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Europe's energy efficiency requirements for household appliances

Streszczenie**. W związku z opublikowaniem w Dzienniku Urzędowym Unii Europejskiej Rozporządzeń Komisji nr 66/2014 oraz 65/2014 dotyczących klas energetycznych piekarników, płyt grzewczych, okapów nadkuchennych w Polsce firmy produkujące ten rodzaj sprzętu AGD zobowiązane są do załączania informacji o produkcje zgodnie Rozporządzeniem od 1 stycznia 2015* ***Wymagania w zakresie efektywności energetycznej w Europie dla sprzętu gospodarstwa domowego

***Abstract**. Following the publication in the Official Journal of the European Union Commission Regulations No. 66/2014 and 65/2014 on energy classes oven, hob, range hood in Poland, the company producing household appliances are required to attach information about the product in accordance with Regulation from 1 January 2015.*

Słowa kluczowe: efektywność energetyczna, piekarnik, płyta grzewcza, okap nadkuchenny.
Keywords: Energy effectiveness, oven, hob, range hood.

Introduction

Over the next 20 years, Poland has become a safe country energy.[5,6] In recent years there has been rapid technological progress in the field of used household cooking appliances.[11,1] In studies ecodesign indicated that household appliances have a significant potential for energy savings. [12,4].

It is expected that the combined effect of the provisions laid down in Commission Regulations (EU) No 66/2014, No. 65/2014 on energy labeling of household ovens and range hoods will lead to annual savings of primary energy at the level of 27 PJ / year in 2020 and that will increase to 60 PJ / year by 2030.The information provided on the respective labels should be obtained through reliable, accurate and reproducible calculation and measurement methods that take into account the recognised state-of-the-art calculation and measurement methods including, where available, harmonised standards adopted by the European standardisation organisations, as listed in Annex I to Regulation (EU) No 1025/2012 of the European Parliament and of the Council of 25 October 2012 on European standardisation [2]

Efficiency classes

Domestc ovens

The energy efficiency classes of domestic ovens shall be determined separately for each cavity in accordancewith values as set out in Table 1. The energy efficiency of ovens shall be determined in accordance with point - Domestic ovens.

Table 1. Energy efficiency classes of domestic ovens [2]

Energy Efficiency Class	Energy Efficiency Index (EEI_{cavity})
A+++ (most efficient)	$EEI_{cavity} < 45$
A++	$45 \le EEI_{cavity} < 62$
A+	$62 \le EEI_{cavity} < 82$
A	$82 \le EEI_{cavity} < 107$
B	$107 \le EEI_{cavity} < 132$
C	$132 \le EEI_{cavity} < 159$
D (least efficient)	$EEI_{cavity} \ge 159$

Domestic Range hoods

a) The energy efficiency classes of domestic range hoods shall be determined in accordance with values as set out in Table 2. The Energy Efficiency Index (EEI_{hood}) of domestic range hoods shall be calculated in accordance with point - Calculation of the Energy Efficiency Index.

Table 2. Energy efficiency classes of domestic range hoods [2]

Energy Efficiency Class	Energy Efficiency Index (EEI_{hood})			
	Label 1	Label 2	Label 3	Label 4
A+++ (most efficient)				$EEI_{hood} < 30$
A++			$EEI_{hood} < 37$	$30 \le EEI_{hood} < 37$
A+		$EEI_{hood} < 45$	$37 \le EEI_{hood} < 45$	$37 \le EEI_{hood} < 45$
A	$EEI_{hood} < 55$	$45 \le EEI_{hood} < 55$	$45 \le EEI_{hood} < 55$	$45 \le EEI_{hood} < 55$
B	$55 \le EEI_{hood} < 70$	$55 \le EEI_{hood} < 70$	$55 \le EEI_{hood} < 70$	$55 \le EEI_{hood} < 70$
C	$70 \le EEI_{hood} < 85$	$70 \le EEI_{hood} < 85$	$70 \le EEI_{hood} < 85$	$70 \le EEI_{hood} < 85$
D	$85 \le EEI_{hood} < 100$	$85 \le EEI_{hood} < 100$	$85 \le EEI_{hood} < 100$	$EEI_{hood} \ge 85$
E	$100 \le EEI_{hood} < 110$	$100 \le EEI_{hood} < 110$	$EEI_{hood} \ge 100$	
F	$110 \le EE_{Ihood} < 120$	$EEI_{hood} \ge 110$		
G (least efficient)	$EEI_{hood} \ge 120$			

b) The fluid dynamic efficiency classes of a domestic range hood shall be determined in accordance with its Fluid Dynamic Efficiency (FDE_{hood}) as in the following Table 3. The Fluid Dynamic Efficiency of domestic range hoods shall be determined in accordance with point -Calculation of the Fluid Dynamic Efficiency

Table 3. Fluid Dynamic Efficiency classes for domestic range hoods [2]

Fluid Dynamic Efficiency Class	Fluid Dynamic Efficiency (FDE_{hood})
A (most efficient)	FDEhood > 28
B	$23 < FDE_{hood} \le 28$
C	$18 < FDE_{hood} \le 23$
D	$13 < FDE_{hood} \le 18$
E	$8 < FDE_{hood} \le 13$
F	$4 < FDE_{hood} \le 8$
G (least efficient)	$FDE_{hood} \le 4$

c) The lighting efficiency classes of a domestic range hood shall be determined in accordance with its Lighting Efficiency (LE_{hood}) as in the following Table 4. The Lighting

Efficiency of domestic range hoods shall be determined in accordance with point -Calculation of the Lighting Efficiency

Table 4. Lighting Efficiency classes for domestic range hoods [2]

Lighting Efficiency Class	Lighting Efficiency (LEhood)
A (most efficient)	$LE_{hood} > 28$
B	$20 < LE_{hood} \leq 28$
C	$16 < LE_{hood} \leq 20$
D	$12 < LE_{hood} \leq 16$
E	$8 < LE_{hood} \leq 12$
F	$4 < LE_{hood} \leq 8$
G (least efficient)	$LE_{hood} \leq 4$

d) The grease filtering efficiency classes of a domestic range hood shall be determined in accordance with its Grease Filtering Efficiency (GFE_{hood}) as in the following Table 5. The Grease Filtering Efficiency of domestic range hoods shall be determined in accordance with point-Calculation of the Grease Filtering Efficiency

Table 5. Grease Filtering Efficiency (GFE_{hood}) classes for domestic range hoods [2]

Grease Filtering Efficiency Class	Grease Filtering Efficiency (%)
A (most efficient)	$GFE_{hood} > 95$
B	$85 < GFE_{hood} \leq 95$
C	$75 < GFE_{hood} \leq 85$
D	$65 < GFE_{hood} \leq 75$
E	$55 < GFE_{hood} \leq 65$
F	$45 < GFE_{hood} \leq 55$
G (least efficient)	$GFE_{hood} \leq 45$

Measurements and calculations

For the purposes of compliance and verification of compliance with the requirements of this Regulation, measurements and calculations shall be made using a reliable, accurate and reproducible method that take into account the generally recognised state-of-the-art measurement and calculation methods, including harmonised standards the reference numbers of which have been published for the purpose in the *Official Journal of the European Union*. They shall meet the technical definitions, conditions, equations and parameters set out in this Annex II (UE) nr 65/20014. [2, 3]

Domestic ovens

The energy consumption of a cavity of a domestic oven shall be measured for one standardised cycle, in a conventional mode and in a fan-forced mode, if available, by heating a standardised load soaked with water. It shall be verified that the temperature inside the oven cavity reaches the temperature setting of the thermostat and/or the oven control display within the duration of the test cycle. The energy consumption per cycle corresponding to the best performing mode (conventional mode or fan-forced mode) shall be used in the following calculations.

For each cavity of a domestic oven, the Energy Efficiency Index (EEI_{cavity}) shall be calculated according to the following formulas:

- for domestic electric movens (1, 2):

$$EEI_{cavity} = \frac{EC_{electric\ cavity}}{SAEC_{electric\ cavity}} \times 100 \quad (1)$$

$$SEI_{electric\ cavity} = 0{,}0042 \times V + 0{,}55 (in\ kWh) \quad (2)$$

- for domestic electric ovens (3, 4):

$$EEI_{cavity} = \frac{EC_{electric\ cavity}}{SAEC_{electric\ cavity}} \times 100 \quad (3)$$

$$SEI_{electric\ cavity} = 0{,}044 \times V + 3{,}53 (in\ MJ) \quad (4)$$

where: EEI_{cavity} - Energy Efficiency Index for each cavity of a domestic oven, in %, rounded to the first decimal place, $SEC_{electric\ cavity}$ - Standard Energy Consumption (electricity) required to heat a standardised load in a cavity of an electric heated domestic oven during a cycle, expressed in kWh, rounded to the second decimal place, $SEC_{gas\ cavity}$ - Standard Energy Consumption required to heat a standardised load in a cavity of a domestic gas-fired oven during a cycle, expressed in MJ, rounded to the second decimal place, V - Volume of the cavity of the domestic oven in litres (L), rounded to the nearest integer, $EC_{electric\ cavity}$ - Energy consumption required to heat a standardised load in a cavity of an electric heated domestic oven during a cycle, expressed in kWh, rounded to the second decimal place, $EC_{gas\ cavity}$ - Energy consumption required to heat a standardised load in a gas-fired cavity of a domestic oven during a cycle, expressed in MJ, rounded to the second decimal place.

Domestic range hoods

Calculation of the Energy Efficiency Index (EEI_{hood})

The Energy Efficiency Index (EEI_{hood}) is calculated as:

$$EEI_{hood} = \frac{AEC_{hood}}{SAEC_{hood}} \times 100 \quad (5)$$

and is rounded to the first decimal place.

where: $SAEC_{hood}$ - is the Standard Annual Energy consumption of the domestic range hood in kWh/a, rounded to the first decimal place, AEC_{hood} - is the Annual Energy Consumption of the domestic range hood in kWh/a, rounded to the first decimal place.

The Standard Annual Energy Consumption ($SAEC_{hood}$) of a domestic range hood shall be calculated as (6):

$$SAEC_{hood} 0{,}55 \times (W_{BEP} + W_L) + 15{,}3 \quad (6)$$

where: W_{BEP} - is the electric power input of the domestic range hood at the best efficiency point, in Watt and rounded to the first decimal place, W_L - is the nominal electric power input of the lighting system of the domestic range hood on the cooking surface, in Watt and rounded to the first decimal place.

The Annual Energy Consumption (AEC_{hood}) of a domestic range hood is calculated as (7):

- for the fully automatic domestic range hoods:

$$AEC_{hood} = [\frac{(W_{BEP} \times t_H \times f) + (W_L \times t_L)}{60 + 1000} + \frac{P_o \times (1440 - t_H \times f)}{2 \times 60 \times 1000} + \frac{P_s \times (1440 - t_H \times f)}{2 \times 60 \times 1000}] \times 365 \quad (7)$$

- for all other domestic range hoods (8):

$$AEC_{hood} = [\frac{[W_{BEP} \times (t_H \times f) + W_L \times t_L]}{60 + 1000} \times 365 \quad (8)$$

where: t_L - is the average lighting time per day, in minutes (t_L = 120), t_H - is the average running time per day for domestic range hoods, in minutes (t_H = 60), P_o - is the electric power input in off-mode of the domestic range hood, in Watt and rounded to the second decimal place, P_s - is the

electric power input in standby mode of the domestic range hood, in Watt and rounded to the second decimal place, f - is the time increase factor, calculated and rounded to the first decimal place, as (9):

(9) $$f = 2 - (FDE_{hood} \times 3{,}6) / 100$$

Calculation of the Fluid Dynamic Efficiency (FDE_{hood})

The Fluid Dynamic Efficiency (FDE_{hood}) at the best efficiency point is calculated by the following formula, and is rounded to the first decimal place (10):

(10) $$FDE_{hood} = \frac{Q_{BEP} \times P_{BEP}}{3600 \times W_{BEP}} \times 100$$

where: Q_{BEP} - is the flow rate of the domestic range hood at best efficiency point, expressed in m^3/h and rounded to the first decimal place, P_{BEP} - is the static pressure difference of the domestic range hood at best efficiency point, expressed in Pa and rounded to the nearest integer, W_{BEP} - is the electric power input of the domestic range hood at the best efficiency point, expressed in Watt and rounded to the first decimal place.

Calculation of the Lighting Efficiency (LE_{hood})

The Lighting Efficiency (LE_{hood}) of a domestic range hood means the ratio between the average illumination and the nominal electric power input of the lighting system. It shall be calculated in lux per Watt and rounded at the nearest integer, as (11):

(11) $$LE_{hood} = \frac{E_{middle}}{W_L}$$

where: E_{middle} - is the average illumination of the lighting system on the cooking surface measured under standard conditions, in lux and rounded to the nearest integer, W_L - is the nominal electric power input of the lighting system of the domestic range hood on the cooking surface, in Watt and rounded to the first decimal place.

Calculation of the Grease Filtering Efficiency (GFE_{hood})

The Grease Filtering Efficiency (GFE_{hood}) of a domestic range hood means the relative amount of grease retained within the range hood grease filters. It shall be calculated and rounded to the first decimal place as (12):

(12) $$GFE_{hood} = [w_g / (w_r + w_t + w_g)] \times 100 [\%]$$

where: w_g - the mass of oil in the grease filter, including all detachable coverings, in g and rounded to the first decimal place, w_r - the mass of oil retained in the airways of the range hood, in g and rounded to the first decimal place, w_t - the mass of oil retained in the absolute filter, in g and rounded to the first decimal place.

Noise

The Noise Value (in dB) is measured as the airborne acoustical A-weighted sound power emissions (weighted average value – L_{WA}) of a domestic range hood at the highest setting for normal use, rounded to the nearest integer.

Conclusions

Publication in the Official Journal of the European Union Commission Regulations No. 66/2014 and 65/2014 on energy classes ovens, range hoods in Poland, the company producing the kind of household appliances are required to attach the following information from Jan. 1, 2015.[7,8,9,10]

Starting from year 2015 Poland is expected to pursue a policy of continuous improvement of performance, browsing the minimum limits every two years, to the gradual elimination of the household appliances market less efficient, which will help to optimize energy consumption and reduce the demand for it in Europe.

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