

### SLOVENSKI STANDARD oSIST prEN 12309-6:2012

01-oktober-2012

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

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

ST EN 12309-6:2015

Appareils à sorption à chauffage direct au gaz pour chauffage et/ou refroidissement d'un débit calorifique sur PCI inférieur à 70 kW - Partie 6: Performances saisonnières

Ta slovenski standard je istoveten z: prEN 12309-6

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**English Version** 

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

Appareils à sorption à chauffage direct au gaz pour chauffage et/ou refroidissement d'un débit calorifique sur PCI inférieur à 70 kW - Partie 6: Performances saisonnières Gasbefeuerte Sorptions-Geräte für Heizung und/oder Kühlung mit einer Nennwärmebelastung nicht über 70 kW -Teil 6: Berechnung der saisonalen Effizienzkennzahlen

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

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#### Foreword

This document (prEN 12309-6:2012) 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 12309-2:2000.

EN 12309 comprises the following parts under the general title «*Gas-fired sorption appliances for heating and/or cooling with a net heat input not exceeding 70 kW*»:

- Part 1: Terms and definitions;
- Part 2: Safety;
- Part 3: Test conditions;
- Part 4: Test methods;
- Part 5: Requirements;
- Part 6: Calculation of seasonal performances;
- Part 7: Specific provisions for hybrid appliances; 00\_6-2014
- Part 8: Environmental aspects.
- 69ed2c9e42c0/sist-en-12309-6-201

Parts 1 and 2 to EN 12309 will supersede EN 12309-1:1999, whereas Part 1 and Parts 3 to 7 of EN 12309 will supersede EN 12309-2:2000. Parts 1 to 7 have been prepared to address the essential requirements of the European Directive 2009/142/EC relating to appliances burning gaseous fuels (see informative Annex ZA of EN 12309-2:20xx for safety aspects and Annex ZA of prEN 12309-5:2012 for rational use of energy aspects).

These documents are linked to the following European Directives:

- Energy Related Products Directive (2009/125/EC) in terms of tests conditions, tests methods and seasonal performances calculation methods under Mandate M/495 (see Annex ZB of prEN 12309-5:2012);
- Promotion of the Use of Renewable Energy Directive (2009/28/EC Annex VII) (see Annex A of prEN 12309-5:2012).

For the relationship with EU Directive(s), see informative Annexes ZA and ZB in EN 12309-2:20xx and in prEN 12309-5:2012, which are an integral part of this document. These documents will be reviewed whenever new mandates could apply.

Part 8 of EN 12309 ("Environmental aspects") deals with the incorporation of the Resolution BT 27/2008 regarding CEN approach on addressing environmental issues in product and service standards.

#### prEN 12309-6:2012 (E)

#### 1 Scope

#### 1.1 Scope of EN 12309 series

Appliances covered by EN 12309 include one or a combination of the following:

- gas-fired sorption chiller;
- gas-fired sorption chiller/heater;
- gas-fired sorption heat pump.

EN 12309 applies to appliances only when used for space heating and cooling with or without heat recovery. Appliances can be monovalent, bivalent or hybrid types.

EN 12309 applies to appliances having flue gas systems of type B and C (according to CEN/TR 1749) and to appliances designed for outdoor installations. EN 12309 applies to appliances that can be single ducted or double ducted.

EN 12309 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 12309-1:2012) and EN 12309 applies to all such functions providing that the function concerned is dependent on circulation of fluid (refrigerant and/or solution) within the absorption, adsorption or refrigerant circuit(s).

NOTE 1 Any appliance function that is not dependent on circulation of the fluid within the absorption, adsorption, or refrigerant circuit(s) should be assessed separately.

EN 12309 is applicable to appliances that are intended to be type tested. Requirements for appliances that are not type tested would need to be subject to further consideration.

In the case of packaged units (consisting of several parts), EN 12309 applies only to those designed and supplied as a complete package.

EN 12309 does not apply to air conditioners.

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.

NOTE 2 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.

This part of EN 12309 deals in particular with the calculation methods of reference seasonal performances in cooling and heating mode for monovalent and bivalent appliances. Moreover, this European Standard serves as an input for the calculation of the system energy efficiency in heating mode of specific heat pump systems in buildings, as stipulated in EN 15316-4-2.

#### 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

prEN 12309-1:2012, Gas-fired sorption appliances for heating and/or cooling with a net heat input not exceeding 70 kW – Part 1: Terms and definitions

prEN 12309-3:2012, Gas-fired sorption appliances for heating and/or cooling with a net heat input not exceeding 70 kW – Part 3: Test conditions

prEN 12309-4:2012, Gas-fired sorption appliances for heating and/or cooling with a net heat input not exceeding 70 kW – Part 4: Test methods

FprEN 15502-1:2011, 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 12309-1:2012 apply.

#### 4 Calculation methods for reference seasonal performance in cooling mode

#### 4.1 General

The calculation of the seasonal performance follows from the application of the bin method, where the part load GUEc and AEFc 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 is defined according to Formula (1):

 $PLR_{c}(T_{outdoor}) = (T_{outdoor} - 16)/(35 - 16)$ 

(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. Consequently, 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, will be lower than one. In such conditions, the  $GUEc_{PL}$  and  $AEFc_{PL}$  are affected by both temperature test conditions and capacity ratio. The methods for the determination of  $GUEc_{PL}$  and  $AEFc_{PL}$  are defined in prEN 12309-4:2012.

#### 4.2 Part load conditions

#### 4.2.1 Air-to-water appliances

For each application, appliances which either do or do not allow a variation of the outlet water temperature with the outdoor temperature are both considered. The variable outlet temperature shall only be applied when the control provides an outdoor air temperature dependant modification of the outlet temperature.

		Outdoor heat exchanger	Indoor heat exchanger								
	Port load ratio	Air dry bulb temperature	Fan coil a	Cooling floor application Inlet / outlet water temperatures °C							
	Fait loau failo	°C	Inlet / outlet wa								
			Fixed outlet	Variable outlet							
А	1	35	12 / 7	12 / 7	23 / 18						
В	(30-16) / (35-16)	30	<sup>a</sup> / 7	<sup>a</sup> / 8.5	<sup>a</sup> / 18						
С	(25-16) / (35-16)	25	<sup>a</sup> / 7	<sup>a</sup> / 10	<sup>a</sup> / 18						
D	(20-16) / (35-16)	20	<sup>a</sup> / 7	<sup>a</sup> / 11,5	<sup>a</sup> / 18						
<sup>a</sup> With t	With the water flow rate as determined during standard rating test with a fixed water flow rate.										

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

#### 4.2.2 Water-to-water and brine-to-water appliances

The part load conditions are given in Table 2.

### 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	OLOT EN 1	2200 (-2015	Indo exch	or heat langer				
	http	Cooling tower application	Ground coupled application (water or brine)	Dry cooler application	Far 8b4 appli )15	1 coil cation <sup>c-9</sup>	Cooling floor application			
		Inlet/outlet water temperatures °C	Inlet/outlet water temperatures °C	Inlet/outlet water temperatures °C	Inlet/ou tempe	tlet water eratures °C	Inlet/outlet water temperatures °C			
					Fixed outlet	Variable outlet				
Α	1	30 / 35	10 / 15	50 / 55	12 / 7	12 / 7	23 / 18			
В	(30-16) / (35-16)	26 / <sup>a</sup>	10 / <sup>a</sup>	45 / <sup>a</sup>	<sup>a</sup> / 7	<sup>a</sup> / 8,5	<sup>a</sup> / 18			
С	(25-16) / (35-16)	22 / <sup>a</sup>	10 / <sup>a</sup>	40 / <sup>a</sup>	<sup>a</sup> / 7	<sup>a</sup> / 10	<sup>a</sup> / 18			
D	(20-16) / (35-16)	18 / <sup>a</sup>	10 / <sup>a</sup>	35 / <sup>a</sup>	<sup>a</sup> / 7	<sup>a</sup> / 11,5	<sup>a</sup> / 18			
a V	<sup>3</sup> 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 SGUEc that applies to all types of appliances is given by Formula (2):

$$SGUEc = \frac{\sum_{j=1}^{n} hj \times Pc(Tj)}{\sum_{j=1}^{n} hj \times \left(\frac{Pc(Tj)}{GUEc_{PL}(Tj)}\right)}$$
(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 for the corresponding temperature Tj;

hj is the number of bin hours occurring at the corresponding temperature Tj;

GUEc<sub>PL</sub>(Tj) is the part load GUEc values 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 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	88	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	2 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  $P_c(Tj)$  can be determined by multiplying the full load value (Pdesignc) with the part load ratio  $PLR_c(Tj)$  of the corresponding bin:

 $P_{c}(Tj)$  = Pdesignc × PLR<sub>c</sub>(Tj)

where

PLR<sub>c</sub>(Tj) is defined according to Formula (1).

The  $GUEc_{PL}$  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.

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(3)

#### 4.4 Calculation of reference SAEFc

The calculation of the reference 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:

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

where

- Q<sub>ref,C</sub> is the reference annual cooling demand, expressed in kWh, as defined in 4.5;
- SAEFc<sub>on</sub> is the Seasonal Auxiliary Energy Factor in cooling mode and active mode, as defined in 4.6;
- H<sub>TO</sub>, H<sub>SB</sub>, H<sub>OFF</sub> 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<sub>TO</sub>, P<sub>SB</sub>, P<sub>OFF</sub> are the electricity consumption during respectively thermostat off mode, standby mode and off mode, expressed in kW. The measurement of P<sub>TO</sub>, P<sub>SB</sub>, P<sub>OFF</sub> shall be made according to prEN 12309-4:2012.

#### 4.5 Calculation of reference annual cooling demand (Q<sub>refc</sub>)

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

(5)

(6)

The number of equivalent cooling hours (H<sub>ec</sub>) can be found in Annex C.

#### 4.6 Calculation of reference SAEFcon

The reference SAEFcon is determined as follows:

$$SAEFc_{on} = \frac{\sum_{j=1}^{n} hj \times Pc(Tj)}{\sum_{j=1}^{n} hj \times \left(\frac{Pc(Tj)}{AEFc_{PL}(Tj)}\right)}$$

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<sub>PL</sub>(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<sub>PL</sub> / AEFc<sub>PL</sub> values

In part load condition A (full load), the declared capacity of an appliance is considered equal to the cooling load (Pdesignc). Accordingly, the  $GUEc_{DC}$  /  $AEFc_{DC}$  is to be used.

In part load conditions B, C, D, the test methods at part load shall be used in order to measure  $GUEc_{PL}$  /  $AEFc_{PL}$ , as defined in prEN 12309-4:2012.

### Calculation methods for reference seasonal performance in heating mode

#### 5.1 General

5

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 Tdesignh, Tindoor and Tbivalent values are set as follows:

Potoronoo HootingSoooon	Dry bulb temperature conditions									
Reference neatingSeason	Tdesignh	Tindoor	Tbivalent upper limit							
Average (A)	-10 °C	20 °C	2 °C							
Colder (C)	-22 °C	20 °C	-7 °C							
Warmer (W)	+2 °C	20 °C	+7 °C							

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

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

For air to water appliances, the declared TOL of the heat pump appliance shall also be considered. TOL higher than Tdesignh is an acceptable condition only for bivalent appliances. If TOL is lower than Tdesignh, TOL can be assumed equal to Tdesignh.

The calculation of the seasonal performance follows from the application of the bin method, where the part load GUEh and 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 and F.

#### prEN 12309-6:2012 (E)

The part load conditions A, B, C and D provide the part load ratios and the temperature test conditions at four reference outdoor air dry bulb temperatures: -7 °C, +2 °C, +7 °C and +12 °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 (Tbivalent), respectively.

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

$$PLR_{h}(T_{outdoor}) = (T_{outdoor} - 16) / (T_{designh} - 16)$$
(7)

At part load conditions for which the outdoor temperature is lower than or equal to the defined Tbivalent temperature (such as condition E), the appliance declared capacity is lower than or equal to the requested heating load. In this condition, it is assumed that the appliance operates at its maximum capacity and that the gap between heating load and appliance declared capacity is covered by an auxiliary gas boiler. The GUE<sub>DC</sub> and  $AEF_{DC}$  are to be used.

At the Tbivalent part load condition (F), the appliance's declared capacity matches the requested heating load. In this condition, the appliance operates at its maximum capacity and that auxiliary gas-fired heating system (if any) is turned off. The  $GUE_{DC}$  and  $AEF_{DC}$  are to be used.

At any other part load conditions, the declared capacity of the appliance is larger than the building load. Accordingly, the auxiliary gas-fired heating system (if any) is turned off and the appliance capacity ratio (CR), i.e. the ratio of the heating load (Ph) over the declared capacity (DC) of the appliance at the same temperature conditions, will be lower than 1. In such conditions, the GUEh<sub>PL</sub> and AEFh<sub>PL</sub> are affected by both temperature test conditions and capacity ratio. The methods for the determination of GUEh<sub>PL</sub> and AEFh<sub>PL</sub> are defined in prEN 12309-4:2012.



#### 5.2 Part load conditions

5.2.1 Air-to-water appliances and site hai/catalog/standards/sist/fed118b4-d72d-421c-9de2-

#### 5.2.1.1 General

For each application, appliances which either do or do not allow a variation of the outlet water temperature with the outdoor temperature are both considered. The variable outlet temperature test point scheme in the following tables shall only be applied when the control provides an outdoor air temperature dependant modification of the outlet temperature.

The part load conditions for the different application temperatures and heating seasons are given in the following tables.

#### 5.2.1.2 Low temperature application

	(A)		Outdoor heat exchanger	Indoor heat exchanger						
			Outdoor air	Inlet / outlet temperatures						
	Part load ratio	load ratio	Inlet dry bulb (wet bulb) temperature	Fixed outlet	Variable outlet					
		%	°C	°C	°C					
А	(-7-16) / (Tdesignh-16)	88	-7(-8)	<sup>a</sup> / 35	<sup>a</sup> / 34					
В	(+2-16) / (Tdesignh-16)	54	2(1)	<sup>a</sup> / 35	<sup>a</sup> / 30					
С	(+7-16) / (Tdesignh-16)	35	7(6)	<sup>a</sup> / 35	<sup>a</sup> / 27					
D	(+12-16) / (Tdesignh-16)	15	12(11)	<sup>a</sup> / 35	<sup>a</sup> / 24					
E	(TOL-16) / (Tdesignh-	16)	TOL	<sup>a</sup> / 35	<sup>a</sup> / 34-(-7-TOL)/(-7-2)x(34-30)					
F	(Tbivalent-16) / (Tdesigr	nh-16)	Tbivalent	<sup>a</sup> / 35	Variable outlet shall be calculated by interpolation between the upper and lower temperatures which are closest to the bivalent temperature.					
a \//	". With the water flow rate on determined at standard rating test conditions for law temperature applications given in									

Table 5 — Part load conditions for reference seasonal performance calculation in heating mode of air-to-water appliances for low temperature application for the reference heating season (A) = average

<sup>a</sup> With the water flow rate as determined at standard rating test conditions for low temperature applications given in prEN 12309-3:2012 for appliances with a fixed water flow rate, or with the flow rate defined and set by the appliance controller for an appliance using a variable water flow rate.

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Table 6 — Part load conditions for reference seasonal performance calculation in heating mode of air-to-water appliances for low temperature application for the reference heating season (W) = warmer

	https://stan(W)ds.ite	h.ai/catalo	Outdoor Heat Exchanger	4-d72d-4Indoor Heat Exchanger							
	C	9e Part e4	2c0/sis Outdoor Air 6-201	Inlet/Out	Inlet/Outlet temperatures						
	Part load ratio	load ratio	Inlet dry (wet) bulb	Fixed outlet	Variable outlet						
		%	°C	°C	°C						
А	Not applicable		-7(-8)								
В	(+2-16) / (Tdesignh-16)	100	2(1)	<sup>a</sup> / 35	<sup>a</sup> / 35						
С	(+7-16) / (Tdesignh-16)	64	7(6)	<sup>a</sup> / 35	<sup>a</sup> / 31						
D	(+12-16) / (Tdesignh-16)	29	12(11)	<sup>a</sup> / 35	<sup>a</sup> / 26						
н	(Tbivalent-16) / (Tdesiç	Jnh-16)	Tbivalent	<sup>a</sup> / 35	Variable outlet shall be calculated by interpolation between the upper and lower temperatures which are closest to the bivalent temperature.						
<sup>a</sup> With	<sup>a</sup> With the water flow rate as determined at standard rating test conditions for low temperature applications given in										

prEN 12309-3:2012 for appliances with a fixed water flow rate, or with the flow rate defined and set by the appliance controller for an appliance using a variable water flow rate.