motor, its capacity is the maximum cooling capacity, which is also known as the maximum cooling effect;

b) Test under the low temperature heating capacity operating conditions shown in Table A.1, when it is in continuous operation at the maximum allowable

A.2.2 Test requirements

6.2 of GB/T 7725-2004 is applicable, except for the addition of the following content.

Except for the load fluctuation of the air conditioner when it is turned on or turned off, the power supply voltage fluctuation is ± 2%; the frequency fluctuation is ± 1% of the rated frequency.

A.2.3 Test methods

A.2.3.1 Basic requirements

6.3 of GB/T 7725-2004 is applicable, except for the replacement of relevant content of A.2.3.2 ~ A.2.3.5.

A.2.3.2 Test of cooling capacity

The relevant test methods for cooling capacity are specified below:

a) Rated cooling capacity

In accordance with the method of 6.3.2 in GB/T 7725-2004, conduct the test. Under the rated operating conditions of cooling and the specified conditions, after the air conditioner is continuously and stably operated for 1 h, conduct the test.

b) Rated intermediate cooling capacity

In accordance with the method of 6.3.2 in GB/T 7725-2004, conduct the test. Under the rated operating conditions of cooling and the specified conditions, when the air conditioner reaches “1/2 of the rated cooling capacity” ± 100 W, after 1 h of continuous and stable operation at the current speed of the compressor motor, conduct the test.

NOTE 1: when the machine’s minimum cooling capacity is greater than 55% of the rated cooling capacity, the minimum cooling capacity is the intermediate cooling capacity.

c) Rated minimum cooling capacity

In accordance with the method of 6.3.2 in GB/T 7725-2004, under the rated operating conditions of cooling and the specified conditions of the air conditioner, after 1 h of stable operation at the minimum speed of the compressor, conduct the test.

d) Rated maximum cooling capacity (if the maximum allowable speed of the compressor with the rated maximum cooling capacity is the operating speed of the compressor with the rated cooling capacity, this test may not be

heating capacity.

c) Rated low temperature heating capacity

In accordance with the method of 6.3.4 and Appendix C in GB/T 7725-2004, place the air conditioner in the air enthalpy method test device. Under the operating conditions of low-temperature heating in Table A.1 and the specified conditions, (the circuit of the electric auxiliary heating device is disconnected) after stable operation at the maximum speed of the compressor, conduct the test.

d) Rated minimum heating capacity

In accordance with the method of 6.3.4 in GB/T 7725-2004, conduct the test. Under the rated operating conditions of high-temperature heating and the specified conditions of the air conditioner, ensure 1 h of stable operation at the minimum speed of the compressor, then, conduct the test.

e) Rated maximum heating capacity

The maximum heating capacity is calculated through a formula (the maximum heating capacity is calculated by low temperature heating capacity × 1.38).

f) 25% rated heating capacity

In accordance with the method of 6.3.4 in GB/T 7725-2004, conduct the test. Under the rated operating conditions of high temperature heating and the specified conditions, when the air conditioner reaches “25% rated heating capacity” or the minimum heating capacity claimed by the manufacturer (whichever is larger), after 1 h of continuous and stable operation at the current speed of the compressor motor, conduct the test.

NOTE 2: the speed setting of the compressor in the above-mentioned tests may be carried out in accordance with the methods provided by the manufacturer.

A.2.3.5 Test of heating power input

In accordance with the method of 6.3.5 in GB/T 7725-2004, while conducting the tests of rated heating capacity, rated intermediate heating capacity, rated low temperature heating capacity, minimum heating capacity and 25% rated heating capacity, determine the input power and electric current of the air conditioner. In addition, in accordance with the formula, calculate the maximum heating power input of the air conditioner (the maximum heating power input is calculated by low temperature heating power input × 1.17).

A.2.4 Supplementary tests

A.2.4.1 Test requirements

Appendix C

(normative)

Test Method for Unsteady-state Heating

C.1 Defrosting Operation

C.1.1 The automatic defrosting control shall not be replaced by other controls. The automatic defrosting control can only be replaced by the manual activation of the defrosting process in the pre-adjustment stage.

C.1.2 If the indoor fan of the air conditioner stops running during the defrosting process, then, the airflow through the indoor coil shall be stopped.

C.2 Test Procedures - Overview

The test process consists of three stages: pre-adjustment stage, balancing stage and data acquisition stage. The time of the data acquisition stage varies with the steady-state operation or unsteady-state operation of the air conditioner. During the unsteady-state operation, the time of the data acquisition stage using the indoor air enthalpy method and the calorimeter method is different.

C.3 Pre-adjustment Stage

C.3.1 Adjust the re-processing equipment and the air conditioner of the test chamber. After the ambient temperature requirements for rated low-temperature heating in Table A.1 and Table A.2 are established, the air conditioner shall be operated for at least 10 min.

C.3.2 The pre-conditioning stage may be completed when the defrosting cycle occurs. If this circumstance happens, before the balancing stage begins, and after the end of the defrosting, the air conditioner shall be operated for at least 10 min in the heating mode.

C.3.3 When testing under the temperature conditions of H2 and H3, it is recommended to start the defrosting cycle automatically or manually, so as to end the pre-adjustment stage.

C.4 Balancing Stage

C.4.1 A complete balancing stage lasts for at least 1 h.

C.4.2 During the unsteady-state heating process, the air conditioner shall satisfy the requirements of C.8.3. During the other heat pump heating process, the air conditioner shall satisfy the requirements for test tolerances in Table A.1 and Table A.2.

during data acquisition, expressed in (°C);

$\Delta T_{i(\tau)}$---the average value of inlet and outlet temperature difference in any 5 min during data acquisition, expressed in (°C).

C.6 Test Procedures - Pre-adjustment Stage (automatic or manual) Ended with Defrosting Cycle

C.6.1 In the initial 35 min of the data acquisition stage, if ΔT is greater than 2.5%, then, the heating capacity test shall comply with the unsteady-state test. Similarly, if the defrosting cycle starts during the balancing stage of the heat pump or the initial 35 min of the data acquisition stage, then, the heating capacity test shall comply with the unsteady-state test.

C.6.2 If the situation specified in C.6.1 does not occur, and in the balancing stage and the initial 35 min of the data acquisition stage, the test tolerances satisfy the requirements of Table A.2, then, the heating capacity test shall comply with the steady-state test. After 35 min in the data acquisition stage, the steady-state test shall be ended.

C.7 Test Procedures - Pre-adjustment Stage not Ended with Defrosting Cycle

C.7.1 If in the pre-adjustment stage or the initial 35 min of the data acquisition stage, the air conditioner starts the defrosting cycle, then, the heating capacity test shall be re-started in accordance with the requirements of C.7.3.

C.7.2 Within the initial 35 min of the data acquisition stage, if ΔT is greater than 2.5%, then, the heating capacity test shall be re-started in accordance with the requirements of C.7.3. Before re-restarting, the defrosting cycle shall occur. The defrosting cycle may be manually or automatically started.

C.7.3 If C.7.1 or C.7.2 is applicable, then, 10 min after the end of the defrosting cycle, a new 1 h balancing stage shall be re-started. The second test shall satisfy the requirements of C.4 and C.5 and the test procedures of C.8.

C.7.4 If the circumstance of C.7.1 or C.7.2 does not occur, and in the balancing stage and the initial 35 min of the data acquisition stage, the test tolerances satisfy the requirements of Table A.2, then, the heating capacity test shall comply with the steady-state test. After 35 min in the data acquisition stage, the steady-state test shall be ended.

C.8 Test Procedures - Unsteady-state Test

C.8.1 Test that satisfies the requirements of C.6.1 is unsteady state heating capacity test. The test shall be conducted in accordance with the requirements of C.8.2 ~ C.8.5.

C.8.2 The normal outdoor-side airflow of the air conditioner shall not be interfered. If

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