

[<sup>F1</sup>SCHEDULE 1E

Regulations 2 and 39(1)

ACTIVE ELECTRICAL ENERGY METERS (MI-003) (Annex V to the Directive)

**Textual Amendments**

**F1** Schs. 1A-1K inserted (E.W.S.) (31.12.2020) by The Product Safety and Metrology etc. (Amendment etc.) (EU Exit) Regulations 2019 (S.I. 2019/696), reg. 1, Sch. 27 para. 49 (with Sch. 27 para. 50(a)) (as amended by S.I. 2020/676, regs. 1(1), 2); 2020 c. 1, Sch. 5 para. 1(1)

The relevant requirements of Schedule 1A, the specific requirements of this Schedule and the conformity assessment procedures listed in this Schedule, apply to active electrical energy meters.

Note:

Electrical energy meters may be used in combination with external instrument transformers, depending upon the measurement technique applied. However, this Schedule covers only electrical energy meters but not instrument transformers.

**DEFINITIONS**

An active electrical energy meter is a device which measures the active electrical energy consumed in a circuit.

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I	=	the electrical current flowing through the meter;
I <sub>n</sub>	=	the specified reference current for which the transformer operated meter has been designed;
I <sub>st</sub>	=	the lowest declared value of I at which the meter registers active electrical energy at unity power factor (polyphase meters with balanced load);
I <sub>min</sub>	=	the value of I above which the error lies within maximum permissible errors (MPEs) (polyphase meters with balanced load);
I <sub>tr</sub>	=	the value of I above which the error lies within the smallest MPE corresponding to the class index of the meter;
I <sub>max</sub>	=	the maximum value of I for which the error lies within the MPEs;
U	=	the voltage of the electricity supplied to the meter;
U <sub>n</sub>	=	the specified reference voltage;
f	=	the frequency of the voltage supplied to the meter;
f <sub>n</sub>	=	the specified reference frequency;
PF	=	power factor = cosφ = the cosine of the phase difference φ between I and U.

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**SPECIFIC REQUIREMENTS**

## Accuracy

1. The manufacturer shall specify the class index of the meter. The class indices are defined as: Class A, B and C.

## Rated operating conditions

2. The manufacturer shall specify the rated operating conditions of the meter; in particular:

The values of  $f_n$ ,  $U_n$ ,  $I_n$ ,  $I_{st}$ ,  $I_{min}$ ,  $I_{tr}$  and  $I_{max}$  that apply to the meter. For the current values specified, the meter shall satisfy the conditions given in Table 1;

**Table 1**

	<i>Class A</i>	<i>Class B</i>	<i>Class C</i>
For direct-connected meters			
$I_{st}$	$\leq 0.05 \cdot I_{tr}$	$\leq 0.04 \cdot I_{tr}$	$\leq 0.04 \cdot I_{tr}$
$I_{min}$	$\leq 0.5 \cdot I_{tr}$	$\leq 0.5 \cdot I_{tr}$	$\leq 0.3 \cdot I_{tr}$
$I_{max}$	$\geq 50 \cdot I_{tr}$	$\geq 50 \cdot I_{tr}$	$\geq 50 \cdot I_{tr}$
For transformer-operated meters			
$I_{st}$	$\leq 0.06 \cdot I_{tr}$	$\leq 0.04 \cdot I_{tr}$	$\leq 0.02 \cdot I_{tr}$
$I_{min}$	$\leq 0.4 \cdot I_{tr}$	$\leq 0.2 \cdot I_{tr}^1$	$\leq 0.2 \cdot I_{tr}$
$I_n$	$= 20 \cdot I_{tr}$	$= 20 \cdot I_{tr}$	$= 20 \cdot I_{tr}$
$I_{max}$	$\geq 1.2 \cdot I_n$	$\geq 1.2 \cdot I_n$	$\geq 1.2 \cdot I_n$

<sup>1</sup> For Class B electromechanical meters  $I_{min} \leq 0.4 \cdot I_{tr}$  shall apply.

The voltage, frequency and power factor ranges within which the meter shall satisfy the MPE requirements are specified in Table 2. These ranges shall recognise the typical characteristics of electricity supplied by public distribution systems.

The voltage and frequency ranges shall be at least:

$$0.9 \cdot U_n \leq U \leq 1.1 \cdot U_n$$

$$0.98 \cdot f_n \leq f \leq 1.02 \cdot f_n$$

power factor range at least from  $\cos\phi = 0.5$  inductive to  $\cos\phi = 0.8$  capacitive.

## MPEs

3. The effects of the various measurands and influence quantities (a, b, c,...) are evaluated separately, all other measurands and influence quantities being kept relatively constant at their reference values. The error of measurement, that shall not exceed the MPE stated in Table 2, is calculated as:

$$\text{Error of measurement} = \sqrt{(a^2 + b^2 + c^2 \dots)}$$

When the meter is operating under varying-load current, the percentage errors shall not exceed the limits given in Table 2.

**Table 2**

	<i>Operating temperatures</i>			<i>Operating temperatures</i>			<i>Operating temperatures</i>			<i>Operating temperatures</i>		
MPEs in percent at rated operating conditions and defined load current levels and operating temperature	Operating temperatures			Operating temperatures			Operating temperatures			Operating temperatures		
	+ 5 °C ... + 30 °C			- 10 °C ... + 5 °C			- 25 °C ... - 10 °C			- 40 °C ... - 25 °C		
				or			or			or		
				+ 30 °C ... + 40 °C			+ 40 °C ... + 55 °C			+ 55 °C ... + 70 °C		
<b>Meter class</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>A</b>	<b>B</b>	<b>C</b>
<b>Single phase meter; polyphase meter if operating with balanced loads</b>												
$I_{\min} \leq I < I_{tr}$	3.5	2	1	5	2.5	1.3	7	3.5	1.7	9	4	2
$I_{tr} \leq I < I_{\max}$	3.5	2	0	4.5	2.5	1	7	3.5	1.3	9	4	1.5
<b>Polyphase meter if operating with single phase load</b>												
$I_{tr} \leq I < I_{\max}$	4	2.5	1	5	3	1.3	7	4	1.7	9	4.5	2
, see exception below												
For electromechanical polyphase meters the current range for single-phase load is limited to $5I_{tr} \leq I \leq I_{\max}$												

When a meter operates in different temperature ranges the relevant MPE values shall apply.

The meter shall not exploit the MPEs or systematically favour any party.

**4. Permissible effect of disturbances**

**4.1. General**

As electrical energy meters are directly connected to the mains supply and as mains current is also one of the measurands, a special electromagnetic environment is used for electricity meters.

The meter shall comply with the electromagnetic environment E2 and the additional requirements in paragraphs 4.2 and 4.3.

The electromagnetic environment and permissible effects reflect the situation that there are disturbances of long duration which shall not affect the accuracy beyond the critical change values and transient disturbances, which may cause a temporary degradation or loss of function or performance but from which the meter shall recover and shall not affect the accuracy beyond the critical change values.

When there is a foreseeable high risk due to lightning or where overhead supply networks are predominant, the metrological characteristics of the meter shall be protected.

## Effect of disturbances of long duration

**Table 3**

<i><b>Disturbance</b></i>	<i><b>Critical change values in percent for meters of class</b></i>		
	<i><b>A</b></i>	<i><b>B</b></i>	<i><b>C</b></i>
Reversed phase sequence	1.5	1.5	0.3
Voltage unbalance (only applicable to polyphase meters)	4	2	1
Harmonic contents in the current circuits	1	0.8	0.5
DC and harmonics in the current circuit	6	3	1.5
Fast transient bursts	6	4	2
Magnetic fields; HF (radiated RF) electromagnetic field; 3 Conducted disturbances introduced by radio-frequency fields; and Oscillatory waves immunity	3	2	1

In the case of electromechanical electricity meters, no critical change values are defined for harmonic contents in the current circuits and for DC and harmonics in the current circuit.

### ***Permissible effect of transient electromagnetic phenomena***

#### **4**

**4.3.1** The effect of an electromagnetic disturbance on an electrical energy meter shall be such that during and immediately after a disturbance:

— any output intended for testing the accuracy of the meter does not produce pulses or signals corresponding to an energy of more than the critical change value,

and in reasonable time after the disturbance the meter shall:

- recover to operate within the MPE limits, and
- have all measurement functions safeguarded, and
- allow recovery of all measurement data present prior to the disturbance, and
- not indicate a change in the registered energy of more than the critical change value.

$$m \cdot U_n \cdot I_{\max} \cdot 10^{-6}$$

(m being the number of measuring elements of the meter,  $U_n$  in Volts and  $I_{\max}$  in Amps).

**4.3.2.** For overcurrent the critical change value is 1.5 %.

### **Suitability**

#### **5**

**5.1.** Below the rated operating voltage the positive error of the meter shall not exceed 10 %.

**5.2.** The display of the total energy shall have a sufficient number of digits to ensure that when the meter is operated for 4,000 hours at full load ( $I = I_{\max}$ ,  $U = U_n$  and  $PF = 1$ ) the indication does not return to its initial value and shall not be able to be reset during use.

**5.3.** In the event of loss of electricity in the circuit, the amounts of electrical energy measured shall remain available for reading during a period of at least 4 months.

### **Running with no load**

5.4. When the voltage is applied with no current flowing in the current circuit (current circuit shall be open circuit), the meter shall not register energy at any voltage between  $0.8 \cdot U_n$  and  $1.1 U_n$ .

### **Starting**

5.5. The meter shall start and continue to register at  $U_n$ , PF = 1 (polyphase meter with balanced loads) and a current which is equal to  $I_{st}$ .

### **Units**

6. The electrical energy measured shall be displayed in kilowatt-hours or in megawatt-hours.

### **Putting into use**

- (a) (a) Subject to sub-paragraph (b), measurement may be performed by means of any active electrical energy meter provided that the temperature range to which an active electrical energy meter is exposed is not wider than the range specified by the manufacturer in relation to that active electrical energy meter in accordance with paragraph 1.3.1 and Table 1 in Schedule 1A to these Regulations.
- (b) Class A active electrical energy meters may not be used when operating outside the temperature range of an upper temperature limit of 30°C to a lower temperature limit of 5°C.
- (c) The person responsible for installing the active electrical energy meter must determine the correct current range and assess the climatic environment.

**CONFORMITY ASSESSMENT** The conformity assessment procedures specified in the modules in Schedule 1B applicable to active electrical energy meters that the manufacturer can choose between are:

- (a) B and F;
- (b) B and D; or
- (c) H1.]

**Changes to legislation:**

There are currently no known outstanding effects for the The Measuring Instruments Regulations 2016, SCHEDULE 1E.