Guidance for Assessing Compliance with Air Conditioner MEPS and Zoned Energy Rating Label (ZERL)

Requirements using the Energy Efficiency (Energy Using Products) Regulations 2002 Schedule 2A Part 3.

Introduction

This advice is primarily aimed at air-to-air single-split systems that have the following attributes:

- Fall in scope of the *Efficiency (Energy Using Products) Regulations 2002*[1] (Regulations) Schedule 2A; and
- are in product classes 8, 9 and 11 as given in the Regulations Schedule 2A Part 1 Clause 2 (relevant product classes).

This document gives the measurements that are required or optional for assessing a product's compliance with the Regulations for MEPS and labelling. It expands on advice given on EECA's website[2] for assessing air conditioner compliance, explaining the respective test standards for computing heating and cooling performance.

Status

This document is designed to help navigate the Regulations and does not form part of the Regulations. Where there is any variation between the guidance below and the Regulations, the Regulations take precedence.

Importers and manufacturers are advised to ensure that they are familiar with the referenced standards and regulations listed below.

It is not a statutory defence to any proceedings for non-compliance with the Regulations that a party followed this advice in its dealings with or representations about a regulated product.

[1] Energy Efficiency (Energy Using Products) Regulations 2002 (SR 2002/9) (as at 12 April 2022) – New Zealand Legislation [https://www.legislation.govt.nz/regulation/public/2002/0009/latest/whole.html]

[2] Air conditioners 65 kW and under | EECA [https://www.eeca.govt.nz/regulations/equipment-energy-efficiency/about-the-e3-programme/products-under-e3/air-conditioners-above-65-kw/]

References

In addition to the Regulations, the following standards are also relevant:

- AS/NZS 3823.1.1:2012 *Performance of electrical appliances— Air conditioners and heat pumps— Part 1.1: Non-ducted air conditioners and heat pumps—Testing and rating for performance* (AS/NZS 3823.1.1)
- AS/NZS 3823.4.1:2014 *Performance of electrical appliances - Air conditioners and heat pumps - Part 4.1: Air-cooled air conditioners and air-to-air heat pumps - Testing and calculating methods for seasonal performance factors - Cooling seasonal performance factor* (AS/NZS 3823.4.1)
- AS/NZS 3823.4.2:2014 *Performance of electrical appliances - Air conditioners and heat pumps - Part 4.2: Air-cooled air conditioners and air-to-air heat pumps - Testing and calculating methods for seasonal performance factors - Heating seasonal performance factor* (AS/NZS 3823.4.2)

How to read this guide

A term that is used repeatedly in an abbreviated form is written in full the first time it is used with the abbreviation following it in brackets.

A term that is defined in the Regulations is written in italics. We have referred to where in the Regulations the definition is found the first time each term is used.

Product class and relevant MEPS level

The MEPS requirement for a product in a particular product class is referred to in the Regulations as the *relevant MEPS level* (see Regulations Schedule 2A Part 2 Clause 4). The relevant MEPS levels for product classes 8, 9 and 11 are shown below in Table 1.

Table 1 is an extract from the associated table in Regulations Schedule 2A Clause 2(1) (*Products covered by schedule)* for *non-ducted* product that fall in Product class 11.

R means *rated value*. This value is either (a) the rated standard cooling full capacity; or (b) for heating-only products, the rated standard heating full capacity.

MEPS level is the relevant MEPS level the product must meet before being modified by anything else such as part-load factors.

Table 1: Relevant product classes

Product class	Characteristics	Value of R	Relevant MEPS level
8	Non-ducted	R < 4 kW	3.66
9	Non-ducted	4 kW ≤ R < 10 kW	3.22
11	Ducted or non-ducted	10 kW ≤ R ≤ 39 kW	3.1

Temperature test conditions

For the purposes of MEPS compliance, the heat capacity is measured at *standard rating conditions*. These conditions are defined in the following places:

- Heating: Schedule 2A Clause 57(1), and AS/NZS 3824.1.1 Table 1.
- Cooling: Schedule 2A Clause 56(1), and AS/NZS 3824.1.1 Table 6.

The conditions are referred to using a temperature condition descriptor:

- Heating: H1, H2, H3.
- Cooling: T1, T2.

The temperature condition descriptors for T1, T2, H1, H2 and H3 are given in Table 2 below.

Table 2: Standard temperature conditions

Operating mode	Temperature condition descriptor	Outside dry-bulb temperature	Outside wet-bulb temperature	Inside dry-bulb temperature	Inside wet-bulb temperature
Standard cooling	T1	35°C	24°C	27°C	19°C
Low temperature cooling	T2	29°C	19°C	27°C	19°C
Standard heating	H1	7°C	6°C	20°C	15°C
Low temperature heating	H2	2°C	1°C	20°C	15°C
Extra-low temperature heating	H3	-7°C	-8°C	20°C	15°C

Fixed and variable capacity

The meanings of the capacity type are given in Schedule 2A Clause 54(1). These settings are shown in Table 3. It is considered in AS/NZS 3824.4.1 and AS/NZS 3824.4.2 that products with continuously variable capacity fit into the "5 or more" capacity settings category.

Table 3: Capacity settings description

Capacity settings	Capacity description	MEPS category
1	Fixed capacity	Fixed capacity
2	Two-stage capacity	Fixed capacity
3	Multi-stage capacity	Fixed capacity
4	Multi-stage capacity	Fixed capacity
5 or more	Variable capacity	Fixed capacity or variable capacity

It is possible (per Schedule 2A Clause 42) to rate any product with more than one capacity setting as a fixed capacity unit.

For the purposes of this guide, the following applies:

1. All products with 4 or fewer capacity settings are treated as *fixed capacity*.
2. All products with 5 or more capacity settings are treated as *variable capacity*.

Note that in some circumstances, the MEPS requirements for variable capacity units are identical to the fixed capacity units.

Performance test points

The required and optional test points are described in this section. The source of this test data is AS/NZS 3824.1.1.

Note that a product that cannot function in a particular mode (e.g. cannot function as a heater) does not need any measurements in that mode.

- R means *required*. A test for this operating point *must* be completed for the particular subscript.
- O means *optional*. A test for this operating point *may* be completed for the particular subscript.
- The subscript M means MEPS. For example, R_M means this test point is required for MEPS assessment.
- The subscript L means labelling. For example, R_L means this test point is required for labelling.
- N/A means not applicable.
- Two-stage and multi-stage air conditioners are deemed fixed capacity for the purposes of MEPS assessment.
- Variable capacity air conditioners may be deemed fixed capacity for purposes of MEPS assessment. However, this is almost never necessary, since the full output only MEPS requirement for variable capacity is the same as fixed capacity.
- Any type of air conditioner may be deemed fixed capacity for the purposes of labelling calculations.

An optional test point may have a default value assigned.

Cooling

Table 4 shows the required test points for assessing MEPS compliance for cooling performance. It is based on the test conditions in AS/NZS 3824.4.1 Table 1. The measurements include the cooling output and power consumption.

Table 4: Required test conditions for cooling MEPS and labelling

Operating point	Fixed	Two-stage	Multi-stage	Variable
T1 cooling full capacity	R_M	R_M	R_M	R_M
T1 cooling half capacity	N/A	N/A	O_L	O_M, R_L
T1 cooling minimum capacity	N/A	O_L	O_L	O_L
T2 cooling full capacity	R_L	R_L	R_L	N/A
T2 cooling half capacity	N/A	N/A	R_L	O_M, O_L
T2 cooling minimum capacity	N/A	O_L	O_L	O_L
Degradation coefficient full capacity	O_L	N/A	N/A	N/A
Degradation coefficient half capacity	N/A	N/A	O_L	N/A
Degradation coefficient minimum capacity	N/A	O_L	O_L	N/A

The standard half cooling capacity measurement is marked as “optional” for variable capacity products. Its measurement is required if and only if MEPS compliance using Schedule 2A Clause 8(2)(b) is being sought.

Heating

Table 5 shows the required test points for assessing MEPS compliance for cooling performance. It is based on the test conditions in AS/NZS 3824.4.2 Table 1. The measurements include the cooling output and power consumption.

There is one extra symbol used in this table:

- X pertains to extended mode and full mode. If the air conditioner has an extended mode, extended capacity must be tested, while the full capacity test is optional. If the air conditioner does not have an extended mode, the full capacity is required.

Table 5: Required test conditions for heating MEPS

Operating point	Fixed	Two-stage	Multi-stage	Variable
H1 full capacity	R_M	R_M	R_M	R_M
H1 half capacity	N/A	N/A	O_L	O_M, R_L
H1 minimum capacity	N/A	R_L	O_L	O_L
H2 extended capacity	N/A	N/A	X_L	X_L
H2 full capacity	R_L	R_L	X_L	X_L
H2 half capacity	N/A	N/A	O_L	O_L
H2 minimum capacity	N/A	O_L	N/A	N/A
H3 extended capacity	N/A	N/A	O_L	O_L
H3 full capacity	O_L	O_L	O_L	O_L
H3 half capacity	N/A	N/A	O_L	O_L
H3 minimum capacity	N/A	N/A	N/A	N/A
Degradation coefficient full capacity	O_L	N/A	N/A	N/A
Degradation coefficient half capacity	N/A	N/A	O_L	N/A
Degradation coefficient minimum capacity	N/A	O_L	O_L	N/A

The standard half cooling capacity measurement is marked as “optional” for variable capacity products. Its measurement is required if and only if MEPS compliance using Schedule 2A Clause 8(3)(b) is being sought.

Inactive power consumption

Measurement of inactive power consumption is required for both MEPS and labelling purposes.

The inactive power consumption is computed as below.

$$P_{\mathrm{ia},m} = \sum_{n} w_{m,n} P_{\mathrm{ia},m,n}$$

Where:

- $P_{\mathrm{ia},m}$ is the weighted average inactive power consumption for the particular operating mode m.
- $w_{m,n}$ is the weighting for the operating mode m and the temperature point n.
- $P_{\mathrm{ia},m,n}$ is the measured inactive power for the operating mode m and the temperature point n.

The relevant temperature points and weightings are given in AS/NZS 3823.4.1 Table B.1 (heating) and AS/NZS 3823.4.2 Table B.1 (cooling). The temperatures and weightings are the same in both standards, so only one set is given in this document. This information is shown in Table 6.

Table 6: Inactive power weightings and measurement points

n	$T_{m,n}$	$w_{m,n}$
1	5°C	0.05
2	10°C	0.13
3	15°C	0.27
4	20°C	0.55

If $P_{\mathrm{ia},m,1}$ and $P_{\mathrm{ia},m,4}$ (5°C and 20°C) are within 5% or 1 W of each other, the measurements at 10°C and 15°C may be taken as the average of $P_{\mathrm{ia},m,1}$ and $P_{\mathrm{ia},m,4}$. It is possible to use the sum-product to compute $P_{\mathrm{ia},m}$, but a simplification is shown below.

$$P_{\mathrm{ia},m} = 0.25 \cdot P_{\mathrm{ia},m,1} + 0.75 \cdot P_{\mathrm{ia},m,4}$$

ACOP and AEER

The MEPS compliance requirement is based on ACOP and AEER. The ACOP and AEER is defined in Schedule 2A Clause 5(1).

The ACOP or AEER is based on 2000 active hours and 6760 inactive hours per annum (8760 hours).

If a product is capable of heating, the ACOP must be computed.

If a product is capable of cooling, the AEER must be computed.

The general formula for ACOP or AEER (denoted A) is given below.

$$A_{p,m} = \frac{2000\phi_{p,m}}{2000P_{p,m} + 6.76P_{\mathrm{ia},m}}$$

Where:

- $A_{p,m}$ is the ACOP (heating) or AEER (cooling) at operating point p, in operating mode m.
- $\phi_{p,m}$ is the heating or cooling capacity of interest (kW) at operating point p, in operating mode m
- $P_{p,m}$ is the heating or cooling power consumption of interest (kW) at operating point p, in operating mode m
- $P_{\mathrm{ia},m}$ is the weighted average inactive power consumption for either heating or cooling (W) in operating mode m.
- Operating mode m may be heating (*heat*) or cooling (*cool*).
- Operating point p is as shown in Table 7.

Table 7: Operating point notation

Operating point ***p***	Description	Explanation
ful	Full output	Output set specifically to rated value.
haf	Half output	Output set specifically to half of rated value.
hi	High output	Output set to anywhere between 83.3% and 100% of rated output.
mid	Mid output	Output set to anywhere between 50% and 83.3% of rated output.

The operating point notation *ful* and *haf* comes from AS/NZS 3823.4.1 Clause 4 and AS/NZS 3823.4.2 Clause 4. The notation *hi* and *mid* is an extension of this notation, most particularly the *haf* notation used in AS/NZS 3823.4.1 Clause 4 and AS/NZS 3823.4.2 Clause 4.

The status of the operation at exactly 50%, 83.3% and 100% of rated output in terms of the classification into hi and mid operation is not clear. The following behaviour is assumed to resolve any mathematical ambiguity.

- Operation if in *hi* range if $0.833\phi_{\mathrm{ful}} \leq \phi_{\mathrm{hi}} \leq \phi_{\mathrm{ful}}$.
- Operation in *mid* range if $0.5\phi_{\mathrm{ful}} \leq \phi_{\mathrm{mid}} < 0.833\phi_{\mathrm{ful}}$.

The weighted inactive power consumption is measured using the following methods:

- AS/NZS 3823.4.1 Annex B.
- AS/NZS 3823.4.2 Annex B.

MEPS Compliance - Fixed capacity air conditioners (Schedule 2A Clause 7)

For fixed capacity air conditioners, the following MEPS compliance requirement applies.

$$A_{\mathrm{ful},m} \geq M_{\mathrm{r}}$$

Where:

- $A_{\mathrm{ful},m}$ is any one or more of the full-load ACOP and AEER.
- M_{r} is the relevant MEPS level.

The air conditioner must comply in all modes.

MEPS Compliance – Variable capacity air conditioners (Schedule 2A Clause 8)

Importers and manufacturers can choose one of two pathways for assessing MEPS compliance for variable capacity air conditioners:

- Compliance analogous to fixed capacity (Schedule 2A Clause 8(2)(a) and Schedule 2A Clause 8(3)(a)); or
- Special conditions for variable capacity (Schedule 2A Clause 8(2)(b) and Schedule 2A Clause 8(3)(b)).

The special conditions are given below.

$$A_{\mathrm{part},m} \geq \left(1.25 - 0.3 \cdot \frac{\phi_{\mathrm{part},m}}{\phi_{\mathrm{ful},m}}\right) \cdot M_{\mathrm{r}}$$

Where:

- M_{r} is the relevant MEPS level.
- $A_{\mathrm{part},m}$ is the ACOP or AEER for the relevant operation (*ful*, *hi*, or *mid*) in operation mode m.
- $\phi_{\mathrm{part},m}$ is the heating or cooling capacity (as applicable) for the relevant operation (*ful*, *hi*, or *mid*) in operation mode m.
- $\phi_{\mathrm{ful},m}$ is the full load heating capacity in operation mode m.

Note that this requirement applies at full capacity i.e. the compliance requirement at full capacity is 95% of the relevant MEPS level. This requirement is given explicitly in Schedule 2A Clause 8(2)(b)(i) for cooling and Schedule 2A Clause 8(3)(b)(i) for heating.

Labelling compliance

The labelling (Zoned Energy Rating Label, ZERL) is based on a *seasonal* performance evaluation.

The seasonal performance and labelling is based on:

- Climate zone.
- Energy consumption.
- Seasonal performance factor.

The standards used to compute the seasonal performance are:

- AS/NZS 3824.4.1 (cooling).
- AS/NZS 3824.4.2 (heating).

The computation method for the seasonal performance factor may be done by implementing the computations in AS/NZS 3824.4.1 and AS/NZS 3824.4.2. These computations are used to yield four quantities for each climate zone (label measurements):

- Heating seasonal energy consumption.
- Heating seasonal performance factor.
- Cooling seasonal energy consumption.
- Total cooling seasonal performance factor.

The difference between a *seasonal performance factor* and a *total seasonal performance factor* is that the total seasonal performance factor takes into account inactive energy consumption.

The seasonal performance factors are used to compute the star ratings for each climate zone and mode of operation.

Note that the label measurements must comply with MEPS on their own, before the label values are selected.

While the label measurements may be used directly as label values, a manufacturer may wish to "de-rate" these quantities to allow for "headroom":

- Seasonal energy consumptions may be increased.
- Star ratings may be lowered.

Any derating of label measurements to label values is a matter of discretion for the manufacturer.

In general, a product must be able to achieve its energy consumption (energy consumption not exceeding the label value) and star rating (star rating not lower than the label value).

Tolerance compliance

The tolerance requirements are given in Schedule 2A Clause 58.

The manner in which the tolerance requirements are expressed are somewhat obtuse; an equivalent formulation is presented here which is more directly in terms of the rated value.

Cooling or heating output

The cooling or heating output must obey the relationship below.

$$\frac{T}{R} \geq 0.95$$

Where:

- T is a tested value.
- R is a rated value.

Any measured output that does not meet this requirement is deemed out of tolerance and not compliant.

Cooling or heating power consumption

The cooling or heating power consumption must obey the relationship below.

$$\frac{T}{R} \leq 1.05$$

Where:

- T is a tested value.
- R is a rated value.

Any measured output that does not meet this requirement is deemed out of tolerance and not compliant.