



INSTRUMENT TRANSFORMERS

III. ACCURACY REQUIREMENTS



A. REQUIREMENTS FOR THE ACCURACY OF INDUCTIVE CURRENT AND VOLTAGE TRANSFORMERS FOR MEASURE

A.1. Designation of accuracy class

The accuracy class is designated by a number (class index) equal to the upper limit of the permissible current or voltage error, expressed as a percentage, for the assigned primary current or voltage and the precision charge.

A.2. Normal accuracy classes

The normal accuracy classes of inductive current and voltage transformers for measurement are:

0,1 – 0,2 – 0,5 – 1,0 – 3,0

A.3. Limits of errors of voltage transformers for measurement

The voltage error and the phase displacement to the assigned frequency must not exceed the values in *table 1* at any voltage comprised between 80% and 120% of the rated voltage and for any charge between 25% and 100% of the precision charge, with a power factor of 0.8 inductive.

The errors are determined at the terminals of the transformer, including the effects of the fuses or resistors that are part of it.

| Accuracy class | Voltage error (ratio) in percentage \pm | Phase displacement (offset) \pm | |
|----------------|---|-----------------------------------|--------------|
| | | Minutes | Centiradians |
| 0,1 | 0,1 | 5 | 0,15 |
| 0,2 | 0,2 | 10 | 0,3 |
| 0,5 | 0,5 | 20 | 0,6 |
| 1,0 | 1,0 | 40 | 1,2 |
| 3,0 | 3,0 | Unspecified | Unspecified |

Table 1. Limits of voltage error and phase displacement of voltage transformers for measurement

When ordering transformers with two separate secondary windings and due to their interdependence, the customer must specify two power ranges, one for each winding, corresponding to the upper limit of each of these power ranges a normal value of power precision. Each of the windings will satisfy its own precision specifications throughout its power range while at the same time the other winding will supply a power of any value between zero and the upper limit of its power range.

A.4. Error limits for the current transformers for measurement

For transformers of classes 0.1 - 0.2 - 0.5 and 1, the current error and the phase displacement at the assigned frequency must not exceed the values in table 2 when the secondary charge is between 25% and 100% precision charge.

For transformers of classes 0.2S and 0.5S for special applications (particularly in connection with special electrical energy meters that correctly measure between 50 mA and 6 A, that is between 1% and 120% of the rated current 5A) the current error and the phase displacement to the assigned frequency must not exceed the values in table 3 when the secondary charge is between 25% and 100% of the precision charge. These classes should preferably be used for the 25/5, 50/5 and 100/5 ratios and their decimal multiples and only for the assigned secondary current of 5 A.

For transformers of classes 3 and 5, the current error at the assigned frequency shall not exceed the values in table 4 when the secondary charge is between 50% and 100% of the precision charge.

In all cases, the secondary charge used must be inductive with a power factor of 0.8; except when the charge is less than 5 VA, in which case, the power factor will be unity. In no case, the charge will be less than 1 VA.

| Accuracy class | Current error in %, \pm , for the current values expressed in % of the assigned current | | | | Phase displacement, \pm , for the values of the current expressed in % of the assigned current | | | | | | | |
|----------------|---|------|-----|-----|--|----|-----|-----|--------------|------|------|------|
| | | | | | Minutes | | | | Centiradians | | | |
| | 5 | 20 | 100 | 120 | 5 | 20 | 100 | 120 | 5 | 20 | 100 | 120 |
| 0,1 | 0,4 | 0,2 | 0,1 | 0,1 | 15 | 8 | 5 | 5 | 0,45 | 0,24 | 0,15 | 0,15 |
| 0,2 | 0,75 | 0,35 | 0,2 | 0,2 | 30 | 15 | 10 | 10 | 0,9 | 0,45 | 0,3 | 0,3 |
| 0,5 | 1,5 | 0,75 | 0,5 | 0,5 | 90 | 45 | 30 | 30 | 2,7 | 1,35 | 0,9 | 0,9 |
| 1,0 | 3,0 | 1,5 | 1,0 | 1,0 | 180 | 90 | 60 | 60 | 5,4 | 2,7 | 1,8 | 1,8 |

Table 2. Limits of the current and phase displacement error of current transformers for measurement (classes 0.1 to 1)

| Accuracy class | Current error in %, \pm , for the current values expressed in % of the assigned current | | | | | Phase displacement, \pm , for the values of the current expressed in % of the assigned current | | | | | | | | | |
|----------------|---|------|-----|-----|-----|--|----|----|-----|-----|--------------|------|-----|-----|-----|
| | | | | | | Minutes | | | | | Centiradians | | | | |
| | 1 | 5 | 20 | 100 | 120 | 1 | 5 | 20 | 100 | 120 | 1 | 5 | 20 | 100 | 120 |
| 0,2S | 0,75 | 0,35 | 0,2 | 0,2 | 0,2 | 30 | 15 | 10 | 10 | 10 | 0,9 | 0,45 | 0,3 | 0,3 | 0,3 |
| 0,5S | 1,5 | 0,75 | 0,5 | 0,5 | 0,5 | 90 | 45 | 30 | 30 | 30 | 2,7 | 1,35 | 0,9 | 0,9 | 0,9 |

NOTE: This table is applicable only to transformers whose assigned secondary current is 5A.

Table 3. Limits of the current and phase displacement error of current transformers for measurement for special applications

| Accuracy class | Current error in %, \pm , for the current values expressed in % of the assigned current | |
|----------------|---|-----|
| | 50 | 120 |
| 3 | 3 | 3 |
| 5 | 5 | 5 |

Table 4. Limits of the current error of current transformers for measurement (classes 3 and 5)

For class 3 and 5, no phase displacement limits are specified.

A.5. Extended-range current transformers

Current transformers of classes 0.1 to 1 shall be considered as extended range in current, if they satisfy the following two conditions:

- a) the permanent thermal current assigned will be the value of the assigned extended-range primary current expressed as a percentage of the assigned primary current;
- b) the limits of the current and phase displacement error specified for 120% of the primary current assigned in table 2, shall be maintained up to the value of the primary extended range current assigned.

The normal values of the heating currents for the extended range transformers are 120%, 150% and 200% of the assigned primary current.

A.6. Safety Factor (for current transformers)

It is the multiple of the primary rated current, for which, and with the nominal charge, the current error reaches -10%. The Safety Factor (SF) tells us the number of times of primary current that the transformer is capable of transferring to the measuring equipment.

It must be taken into account that the safety factor depends on the charge applied to the secondary. If the transformer charge is lower than the nominal charge, the safety factor increases almost inversely proportionally.

For connection to measuring instruments, the safety factor should be reduced, in order to provide protection against overloads. In the event of a short circuit in the network in which the primary winding is interposed, the safety of the devices powered by the transformer is greater the lower the value of the safety factor (SF).

It is usually specified SF <...

B. COMPLEMENTARY REQUIREMENTS FOR INDUCTIVE CURRENT AND VOLTAGE TRANSFORMERS FOR PROTECTION

B.1. Designation of accuracy class

All protection voltage transformers must have a class of measurement accuracy assigned. This requirement does not extend to windings intended to supply a residual voltage.

The accuracy class of a voltage transformer for protection is designated by the maximum permissible error of the voltage in percentage, between 5% of the assigned voltage and the value of the voltage corresponding to the assigned voltage factor. This expression is followed by the letter "P".

The accuracy class of a current transformer for protection is designated by a number (class index) and the letter "P" (protection initial). The class index indicates the upper limit of the composite error for the assigned precision limit current and the precision charge.

B.2. Normal accuracy classes

The normal accuracy classes of voltage transformers for protection are 3P and 6P.

The normal accuracy classes of current transformers for protection are 5P and 10P.

B.3. Limits of errors of voltage transformers for protection

The voltage error and the phase displacement, at the assigned frequency, must not exceed the values in table 5 at 5% of the assigned voltage and at the product of the voltage assigned by the assigned voltage factor (1,2; 1,5; or 1.9) and for any charge between 25% and 100% of the precision charge, with a power factor of 0.8 inductive.

At 2% of the rated voltage, the limits of the voltage error and the phase displacement of the indicators in table 5 for the charge between 25% and 100% of the precision charge, with a power factor of 0.8 inductive.

| Accuracy class | Voltage error (ratio) in percentage \pm | Phase displacement \pm | |
|----------------|---|--------------------------|--------------|
| | | Minutes | Centiradians |
| 3P | 3,0 | 120 | 3,5 |
| 6P | 6,0 | 240 | 7,0 |

Table 5. Limits of voltage error and phase displacement of voltage transformers for protection

B.4. Limits of error in current transformers for protection

For the precision burden and the assigned frequency, the current error, the phase displacement and the compound error must not exceed the values indicated in *table 6*.

To determine the current error and the phase displacement, the charge must be inductive and equal to the precision charge with a power factor equal to 0.8 except when it is less than 5 VA; in which case it may be resistive (unit power factor).

| Accuracy class | Current error for the primary current assigned in (%) | Phase displacement for the assigned primary current | | Composite error for the primary current limit of precision in % |
|----------------|---|---|--------------|---|
| | | Minutes | Centiradians | |
| 5P | ± 1 | ± 60 | $\pm 1,8$ | 5 |
| 10P | ± 3 | -- | -- | 10 |

Table 6. Current transformer error limits for protection