# غسالات الملابس الكهربائية – متطلبات أداء الطاقة والاختبار وبطاقة الكفاءة

# Electrical Clothes Washing Machines –
# Energy Performance, Testing and Labeling Requirements

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## 1. Scope

This regulation specifies the Minimum Energy Performance Standard (MEPS) and testing requirements of electric clothes washing machines with capacity up to 25 kg, that operate in AC single-phase of 230V with a frequency of 50 Hz according to GSO 1899.

Washing machines with additional function (dryer) are included in this regulation (this regulation covers washing function only).

Note: This regulation does not specify safety requirements, which are covered by GSO IEC 60335-2-11 or GSO IEC 60335-2-43

## 2. Normative References

The following normative reference standards apply. However, this regulation supersedes the below reference standards in case of conflicting requirements.

- GSO 1899: 2016 "GCC Standard Voltages and Frequencies for Alternating Current Distribution Systems".
- EN 60456:2016 - Clothes washing machines for household use - Methods for measuring the performance.

In case of update of the standards mentioned as adoption herein above, the updated version shall be effective after 2 years of the last international update.

## 3. Terms and Definitions

For the purposes of this regulation, the following terms, definitions, and symbols apply.

- **Left-on mode:** the lowest power consumption mode that may persist for an indefinite time after completion of the program without any further intervention by the end-user besides unloading of the washing machine

- **Off-mode:** means a condition where the washing machine is switched off using appliance controls or switches accessible to and intended for operation by the end-user during normal use to attain the lowest power consumption that may persist for an indefinite time while the washing machine is connected to a power source and used in accordance with the supplier's instructions; where there is no control or switch accessible to the end-user, 'off-mode' means the condition reached after the washing machine reverts to a steady-state power consumption on its own
- **Partial load:** means half of the rated capacity of a washing machine for a given program

- **Program:** series of pre-defined operations declared by the supplier as suitable for washing certain types of textile

- **Rated capacity ($C_{rated}$):** maximum mass in kg of dry textiles of a particular type, which the manufacturer declares, can be treated in the washing machine on the program selected

- **Rated frequency ($f_{rated}$):** the number of cycles per second through which an alternating electric current passes as claimed by the manufacturer
- **Rated power ($P_{rated}$):** effective power input of the water as claimed by the manufacturer
- **Rated program time**: time that elapses from the initiation of the program until the completion of the program excluding any end-user programed delay as claimed by the manufacturer

- **Rated voltage ($V_{rated}$):** the voltage needed to operate the product, as claimed by the manufacturer
- **"Shall":** where "shall" or "shall not" is used for a provision specified, that provision is mandatory if compliance with the regulation is claimed.
- **Spin speed:** rotational speed of the moving part about its axis expressed in revolutions per minute
- **Washing machine:** appliance for cleaning and rinsing of textiles using water, which may also have a means of extracting excess water from the textile
- **Automatic washing machine**: means a washing machine where the load is fully treated by the machine without the need for user intervention at any point during the program
- **Combined washer-drier**: means a washing machine which includes both a spin extraction function and also a means for drying the textiles, usually by heating and tumbling
- **Drum type machine**: a clothes washing machine in which the textile material is contained in a horizontal or inclined drum and in which the mechanical action is produced by a rotation of the drum about its axis, the movement being either continuous or periodically reversed

  Note: All types of machine not conforming to this definition are classified as 'other than drum type'
- **Front load washing machine**: a drum type washing machine where the loading of clothes is located on the front

  Note: front load is usually considered as horizontal axis washing machine (see IEC 60456)
- **Top load washing machine**: a washing machine where the clothes are loaded through the top of the machine, which is usually but not always covered with a hinged door

  Note: top load can be horizontal or vertical axis washing machine (see IEC 60456)
- **Twin-tub washing machine**: washing machine equipped with two tubs; one tub is used for washing the clothes in and second one is for spinning the clothes dry. Clothes are manually moved from the washing tub to the spinning tub once the washing cycle has been completed

  Note: twin tub washing machine is also named manual washing machine and usually considered as vertical axis washing machine (see IEC 60456)
- **Vertical axis washing machine:** washing machine in which the load is placed in a drum which rotates around an axis which is vertical or close to vertical. For the purposes of this document, vertical axis is where the angle of the axis of rotation is more than 45 degrees to horizontal. Where the drum does not rotate, the washing machine shall be classified as a vertical axis washing machine.

  Note: The classification of vertical axis or horizontal axis in EN IEC 60456 is only used to define the placement of the load into the drum.

- **Horizontal axis washing machine:** washing machine in which the load is placed in a drum which rotates around an axis which is horizontal or close to horizontal. For the purposes of this document, horizontal axis is where the angle of the axis is less than or equal to 45 degrees to horizontal**.**

  Note: The classification of vertical axis or horizontal axis in EN IEC 60456 is only used to define the placement of the load into the drum**.**

- **Motor operated washing machine**: appliance operating with motor only, without any internal heater
- **Wash cycle:** complete washing, rinsing and spinning process, as defined for the selected program
- **Washing Efficiency Index (Iw):** an indicator representative of the cleanliness of the washed item
- **Water Extraction Index (WEI):** means the amount of moisture contained in the load at the end of the spinning phase

## 4. Criteria for Applying the Minimum Efficiency Performance Standard (MEPS)

### *4.1 Declaration of rated values*

The declaration of the rated capacity shall be expressed only in terms of weight (kg) as multiples of 0.5 kg.
If the heating is included in the washing machine, the declaration of the rated power shall be expressed only in terms of watt (W) as multiples of 50 W.
The declaration of the Energy Efficiency Index as an integer value (no unit).
The declaration of the annual energy consumption as a multiple of 1 kWh.
The declaration of the annual water consumption as a multiple of 1 liter*.*

### *4.2 Determining the Minimum Energy Performance Standard (MEPS)*

The Minimum Energy Performance Standard are based on the Energy Efficiency Index (EEI) which is established from the comparison with a reference appliance.
Washing machine appliances within the scope of this regulation shall achieve EEI value that is < 68.
Details for calculation of the EEI are given in annex C.

### *4.3 Determining the minimum efficiency for Water Consumption Index (WCI)*

The water efficiency rating of washing machines is determined using the formula for the rated Water Consumption Index (WCI) determined under Annex D for 1 cycle at full load (cotton cycle at 60°C).

| **Table 1 – Minimum Water Consumption Index** | | |
|---|---|---|
| Type of machines | Limit value for the Water Consumption Index (WCI ) | |
| Rated Capacity | $C_{rated}$ < 5kg | $C_{rated}$ ≥ 5kg |

| | | |
|---|---|---|
| Horizontal axis washing machines | ≥ 2.5 | ≥ 3.0 |
| Vertical axis washing machines | ≥ 2.0 | ≥ 2.0 |

***4.4 Acceptance criteria for Water Extraction Index (WEI)***

When tested at rated capacity, the weighted Water Extraction Index of the washing machine shall achieve an average water extraction index not exceeding 82% (see Annex E).

***4.5 Acceptance criteria for labelling and market surveillance***

The energy label shall be accepted when a sample unit(s) tested meets the following criteria:

a) Measured power ……..……..……....≥ 0.90 x rated value
b) Measured power (general)..…….…..... ≤ 1.05 x rated value
c) Measured annual energy...……..……..……..…≤1.10 x rated value energy
d) Measured program time ……..…….……≤ 1.10 x rated value
e) Measured water consumption……≤ 1.05 x rated value
f) Measured water extraction index (moisture content)……..…..≤ 1.10 x rated value
g) Measured Maximal Spin Speed (if available)……..……...≥ 0.90 x rated value
h) Measured duration of the left-on mode……..≤ 1.10 x rated value
i) The measured value of power consumption in off-mode ($P_o$) and left-on mode ($P_l$):
    - More than 1.00 W ≤ 110 % x rated power
    - Less than or equal to 1.00 W ≤ (0.10 W + rated power)
j) If the rated/measured spinning capacity is different from the rated washing capacity, this value shall not be lower than 55% of the rated (washing) capacity.

**5. Label and Classification**

***5.1 Determining the energy efficiency class***

The energy efficiency classification for each type of product is based on the rated value of the Energy Efficiency Index (EEI) and shall be determined as outlined in Table 2, see Annex C.

**Table 2 - Energy Efficiency Classification**

| Star Rating | Energy Efficiency Index (EEI) |
|---|---|
| 6 Stars | EEI < 28 |
| 5 Stars | 28 ≤ EEI < 36 |

| | |
|---|---|
| 4 Stars | 36 ≤ EEI < 44 |
| 3 Stars | 44 ≤ EEI <52 |
| 2 Stars | 52 ≤ EEI < 60 |
| 1 Star | 60 ≤ EEI < 68 |

***5.2 Determining the water efficiency class***

The water efficiency classification for each product is based on the rated Water Consumption Index (WCI) and shall be determined as outlined in Table 3, see Annex D.

| **Table 3 - Water Consumption Index Classification** | |
|---|---|
| **Star Rating** | **Water Consumption Index (WCI)** |
| 6 Stars | WCI ≥ 5.5 |
| 5 Stars | 5.0 ≤ WCI < 5.5 |
| 4 Stars | 4.5 ≤ WCI < 5.0 |
| 3 Stars | 3.5 ≤ WCI < 4.5 |
| 2 Stars | 3.0 ≤ WCI < 3.5 |
| 1 Star | 2.0 ≤ WCI < 3.0 |

***5.3 Determining the water extraction efficiency class***

The water extraction efficiency classification for each product is based on the rated Water Extraction Index (WEI) and shall be determined as outlined in Table 4, see Annex E.

| **Table 4 - Water Extraction Efficiency Classification** | |
|---|---|
| **Star Rating** | **Water Extraction Index (WEI)** |
| 6 Stars | WEI < 54 |
| 5 Stars | 54 ≤ WEI < 63 |
| 4 Stars | 63 ≤ WEI < 72 |

| | |
|---|---|
| 3 Stars | 72 ≤ WEI < 81 |
| 2 Stars | 81 ≤ WEI < 90 |
| 1 Star | 90 ≤ WEI |

***5.4 Design and placement of the label***

The label shall be printed, visible, and fixed on both the product and the package.
The label shall be on the most prominent part of the product packaging to be easily visible to the consumer. The label format and layout are provided for illustrative purposes and the final design is available in Annex A.

***5.5 Information and values contained on the label***

The following requirements shall be displayed on the energy efficiency label based on the design provided in Annex A:

- Logo of the Kingdom of Bahrain.
- QR code representing the main characteristics of the washing machine, this may include the following items based:
    - Manufacturer name
    - Model number
    - Brand name
    - Country of origin
    - Rated power (W)
    - Rated voltage (V)
    - Rated capacity (kg)
    - Energy Classification (unit-less)
    - Water Efficiency classification (unit-less)
    - Rated Annual Energy consumption - AEC (kWh)
    - Rated Annual Water Consumption – WEC (litters and class)
    - Rated Water Extraction Index - WEI (%)
- Energy efficiency class, which the product attained.
- EEI.
- General product information: brand name and model number.
- Capacity of the product.
- Annual water consumption in Liters per year.
- Water efficiency class.
- Annual energy consumption in kWh per year.
- Type of washing machine.
- Legal statement attached to energy efficiency labels.

## 6. Marking and Instructions

### *6.1 General information*

The following information shall be marked on the nameplate of the washing machine in English or both Arabic and English. The marking shall not be on a detachable part of the unit and shall be indelible, durable and easily legible.

Any information related to energy performance added on any part of the unit or packaging shall not have any ambiguity or lead to misunderstanding of the performance of the unit.

### *6.2 Nameplate information*

For compliance to this regulation, the nameplate information shall include at least the following information:

- Manufacturer's name and/or trademark.
- Country of origin.
- Manufacturer's model or type reference and serial number of the unit.
- Rated voltage or rated voltage range in volts (V).
- Rated frequency in hertz (Hz).
- Rated power input in Watt (W) or kiloWatts (kW)
- Rated Capacity (kg)
- Annual Energy Consumption (kWh/year or kWh)
- Annual Water Consumption (liters/year or liters)

### *6.3 Instruction sheet*

An instruction sheet and manual in Arabic or both Arabic and English shall be delivered with each product. Tables, drawings and circuit diagrams may be depicted in English only.

The instruction sheet or manual shall include the following information as a minimum:

- The information specified in clause 6.2 except 'Country of origin' and model number'
- Dimensions of the unit
- Instruction for mounting and connection to the pipes
- Instruction for connection to the electrical installation
- Instructions necessary for the correct operation of the unit and any special precautions to be observed to ensure its safe use and maintenance
- Instruction for packing and unpacking the unit
- Instructions on unit handling and rigging
- Net weight of the unit

### *6.4 Additional submittal*

For the washing machines that does not include a heating element nor apply 60° C and 40° C cotton programs, the following information shall be submitted as a supplementary document with the instruction sheet:

- Number of washing cycles, and Water quantity for each washing cycle in (L), time for each washing cycle in (min).

- Number of rinse cycles, and water quantity for each rinse cycle in (L), time for each rinse cycle in (min).
- Number of Spin cycles and time for each Spin cycle in (min).

**7. Registration Requirements**

Registration is mandatory for all imported and locally manufactured products. The information about registration requirement for energy labelling and MEPS is available at the online EER platform.

## Annex A – Energy Efficiency Label Design

## Annex B – Determination of Washing Efficiency

### *B.1 Preparation of the test load*

Test loads are prepared as given in EN60456 Annex ZA.2

For washing machines with a rated capacity up to 15 kg, conditions for the preparation of the loads expressed in EN60456 Table ZA.1 apply

For washing machines with a rated capacity from 15 kg up to 25 kg the following rules apply as a supplement to Table ZA.1 in EN 60456

- For test load masses to the whole or half kilogram rating which are greater than those specified in the table ZA.1, the number of stain test strips is equal to the nominal test load mass (rounded to the nearest kilogram), the number of sheets is the nominal test load mass divided by (3 × 0,725) (rounded to the nearest whole sheet) and the number of pillowcases is the nominal test load mass divided by (3 × 0,24) (rounded to the nearest whole pillow case). The balance of the required nominal test load mass is made up of towels as required. The mass of all base load items can be expected to decline slightly with increasing age.
- Difference between base load mass and test load mass is due to the mass of the test strips as
- The actual number of towels may differ from the number indicated above (which is intended to be indicative)

### *B.2 Criteria for washing efficiency index*

For washing machines the Washing Efficiency Index (Iw) shall be greater than 0.88 (Formula A.1) for each testing conditions at full load, 60°C and half load 60°C and 40°C.

Tests are conducted with a water hardness of 2.5 (± 0.2) mmol/l of $CaCO_3$ equivalent.

### *B.3 Calculation of the washing efficiency index*

For the calculation of the Washing Efficiency Index ($I_w$), the weighted washing efficiency of the washing machine for the standard 60°C cotton program at full and partial load and for the standard 40°C cotton program at partial load is compared to the washing efficiency of a reference washing machine, where the reference washing machine shall have the characteristics indicated in the generally recognized state-of-the-art measurement methods, including methods set out in EN60456.

The Washing Efficiency Index ($I_w$) is calculated as follows and rounded to three decimal places

$$I_w = (3 \times I_{w;60} + 2 \times I_{w;60;½} + 2 \times I_{w;40;½})/7 \qquad \text{Formula (B.1)}$$

Where:
$I_{w;60}$ : washing efficiency index of the standard 60°C cotton program at full load;
$I_{w;60;½}$ : washing efficiency index of the standard 60°C cotton program at partial load;
$I_{w;40;½}$ : washing efficiency index of the standard 40°C cotton program at partial load.

The Washing Efficiency Index of one standard cotton program ($I_{W,p}$) is calculated as follows:

$$I_{W,p} = \frac{1}{n} \times \sum_{i=1}^{n} \left( \frac{W_{T,i}}{W_{R,a}} \right)$$

Formula (B.2)

Where:
$W_{T,i}$ = Washing Efficiency of the washing machine under test for one test cycle (i);
$W_{R,a}$ = Average Washing Efficiency of the reference washing machine;
n = number of test cycles, n ≥ 3 for the standard 60°C cotton program at full load, n ≥ 2 for the standard 60 °C cotton program at partial load and n ≥ 2 for the standard 40°C cotton program at partial load.

The Washing Efficiency ($W_{T,i}$) is the average of the reflectance values of each test strip after completion of a test cycle.

## Annex C – Determination of Energy Efficiency Index

### *C.1 Calculation of the energy efficiency index - general*

For the calculation of the Energy Efficiency Index (EEI) of a washing machine model, the weighted annual energy consumption of a washing machine for the standard 60°C cotton program at full and partial load and for the standard 40°C cotton program at partial load is compared to its standard annual energy consumption.

The Energy Efficiency Index (EEI) is calculated as follows and rounded to one decimal place:

$$EEI = 100 \frac{AEC}{AEC_{ref}}$$ Formula (C.1)

Where:
AEC = annual energy consumption of the washing machine (kWh);
$AEC_{ref}$ = standard annual energy consumption used as reference value (kWh).

The standard annual energy consumption ($AEC_{ref}$) is calculated in kWh as follows and rounded to two decimal places:

$$AEC_{ref} = 47.0 \times C_{rated} + 51.7$$ Formula (C.2)

Where:
$C_{rated}$ = rated capacity of the washing machine for the standard 60°C cotton program at full load or the standard 40°C cotton program at full load, whichever is the lower.

The weighted annual energy consumption (AEC) is calculated in kWh as follows and is rounded to two decimal places:

$$AEC = E_t \times 220 + \left[ \frac{P_o \times \frac{525600 - (T_t \times 220)}{2} + P_l \times \frac{525600 - (T_t \times 220)}{2}}{60 \times 1000} \right]$$ Formula (C.3)

Where:
$E_t$ = weighted energy consumption (in kWh);
$P_o$ = weighted power in 'off-mode (in W)';
$P_l$ = weighted power in the 'left-on mode' ( in W);
$T_t$ = weighted program time (in minutes – min);
220 = total number of standard washing cycles per year.
constant (time)
Where the washing machine is equipped with a power management system, with the washing machine reverting automatically to 'off-mode' after the end of the program, the weighted annual

energy consumption (AEC) is calculated taking into consideration the effective duration of 'left-on mode', according to the following formula C.6

$$AEC = E_t \times 220 + \left[\frac{P_l \times T_l \times 220 + P_o \times [525600 - (T_t \times 220) - (T_l \times 220)]}{60 \times 1000}\right] \quad \text{Formula (C.4)}$$

Where:
$T_l$ = time in 'left-on mode (in minutes–min)'

### *C.3 Calculation of the weighted energy efficiency*

The weighted energy consumption ($E_t$) is calculated in kWh as follows and rounded to three decimal places:

$$E_t = (3 \times E_{t;60} + 2 \times E_{t;60;½} + 2 \times E_{t;40;½})/7 \quad \text{Formula (C.5)}$$

Where:
$E_{t;60}$ : energy consumption of the standard 60°C cotton program at full load;
$E_{t;60;½}$ : energy consumption of the standard 60°C cotton program at partial load;
$E_{t;40;½}$ : energy consumption of the standard 40°C cotton program at partial load.

### *C.4 Calculation of the weighted power in 'off-mode'*

The weighted power in 'off-mode' ($P_o$) is calculated in Watt as follows and rounded to two decimal places:

$$P_o = (3 \times P_{o;60} + 2 \times P_{o;60;½} + 2 \times P_{o;40;½})/7 \quad \text{Formula (C.6)}$$

Where:
$P_{o;60}$ : power in 'off-mode' of the standard 60°C cotton program at full load;
$P_{o;60;½}$ : power in 'off-mode' of the standard 60°C cotton program at partial load;
$P_{o;40;½}$ : power in 'off-mode' of the standard 40°C cotton program at partial load.

### *C.5 Calculation of the weighted program time*

The weighted program time ($T_t$) is calculated in minutes as follows and rounded to the nearest minute:

$$T_t = (3 \times T_{t;60} + 2 \times T_{t;60;½} + 2 \times T_{t;40;½})/7 \quad \text{Formula (C.7)}$$

Where:
$T_{t,60}$ : program time of the standard 60°C cotton program at full load;
$T_{t;60;½}$ : program time of the standard 60°C cotton program at partial load;
$T_{t;40;½}$ : program time of the standard 40°C cotton program at partial load.

### *C.6 Calculation of the weighted power in left-on mode*

The weighted power in the 'left-on mode' ($P_l$) is calculated in Watt as follows and rounded to two decimal places:

$$P_l = (3 \times P_{l;60} + 2 \times P_{l;60;½} + 2 \times P_{l;40;½})/7 \quad \text{Formula (C.8)}$$

Where:
$P_{l;60}$ : power in 'left-on mode' of the standard 60°C cotton program at full load;
$P_{l;60;½}$ : power in 'left-on mode' of the standard 60°C cotton program at partial load;
$P_{l;40;½}$ : power in 'left-on mode' of the standard 40°C cotton program at partial load.

### *C.7 Calculation of the weighted time in 'left-on' mode*

The weighted time in 'left-on mode' ($T_l$) is calculated in minutes as follows and rounded to the nearest minute:

$$T_l = (3 \times T_{l;60} + 2 \times T_{l;60;½} + 2 \times T_{l;40;½})/7 \quad \text{Formula (C.9)}$$

Where:
$T_{l;60}$ : time in 'left-on mode' of the standard 60°C cotton program at full load;
$T_{l;60;½}$ : time in 'left-on mode' of the standard 60°C cotton program at partial load;
$T_{l;40;½}$ : time in 'left-on mode' of the standard 40°C cotton program at partial load.

## Annex D - Calculation of the Water Consumption

### *D.1 Calculation of the Water Consumption Index (WCI)*

The water consumption index of a washing machine is calculated as follows based on the energy consumption of 1 standard cycle at $60^0$C cotton at full load and rounded up to with 2 decimals.

$$WCI = 1 + \frac{Log_e\left(\frac{W_{t60}}{30 \times C_{rated}}\right)}{Log_e\left(1 - F\right)} \qquad \text{Formula (D.1)}$$

Where:
WCI : value used to determine the classification of the appliance related to water consumption;
$W_{t;60}$ : water consumption of the standard 60°C cotton program at full load;
30 : base water consumption per kg of capacity;
$C_{rated}$ : rated capacity of clothes washer in (kg);
$F$ : water reduction factor (30%) = 0.30.

### *D.2 Calculation of the Annual Water Consumption (AWC)*

The weighted annual water consumption (AWC) of a washing machine is on the water consumption for the standard 60°C cotton program at full and partial load and for the standard 40°C cotton program at partial load as follows and rounded up to the integer.

$$AWC = 220 \times W_t \qquad \text{Formula (D.2)}$$

Where:
$W_t$ : weighted water consumption (liter)
220 : number of cycles per year

The weighted water consumption is calculated as follows and rounded up to the integer.

$$W_t = (3 \times W_{t;60} + 2 \times W_{t;60;½} + 2 \times W_{t;40;½})/7 \qquad \text{Formula (D.3)}$$

Where:
$W_{t;60}$ : water consumption of the standard 60°C cotton program at full load;
$W_{t;60;½}$ : water consumption of the standard 60°C cotton program at partial load;
$W_{t;40;½}$ : water consumption of the standard 40°C cotton program at partial load.

## Annex E - Calculation of the Water Extraction Index (WEI)

The weighted remaining moisture content which is referred to as the Water Extraction Index (WEI) of a washing machine is calculated in percentage as follows and rounded to the nearest whole percent:

$$WEI = \frac{(3.WEI_{60} + 2.WEI_{60;½} + 2.WEI_{40;½})}{7} \qquad \text{Formula (E.1)}$$

Where:

$WEI_{60}$: is the water extraction index for the standard 60°C cotton program at full load, in percentage and rounded to the nearest whole percent;

$WEI_{60;½}$: is the water extraction index for the standard 60°C cotton program at partial load, in percentage and rounded to the nearest whole per cent;

$WEI_{40;½}$: is the water extraction index for the standard 40°C cotton program at partial load, in percentage and rounded to the nearest whole per cent.

The Water extraction index for each standard cotton program is calculated according to EN60456 Annex ZA 5.4 (noted D in EN60456)