

Australian Standard<sup>®</sup>

## Instrument transformers

### Part 1: Current transformers (IEC 60044-1 Ed.1.2 (2003) MOD)



This Australian Standard® was prepared by Committee EL-013, Measurement and protection transformers. It was approved on behalf of the Council of Standards Australia on 17 January 2007.

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The following are represented on Committee EL-013:

- Australian Electrical and Electronic Manufacturers Association
  - Cigre APA2
  - Energy Networks Association
  - National Measurement Institute
  - University of South Australia
- 

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Australian Standard<sup>®</sup>

## Instrument transformers

### Part 1: Current transformers (IEC 60044-1 Ed.1.2 (2003) MOD)

Originated as part of AS C45—1928.  
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## PREFACE

This Standard was prepared by the Standards Australia Committee EL-013, Measurement and protection transformers to supersede AS 60044.1—2003.

*This Standard incorporates Amendment No. 1 (January 2012). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.*

The objective of this Standard is to provide users and manufacturers of current transformers with definitions of terms, safety requirements, methods of specifying performance and methods of test.

This Standard is Part One of a series covering instrument transformers. The series consists of the following Standards:

AS

60044 Instrument transformers

60044.1 Part 1: Current transformers (this Standard)

60044.2 Part 2: Single-phase inductive voltage transformers

This Standard is an adoption with national modifications and has been reproduced from IEC 60044-1, Ed.1.2 (2003), *Instrument transformers – Part 1: Current transformers*, (including Amendment 1: 2000 and Amendment 2:2002).and has been varied as indicated to take account of Australian conditions.

Variations to IEC 60044-1, Ed.1.2 (2003) are indicated at the appropriate places throughout this standard. Strikethrough (**example**) identifies IEC text, tables and figures which, for the purposes of this Australian Standard, are deleted. Where text, tables or figures are added, each is set in its proper place and identified by shading (**example**). Added figures are not themselves shaded, but are identified by a shaded border.

As this Standard is reproduced from an International Standard, the following applies:

- (a) Its number does not appear on each page of text and its identity is shown only on the cover and title page.
- (b) In the source text ‘this part of IEC 60044’ should read ‘this part of AS 60044’.
- (c) A full point should be substituted for a comma when referring to a decimal marker.

The terms ‘normative’ and ‘informative’ are used to define the application of the annex to which they apply. A normative annex is an integral part of a standard, whereas an informative annex is only for information and guidance.

Attention is drawn to the following differences between this Standard and AS 1675—1986 which is now obsolescent.

- (a) This Standard has a new thermal class for windings in oil and hermetically sealed that allows 65 K temperature rise. See Table 2, Limits of temperature rise of the windings.
- (b) This Standard has highest voltages for equipment of 170 kV and 245 kV in place of 245 kV in AS 1675—1986. See Table 3, Rated insulation levels for transformer primary windings.
- (c) This Standard introduces reduced levels of permissible partial discharges across the complete range of system earthing types and voltages, with increases in prestress voltage level (from the current 1.3 times the nominal voltage of the system  $U_m$  level to the induced voltage withstand test level) and in testing voltage level (from 1.1  $U_m$  to 1.3  $U_m$ ). See Clause 5.1.2.2, Partial discharges and Clause 8.2.2.2, Partial discharge test procedure.

- (d) This Standard allows a maximum permissible voltage across secondary winding of up to 4.5 kV or for current transformers having a rated knee point e.m.f. greater than 450 V, 10 times the rated knee point voltage up to a limit of 10 kV. See Clause 5.1.5, Inter-turn insulation requirements.
- (e) This Standard introduces requirements for minimum insulator creepage distance and arcing/creepage ratio for various pollution levels. See Clause 5.1.6, Requirements for the external insulation.
- (f) This Standard requires repeated dielectric testing to be performed at 80% of the initial power frequency voltage (and not 75% as in AS 1675—1986). See Clause 6.2, Routine tests.
- (g) This Standard covers measurement of dielectric dissipation factor as a special test, and not as a routine test as does AS 1675—1986. See Clause 6.3, Special tests.
- (h) This Standard tests radio interference voltage with a prestress voltage of  $1.5 U_m/\sqrt{3}$ , and a limit of 300 pC or 2500  $\mu$ V at  $1.1 U_m/\sqrt{3}$ . This test is also required for voltages 123 kV and upwards (and not from 245 kV as in AS 1675—1986). See Clause 7.5, Radio interference voltage measurement.
- (i) This Standard includes requirements for measurement of partial discharges different to those in AS 1675—1986 (which calls up AS 2532 which has been withdrawn). See Clause 8.2.2, Partial discharge measurement.
- (j) This Standard introduces new special tests of chopped impulse on primary winding and mechanical testing of primary terminals. See Clause 6.3, Special tests.
- (k) Special Metering Classes are introduced in this Standard as classes 0.2S and 0.5S, with a current range from 1-120% (that can be extended to 150% and 200%). AS 1675—1986 has classes 0.1ME, 0.2ME and 0.5ME for secondary currents 1 A and 5 A, but the current range is 2.5-125/150/200%. See Clause 11.2, Limits of current error and phase displacement for measuring current transformers.
- (l) This Standard allows a higher error margin for errors measured at 5% and 20% of rated current than does AS 1675—1986, but better accuracy can be achieved by selecting a different class for such needs. See Clause 11.2, Limits of current error and phase displacement for measuring current transformers.
- (m) This Standard requires a maximum current of 120% for accuracy testing of metering CTs instead of the 125% required in AS 1675—1986. See Clause 11.2, Limits of current error and phase displacement for measuring current transformers.
- (n) This Standard allows protection classes 5P and 10P to have current errors at rated current of 1% and 3% respectively. See Clause 12.3, Limits of errors for protective current transformers.
- (o) Tests for accuracy are done at 1.0 power factor in AS 1675—1986. This Standard requires tests for accuracy to be done at 0.8 power factor or at 1.0 power factor with the results converted to equivalent results at 0.8 power factor. See Clause 12.3, Limits of errors for protective current transformers.
- (p) AS 1675—1986 covered class PS which is not covered in this Standard. However, class PR (air gaps) of this Standard deals with requirements of this type. See Clause 13, Additional requirements for class PR protective current transformers.
- (q) This Standard includes a class PX which covers all requirements of class PL in AS 1675—1986. See Clause 14, Additional requirements for class PX protective current transformers.
- (r) This Standard does not have requirements for thermal stability testing.
- (s) This Standard has no requirements for variation of error margins during accuracy testing of metering cores.

- (t) This Standard introduces a test of transmitted overvoltage as a special test. See Clause 6.3, Special tests.

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## STANDARDS AUSTRALIA

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**Australian Standard****Instrument transformers  
Part 1: Current transformers  
(IEC 60044-1 Ed.1.2 (2003)MOD)**

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Any table, figure or text of the international standard that is struck through is not part of this standard. Any Australian table, figure or text that is added is part of this standard and is identified by shading.

**1 General****1.1 Scope**

This part of IEC 60044 applies to newly manufactured current transformers for use with electrical measuring instruments and electrical protective devices at frequencies from 15 Hz to 100 Hz.

Although the requirements relate basically to transformers with separate windings, they are also applicable, where appropriate, to autotransformers.

Clause 11 covers the requirements and tests, in addition to those in clauses 3 to 10, that are necessary for current transformers for use with electrical measuring instruments.

Clause 12 covers the requirements and tests, in addition to those in clauses 3 to 10, that are necessary for current transformers for use with electrical protective relays, and in particular for forms of protection in which the prime requirement is the maintenance of accuracy up to several times the rated current.

For certain protective systems, where the current transformer characteristics are dependant on the overall design of the protective equipment (for example high-speed balanced systems and earth-fault protection in resonant earthed networks), additional requirements are given in clause 13 for class PR transformers and in clause 14 for class PX transformers.

Clause 13 covers the requirements and tests in addition to those in clauses 3 to 10 that are necessary for current transformers for use with electrical protective relays, and in particular for forms of protection in which the prime requirement is the absence of remanent flux.

Clause 14 covers the requirements and tests in addition to those in clauses 3 to 10 that are necessary for current transformers for use with electrical protective relays, and in particular for forms of protection for which knowledge of the transformer's secondary excitation characteristic, secondary winding resistance, secondary burden resistance and turns ratio is sufficient to assess its performance in relation to the protective relay system with which it is to be used.

Current transformers intended for both measurement and protection shall comply with all the clauses of this standard.

## 1.2 Normative references

References to international standards that are struck through in this clause are replaced by references to Australian or Australian/New Zealand Standards that are listed immediately thereafter and identified by shading. Any Australian or Australian/New Zealand Standard that is identical to the International Standard it replaces is identified as such.

IEC 60028:1925, *International standard of resistance for copper*

~~IEC 60038:1983, IEC standard voltages~~

AS 60038, *Standard voltages*

IEC 60044-6:1992, *Instrument transformers – Part 6: Requirements for protective current transformers for transient performance*

~~IEC 60050(321):1986, International Electrotechnical Vocabulary – Chapter 321: Instrument transformers~~

AS 1852.321, *International Electrotechnical Vocabulary – Chapter 321: Instrument transformers* (identical to IEC 60050(321):1986)

~~IEC 60060-1:1989, High-voltage test techniques – Part 1: General definitions and test requirements~~

AS 1931.1, *High-voltage test techniques, Part 1: General definitions and test requirements* (identical to IEC 60060-1:1989)

~~IEC 60071-1:1993, Insulation co-ordination – Part 1: Definitions, principles and rules~~

AS 1824.1, *Insulation co-ordination, Part 1: Definitions, principles and rules*

IEC 60085:1984, *Thermal evaluation and classification of electrical insulation*

IEC 60121:1960, *Recommendation for commercial annealed aluminium electrical conductor wire*

~~IEC 60270:1981, Partial discharge measurements~~

AS 60270, *Partial discharge measurements* (identical to IEC 60270:2000)

IEC 60567:1992, *Guide for the sampling of gases and of oil from oil-filled electrical equipment and for the analysis of free and dissolved gases*

IEC 60599:1978, *Interpretation of the analysis of gases in transformers and other oil-filled electrical equipment in service*

IEC 60721: *Classification of environmental conditions*

~~IEC 60815:1986, Guide for the selection of insulators in respect of polluted conditions~~

AS 4436, *Guide for the selection of insulators in respect of polluted conditions* (identical to IEC 815:1986)

~~CISPR 18-2:1986, Radio interference characteristics of overhead power lines and high-voltage equipment – Part 2: Methods of measurement and procedure for determining limits~~

AS/NZS 2344, *Limits of electromagnetic interference from overhead a.c. powerlines and high voltage equipment installations in the frequency range 0.15 to 1000 MHz*

## 2 Definitions

For the purpose of this part of IEC 60044, the following definitions apply:

### 2.1 General definitions

#### 2.1.1

##### **instrument transformer**

a transformer intended to supply measuring instruments, meters, relays and other similar apparatus

[IEV 321-01-01 modified]

#### 2.1.2

##### **current transformer**

an instrument transformer in which the secondary current, in normal conditions of use, is substantially proportional to the primary current and differs in phase from it by an angle which is approximately zero for an appropriate direction of the connections

[IEV 321-02-01]

#### 2.1.3

##### **primary winding**

the winding through which flows the current to be transformed

#### 2.1.4

##### **secondary winding**

the winding which supplies the current circuits of measuring instruments, meters, relays or similar apparatus

#### 2.1.5

##### **secondary circuit**

the external circuit supplied by the secondary winding of a transformer

#### 2.1.6

##### **rated primary current**

the value of the primary current on which the performance of the transformer is based

[IEV 321-01-11 modified]

#### 2.1.7

##### **rated secondary current**

the value of the secondary current on which the performance of the transformer is based

[IEV 321-01-15 modified]

#### 2.1.8

##### **actual transformation ratio**

the ratio of the actual primary current to the actual secondary current

[IEV 321-01-17 modified]

#### 2.1.9

##### **rated transformation ratio**

the ratio of the rated primary current to the rated secondary current

[IEV 321-01-19 modified]

**2.1.10****current error (ratio error)**

the error which a transformer introduces into the measurement of a current and which arises from the fact that the actual transformation ratio is not equal to the rated transformation ratio

[IEV 321-01-21 modified]

The current error expressed in per cent is given by the formula:

$$\text{Current error \%} = \frac{(K_n I_s - I_p) \times 100}{I_p}$$

where

$K_n$  is the rated transformation ratio;

$I_p$  is the actual primary current;

$I_s$  is the actual secondary current when  $I_p$  is flowing, under the conditions of measurement.

**2.1.11****phase displacement**

the difference in phase between the primary and secondary current vectors, the direction of the vectors being so chosen that the angle is zero for a perfect transformer

[IEV 321-01-23 modified]

The phase displacement is said to be positive when the secondary current vector leads the primary current vector. It is usually expressed in minutes or centiradians.

NOTE This definition is strictly correct for sinusoidal currents only.

**2.1.12****accuracy class**

a designation assigned to a current transformer the errors of which remain within specified limits under prescribed conditions of use

**2.1.13****burden**

the impedance of the secondary circuit in ohms and power-factor

The burden is usually expressed as the apparent power in voltamperes absorbed at a specified power-factor and at the rated secondary current.

**2.1.14****rated burden**

the value of the burden on which the accuracy requirements of this specification are based

**2.1.15****rated output**

the value of the apparent power (in voltamperes at a specified power-factor) which the transformer is intended to supply to the secondary circuit at the rated secondary current and with rated burden connected to it

**2.1.16****highest voltage for equipment**

the highest r.m.s. phase-to-phase voltage for which a transformer is designed in respect of its insulation

**2.1.17****highest voltage of a system**

highest value of operating voltage which occurs under normal operating conditions at any time and at any point in the system

**2.1.18****rated insulation level**

the combination of voltage values which characterizes the insulation of a transformer with regard to its capability to withstand dielectric stresses

**2.1.19****isolated neutral system**

a system where the neutral point is not intentionally connected to earth, except for high impedance connections for protection or measurement purposes

[IEV 601-02-24]

**2.1.20****solidly earthed neutral system**

a system whose neutral point(s) is(are) earthed directly

[IEV 601-02-25]

**2.1.21****impedance earthed (neutral) system**

a system whose neutral point(s) is(are) earthed through impedances to limit earth fault currents

[IEV 601-02-26]

**2.1.22****resonant earthed (neutral) system**

a system in which one or more neutral points are connected to earth through reactances which approximately compensate the capacitive component of a single-phase-to-earth fault current

[IEV 601-02-27]

NOTE With resonant earthing of a system, the residual current in the fault is limited to such an extent that an arcing fault in air is usually self-extinguishing.

**2.1.23****earth fault factor**

at a given location of a three-phase system, and for a given system configuration, the ratio of the highest r.m.s. phase-to-earth power frequency voltage on a healthy phase during a fault to earth affecting one or more phases at any point on the system to the r.m.s. phase-to-earth power frequency voltage which would be obtained at the given location in the absence of any such fault

[IEV 604-03-06]

**2.1.24****earthed neutral system**

a system in which the neutral is connected to earth, either solidly, or through a resistance or reactance of low enough value to reduce materially transient oscillations and to give a current sufficient for selective earth fault protection:

- a) a system with effectively-earthed neutral at a given location is a system characterized by an earth fault factor at this point which does not exceed 1,4;

NOTE This condition is obtained in general when, for all system configurations, the ratio of zero-sequence reactance to positive-sequence reactance is less than 3 and the ratio of zero-sequence resistance to positive-sequence reactance is less than 1.

- b) a system with non-effectively earthed neutral at a given location is a system characterized by an earth fault factor at this point that may exceed 1,4.

**2.1.25****exposed installation**

an installation in which the apparatus is subject to overvoltages of atmospheric origin

NOTE Such installations are usually connected to overhead transmission lines, either directly, or through a short length of cable.

#### 2.1.26

##### **non-exposed installation**

an installation in which the apparatus is not subject to overvoltages of atmospheric origin

NOTE Such installations are usually connected to cable networks.

#### 2.1.27

##### **rated frequency**

the value of the frequency on which the requirements of this standard are based

#### 2.1.28

##### **rated short-time thermal current ( $I_{th}$ )**

the r.m.s. value of the primary current which a transformer will withstand for one second without suffering harmful effects, the secondary winding being short-circuited

#### 2.1.29

##### **rated dynamic current ( $I_{dyn}$ )**

the peak value of the primary current which a transformer will withstand, without being damaged electrically or mechanically by the resulting electromagnetic forces, the secondary winding being short-circuited

#### 2.1.30

##### **rated continuous thermal current ( $I_{cth}$ )**

the value of the current which can be permitted to flow continuously in the primary winding, the secondary winding being connected to the rated burden, without the temperature rise exceeding the values specified

#### 2.1.31

##### **exciting current**

the r.m.s. value of the current taken by the secondary winding of a current transformer, when a sinusoidal voltage of rated frequency is applied to the secondary terminals, the primary and any other windings being open-circuited

#### 2.1.32

##### **rated resistive burden ( $R_b$ )**

rated value of the secondary connected resistive burden in ohms

#### 2.1.33

##### **secondary winding resistance ( $R_{ct}$ )**

secondary winding d.c. resistance in ohms corrected to 75 °C or such other temperature as may be specified

#### 2.1.34

##### **composite error\***

under steady-state conditions, the r.m.s. value of the difference between:

- a) the instantaneous values of the primary current, and
- b) the instantaneous values of the actual secondary current multiplied by the rated transformation ratio, the positive signs of the primary and secondary currents corresponding to the convention for terminal markings.

The composite error  $\varepsilon_c$  is generally expressed as a percentage of the r.m.s. values of the primary current according to the formula:

---

\* See annexe A.

$$\varepsilon_c = \frac{100}{I_p} \sqrt{\frac{1}{T} \int_0^T (K_n i_s - i_p)^2 dt}$$

where

- $K_n$  is the rated transformation ratio;  
 $I_p$  is the r.m.s. value of the primary current;  
 $i_p$  is the instantaneous value of the primary current;  
 $i_s$  is the instantaneous value of the secondary current;  
 $T$  is the duration of one cycle.

### 2.1.35

#### multi-ratio current transformer

current transformer on which more ratios are obtained by connecting the primary winding sections in series or parallel or by means of taps on the secondary winding

## 2.2 Additional definitions for measuring current transformers

### 2.2.1

#### measuring current transformer

a current transformer intended to supply indicating instruments, integrating meters and similar apparatus

### 2.2.2

#### rated instrument limit primary current (IPL)

the value of the minimum primary current at which the composite error of the measuring current transformer is equal to or greater than 10 %, the secondary burden being equal to the rated burden

NOTE The composite error should be greater than 10 %, in order to protect the apparatus supplied by the instrument transformer against the high currents produced in the event of system fault.

### 2.2.3

#### instrument security factor (FS)

the ratio of rated instrument limit primary current to the rated primary current

NOTE 1 Attention should be paid to the fact that the actual instrument security factor is affected by the burden.

NOTE 2 In the event of system fault currents flowing through the primary winding of a current transformer, the safety of the apparatus supplied by the transformer is greatest when the value of the rated instrument security factor (FS) is small.

### 2.2.4

#### secondary limiting e.m.f

the product of the instrument security factor FS, the rated secondary current and the vectorial sum of the rated burden and the impedance of the secondary winding

NOTE 1 The method by which the secondary limiting e.m.f. is calculated will give a higher value than the real one. It was chosen in order to apply the same test method as in 11.6 and 12.5 for protective current transformers.

Other methods may be used by agreement between manufacturer and purchaser.

NOTE 2 For calculating the secondary limiting e.m.f., the secondary winding resistance should be corrected to a temperature of 75 °C.

## 2.3 Additional definitions for protective current transformers

### 2.3.1

#### protective current transformer

a current transformer intended to supply protective relays

**2.3.2****rated accuracy limit primary current**

the value of primary current up to which the transformer will comply with the requirements for composite error

**2.3.3****accuracy limit factor**

the ratio of the rated accuracy limit primary current to the rated primary current

**2.3.4****secondary limiting e.m.f.**

the product of the accuracy limit factor, the rated secondary current and the vectorial sum of the rated burden and the impedance of the secondary winding

**2.3.5****class PR protective current transformer**

a current transformer with limited remanence factor for which, in some cases, a value of the secondary loop time constant and/or a limiting value of the winding resistance may also be specified

**2.3.6****saturation flux ( $\Psi_s$ )**

that peak value of the flux which would exist in a core in the transition from the non-saturated to the fully saturated condition and deemed to be that point on the B-H characteristic for the core concerned at which a 10 % increase in B causes H to be increased by 50 %

**2.3.7****remanent flux ( $\Psi_r$ )**

that value of flux which would remain in the core 3 min after the interruption of an exciting current of sufficient magnitude to induce the saturation flux ( $\Psi_s$ ) defined in 2.3.6

**2.3.8****remanence factor ( $K_r$ )**

the ratio  $K_r = 100 \times \Psi_r / \Psi_s$ , expressed as a percentage (%)

**2.3.9****rated secondary loop time constant ( $T_s$ )**

value of the time constant of the secondary loop of the current transformer obtained from the sum of the magnetizing and the leakage inductance ( $L_s$ ) and the secondary loop resistance ( $R_s$ )

$$T_s = L_s / R_s$$

**2.3.10****excitation characteristic**

a graphical or tabular presentation of the relationship between the r.m.s. value of the exciting current and a sinusoidal r.m.s. e.m.f. applied to the secondary terminals of a current transformer, the primary and other windings being open-circuited, over a range of values sufficient to define the characteristics from low levels of excitation up to the rated knee point e.m.f.

**2.3.11****class PX protective current transformer**

a transformer of low leakage reactance for which knowledge of the transformer secondary excitation characteristic, secondary winding resistance, secondary burden resistance and turns ratio is sufficient to assess its performance in relation to the protective relay system with which it is to be used

**2.3.12****rated knee point e.m.f. ( $E_k$ )**

that minimum sinusoidal e.m.f. (r.m.s.) at rated power frequency when applied to the secondary terminals of the transformer, all other terminals being open-circuited, which when increased by 10 % causes the r.m.s. exciting current to increase by no more than 50 %

NOTE The actual knee point e.m.f. will be  $\geq$  the rated knee point e.m.f.

**2.3.13****rated turns ratio**

the required ratio of the number of primary turns to the number of secondary turns

EXAMPLE 1 1/600 (one primary turn with six hundred secondary turns).

EXAMPLE 2 2/1 200 (a current transformer of similar ratio to example 1 but employing two primary turns).

**2.3.14****turns ratio error**

the difference between the rated and actual turns ratios, expressed as a percentage

$$\text{Turns ratio error (\%)} = \frac{(\text{actual turns ratio} - \text{rated turns ratio})}{\text{rated turns ratio}} \times 100$$

**2.3.15****dimensioning factor ( $K_x$ )**

a factor assigned by the purchaser to indicate the multiple of rated secondary current ( $I_{sn}$ ) occurring under power system fault conditions, inclusive of safety factors, up to which the transformer is required to meet performance requirements

**3 Normal and special service conditions**

Detailed information concerning classification of environmental conditions is given in the IEC 60721 series.

**3.1 Normal service conditions****3.1.1 Ambient air temperature**

The current transformers are classified in three categories as given in table 1.

**Table 1 – Temperature categories**

| Category                                                                                                         | Minimum temperature<br>°C | Maximum temperature<br>°C |
|------------------------------------------------------------------------------------------------------------------|---------------------------|---------------------------|
| –5/40                                                                                                            | –5                        | 40                        |
| –25/40                                                                                                           | –25                       | 40                        |
| –40/40                                                                                                           | –40                       | 40                        |
| NOTE In the choice of the temperature category, storage and transportation conditions should be also considered. |                           |                           |

**3.1.2 Altitude**

The altitude does not exceed 1000 m.

**3.1.3 Vibrations or earth tremors**

Vibrations due to causes external to the current transformer or earth tremors are negligible.

### 3.1.4 Other service conditions for indoor current transformers

Other service conditions considered are the following:

- a) the influence of solar radiation may be neglected;
- b) the ambient air is not significantly polluted by dust, smoke, corrosive gases, vapours or salt;
- c) the conditions of humidity are as follows:
  - 1) the average value of the relative humidity, measured during a period of 24 h, does not exceed 95 %;
  - 2) the average value of the water vapour pressure for a period of 24 h does not exceed 2,2 kPa;
  - 3) the average value of the relative humidity, for a period of one month, does not exceed 90 %;
  - 4) the average value of the water vapour pressure, for a period of one month, does not exceed 1,8 kPa.

For these conditions, condensation may occasionally occur.

NOTE 1 Condensation can be expected where sudden temperature changes occur in periods of high humidity.

NOTE 2 To withstand the effects of high humidity and condensation, such as breakdown of insulation or corrosion of metallic parts, current transformers designed for such conditions should be used.

NOTE 3 Condensation may be prevented by special design of the housing, by suitable ventilation and heating or by the use of dehumidifying equipment.

### 3.1.5 Other service conditions for outdoor current transformers

Other service conditions considered are:

- a) average value of the ambient air temperature, measured over a period of 24 h, does not exceed 35 °C;
- ~~b) solar radiation up to a level of 1000 W/m<sup>2</sup> (on a clear day at noon) should be considered;~~

- b) Maximum solar radiation does not exceed 1.1 kW/m<sup>2</sup> (equivalent to a black body temperature of 80°C).

NOTES:

1 Under certain conditions of solar radiation appropriate measures, e.g. roofing, forced ventilation, etc. may be necessary, or derating may be used, in order not to exceed the specified temperature rises.

2 Details of global solar radiation are given in IEC 60721-2-4.

- c) the ambient air may be polluted by dust, smoke, corrosive gas, vapours or salt.  
The pollution levels are given in table 7;
- d) the wind pressure does not exceed 700 Pa (corresponding to 34 m/s wind speed);
- e) account should be taken of the presence of condensation or precipitation.

## 3.2 Special service conditions

When current transformers may be used under conditions different from the normal service conditions given in 3.1, the user's requirements should refer to standardized steps as follows.

### 3.2.1 Ambient air temperature

For installation in a place where the ambient temperature can be significantly outside the normal service condition range stated in 3.1.1, the preferred ranges of minimum and maximum temperature to be specified should be:

- –50 °C and 40 °C for very cold climates;
- –5 °C and 50 °C for very hot climates.