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Swimming pool heat pump systems



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- International Copper Association Australia
- Pump Industry Australia
- Swimming Pool & Spa Association of Australia

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Preface

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee EL-058, Energy Efficiency for Swimming Pool Pumps.

The objective of this document is to specify the procedures for determining the heating and cooling capacity, coefficient of performance and installation, and sizing of residential and commercial swimming pool heat pump systems.

The terms “normative” and “informative” are used in Standards to define the application of the appendices to which they apply. A “normative” appendix is an integral part of a Standard, whereas an “informative” appendix is only for information and guidance.

Contents

Preface	ii
Introduction	v
1 Scope and general	1
1.1 Scope.....	1
1.2 Application.....	1
1.2.1 Intended users.....	1
1.2.2 Application of NF 414 and ANSI/AHRI 1161.....	1
1.3 Normative references.....	1
1.4 Terms and definitions.....	2
2 Rating requirements — Operating conditions	4
3 Test facility	5
3.1 Scope.....	5
3.2 Test chamber.....	5
3.2.1 General.....	5
3.2.2 Air temperature and circulation.....	5
3.2.3 Radiant heat sources.....	5
3.2.4 Electricity supply.....	6
3.3 Test system.....	6
3.3.1 General.....	6
3.3.2 Water flow rate.....	6
3.3.3 Location of water temperature sensors.....	6
3.3.4 Location of air temperature and humidity sensors.....	7
3.4 Measurement accuracy.....	9
3.4.1 General.....	9
3.4.2 Air temperature.....	10
3.5 Water temperature.....	10
3.5.1 General.....	10
3.5.2 Water inlet temperature.....	10
3.5.3 Water temperature rise.....	10
3.5.4 Water pressure drop.....	11
3.6 Electrical power.....	11
3.7 Flow rate.....	11
3.8 Test procedure.....	11
3.9 Data to be recorded.....	11
3.10 Calculation of capacity, COP and EER.....	12
3.11 Reporting of results.....	13
4 Instructions and nameplate data	13
4.1 Nameplate.....	13
4.2 Instructions.....	13
5 Product conformity	15
6 Calculation of pool heating load and heat pump selection	15
6.1 General.....	15
6.2 Evaporation heat loss.....	16
6.3 Radiation heat loss.....	18
6.4 Convection heat loss.....	19
6.5 Solar radiation heat gain.....	20
6.6 Effect of pool covers on heat loss.....	20
6.6.1 General.....	20
6.6.2 Evaporative heat loss with cover.....	20
6.6.3 Radiation heat loss with cover.....	21
6.6.4 Convective heat loss with cover.....	21
6.6.5 Solar radiation heat gain with a cover.....	21

6.6.6	Time of use of cover	22
6.7	Heat pump selection	23
6.8	Estimation of heat-up time	23
7	Operating requirements	24
7.1	Installation	24
7.1.1	General	24
7.1.2	Installation clearances	24
7.1.3	Installation method	24
7.1.4	Proximity to pool equipment	24
7.1.5	Electrical considerations	25
7.1.6	Water flow rates	25
7.1.7	Temperature control	25
7.2	Hydraulic requirements	25
7.2.1	Water piping	25
7.2.2	Pipe size and outlets	27
7.2.3	Water bypass	27
7.2.4	Plumbing multiple units	27
Appendix A (informative) Uncertainty in COP and capacity		29
Appendix B (informative) Climate data		35
Bibliography		37

Introduction

Heat pumps have grown from a niche segment of the swimming pool heating market to a commonplace choice for consumers, rivalling gas in market uptake.

There is a community expectation that products available and installed in Australia comply with current legislation, Australian Standards or best practice. This expectation supports increasing consumer demand that the performance of heat pumps is underpinned by data and provides environmental and social benefits to consumers.

While consumers gain assurance from Australian Standards for gas and solar heating, the lack of a comparable approach for heat pumps leaves consumers to purchase products that meet neither the heating capacity required nor their expectation of energy efficiency.

This document was developed due to the concerns of the Swimming Pool and Spa industry that current claims in the market for heat pumps have historically lacked engineering rigour and claims of performance. Swimming Pool and Spa industry working groups identified a significant need to establish performance benchmarks for consumers in the marketplace.

NOTES

Australian Standard®

Swimming pool heat pump systems

1 Scope and general

1.1 Scope

This document sets out test requirements, rating requirements, minimum data requirements for published ratings, and operating requirements for residential and commercial swimming pool heat pump systems. It also specifies definitions, classifications, sizing guidelines, marking and nameplate data, and conformance conditions relevant to these systems.

This document applies to air-to-water heat pumps used for swimming pool water heating and cooling. This document is also applicable to packaged heat pumps comprising of electrically driven mechanical compression types.

The variation of coefficient of performance (COP) and electric input power (kW demand) as a function of operating conditions is to be determined by this document. The results can be used in annual performance calculations of heat pump applications for swimming pool water heating and cooling.

1.2 Application

1.2.1 Intended users

This document is intended to be used by —

- (a) installers as a guide for the correct and safe installation of swimming pool heat pumps;
- (b) specifiers as a guide for the correct selection and sizing of swimming pool heat pumps; and
- (c) manufacturers and suppliers of swimming pool heat pumps for guidance on safety and standardized testing and rating conditions.

1.2.2 Application of NF 414 and ANSI/AHRI 1161

Products tested in accordance with NF 414 meet the performance assessment requirements of this document if NF 414 testing was carried out for water temperature rises of 5 K operating conditions.

Products tested in accordance with ANSI/AHRI 1161 meet this document's performance assessment requirements if the product capacity is greater than 20 kW.

1.3 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document:

NOTE Documents for informative purposes are listed in the Bibliography.

AS 1926.3, *Swimming pool safety, Part 3: Water recirculation systems*

AS/NZS 2712:2007, *Solar and heat pump water heaters — Design and construction*

AS/NZS 3000, *Electrical installations (known as the Australian/New Zealand Wiring Rules)*

AS/NZS 60335.2.40, *Household and similar electrical appliances—Safety, Part 2.40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers*

1.4 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

NOTE ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- (a) IEC Electropedia: available at <https://www.electropedia.org/>
- (b) ISO Online browsing platform: available at <https://www.iso.org/obp>

1.4.1

accuracy

ability of an instrument to indicate the true value of the measured physical quantity

1.4.2

ambient air

air in the space (either indoors or outdoors) surrounding the device or unit

[SOURCE: ISO 9459-1:1993, 3.3, modified]

1.4.3

ambient air temperature

temperature of the air surrounding the heat pump

[SOURCE: ISO 9459-1:1993, 3.44, modified]

1.4.4

capacity (thermal)

heat energy delivered as a heat pump or heat energy removed as a water chiller

1.4.5

coefficient of performance

COP

ratio of the heating capacity (kW) to the active electric power input (kW) to the device at any given set of rating conditions

1.4.6

controls

device or sub-component for regulation of the thermal system or device in normal operation

Note 1 to entry: Controls may be manual or automatic.

1.4.7

convection heat loss

loss of heat from the pool water to the air above the pool surface via natural or forced convection or both (kW)

1.4.8

cooling capacity

rate at which heat is removed from the water in kilowatts when the pool heat pump is operating at rated input and standard rating conditions

1.4.9

dry bulb air temperature

temperature indicated by a dry temperature-sensing element shielded from the effects of radiation

[SOURCE: ISO 7547:2022 Clause 3.7]

1.4.10**energy efficiency ratio****EER**

ratio of the cooling capacity (kW) to the active power input (kW) to the device at any given set of rating conditions

1.4.11**evaporation heat loss**

rate of heat loss due to evaporation of pool water (kW)

1.4.12**flow rate** **$\dot{Q}$**

volumetric flow rate expressed as L/min

1.4.13**head loss****pressure drop**

reduction in the total head or pressure of fluid as it flows through a hydraulic system

1.4.14**heat exchanger**

device specifically designed to transfer heat between two physically separated fluids

[SOURCE: IEC 60335-2-40:2018]

1.4.15**heat pump (air source)**

device that uses a vapour compression cycle and incorporates a mechanical compressor, an evaporator and a condenser that delivers or removes heat from the water either directly or indirectly

1.4.16**heating capacity**

rate at which heat is passed to the water in kilowatts when the pool heater is operating at rated input and standard rating conditions

[SOURCE: ©ASHRAE, www.ashrae.org. 2020 ASHRAE Standard-146: Modified]

1.4.17**input power**

power supplied to the heat pump or chiller under normal operating conditions measured at the supply point (kW)

Note 1 to entry: This is synonymous with active, effective, or real power

1.4.18**may**

indicates the existence of an option

1.4.19**radiant heat loss**

loss of heat from the pool to the surrounding environment through radiation

1.4.20**radiant heat source**

source of heat transmitted via radiation

Note 1 to entry: It does not require a medium in which it propagates

1.4.21**relative humidity**

measure of water vapor in the air as a percentage of the amount the air can hold

1.4.22**run time**

duration in hours for which the heat pump is run per day

1.4.23**sampling period**

time during which measurements are made and recorded

1.4.24**shall**

indicates that a statement is mandatory

1.4.25**should**

indicates a recommendation

1.4.26**swimming pool**

excavation or structure containing water that is designed, manufactured or adapted to be principally used for swimming, wading, paddling, or the like, including a bathing or wading pool, or spa

1.4.27**uncertainty**

dispersion of the values that could reasonably be attributed to the measuring device, procedure of measurement or both

Note 1 to entry: The word “better” in this context throughout this document is to imply a value less than that specified.

1.4.28**variation**

changes in recorded value that take place between one reading and the next

1.4.29**wet bulb temperature**

air temperature measured by a temperature sensor covered by a water-moistened wick and exposed to air in motion

[SOURCE: ISO 5802:2001 Clause 3.1.18]

2 Rating requirements — Operating conditions

The heat pump performance shall be rated by at least two different ambient operating conditions. These two conditions shall include the following point, in accordance with [Table 2\(A\)](#), and at least one other ambient condition from [Table 2\(B\)](#).

Table 2(A) — Reference rating condition

Air temperature (dry bulb)	Air temperature (wet bulb)	Water inlet temperature	Water outlet temperature
15 °C	12 °C	26 °C	28 °C

For heat pumps with cooling ability, an additional rating point for cooling performance shall be used.

Air to water heat pumps fitted with inverter variable speed compressors should be tested at 100 % of capacity (or maximum selectable speed), and part load capacity (50 % or less of maximum capacity or 75 % or less of maximum speed).

Table 2(B) — Standard rating conditions

	Ambient air temperature		Intake water temp °C	Water temperature rise K
	Dry bulb °C	Wet bulb °C		
High air temperature — high humidity	27	24	26	> 2
Standard air temperature — mid humidity	15	12	26	> 2
Low air temperature — high humidity	7	6	26	> 2
For cooling units, high air temperature — mid humidity	35	30	29	> 2

3 Test facility

3.1 Scope

This section sets out the test room conditions and instrumentation requirements for the performance testing of swimming pool heat pumps. The heat pump shall be charged with refrigerant type and quantity as specified on its nameplate.

3.2 Test chamber

3.2.1 General

The test chamber shall be capable of maintaining the required temperature and humidity conditions within the specified tolerances (see [Table 3.8](#)) while the heat pump is operating. The test chamber's dimensions shall allow for a distance of at least 1.8 m from any room surface to any test product surface from which air is discharged. The distance from any other room surface to any other surface of the heat pump under test shall not be less than 0.9 m, except for typical floor or wall spacings required for equipment installation as specified by the manufacturer.

3.2.2 Air temperature and circulation

The room conditioning apparatus shall handle air at a flow rate no less than that specified at the evaporator for maximum capacity operation of the test product. Intake and exhaust of test room air shall not change the normal pattern of air-circulation around the equipment under test. The empty test chamber shall be configured to achieve an air speed of between 0.25 and 0.5 m/s at the midpoint of the heat pump's evaporator intake location. The configuration of the test room and the associated controls, (e.g. position of partitions and equipment, airflow rates, fan settings and controls) shall be maintained for the entire duration of the test.

3.2.3 Radiant heat sources

During the test the heat pump shall not be exposed to any radiant heat sources. External windows, where incorporated in a test room, shall be provided with radiation shading devices. The test room

walls and ceilings shall be insulated to ensure that the inside wall and ceiling surface temperatures in the room are within 2 K of the air temperature. Where the temperature difference between any test room equipment, the test room ambient temperature and the appliance under test is greater than 5 K, radiation shading devices shall be employed to avoid radiant heat transfer. The heat pump shall not be in view of any hot surfaces associated with the test room temperature regulation system or any other equipment, including any other products under test. Radiation shields or partitions shall not be closer than 200 mm from the heat pump unit under test.

Fluorescent or LED lighting should be used due to its high light output, low surface temperature and low heat load on the test room. Lighting sources such as incandescent, quartz halogen and high intensity discharge lamps shall not be used closer than 3 m to the heat pump. Shielding from direct radiation of such lamps shall be used.

3.2.4 Electricity supply

The electricity supply to the heat pump unit's connection point during all tests shall be as follows:

- (a) *Voltage* — 230 V a.c. $\pm 1\%$.
- (b) *Frequency* — 50 Hz $\pm 1\%$.

Control of the power supply is critical to ensure the electrical supply requirements are met. This shall be achieved via methods including, but not limited to —

- (i) a toroidal variable auto-transformer, such as a “variac”;
- (ii) a voltage stabilizer; or
- (iii) an electronically generated power supply.

The connection point for electrical measurements shall be made as close as is practicable to the end of the manufacturer-supplied power lead(s) for the pump unit. The connection point shall include all electrical inputs to the pump unit, even if there are independent components with separate leads.

NOTE Measurement of voltage, at points further removed from the pump unit other than specified above, results in additional supply cable losses being counted against the test object.

3.3 Test system

3.3.1 General

The equipment to be tested shall be installed in accordance with the manufacturer's instructions. Equipment may be mounted on a platform above the floor of the test chamber to meet the chamber air flow uniformity requirements specified in [Clause 3.2.1](#).

3.3.2 Water flow rate

To achieve the specified maximum uncertainty of $\pm 5\%$ (see [Clause 3.6](#)) for COP and capacity, a minimum water temperature rise of 2 K shall be used. The flow rate and plumbing configuration, including flow bypass, specified in the manufacturer's instructions may be used provided the minimum 2 K temperature rise has been used across the heat exchanger.

3.3.3 Location of water temperature sensors

The temperature of the water shall be measured with a temperature-sensing device held in the path of the water entering and leaving the heat pump fittings similar to that illustrated in [Figure 3.3.3](#). The temperature sensor shall not protrude more than 150 mm into the pipe from the outlet of the mounting T as shown in [Figure 3.3.3](#).

The piping dimensions are ± 50 mm.

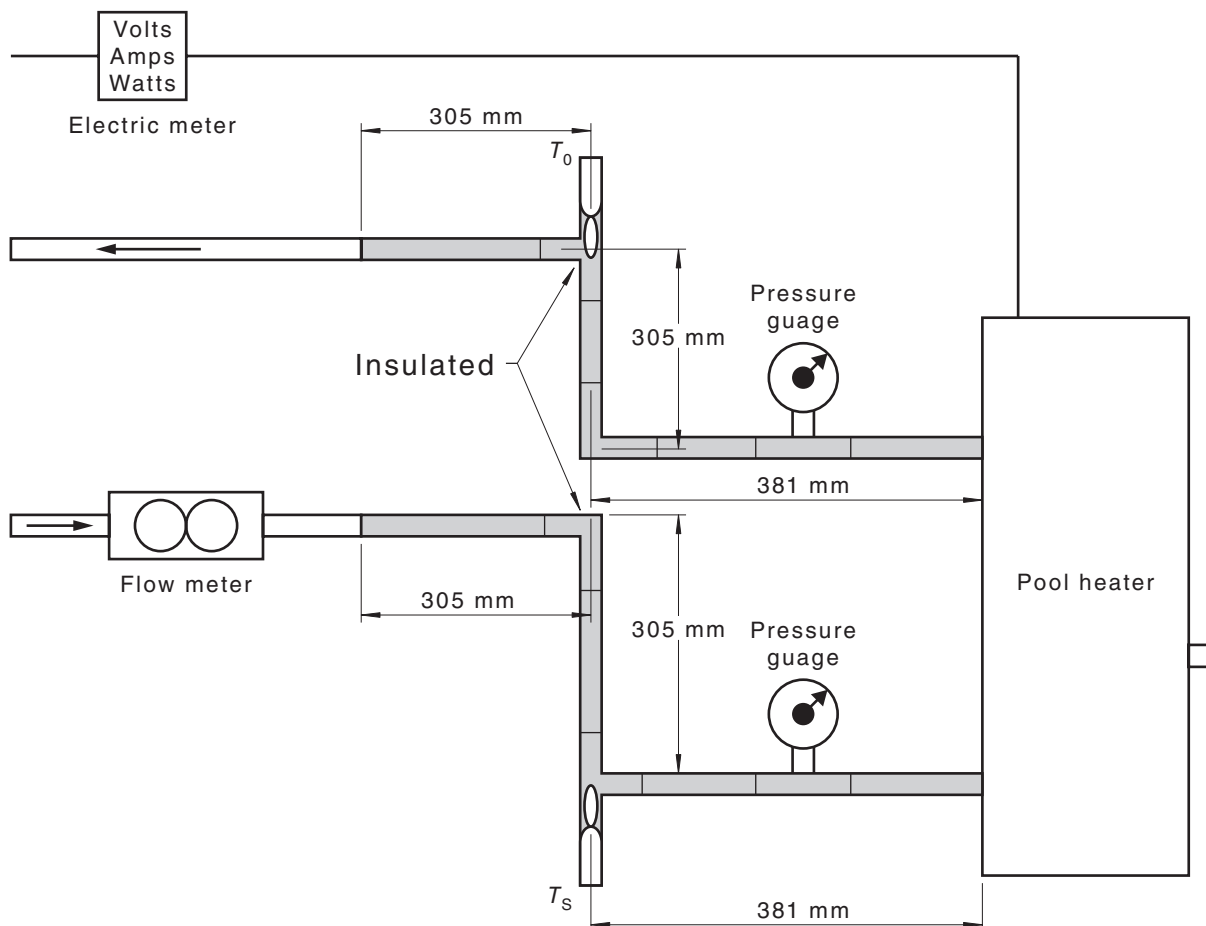


Figure 3.3.3 — Location of water temperature sensors

3.3.4 Location of air temperature and humidity sensors

The test room air temperature and humidity shall be measured at locations that satisfy the following conditions:

- The measured air temperature and humidity is representative of the air conditions surrounding the outdoor section of the heat pump and simulates the conditions encountered in an actual application.
- At the point of measurement, the air temperature and humidity shall not be affected by the air discharged from the outdoor unit of the heat pump and be measured upstream of any recirculation between the outlet and inlet.
- The air temperature measurement system shall draw air from a sampling tube that spans at least half the width of the evaporator inlet, as shown in [Figures 3.3.4\(A\)](#) and [3.3.4\(B\)](#). The sampling tube shall be mounted 0.6 m upstream of the heat pump air inlet and at the mid-height of the heat pump air inlet. The plane of the sampling tube shall be normal to the primary free airflow direction. The air speed inside the sampling tube over the air temperature sensor shall be greater than 2.0 m/s.