ANNEX VII

Measurements and calculations

1. For the purposes of compliance and verification of compliance with the requirements of this Regulation, measurements and calculations shall be made using harmonised standards the reference numbers of which have been published for this purpose in the *Official Journal of the European Union*, or using other reliable, accurate and reproducible methods that take into account the generally recognised state-of-the-art methods. They shall meet the conditions and technical parameters set out in points 2 to 6.

2. **General conditions for measurements and calculations**

(a) For the purposes of the measurements set out in points 3 to 7, the indoor ambient temperature shall be set at 20 °C.

(b) For the purposes of the calculations set out in points 3 to 7, electricity consumption shall be multiplied by a conversion coefficient *CC* of 2,5, unless the annual electricity consumption is expressed in final energy for the end-user, as set out in points 3(b), 4(g), 5(e) and 6.

(c) For heaters equipped with supplementary heaters, the measurement and calculation of rated heat output, seasonal space heating energy efficiency, water heating energy efficiency, sound power level and emissions of nitrogen oxides shall take account of the supplementary heater.

(d) Declared values for rated heat output, seasonal space heating energy efficiency, water heating energy efficiency, annual energy consumption and sound power level shall be rounded to the nearest integer.

3. **Seasonal space heating energy efficiency and consumption of boiler space heaters, boiler combination heaters and cogeneration space heaters**

(a) The seasonal space heating energy efficiency η_s shall be calculated as the seasonal space heating energy efficiency in active mode η_{son}, corrected by contributions accounting for temperature controls, auxiliary electricity consumption, standby heat loss, ignition burner power consumption (if applicable) and, for cogeneration space heaters, corrected by adding the electrical efficiency multiplied by a conversion coefficient *CC* of 2,5.

(b) The annual energy consumption Q_{HE} in kWh in terms of final energy and/or in GJ in terms of *GCV* shall be calculated as the ratio of the reference annual heating demand and the seasonal space heating energy efficiency.

4. **Seasonal space heating energy efficiency and consumption of heat pump space heaters and heat pump combination heaters**

(a) For establishing the rated coefficient of performance COP_{rated} or rated primary energy ratio PER_{rated}, or the sound power level, the operating conditions shall be the standard rating conditions set out in Table 9 and the same declared capacity for heating shall be used.

(b) The active mode coefficient of performance $SCOP_{on}$ for average, colder and warmer climate conditions shall be calculated on the basis of the part load for heating $Ph(T_j)$, the supplementary capacity for heating $sup(T_j)$ (if applicable), and the bin-

specific coefficient of performance *COPbin(Tj)* or bin-specific primary energy ratio *PERbin(T_j)*, weighted by the bin-hours for which the bin conditions apply, using the following conditions:

— the reference design conditions set out in Table 10;

— the European reference heating season under average, colder and warmer climate conditions set out in Table 12;

— if applicable, the effects of any degradation of energy efficiency caused by cycling, depending on the type of control of the heating capacity.

(c) The reference annual heating demand Q_H shall be the design load for heating *Pdesignh* for average, colder and warmer climate conditions, multiplied by the annual equivalent active mode hours H_{HE} of 2 066, 2 465 and 1 336 for average, colder and warmer climate conditions, respectively.

(d) The annual energy consumption Q_{HE} shall be calculated as the sum of:

— the ratio of the reference annual heating demand Q_H and the active mode coefficient of performance $SCOP_{on}$ or active mode primary energy ratio $SPER_{on}$; and

— the energy consumption for off, thermostat-off, standby, and crankcase heater mode during the heating season.

(e) The seasonal coefficient of performance *SCOP* or seasonal primary energy ratio *SPER* shall be calculated as the ratio of the reference annual heating demand Q_H and the annual energy consumption Q_{HE}.

(f) The seasonal space heating energy efficiency η_s shall be calculated as the seasonal coefficient of performance *SCOP* divided by the conversion coefficient *CC* or the seasonal primary energy ratio *SPER*, corrected by contributions accounting for temperature controls and, for water-/brine-to-water heat pump space heaters and heat pump combination heaters, the electricity consumption of one or more ground water pumps.

(g) The annual energy consumption Q_{HE} in kWh in terms of final energy and/or GJ in terms of *GCV* shall be calculated as the ratio of the reference annual heating demand Q_H and the seasonal space heating energy efficiency η_s.

5. **Water heating energy efficiency of combination heaters**

The water heating energy efficiency η_{wh} of a combination heater shall be calculated as the ratio between the reference energy Q_{ref} and the energy required for its generation under the following conditions:

(a) measurements shall be carried out using the load profiles set out in Table 15;

(b) measurements shall be carried out using a 24-hour measurement cycle as follows:
- 00:00 to 06:59: no water draw-off;
- from 07:00: water draw-offs according to the declared load profile;
- from end of last water draw-off until 24:00: no water draw-off;

(c) the declared load profile shall be the maximum load profile or the load profile one below the maximum load profile;

(d) for heat pump combination heaters, the following additional conditions apply:
- heat pump combination heaters shall be tested under the conditions set out in Table 9;

— heat pump combination heaters which use ventilation exhaust air as the heat source shall be tested under the conditions set out in Table 11;

(e) the annual electricity consumption *AEC* in kWh in terms of final energy shall be calculated as daily electricity consumption Q_{elec} in kWh in terms of final energy multiplied by 220;

(f) the annual fuel consumption *AFC* in GJ in terms of *GCV* shall be calculated as daily fuel consumption Q_{fuel} multiplied by 220.

6. **Conditions for measurements and calculations of solar devices**

The solar collector, solar hot water storage tank and pump in the collector loop (if applicable) shall be tested separately. Where the solar collector and solar hot water storage tank cannot be tested separately, they shall be tested in combination.

The results shall be used for the determination of the standing loss *S* and the calculations of the collector efficiency η_{col}, the annual non-solar heat contribution Q_{nonsol} for the load profiles M, L, XL and XXL under the average climate conditions set out in Tables 13 and 14, and the annual auxiliary electricity consumption Q_{aux} in kWh in terms of final energy.

TABLE 9

Standard rating conditions for heat pump space heaters and heat pump combination heaters

Heat source	**Outdoor heat exchanger**		**Indoor heat exchanger**			
	Climate condition	**Inlet dry bulb (wet bulb) temperature**	**Heat pump space heaters and heat pump combination heaters, except low-temperature heat pumps**		**Low-temperature heat pumps**	
			Inlet temperature	**Outlet temperature**	**Inlet temperature**	**Outlet temperature**
Outdoor air	Average	+ 7 °C (+ 6 °C)	47 °C	55 °C	30 °C	35 °C
	Colder	+ 2 °C (+ 1 °C)				
	Warmer	+ 14 °C (+ 13 °C)				
Exhaust air	All	+ 20 °C (+ 12 °C)				
		Inlet / outlet temperature				
Water	All	+ 10 °C / + 7 °C				
Brine	All	0 °C/– 3 °C				

TABLE 10

Reference design conditions for heat pump space heaters and heat pump combination heaters, temperatures in dry bulb air temperature (wet bulb air temperature indicated in brackets)

Climate condition	Reference design temperature	Bivalent temperature	Operation limit temperature
	Tdesignh	T_{biv}	***TOL***
Average	– 10 (– 11) °C	maximum + 2 °C	maximum – 7 °C
Colder	– 22 (– 23) °C	maximum – 7 °C	maximum – 15 °C
Warmer	+ 2 (+ 1) °C	maximum + 7 °C	maximum + 2 °C

TABLE 11

Maximum ventilation exhaust air available [m^3/h], with humidity of 5,5 g/m^3

Declared load profile	XXS	XS	S	M	L	XL	XXL
Maximum ventilation exhaust air available	109	128	128	159	190	870	1 021

TABLE 12

European reference heating season under average, colder and warmer climate conditions for heat pump space heaters and heat pump combination heaters

bin_j	T_j [°C]	Average climate conditions	Colder climate conditions	Warmer climate conditions
		H_j [h/annum]	H_j [h/annum]	H_j [h/annum]
1 to 8	–30 to –23	0	0	0
9	-22	0	1	0
10	-21	0	6	0
11	-20	0	13	0
12	-19	0	17	0
13	-18	0	19	0
14	-17	0	26	0
15	-16	0	39	0
16	-15	0	41	0
17	-14	0	35	0
18	-13	0	52	0

19	-12	0	37	0
20	-11	0	41	0
21	-10	1	43	0
22	-9	25	54	0
23	-8	23	90	0
24	-7	24	125	0
25	-6	27	169	0
26	-5	68	195	0
27	-4	91	278	0
28	-3	89	306	0
29	-2	165	454	0
30	-1	173	385	0
31	0	240	490	0
32	1	280	533	0
33	2	320	380	3
34	3	357	228	22
35	4	356	261	63
36	5	303	279	63
37	6	330	229	175
38	7	326	269	162
39	8	348	233	259
40	9	335	230	360
41	10	315	243	428
42	11	215	191	430
43	12	169	146	503
44	13	151	150	444
45	14	105	97	384
46	15	74	61	294
Total hours:		4 910	6 446	3 590

TABLE 13

Average daytime temperature [°C]

	January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
Average climate conditions	2,8	2,6	7,4	12,2	16,3	19,8	21,0	22,0	17,0	11,9	5,6	3,2

TABLE 14

Average global solar irradiance [W/m^2]

	January	February	March	April	May	June	July	August	September	October	November	December
Average climate conditions	90	104	149	192	221	222	232	217	176	129	80	56

TABLE 15

Water heating load profiles of combination heaters

h	3XS			XXS			XS			S			
	Q_{tap}	f	T_m	Q_{tap}	f	T_m	Q_{tap}	f	T_m	Q_{tap}	f	T_m	T_p
	kWh	**l/ min**	**°C**	kWh	**l/ min**	**°C**	kWh	**l/ min**	**°C**	kWh	**l/ min**	**°C**	**°C**
07:00	**0,015**	2	25	**0,105**	2	25				**0,105**	3	25	
07:05	**0,015**	2	25										
07:15	**0,015**	2	25										
07:26	**0,015**	2	25										
07:30	**0,015**	2	25	**0,105**	2	25	**0,525**	3	35	**0,105**	3	25	
07:45													
08:01													
08:05													
08:15													
08:25													
08:30				**0,105**	2	25				**0,105**	3	25	
08:45													
09:00	**0,015**	2	25										
09:30	**0,015**	2	25	**0,105**	2	25				**0,105**	3	25	
10:00													
10:30													
11:00													
11:30	**0,015**	2	25	**0,105**	2	25				**0,105**	3	25	
11:45	**0,015**	2	25	**0,105**	2	25				**0,105**	3	25	
12:00	**0,015**	2	25	**0,105**	2	25							
12:30	**0,015**	2	25	**0,105**	2	25							
12:45	**0,015**	2	25	**0,105**	2	25	**0,525**	3	35	**0,315**	4	10	55
14:30	**0,015**	2	25										
15:00	**0,015**	2	25										

15:30	**0,015**	2	25										
16:00	**0,015**	2	25										
16:30													
17:00													
18:00				**0,105**	2	25				**0,105**	3	25	
18:15				**0,105**	2	25				**0,105**	3	40	
18:30	**0,015**	2	25	**0,105**	2	25							
19:00	**0,015**	2	25	**0,105**	2	25							
19:30	**0,015**	2	25	**0,105**	2	25							
20:00				**0,105**	2	25							
20:30							**1,05**	3	35	**0,42**	4	10	55
20:45				**0,105**	2	25							
20:46													
21:00				**0,105**	2	25							
21:15	**0,015**	2	25	**0,105**	2	25							
21:30	**0,015**	2	25							**0,525**	5	45	
21:35	**0,015**	2	25	**0,105**	2	25							
21:45	**0,015**	2	25	**0,105**	2	25							
Q_{ref}	0,345			2,1			2,1			2,1			

CONTINUED TABLE 15

Water heating load profiles of combination heaters

h	M				L				XL			
	Q_{tap}	f	T_m	T_p	Q_{tap}	f	T_m	T_p	Q_{tap}	f	T_m	T_p
	kWh	**l/ min**	**°C**	**°C**	kWh	**l/ min**	**°C**	**°C**	kWh	**l/ min**	**°C**	**°C**
07:00	**0,105**	3	25		**0,105**	3	25		**0,105**	3	25	
07:05	**1,4**	6	40		**1,4**	6	40					
07:15									**1,82**	6	40	
07:26									**0,105**	3	25	
07:30	**0,105**	3	25		**0,105**	3	25					
07:45					**0,105**	3	25		**4,42**	10	10	40
08:01	**0,105**	3	25						**0,105**	3	25	
08:05					**3,605**	10	10	40				
08:15	**0,105**	3	25						**0,105**	3	25	
08:25					**0,105**	3	25					

08:30	**0,105**	3	25		**0,105**	3	25		**0,105**	3	25	
08:45	**0,105**	3	25		**0,105**	3	25		**0,105**	3	25	
09:00	**0,105**	3	25		**0,105**	3	25		**0,105**	3	25	
09:30	**0,105**	3	25		**0,105**	3	25		**0,105**	3	25	
10:00									**0,105**	3	25	
10:30	**0,105**	3	10	40	**0,105**	3	10	40	**0,105**	3	10	40
11:00									**0,105**	3	25	
11:30	**0,105**	3	25		**0,105**	3	25		**0,105**	3	25	
11:45	**0,105**	3	25		**0,105**	3	25		**0,105**	3	25	
12:00												
12:30												
12:45	**0,315**	4	10	55	**0,315**	4	10	55	**0,735**	4	10	55
14:30	**0,105**	3	25		**0,105**	3	25		**0,105**	3	25	
15:00									**0,105**	3	25	
15:30	**0,105**	3	25		**0,105**	3	25		**0,105**	3	25	
16:00									**0,105**	3	25	
16:30	**0,105**	3	25		**0,105**	3	25		**0,105**	3	25	
17:00									**0,105**	3	25	
18:00	**0,105**	3	25		**0,105**	3	25		**0,105**	3	25	
18:15	**0,105**	3	40		**0,105**	3	40		**0,105**	3	40	
18:30	**0,105**	3	40		**0,105**	3	40		**0,105**	3	40	
19:00	**0,105**	3	25		**0,105**	3	25		**0,105**	3	25	
19:30												
20:00												
20:30	**0,735**	4	10	55	**0,735**	4	10	55	**0,735**	4	10	55
20:45												
20:46									**4,42**	10	10	40
21:00					**3,605**	10	10	40				
21:15	**0,105**	3	25						**0,105**	3	25	
21:30	**1,4**	6	40		**0,105**	3	25		**4,42**	10	10	40
21:35												
21:45												
Q_{ref}	5,845				11,655				19,07			

CONTINUED TABLE 15

Water heating load profiles of combination heaters

h	XXL			
	Q_{tap}	f	T_m	T_p
	kWh	**l/min**	**°C**	**°C**
07:00	**0,105**	3	25	
07:05				
07:15	**1,82**	6	40	
07:26	**0,105**	3	25	
07:30				
07:45	**6,24**	16	10	40
08:01	**0,105**	3	25	
08:05				
08:15	**0,105**	3	25	
08:25				
08:30	**0,105**	3	25	
08:45	**0,105**	3	25	
09:00	**0,105**	3	25	
09:30	**0,105**	3	25	
10:00	**0,105**	3	25	
10:30	**0,105**	3	10	40
11:00	**0,105**	3	25	
11:30	**0,105**	3	25	
11:45	**0,105**	3	25	
12:00				
12:30				
12:45	**0,735**	4	10	55
14:30	**0,105**	3	25	
15:00	**0,105**	3	25	
15:30	**0,105**	3	25	
16:00	**0,105**	3	25	
16:30	**0,105**	3	25	
17:00	**0,105**	3	25	
18:00	**0,105**	3	25	
18:15	**0,105**	3	40	

18:30	**0,105**	3	40	
19:00	**0,105**	3	25	
19:30				
20:00				
20:30	**0,735**	4	10	55
20:45				
20:46	**6,24**	16	10	40
21:00				
21:15	**0,105**	3	25	
21:30	**6,24**	16	10	40
21:35				
21:45				
Q_{ref}	24,53			