C57.13.6

IEEE Standard for High-Accuracy Instrument Transformers

IEEE Power Engineering Society

Sponsored by the
Transformers Committee

IEEE
3 Park Avenue
New York, NY 10016-5997, USA

9 December 2005

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IEEE Standard for High-Accuracy Instrument Transformers

Sponsor

Transformers Committee
of the
IEEE Power Engineering Society

Approved 22 September 2005

IEEE-SA Standards Board

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Abstract: This standard defines one new 0.15 accuracy class for voltage transformers, two new 0.15 accuracy classes for current transformers, two new current transformer burdens, and two new current transformer routine accuracy test methods.
Keywords: accuracy class, burden, CT, current transformer, high-accuracy, instrument transformer, metering, meters, phase angle, PT, ratio correction factor, RCF, relays, revenue metering, TCF, transformer correction factor, voltage transformer, VT

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Introduction

This introduction is not part of IEEE Std C57.13.6-2005, IEEE Standard for High-Accuracy Instrument Transformers.

This standard defines two new accuracy classes and burdens for current transformers, and one new accuracy class for voltage transformers. These new definitions supplement those defined in IEEE Std 57.13™[a].

Widespread use of electronic meters and relays necessitates new current transformer test burden definitions because they present lower impedance than traditional induction devices. This can result in applications where the total circuit burden on the current transformer is less than the lowest IEEE Std C57.13 definition of B0.1 (2.5 VA at 5 A, 0.9 power factor). Under these conditions, a current transformer meeting a given accuracy class at B0.1 is not assured.

The new accuracy classes more closely complement the capabilities of electronic meters in both accuracy and dynamic range.

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IEEE Standard for High-Accuracy Instrument Transformers

1. Scope

This standard defines one new 0.15 accuracy class for voltage transformers, two new 0.15 accuracy classes for current transformers, two new current transformer burdens, and two new current transformer routine accuracy test methods. These supplement IEEE Std C57.13™[1]. The new burdens shall be considered for use when current transformers are to be used with electronic meters, and the total in-circuit burden will be less than B-0.1 (2.5 VA at 5 A, 0.9 power factor) defined in IEEE Std C57.13. The new accuracy classes, 0.15 and 0.15S, are available to complement the capabilities of solid state electricity metering of equipment associated with the generation, transmission, and distribution of alternating current.

There are two important differences about these new accuracy class definitions as they apply to routine current transformer test requirements:

a) A low current test is required at 5% of rated current (0.25 A secondary), in lieu of the 10% of rated current test specified in IEEE Std C57.13. This test point corresponds with the light load test point of transformer rated electromechanical and solid state electricity meters as specified in ANSI C12.20.

b) Routine testing for current transformers certified to meet 0.15 or 0.15S accuracy must include accuracy reading(s) using new burden definition E-0.04. The intent of burden E-0.04 (1.0 VA at 5 A, unity power factor) is to approximate the lowest secondary circuit burden that can occur in practical applications. Testing a current transformer at this burden is analogous to the routine no-load voltage transformer test required by IEEE Std C57.13.

2. Normative references

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ANSI C12.10, American National Standard Physical Aspects of Watthour Meters—Safety Standards.[2]

ANSI C12.20, American National Standard Electricity Meters 0.2 and 0.5 Accuracy Classes.

IEEE Std C57.13, IEEE Standard Requirements for Instrument Transformers.[3,4]

3. Definitions

All definitions shall be in accordance with IEEE 100, *The Authoritative Dictionary of IEEE Standards Terms*, and IEEE Std C57.13.

4. Basis for 0.15 and 0.15S accuracy classes for metering

The 0.15 and 0.15S accuracy classes are based on the requirement that the transformer correction factor (TCF) of the voltage or current transformer shall be within the specified limits of Table 1 when the power factor of the metered load has any value from 0.6 lagging to unity, under the following specified conditions:

a) For current transformers, burden E-0.04, and each additional specified standard burden, at 5% and at 100% of rated primary current, and at the current corresponding to the continuous thermal rating factor (RF), if it is greater than 1.0. The accuracy class at a lower standard burden is not necessarily the same as at the specified standard burden.

b) For voltage transformers, from 0 VA through the specified standard burden, and from 90% to 110% of the rated voltage. The accuracy class at a lower standard burden of different power factor is not necessarily the same as at the specified standard burden.

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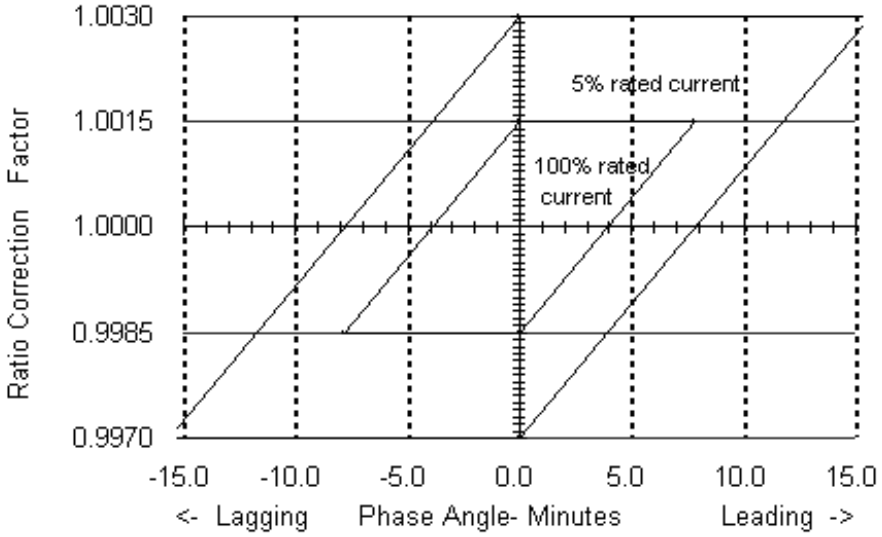
Table 1— Standard for high accuracy class metering service, with corresponding limits of transformer correction factor [0.6 to 1.0 power factor (lagging) of metered load]

	Voltage transformers (from 90% to 110% rated voltage)		Current transformers			
Metering accuracy class	*Minimum*	*Maximum*	*At 100% rated current*[a] *Minimum*	*Maximum*	*At 5% rated current Minimum*	*Maximum*
0.15	0.9985	1.0015	0.9985	1.0015	0.9970	1.0030
0.15S	N/A	N/A	0.9985	1.0015	0.9985	1.0015
NOTE—These relations are shown graphically in Figure 1 and Figure 2 for current transformers and in Figure 3 for voltage transformers.[5]						

[a] For current transformers, the 100 % rated current limit also applies to the current corresponding to the continuous thermal current rating factor, if it is greater than 1.0.



NOTE—The transformer characteristics shall lie within the stated limits of the parallelogram at 5% and 100% of rated current. For current transformers, the 100% rated current limit also applies to the current corresponding to the continuous thermal current rating factor, if it is greater than 1.0.

Figure 1—Limits for 0.15 accuracy class for current transformers for metering

[5] Notes in text, tables, and figures are given for information only, and do not contain requirements needed to implement the standard.

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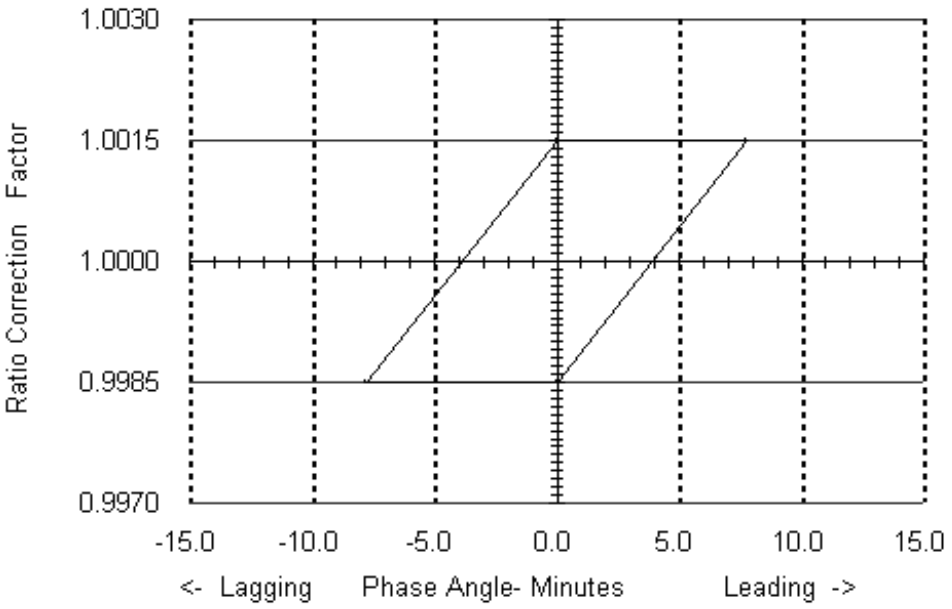
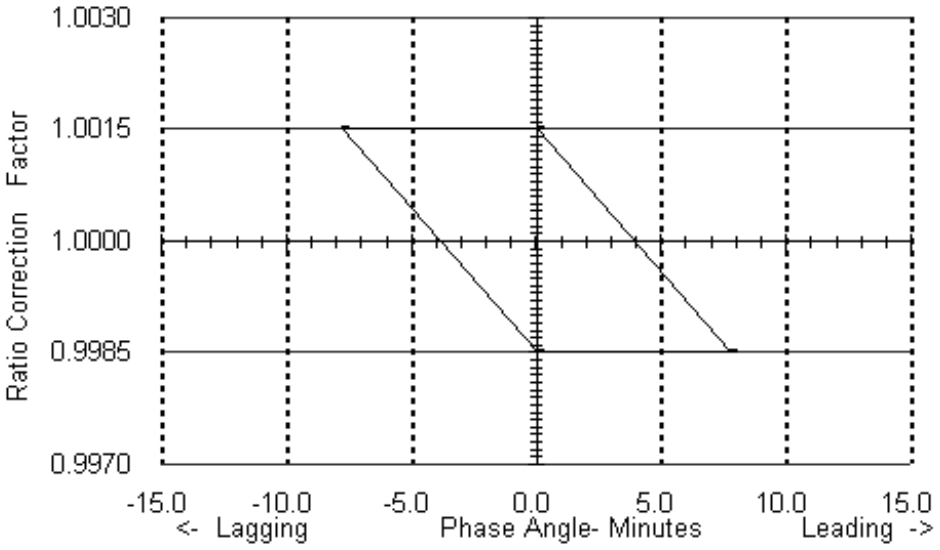


NOTE—The transformer characteristics shall lie within the stated limits of the parallelogram from 5% through 100% of rated current. For current transformers, the 100% rated current limit also applies to the current corresponding to the continuous thermal current rating factor, if it is greater than 1.0.

Figure 2——Limits for 0.15S accuracy class for current transformers for metering



NOTE—The transformer characteristics shall lie within the limits of the parallelogram for all voltages between 90% to 100% of rated voltage.

Figure 3—Limits of 0.15 accuracy class for voltage transformers for metering

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5. Basis for standard burdens for use with electronic meters and relays

Electronic meters, relays, and connecting circuits may present a lower burden or lower burden phase angle to the secondary of the current transformer than standard burdens defined in IEEE Std C57.13. An instrument transformer meeting a given accuracy class at burden B0.1 may not meet the same accuracy class when the application calls for a burden power factor between 0.9 and unity, and or less than 2.5 VA (at 5 A).

Two standard 'E' burdens for current transformers with 5 A rated secondary are defined in Table 2. These may be used with, or in addition to, burdens and accuracy classes defined in IEEE Std C57.13.

Table 2—Standard burdens for current transformers with 5 A secondary windings[a]

Burden type	Burden designation[b]	Resistance (Ω)	Inductance (mH)	Impedance (Ω)	Total Power (VA) [at 5 A]	Power factor
Electronic Metering Burdens	E-0.2	0.20	0.0	0.20	5.0	1.0
	E-0.04	0.04	0.0	0.04	1.0	1.0

[a] If a current transformer secondary winding is rated at other than 5 A, ohmic burdens for a specification and rating shall be derived by multiplying the resistance and inductance values provided in Table 2 by the factor: $[5\ A/(\text{current rating in amperes})]^2$. The burden designation, total power, and the power factor remain unchanged.

[b] These standard burden designations have no significance at frequencies other than 60 Hz.

6. Nameplates

Accuracy rating on the nameplate of a current transformer or voltage transformer shall include, as a minimum, the following (see 6.1 and 6.2):

6.1 Current transformer

The standard burdens at which the transformer is rated 0.15 or 0.15S accuracy class.

6.2 Voltage transformer

The standard burdens at which the transformer is rated 0.15 accuracy class.

7. Routine accuracy tests

7.1 Current transformers

Accuracy tests for current transformers with 0.15 or 0.15S metering accuracy ratings shall be made on each transformer when energized at rated frequency. Two or four test points defined in Table 3 may be required.

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Table 3—0.15 and 0.15S accuracy test points

Test Point[a]	Rated Current	Test Burden
1	100%	E-0.04
2	5%	Maximum rated burden
3	100%	Maximum rated burden
4	5%	E-0.04

[a] No significance to test sequence.

Test points 1, 2, 3, and 4 in Table 3 are generally required for 0.15 and 0.15S accuracy class transformers. Ratio and phase angle readings must meet the limits specified in Table 1 for the stated accuracy class.

A transformer may be certified to 0.15 or 0.15S accuracy when it can be demonstrated to inherently meet the limits specified in Table 1 for the stated accuracy class using only test point 1 and test point 2.

7.2 Voltage transformers

Tests for voltage transformers with 0.15 accuracy class ratings shall be made on each transformer, and shall consist of measurement of ratio and phase angle error when energized at 100% rated primary voltage and rated frequency.

A total of two test readings shall be made. At zero burden, and at the maximum burden for which the voltage transformer is rated to meet this accuracy class, the ratio and phase angle readings must meet limits specified in Table 1.

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