COMMITTEE ME-086

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Draft for Public Comment Australian/New Zealand Standard

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Liquid-chilling packages using the vapour compression cycle
Part 1.1: Method of rating and testing for performance—Rating

STANDARDS Australia

STANDARDS NEW ZEALAND Paerewa Aotearoa

Draft for Public Comment
Australian/New Zealand Standard

The committee responsible for the issue of this draft comprised representatives of organizations interested in the subject matter of the proposed Standard. These organizations are listed on the inside back cover.

Comments are invited on the technical content, wording and general arrangement of the draft.

The preferred method for submission of comment is to download the MS Word comment form found at *http://www.standards.com.au/Catalogue/misc/Public Comment Form.doc*. This form also includes instructions and examples of comment submission.

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Editorial matters (i.e. spelling, punctuation, grammar etc.) will be corrected before final publication.

The coordination of the requirements of this draft with those of any related Standards is of particular importance and you are invited to point out any areas where this may be necessary.

Please provide supporting reasons and suggested wording for each comment. Where you consider that specific content is too simplistic, too complex or too detailed please provide an alternative.

If the draft is acceptable without change, an acknowledgment to this effect would be appreciated.

When completed, this form should be returned to the Projects Manager, **Boris Krastev** via email to **boris.krastev@standards.org.au**.

Normally no acknowledgment of comment is sent. All comments received electronically by the due date will be put before the relevant drafting committee. Because Standards committees operate electronically we cannot guarantee that comments submitted in hard copy will be considered along with those submitted electronically. Where appropriate, changes will be incorporated before the Standard is formally approved.

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Draft for Public Comment

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Committee ME-086—Commercial Airconditioning Equipment

DRAFT

Australian/New Zealand Standard

Liquid-chilling packages using the vapour compression cycle

Part 1.1: Method of rating and testing for performance—Rating

(To be AS/NZS 4776.1.1:200X)

This draft was prepared by the Joint Standards Australia/Standards New Zealand Committee ME-086, Commercial Air Conditioning.

Comment on the draft is invited from people and organizations concerned with this subject. It would be appreciated if those submitting comment would follow the guidelines given on the inside front cover.

This document is a draft Australian/New Zealand Standard only and is liable to alteration in the light of comment received. It is not to be regarded as an Australian/New Zealand Standard until finally issued as such by Standards Australia/Standards New Zealand.

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee ME-086, Commercial Air Conditioning. It is based on ISO document PWD 19298-1, *Liquid-chilling packages using the vapour compression cycle*, Part 1: *Method for rating for performance*. Other documents in the series of Standards for air conditioning chillers are—

Part 1.2: Method for rating and testing for performance—Testing

Part 2: Minimum energy performance standard (MEPS) and compliance requirements

This part of the Standard is published with the express approval of the Australian Greenhouse Office, and State and Territory regulatory authorities and it is structured to be suitable for reference in legislation in Australia.

In order for a manufacturer to comply with this Standard, conformance to both Part 1 and Part 2 is required. Agencies or companies that offer testing services only can use Part 2 of the Standard. The Standard is intended for use as the basis for certification programs in various geographic regions. This Standard may also be used for customer specific tests conducted in appropriate test facilities, but it is not intended for field-testing.

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

Liquid-chilling packages using the vapour compression cycle

Part 1.1: Method of rating and testing for performance—Rating

1 SCOPE

This Standard covers liquid-chilling packages used in applications with temperatures as described in Clause 5.3. These packages consist of any type of compressor and an evaporator and are equipped with air-cooled condensers with axial fans or liquid-cooled condensers and can be supplied with or without water pumps. This Standard covers chillers within the following capacity ranges:

	Capacity range, kW	
	COP rating	**IPLV rating**
Water cooled	110–3500	250–3500
Air cooled	0–600*	250–600*

NOTE: * or higher, as applicable within Eurovent, ARI and AS/NZS frameworks.

This Standard does not cover—

(a) chillers driven by other than electric motors;

(b) heat recovery chillers;

(c) 60 Hz chillers;

(d) chillers with remote condensers; and

(e) low temperature brine chillers.

2 OBJECTIVE

This Standard establishes methods of rating the performance of factory made liquid-chilling packages using the vapour compression cycle.

This Standard covers full load and part load ratings to allow for an energy analysis of the unit in different applications.

3 NORMATIVE REFERENCES

The following documents are referred to in this Standard:

AS/NZS
1677 Refrigerating systems
1677.1 Part 1: Refrigerant classification

ARI
550/590 Water chilling packages using the vapour compression cycle

4 DEFINITIONS

For the purposes of this Australian Standard, the following definitions apply:

4.1 Air-cooled condenser

A refrigeration system component that condenses refrigerant vapour by rejecting heat to air circulated over its heat transfer surface causing a rise in the air temperature. Desuperheating and sub-cooling of the refrigerant may occur as well.

4.2 Bubble point

Refrigerant liquid saturation temperature at a specified pressure (°C).

4.3 Coefficient of performance (COP)

A ratio of the cooling capacity in kW to the total power input (as defined in Clause 4.16) in kW (kW/kW). This represents the efficiency of the liquid chilling package at specific rating conditions.

4.4 Condenser rejection capacity

The heat removed by the heat transfer medium of the condenser per unit of time (kW).

4.5 Cooling capacity

Heat given off from the liquid to the refrigerant per unit of time (kW).

4.6 Dew point

Refrigerant vapour saturation temperature at a specified pressure (°C).

4.7 Effective COP

A ratio of the effective cooling capacity in kW to the total power input in kW for units with integral pumps (kW/kW).

4.8 Effective cooling capacity

For units with integral pumps, the effective cooling capacity (kW) includes the power from the pumps.

4.9 Evaporator

A heat transfer device, which utilizes refrigerant-to-liquid heat transfer means, causing the refrigerant to evaporate and the liquid to be cooled. Superheating of the refrigerant may occur as well.

4.10 Fouling factor

The thermal resistance due to fouling accumulated on the fluid side of the heat transfer surface (m^2 K/kW).

4.11 Fouling factor allowance

Provision for anticipated fouling during use specified in m^2 K/kW.

4.12 Liquid-cooled condenser

A heat transfer device, which utilizes refrigerant-to-liquid heat transfer means, causing the refrigerant to condense and the liquid to be heated. Desuperheating and sub-cooling of the refrigerant may occur as well.

4.13 Liquid refrigerant temperature

Temperature of the refrigerant entering the expansion device (°C).

4.14 Part-load value (PLV)

A single number figure expressing part-load efficiency for chillers on the basis of weighted average operation at various partial load capacities and specific ambient conditions.

4.14.1 *Integrated part-load value (IPLV)*

A single number part-load efficiency figure for chillers calculated per the method described in this Standard at standard rating conditions defined in Clause 5.2.

4.14.2 *Non-standard part-load value (NPLV)*

A single number part-load efficiency figure for chillers calculated per the method described in this Standard at conditions other than conditions defined in Clause 5.2.

4.15 Saturated discharge temperature

For single component and azeotropic refrigerants, it is the saturated temperature corresponding to the refrigerant pressure at the compressor discharge. For zeotropic refrigerants, it is the arithmetic average of the dew point and bubble point temperatures corresponding to refrigerant pressure at the compressor discharge. It is usually taken at or immediately downstream of the compressor discharge service valve (in either case on the downstream side of the valve seat), where discharge valves are used (°C).

4.16 Total power input

Power input of all components of the unit in operation includes—

(a) the power input for operation of the compressor (kW);

(b) the power input of all controls, safety devices, starters, and drives of the unit, including devices necessary for correct operation of the refrigerating circuit (e.g., oil pump, refrigerant pump) (kW);

(c) the power for fans for air cooled liquid chillers (kW); and

(d) if rated with integral pumps the power supplied to the pumps (kW).

4.17 Published ratings

Performance data over the operating range of the unit at full load or part load in the form of a catalog or output from a computer selection code.

5 RATING REQUIREMENTS

5.1 Test requirements

All tests for chiller ratings shall be conducted in accordance with Part 2 of this Standard.

5.2 Standard Rating conditions

Published ratings for all liquid-chilling packages as in Clause 6 shall include the standard ratings, corresponding to the standard rating conditions shown in Table 1 within the operating limits of the unit.

5.3 Application rating conditions

Application ratings should include the following range of rating conditions or be within the operating limits of the equipment:

(a) *All condenser types*:

Leaving chilled water temperature ..... 4 to 9°C.

(b) *Water-cooled condensers*:

Entering condenser water temperature ..... 18 to 40°C.

(c) *Air-cooled condensers*:

Entering condenser air-dry-bulb temperature ..... 13 to 52°C.

5.4 Part-load rating

Water-chilling packages, which are capable of capacity reduction shall be rated at 100% and at each step of capacity reduction provided by the refrigeration system(s) as published by the manufacturer.

Part-load ratings points shall be based on the conditions defined in Table 2 for IPLV and NPLV.

5.4.1 *Determination of part-load performance*

For water-chilling packages covered by this Standard, the IPLV or NPLV shall be calculated as follows:

(a) Determine the part-load energy efficiency at 100%, 75%, 50% and 25% load points at the conditions specified in Table 2.

(b) Use the following equation to calculate the IPLV or NPLV:

$$0.01A + 0.42B + 0.45C + 0.12D \quad \ldots (1)$$

where

A = COP at 100% load

B = COP at 75% load

C = COP at 50% load

D = COP at 25% load

Note that the part load rating conditions are measured with condenser relief conditions defined in Table 2.

TABLE 1

STANDARD RATING CONDITIONS FOR COOLING

Method	Liquid-cooled		Air-cooled	
	1	2	1	2
Liquid cooled condenser				
Entering temperature	30°C	29.4°C	N/A	N/A
Delta T	5 K	N/A	N/A	N/A
Flow rate	N/A	0.054 L/s/kW	N/A	N/A
Liquid-side fouling factor allowance	0.044 m^2 K/kW		N/A	N/A
Air cooled condenser				
Condenser coil entering dry-bulb temperature	N/A	N/A	35°C	35°C
Air-side fouling factor allowance	N/A		0.000 m^2 K/kW	
Evaporator liquid temperature	**1**		**2**	
Leaving	7°C		6.7°C	
Delta T	5 K		N/A	
Flow rate	N/A		0.043 L/s/kW	
Liquid-side fouling factor allowance	0.018 m^2 K/kW		0.018 m^2 K/kW	

NOTE: Method 1 is according to Eurovent Liquid Chilling Packages Certification Programme; Method 2 is according to ARI 550/590.

TABLE 2

IPLV AND NPLV RATING CONDITIONS

	IPLV	NPLV
Evaporator LWT		
100% load	6.7°C	Application LWT
0% load	6.7°C	Application LWT
Flow rate	0.043 L/s/kW	Application L/s/kW
Fouling factor allowance	0.018 L/s/kW	As specified
Water-cooled condenser		
100% load EWT	29.4°C	Application EWT
75% load EWT	23.9°C	See Note
50% load EWT	18.3°C	18.3°C
25% load EWT	18.3°C	18.3°C
0% load EWT	18.3°C	18.3°C
Flow rate	0.054 L/s/kW	Application L/s/kW
Fouling factor allowance	0.044 m^2 K/kW	As specified
Air-cooled condenser		
100% load EDB	35.0°C	N/A
75% load EDB	26.7°C	N/A
50% load EDB	18.3°C	N/A
25% load EDB	12.8°C	N/A
0% load EDB	12.8°C	N/A
Fouling factor allowance	0.000 m^2 K/kW	N/A

LWT = leaving water temperature

EWT = entering water temperature

EDB = entering air dry bulb temperature

NOTE: EWT vary linearly from EWT at 100% load to a minimum of 18.3°C at 50% load.

6 PUBLISHED RATINGS

To comply with this Standard performance ratings shall be based on test data or models derived from test data.

Published ratings shall include the following:

(a) Refrigerant in accordance with AS/NZS 1677.1.

(b) Model number designations providing identification of the liquid-chilling packages to which the ratings shall apply.

(c) Nominal voltage and frequency.

Fouling allowance Published ratings shall clearly state the fouling factor allowance. Corrections and calculations for different fouling factors shall be made. Ratings shall be published using the nominal fouling factors as per Table 1.

6.1 Standard ratings

The standard ratings shall include the following data:

(a) *For all units*

(i) Total power input to chiller (kW).

(ii) Cooling capacity (kW).

(iii) Effective cooling capacity for units supplied with integral pumps.

(iv) COP (kW/kW).

(v) Any two of the following:

(A) Entering evaporator liquid temperature (°C).

(B) Leaving evaporator liquid temperature (°C).

(C) Liquid temperature difference through the evaporator (K).

(vi) For all units without integral evaporator pump, evaporator liquid pressure drop (kPa). For units with integral evaporator pumps the available static pressure (kPa).

(vii) Chilled liquid flow rate (L/s).

(b) *For liquid-cooled condenser packages*

(i) For water cooled units without integral pump condenser liquid pressure drop (kPa). For units with integral pump the available static pressure, kPa.

(ii) Any two of the following:

(A) Entering condenser liquid temperature, (°C).

(B) Leaving condenser liquid temperature, (°C).

(C) Liquid temperature difference through the condenser, (K).

(D) Condenser liquid flow rate (L/s).

(c) *For air-cooled condenser units*

(i) Condenser coil entering air dry-bulb temperature (°C).

7 RATING TOLERANCES

Ratings published and claimed to be in compliance with this Standard shall meet the allowable tolerance as specified in Clause 7.1.

Full load capacity, full and part load COP values shall not be less than 100% of the rating less the allowable tolerance in Clause 7.1. Liquid pressure drop in the evaporator or the condenser shall not exceed 115% of the rated pressure drop at the specified liquid flow rate at any rated condition. The pump head for units with integral pump(s) in the evaporator or the condenser shall not be less than 85% of the rated pump head at the specified liquid flow rate at any rated condition.

7.1 Allowable tolerance

The full load and part load allowable tolerances on capacity (kW) and COP (W/W) shall be determined from the following equation:

$$\text{Allowable tolerance in percent} = 10.5 - (0.07 \times \%FL) + \left(\frac{833.3}{DT_{\text{FL}} \times \%FL} \right)$$

where

$\%FL$ = percent of selected full-load rating conditions

DT_{FL} = difference between entering and leaving chilled water temperature at full-load (K)

7.2 Full-load example in COP

Rated capacity = 500 kW

Rated power input = 100 kW

Cooling DT_{FL} = 5 K

7.3 Part-load example in COP

Assume a part load of 75% of the rated capacity.

Part load capacity = 375 kW

Part load power input = 70 kW

Cooling DT_{FL} = 5 K

*** END OF DRAFT ***

PREPARATION OF JOINT AUSTRALIAN/NEW ZEALAND STANDARDS

Joint Australian/New Zealand Standards are prepared by a consensus process involving representatives nominated by organizations in both countries drawn from all major interests associated with the subject. Australian/New Zealand Standards may be derived from existing industry Standards, from established international Standards and practices or may be developed within a Standards Australia, Standards New Zealand or joint technical committee.

During the development process, Australian/New Zealand Standards are made available in draft form at all sales offices and through affiliated overseas bodies in order that all interests concerned with the application of a proposed Standard are given the opportunity to submit views on the requirements to be included.

The following interests are represented on the committee responsible for this draft Australian/ New Zealand Standard:

Airconditioning & Refrigeration Equipment Manufacturers Association of Australia

Australian Building Codes Board

Australian Greenhouse Office, Department of the Environment and Water Resources

Australian Institute of Refrigeration Air Conditioning and Heating (Inc)

Energy Efficiency and Conservation Authority of New Zealand

Engineers Australia

Standards Australia

Standards Australia is an independent company, limited by guarantee, which prepares and publishes most of the voluntary technical and commercial standards used in Australia. These standards are developed through an open process of consultation and consensus, in which all interested parties are invited to participate. Through a Memorandum of Understanding with the Commonwealth government, Standards Australia is recognized as Australia's peak national standards body.

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The first national Standards organization was created in New Zealand in 1932. The Standards Council of New Zealand is the national authority responsible for the production of Standards. Standards New Zealand is the trading arm of the Standards Council established under the Standards Act 1988.

Australian/New Zealand Standards

Under a Memorandum of Understanding between Standards Australia and Standards New Zealand, Australian/New Zealand Standards are prepared by committees of experts from industry, governments, consumers and other sectors. The requirements or recommendations contained in published Standards are a consensus of the views of representative interests and also take account of comments received from other sources. They reflect the latest scientific and industry experience. Australian/New Zealand Standards are kept under continuous review after publication and are updated regularly to take account of changing technology.

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Standards Australia and Standards New Zealand are responsible for ensuring that the Australian and New Zealand viewpoints are considered in the formulation of international Standards and that the latest international experience is incorporated in national and Joint Standards. This role is vital in assisting local industry to compete in international markets. Both organizations are the national members of ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission).

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