Working document for a

Commission communication in the framework of the implementation of Commission Regulation (EC) No …/… implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for central heating equipment, and of the implementation of Commission Delegated Regulation (EU) No …/… implementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of central heating equipment

(Text wit EEA relevance)

(Publication of titles and references of transitional methods of measurement and calculation[1] for the implementation of Regulation (EC) No …/…, and in particular Annexes II and III thereof, and for the implementation of Regulation (EU) No …/…, and in particular Annexes VI and VIII thereof)

(20../C …/…)

A. FOSSIL FUEL BOILERS AND COGENERATION BOILERS

1. REFERENCES

Table 1.

Gas-fired heating boilers with nominal heating power input not exceeding 400 kW:		
Parameter	**Reference**	**Notes**
eta, Pfos, design types, *F(9)*, *Pstby, Pign* as specified below	FprEN 15502-1:July 2010. *Gas-fired heating boilers - Part 1: General requirements and tests* (CEN);	FprEN 15502-1 is set to replace EN 297, EN 483, EN 677, EN 656, EN 13868, EN 15420
Nominal output *Pfos4* and efficiency at nominal output *eta4 at 80/60°C*	§ 3.1.6 *Nominal output* (definition, symbol P_n) ; § 3.1.5.7 *Useful efficiency* (definition, symbol η_u); § 9.2.2 (test)	All efficiency values, also the ones below, shall be expressed in gross calorific value H_s
parameter *F(9)*, definition 'outdoor'	§ 3.1.11. *Installation* with definition of "*boilers intended to be installed in a partially protected place"*; § 5.7.11. Frost protection; § 8.14 Special provisions	

[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.

Design types, definitions	§ 3.1.10. *Design types of boilers* with definitions of "*combination-boiler"; "low temperature boiler" and "condensing boiler"*. § 8.15. *Formation of condensate* (requirements and test);	*'non-condensing'* or *'standard'* boilers are boilers that are neither "condensing" boilers nor "low temperature" boilers
Output *Pfos1* and efficiency *eta1* at partial heat input and low temperature regime	§ 3.1.5.7. *Useful efficiency* (definition, symbol η_u) § 9.3.2. *Useful efficiency at part load, Tests.*	Note that according to the standards: 1) tests are carried out at 30% of nominal heat input, not at minimum steady state heat input; 2) test return temperatures are 30°C (condensing boiler), 37°C (low temperature boiler) or 47°C (standard boiler).
Standby heat loss *Pstby*	§ 9.3.2.3.1.3 *Standby losses* (test)	
Pilot flame power Pign	§ 8.4.3. *Ignition rate*	Applies to ignition burners operating at main burner-off mode
NO_x emission	FprEN 15502-1:July 2010. § 8.13. *NOx* (classification, test- and calculation methods)	NOx emission of 70 mg/kWh is in Class 5.
Oil-fired boilers with nominal heating power input not exceeding 400 kW:		
General test conditions	EN 304:1992; A1:1998; A2:2003; *Heating boilers - Test code for heating boilers for atomizing oil burners*.(CEN) Section 5 ('Tests')	Includes references in the given sections
Standby heat loss *Pstby*	EN 304 as above. § 5.7 *Determination of standby loss.*	*Pstby* corresponds to parameter '*q*' in EN 304
Thermal steady-state efficiencies *eta*, with concurrent test results for useful power outputs *Pfos*	for condensing boilers: EN 15034:2008. Heating boilers - Condensing heating boilers for fuel oil. (CEN) § 5.6 *Useful efficiency* for standard and low temperature boilers EN 304:1992; A1:1998; A2:2003; *Heating boilers - Test code for heating boilers for atomizing oil burners*.(CEN) Section 5 ('Tests')	EN 15034 refers to condensing oil boilers. For boilers with forced draught burner similar sections apply in EN 303-1, EN 303-2 and EN 303-4. For atmospheric, not fan-assisted burners EN 1:1998 applies. Test conditions (power and temperature settings) for eta1, eta2, eta4 are the same as for gas-fired boilers described above.
NO_x emission	EN 267:2009 Automatic forced draught burners for liquid fuels § 4.8.5. *Emission limit values for NOx and CO.* § 5. Testing. ANNEX B. *Emission measurements and corrections.*	NOx emission of 120 mg/kWh is in class 3 (at 60 mg/kWh CO).
Auxiliary electricity consumption		

Electricity consumption *elmin, elmax, fossb*	EN 15456:2008. Heating boilers - Electrical power consumption for heat. FprEN 15502 for gas boilers	measurement without circulator (pump); elmin, elmax and fossb correspond to the following parameters in EN 15456:2008: *elmax*=P_{aux}, *elmin*=P_{aux30}, *fossb*= $P_{aux\,sb}$
Combined Heat and Power (CHP) boilers with maximum electric power output not exceeding 50 kW:		
Electric efficiency *chp*	prEN 50465: 2010 Draft ed. 2. *Gas appliances – Combined Heat and Power appliance of nominal heat input inferior or equal to 70 kW (CEN)*	Electric efficiency is the ratio of net electric AC output W_{el}, in kW electric)* , to heat input Q ,in hourly consumption kWh (H_s of gas) per hour. Test conditions for chp1, chp2, chp4 are the same as for eta1, eta2, eta 4 respectively as defined above. *=Net electric AC output includes the losses of AC electricity generation, but excludes conventional boiler auxiliary electricity (pump, fan, valves, control unit).
Generic definitions		
Low/medium/high system temperature, definition	EN 15316-4-1:2008 *Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-1: Space heating generation systems, combustion systems (boilers).* ANNEX B. Table B.10 EN 442:1996/A1:2003 *Radiators and convectors. Part 2: Test methods and rating* EN 12831:2004. *Heating systems in buildings - Method for calculation of the design heat load.*	Low, medium, high corresponds to design system temperatures of ca. 35, 50 and 70 °C respectively and radiator nominal (EN 442) capacities of 3,6 (4,3 for colder climate), 1,66 and 1 times the design heat load as set out in EN 12831:2004 for continuous heating operation (=no setback)
Setback regime *F(2)*, definitions and calculation methods	EN 12831:2004. § 9.2.2. *Intermittently heated spaces* (design heat load) EN 13790: 2008. *Energy performance of buildings - Calculation of energy use for space heating and cooling* §13.2 *Set points and corrections for intermittency, monthly method, heating mode* (determines equivalent internal temperature)	Includes interaction with boiler and controls characteristics
Fluctuation and stratification losses *F(4)* and distribution losses *F(3)*, definitions and calculation methods	EN 15316-2-1:2007. *Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 2-1: Space heating emission systems* EN 12831:2004. ANNEX A. *Basic parameters on human comfort in interior thermal environments- significance of operative temperature in heat load*	Includes interaction with boiler and controls characteristics

	calculations.	
Combination boilers		
Annual energy consumption for sanitary water heating of combination boilers	Commission Communication … *[NB: Communication for water heaters]*	
Flue gas heat	Commission Communication … *[NB: Communication for water heaters]*	
Water heating energy efficiency of combination boilers	Section C of this Communication	

2. ADDITIONAL ELEMENTS FOR MEASUREMENTS AND CALCULATIONS FOR THE SEASONAL SPACE HEATING ENERGY EFFICIENCY OF FOSSIL FUEL BOILERS AND COGENERATION BOILERS

2.1 Definitions

In addition to the definitions set out in Commission Regulation (EC) No ../.. , and Commission Delegated Regulation (EU) No ../.. , the following definitions apply:

(1) "staged capacity boiler" means a boiler with a heat generator featuring two fuel-burning rates, i.e. a full rate and reduced rate;

(2) "on/off boiler" or “fixed capacity boiler” means a boiler equipped with a burner that has one fixed fuel burning rate for space heating. This includes appliances with alternative burning rates set once only at the moment of installation, referred to as ‘range rating’;

(3) “modulating boiler” or “variable capacity boiler” means a boiler with two or more reduced rates.

2.2 Test points

(1) fossil fuel boilers: the efficiency values eta4, eta1 and the power output value Pfos4, Pfos1 shall be measured;

(2) cogeneration boilers: the efficiency values eta1, eta2, eta4, the power output values Pfos1, Pfos2, Pfos4, and the electric efficiency values chp1, chp2 and chp4 shall be measured. [NB: alternative suggestion of EHI received just before sending out working documents – see below]

2.3 Calculation of the seasonal space heating energy efficiency

The seasonal space heating energy efficiency etas is defined as

$etas = etason - \sum F(i),$

where

– *etason* is the seasonal steady-state thermal efficiency in on-mode calculated according to point 2(4),

– *F(i)* are corrections calculated according to point 2(5).

2.4 Calculation of the seasonal steady-state thermal efficiency in on-mode etason

The seasonal steady-state thermal efficiency in on-mode is calculated as

etason = 0,85•eta1 + 0,15•eta4.

2.5 Calculation of *F(i)*

(1) The correction F(1) accounts for the turndown ratio td as set out in Table 2.

Table 2: values for *F(1)*

td	1,00≤*td*< 0,80	0,80≤*td*< 0,66	0,66≤*td*< 0,50	0,50≤*td*< 0,30	*td*≤0,30
F(1)	0,07	0,04	0,02	0,01	0

(2) The correction F(2) accounts for controls. For boilers which are compatible with an open communication protocol F(2)=0,025. For boilers which are not compatible with an open communication protocol F(2)=0,03.

(3) The correction F(3) accounts for auxiliary electricity consumption and is given as follows:

F(3)=2,5*(0,15•elmax+0,85•elmin+3,3•fossb)/Pfos4; OR a default value as set out in EN 15316-4-1 may be applied.

(4) The correction F(4) accounts for stand-by heat loss and is given as

F(4)= 0,5•Pstby/Pfos4; OR a default value as set out in EN 15316-4-1 may be applied.

(5) The correction F(5) accounts for pilot flame energy consumption and is given as

F(5) = Pign/Pfos4.

(6) The correction F(6) accounts for the seasonal electric efficiency. For fossil fuel boilers F(6)=0. For cogeneration boilers F(6) is given as follows.

[NB: negative, to result in an overall positive contribution]

F(6)=-2,5•(0,57•chp1+0,09•chp2+0,34•chp4).

Alternative suggestion of EHI received just before sending out working documents: The seasonal steady-state thermal efficiency in on-mode of cogeneration boilers is calculated as

etason = eta1 • $(1+x+x^2+x^3)$,

with x = 2,5 • chp1.

B. HEAT PUMPS

1. REFERENCES

Table 3

Heat pump boilers		
Parameter	**Reference**	**Notes**
Testing methods, electric heat pumps	prEN 14825: June 2010 *Air conditioners, liquid chilling packages and heat pumps, with electrically driven compressors, for space heating and cooling – Testing and rating at part load conditions and calculation of seasonal performance*, Section 8 (Page 34-38): Test methods for testing capacities, EER and COP values during active mode at part load conditions Section 9 (Page 38-39): Test methods for electric power consumption during thermostat off mode, standby mode and crankcase heater mode	
Test methods, fossil-fuel fired heat pumps	prEN 12309 – 2 Gas-fired absorption and adsorption air-conditioning and/or heat pump appliances with a net heat input not exceeding 70 kW – Part 2: Rational use of energy. Section 6.1 Methods of test, General; Section 6.3 Heating mode tests (excluding Table 12. Rating test conditions for all appliances in the heating mode)	Instead of Table 12 the test-points (temperatures, power settings) as given in prEN 14825 will be used to determine the gas utilisation efficiencies η_h ("COP" in prEN 14825) with heat input Q_τ expressed in kWh/h (=kW) gross calorific value H_s of the fuel input.
Declaration points for air-to-water, brine-to-water and water-to-water units for medium temperature application for average climate conditions for calculation of reference SCOP	prEN 14825: June 2010. Section 5(3), Table 17 (air-to-water) Section 5(4), Table 26 (brine-to-water, water-to-water) where the outlet temperatures set out in column "variable outlet" are to be applied to all types.	Test points according to EN 14511. Declaration points for prEN 14825 shall be linearly interpolated / extrapolated. Medium temperature in this communication corresponds to "high temperature" in prEN 14825: June 2010. Fixed capacity units at the given sink outlet temperatures are to be tested as stipulated in § 8.5.1, second bullet point under steady conditions of prEN 14825:June 2010 Apart from test points A to F, "in case the TOL is below -20 oC, an additional calculation

		point has to be taken from the capacity and COP at -15 oC conditions" (cit. prEN 14825 § 7.3). For the purpose of this communication, this point will be called "G".
Declaration points for air-to-water, brine-to-water and water-to-water units for medium temperature application for warmer and colder climate conditions for calculation of reference SCOP	prEN 14825: June 2010. Section 5(3), Tables 18 and 19, respectively, where the outlet temperatures set out in column "variable outlet" are to be applied to all types.	
Declaration points for air-to-water units under low temperature application for average, warmer and colder climate conditions for calculation of reference SCOP	prEN 14825: June 2010. Section 5(4), Tables 11, 12 and 13, respectively, where the outlet temperatures set out in column "variable outlet" are to be applied.	
Declaration points for water-to-water and brine-to-water units under medium temperature application for warmer and colder climate conditions	prEN 14825: June 2010. Section 5(5), Tables 27 and 28, respectively, where the outlet temperatures set out in column "variable outlet" are to be applied.	Medium temperature corresponds to "high temperature" in prEN 14825: June 2010
Auxiliary electricity consumption of fossil-fuel fired heat pump in active heating mode (*Phe* × *Hhe*)	This communication, section 2(4).	Electricity consumption during heating is not covered by EN 12309-2 and is measured separately.
calculation of *referenceSCOP*	prEN 14825: June 2010 *Air conditioners, liquid chilling packages and heat pumps, with electrically driven compressors, for space heating and cooling – Testing and rating at part load conditions and calculation of seasonal performance*, Section 7.	
Fixed, staged and variable capacity, definition	*Air conditioners, liquid chilling packages and heat pumps, with electrically driven compressors, for space heating and cooling – Testing and rating at part load conditions and calculation of seasonal performance*, Sections 3.29 to 3.31.	
Annual energy consumption for sanitary water heating of combination boilers	Commission Communication … *[NB: Communication for water heaters]*	
Water heating energy efficiency	Section C of this Communication	

2. ADDITIONAL ELEMENTS FOR CALCULATIONS FOR THE SPACE HEATING ENERGY EFFICIENCY OF HEAT PUMPS

2.1 Additional test options for air-to-water heat pumps

Test points for air-to-water heat pumps referenced in Table 3 apply to all types of air-to-water heat pumps.

Optionally, additional measurements may be carried out with increased source inlet temperatures at the referenced test points, to reflect the (partial) use of exhaust ventilation air at 20°C at a maximum volume flow rate, in m3/h, of 20•Pdesignh, where Pdesignh is expressed in kW.

If the air-intake of the heat pump at the declared capacities exceeds that maximum volume flow rate, measurements are carried out at source temperatures that are a flow-rate weighted average of the increased source temperature at maximum flow rate and the outdoor air temperature at the test point at the residual flow rate.

[NB: The air inlet source temperature Tmix at a test point for a situation where ventreal>ventex is

Tmix={Tex•ventex + Tout• (ventreal-ventex)}/ventreal,

where

Tex is ventilation exhaust temperature set at 20°C;

ventex is the maximum hourly ventilation flow, in m3/h, given as

ventex=20•Pdesignh, with Pdesignh expressed in kW;

Tout is the outdoor air temperature, in °C, defined for the test point in prEN 14825;

ventreal is the rated heat pump air intake for the test point, in m3/h.]

2.2 Calculation of the seasonal space heating energy efficiency etas

The seasonal space heating energy efficiency etas is defined as

$etas = (1/prim) \bullet referenceSCOP - \sum F(i)$

where

– *referenceSCOP* is the reference seasonal coefficient of performance calculated for the reference annual heating demand;

– *F(i)* are corrections calculated according to point 2(4);

– *prim* is the primary energy conversion factor accounting for the efficiency of providing electricity from primary energy.

2.3 Value of the primary energy conversion factor

– For heat pump boilers using electricity, the value of the primary energy conversion factor is *prim*=2,5;

– for heat pump boiler using liquid or gaseous fossil fuels, the value of the primary energy conversion factor is *prim*=1,0.

2.4 Calculation of *F(i)*

(1) The correction *F(1)* accounts for controls. For heat pumps which are compatible with an open communication protocol *F(1)*=0,025. For heat pumps which are not compatible with an open communication protocol *F(4)*=0,03.

(2) The correction *F(2)* accounts for auxiliary electricity consumption in active heating mode (*Hhe* × *Phe*) of e.g. source fan or pump and is given as follows

For heat pumps with electrically driven compressors *F(2)*=0;

for heat pumps using liquid or gaseous fuels:

$F(2) = [(prim) - auxrecov] \bullet 0{,}5 \bullet hpaux / DC_A$,

where

– *auxrecov* is the heat recovery fraction of electricity losses with value 0,55;

– *hpaux* is the electric power input, in kW, during active heating mode, at test point A;

– DC_A is the declared heat pump capacity, in kW, at test point A.

C. TEMPERATURE CONTROLS, PASSIVE FLUE HEAT RECOVERY DEVICES AND ADDITIONAL CALCULATIONS

1. TEMPERATURE CONTROLS

1.1 Definition of temperature controls classes and open protocol interface

Class I - Boiler Thermostat: A manually adjusted boiler control that regulates the flow temperature of the boiler to a level equal to the thermostat setting.

Class II - On/off Room Thermostat: A room thermostat that controls the on/off operation of a boiler. Performance parameters, including switching differential and room temperature control accuracy are determined by the thermostat's mechanical construction.

Class III - Weather compensator control, for use with modulating boilers: A boiler flow temperature control that varies the set point of the flow temperature of water leaving the boiler dependant upon prevailing outside temperature and selected weather compensation curve. Boiler flow temperature is varied by directly modulating the output of the burner.

Class IV - Weather compensator control, for use with on/off output boilers: A boiler flow temperature control that varies the set point of the flow temperature of water leaving the boiler dependant upon prevailing outside temperature and selected weather compensation curve. Boiler flow temperature is varied by controlling the on/off operation of the burner.

Class V - TPI room thermostat, for use with on/off output boilers: An electronic room thermostat that controls both thermostat cycle rate and in-cycle on/off ratio of the boiler proportional to room temperature. TPI control strategy reduces mean water temperature, improves room temperature control accuracy and enhances system efficiency. TPI RT+variable capacity boiler is not a recommended option.

Class VI - Modulating Room thermostat, for use with modulating boilers: An electronic room thermostat that varies the flow temperature of the water leaving the boiler dependant upon measured room temperature deviation from room thermostat set point. Control is achieved by modulating the output of the burner.

Class VII - Weather compensator + Room sensor, for use with modulating boilers: A boiler flow temperature control that varies the flow temperature of water leaving the boiler dependant upon prevailing outside temperature and selected weather compensation curve. A room temperature sensor monitors room temperature and adjusts the compensation curve parallel displacement to improve room comfort. Boiler flow temperature is varied by directly modulating the output of the burner.

Class VIII - Weather compensator + Room sensor, for use with on/off output boilers: A boiler flow temperature control that varies the flow temperature of water leaving the boiler dependant upon prevailing outside temperature and selected weather compensation curve. A room temperature sensor monitors room temperature and adjusts the compensation curve parallel displacement to improve room comfort. Boiler flow temperature is varied by controlling the on/off operation of the burner.

Class IX – Multi-sensor room temperature control, for use with modulating boilers: An electronic control, equipped with 3 or more room sensors that varies the flow temperature of the water leaving the boiler dependant upon the aggregated measured room temperature deviation from room sensor set points. Control is achieved by directly modulating the output of the burner.

Open protocol: If data is exchanged between temperature controller and boiler using an Open Communication Protocol, facilitating transformation to temperature controls classes III, IV, VI, VII, VIII and IX.

Open Communication Protocol means a standard specifying communication between boilers and temperature controls, and in particular facilitating use of temperature controls classes III, IV, VI, VII, VIII and IX, such that parts from multiple suppliers/manufacturers can be connected to work together, and which fulfils all of the following conditions:

– the standard is adopted and will be maintained by a not-for-profit organisation, and its ongoing development occurs on the basis of an open decision-making procedure available to all interested parties (such as consensus or majority decision);

– the standard has been published and the standard specification document is available at a nominal charge. It must be permissible to all to copy, distribute and use it at a nominal

charge (cost effective charge that covers the costs incurring when making the protocol available for all parties);

– the intellectual property of (parts of) the standard is made irrevocably available to concerned parties on a royalty-free basis.

1.2 Contribution of temperature controls to seasonal space heating energy efficiency

[NB: the values indicated in the working document for energy labelling, as circulated on 31 March, have to be replaced with the values of this table]

Class no.	***I***	***II***	***III***	***IV***	***V***	***VI***	***VII***	***VIII***	***IX***
Value in %	0	0	2	1,5	2	3	4	3,5	5

2. PASSIVE FLUE HEAT RECOVERY DEVICES (PFHRD)

The contribution of PFHRD to the water heating energy efficiency of combination boilers for the purposes of Sheet 2 of the fiche for combination boilers as related to the water heating energy efficiency shall be established as follows.

1. Testing

(1) Ensure that combination boiler and PFHRD are at ambient temperature Ta.

(2) Flush PFHRD with cold water *Tcold* of 10 °C until ingoing water temperature equals outgoing wat*er te*mperature and immediately run boiler in space heating mode at 50% part load for 20 minutes at the temperature regime 55/45 °C.

(3) Stop the boiler for 20 minutes (burner-off) to account for standing losses.

(4) Draw-off water from the PFHRD at 3 l/min, until water temperature is again 10°C. During draw-off record water temperature and flow with in interval of 2 seconds or below.

2. Calculations

(1) Calculate the thermal energy content of the first 3,5 liters water drawn off (that is: average of small water draw-offs), *Qtappedsmall*.

(2) Calculate the thermal energy content of the complete draw-off (until Tout = 10°C), *Qtappedlarge.*

(3) Calculate the 24h average heat store power capacity Pstore in kW for the maximum load profile of the combination boiler as follows:

$$Pstore = (x * Qtappedsmall + y * Qtappedlarge)/24$$

where

– x = number of small draw-offs of declared maximum load profile,

– y = number of large draw-offs of declared maximum load profile.

(4) Calculate the average hourly hot water energy demand *Ptap* in kW of the declared maximum load profile between first and last daily draw-off (15 h): *Ptap=Qref*/15

(5) From the annual flue gas losses in space heating mode *Qflue* in kWh/a, calculate the average loss over the *heati*ng season as:

Pflue=Qflue/allhrs [kW],

where *allhrs* =5124 hours

(6) The annual heat recovery contribution of the PFHRD combitrans in kWh/a is given as:

combitrans= allhrs* MIN(Pstore; Ptap; Pflue)

(7) For the purposes of Sheet 2 of the fiche of combination boilers, as related to the water heating energy efficiency, the contribution of PFHRD is calculated as follows [%]:

[NB: the difference between the water heating energy efficiency when the heat recovered by the PFHRD is subtracted from Qatot, and the efficiency of the combination boiler without PFHRD]

PFHRD = 0.6 * 366 * Qref * [1/(Qatot – combitrans) – 1/Qatot]

3. ADDITIONAL CALCULATION FOR THE CONTRIBUTION OF STORAGE TANKS FOR BUFFERING HOT HEATING WATER TO THE SEASONAL SPACE HEATING ENERGY EFFICIENCY

For the purposes of specifying entry 'II' of Sheet No 2 of the boiler fiche, the contributions of storage tanks for buffering hot heating water to the seasonal space heating energy efficiency is give as follows:

Turndown ratio td*	Storage tank energy label rating			
	D – G	C	B	A
100%	2,5%	3,0%	3,5%	4,0%
80%	0,5%	1,0%	1,5%	2,0%
66% and below	0,5%	0,5%	0,5%	1,0%

*= select closest value.

4. ADDITIONAL CALCULATION FOR THE WATER HEATING ENERGY EFFICIENCY OF COMBINATION BOILERS

The water heating energy efficiency of combination boilers is given as follows:

$$etawh = \frac{0{,}6 * 366 * Q_{ref}}{Qatot} + 5\% ,$$

where Q_{atot} is the annual energy consumption in kWh/a as defined in [NB: water heater regulations].