

IEEE Standard
DRAFT: PC57.13.6/D3

Draft Standard for High Accuracy Instrument Transformers

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Introduction

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. 57.13-1993R, Standard Requirements for Instrument Transformers.

Widespread use of electronic meters and relays necessitate 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. C57.13-1993R definition of B0.1 (2.5Volt-Amperes at 5Amp, 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.

This draft standard was prepared by the IEEE working group PC 57.13.6, Standard for High Accuracy Instrument Transformers, which had the following membership:

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Standard for High Accuracy Instrument Transformers

1. Scope

This Standard defines one new 0.15 voltage transformer accuracy class, two new 0.15 current transformer accuracy classes, two new current transformer burdens, and two new current transformer routine accuracy test methods. These supplement IEEE Std. C57.13-1993R, Standard Requirements for Instrument Transformers. 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 B0.1 (2.5Volt-Amperes at 5 Amp, 0.9 power factor) defined in IEEE Std. C57.13-1993R. 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-

- 1.1 A low current test is required at 5% of rated current (0.25A secondary), in lieu of the 10% of rated current test specified in IEEE Std. C57.13-1993R. This test point corresponds with the light load test point of transformer rated electromechanical and solid state electricity meters as specified in ANSI C12.20-2002.
- 1.2 Routine testing for current transformers certified to meet 0.15 or 0.15S accuracy must include accuracy reading(s) using new burden definition E0.04. The intent of burden E0.04 (1.0 Volt-Ampere at 5Amp, 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. C57.13-1993R.

2. References

This standard shall be used in conjunction with the following publications. When the following publications are superseded by an approved revision, the revision shall apply.

IEEE Std. C57.13-1993R, IEEE Standard Requirements for Instrument Transformers
IEEE Std. C12.10-1997, American National Standard for Electromechanical Watt-hour Meters
ANSI C12.20-2002, Standard for Electricity Meter 0.2 AND 0.5 Accuracy Classes

3. Definitions

All definitions, and IEEE Std. C57.13-1993R, shall be in accordance with "The Authoritative Dictionary of IEEE Standards Terms", IEEE 100, Seventh Edition.

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

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

- 4.1 For current transformers, burden E0.04, 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.
- 4.2 For voltage transformers, from zero volt-amperes 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.

4.3 The limits of transformer correction factor for 0.15 and 0.15s accuracy class shall be as shown in Table 1.

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]

Metering accuracy class	Voltage transformers (from 90% to 110% rated voltage)		Current transformers			
	<i>Minimum</i>	<i>Maximum</i>	<i>At 100% rated current¹</i>		<i>At 5% rated current</i>	
			<i>Minimum</i>	<i>Maximum</i>	<i>Minimum</i>	<i>Maximum</i>
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 & 2 for current transformers, and in Figure 3 for voltage transformers.

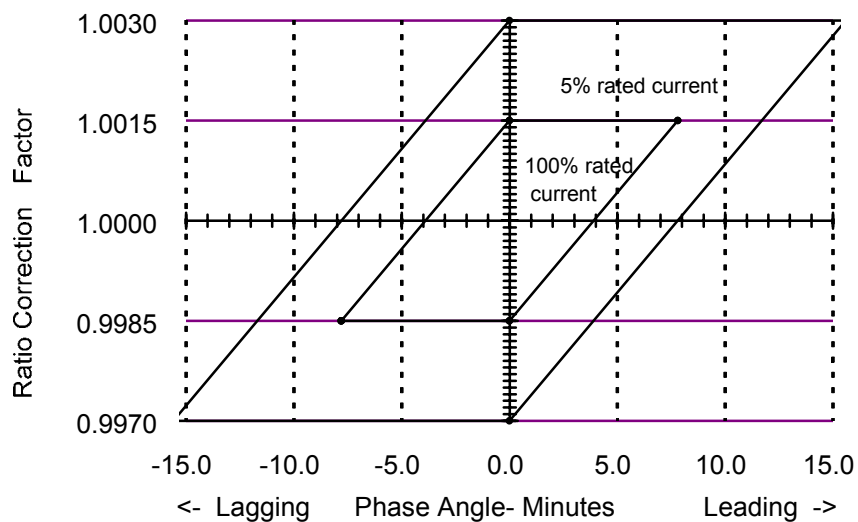


Figure 1- Limits for 0.15 accuracy class for current transformers for Metering

NOTE- The transformer characteristics shall lie within the stated limits of the parallelogram at 5%, and 100% of rated current¹.

¹For 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.

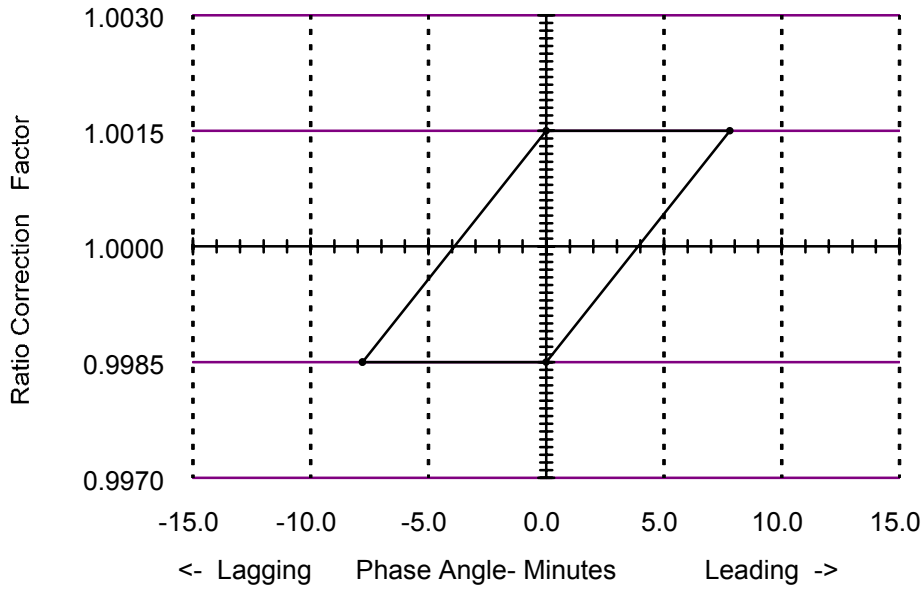


Figure 2- Limits for 0.15S accuracy class for current transformers for metering

NOTE- The transformer characteristics shall lie within the stated limits of the parallelogram from 5% through 100% of rated current¹.

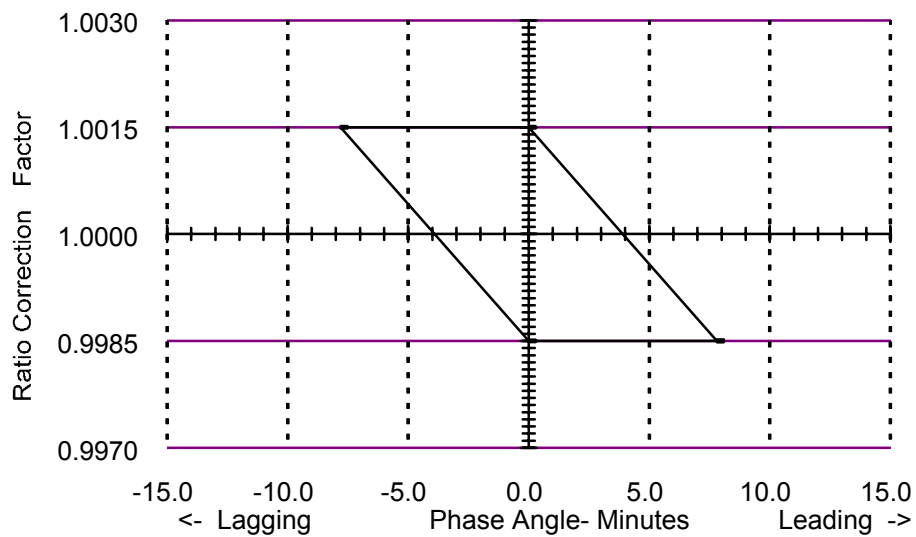


Figure 3- Limits of 0.15 accuracy class for voltage transformers for metering

NOTE- The transformer characteristics shall lie within the limits of the parallelogram for all voltages between 90% to 110% of rated voltage.

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. C57.13-1993R. 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 2.5VA (at 5A).

Two standard 'E' burdens for current transformers with 5A rated secondary are defined in Table 2. These may be used with, or in addition to, burdens and accuracy classes defined in IEEE Std. C57.13-1993R.

Table 2- Standard burdens for current transformers with 5A secondary windings*.

Burden type	Burden designation†	Resistance (Ω)	Inductance (mH)	Impedance (Ω)	Volt Amperes (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

* If a current transformer secondary windings rated at other than 5 A, ohmic burdens for a specification and rating shall be derived by multiplying the resistance and inductance of the table $[5/(\text{ampere rating})]^2$, the VA at rated current, the power factor, and the burden designation remaining the same.

† These standard burden designations have no significance at frequencies other than 60 Hz.

6. Nameplates

Accuracy rating on Nameplates shall include, as a minimum, the following:

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.

Table 3- 0.15 and 0.15S accuracy test points

Test Point*	Rated Current	Test Burden
1	100%	E-0.04
2	5%	Maximum rated Burden
3	100%	Maximum rated Burden
4	5%	E-0.04

* 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 points 1 and 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.