هيئة الإمارات للمواصفات والمقاييس

Emirates Authority For Standardization & Metrology (ESMA)

المواصفة القياسية الإماراتية

UAE.S 5010 - 5 :2019

بطاقة البيان - بطاقة بيان كفاءة الطاقة للأجهزة الكهربائية- الجزء الخامس: مكيفات الهواء التجارية والمركزية

Labeling – Energy efficiency label for electrical appliances - Part five: commercial and central Air conditioners

الإمارات العربية المتحدة

UNITED ARAB EMIRATES

DRAFT Feb 2019

تقـــــــــديم

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 بإعداد المواصفة القياسية الإماراتية رقم 5 - 5010 لعام 2016 "ببطاقة بيان كفاءة الطاقة للأجهزة الكهربائية الجزء الخامس : مكيفات الهواء التجارية والمركزية".
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 prepared the Standard No.

UAE.S 5010- 5: 2016 “Labeling - Energy efficiency label for electrical appliances-
Part five: commercial and central air conditioners”

This standard has been approved as Emirates (Technical Regulation) by Decree of UAE Cabinet No.( ),held on / / H , / /

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Labeling – Energy Efficiency Label for Electrical Appliances

Commercial and central Air conditioners

1. Scope

This standard deals with the energy efficiency labels and the minimum energy performance standard (MEPS) requirements for factory-made residential, commercial and industrial, electrically driven, mechanical-compression of :

- ducted air conditioners using air and water-cooled condensers and ducted air-to-air heat pumps
- Water-source heat pumps
- Water-Chilling Packages
- Multiple split-system air-conditioners and air-to-air heat pumps

2. Normative Reference

ISO 13253:2011 - Ducted air-conditioners and air-to-air heat pumps — Testing and rating for performance

ISO 15042:2011 - Multiple split-system air-conditioners and air-to-air heat pumps — Testing and rating for performance

ISO 13256-1:1998 - Water-source heat pumps — Testing and rating for performance — Part 1: Water-to-air and brine-to-air heat pumps

ISO 13256-2:1998 - Water-source heat pumps — Testing and rating for performance — Part 2: Water-to-water and brine-to-water heat pumps

AHRI 550/590 Performance Rating Of Water-Chilling and Heat Pump Water-Heating Packages using the Vapor Compression Cycle.

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

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.

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. Ducted Air-Conditioners

An air-conditioner model configuration where the indoor side is situated remote to the space where the conditioned air is supplied and extracted via a duct.

3.6. 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.

3.7. 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*)) for chiller it will be at T1)

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

3.8. 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*).

3.9. 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.

3.10. ducted heat pump

encased assembly or assemblies designed primarily to provide ducted delivery of conditioned air to an enclosed space, room or zone (conditioned space), including a prime source of refrigeration for heating

3.11. 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

3.12. part-load capacity

capacity of the system when the capacity ratio is less than 1

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3.13. basic multi-split system

a split-system air-conditioner or heat pump incorporating a single refrigerant circuit with one or more compressors, multiple evaporators (indoor units) designed for individual operation, and one outdoor unit
NOTE The system has no more than two steps of control and is capable of operating either as an air-conditioner or as a heat pump. Alternatively, a system having a variable speed compressor and a fixed combination of indoor units specified by the manufacturer can also be considered a basic multi-split system.

3.14. water-to-air heat pump and/or brine-to-air heat pump

heat pump which consists of one or more factory-made assemblies which normally include an indoor conditioning coil with air-moving means, compressor(s), and refrigerant-to-water or refrigerant-to-brine heat exchanger(s), including means to provide both cooling and heating, cooling-only, or heating-only functions
NOTES
1 When such equipment is provided in more than one assembly, the separated assemblies should be designed to be used together.
2 Such equipment may also provide functions of sanitary water heating, air cleaning, dehumidifying, and humidifying.

3.15. water-to-water and brine-to-water heat pump

heat pump which consists of one or more factory-made assemblies which normally include an indoor-side refrigerant-to-water heat exchanger, compressor(s), and an outdoor-side refrigerant-to-water or refrigerant-to-brine heat exchanger(s), including means to indirectly provide both cooling and heating, cooling-only, or heating-only functions
NOTES
1 When such equipment is provided in more than one assembly, the separated assemblies should be designed to be used together.
2 Such equipment may also provide functions for sanitary water heating.

3.16. multi-stage capacity unit

equipment where the capacity is varied by three or four steps
NOTE This definition applies to each cooling and heating operation individually.

3.17 **VRF Multi Split System**
This system is one of the Multi split system which is Split system that has one outdoor unit and two or more indoor units and/or blower coil indoor units connected with a single refrigerant circuit. The indoor units operate independently and can condition multiple zones in response to at least two indoor thermostats or temperature sensors. The outdoor unit operates in response to independent operation of the indoor units based on control input of multiple indoor thermostats or temperature sensors, and/or based on refrigeration circuit sensor input with Variable Refrigerant Flow technology.

3.18 Cooling Coefficient of Performance **COP**
A ratio of the Net Refrigerating Capacity to the total input power at any given set of Rating Conditions

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4. Minimum energy performance standard (MEPS)

4.1 The minimum energy performance standard MEPS value for the air conditioner in the scope of this standard shall be greater than or equal to the value in this regulation when calculating the cooling capacity at test conditions (T3) .

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 is reference for ESMA not for evaluation the ACs)

(Except for chillers and heat pumps)

- The Annex 2 is identical to the project proposed by the ISO Working Group as Annex F to ISO 16358-1 and will be used as a reference for the UAE until it is officially approved by the ISO.

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Ducted and Packaged air cooled units

ISO 13253, *Ducted air-conditioners and air-to-air heat pumps — Testing and rating for performance*

- 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)

The minimum allowable value of the EER :

Rated Capacity	Minimum Energy Efficiency (EER) (But.h /watt) T3
CC < 135000	8.5
135000 ≤ CC < 240000	8.3
240000 ≤ CC < 760000	7.8
760000 ≤ CC	7.5

Water cooled unit

The test should be according UAE.S ISO 13256-1 and UAE.S ISO 13256-2 . The minimum allowable value of the EER and energy efficiency grade:

Type	Entering water or fluid	Rated Capacity	Minimum Energy Efficiency (EER) (But.h /watt)
Water Source	30 ^{0}C	ALL	**8.2**
Ground Water Source	25 ^{0}C	ALL	**9.0**

Water chiller:

The test should be according AHRI 550/590 Performance Rating of Water-chilling and Heat Pump Water-heating Packages Using the Vapor Compression Cycle.

- All chillers should be operated continuously for 2 hours at an ambient temperature of 46 ° C. the COP value is calculated under T1 conditions.

the minimum value of the COP and energy efficiency grade as table 3 :

Table 3

Cooling type	Rated Capacity (KW)	Minimum Energy Efficiency (COP) (Full Load) (watt/watt)
Air cooled package chillers (T1)	CC < 630	2.8
	630 ≤ CC	3.1
Water cooled chilers	CC < 528	4.3
	528≤ CC < 1055	4.8
	1055 ≤ CC	5.3

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- The testing Energy Efficiency(COP) ≥92% ×the rated energy efficiency (COP) ;
- The rated Energy Efficiency (COP) ≥ Minimum Energy Efficiency (COP)

Multiple split and VRF system

- The testing cooling capacity≥- 95%×the rated cooling capacity ;
- The testing IPLV(C)≥90%×the rate IPLV(C) ;
- The rated Energy Efficiency (IPLV) ≥ Minimum Energy Efficiency (IPLV)

1- Multiple split system

The minimum allowable Energy Efficiency value, according the requirements and the test methods mentioned in the standard ISO 15042, Multiple split-system air-conditioners and air-to-air heat pumps — Testing and rating for performance

Rated Capacity	Minimum Energy Efficiency (IPLV) (watt/watt) T3
CC < 135000	15.0
240000 ≤ CC < 760000	15
760000 ≤ CC	14.5

The minimum allowable value of the IPLV and energy efficiency grade

2- VRF systems :

The minimum allowable Energy Efficiency as (CSPF) value, according the requirements and the test methods mentioned in annex 2 and the standard UAE.S 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 , should be as following :

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Rated Capacity	Minimum Energy Efficiency (Watt/Watt) T3
CC < 135000	4.2
240000 ≤ CC < 760000	4.2
760000 ≤ CC	4.1

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.

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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.

a. 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) Energy efficiency value (EER, COP, CSPF)

b. 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

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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)

Annex F proposal 10 05 2017 v4

Document type: Other draft

Date of document: 2017-05-16

Expected action: INFO

Background:

Committee URL: http://isotc.iso.org/livelink/livelink/open/tc86sc6wg1

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

<table>
<tr><th>Test</th><th colspan="2">Characteristics</th><th>Fixed</th><th>Two-stage</th><th>Multi-stage</th><th>Variable</th><th>Default value</th></tr>
<tr><td rowspan="6">Standard cooling capacity test
Indoor DB 29°C
WB 19°C
Outdoor DB 46°C
WB 24°C</td><td colspan="2">Full capacity $\phi_{ful}(46)$ (W)</td><td rowspan="2">▪</td><td rowspan="2">▪</td><td rowspan="2">▪</td><td rowspan="2">▪</td><td rowspan="2">-</td></tr>
<tr><td colspan="2">Full power input $P_{ful}(46)$ (W)</td></tr>
<tr><td colspan="2">Half capacity$\phi_{haf}(46)$ (W)</td><td rowspan="2">-</td><td rowspan="2">-</td><td rowspan="2">◦</td><td rowspan="2">◦</td><td>0,859 x $\phi_{haf}(35)$</td></tr>
<tr><td colspan="2">Half power input $P_{haf}(46)$ (W)</td><td>1,25 x $P_{haf}(35)$</td></tr>
<tr><td colspan="2">Minimum capacity$\phi_{min}(46)$ (W)</td><td rowspan="2">-</td><td rowspan="2">◦</td><td rowspan="2">◦</td><td rowspan="2">◦</td><td>0,859 x $\phi_{min}(35)$</td></tr>
<tr><td colspan="2">Minimum power input $P_{min}(46)$ (W)</td><td>1,25 x $P_{min}(35)$</td></tr>
<tr><td rowspan="6">Medium cooling capacity test
Indoor DB 27°C
WB 19°C
Outdoor DB 35°C
WB 24°C</td><td colspan="2">Full capacity $\phi_{ful}(35)$ (W)</td><td rowspan="2">▪</td><td rowspan="2">▪</td><td rowspan="2">▪</td><td rowspan="2">▪</td><td rowspan="2">-</td></tr>
<tr><td colspan="2">Full power input $P_{ful}(35)$ (W)</td></tr>
<tr><td colspan="2">Half capacity$\phi_{haf}(35)$ (W)</td><td rowspan="2">-</td><td rowspan="2">-</td><td rowspan="2">▪</td><td rowspan="2">▪</td><td rowspan="2">-</td></tr>
<tr><td colspan="2">Half power input $P_{haf}(35)$ (W)</td></tr>
<tr><td colspan="2">Minimum capacity$\phi_{min}(35)$ (W)</td><td rowspan="2">-</td><td rowspan="2">▪</td><td rowspan="2">◦</td><td rowspan="2">◦</td><td rowspan="2">-</td></tr>
<tr><td colspan="2">Minimum power input $P_{min}(35)$ (W)</td></tr>
<tr><td rowspan="6">Medium cooling capacity test
Indoor DB 27°C
WB 19°C
Outdoor DB 29°C
WB 24°C</td><td colspan="2">Full capacity $\phi_{ful}(29)$ (W)</td><td rowspan="2">◦</td><td rowspan="2">◦</td><td rowspan="2">◦</td><td rowspan="2">-</td><td>1,077 x $\phi_{ful}(35)$</td></tr>
<tr><td colspan="2">Full power input $P_{ful}(29)$ (W)</td><td>0,914 x $P_{ful}(35)$</td></tr>
<tr><td colspan="2">Half capacity$\phi_{haf}(29)$ (W)</td><td rowspan="2">-</td><td rowspan="2">-</td><td rowspan="2">◦</td><td rowspan="2">◦</td><td>1,077x $\phi_{haf}(35)$</td></tr>
<tr><td colspan="2">Half power input $P_{haf}(29)$ (W)</td><td>0,914x $P_{haf}(35)$</td></tr>
<tr><td colspan="2">Minimum capacity$\phi_{min}(29)$ (W)</td><td rowspan="2">-</td><td rowspan="2">◦</td><td rowspan="2">◦</td><td rowspan="2">◦</td><td rowspan="2">-</td></tr>
<tr><td colspan="2">Minimum power input $P_{min}(29)$ (W)</td></tr>
<tr><td rowspan="3">Low humidity and cyclic cooling Indoor DB 27°C
WB 16°C or lower
Outdoor DB 35°C
WB -</td><td rowspan="3">Degradation coefficient C_D</td><td>Full capacity</td><td>◦</td><td>-</td><td>-</td><td>-</td><td>0.27</td></tr>
<tr><td>Half capacity</td><td>-</td><td>-</td><td>◦</td><td>-</td><td>0.27</td></tr>
<tr><td>Minimum capacity</td><td>-</td><td>◦</td><td>◦</td><td>-</td><td>0.27</td></tr>
<tr><td colspan="8">▪ 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.</td></tr>
</table>

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 $t_j \le 35°C$

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

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 $t_j \le 35°C$

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

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 $t_j \leq 35°C$

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

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

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

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 $t_j \leq 35°C$

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

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

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

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 $t_j > 35°C$

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

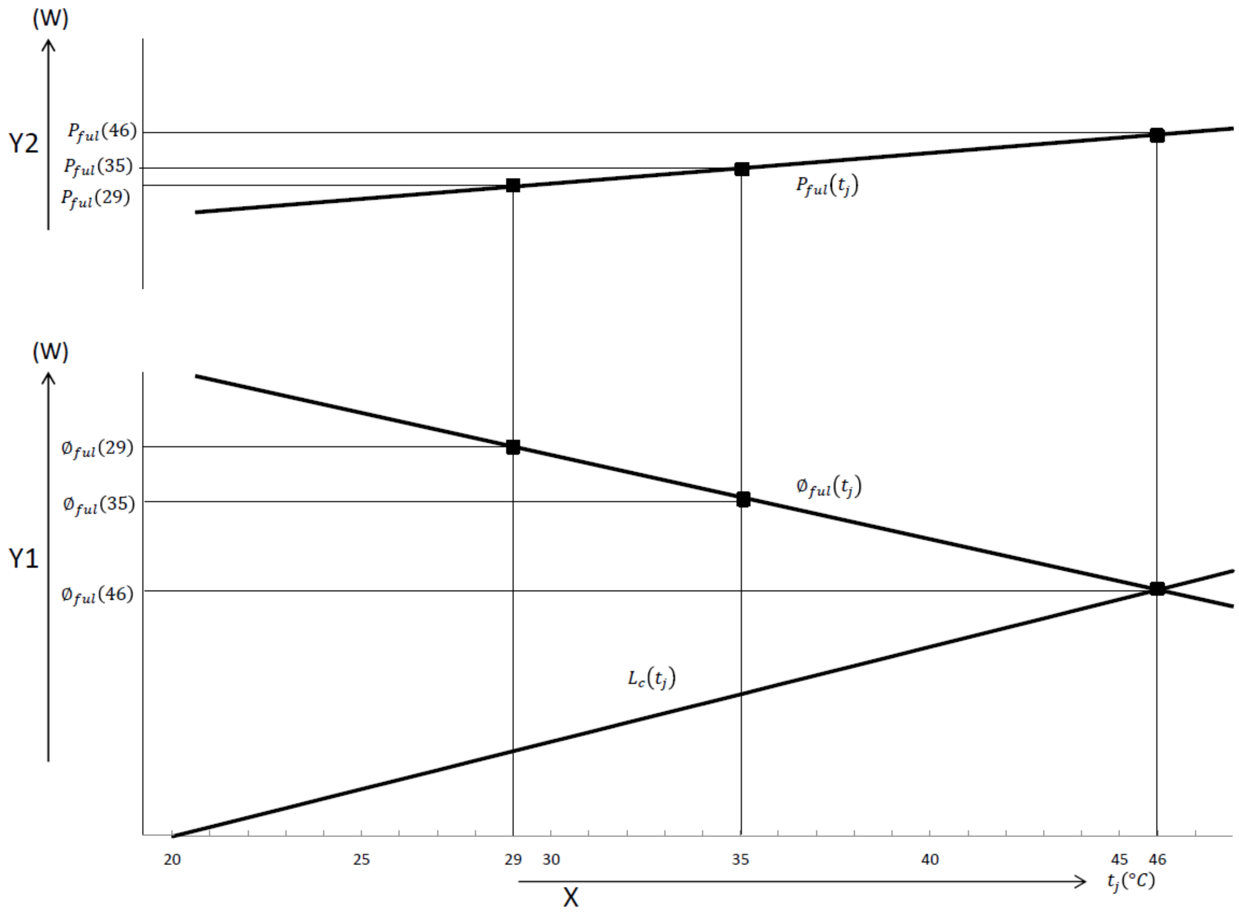
In formula (25) and (26), t_b shall be calculated from (F.17) and (F.18):

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 $t_j > 35°C$

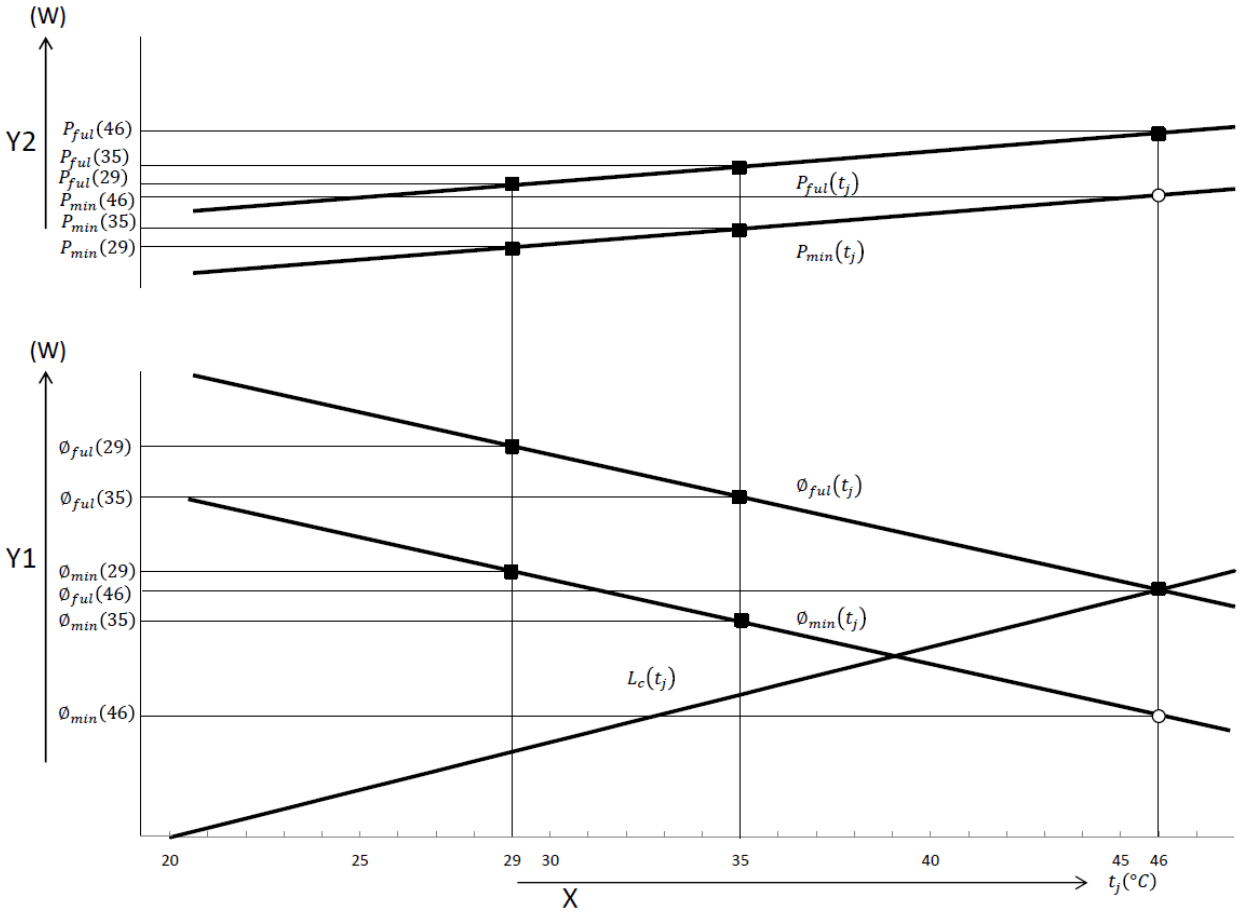
$$t_b = \frac{(46-35)\emptyset_{ful}(t_{100})t_0 + (46-35)\emptyset_{\mathrm{ful}}(46)(t_{100}-t_0) + 46(\emptyset_{ful}(35) - \emptyset_{ful}(46))(t_{100}-t_0)}{(46-35)\emptyset_{ful}(t_{100}) + (\emptyset_{ful}(35) - \emptyset_{ful}(46))(t_{100}-t_0)} \quad \text{(F.18)}$$



Key

X	outdoor temperature
Y1	capacity or load
Y2	power input

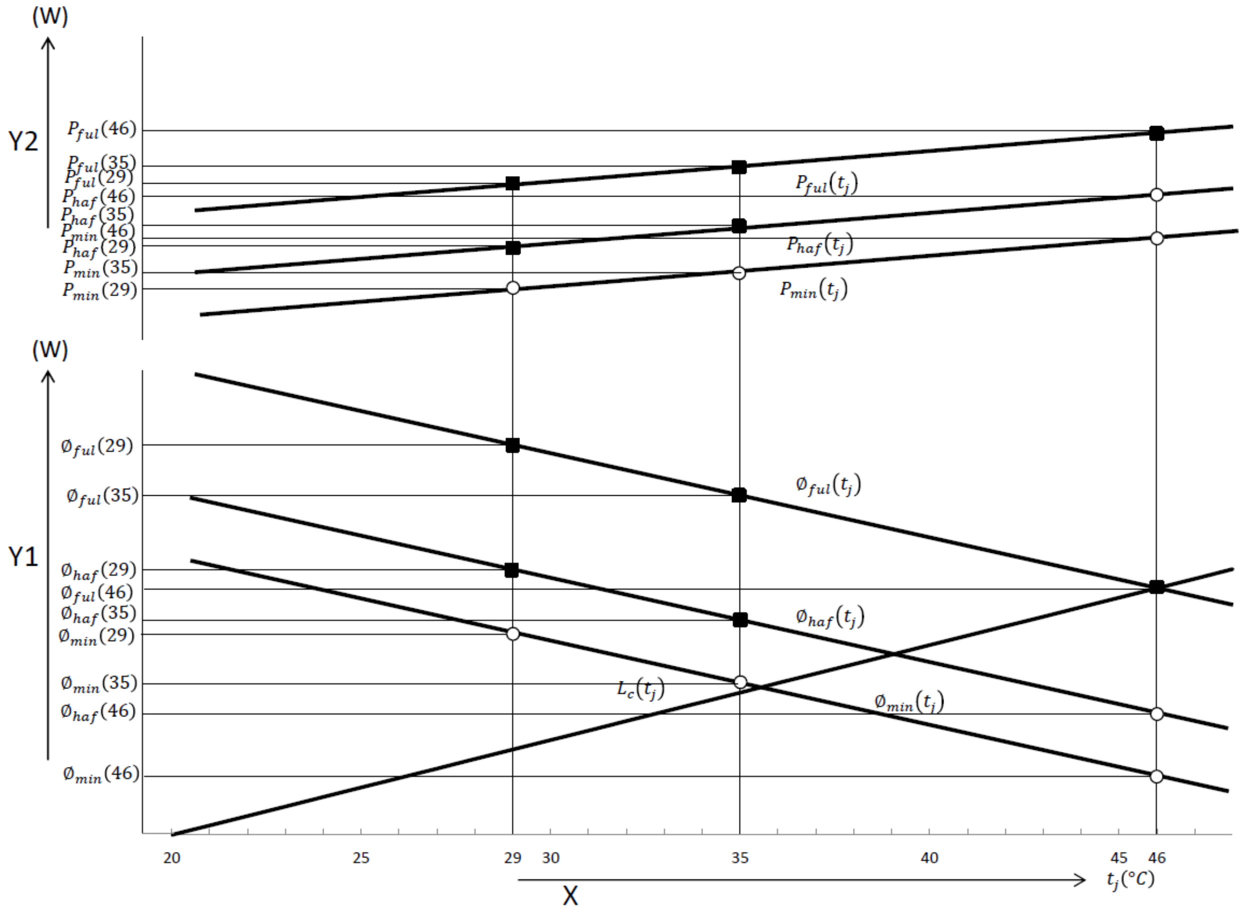
Figure F.1: Cooling capacity, power input and cooling load for fixed capacity units



Key

X	outdoor temperature
Y1	capacity or load
Y2	power input

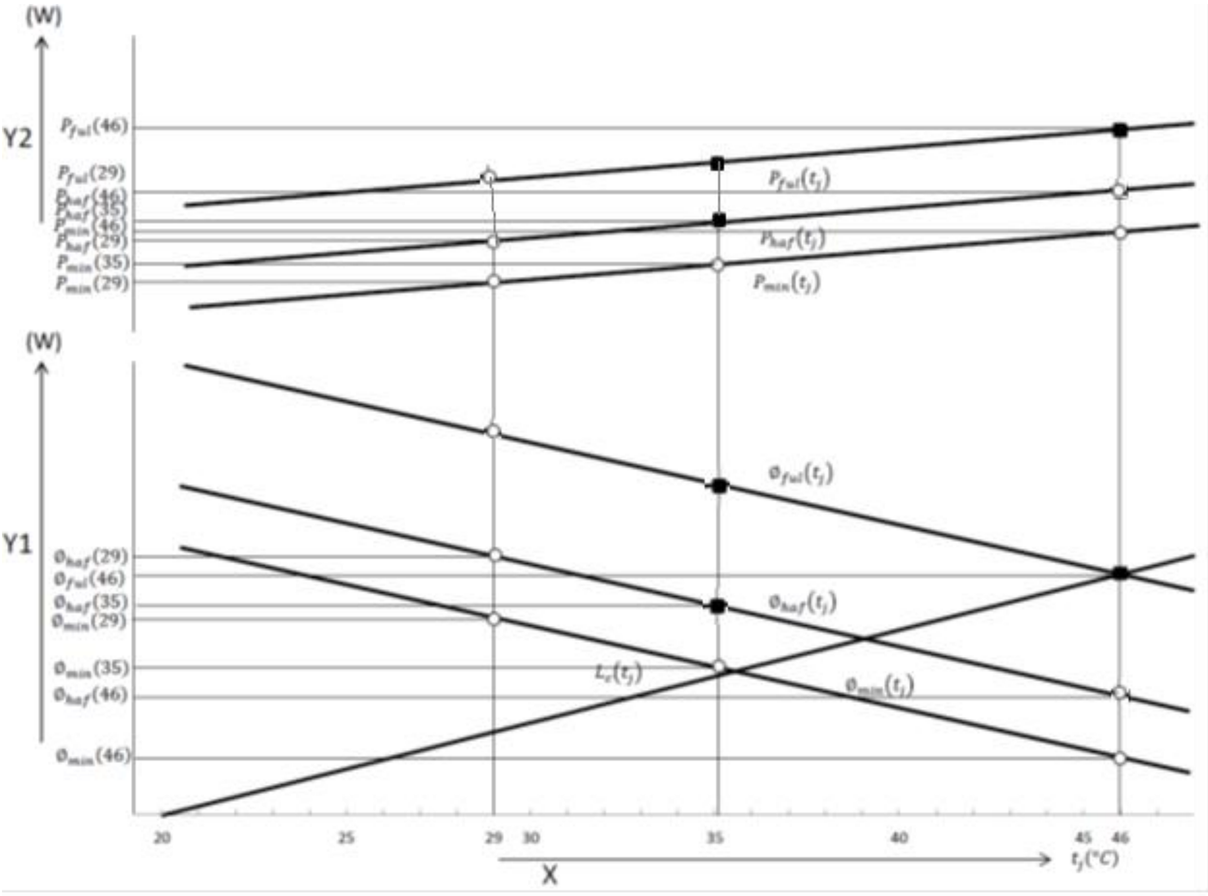
Figure F.2: Cooling capacity, power input and cooling load for two-stage capacity units



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