

Australian/New Zealand Standard™

Performance of close control airconditioners

Part 1: Testing for rating



AS/NZS 4965.1:2008

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee EL-015, Quality and Performance of Household Electrical Appliances. It was approved on behalf of the Council of Standards Australia on 15 September 2008 and on behalf of the Council of Standards New Zealand on 24 September 2008.

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Australian Industry Group
Australian Retailers Association
Business New Zealand
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Department of Energy, Utilities and Sustainability, New South Wales
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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-015, Quality and Performance of Household Electrical Appliances.

The overall objective of the AS/NZS 4965 series of Standards is to promote high levels of performance and energy efficiency in close control airconditioners.

The AS/NZS 4965 series of Standards consists of the following:

AS/NZS

4965 Performance of close control airconditioners

4965.1 Part 1: Testing for rating (this Standard)

4965.2 Part 2: Minimum energy performance standard (MEPS) requirements

This Standard is published with the approval of the combined state and territory regulatory authorities and is structured to be suitable for reference in legislation calling up minimum energy performance standards and also for reference in energy labelling regulatory legislation.

Acknowledgment is due to the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, whose Standard ASHRAE 127-2007 was reviewed during the development of this Standard. This Standard is a Joint Australian/New Zealand Standard and is not an ASHRAE Standard.

Statements expressed in mandatory terms in notes to figures are deemed to be requirements of this Standard.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance.

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STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard
Performance of close control airconditioners**Part 1: Testing for rating****1 SCOPE**

This Standard specifies the conditions on which the capacity and energy consumption of factory-made close control airconditioners are based and the test methods to be applied to determine the capacity and efficiency ratings. This Standard covers equipment utilizing a single or multiple refrigerated direct expansion (DX) system designed to control and monitor temperature and humidity and may include supplementary conditioning equipment.

Appendix A establishes testing procedures. Appendix B describes the test facilities required for the calorimeter method. Appendix C provides formulae for calculating heating and cooling capacities. Appendix D describes methods for measuring airflow. Appendix E describes the refrigerant enthalpy test method. Appendix F lists the symbols used in this Standard.

This Standard does not cover the determination of seasonal efficiencies, which may be required in some countries.

2 APPLICATION

Close control airconditioners are used for applications where temperature and humidity are required to be monitored and maintained within narrow limits. Examples of such applications are computer rooms, data processing units, telecommunication facilities and other industrial process areas.

3 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS/NZS

62301 Household electrical appliances—Measurement of standby power (IEC 62301, Ed. 1.01 (2005) MOD)

ASHRAE

52.2 Method of testing general ventilation air-cleaning devices for removal efficiency by particle size

127 Method of testing for rating computer and data processing room unitary air conditioners

4 DEFINITIONS

For the purpose of this Standard, the definitions below apply. Appendix F lists the symbols used in this Standard.

4.1 Close control airconditioner

A unitary airconditioner designed for high sensible heat ratio applications that is capable of maintaining close control of both temperature and humidity. The airconditioner consists of one or more factory-made assemblies, which include a compressor, a direct expansion evaporator, an air-moving device and air-filtering devices, and may include a condenser, a humidifier or a reheating function.

4.2 Cooling energy efficiency ratio (EER)

A ratio calculated by dividing the net total cooling capacity in watts by the effective power input in watts (excluding reheaters and humidifiers) at the rating conditions.

4.3 Effective power input (P_E)

The average electrical power input to the equipment, expressed in watts, within a defined interval of time, obtained from the power input for operation of the compressor, supply air fan and controls, excluding power input for heat rejection equipment.

4.4 Full load operation

Operation with the equipment and the controls configured for the maximum continuous duty refrigeration capacity specified by the manufacturer and allowed by the unit controls.

4.5 Gross sensible cooling capacity

The evaporator sensible heat removal disregarding the effect of evaporator fan heat, expressed in watts.

4.6 Gross total cooling capacity

The evaporator sensible heat removal plus latent heat removal disregarding the effect of evaporator fan heat, expressed in watts.

4.7 Indoor discharge airflow

The rate of flow of air from the indoor-side outlet of the equipment into the conditioned space.

4.8 Indoor intake airflow

The rate of flow of air into the equipment from the conditioned space.

4.9 Latent capacity—Room dehumidifying capacity

The amount of latent heat that the equipment can remove from the conditioned space in a defined interval of time, expressed in watts.

4.10 Net sensible cooling capacity

The amount of sensible heat that the equipment can remove from the conditioned space in a defined interval of time, expressed in watts.

4.11 Net total cooling capacity

The amount of sensible plus latent heat that the equipment can remove from the conditioned space in a defined interval of time, expressed in watts.

4.12 Outdoor discharge airflow

The discharge rate of flow of air from the outdoor-side of the equipment to the outdoors.

4.13 Outdoor intake airflow

The rate of flow of air into the equipment from the outdoor-side.

4.14 Rated frequency(ies)

Frequency(ies) shown on the nameplate of the equipment.

4.15 Rated voltage(s)

Voltage(s) shown on the nameplate of the equipment.

4.16 Sensible energy efficiency ratio (EERS)

A ratio calculated by dividing the net sensible cooling capacity in watts by the effective power input in watts (excluding reheaters and humidifiers) at the rating conditions.

4.17 Sensible heat ratio

The ratio of the sensible cooling capacity to the total cooling capacity.

4.18 Shall

Indicates that a statement is mandatory.

4.19 Should

Indicates a recommendation.

4.20 Standard air

Dry air at 20.0°C, and at a standard barometric pressure of 101.325 kPa, having a mass density of 1.204 kg/m³.

5 COOLING TESTS**5.1 Cooling capacity ratings****5.1.1 General conditions**

All equipment within the scope of this Standard shall have the cooling capacities and energy efficiency ratios determined in accordance with the provisions of this Standard and rated at the cooling conditions specified in Table 1. The electrical input values used for rating purposes shall be measured during the cooling capacity test.

5.1.2 Temperature conditions

The test conditions stated in Table 1 shall be considered to be standard rating conditions.

5.1.3 Airflow conditions**5.1.3.1 Airflow tests**

Airflow tests shall be conducted with 50 Pa static maintained at the air discharge of the equipment and may be measured without the refrigeration system in operation. All air quantities shall be measured in accordance with Appendix D and expressed in cubic metres per second (m³/s) of standard air.

5.1.3.2 Test conditions

The following test conditions shall apply:

- (a) Where equipment design incorporates filters and grilles, these shall be in position. Filters shall be in accordance with ASHRAE Standard 52.2, MERV 8.
- (b) Where the airconditioner is equipped to operate at two or more fan speeds, the test shall be conducted at a fan speed set to achieve rated airflow.
- (c) Where the airconditioner is equipped to operate at two or more compressor speeds, the test shall be conducted at the compressor speed that will achieve the rated cooling capacity.

TABLE 1
TEST CONDITIONS FOR DETERMINATING
COOLING CAPACITY

Parameter	Standard test conditions T1
Temperature of air entering indoor-side (°C)	
dry-bulb	23.9
wet-bulb	16.3
Relative humidity (%)	45
Saturated refrigerant condensing temperature (°C)	45
TX device entering liquid temperature (°C)	40 ±5
Test frequency	Rated frequency
Test voltage	Rated voltage (see Note)

NOTE: Where the rated voltage of the equipment lies wholly or partly between 208 V and 253 V, the test voltage shall be 230 V. If the equipment is rated for 240 V only, the test voltage shall be 240 V. Where the rated voltage of the equipment lies wholly or partly between 360 V and 440 V, the test voltage shall be 400 V. If the equipment is rated for 415 V only, the test voltage shall be 415 V. For other rated voltage ranges, the test voltage shall be the mean value of the range.

5.1.4 Test conditions

5.1.4.1 Preconditions

- (a) When using the calorimeter method, two methods of determining capacities shall be used simultaneously. One method determines the capacity on the indoor-side; the other measures the capacity on the outdoor-side. For the test to be valid, these two simultaneous determinations shall agree within 5% of the value obtained on the indoor-side. In the case of non-ducted airconditioners with water-cooled condensers, the heat-flow rejected via the cooling water is measured.
- (b) The test capacity shall include the net sensible plus latent (net total cooling) capacity and the effective power input, P_E , as determined in the indoor-side compartment.
- (c) Tests shall be conducted under the selected conditions with no changes made in fan speed or system resistance to correct for variations from the standard barometric pressure.
- (d) The test room reconditioning apparatus and the equipment under test shall be operated until thermal equilibrium conditions are attained, and equilibrium shall be maintained for not less than one hour before capacity test data may be recorded.

5.1.4.2 Duration of test

The data shall be recorded at equal intervals of five minutes or less. The data shall continue to be recorded for at least a 30-minute period, during which the tolerances specified in Clause 6.4 shall be met.

6 TEST METHODS AND UNCERTAINTY OF MEASUREMENT

6.1 Test methods

Capacity and performance tests are conducted using either the room calorimeter method or the indoor air-enthalpy method. Both methods are permitted, subject to the proviso that the results are within the uncertainty of measurement limits specified in Clause 6.2.

The room calorimeter can be of either the calibrated type or the balanced ambient type, as described in Appendix B.

In the air-enthalpy method, cooling capacities are determined from measurements of wet-bulb and dry-bulb temperatures on entering and leaving and the associated airflow rate. This method can be employed for the indoor-side tests of all equipment and for the outdoor-side tests. This method can be applied to water-cooled condensing equipment for which a second determination of the cooling capacity from measurements on the water-side is possible.

6.2 Uncertainty of measurement

Uncertainty of measurement shall not exceed the values specified in Table 2.

The steady-state cooling and heating capacities determined using the calorimeter method shall be determined with a maximum uncertainty of 5%. This value is an expanded uncertainty of measurement expressed at the level of confidence of 95%.

The heating and cooling capacities measured on the air side using the air-enthalpy method shall be determined with a maximum uncertainty of 10%. This value is an expanded uncertainty of measurement expressed at the level of confidence of 95%.

6.3 Variations in individual readings

The maximum permissible variation of any observation during the capacity test shall be as shown in Table 3.

6.4 Test tolerances

The maximum variation of any observation represents the greatest permissible difference between maximum and minimum instrument observations during the test. When expressed as a percentage, the maximum allowable variation is the specified percentage of the arithmetical mean of the observations.

The maximum permissible variations of the mean of the test observations from the standard or desired test conditions are shown in Table 3.

TABLE 2
UNCERTAINTY OF MEASUREMENT
OF INDICATED VALUES

Measured quantity	Uncertainty of measurement (see Note)
Water	
temperature	$\pm 0.1^{\circ}\text{C}$
temperature difference	$\pm 0.1^{\circ}\text{C}$
volume flow	$\pm 1\%$
static pressure difference	$\pm 5\%$
Air	
dry-bulb temperature	$\pm 0.2^{\circ}\text{C}$
wet-bulb temperature	$\pm 0.2^{\circ}\text{C}$
volume flow	$\pm 5\%$
static pressure difference	$\pm 5\text{ Pa}$ for pressure $\leq 100\text{ Pa}$ $\pm 5\%$ for pressure $> 100\text{ Pa}$
Refrigerant temperatures and pressures	$\pm 10\text{ kPa}$ for pressure $\pm 1.0^{\circ}\text{C}$ for temperature
Temperature/pressure of saturated condensing conditions	$\pm 10\text{ kPa}$ for pressure $\pm 0.2^{\circ}\text{C}$ for temperature
Electrical inputs	$\pm 0.5\%$
Time	$\pm 0.2\%$
Mass	$\pm 1.0\%$
Speed	$\pm 1.0\%$

NOTE: Uncertainty of measurement comprises, in general, many components. Some of these components may be estimated on the basis of the statistical distribution of the results of series of measurements and can be characterized by experimental standard deviations. Estimates of other components can be based on experience or other information. (See ISO *Guide to the expression of uncertainty in measurement*.)

6.5 Standby power and crankcase heaters

6.5.1 General

Standby power and crankcase heater power shall be measured in accordance with the procedures and instruments specified in AS/NZS 62301, and these measurements shall be determined for the following modes of the airconditioner (as applicable):

- (a) Off mode.
- (b) Passive standby mode.
- (c) Delay start mode.
- (d) Average crankcase heater power for various outdoor conditions.

The power in each applicable mode shall be reported in watts, to the nearest 0.1 W or better.

6.5.2 Off mode

Where the airconditioner is not operational and either has no remote control or automatic program functions or these are inoperative. This mode is the lowest power consumption mode that cannot be switched off (influenced) by the user and persists for an indefinite time when an appliance is connected to the mains electricity supply and used in accordance with the manufacturer's instructions. The power used by crankcase heaters (where present) shall be measured and reported separately to the power used in this mode (see Clause 6.5.5), where possible.

NOTE: Airconditioners may use some power when in off mode to supply electronic controls.

6.5.3 *Passive standby mode*

The state of an airconditioner with a remote control or remote communication capability when it is not operational but is monitoring for a signal from the remote control unit. An airconditioner capable of responding to a control system with some programming capacity, such as a timer (e.g. timed or delay start), is also in this mode. Where there are several possible power levels in this mode, the power for each shall be recorded together with a description of the relevant function. The power used by crankcase heaters (where present) shall be reported separately to the power used in this mode (see Clause 6.5.5), where possible.

6.5.4 *Delay start mode*

Where an airconditioner equipped with a separate user-initiated facility to delay the start operation is not operational but is capable of being activated at the programmed time. (This mode applies only to models that have this function as a separate feature, not to those that incorporate this function in passive standby mode.)

6.5.5 *Crankcase heaters*

Where an airconditioner has a crankcase heater (a small resistive heater attached to the compressor sump or crankcase—the sump is where oil and some refrigerant collects when the unit is not operating), the following measurements shall be taken:

- (a) Average heater power (watts) with the section containing the compressor under a dry-bulb ambient temperature of $20^{\circ}\text{C} \pm 2 \text{ K}$.
- (b) Average heater power (watts) with the section containing the compressor under a dry-bulb ambient temperature of $7^{\circ}\text{C} \pm 2 \text{ K}$.

Measurements shall be made over a period of not less than 3 hours. Where the heater exhibits any regular cyclic behaviour, the average power shall be determined from measurements taken over a number of complete cycles.

Where the ambient temperature does not influence the power consumption of the crankcase heater, the measurements may be taken at any ambient temperature. Manufacturers may declare the values for Items (a) and (b) above based on their measurements and their knowledge of the control of the crankcase heater. For verification purposes, a combination of analysis of the control system and measurements may be used to assess compliance, but a measurement taken under the specified conditions shall have precedence over one obtained by any other method.

6.6 **Testing airconditioners with variable output compressors**

In the case of some types of variable output capacity airconditioners, non-user-accessible controls may need to be set in order to lock the output capacity at the rated capacity (or part-load capacity) specified by the manufacturer. Where special tools or software are required for this purpose, the manufacturer shall provide the tools or software to the laboratory.

TABLE 3
VARIATIONS ALLOWED IN CAPACITY TEST READINGS

Readings	Variations of arithmetical mean values from specified test conditions	Maximum variation of individual reading
Temperature of air entering indoor-side dry-bulb wet-bulb	$\pm 0.3^{\circ}\text{C}$ $\pm 0.2^{\circ}\text{C}$	1.0°C 0.6°C
Saturated condensing temperature	$\pm 0.3^{\circ}\text{C}$	1.0°C
Air volume flow rate	$\pm 5\%$	10%
Voltage	$\pm 1\%$	2%
Water temperature inlet outlet	$\pm 0.1^{\circ}\text{C}$ $\pm 0.1^{\circ}\text{C}$	0.2°C 0.2°C
Water volume flow rate	$\pm 1\%$	2%
External resistance to airflow	$\pm 5\text{ Pa}$	10 Pa

7 TEST RESULTS

7.1 Capacity calculations

7.1.1 General

The results of a capacity test shall express quantitatively the effects produced upon air by the equipment tested. For given test conditions, the capacity test results shall include such of the following quantities as are applicable to the type of equipment tested:

- (a) Net total cooling capacity, in watts.
- (b) Net sensible cooling capacity, in watts.
- (c) Latent capacity, in watts.
- (d) Indoor-side airflow rate, in cubic metres per second, of standard air.
- (e) External resistance to indoor airflow, in pascals.
- (f) Effective power input to the equipment or individual power inputs to each of the electrical equipment components, in watts.

7.1.2 Adjustments

The test results shall be used to determine capacities without any adjustment for permissible variations in test conditions, except that air enthalpies, specific volumes and isobaric specific heat capacities shall be corrected for deviations from saturation temperature and standard barometric pressure.

7.2 Data to be recorded

The data to be recorded for the capacity tests is given in Table 4 for the calorimeter test method and in Table 5 for the indoor air-enthalpy test method. The tables identify the general information required but are not intended to limit the data to be obtained. Electrical input values used for rating purposes shall be those measured during the capacity tests.