هيئة الإمارات للمواصفات والمقاييس

Emirates Authority For Standardization & Metrology (ESMA)

المواصفات القياسية الإماراتية

UAE .S 5010 -1 :2019

بطاقة البيان ـ بطاقة بيان كفاءة الطاقة للأجهزة الكهربائية ـ

الجزء الأول: مكيفات الهواء المنزلية

Labeling – Energy efficiency label for electrical appliances

Part 1: household air conditioners

الإمارات العربية المتحدة

UNITED ARAB EMIRATES

Table of Contents

تقـــــــــــديم

هيئة الإمارات للمواصفات والمقاييس هي الهيئة المسئولة عن أنشطة التقييس بالدولة ومن مهامها إعداد المواصفات القياسية أو اللوائح الفنية الإماراتية بواسطة لجان فنية متخصصة .

وقد قامت الهيئة ضمن برنامج عمل اللجنة الفنية "برنامج كفاءة الطاقة للمكيفات الكهربائية بتحديث المواصفة القياسية الإماراتية رقم 1 - 5010 لعام 2016 ببطاقة بيان كفاءة الطاقة للأجهزة الكهربائية . الجزء الأول : مكيفات الهواء

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وقد اعتمدت هذه المواصفة كمواصفة قياسية إلزامية (لائحة فنية) وذلك بموجب قرار مجلس الوزراء رقم ( ) بتاريخ / / هـ ، الموافق / / م.

Foreword

Emirates Authority for Standardization & Metrology (ESMA) has a national responsibility for standardization activities. One of ESMA main functions is to issue Emirates Standards /Technical regulations through specialized technical committees (TCs).

ESMA through the technical program of committee "Technical committee for program of Energy Efficiency for Electrical Air Conditioner ……… has Updated the Standard:. *Labeling – Energy efficiency label for electrical appliances*

Part one: household air conditioners This standard has been approved as Emirates (Technical Regulation) by Decree of UAE Cabinet No.( ),held on / / H , / /

Labeling – Energy Efficiency Label for Electrical Appliances

Part One: Air-Conditioners

1. Scope

This standard deals with the energy efficiency labels requirements for residential non-ducted air conditioners.

2. - Normative Reference

UAE.S ISO 5151:2017- Non-ducted air-conditioners and heat pumps – Testing and Rating for performance

3. Terms and Definitions

For the purpose of this document, the following terms and definitions apply:

3.1. Total Cooling Capacity

Amount of sensible and latent heat that the equipment can remove from the conditioned space in a defined interval of time

3.2. Energy Efficiency Ratio (EER)

Ratio of the total cooling capacity to the effective power input at any given set of rating conditions. Where the EER is stated without an indication of units, it shall be understood that it is derived from watts/watt.

3.3. Effective Power Input (P_E)

Average electrical power input to the equipment within a defined interval of time, obtained from:

- The power input for operation of the compressor and any power input for defrosting, excluding additional electrical heating devices not used for defrosting;
- The power input of all control and safety devices of the equipment;
- The power input of the conveying devices within the equipment for heat transport media (*e.g. fan, pump*)

3.4. Total Power Input (P_t)

Power input to all components of the equipment as delivered.

3.5. Non-Ducted Air-Conditioners

An air-conditioner model configuration where the indoor side is situated party or wholly within the space to be conditioned air is supplied and extracted directly to and from the conditioned space.

3.6. Rated Capacity

The nominal rated capacity claimed by the manufacturer of an air-conditioner model determined as follows, as applicable:

(a) Rated total cooling capacity, as claimed by the manufacturer for temperature condition T3 (*unit: KW-h*)

The rated capacity appears on the energy label as "*Capacity Output* (*unit: KW-h*)"

3.7. Rated Power

Effective power input of the air-conditioner model as claimed by the manufacturer during the determination of rated cooling capacity (*unit: W or KW*).

3.8. Split System

An air-conditioner with separate indoor and outdoor component that are connected with refrigerant piping. The indoor unit usually lies within the conditioned space.

3.9. Star Rating

The number of stars displayed on the energy label. Available stars are between a minimum of one and maximum of five, it is considered as an indication of the claimed energy efficiency of a model at rated condition. A higher star rating indicates a higher energy efficiency. it is derived from the measured EER.

3.10. Energy Efficiency Label

Is a sticker to be placed on electrical appliances which contain important information about the level of energy consumption of the device.

3.11. Annual Energy Consumption

Is the expected consumption of the device within one year of normal use.

3.12. full-load operation

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

4. Energy Efficiency Classifications

4.1. Energy Efficiency Classifications for Cooling Mode

The energy efficiency class rating is used for the comparative label used with window type and split type air-cooled air-conditioner

The energy efficiency class is then determined in accordance with the following table (Table 1) where the EER (Energy Efficiency Ratio) is determined in accordance with the test procedure of the UAE.S ISO 5151:2017- Non-ducted air-conditioners and heat pumps – Testing and Rating Performance,.

Table 1

Star Rating	EER (Btu-h)/W at T3 Window Type	EER (Btu-h)/W at T3 non-ducted split types of AC
5	EER ≥ 9.01	EER ≥ 10.31
4	9.00 ≥ EER ≥ 8.51	10.30 ≥ EER ≥ 9.71
3	8.50 ≥ EER ≥ 8.01	9.70 ≥ EER ≥ 9.01
2	8.00 ≥ EER ≥ 7.51	9.00 ≥ EER ≥ 8.31
1	7.50 ≥ EER ≥ 6.80	8.30 ≥ EER ≥ 7.70

Note 1: *The value of EER (Btu-h)/W shall be rounded and recorded to three (3) significant figures.*
Note 2: *Test voltage shall be 230 volts (V).*
Note 3: *1 watt = 3.41214 BTU/h*

4.2 All manufacturer need to provide additional test report for their ACs according " ISO 16358-1 : Air-cooled air conditioners and air-to-air heat pumps -- Testing and calculating methods for seasonal performance factors -- Part 1: Cooling seasonal performance factor" and annex 2 in this standard at T3 condition showing the value of CSPF and submit it while applying for conformity certificate for energy efficient. (CSPF value is a reference for ESMA not for evaluation the units).

4.3 - The **Maximum cooling performance test**

The test shall be conducted with the equipment functioning at full-load operation.
The test voltages in shall be :

- 90 % and 110 % of rated voltage with a single nameplate rating;
- 90 % of the lower rated voltage and 110 % of the higher rated voltage for units with a dual or extended nameplate voltage

5 - Setting lower temperature of the air conditioner

1. Tolerance Specified:

   All appliances subject for certification shall comply with the temperature setting/limit set to 20ºC with the following applicable tolerance depending on the type or thermostat:

Thermostat Type	Tolerance
Mechanical	±2ºC
Electronic / Digital	±1ºC

2. Test Method:

   a. Each model/type shall be represented by three (3) test units;
   b. Each unit shall be tested under T3 (Tropical - 46ºC) condition;
   c. Thermostat is adjusted to the lowest possible value;
   d. Three (3) readings (set-off) are recorded along with the EESL performance test report.

6. Name Plate and Instruction Sheet or Manual

In addition to any information needed to be displayed on the air-conditioner unit, the following shall be marked on the name plate of the air-conditioner, in Arabic or English or both, the marking shall not be on a detachable part of the unit and shall be indelible, durable and easily legible.

Any information related energy performance added showed in any part of the air-conditioner unit or packaging shall not have any ambiguity or lead to miss understand of the performance of the unit.

6.1 The information on the name plate in Arabic or English or both shall include at least:

a) Manufacturer's name and/or trademark
b) Country of origin
c) Rated voltage or rated voltage range (*V or Volts*)
d) Manufacturer's model or type reference and serial number of the unit
e) Rated frequency (*Hz or Hertz*)
f) Rated current (*A or Amperes*)
g) Rated power input (*W or KW, watts or kilowatts*)
h) Net total room cooling capacity in Btu/h (and any units of KW or Kcal/h) when tested according to the related standard.
i) Energy efficiency ratio (*EER*)
j) Annual energy consumption (*kWh*)

6.2 An instruction sheer or manual in both Arabic and English shall be delivered with each air-conditioner, including the following information:

a. The information specified in clause 5.1
b. Dimensions of the unit and its method of mounting
c. Minimum clearances between the various parts of the unit and the surrounding framework
d. Instruction necessary for the correct operation of the unit and any special precaution to be observed to ensure its safe use and maintenance
e. Weight of the unit
f. Instruction for packing and unpacking the unit.
g. Any additional information

6.3 This energy efficiency label should only be issued for those appliances that have been tested. The manufacturer or the importer shall affix this energy efficiency label on each indoor unit in the local market. This label must not be removed before handing over the appliance to the end user.

6.4 The energy label shall be on the product (indoor unit) and on the indoor packing box.The QR code & RF chip also shall be on the energy label

7 Sampling and Testing Requirements for evaluation :

- Two (2) samples are subjected for testing according to the requirements of the standard (UAE.S ISO 5151:2017).

- The following are to be tested:
  - Energy Consumption (kW)
  - Cooling Capacity (in Btu/h)
  - Power input (in W)

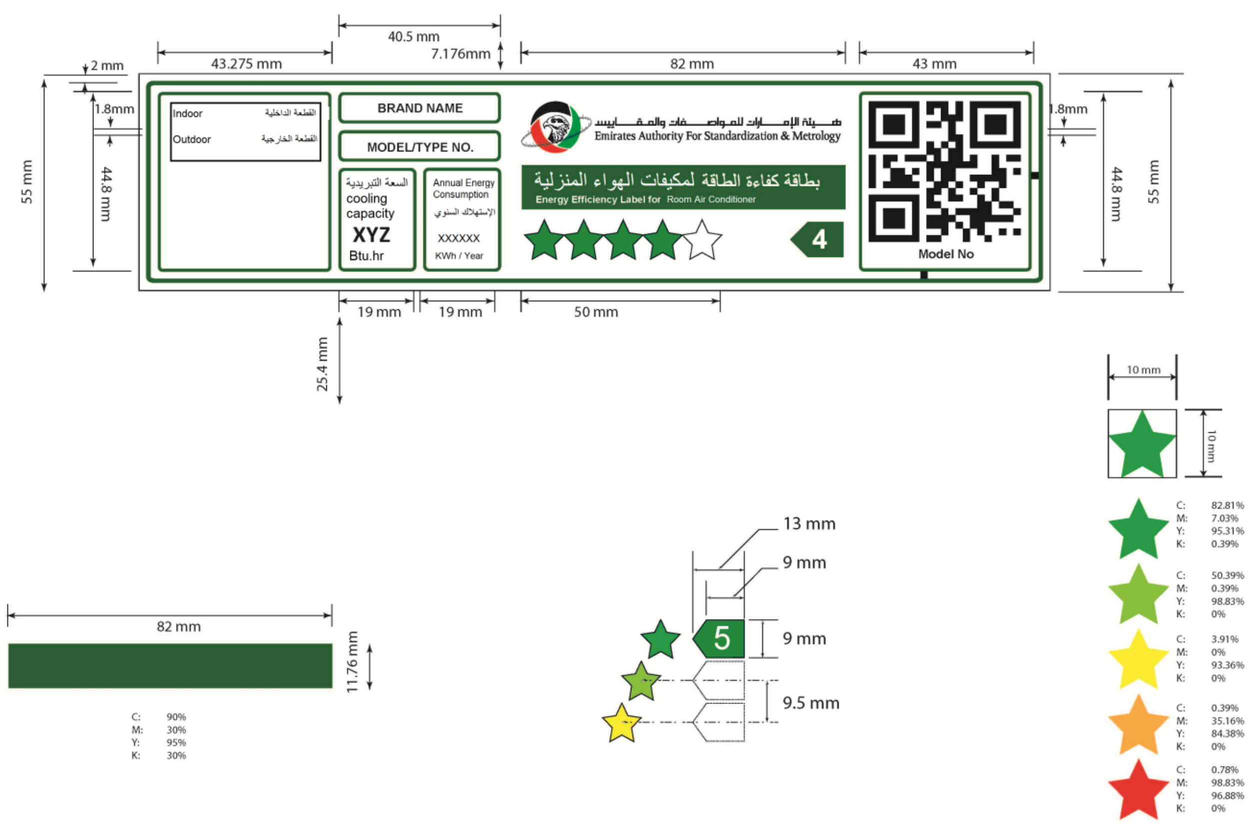
- Tolerance for the test result :
  - The testing cooling capacity ≥ 95% ×the rated cooling capacity
  - The testing Energy Efficiency (EER, CSPF) ≥92% ×the rated energy efficiency (EER, CSPF)
  - The rated Energy Efficiency ≥ Minimum Energy Efficiency (EER)

8 Annual Energy Consumption

The annual energy consumption for cooling mode shall also be calculated according to the following formula:

Annual Energy Consumption = (*Total Input Power in KW*) X (*2000 hour/year*)

Note: *This value should be shown on the specified space on the label.*



<u>**Sample of the energy label**</u>

ANNEX 2

Test conditions and calculations of the cooling seasonal performance factor (CSPF) for hot climates

ISO/TC 86/SC 6/WG 1
Air-source air-conditioners and heat pumps

Email of convenor: rusty.tharp@goodmanmfg.com
Convenorship: ANSI (United States)

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Background:

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Annex F: Test conditions and calculations of the cooling seasonal performance factor (CSPF) and total cooling seasonal performance factor (TCSPF) for hot climates

F.1 Test conditions

For hot climates temperature conditions and humidity conditions as well as default values are for calculation shall be as specified in Table F.1.

Table F.1 - Temperature and humidity conditions and default values for cooling at T3 hot climate condition ISO 5151, ISO 13253, ISO 15042

Test	Characteristics	Fixed	Two-stage	Multi-stage	Variable	Default value
Standard cooling capacity test Indoor DB 29°C WB 19°C Outdoor DB 46°C WB 24°C	Full capacity $\phi_{ful}(46)$ (W)	▪	▪	▪	▪	-
	Full power input $P_{ful}(46)$ (W)					
	Half capacity $\phi_{haf}(46)$ (W)	-	-	◦	◦	0,859 x $\phi_{haf}(35)$
	Half power input $P_{haf}(46)$ (W)					1,25 x $P_{haf}(35)$
	Minimum capacity $\phi_{min}(46)$ (W)	-	◦	◦	◦	0,859 x $\phi_{min}(35)$
	Minimum power input $P_{min}(46)$ (W)					1,25 x $P_{min}(35)$
Medium cooling capacity test Indoor DB 27°C WB 19°C Outdoor DB 35°C WB 24°C	Full capacity $\phi_{ful}(35)$ (W)	▪	▪	▪	▪	-
	Full power input $P_{ful}(35)$ (W)					
	Half capacity $\phi_{haf}(35)$ (W)	-	-	▪	▪	-
	Half power input $P_{haf}(35)$ (W)					
	Minimum capacity $\phi_{min}(35)$ (W)	-	▪	◦	◦	-
	Minimum power input $P_{min}(35)$ (W)					
Medium cooling capacity test Indoor DB 27°C WB 19°C Outdoor DB 29°C WB 24°C	Full capacity $\phi_{ful}(29)$ (W)	◦	◦	◦	-	1,077 x $\phi_{ful}(35)$
	Full power input $P_{ful}(29)$ (W)					0,914 x $P_{ful}(35)$
	Half capacity $\phi_{haf}(29)$ (W)	-	-	◦	◦	1,077x $\phi_{haf}(35)$
	Half power input $P_{haf}(29)$ (W)					0,914x $P_{haf}(35)$
	Minimum capacity $\phi_{min}(29)$ (W)	-	◦	◦	◦	-
	Minimum power input $P_{min}(29)$ (W)					
Low humidity and cyclic cooling Indoor DB 27°C WB 16°C or lower Outdoor DB 35°C WB -	Degradation coefficient C_D — Full capacity	◦	-	-	-	0.27
	Degradation coefficient C_D — Half capacity	-	-	◦	-	0.27
	Degradation coefficient C_D — Minimum capacity	-	◦	◦	-	0.27

▪ required test
◦ optional test
NOTE 1 If the medium capacity test is measured, min (35) test is conducted first. Min (46) or min(29) test may be measured or may be calculated by using default values.
NOTE 2 Voltage(s) and frequenc(i)e(s) are as given in the three referenced standards.
NOTE 3 In lieu of conducting cyclic test at 35°C, the C_D from the 29°C cyclic test multiplied by 1,08 may be used.

F.2 Calculations

The calculations shall be performed as per clause 6, unless specified differently in this clause.

F.2.2. Defined cooling load

The defined cooling load $L_c(t_j)$ at outdoor temperature t_j shall be determined by Formula (2).

In Formula (2), $t_0 = 20$ and $t_{100} = 46$.

In case of setting other cooling load, refer to the setting method as described in Annex D.

F.2.3. Outdoor temperature bin distribution for cooling

Cooling seasonal performance factor (CSPF) for **T3 climate** shall be calculated at the reference climate condition in Table F.2.

The calculation of cooling seasonal performance factor may also be done for other climate conditions using different bin distribution under hot climate conditions.

Table F.2 – Reference outdoor temperature bin distribution for T3 climate

Bin number j	Outdoor temperature t_j °C	Fractional bin hours (informative)	Bin hours n_j	Reference bin hours (n_j) h
1	21	0,047	n_1	307
2	22	0,048	n_2	311
3	23	0,049	n_3	317
4	24	0,050	n_4	325
5	25	0,051	n_5	334
6	26	0,053	n_6	342
7	27	0,054	n_7	349
8	28	0,054	n_8	354
9	29	0,055	n_9	356
10	30	0,055	n_{10}	355
11	31	0,054	n_{11}	351
12	32	0,053	n_{12}	344
13	33	0,051	n_{13}	332
14	34	0,049	n_{14}	317
15	35	0,046	n_{15}	299
16	36	0,043	n_{16}	277
17	37	0,039	n_{17}	252
18	38	0,035	n_{18}	225
19	39	0,030	n_{19}	195
20	40	0,025	n_{20}	165
21	41	0,021	n_{21}	133
22	42	0,016	n_{22}	103
23	43	0,011	n_{23}	73
24	44	0,007	n_{24}	47
25	45	0,004	n_{25}	24
26	46	0,001	n_{26}	6
			Total	6494

NOTE: The fractional bin hours are rounded to the closest one-thousandth.

The calculation of cooling performance factor may also be done for other climate conditions, e.g. instead of the reference climate a climate of a specific city.

In case the outdoor temperature is higher than 46°C, the 100% cooling load can be set based on that temperature without changing the test conditions in Table F.1. In case of setting other temperature bin distribution, refer to the setting method as described in Annex D.

F.2.4. Cooling seasonal characteristics of fixed speed capacity units

Operational performance at each test, which is used for calculation of seasonal performance factor, shall be in accordance with Table F.1.

F. 2.4.1 Capacity characteristics against outdoor temperature

The capacity $\phi_{ful}(t_j)$ (W) of the equipment when it is operated for cooling at outdoor temperature t_j linearly changes depending on outdoor temperatures as shown in Figure F.1, and it is determined by Formula (F.1) and (F.2) from three characteristics, one at 46°C, one at 35°C and the other at 29°C.

a) Lower temperature range $t_j \leq 35°C$

$$\phi_{ful}(t_j) = \phi_{ful}(35) + \frac{\phi_{ful}(29) - \phi_{ful}(35)}{35 - 29} \text{x} (35 - t_j) \quad \text{(F.1)}$$

b) Higher temperature range $t_j > 35°C$

$$\phi_{ful}(t_j) = \phi_{ful}(46) + \frac{\phi_{ful}(35) - \phi_{ful}(46)}{46 - 35} \text{x} (46 - t_j) \quad \text{(F.2)}$$

F. 2.4.2 Power input characteristics against outdoor temperature

The power input $P_{ful}(t_j)$ (W) of the equipment when it is operated for cooling at outdoor temperature t_j linearly changes depending on outdoor temperatures as shown in Figure F.1, and it is determined by Formula (F.3) and (F.4) from three characteristics, one at 46°C, one at 35°C and the other at 29°C.

a) Lower temperature range $t_j \leq 35°C$

$$P_{ful}(t_j) = P_{ful}(35) + \frac{P_{ful}(29) - P_{ful}(35)}{35 - 29} \text{x} (35 - t_j) \quad \text{(F.3)}$$

b) Higher temperature range $t_j > 35°C$

$$P_{ful}(t_j) = P_{ful}(46) + \frac{P_{ful}(35) - P_{ful}(46)}{46 - 35} \text{x} (46 - t_j) \quad \text{(F.4)}$$

2.4.3 Calculation of cooling seasonal total load ($\boldsymbol{CSTL}$)

Cooling seasonal total load (CSTL), L_{CST}, shall be determined using Formula (5).

$L_C(t_j)$ shall be calculated by Formula (2), modified as described in Clause F.2.2.

$\phi_{ful}(t_j)$ shall be calculated by Formula (F.1) and (F.2).

F.2.5. Cooling seasonal characteristics of two-stage capacity units

Operational performance at each test, which is used for calculation of seasonal performance factor, shall be in accordance with Table F.1.

F.2.5.1 Capacity characteristics against outdoor temperature

The capacity $\phi_{ful}(t_j)$ (W) of the equipment when it is operated for cooling full capacity at outdoor temperature t_j are shown in Figure F.2 and calculated by Formula (F.1) and (F.2).

The capacity $\phi_{min}(t_j)$ (W) of the equipment when it is operated for cooling minimum capacity at outdoor temperature t_j shall be calculated by Formula (F.5) and (F.6) from three characteristics, one at 46°C, one at 35°C and the other at 29°C.

a) Lower temperature range $t_j \leq 35°C$

$$\phi_{min}(t_j) = \phi_{min}(35) + \frac{\phi_{min}(29) - \phi_{min}(35)}{35 - 29} \text{ x } (35 - t_j) \tag{F.5}$$

b) Higher temperature range $t_j > 35°C$

$$\phi_{min}(t_j) = \phi_{min}(46) + \frac{\phi_{min}(35) - \phi_{min}(46)}{46 - 35} \text{ x } (46 - t_j) \tag{F.6}$$

F.2.5.2 Power input characteristics against outdoor temperature

The power input $P_{ful}(t_j)$ (W) of the equipment when it is operated for cooling full capacity at outdoor temperature t_j are shown in Figure F.2 and calculated by Formula (F.3) and (F.4).

The power input $P_{min}(t_j)$ (W) of the equipment when it is operated for cooling minimum capacity at outdoor temperature t_j shall be calculated by Formula (F.7) and (F.8) from three characteristics, one at 46°C, one at 35°C and the other at 29°C.

a) Lower temperature range $t_j \leq 35°C$

$$P_{min}(t_j) = P_{min}(35) + \frac{P_{min}(29) - P_{min}(35)}{35 - 29} \text{ x } (35 - t_j) \tag{F.7}$$

b) Higher temperature range $t_j > 35°C$

$$P_{min}(t_j) = P_{min}(46) + \frac{P_{min}(35) - P_{min}(46)}{46 - 35} \text{ x } (46 - t_j) \tag{F.8}$$

F.2.6. Cooling seasonal characteristic of multistage capacity units

Operational performance at each test, which is used for calculation of seasonal performance factor, shall be in accordance with Table F.1.

F.2.6.1 Capacity characteristics against outdoor temperature

The capacity $\phi_{ful}(t_j)$ and $\phi_{min}(t_j)$ (W) of the equipment when it is operated for cooling full capacity at outdoor temperature t_j are shown in Figure F.3 and calculated by Formulas (F.1) and (F.2) and (F.5) and (F.6).

Formulas (F.9) and (F.10) show cooling half capacity characteristics at outdoor temperature t_j from three characteristics, one at 46°C, one at 35°C and the other at 29°C.

a) Lower temperature range $t_j \leq 35°C$

$$\phi_{haf}(t_j) = \phi_{haf}(35) + \frac{\phi_{haf}(29) - \phi_{haf}(35)}{35 - 29} \text{x } (35 - t_j) \quad \text{(F.9)}$$

b) Higher temperature range $t_j > 35°C$

$$\phi_{haf}(t_j) = \phi_{haf}(46) + \frac{\phi_{haf}(35) - \phi_{haf}(46)}{46 - 35} \text{x } (46 - t_j) \quad \text{(F.10)}$$

F.2.6.2 Power input characteristics against outdoor temperature

The power input $P_{ful}(t_j)$ and $P_{min}(t_j)$ (W) of the equipment when it is operated for cooling full capacity at outdoor temperature t_j are shown in Figure F.3 and calculated by Formulas (F.3) and (F.4) and (F.7) and (F.8).

Formulas (F.11) and (F.12) show cooling half power input characteristics at outdoor temperature t_j.

a) Lower temperature range $t_j \leq 35°C$

$$P_{haf}(t_j) = P_{haf}(35) + \frac{P_{haf}(29) - P_{haf}(35)}{35 - 29} \text{x } (35 - t_j) \quad \text{(F.11)}$$

b) Higher temperature range $t_j > 35°C$

$$P_{haf}(t_j) = P_{haf}(46) + \frac{P_{haf}(35) - P_{haf}(46)}{46 - 35} \text{x } (46 - t_j) \quad \text{(F.12)}$$

F.2.7. Cooling seasonal characteristics of variable capacity units

Operational performance at each test, which is used for calculation of seasonal performance factor, shall be in accordance with Table F.1.

F. 2.7.1 Capacity characteristics against outdoor temperature

The capacity $\phi_{ful}(t_j)$, $\phi_{haf}(t_j)$ and $\phi_{min}(t_j)$ (W) of the equipment when it is operated for cooling full capacity at outdoor temperature t_j are shown in Figure F.4 and calculated by Formula (F.1) and (F.2), (F.9) and (F.10) and (F.5) and (F.6).

F.2.7.2 Power input characteristics against outdoor temperature

The power input $P_{ful}(t_j)$, $P_{haf}(t_j)$ and $P_{min}(t_j)$ (W) of the equipment when it is operated for cooling full capacity at outdoor temperature t_j are shown in Figure F.4 and calculated by Formula (F.3) and (F.4), (F.11) and (F.12) and (F.7) and (F.8).

F.2.7.3 Calculation of cooling seasonal energy consumption (CSEC)

The cooling seasonal energy consumption shall be calculated as described in section 6.7.4.

Relation of cooling capacity, power input and EER characteristics to cooling load at outdoor temperature t_j is shown in Figure F.4.

In formula (22), t_p shall be calculated from formula (F.13) and formula (F.14):

a) Lower temperature range $t_j \leq 35°C$

$$t_p = \frac{(35-29)\emptyset_{ful}(t_{100})t_0 + (35-29)\emptyset_{\min}(35)(t_{100}-t_0) + 35(\emptyset_{min}(29) - \emptyset_{min}(35))(t_{100}-t_0)}{(35-29)\emptyset_{ful}(t_{100}) + (\emptyset_{min}(29) - \emptyset_{min}(35))(t_{100}-t_0)} \quad \text{(F.13)}$$

b) Higher temperature range $t_j > 35°C$

$$t_p = \frac{(46-35)\emptyset_{ful}(t_{100})t_0 + (46-35)\emptyset_{\min}(46)(t_{100}-t_0) + 46(\emptyset_{min}(35) - \emptyset_{min}(46))(t_{100}-t_0)}{(46-35)\emptyset_{ful}(t_{100}) + (\emptyset_{min}(35) - \emptyset_{min}(46))(t_{100}-t_0)} \quad \text{(F.14)}$$

In formula (22), (24) and (26), t_c shall be calculated from (F.15) and (F.16):

a) Lower temperature range $t_j \leq 35°C$

$$t_c = \frac{(35-29)\emptyset_{ful}(t_{100})t_0 + (35-29)\emptyset_{\mathrm{haf}}(35)(t_{100}-t_0) + 35(\emptyset_{haf}(29) - \emptyset_{haf}(35))(t_{100}-t_0)}{(35-29)\emptyset_{ful}(t_{100}) + (\emptyset_{haf}(29) - \emptyset_{haf}(35))(t_{100}-t_0)} \quad \text{(F.15)}$$

b) Higher temperature range $t_j > 35°C$

$$t_c = \frac{(46-35)\emptyset_{ful}(t_{100})t_0 + (46-35)\emptyset_{\mathrm{haf}}(46)(t_{100}-t_0) + 46(\emptyset_{haf}(35) - \emptyset_{haf}(46))(t_{100}-t_0)}{(46-35)\emptyset_{ful}(t_{100}) + (\emptyset_{haf}(35) - \emptyset_{haf}(46))(t_{100}-t_0)} \quad \text{(F.16)}$$

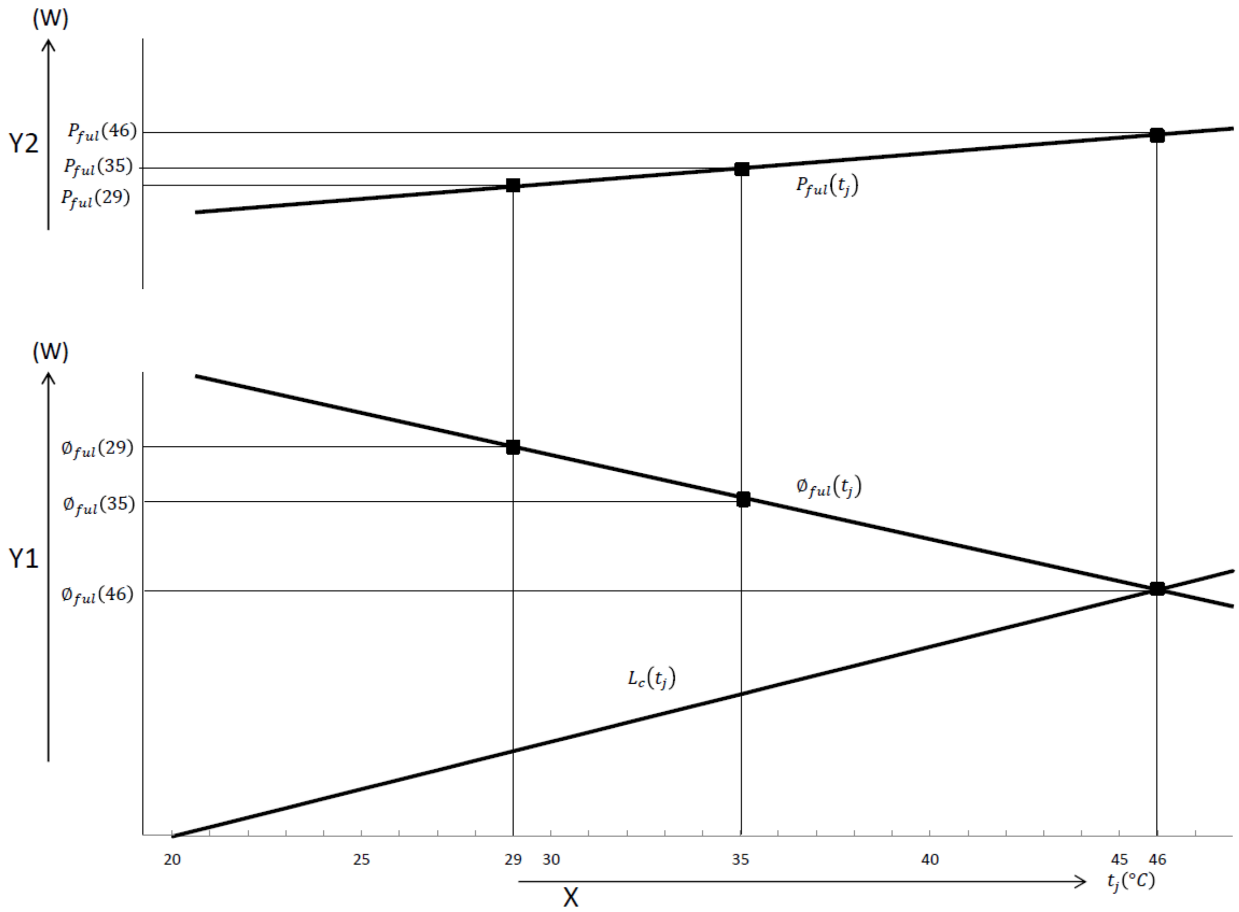
In formula (25) and (26), t_b shall be calculated from (F.17) and (F.18):

a) Lower temperature range $t_j \leq 35°C$

$$t_b = \frac{(35-29)\emptyset_{ful}(t_{100})t_0 + (35-29)\emptyset_{\mathrm{ful}}(35)(t_{100}-t_0) + 35(\emptyset_{ful}(29) - \emptyset_{ful}(35))(t_{100}-t_0)}{(35-29)\emptyset_{ful}(t_{100}) + (\emptyset_{ful}(29) - \emptyset_{ful}(35))(t_{100}-t_0)} \quad \text{(F.17)}$$

b) Higher temperature range $t_j > 35°C$

$$t_b = \frac{(46-35)\emptyset_{ful}(t_{100})t_0 + (46-35)\emptyset_{\mathrm{ful}}(46)(t_{100}-t_0) + 46(\emptyset_{ful}(35) - \emptyset_{ful}(46))(t_{100}-t_0)}{(46-35)\emptyset_{ful}(t_{100}) + (\emptyset_{ful}(35) - \emptyset_{ful}(46))(t_{100}-t_0)} \quad \text{(F.18)}$$



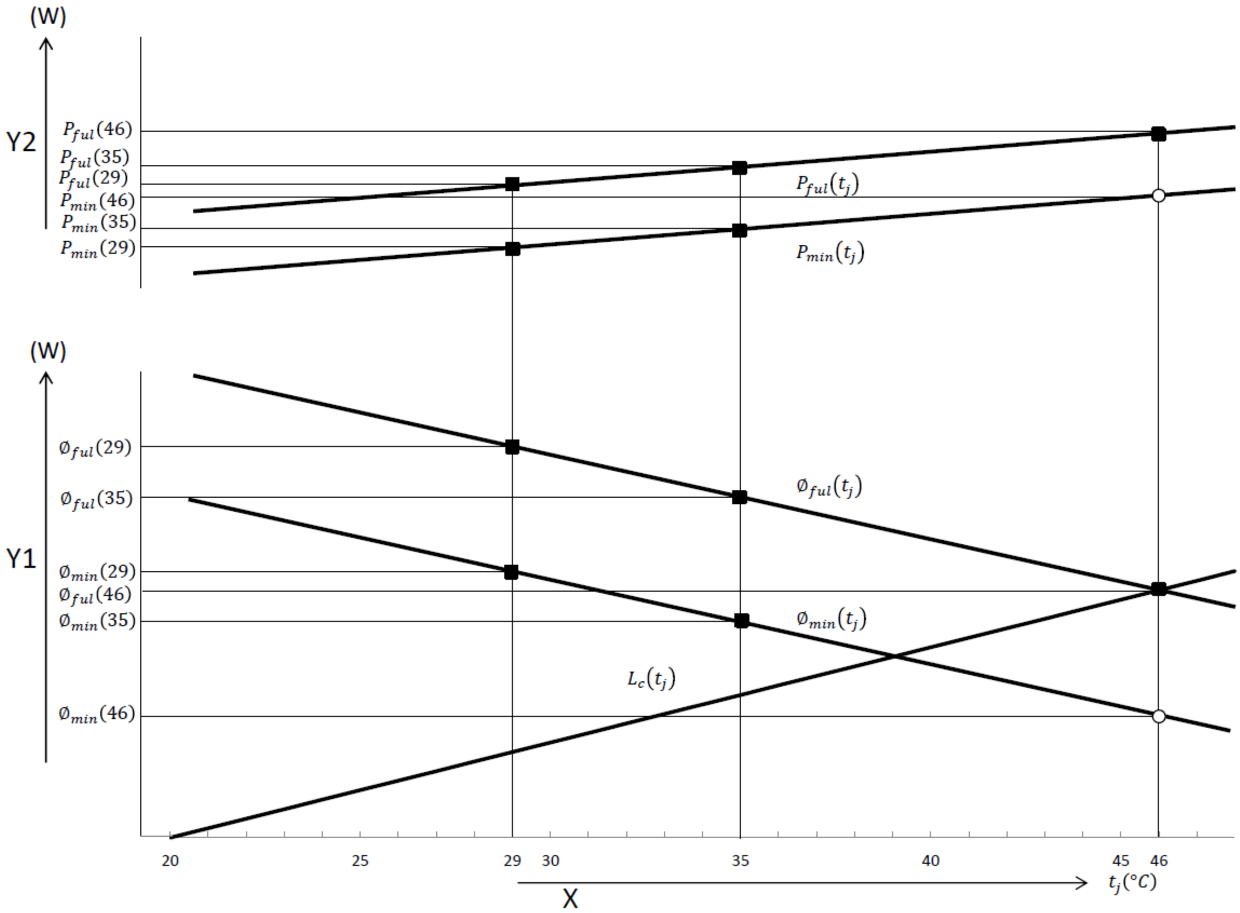
Key

X outdoor temperature

Y1 capacity or load

Y2 power input

Figure F.1: Cooling capacity, power input and cooling load for fixed capacity units



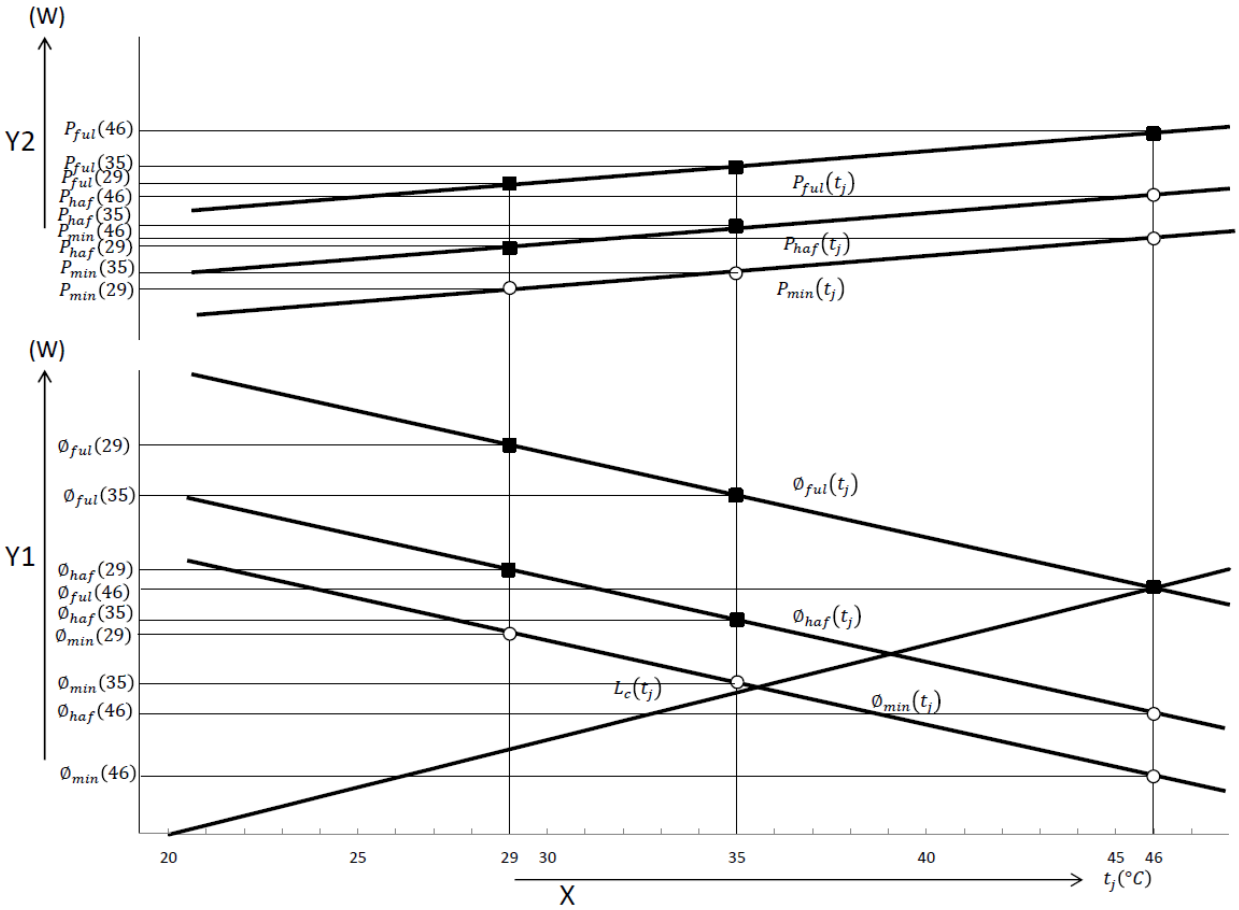
Key

X outdoor temperature

Y1 capacity or load

Y2 power input

Figure F.2: Cooling capacity, power input and cooling load for two-stage capacity units



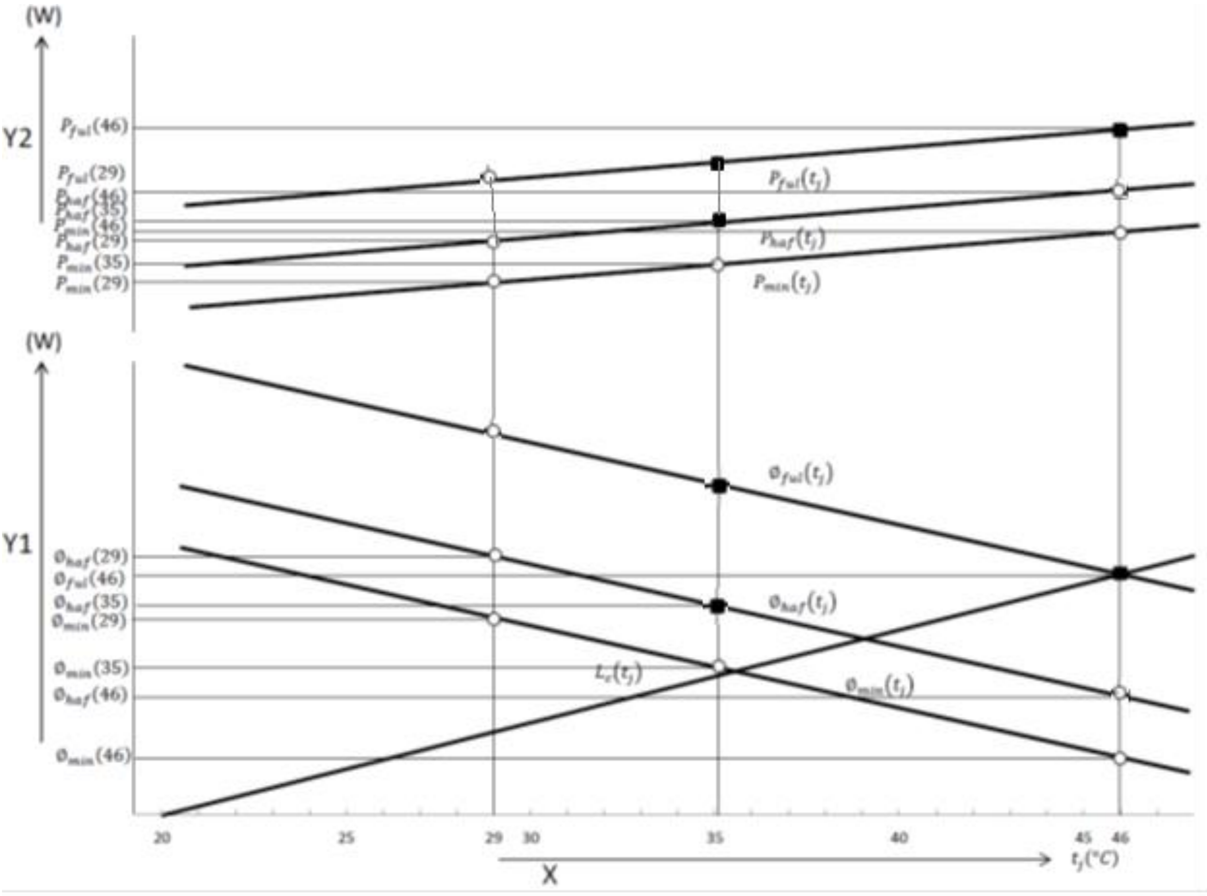
Key

X outdoor temperature

Y1 capacity or load

Y2 power input

Figure 3: Cooling capacity, power input and cooling load for multi-stage capacity units



Tp Tc Tb

Key

X outdoor temperature

Y1 capacity or load

Y2 power input

Figure 4: Cooling capacity, power input and cooling load for variable capacity units