SLOVENSKI STANDARD
oSIST prEN 12309-6:2023

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Absorpcijske in adsorpcijske plinske naprave za gretje in/ali hlajenje z grelno močjo do vključno 70 kW - 6. del: Izračun sezonske zmogljivosti

Gas-fired sorption appliances for heating and/or cooling with a net heat input not exceeding 70 kW - Part 6: Calculation of seasonal performances

Gasbefeuerte Sorptions-Geräte für Heizung und/oder Kühlung mit einer Nennwärmebelastung nicht über 70 kW - Teil 6: Berechnung der saisonalen Effizienzkennzahlen

Appareils à sorption fonctionnant au gaz pour le chauffage et/ou le refroidissement de débit calorifique sur PCI inférieur ou égal à 70 kW - Partie 6 : Calcul des performances saisonnières

Ta slovenski standard je istoveten z: **prEN 12309-6**

ICS:

27.080	Toplotne črpalke	Heat pumps
91.140.30	Prezračevalni in klimatski sistemi	Ventilation and air-conditioning systems

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EUROPEAN STANDARD

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Gas-fired sorption appliances for heating and/or cooling with a net heat input not exceeding 70 kW - Part 6: Calculation of seasonal performances

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This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 299.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (prEN 12309-6:2022) has been prepared by Technical Committee CEN/TC 299 “Gas-fired sorption appliances, indirect fired sorption appliances, gas-fired endothermic engine heat pumps and domestic gas-fired washing and drying appliances”, the secretariat of which is held by UNI.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 12309-6:2014.

This document includes the following significant technical changes with respect to EN 12309-6:2014:

— Terminology has been aligned to Commission Regulation (EU) No 813/2013 of 2 August 2013 and Commission Delegated Regulation (EU) No 811/2013 of 18 February 2013;

— Heating temperature profile 45 °C has been eliminated;

— Optional testing points have been added.

This standard comprises parts under the general title, Gas-fired sorption appliances for heating and/or cooling with a net heat input not exceeding 70 kW. A list of all parts in a series can be found on the CEN website.

This document will be reviewed whenever new mandates could apply.

This document has been prepared under a Standardization Request given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s) / Regulation(s).

For relationship with EU Directive(s) / Regulation(s), see informative Annex ZA and ZB which are integral parts of this document.

1 Scope

1.1 Scope of EN 12309

Appliances covered by this document include one or a combination of the following:

— gas-fired sorption chiller;

— gas-fired sorption chiller/heater;

— gas-fired sorption heat pump.

This document applies to appliances designed to be used for space heating or cooling or refrigeration with or without heat recovery.

This document applies to appliances having flue gas systems of Type B and Type C (according to EN 1749:2020) and to appliances designed for outdoor installations, including Type A. EN 12309 does not apply to air conditioners, it only applies to appliances having:

— integral burners under the control of fully automatic burner control systems,

— closed system refrigerant circuits in which the refrigerant does not come into direct contact with the water or air to be cooled or heated,

— mechanical means to assist transportation of the combustion air and/or the flue gas.

The above appliances can have one or more primary or secondary functions (i.e. heat recovery - see definitions in prEN 12309-1:2022).

In the case of packaged units (consisting of several parts), this European Standard applies only to those designed and supplied as a complete package.

The appliances having their condenser cooled by air and by the evaporation of external additional water are not covered by EN 12309.

Installations used for heating and/or cooling of industrial processes are not within the scope of EN 12309.

All the symbols given in this text should be used regardless of the language used.

1.2 Scope of this Part 6 to EN 12309

This part of EN 12309 specifies the calculation methods of seasonal performances for gas-fired sorption appliances for heating and/or cooling with a net heat input not exceeding 70 kW. It deals in particular with the calculation methods of reference seasonal performances in cooling and heating mode for monovalent and bivalent appliances.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

prEN 12309-1:2022 ,[1] *Gas-fired sorption appliances for heating and/or cooling with a net heat input not exceeding 70 kW — Part 1: Terms and definitions*

prEN 12309-3:2022 ,[2] *Gas-fired sorption appliances for heating and/or cooling with a net heat input not exceeding 70 kW - Part 3: Requirements, test conditions and test methods*

EN 15502-1:2021, *Gas-fired heating boilers - Part 1: General requirements and tests*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in prEN 12309-1:2022 apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp/

— IEC Electropedia: available at https://www.electropedia.org/

4 Calculation methods for reference *SGUE* and *SAEF* in cooling mode

4.1 General

The calculation of the reference Seasonal Gas Utilization Efficiency ratio in cooling mode (*SGUE*c) and reference Seasonal Auxiliary Energy factor in cooling mode (*SAEF*c) follows from the application of the bin method, where the part load Gas Utilization Efficiency ratio in cooling mode (*GUE*c) and Auxiliary Energy Factor in cooling mode (*AEF*c) at each bin temperature is determined via linear interpolation of the respective part load values at the reference part load conditions A, B, C and D.

The part load conditions A, B, C, D provide the part load ratios and the temperature test conditions at four reference outdoor air dry bulb temperatures: 35 °C, 30 °C, 25 °C and 20 °C.

The part load ratio corresponding to a given outdoor temperature *Tj* is defined according to Formula (1):

$$PLRc\left(Tj\right)=\left(Tj-16\right)/\left(35-16\right) \quad (1)$$

At part load condition A, the declared capacity of the appliance is assumed equal to the building load (i.e. capacity ratio = 100 %).

At part load conditions B, C and D, the declared capacity of the appliance is higher than the building load. The capacity ratio (CR), i.e. the ratio of the cooling load (Pc) over the declared capacity (DC) of the appliance at the same temperature conditions, is lower than one. In such conditions, the *GUE*c and *AEF*c are affected by both temperature test conditions and capacity ratio. The methods for the determination of *GUE*c and *AEF*c are defined in prEN 12309-3:2022.

[1] Currently in preparation.
[2] Currently in preparation.

4.2 Part load conditions

4.2.1 General

For the indoor heat exchanger both fan coil and floor cooling applications are considered.

For the fan coil application, appliances which do, and do not, allow variations of the outlet water temperature with the outdoor temperature are considered. Variable outlet temperatures shall only be applied when the programming unit provides an outdoor air temperature dependant modification of the outlet temperature.

4.2.2 Air-to-water appliances

Table 1 — Part load conditions for the seasonal performance calculation in cooling mode of air-to-water appliances

	Part load ratio	Outdoor heat exchanger	Indoor heat exchanger		
		Air dry bulb temperature °C	Fan coil application Inlet / outlet water temperatures °C		Floor cooling application Inlet / outlet water temperatures °C
			Fixed outlet	Variable outlet	
A	1	35	12 / 7	12 / 7	23 / 18
B	(30–16) / (35–16)	30	[a] / 7	[a] / 8,5	[a] / 18
C	(25–16) / (35–16)	25	[a] / 7	[a] / 10	[a] / 18
D	(20–16) / (35–16)	20	[a] / 7	[a] / 11,5	[a] / 18

[a] With the water flow rate as determined during standard rating test with a fixed water flow rate.

4.2.3 Water-to-water and brine-to-water appliances

Table 2 — Part load conditions for the seasonal performance calculation in cooling mode of water-to-water appliances and brine to water appliances

	Part load ratio	Outdoor heat exchanger			Indoor heat exchanger		
		Cooling tower application Inlet/outlet water temperatures °C	Ground coupled application (water or brine) Inlet/outlet water temperatures °C	Dry cooler application Inlet/outlet water temperatures °C	Fan coil application Inlet/outlet water temperatures °C		Floor cooling application Inlet/outlet water temperatures °C
					Fixed outlet	Variable outlet	
A	1	30 / 35	10 / 15	50 / 55	12 / 7	12 / 7	23 / 18
B	(30–16) / (35–16)	26 / [a]	10 / [a]	45 / [a]	[a] / 7	[a] / 8,5	[a] / 18
C	(25–16) / (35–16)	22 / [a]	10 / [a]	40 / [a]	[a] / 7	[a] / 10	[a] / 18
D	(20–16) / (35–16)	18 / [a]	10 / [a]	35 / [a]	[a] / 7	[a] / 11,5	[a] / 18
[a] With the water flow rate as determined during standard rating test with a fixed water flow rate.							

4.3 Calculation of reference *SGUEc*

The calculation of the reference Seasonal Gas Utilization Efficiency ratio in cooling mode (*SGUEc*) that applies to all types of appliances is given by Formula (2):

$$SGUEc = \frac{\sum_{j=1}^{n} hj \times Pc(Tj)}{\sum_{j=1}^{n} hj \times \frac{Pc(Tj)}{GUEc(Tj)}} \quad (2)$$

where

Tj is the bin temperature;

j is the bin number;

n is the number of bins;

Pc(Tj) is the cooling load of the building not exceeding the appliance declared capacity at the corresponding temperature *Tj*;

*h*j is the number of bin hours occurring at the corresponding temperature *Tj*;

GUEc(Tj) is the *GUEc* of the appliance for the corresponding temperature *Tj*.

The values to be used for *j*, *Tj* and *hj* are determined in Table 3.

Table 3 — bin number *j*, outdoor bin temperature *Tj* in °C and number of hours per bin *hj* corresponding to the reference cooling season

j (#)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Tj (°C)	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
hj (h)	205	227	225	225	216	215	218	197	178	158	137	109	88	63	39	31	24	17	13	9	4	3	1	0

The cooling load that is not exceeding the appliance declared capacity is determined by multiplying the full load value ($P_{design,c}$) with the part load ratio *PLRc*(*Tj*) of the corresponding bin:

$$Pc(Tj) = P_{designc} \times PLRc(Tj) \quad (3)$$

where *PLRc*(*Tj*) is:

— defined according to Formula (1) for *Tj* less than or equal to 35 °C;

— always 1 for *Tj* greater than 35 °C.

The *GUEc* values at each bin are determined via interpolation of the *GUEc* values at part load conditions A, B, C and D as defined in 4.1.

For part load conditions above part load condition A, the same *GUEc* values as for condition A shall be used.

For part load conditions below part load condition D, the same *GUEc* values as for condition D shall be used.

4.4 Calculation of reference SAEFc

The calculation of the reference Seasonal Auxiliary Energy Factor in cooling mode (*SAEFc*) that applies to all types of appliances is given by reference annual cooling demand divided by the annual electricity consumption.

The annual electricity consumption includes the power consumption during active mode, thermostat off mode, standby mode and off mode.

$$SAEFc = \frac{Q_{refc}}{\frac{Q_{ref}}{SAEFc_{on}} + H_{TO} \times P_{TO} + H_{SB} \times P_{SB} + H_{OFF} \times P_{OFF}} \quad (4)$$

where

$Qref_c$	is the reference annual cooling demand, expressed in kWh, as defined in 4.5;
$SAEFc_{on}$	is the Seasonal Auxiliary Energy Factor in cooling mode and active mode, as defined in 4.6;
H_{TO}, H_{SB}, H_{OFF}	are the number of hours the appliance is considered to work in respectively thermostat off mode, standby mode and off mode. The number of hours to be used for cooling is indicated in Annex C;
P_{TO}, P_{SB}, P_{OFF}	are the electricity consumption during respectively thermostat off mode, standby mode and off mode, expressed in kW. The measurement of P_{TO}, P_{SB}, P_{OFF} shall be made according to prEN 12309-3:2022.

4.5 Calculation of reference annual cooling demand (Q_{refc})

The reference annual cooling demand is expressed in kWh and can be calculated as the design cooling load ($P_{design,c}$) multiplied by the number of equivalent cooling hours (H_{ec}):

$$Q_{refc} = P_{designc} \times H_{ec} \tag{5}$$

The number of equivalent cooling hours (H_{ec}) can be found in Annex C.

4.6 Calculation of reference $SAEFc_{on}$

The reference $SAEFc_{on}$ is determined as follows:

$$SAEFc_{on} = \frac{\sum_{j=1}^{n} hj \times Pc(Tj)}{\sum_{j=1}^{n} hj \times \frac{Pc(Tj)}{AEFc(Tj)}} \tag{6}$$

where

Tj	is the bin temperature;
j	is the bin number;
n	is the number of bin;
$Pc(Tj)$	is the cooling load of the building for the corresponding temperature Tj;
hj	is the number of bin hours occurring at the corresponding temperature Tj;
$AEFc\ (Tj)$	is the AEFc values of the appliance for the corresponding temperature Tj.

The values to be used for j, Tj and hj are determined in Table 3.

The cooling load $Pc(Tj)$ shall be determined according to Formula (3).

The *AEFc* values at each bin are determined via interpolation of the *AEFc* values at part load conditions A, B, C and D as defined in 4.1.

For part load conditions above part load condition A, the same *AEFc* values as for condition A shall be used.

For part load conditions below part load condition D, the same *AEFc* values as for condition D shall be used.

4.7 Procedures for the determination of *GUEc* / *AEFc* values

In part load condition A (full load), the declared capacity of an appliance is considered equal to the cooling load ($P_{design,c}$). Accordingly, the test methods at full capacity shall be used, as defined in prEN 12309-3:2022.

In part load conditions B, C, D, the test methods at reduced capacity shall be used, as defined in prEN 12309-3:2022.

5 Calculation methods for reference seasonal performance in heating mode

5.1 General

For the purpose of calculating the reference seasonal performance in heating mode, three reference climatic conditions are defined: average (A), warmer (W) and colder (C).

The relevant reference design outdoor temperature for heating ($T_{design,h}$) and bivalent temperature ($T_{bivalent}$) values are set as follows:

Table 4 — Design temperature and bivalent temperature upper limit for the different reference heating seasons

Reference Heating Season	Dry bulb temperature conditions	
	$T_{design,h}$	$T_{bivalent}$ upper limit
Average (A)	−10 °C	2 °C
Warmer (W)	+2 °C	+7 °C
Colder (C)	−22 °C	−7 °C

For bivalent appliances, $T_{bivalent}$ can be any value between $T_{design,h}$ and the $T_{bivalent}$ upper limit. Once $T_{bivalent}$ is defined in dry bulb, the corresponding wet bulb temperature shall be calculated as dry bulb temperature minus 1 K. For monovalent appliances, $T_{bivalent}$ shall be assumed equal to $T_{design,h}$.

For air to water appliances, the declared Operation Limit Temperature (TOL) of the heat pump appliance shall also be considered. TOL higher than $T_{design,h}$ is an acceptable condition only for bivalent appliances. If TOL is lower than $T_{design,h}$, TOL is not taken into account for the calculation of the seasonal performance and it can be assumed equal to $T_{design,h}$.

The calculation of the seasonal performance follows from the application of the bin method, where the part load Gas Utilization Efficiency ratio in heating mode (*GUEh*) and Auxiliary Energy Factor in heating mode (*AEFh*) at each bin temperature is determined via linear interpolation of the respective part load values at the reference part load conditions A, B, C, D, E, F and G.

The part load conditions A, B, C, D and G provide the part load ratios and the temperature test conditions at five reference outdoor air dry bulb temperatures: −7 °C, +2 °C, +7 °C, +12 °C and −15 °C.

The part load conditions E and F provide the part load ratios and temperature test conditions at the appliance operation limit outdoor temperature (TOL) and at the appliance bivalent outdoor temperature ($T_{bivalent}$), respectively.

Optional test conditions at outdoor air dry bulb temperatures T_j different from A, B, C, D, E, F and G can be measured; inlet/outlet temperatures shall be determined via linear interpolation between the two closest reference part load conditions A, B, C, D, E, F and G. Optional testing points, if used for the calculation of seasonal performance, shall be declared.

The part load ratio corresponding to a given outdoor temperature *Tj* is defined according to Formula (7):

$$PLRh(Tj) = (Tj - 16) / (T_{designh} - 16) \quad (7)$$

At part load conditions for which the outdoor temperature is lower than or equal to the defined $T_{bivalent}$ temperature, the appliance declared capacity is lower than or equal to the requested heating load. In this condition, the appliance operates at its maximum capacity and the gap between heating load and appliance declared capacity is covered by a supplementary heater. The *GUE*h and *AEF*h at full capacity are to be used.