Commission Working Document

on transitional methods of calculation and measurement[1] for the implementation of a possible Ecodesign Regulation on air-conditioning appliances and comfort fans and Energy Labelling delegated Regulation on air-conditioning appliances

Measured parameter	Organisation	Reference	Title
Energy efficiency Ratio (EER), Coefficient of Performance (COP)	CEN	EN 14511:2007	Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling
Energy efficiency Ratio (EER)	CEN	EN 15218:2006	Air conditioners and liquid chilling packages with evaporatively cooled condensor and with electrically driven compressors for space cooling
Test methods	CEN	PrEN 14825:2009, version 113WG7 109 rev, chapter 8 and 9	Air conditioners, liquid chilling packages and heat pumps, with electrical compressors, for space heating and cooling – Testing and rating at part load conditions and calculation of seasonal performance
Standby power consumption	CEN	EN 62301:2005	Household Electrical Appliances: Measurement of standby power
Sound power level	CEN	EN 12102 :2008	Air conditioners, liquid chilling packages, heat pumps and dehumidifiers with electrically driven compressors for space heating and cooling - Measurement of airborne noise - Determination of the sound power
Energy efficiency	IEC	IEC 60879: 1986 (corr. 1992)	Performance and construction of electric circulating fans and regulators
Sound power level	ISO	ISO 10302:1996	Acoustics - Method for the measurement of airborne noise emitted by small air-moving devices [applicability up to 1 m3/s]
Sound power level	ISO	ISO 10302:1996 and EN 60704-2-7:1997	Household and similar electrical appliances - Test code for the determination of airborne acoustical noise - Part 2: Particular requirements for fans
Standby power consumption	CEN	EN 62301:2005	Household Electrical Appliances: Measurement of standby power

1 Definitions and descriptions for the purposes of the Communication

Definitions relating to air-conditioning appliances

Relating to room air-conditioners

(1) 'Functionality' means the indication of whether the unit is intended for space cooling (suffix *c*), heating (suffix *h*) or both;

(2) 'Designated climate profile' means a weighted set of climate-specific operating conditions representative of a cooling season or a heating season (indicated by suffix A for 'average', W for 'warmer' and C for 'colder') for which the unit is declared fit for purpose;

(3) 'Climate-specific operating condition' or 'bin' (with index *j*) means a combination of a bin-specific outdoor temperature (*Tj*) in °C, a function-dependent indoor temperature (*Tin*) in °C and a bin-specific part load (*pc(Tj)* for cooling and *ph(Tj)* for heating) in kW;

(4) 'weighted set' in the context of a climate profile means that every operating condition ('bin') is given a relative weight, proportional to number of hours *hj* the rounded bin-specific outdoor temperature *Tj* occurs in a heating or cooling season[2];

(5) 'Outdoor temperature' (*T*) is the dry bulb outdoor air temperature at a given relative humidity with the latter indicated by the wet bulb temperature;

(6) 'Function-dependent indoor temperature' (*Tin*) is the dry bulb indoor air temperature at a given relative humidity - indicated by the wet bulb temperature - in cooling mode (*Tinc*) or –depending on the function-- the dry bulb indoor air temperature in heating mode (*Tinh*), all in °C[3];

(7) 'Bin-specific part load' (*p*) means the cooling power demand (*pc(Tj)*) or the heating power demand (*ph(Tj)*) in kW in bin *j* calculated as a fraction of the climate-specific design load *Pdesign* at outdoor temperature *Tdesign* and the function-dependent indoor temperature *Tin*, whereby the value of the fraction depends on the bin-specific outdoor temperature *Tj* linearly weighted against a reference temperature value of 16 °C (*p*=0) and the aforementioned value of *Tdesign* (*p*=*Pdesign*);

(8) 'Fit for purpose' as regards a designated climate profile means that the unit is not only declared as such but also can meet the minimum performance requirements, i.e. the maximum value of the bivalent temperature *Tbiv* and the operation limit temperature *Tol* for the climate profile, at the design load *Pdesign*;

(9) 'Design load' (*Pdesign*) means the declared peak cooling (*Pdesignc*) and/or declared peak heating power (*Pdesignh*) demand in kW at *Tdesign* outdoor temperature, whereby in heating mode the declaration of the climate-specific *Pdesignh* values is subject to maximum requirements [4] for the bivalent temperature *Tbiv* and the outdoor temperature operating limit *Tol*, both in °C, and in cooling mode *Pdesignc* must be equal to the declared capacity *Pdc* of the unit at *Tdesignc*;

(10) '*Tdesign"* means the outdoor temperature at extreme conditions pertaining to a climate profile [5];

(11) 'Bivalent temperature' (*Tbiv*) is the lowest outdoor temperature point at which the unit is declared to have a monovalent capacity able to meet 100% of the load without additional backup;

(12) 'Operation limit temperature' (*Tol*) in °C is the lowest outdoor temperature at which the unit in heating mode can still deliver heating capacity, as declared by the manufacturer;

(13) 'Declared capacity' (*Pd*) is the declared cooling (*Pdc*) or heating (*Pdh*) power output in kW of the refrigerant cycle of the unit at specific operating conditions [6];

(14) 'Energy Efficiency Ratio' (*EER*) is the cooling power output in kW divided by the electric power input in kW of a unit at operating conditions specified in Table 3 [7];

(15) 'P_{EER}' means the electric power input in kW of a unit when providing cooling at design load (*Pdesignc*) of which the conditions are specified in Table 3 [8];

(16) 'Coefficient of Performance' (*COP*) is the heating power output in kW divided by the electric power input in kW of a unit at operating conditions specified in Table 3 [9];

(17) 'P_{COP}' means the electric power input in kW of a unit when providing heating at design load (*Pdesignc*) of which the conditions are specified in Table 3;

(18) 'Electric back-up heater output' (*elbu*) is the heating power output in kW of a real or assumed electric back-up heater with COP of 1 that supplements the heating power output of the refrigeration cycle if necessary in order to arrive at the required heat demand for a specific operating condition [10];

(19) 'Seasonal Energy Efficiency Ratio' (*SEER*) is the cooling season energy efficiency performance, expressed as the ratio between the reference *seasonal cooling demand* in kWh/a and the seasonal electricity consumption for cooling in kWh/a;

(20) 'Seasonal cooling demand' (Q_C) means the product of *Pdesignc* and the seasonal numbers of hours H_{CE} the unit has the compressor running to supply cooling in kWh/a;

(21) 'Seasonal electricity consumption for cooling' (Q_{CE}) means the seasonal cooling demand divided by the weighted average energy efficiency ratio plus the electricity consumption of the unit in the auxiliary modes during the cooling season;

(22) 'Seasonal Coefficient of Performance' (*SCOP*) is the heating season efficiency performance, expressed as the ratio between the reference seasonal heating energy demand in kWh/a and the seasonal electricity

consumption for heating, which may vary according the climate profile chosen in kWh/a;

(23) 'Seasonal heating demand' (Q_H) means the product of *Pdesignh* and the seasonal numbers of hours H_{HE} the unit has the compressor running to supply heating in kWh/a;

(24) 'Seasonal electricity consumption for heating' cooling ($Q_{CE\ for\ A,\ W\ and/or\ C}$) means the seasonal heating demand divided by the weighted average Coefficient of Performance plus the electricity consumption of the unit in the auxiliairy modes during the heating season;

(25) 'Degradation coefficient' (*Cd*) is the measure of efficiency loss due to cycling (compressor switching on/off in active mode);

(26) 'Capacity control' indicates whether the unit is able to change the rotational speed of the motor of the compressor in a minimum of three or more steps (variable speed), two steps ('staged capacity') or not at all ('fixed capacity');

(27) 'Auxiliary electric power consumption' is the power consumption of the unit in kW in stand-by mode (P_{SB}), thermostat-off mode (P_{TO}), off-mode (P_{OFF}) and crankcase heater operation (P_{CK});

(28) 'Seasonal operating hours in auxiliary modes' is the number of hours per heating and/or cooling season in stand-by mode (H_{SB}), thermostat-off mode (H_{TO}), off-mode (H_{OFF}) and crankcase heater operation (H_{CK});

(29) 'Off mode' is a condition in which the equipment is connected to the mains power source and is not providing any function. Also considered as off mode are conditions providing only an indication of off mode condition, as well as conditions providing only functionalities intended to ensure electromagnetic compatibility pursuant to Directive 2004/108/EC of the European Parliament and of the Council [11];

(30) 'Standby mode' means a condition where the equipment is connected to the mains power source, depends on energy input from the mains power source to work as intended and provides only the following functions, which may persist for an indefinite time: reactivation function, or reactivation function and only an indication of enabled reactivation function, and/or information or status display;

(31) 'Thermostat-off mode' means a condition where the unit is turned on, the compressor is not running and where the unit is waiting for a signal to start the compressor or proceed to another auxiliary power mode [12];

(32) 'Crankcase heater operation' means a condition where the unit is not providing heating or cooling output and has activated a heating device to limit the concentration of refrigerant in oil at compressor start;

(33) 'Reactivation function' means a function facilitating the activation of other modes, including active mode, by remote switch including remote control, internal sensor, timer to a condition providing additional functions, including the main function;

(34) 'Information or status display' is a continuous function providing information or indicating the status of the equipment on a display, including clocks;

(35) 'Nominal air flow rates' means air flow rates in m³/h, measured at the outlet of the indoor and/or outdoor units (whichever applies) of air-conditioning appliances, in operating conditions necessary to realise *Pdesign*;

(36) 'Global warming potential' means the global warming potential of the refrigerant applied in the unit, expressed in kg CO2 equivalents over a 100 year time horizon;

(37) 'Sound power level' means the A-weighted sound power level indoors and outdoors measured during nominal flow rate conditions;

(38) 'Nominal fan flow rate' (*F*) in m³/min means the maximum air flow rate measured at the fan outlet;

(39) 'Nominal fan electric power consumption' (*P*) in W means the electricity consumption of the comfort fan operating at nominal flow rate;

(40) 'Service value' (*SV*) in (m³/min)/W means the ratio of the nominal fan flow rate and the nominal fan electric power consumption;

(41) 'Annual fan electricity consumption' (*Q*) in kWh/a means the reference annual electricity consumption of the comfort fan;

(42) 'Tower fan' means a comfort fan of which the air path through the impeller is in a direction essentially at right angles to the axis of rotation, both entering and leaving the impeller at its periphery (also known as 'cross flow' or 'tangential' fans);

(43) 'Ceiling fan' means a comfort fan designed to be suspended from a ceiling;

(44) 'Other fan' means a comfort fan not covered by the definition of ceiling fan or tower fan.

2 Definition tables

Table 1. Parameter list for calculation of seasonal efficiency

Description	**Symbol**	**Value***	**Unit**	**Symbol**	**Value**
<u>**DECLARED INPUT PARAMETERS**</u>					
Functionality	Cooling (suffix *c*)	Y/N		Heating (suffix *h*)	Y/N
Designated climate profiles apart from Average (suffix A)	Warmer (suffix *W*)	Y/N		Colder (suffix *C*)	Y/N
Design load	*Pdesign*	*Load*			
in cooling mode	*Pdesignc*	0,0	kW		

in heating mode	*Pdesignh*				
Average climate	*PdesignhA*	0,0	kW		
Warmer climate (if designated)	*PdesignhW*	0,0	kW		
Colder climate (if designated)	*PdesignhC*	0,0	kW		
Declared capacity of the unit*	*Pd*	*Capacity*		*EER/COP at Pd*	
in cooling mode	*Pdc*				
T=35, pl 1 (condition A; P_{EER} condition)	*Pdc4*	0,0	kW	*EER4*	0,00
T=30, pl 0,74 (condition B)	*Pdc3*	0,0	kW	*EER3*	0,00
T=25, pl 0,47 (condition C)	*Pdc2*	0,0	kW	*EER2*	0,00
T=20, pl 0,21 (condition D)	*Pdc1*	0,0	kW	*EER1*	0,00
in heating mode					
Average climate					
T=-7, pl 0,88 (condition A)	*Pdh4A*	0,0	kW	*COP4A*	0,00
T=2, pl 0,54(condition B)	*Pdh3A*	0,0	kW	*COP3A*	0,00
T=7, pl 0,35 (condition C)	*Pdh2A*	0,0	kW	*COP2A*	0,00
T=12, pl 0,15 (condition D)	*Pdh1A*	0,0	kW	*COP1A*	0,00
T=Tbiv (condition F)	*Pdh5A*	0,0	kW	*COP5A*	0,00
T=TOL (condition E)	*Pdh6A*	0,0	kW	*COP6A*	0,00
Warmer climate					
T=2, pl 1 (condition B)	*Pdh3W*	0,0	kW	*COP3W*	0,00
T=7, pl 0,64 (condition C)	*Pdh2W*	0,0	kW	*COP2W*	0,00
T=12, pl 0,29 (condition D)	*Pdh1W*	0,0	kW	*COP1W*	0,00
T=Tbiv (condition F)	*Pdh5W*	0,0	kW	*COP5W*	0,00
T=TOL (condition E)	*Pdh6W*	0,0		*COP6W*	0,00
Colder climate					
T=-7, pl 0,61 (condition A)	*Pdh4C*	0,0	kW	*COP4C*	0,00 -
T=2, pl 0,37 (condition B)	*Pdh3C*	0,0	kW	*COP3C*	0,00 -
T=7, pl 0,24 (condition C)	*Pdh2C*	0,0	kW	*COP2C*	0,00 -
T=12, pl 0.105 (condition D)	*Pdh1C*	0,0	kW	*COP1C*	0,00 -
T=Tbiv (condition F)	*Pdh5C*	0,0	kW	*COP5C*	0,00 -
T=TOL (condition E)	*Pdh6C*	0,0	kW	*COP6C*	0,00 -
T=-15, pl 0,82 (condition G)	*Pdh7C*	0,0	kW	*COP7C*	0,00 -

Table 1 continued. Parameter list for calculation seasonal efficiency

Description	Symbol	Value	Unit	Symbol	Value	Unit
Degradation co-efficient	*Cd/Cdh/Cdc*	0,0				
Cooling mode cycling (condition D)***	*Pdcyc*	0,0		*EERcyc*	0,0	
Heating mode cycling (condition D)***	*PhcycA*	0,0		*COPcycA*	0,0	
Bivalent point Tbiv for heating				***Operation limit Tol***		
Average climate	*TbivA*	0,0	°C	*Tol*	0,0	°C

Warmer climate	*TbivW*	0,0	°C				
Colder climate	*TbivC*	0,0	°C				
Capacity control		1. fixed, 2. staged OR 3.variable					
Auxiliary electric power consumption		***Cooling***		***Heating***			
off mode (not if function is both heating and cooling)	P_{OFF}	0,0	kW	P_{OFF}	0,0	kW	
standby mode	P_{SB}	0,0	kW	P_{SB}	0,0	kW	
thermostat-off mode	P_{TO}	0,0	kW	P_{TO}	0,0	kW	
crancase heater operation	P_{CK}	0,0	kW	P_{CK}	0,0	kW	
Global Warming Potential refrigerant		p.m.					
Settings and test report		p.m.					

<u>DECLARED OUTPUT PARAMETERS</u>

Seasonal electricity consumption	Q_E			***Seasonal efficiency***	
in cooling mode	Q_{CE}	0,0	kWh/a	*SEER*	0,00
in heating mode					
Average climate	Q_{HEA}	0,0	kWh/a	SCOPA	0,00
Warmer climate (if designated)	Q_{HEW}	0,0	kWh/a	SCOPW	0,00
Colder climate (if designated)	Q_{HEC}	0,0	kWh/a	SCOPC	0,00

<u>AUXILIARY AND INTERMEDIATE PARAMETERS</u>

Seasonal cooling/heating demand	Q		
in cooling mode	Q_C	0,0	kWh/a
in heating mode			
Average climate	Q_{HA}	0,0	kWh/a
Warmer climate (if designated)	Q_{HW}	0,0	kWh/a
Colder climate (if designated)	Q_{HC}	0,0	kWh/a

Table 1 continued. Parameter list ~~RAC~~ for calculation seasonal efficiency

Description	Symbol	Value	Unit	Note
Bin-parameters				
Bin-index	j	0		
Outdoor temperature in bin j	Tj	0	°C	
Cooling demand in bin j	Pc(Tj)	0,000	kW	
Heating demand in bin j	Ph(Tj)	0,000	kW	
Cooling capacity in bin j	Pdc(Tj)	0,000	kW	
Heating capacity in bin j	Pdh(Tj)	0,000	kW	
Heat output electric back up in bin j	elbu(Tj)	0,000	kW	

CONSTANTS

Design outdoor temperature	*TdesignA* *TdesignW* *TdesignC*	0	°C	Values see table 3
Hours per season in cooling on-mode	H_{CE}	0	h	Values see table 2
Hours per season in heating on-mode	H_{HE}	0	h	
Hours per season in thermostat-off	H_{TO}	0	h	
Hours per season crankcase heater on	H_{CK}	0	h	
Hours per season stand-by mode	H_{SB}	0	h	
Hours per season in off-mode	H_{OFF}	0	h	
Indoor temperature cooling (for tests)	*Tinc*	0	°C	Values see table 3
Indoor temperature heating (for tests)	*Tinh*	0	°C	
Reference indoor temperature (calculation)		0	°C	Value= 16°C

*= For staged capacity units, two values divided by a slash ('/') will be declared in each box in the section "Declared capacity of the unit" . The number of digits in the box indicates the precision of reporting.

**= 'pl' in this table is the fraction of *Pdesign*

***= If default Cd=0,25 is chosen then (results from) cycling tests are not required. Otherwise either heating or cooling cycling test is required, not both.

Table 2. Time periods in hrs./ for cooling and heating seasons for each mode

COOLING	Cooling Only (for SEER)					Cooling and heating (for SEER)				
	H_{CE}	H_{TO}	H_{CK}	H_{OFF}	H_{SB}	H_{CE}	H_{TO}	H_{CK}	H_{OFF}	H_{SB}
	350	221	7760	5088	2142	350	221	2672	0	2142
HEATING	Heating Only (for SCOP)					Cooling and Heating (for SCOP)				
climate	H_{HE}	H_{TO}	H_{CK}	H_{OFF}		H_{HE}	H_{TO}	H_{CK}	H_{OFF}	
A	1400	179	3851	3672		1400	179	179	0	
W	1400	755	2944	2189		1400	755	755	0	
C	2100	131	4476	4345		2100	131	131	0	

Table 3: Indoor and outdoor (Tdesign) air temperatures, bivalent point (Tbiv) and operating limit (Tol) temperatures per climate profile (all values are dry bulb temperatures with wet bulb temperatures indicated between brackets).						
funtionality	Appliance type		Evaporator side (indoor air temp.)	Condensor side (outdoor air temp. Tdesignc)		
cooling	single duct		35 (24) ºC	35 (24) ºC *		
	room air-conditioner and double duct		27 (19) ºC	35 (24) ºC		
		climate profile (suffix A/W/C)	Condensor side (indoor air temp.)	Evaporator side (outdoor air temp. TdesignhA/W/C)	Maximum bivalent point (TbivA/W/C)	Maximum operating limit (TolA/W/C)
heating	single duct	Average	20 (12) ºC	20 (12) ºC *	n.a.	n.a.
	double duct (≤ 1 kW input power)	Average	20 (15 max) ºC	7 (6) ºC	n.a.	n.a.
	room air-conditioner and double duct (> 1 kW input power)	Average	20 (15 max) ºC	-10 (-11) ºC	2 ºC	-7 ºC
		Warmer	20 (15 max) ºC	2 (-11) ºC	7 ºC	2 ºC
		Colder	20 (15 max) ºC	-22 (-23) ºC	-7 ºC	-15 ºC
* = In case of single ducts the condensor/evaporator in cooling/heating mode is not supplied by outdoor air, but indoor air.						

Table 4. Comfort fans: Time periods in h/a in on, stand-by and off mode					
H_F	320	H_{SB}	1120	H_{OFF}	0

Table 5. – bin number j, outdoor temperature Tj in °C and number of hours per bin hj corresponding to the reference heating seasons "warmer", "average", "colder"

COOLING SEASON			HEATING SEASONS		Warmer (W)	Average (A)	Colder (C)
j	**Tj**	**hj**	**j**	**T_j**	**hj W**	**hjA**	**hjC**
#	**°C**	**hrs**	**#**	**°C**	**hrs**	**hrs**	**hrs**
1	17	205	1 to 8	-30 to -23	0	0	0
2	18	227	9	-22	0	0	1
3	19	225	10	-21	0	0	6
4	20	225	11	-20	0	0	13
5	21	216	12	-19	0	0	17
6	22	215	13	-18	0	0	19
7	23	218	14	-17	0	0	26
8	24	197	15	-16	0	0	39
9	25	178	16	-15	0	0	41
10	26	158	17	-14	0	0	35
11	27	137	18	-13	0	0	52

12	28	109	19	-12	0	0	37
13	29	88	20	-11	0	0	41
14	30	63	21	-10	0	1	43
15	31	39	22	-9	0	25	54
16	32	31	23	-8	0	23	90
17	33	24	24	-7	0	24	125
18	34	17	25	-6	0	27	169
19	35	13	26	-5	0	68	195
20	36	9	27	-4	0	91	278
21	37	4	28	-3	0	89	306
22	38	3	29	-2	0	165	454
23	39	1	30	-1	0	173	385
24	40	0	31	0	0	240	490
			32	1	0	280	533
total		2602	33	2	3	320	380
			34	3	22	357	228
			35	4	63	356	261
			36	5	63	303	279
			37	6	175	330	229
			38	7	162	326	269
			39	8	259	348	233
			40	9	360	335	230
			41	10	428	315	243
			42	11	430	215	191
			43	12	503	169	146
			44	13	444	151	150
			45	14	384	105	97
			46	15	294	74	61
				total	3590	4910	6446

3. Calculation procedures

This section describes the energy efficiency procedure for air-conditioning appliances and comfort fans.

3.1. AIR-CONDITIONING APPLIANCES

a) Calculation procedure SEER (cooling mode)

Seasonal energy efficiency ratio is

1

$SEER = Q_E / Q_{CE}$,

Where

2

Q_E is the seasonal cooling demand in kWh/a, with $Q_E = Pdesignc \cdot H_{CE}$
Q_{CE} is the seasonal cooling electricity consumption in kWh/a, with

3

$Q_{CE} = (Q_E / SEER_{on}) + H_{TO} \cdot P_{TO} + H_{CK} \cdot P_{CK} + H_{OFF} \cdot P_{OFF} + H_{SB} \cdot P_{SB}$,

With

4
$SEERon$=SUM($hj \cdot Pc(Tj)$) / SUM($hj \cdot Pc(Tj)$ / EER(Tj))

Where

SUM( ) is the sum per climate profile over all *n* bins with bin-index *j*
hj, Tj are hours and outdoor temperature for bin with index *j*, from Table 5
Pc(Tj) is the load for bin *j* with

5
$Pc(Tj) = Pdesignc*(Tj-16) / (Tdesignc -16)$

Where
Pdesignc is the cooling design load in kW, declared in Table 1
Tdesignc is the cooling season design temperature in °C, from Table 3
EER(Tj) is the energy efficiency ratio for bin with index j,

where
for fixed capacity units,
the following anchor-points are calculated

6a
$EER(35)=EER4$

6b
$EER(30)=EER3 \cdot [1 - Cdc \cdot (1 - Pc(30)/Pdc3)]$

6c
$EER(25)=EER2 \cdot [1 - Cdc \cdot (1 - Pc(25)/Pdc2)]$

6d
$EER(20)=EER1 \cdot [1 - Cdc \cdot (1 - Pc(20)/Pdc1)]$

Where

EER1, EER2, EER3, EER4 as well as *Pdc3, Pdc2, Pdc1* are declared values in Table 1,

Pc(35), *Pc*(30), *Pc*(25) and *Pc*(20) are loads in kW for bins with outdoor temperatures of 20, 25, 30 and 35°C, calculated as above.

Cdc is the degradation factor for cooling, either taken as default value 0,25 or taken as the degradation factor for heating *Cdh* using the expression

7

$$Cdc = (1 - EERcyc/EER1)/(1 - Pcycc/Pdc1)$$

Where

EERcyc is the average energy efficiency ratio over the cycling test interval (on + off mode)

Pcycc is the average power output ('capacity') in kW over the cycling test interval (on + off mode)

EER values for bins *j* with intermediate outdoor temperatures *Tj* are calculated through linear interpolation with the outdoor temperature between the closest two anchor points.

EER values for bins *j* with an outdoor temperature *Tj* higher than 35°C shall have the same values as *EER*(35) .

EER values for bins *j* with an outdoor temperature *Tj* lower than 20°C shall have the same value as *EER*(20).

<u>for staged capacity units</u>,

anchor-points are calculated from *hi/lo* values in Table 1 as follows:

8a

$EER(35) = EER4_{hi}$;

8b

If $0{,}97 \cdot Pc(30) \geq Pdc3_{lo} \geq 1{,}03 \cdot Pc(30)$ then $EER(30) = EER3_{lo}$,
else if $0{,}97 \cdot Pc(30) \geq Pdc3_{hi} \geq 1{,}03 \cdot Pc(30)$ then $EER(30) = EER3_{hi}$,
else if $Pc(30) > Pdc3_{lo}$ then
$EER(30) = Pc(30)/[\ (Pc(30) - Pdc3_{lo}\ )\ /\ EER3_{hi} + (Pdc3_{hi} - Pc(30))/\ EER3_{lo}]$
else
$EER(30) = EER3_{lo} \cdot [1 - Cdc \cdot (1 - Pc(30)\ /\ Pdc3_{lo})\ ]$;

8c

If $0,97 \cdot Pc(25) \geq Pdc2_{lo} \geq 1,03 \cdot Pc(25)$ then $EER(25) = EER2_{lo}$,
else if $0,97 \cdot Pc(25) \geq Pdc2_{hi} \geq 1,03 \cdot Pc(25)$ then $EER(25) = EER2_{hi}$,
else if $Pc(25) > Pdc2_{lo}$ then
$EER(25) = Pc(25) / [(Pc(25) - Pdc2_{lo}) / EER2_{hi} + (Pdc2_{hi} - Pc(25)) / EER2_{lo}]$
else
$EER(25) = EER2_{lo} \cdot [1 - Cdc \cdot (1 - Pc(25)/Pdc2_{lo})]$;

8d

If $0,97 \cdot Pc(20) \geq Pdc1_{lo} \geq 1,03 \cdot Pc(20)$ then $EER(20) = EER1_{lo}$,
else if $0,97 \cdot Pc(20) \geq Pdc1_{hi} \geq 1,03 \cdot Pc(20)$ then $EER(20) = EER1_{hi}$,
else if $Pc(20) > Pdc1_{lo}$ then
$EER(20) = Pc(20) / [(Pc(20) - Pdc1_{lo}) / EER1_{hi} + (Pdc1_{hi} - Pc(20)) / EER1_{lo}]$
else
$EER(20) = EER1_{lo} \cdot [1 - Cdc \cdot (1 - Pc(20) / Pdc1_{lo})]$,

where

$EER1_{lo}$ *to* $EER4_{lo}$ and $EER1_{hi}$ *to* $EER4_{hi}$ as well as $Pdc1_{lo}$, $Pdc2_{lo}$, $Pdc3_{lo}$, $Pdc1_{hi}$, $Pdc2_{hi}$, $Pdc3_{hi}$ are declared values in Table 1;

$Pc(35)$, $Pc(30)$, $Pc(25)$ and $Pc(20)$ are loads in kW for bins with outdoor temperatures of 20, 25, 30 and 35°C, calculated as above.

Cdc is the degradation factor for cooling, assessed as for fixed capacity units but using $EER1_{lo}$ and $Pdc1_{lo}$ instead of *EER1* and *Pdc1*;

EER values for bins *j* with intermediate outdoor temperatures *Tj*, EER values for bins *j* with *Tj* > 35°C and EER values for bins *j* with an outdoor temperature *Tj* lower than 20°C are calculated according to the same rules as apply to fixed capacity units.

<u>for variable capacity units</u>,

If the capacity control of the unit does not allow to obtain a capacity corresponding to the required part load ratio within ±5% , the calculation procedure given for staged capacity units shall be applied

H_{TO}, H_{CK}, H_{OFF}, H_{SB} are the number of hours (h) in thermostat-off, crankcase heater operation, off-mode and stand-by mode, given in Table 2;

P_{TO}, P_{CK}, P_{OFF}, P_{SB} are the average electric power consumption values in thermostat-off, crankcase heater operation, off-mode and stand-by mode.

b) Calculation procedure SCOP (heating mode)

This calculation procedure uses generic parameter names, but depending on the designated heating profile suffix *A* (for average climate), *W* (for warmer climate) or *C* (for colder climate) have to be added at the end of the parameter name. Climate-specific parameter names are used only when specific values from the climate profile occur, in which case the values of the average climate (suffix A) are used.

Seasonal coefficient of performance is

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$SCOP = Q_H / Q_{HE}$,

Where

10

Q_H is the seasonal heating demand in kWh/a, with $Q_H = Pdesignh \cdot H_{HE}$,
Q_{HE} is the seasonal heating electricity consumption in kWh/a, with

11

$Q_{HE} = (Q_H / SCOP_{on}) + H_{TO} \cdot P_{TO} + H_{CK} \cdot P_{CK} + H_{OFF} \cdot P_{OFF} + H_{SB} \cdot P_{SB}$,

Where

12

$SCOP_{on} = \text{SUM}(hj \cdot Ph(Tj)) / \text{SUM}(hj \cdot \{[Ph(Tj) - elbu(Tj)]/COP(Tj) + elbu(Tj)\})$

Where

SUM( ) is the sum per climate profile over all *n* bins with bin-index *j*
hj, Tj are hours and outdoor temperature for bin with index *j*, from Table 5
Ph(Tj) is the load for bin *j* with

13

$Ph(Tj) = Pdesignh*(Tj-16) / (Tdesignh - 16)$

Where

Pdesignh is the heating design load in kW, declared in Table 1
Tdesignh is the heating season design temperature in °C, from Table 4

COP(Tj) is the energy efficiency ratio for bin *j*,

Where

for fixed capacity units,
the following anchor-points (example average climate) are calculated
if $Pdh \geq Ph(\mathrm{Tj})$

14a
$$COPA(\mathrm{TolA}) = COP6A \cdot [1 - Cdh \cdot (1 - Ph(\mathrm{TolA})/Pdh6A)],$$

14b
$$COPA(\mathrm{TbivA}) = COP5A \ ,$$

14c
$$COPA(-7) = COP4A \cdot [1 - Cdh \cdot (1 - Ph(-7)/Pdh4A)] \ ,$$

14d
$$COPA(2) = COP3A \cdot [1 - Cdh \cdot (1 - Ph(2)/Pdh3A)] \ ,$$

14e
$$COPA(7) = COP2A \cdot [1 - Cdh \cdot (1 - Ph(7)/Pdh2A)] \ ,$$

14f
$$COPA(12) = COP1A \cdot [1 - Cdh \cdot (1 - Ph(12)/Pdh1A)] \ ,$$

plus in case of a colder climate and Tol<-20°C

14g
$$COPC(-15) = COP7A \cdot [1 - Cdh \cdot (1 - Ph(-15)/Pdh7A)] \ ,$$

Else

if $Pdh < Ph(\mathrm{Tj})$ [14]

15a
$$COPA(\mathrm{TolA}) = COP6A,$$

15b
$$COPA(\mathrm{TbivA}) = COP5A,$$

15c
$$COPA(-7) = COP4A,$$

plus in case of a colder climate and Tol<-20°C

15d
$$COPC(-15) = COP7C,$$

Where

COP1A to *COP6A* as well as *Pdh1A* to *Pdh6A* are declared values in Table 1.

*Ph(*12), *Ph*(7), *Ph*(2), *Ph(*-7), *Ph*(Tbiv), *Ph*(Tol) are loads in kW for bins with outdoor temperatures of 12, 7, 2, -7, Tbiv and Tol °C, calculated as above.

Cdh is the degradation factor for heating, either taken as default value 0,25 or taken as the degradation factor for cooling *Cdc* using the expression

16 $$Cdh = (1 - COPcych / COP1)/(1 - Pcych/Pdh1)$$

Where

COPcyc is the average energy efficiency ratio over the cycling test interval (on + off mode)

Pcycc is the average power output (‘capacity’) in kW over the cycling test interval (on + off mode)

COP values for bins *j* with intermediate outdoor temperatures *Tj* are calculated through linear interpolation with the outdoor temperature between the closest two anchor points. Only in case of an average climate and the colder climate not being one of the designated climates (i.e. COP7 is not available) an exception to this rule can be made whereby *the COP values for outdoor temperatures -8, -9 and -10°C can be linearly extrapolated from the COP of the anchor points at -7°C and +2°C*

COP values for bins *j* with an outdoor temperature *Tj* higher than 12°C are calculated through linear extrapolation with the outdoor temperature starting from anchor-points *COP*(7) and *COP*(12).

COP values for bins *j* with an outdoor temperature *Tj* lower than Tol are set to 1 in order to avoid a division by zero, but effectively the value is irrelevant because [*Ph(Tj)-elbu(Tj)*] in equation 12c is zero.

<u>for staged capacity units</u>,

anchor-points for an average climate are calculated from *hi/lo* values in Table 1 as follows:

For (Tj,x) is [(12,1), (7,2), (2,3), (-7,4), (Tbiv, 5), (Tol, 6)] do

17

If $0{,}97 \cdot Ph(\mathrm{Tj}) \geq Pdhx_{lo} \geq 1{,}0x \cdot Ph(\mathrm{Tj})$ then $COP(\mathrm{Tj}) = COPx_{lo}$,
else if $0{,}97 \cdot Ph(\mathrm{Tj}) \geq Pdhx_{hi} \geq 1{,}0x \cdot Ph(\mathrm{Tj})$ then $COP(\mathrm{Tj}) = COPx_{hi}$,
else if $Ph(\mathrm{Tj}) > Pdhx_{lo}$ then

COP(Tj)= $Ph($Tj)/[($Ph($Tj)−$Pdhx_{lo}$) /$COPx_{hi}$ + ($Pdhx_{hi}$ − $Ph($Tj)) / $COPx_{lo}$] else
COP(Tj)= $COPx_{lo} \cdot [1 - Cdh \cdot (1 - Ph($Tj) / $Pdhx_{lo})]$;

where

$COP1_{lo}$ to $COP6_{lo}$ and $COP1_{hi}$ *to* $COP6_{hi}$ as well as $Pdh1_{lo}$ to $Pdh6_{lo}$, and $Pdh1_{hi}$ to $Pdh6_{hi}$ are declared values in Table 1;

*Ph(*12), *Ph(*7), *Ph(*2), *Ph*(-7), *Ph*(Tbiv), *Ph*(Tol), are loads in kW for bins with outdoor temperatures of 12, 7, 2, -7, Tbiv and Tol °C, calculated as above.

Cdh is the degradation factor for heating, assessed as for fixed capacity units but using $COP1_{lo}$ and $Pdh1_{lo}$ instead of *COP1* and *Pdh1*;

COP values for bins *j* that are not anchor-points are calculated according to the same rules as apply to fixed capacity units.

for variable capacity units,

If the capacity control of the unit does not allow obtaining a capacity corresponding to the required part load ratio within ±5%, the calculation procedure given for staged capacity units shall be applied

elbu(Tj) is the capacity of an electric back up heater with a COP of 1 expressed in kW, with

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elbu(Tj)= Ph(Tj) – MIN(*Pdh(Tj); Ph(Tj)*)

Where
MIN(;) selects the lowest of the two values between brackets
Ph(Tj) is the load for bin *j* in kW *(as follows from equation 13)*
Pdh(Tj) is the capacity of the unit in bin *j* in kW, with

For average climate[15] anchor-points
(Tj,x) is [(12,1), (7,2), (2,3), (-7,4), (Tbiv, 5), (Tol, 6)] do
for fixed or variable capacity units

19a

Pdh(*Tj*)=*Pdh*x

for staged capacity units

19b

$Pdh(Tj)=Pdhx_{hi}$

Pdh(Tj) values for bins *j* with intermediate outdoor temperatures *Tj* are calculated through linear interpolation with the outdoor temperature between the closest two anchor points. Only in case of an average climate and the colder climate not being one of the designated climates (i.e. Pdh7 is not available) an exception to this rule can be made whereby *if the bivalent temperature equals -7°C, then the capacity at-10°C can be estimated as 90% of the capacity at the anchor point -7°C, and the capacity for bins j between -7°C and -10°C shall be interpolated from the capacity of -7°C and -10°C.*

H_{TO}, H_{CK}, H_{OFF}, H_{SB} are the number of hours (h) in thermostat−off, crankcase heater operation, off−mode and stand−by mode, given in Table 2;

P_{TO}, P_{CK}, P_{OFF}, P_{SB} are the average electric power consumption values in thermostat−off, crankcase heater operation, off−mode and stand−by mode.

c) Calculation procedure EER only (cooling mode)

$EER = Pdesignc / P_{EER}$

Where

Pdesignc is the cooling design load in kW, declared in Table 1
P_{EER} is the total power input to the appliance (as delivered) in kW for the relevant operating condition(s) listed in Table 3.

d) Calculation procedure COP only (heating mode)

$COP = Pdesignh / P_{COP}$

Where

Pdesignh is the heating design load in kW, declared in Table 1
P_{COP} is the total power input to the appliance (as delivered) in kW for the relevant operating condition(s) listed in Table 3.

3.2. COMFORT FANS

The service value *SV* in (m³/min)/W for comfort fans is calculated with the expression

$SV = F/P$

where

F is the nominal flow rate in m^3/min;

P is the nominal electric power consumption in W;

The annual electricity consumption Q in kWh/a of the comfort fan is calculated

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$Q = H_{FE} \cdot P_{CE} + H_{TO} \cdot P_{TO} + H_{SB} \cdot P_{SB}$

where

the (equivalent) number of hours in on-mode H_{CE}, thermostat-off mode H_{TO} and stand-by mode H_{SB} are taken from Table 2;

P_{CE} is the measured nominal electric power consumption in kW;

P_{TO} and P_{SB} are the average power consumption values in thermostat-off and stand-by mode.

For electric power in stand-by (P_{SB}) and thermostat off-mode (P_{TO}) the same testing methods apply as for air-conditioning appliances.

The nominal electric power consumption is measured with the oscillating mechanism on. The flow rate is measured without the oscillations.

4. Test report

For the purposes of conformity assessment, test reports in electronic format shall be kept on file by the manufacturer that are immediately accessible to market surveillance authorities at their request. Failure of the manufacturer to produce the test reports within three working days after receipt of the request shall lead to non-compliance. As opposed to the Product Information test reports are not public domain. Market surveillance authorities shall treat the information confidentially and solely to assess compliance of the product under scrutiny. Publication of detailed and/or aggregated quantitative data from the test reports in the public domain is only possible through written authorisation by the manufacturer.

The test reports shall contain all relevant measurement information including but not limited to:

- relevant charts and sampled value tables of temperatures, relative humidity values, part loads, flow rates, electric voltage/ frequency/ harmonic distortion during the test period(s);
- description of the test method(s) as applicable, laboratory space and ambient conditions, physical test rig set up specifying position of data capturing devices (e.g.

sensors) and data processing equipment, as well as the operating range and measurement accuracy;

- settings of the unit being tested, description of the function of automatic switching of settings (e.g. between off mode and standby mode);
- description of the test sequence followed, e.g. to arrive at equilibrium conditions as applicable.

The test report shall include the results of the part load test(s) and the calculation of EER or COP, reference SEER/SCOP and reference $SEER_{on}$/$SCOP_{on}$/$SCOP_{net}$, where applicable. In the test report, the calculated EER/COP values and reference SEER/ SEERon/ SCOP/ SCOPon values shall be based on the values declared by the manufacturer, on the condition that those values are within the acceptable tolerances.
For variable capacity units, where EER, COP and declared capacities (Pdc) are indicated, they shall be given at the same frequency settings for the same part load conditions.

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[1] It is intended that these transitional methods will ultimately be replaced by harmonised standard(s). When available, reference(s) to the harmonised standard(s) will be published in the Official Journal of the European Union in accordance with Articles 9 and 10 of Directive 2009/125/EC.

[2] Values of *hj* per outdoor temperature *Tj* for the various climate profiles are given in table 5.

[3] Values of *Tinc* and *Tinh* are given in table 3.

[4] Maximum values for *Tbiv* and *Tol* are given in Table 3.

[5] Values of *Tdesign* given in Table 2

[6] As declared inputs for the anchor points the values of Pd follow the unit settings as for EER and COP. Also the nomenclature for declared inputs follows that of EER and COP, i.e. pdc1 to pdc4 for cooling and pdh1 to pdh7 for heating. For a bin-specific Pd value the notation follows the format *Pdc(Tj)* or *Pdh(Tj)* in the calculation procedure. Pdh is climate specific.

[7] For anchor points at 20, 25, 30 and 35 °C the EER value is named *EER1, EER2, EER3* and *EER4* respectively and to be declared by the manufacturer as indicated in Table 1. For notation of a bin-specific EER value the notation follows the format *EER(Tj)* in the calculation procedure.

[8] P_{EER} follows from Pdesignc/ EER4, and the reference facilitates its direct use

[9] For anchor points at 12, 7, 2, -7, *Tbiv*, *Tol* and -15 °C the COP value is named *COP1, COP2, COP3*, *COP4, COP5, COP6* and *COP7* respectively and to be declared by the manufacturer as indicated in Table 1. For a bin-specific COP value the notation follows the format *COP(Tj)* in the calculation procedure. COP-values are climate specific and have suffix ‘A’, ‘W’ or ‘C’ depending on the climate.

[10] The value of *elbu* is climate- and bin-specific and follows the format *elbuA(Tj)* and elbuC(Tj) in the calculation procedure. For a Warmer climate *elbu* is always zero.

[11] OJ L 390 of 31.12.2004, p. 24.

[12] “no demand” is related to outdoor temperature conditions (the ‘bin’), and not to indoor loads. Cycling on / off in active mode is not considered as thermostat off.

[13] This means that the outside air has to be drawn in and blown out through ducts causing extra loss

[14] In a warmer climate equations 14c and 15c are lacking. Equations 14a and 14d will be duplicates. In a colder climate equation 14g shall be added as an extra anchor point in case Tol<-20°C.

[15] For colder climates add anchor point (-15,7) to the array (Tj,x) if Tol<-20°C; for warmer climates point (-7,4) shall be deleted from the array.