UPDATE TO ANSI STANDARDS

2014

UPDATE TO ANSI STANDARDS.

Several new releases to various ANSI standards will soon be issued.

- The purpose of this discussion is to highlight the upcoming changes to:
  - ANSI C12.1 – American National Standard for Electricity Meters -Code for Electricity Metering
  - ANSI C12.20 – American National Standard for Electricity Meters -0.1, 0.2, and 0.5 Accuracy Class

BUT FIRST ……

2 Things to keep in mind when

discussing ANSI Standards

BUT FIRST ……

1 State Regulations ***trump***

ANSI Standards !!

BUT FIRST ……

AND

Understand how each Standard is Organized and where it's applicable

ANSI – APPLICATION AND ORGANIZATION

ANSI C12.1

Applies to all meters that are not cover under a separate standard i.e. ANSI C12.20.

1. Section 1 –**Scope and References**
2. Section 2 **- Definitions**
3. Section 3 - **Standards and standardizing equipment**
4. Section 4 - **Performance requirements**

   Note: Section 4 only applies to Type Testing

   Type Testing is only performed when qualifying a new meter type.
5. Section 5 -**Standards for new and in-service performance**
6. Appendixes are ALL INFORMATIVE

ANSI C12.20

Applies to all AC 01,0.2, and 0.5 meters that MEET BLONDEL'S THEOREM.

Any requirement not explicitly stated in C12.20, falls back onto C12.1.

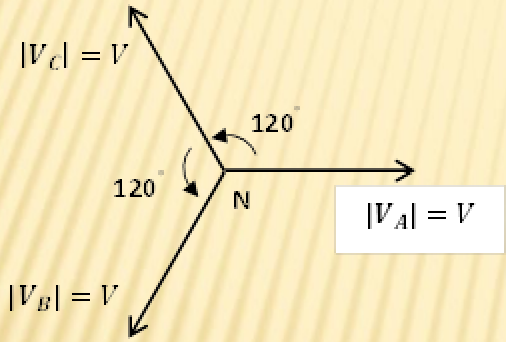
Requirements for any meter type that does not meet BLONDEL's Theorem falls back onto C12.1

CHANGES – ANSI C12.1

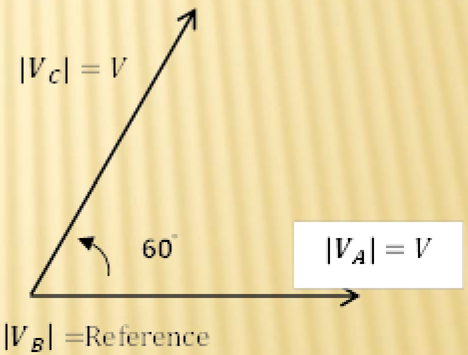
Section 2– Definition Changes

- Added definitions for balanced voltages along with diagrams:

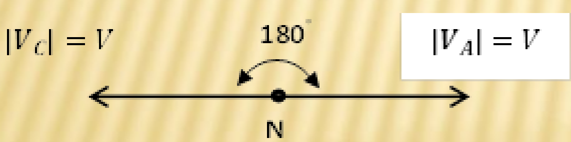
•3 Phase, 4 wire wye – Equal line to neutral magnitudes, 120º relative phase angles



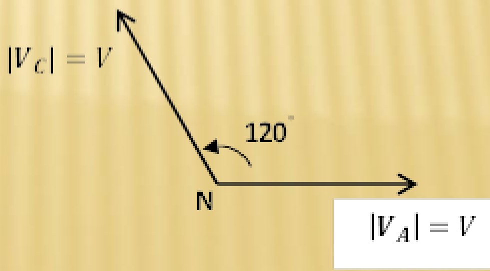
•3 Phase, 3 wire delta – Equal line to line magnitudes, 60º relative phase angles



•1 Phase, 3 wire – Equal line to neutral magnitudes, 180º relative phase angle



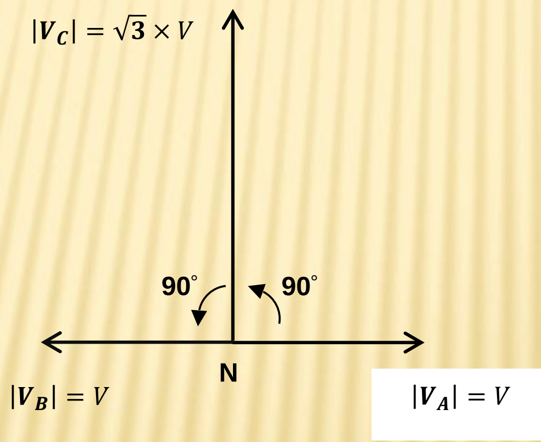
•3 wire network – Equal line to neutral magnitudes, 120º relative phase angle



Section 2– Definition Changes

- Added definitions for balanced voltages along with diagrams:

•3 Phase 4 wire delta – Two equal line to neutral magnitudes, 180º relative phase angle.
•Third line to neutral voltage; 3 times greater magnitude, 90º relative phase angle.



CHANGES – ANSI C12.1

Section 2– Definition Changes

- Added definitions for the following:

2.9 **cover:** a lid or equipment covering used to protect the measurement components of a meter from external elements while allowing the viewing of the dials and nameplate information. A cover may contain other components which may be required for resetting demand and electronically reading the meter

2.41 **Instrument transformer:** A transformer that reproduces in its secondary circuit a definite and known proportion of the voltage or current of its primary circuit with the phase relation substantially preserved.

2.44 **meter**: A device that measures and records the consumption or usage of the product/service. In this standard, the term "meter" refers to a type of metering device.

2.105 **watthour meter – instrument transformer rated:** A meter in which the terminals are arranged for connection to the circuit being measured using external instrument transformers.

CHANGES – ANSI C12.1

Section 3 -Standards and standardizing equipment

1. Section 3.3 Traceability paths to NIST:
   Removed the NIST Traceability Path diagram. It still appears in Appendix B, under B.4 Establishing a Local Reference Standard of Energy

2. Section 3.10.2.2.2 Performance requirements
   Tightened the % errors for portable and reference standards at reference conditions including a specific voltage and current.

   At these reference points, the error, after the application of the calibration values of the portable and reference standards, shall not exceed the values in Table 1a.

Table 1a – Portable and Reference Standards Percent Errors

Standards	Percent Error	
	@ 1.00 PF	@ 0.5 PF
Portable Standard (Section3.8)	0.05 %	0.05 %
Reference Standard (Section3.6)	0.02%	0.02%

CHANGES – ANSI C12.1

Section 3– Standards and standardizing equipment

3. Section 3.10.2.2.3 Variation for reference condition
   Gave additional percent errors for Portable and Reference Maximum Percent Errors @ 23°C over the designed range of voltage and current

Additionally, at the reference temperature the error of the standard shall not exceed the values in Table 1b over the design range of voltage and current.

Table 1b – Portable and Reference Maximum Percent Errors @ 23°C

Standards	Percent Error	
	@ 1.00 PF	@ 0.5 PF
Portable Standard	0.07 %	0.07 %
Reference Standard	0.04%	0.04%

CHANGES – ANSI C12.1

Section 4– Acceptable performance of new types of Electricity meters and associated equipment

Section 4.7.1 Test conditions under Performance Requirements

Addition of some clarity for the calibration level of meters prior to testing and highlighted that no adjustments are to be made during the test.

4.7.1 Test conditions

Unless otherwise specified, all tests shall be made with the meter under test mounted in a conventional manner on a suitably rated meter mounting device (example, socket or load box), free from vibration. All alternating current tests shall be conducted on a circuit supplied by a sine-wave source with a distortion factor not greater than 3%. Where the meter has more than one voltage and current circuit, it shall be tested with the voltage circuits effectively in parallel and the appropriate current circuit(s) energized effectively in series, unless otherwise specified. For meters with auxiliary devices powered line-to-line, the meter shall be tested with the voltage and current circuits individually energized to power the auxiliary device as it would be in normal operation.

Before the start of testing, the meters shall be calibrated to be as close as practical to zero error. The reference performance shall be as close as practical to zero error and in no case shall exceed ±0.4% error for accuracy class 1.0 or exceed ±0.2% error for accuracy class 0.5.

The calibration shall not be readjusted for the duration of the testing.

All tests shall be made at 23ºC ± 5ºC, rated voltage ± 3%, rated frequency ± 1 Hz, test amperes ± 3%, and unity power factor ± 2º, unless otherwise indicated in specific tests. The meter shall be stabilized at ambient temperature before performance tests are made. A list of all the required tests is shown in Table 3.

CHANGES – ANSI C12.1

Section 4– Acceptable performance .....

Section 4.7.2 Accuracy Tests – Internal Influences

1. *Added 0.5% Accuracy Class Limits for applicable tests #s 2 → 7, 11, 19, 20, and 21*
2. *Added conditions for meters that measure in both delivered and received directions for test #2 –Starting Load, test # 3- Load Performance and test #4 – Effect of Variation of Power Factor .*

Table 4 – Starting Load Test

Current Class	Current In Amperes	
	1.0 Accuracy Class	0.5 Accuracy Class
10	0.025	0.01
20	0.025	0.01
100	0.15	0.05
200	0.30	0.10
320	0.50	0.16

Table 5–Load Performance Test

Condition	Current Class					Maximum Deviation In Percent From Reference Performance	
	10	20	100	200	320	1.0 Accuracy Class	0.5 Accuracy Class
	Current In Amperes						
(1)	0.15	0.15	1	2	3	±2.0	±1.0
(2)‡	0.25	0.25	1.5	3	5	±1.0	±0.5
(3)	0.5	0.5	3	6	10	±1.0	±0.5
(4)	1.5	1.5	10	20	30	±1.0	±0.5
(5)‡	2.5	2.5	15	30	50	Reference	Reference
(6)	–	5	30	60	75	±1.0	±0.5
(7)	5	10	50	100	100	±1.5	±0.5
(8)‡	7.5	15	75	150	150	±2.0	±0.5
(9)	–	18	90	180	250	±2.0	±0.5
(10)	10	–	100	200	300	±2.0	±0.5
(11)	–	20	–	–	320	±2.5	±0.5

‡ If the meter is designed for measurement of energy in both directions, , then these conditions shall be performed twice, once with energy flowing only in the forward or "delivered" direction, and once with energy flowing only in the reverse or "received" direction.

CHANGES – ANSI C12.1

Section 4– Acceptable performance .....

Section 4.7.2.4 Test No. 4: Effect of variation of power factor

1. *Added a test amps point for reference for conditions 2 and 3*
2. *Added the lead and lag reference for conditions 2 and 3*
3. *Added the 0.5 accuracy class performance limits.*
4. *Added conditions for meters that measure in both delivered and received directions.*

Table 6 – Effect of Variation of Power Factor for Single-Element Meters

Condition	Current Class 10	20	100	200	320	Power Factor	Maximum Deviation In Percent From Reference Performance: 1.0 Accuracy Class	0.5 Accuracy Class
	Current In Amperes							
Reference performance for Condition (1)	0.2	0.5	1.5	3	5	1.0	Reference	Reference
Condition (1)	0.5	1	3	6	10	0.5 lag	±2.0	±1.0
Reference performance for Condition 2 & 3	2.5	2.5	15	30	50	1.0	Reference	Reference
Condition (2) ‡	2.5	2.5	15	30	50	0.5 lag	±1.0	±0.6
Condition (3) ‡	2.5	2.5	15	30	50	0.866 lead	±1.0	±0.6
Reference performance for Condition (4)	5	10	50	100	150	1.0	Reference	Reference
Condition (4)	5	10	50	100	150	0.5 lag	±2.0	±0.6
Reference performance for Condition (5)	10	20	100	200	320	1.0	Reference	Reference
Condition (5)	10	20	100	200	320	0.5 lag	±2.0	±0.6

‡ If the meter is designed for measurement of energy in both directions, , then these conditions shall be performed twice, once with energy flowing only in the forward or "delivered" direction, and once with energy flowing only in the reverse or "received" direction.

Note that Table 6 provides performance limits for SINGLE Phase Meters.

While Table 7, 8, and 9 provides for various types of polyphase meters.

Table 8 added 320A column.

CHANGES – ANSI C12.1

Section 4– Acceptable performance …..

Section 4.7.2.5 Test No. 5: Effect of variation of voltage on the meter

1. *Added a reference to wide voltage range meters in order to evaluate deviations from Table 13 of ANSI C12.20.*

4.7.2.5 Test No. 5: Effect of variation of voltage on the meter

The effect of variation of voltage upon the performance of the meter shall not exceed the maximum deviation specified in Table 10. For meters with a wide voltage range, the effect of variation of voltage upon the performance of the meter shall not exceed the maximum deviation specified in Table 13 of ANSI C12.20-2010, Accuracy Class 0.5.

Table 10 – Effect of Variation of Voltage

Condition	Current Class					Maximum Deviation In Percent From Reference Performance	
	10	20	100	200	320		
	Current In Amperes					1.0 Accuracy Class	0.5 Accuracy Class
Reference performance 100% of calibration voltage for Condition (1) and (2)	0.25	0.25	1.5	3	5	Reference	Reference
Condition (1) 90% of calibration voltage	0.25	0.25	1.5	3	5	±1.0	±0.2
Condition (2) 110% of calibration voltage	0.25	0.25	1.5	3	5	±1.0	±0.2
Reference performance 100% of calibration voltage for Conditions (3) and (4)	2.5	2.5	15	30	50	Reference	Reference
Condition (3) 90% of calibration voltage	2.5	2.5	15	30	50	±1.0	±0.2
Condition (4) 110% of calibration voltage	2.5	2.5	15	30	50	±1.0	±0.2

CHANGES – ANSI C12.1

Section 4– Acceptable performance …..

Section 4.7.2.8 Test No. 8: Meter Losses

1. *Added for clarity that the loss in each current circuit of a meter will be measured at the reference test amps*

4.7.2.8 Test No. 8: Meter losses

The loss in each current circuit of a meter, measured at test amps, shall not exceed 0.5 VA for Class 10 and Class 20 meters or 1.0 VA for Class 100, Class 200, and Class 320 meters. For two-element, three-phase, four-wire wye Class 10 and Class 20 meters, loss in the current circuit common to both elements shall not exceed 1.0 VA. The loss in each voltage circuit of a meter shall neither exceed 5 watts or 20 VA. The losses in auxiliary devices that are powered by the meter power supply or connected to the line side terminals are not included.

CHANGES – ANSI C12.1

Section 4– Acceptable performance …..

Section 4.7.2.9 Test No. 9: Temperature Rise

1. *Clarified the test methodology i.e. how the test is to be performed, including the wire size and length.*
2. *Added performance conditions which are not to be exceeded in table 16*

4.7.2.9 Test No. 9: Temperature rise

The test shall be made with the specified current applied to all current circuits in series adding. This test shall be applied to one meter of each class. All tests shall be performed in a room essentially free from drafts with the meter cover in place. The meter shall be mounted in a conventional manner on a suitably rated meter mounting device (socket) as defined in Table 16. Not less than 4 ft (1.22 m) (8 ft (2.44 m) jumper between terminals) of stranded, insulated, copper conductor as specified in Table 16 shall be connected to the line and load current terminals of the meter or meter mounting device (socket). Two 2-foot (0.6 m) lengths of rigid steel conduit as specified in Table 16 are to be installed in the top and/or bottom of the meter mounting device. For detachable (type "S") meters, the opening where the conductors enter and leave the conduit and any other openings shall be closed with suitable material to prevent drafts.

Table 16 – Temperature-Rise Test Specifications

Meter Class Designation	Wire-Size* (AWG Copper)	Current In Amperes	Detachable Meters				Conduit trade size inches for
			Socket Rating In Amperes	Simulated Meter	Maximum Temperature Rise, Jaws	Maximum Temperature Rise, Simulated Meter Jumper Bar	4 wires
10	No. 10	10	20 (min)	None	65°C		3/4
20	No. 10	20	20 (min)	None	65°C		3/4
100	No. 2	100	Maximum of 135 continuous	Fig. 1	65°C	85°C	1 1/4
200	No. 4/0	200	Maximum of 200 continuous	Fig. 2	65°C	85°C	2
320	1-500 MCM or 2-4/0	320	Maximum of 320 continuous	Fig. 3	65°C	90°C	3

*Wire sizes for 100, 200, and 320 A are those specified in ANSI/NFPA 70 for 60°C temperature rating.

CHANGES – ANSI C12.1

Section 4– Acceptable performance …..

Section 4.7.2.9 .1 Test No. 9: Temperature Rise (Con't)

1. *Further clarification of the test methodology i.e. location of temperature detectors*
2. *Description of use of the "simulated" meter*
3. *Also clarified that an accuracy test shall be performed after the temperature rise test.*

4.7.2.9.1 Test on class 10, 20, 100, 200, and 320 meters

The temperature-rise test shall be made by means of temperature detectors in intimate contact with the metal of the current circuit and located at its approximate center. The temperature detectors for the socket jaws shall be in intimate contact with the metal of the jaws and located as shown in Figure 1.

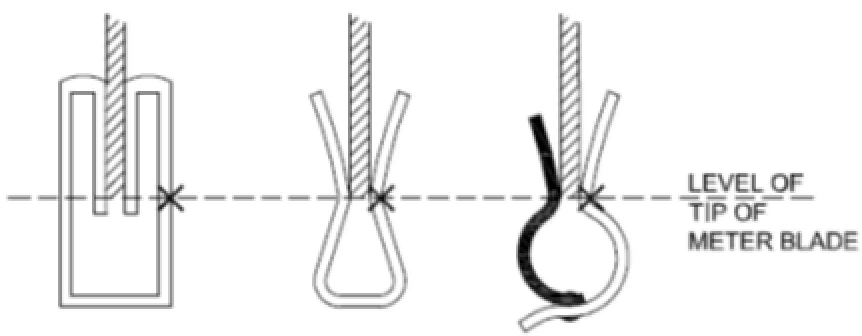


Figure 1 – **location** of temperature detectors

CHANGES – ANSI C12.1

Section 4– Acceptable performance …..

Section 4.7.2.14 Test No. 14: Independence of Elements

1. *Identified test conditions for Accuracy Class 0.5 meters – aligning with ANSI C12.20*

4.7.2.14 Test No. 14: Independence of elements

Meters without independent elements may use isolation transformers or the electronic equivalent for this test. For Accuracy Class 0.5 meters the followingtest shall apply. At full load and light load, with unity power factor, the difference between registration of ABC rotation, CBA rotation, and series load shall not exceed 0.6%. For Accuracy Class 1.0 meters the requirements in sections 4.7.2.14.1 or 4.7.2.14.2 shall apply.

Section 4.7.3.1 Test No. 15: Insulation

1. *Added details specifying that specific components within solid state meters should be disconnected*
2. *Also noting that the potential circuit may be isolated by any means if the meter does not have a test link.*
3. *Removed the accuracy performance check after an insulation test*

4.7.3.1 Test No. 15: Insulation

With the meter voltage and current circuits de-energized, the insulation between current carrying parts of separate circuits and between current-carrying parts and other metallic parts shall be capable of withstanding the application of a sinusoidal voltage of 2.5 kV rms, 60 Hz for 1 minute. The input circuit of the pulse initiators with independent power supplies shall be tested at 1.5 kV rms, 60 Hz for one minute. For both the 1.5 and 2.5 kV rms test, the leakage current shall not exceed 0.005 Amps per circuit. Low-voltage electronic circuits, operating at less than 40 V rms, and all output relay terminals, shall not be subjected to this test.

Components providing a path in parallel with the insulation to be tested, such as discharge resistors for filter capacitors, voltage limiting devices or surge suppressors, should be disconnected.
For self-contained meter forms any potential circuit burden that cannot be isolated by means of test links may be isolated by disconnection or other appropriate means.

CHANGES – ANSI C12.1

Section 4– Acceptable performance …..

Section 4.7.3.3 Test No. 17: Effect of high voltage line surges

1. *Added clarification on when the accuracy check may be performed for the 100kHz ring wave test.*

4.7.3.3.1 100 kHz ring wave

An Accuracy Performance Check shall be performed (4.7.3). It is acceptable to perform the Accuracy Performance Check (4.7.3) once after the completion of both 100 kHz ring wave test and the 1.2/50 microsecond – 8/20 microsecond Combination Wave test.

Section 4.7.3.16 Test No. 30: Effect of operating temperature

1. *Changed the ramp time from 6 hours to 5 hours*
2. *Clarified that the current during the test should be between Light Load and Test Amps.*
3. *Clarified that it is acceptable to perform the accuracy test after Test 31 – Relative Humidity Test*

4.7.3.16 Test No. 30: Effect of operating temperature

An Accuracy Performance Check shall be performed (4.7.3).
It is acceptable to perform the Accuracy Performance Check (4.7.3) once after the completion of both Effect of operating temperature test and the Effect of relative humidity test.

CHANGES – ANSI C12.1

Section 5– Standards for new and in-service performance

Overall changes

1. *Explicitly covers various metering devices as outlined in the general purposes.*
2. *Clarifies the use of ANSI Z1.4/Z1.9 as an acceptable sampling plan along with acceptable AQL levels if Z1.4 or Z1.9 is used.*
3. *Identifies corrective actions if a sampled group does not meet the acceptance criteria.*
4. *Changes to the Variable-Interval Plan allowing for random selection of in-service solid-state meters*
5. *The informational table regarding the Variable-Interval Plan was moved to the appendix.*

5.0 General Principles

5.0.1 Purpose

The purpose of this section is to establish accuracy limits, test plans and inspection procedures that apply to all metering devices including:

5.1) Watthour meters
5.2) Instrument transformers (external to meter)
5.3) Coupling capacitor voltage transformers (external to meter)
5.4) Integrated meter communication devices
5.5) Service Switches (integrated and external to meter)
5.6) Demand and Interval registers (integrated)
5.7) Other energy measurement devices not already listed (integrated and external to meter)
5.8) Other non-energy measurement devices in a meter circuit (integrated and external to meter)

The performance conditions specified within section 5.0 General Principles apply to all metering devices unless superseded by conditions listed within any section herein. Integrated devices refer to devices under the meter cover.

CHANGES – ANSI C12.1

Section 5– Standards for new and in-service performance

Section 5.0.3.2 New metering device acceptance testing

5.0.3.2 New metering device acceptance testing

Sampling and acceptance testing of new device shipments is performed to determine the acceptability of these devices as delivered from the manufacturer or supplier.

The following guidelines are recommended for the sampling and acceptance testing:

The minimum sample size will be based upon the number of metering devices in the shipment or production lot using ANSI/ASQ Z1.9, *Sampling Procedures and Tables for Inspection by Variables for Percent Nonconforming* or ANSI/ASQ Z1.4, *Sampling Procedures and Tables for Inspection by Attributes*. ANSI/ASQ Z1.4 is a statistical sampling plan which evaluates items based on attributes or pass-fail criteria. ANSI/ASQ Z1.9 is a statistical sampling plan which evaluates items based on a measured variable and its conformance within specified limits.
Any combination of these two standards or an alternative statistically valid program, with the appropriate certification documentation for the alternative plan, may be used

When using ANSI/ASQ Z1.9 or ANSI/ASQ Z1.4, the new metering device samples will be tested and the results evaluated using the approved sampling standard. An Acceptable Quality Limit or AQL of 1.0% or less will be used to develop the acceptance criteria for all metering devices. Testing may be performed by either the Utility or the Manufacturer.

Here's our out !!

CHANGES – ANSI C12.1

Section 5– Standards for new and in-service performance

Section 5.0.3.4 Test Plans

5.0.3.4 Test plans

5.0.3.4.1 Periodic interval plan

The periodic interval plan is a schedule of testing for metering devices at various set intervals.

5.0.3.4.2 Variable-interval plan

The Variable Interval Test Plan allows the utility to divide the metering device population into homogeneous groups for testing. Metering devices to be tested shall target those that are most likely to be outside of accuracy tolerances, e.g. those longest in service without test for electromechanical meter devices or any random selection for solid state metering devices. The percentage of metering devices to be tested shall be determined by the past historical results of the percentage of metering devices found outside the acceptable performance limits specified in section 5.1.1.2.

Appendix F shows an example of one method that may be used to determine appropriate test rates. Other methods for determining test rates may be registered within individual regulatory body guidelines.

5.0.3.4.3 Statistical sampling plan

The statistical sampling plan provides for the division of metering devices into homogeneous groups. The selection process is random where each metering device within each group has an equal chance of being selected.

The statistical sampling plan used shall conform to the accepted principles of statistical sampling based on either variables or attributes methods as found in either ANSI/ASQ Z1.9, or ANSI/ASQ Z1.4. Any combination of these two standards or statistically valid programs may be used as described in section 5.0.3.4.

CHANGES – ANSI C12.1

Section 5– Standards for new and in-service performance

Section 5.0.3.4.4 Corrective Action

5.0.3.4.4 Corrective Action for any metering device or group of metering devices failing to meet performance criteria

If a group does not meet the acceptance criteria of any of the in-service test plans listed in section 5.0.3.4, then corrective action shall be taken consisting of one or more of the following:

- an accelerated test program
- splitting a group into two or more subgroups
- a time specific retirement program
- a sample driven retirement program

CHANGES – ANSI C12.1

Section 5– Standards for new and in-service performance

Section 5.2 Instrument transformers

5.2 Instrument transformers (external to meter)

5.2.1 Pre-installation tests

Prior to installation, all new instrument transformers shall be tested for voltage withstand, ratio correction factor, and phase angle. These tests shall be performed in accordance with the criteria established in IEEE C57.13.

5.2.2 Instrument transformers removed from service

Instrument transformers removed from service do not follow the general requirements in section 5.0.2.4 and can be returned to service without further testing.

5.2.4 Inspection

When metering installations are inspected, the instrument transformers associated with the installations should receive a close visual inspection for correctness of connections, evidence of any damage, and verification of the transformers' ratios against ratios recorded by the utility and any ratios programmed into the associated metering device.

CHANGES – ANSI C12.1

Section 5– Standards for new and in-service performance

Section 5.5 Service Switches

1. *Focus is on testing NEW devices; making in-service testing optional.*

5.5 Service Switches (integrated and external to meter)

5.5.1 Performance tests

New Service Switches will be tested using ANSI/ASQ Z1.4 statistical sampling plan which evaluates the performance of the switches based on attributes or pass-fail criteria. As a minimum a switch should be opened and then closed as part of the test. A service switch passes the test if it successfully completes an open and close cycle. The AQL will be as defined in section 5.0.3.2 for new devices. If a utility also elects to perform an in-service tests for service switches this should also be done using ANSI/ASQ Z1.4.

Can be used for In Service testing of service switches
if the Utility chooses to do so!!

CHANGES – ANSI C12.1

Other Sections

Appendix D – Periodic Testing Schedules

1. *The Appendix contains informational items only – no requirements.*
2. *Cleaned up the old table, placed a reference to AMI meters with an attempt at a definition, below.*

APPENDIX D

(Informative)
Periodic Testing Schedule

Based on best business practices in the industry the following table contains a recommended periodic program:

Periodic Testing Schedule

Meter Type	YEARS BETWEEN TESTING
AMI Meters	8
All Other Meters	16

An alternative for the 16 year interval for All Other meters would be to test 1/16 of the defined population each year.

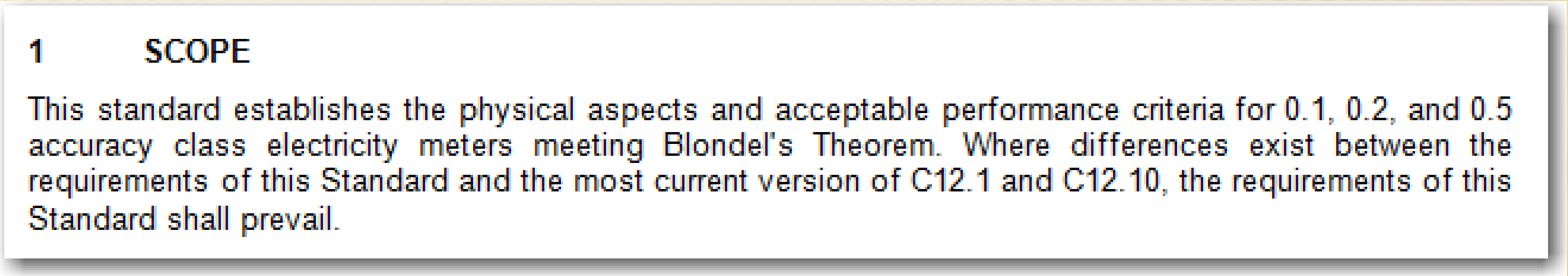
Alternative periodic intervals may be substituted if results demonstrating longer or shorter useful life cycles for a specific type of meter can be documented.

An AMI (Advanced Meter Infrastructure) meter is an electrical meter that records consumption of electrical energy in intervals of an hour or less and communicates that information for monitoring and billing purposes and is capable of secure remote upgrades of the meter's firmware.

CHANGES – ANSI C12.20

Outline of changes

1. Scope change – Now includes 0.1 Accuracy Class meters
   a) General focus is on TYPE TESTING
   b) Defers to ANSI C12.1 for in service testing.



1 SCOPE

This standard establishes the physical aspects and acceptable performance criteria for 0.1, 0.2, and 0.5 accuracy class electricity meters meeting Blondel's Theorem. Where differences exist between the requirements of this Standard and the most current version of C12.1 and C12.10, the requirements of this Standard shall prevail.

2. Clarifies which meter forms meet Blondel's Theorem and are therefore covered under ANSI C12.20. Also list those meter forms that are NOT covered.
3. Moving away from Series-Parallel loading toward true polyphase loading.
4. Identifies Typical and Alternative loading methods for applicable meter forms
5. Test 3 (load performance),4 (Power Factor),5 (voltage variation) and 14 (polyphase loading) must be performed with both the Typical and Alternative loading methods.
6. Added Harmonic Influence tests with 6 specific non-sinusoidal waveforms

Section 5.5.2 – Loading for accuracy Tests

5.5.2 Loading for accuracy tests

Unless otherwise specified, accuracy tests may be done with either series-parallel loading or polyphase loading; however, polyphase loading is recommended for all multi-element meters For series-parallel loading, the meter shall be tested with the voltage circuit(s) effectively in parallel and with the appropriate current circuit(s) energized effectively in series. For polyphase loading, the meter shall be tested with voltage and current phase angles similar to actual service installations as described (polyphase loading) in Table 3.

When polyphase loading is used, the appropriate loading will depend on the meter configuration (meter Form). Accuracy tests done with polyphase loading shall pass for Typical Loading configurations as shown in Table 3. If the meter is certified for use with an alternate loading configuration, then for those tests designated in the last column of Table 6, testing shall be performed using all Alternate Loading configuration(s) particular to the type description shown in Table 3. The internal meter connections for these Forms Designations are provided in ANSI C12.10 Table 3 – Polyphase Service loading for use on Accuracy Tests.

Table 3 – Polyphase Service loading for use on Accuracy Tests

Description	Form Designations	Typical Loading	Alternate Loading
Two Element, Self Contained	12S, 13S, 25S, 13A	Three wire, Network	• Three wire, 3 Phase, delta • Three wire, 1 Phase
Two Element, Transformer Rated	5S, 26S, 35S, 45S, 56S, 5A, 35A, 45A	Three wire, 3 Phase, delta	• Three wire, 1 Phase • Three wire, Network
Three Element, Self Contained	16S, 16A	Four wire, wye	• Four wire, delta
Three Element, Self Contained	17S	Four wire, delta	None
Three Element, Transformer Rated	9S, 10S, 39S, 9A, 10A, 48A	Four wire, wye	• Four wire, delta

CHANGES – ANSI C12.20

Section 5.5.2 – Loading for accuracy Tests

Table 6 – List of tests

ANSI C12.20	Descriptions Of Certification Tests	Polyphase or Series-parallel loading	Tests (✓) Performed in Series	Precision or Nominal Source	Required Alternative Loading Tests *
Test #1	No Load	Either		P	
Test #2	Starting Load	Either		P	
Test #3	Load Performance	Either		P	✓
Test #4	Effect of Variation of Power Factor	Either		P	✓
Test #5a or 5b	Effect of Variation of Voltage	Either		P	✓
Test #6	Effect of Variation of Frequency	Either		P	
Test #7	Equality of Current Circuits	Either		P	
Test #8	Internal Meter Losses	Either		N	
Test #9	Temperature Rise	Either		N	
Test #10	Effect of Register Friction	Either		P	
Test #11	Effect of Internal Heating	Either		P	
Test #12	Effect of Tilt	Either		P	
Test #13	Stability of Performance	Either		N	
Test #14	Effect of Polyphase Loading	Per Test		P	✓
Test #15	Insulation		✓	NA	
Test #16	Voltage Interruptions		✓	N	
Test #17	Effect of High Voltage Line Surges		✓	N	
Test #18	Effect of External Magnetic Field			P	
Test #19	Effect of Variation of Ambient Temperature	Either		P	
Test #20	Effect of Temporary Overloads			N	
Test #21	Effect of Current Surges in Ground Conductors			N	
Test #22	Effect of Superimposed Signals			NA	
Test #23	Effect of Voltage Variation-secondary Time Base			NA	
Test #24	Effect of Variation of Ambient Temperature - Secondary Time Base			NA	
Test #25	Electrical Fast Transient/Burst		✓	N	
Test #26	Effect of Radio Frequency Interference			N	
Test #27	Radio Frequency Conducted and Radiated Emission			N	
Test #28	Effect of Electrostatic Discharge (ESD)		✓	N	
Test #29	Effect of Storage Temperature			N	
Test #30	Effect of Operating Temperature		✓	N	
Test #31	Effect of Relative Humidity		✓	N	
Test #32	Mechanical Shock			NA	
Test #33	Transportation Drop			NA	
Test #34	Mechanical Vibration			NA	
Test #35	Transportation Vibration			NA	
Test #36	Weather Simulation			NA	
Test #37	Salt-spray			NA	
Test #38	Rain-tightness			NA	

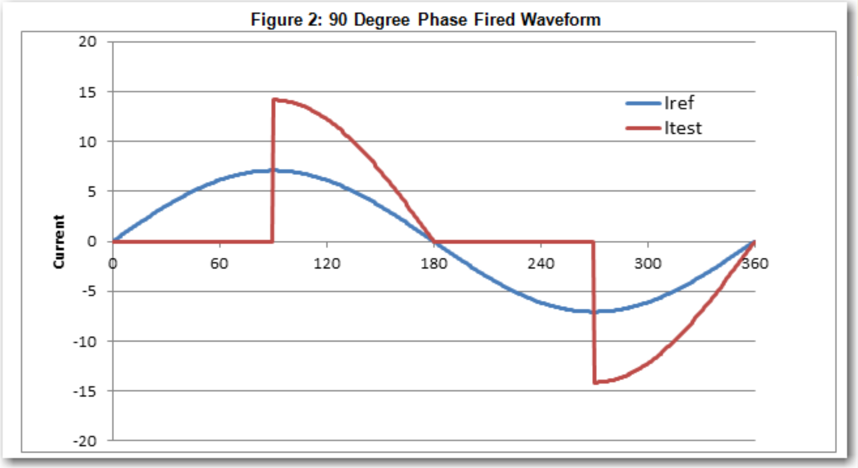
* If applicable per Section 5.5.2

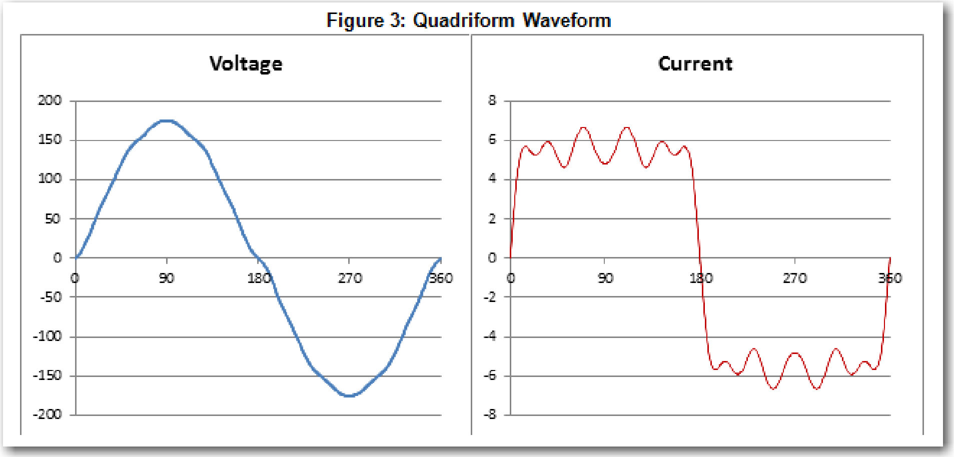
Polyphase or Series-parallel loading

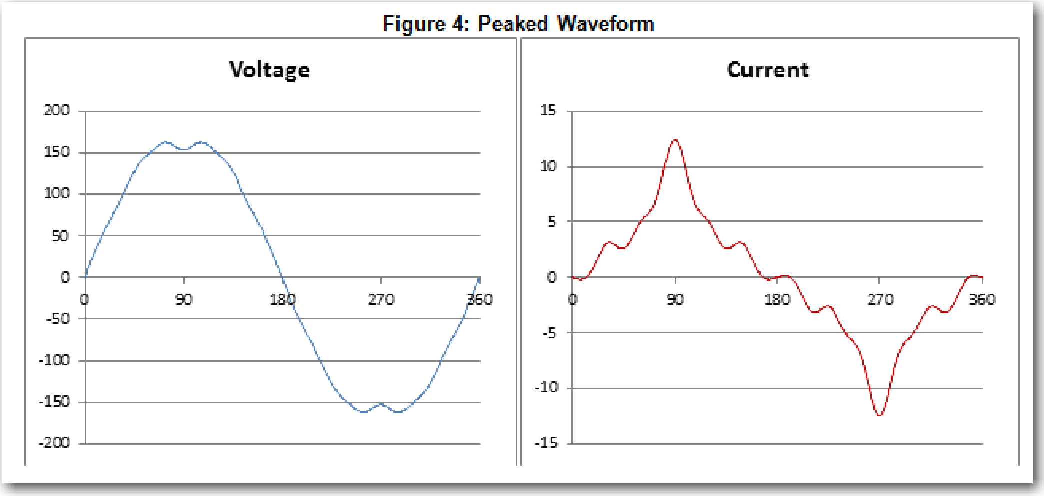
Required Alternative Loading Tests *

CHANGES – ANSI C12.20

Waveforms

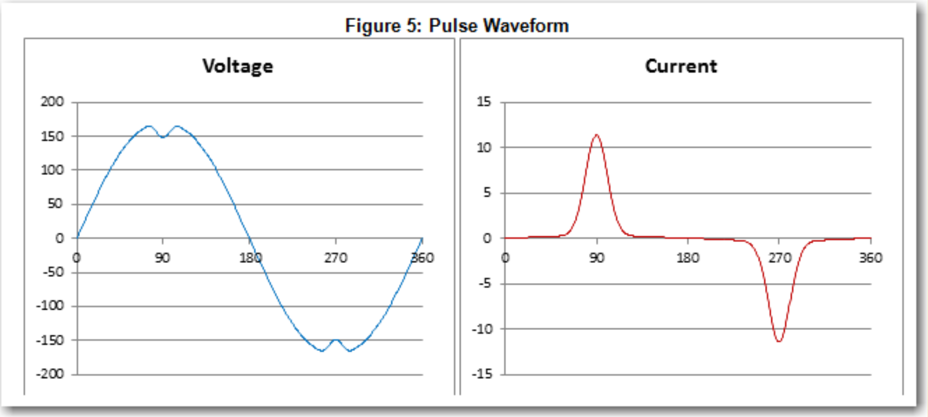


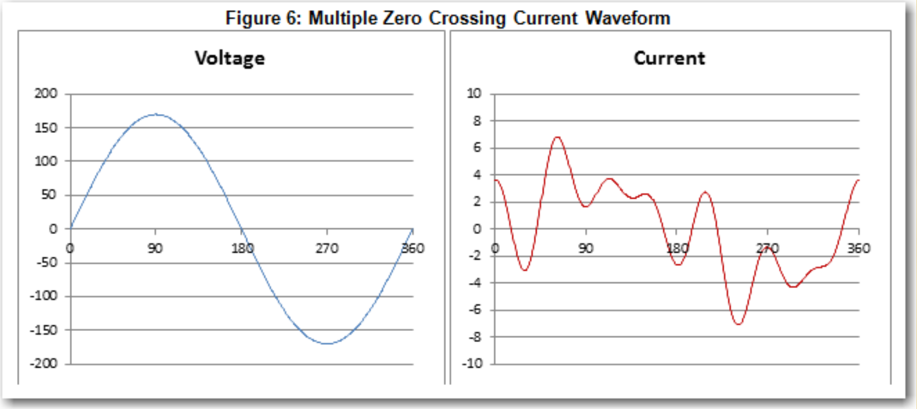


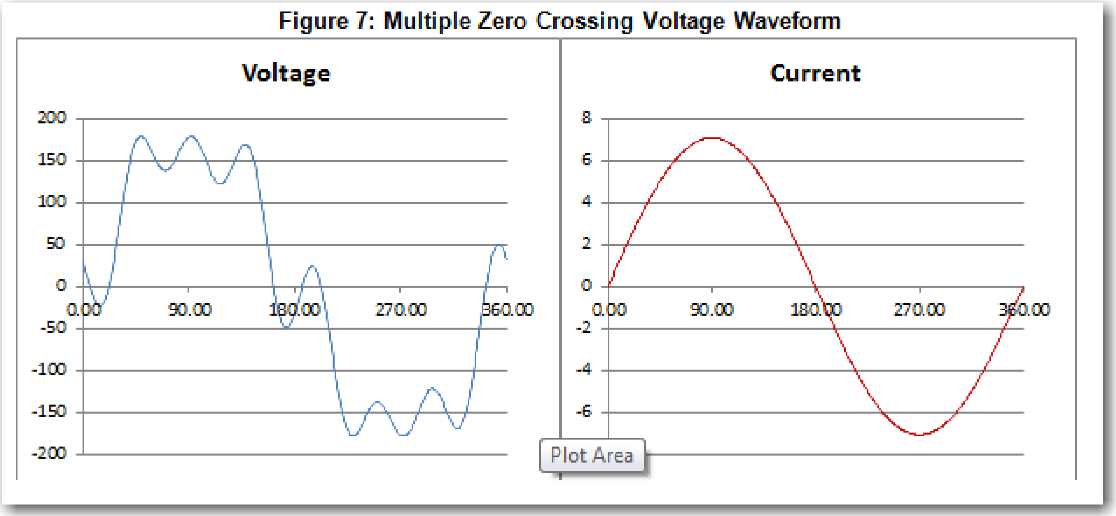


CHANGES – ANSI C12.20

Waveforms







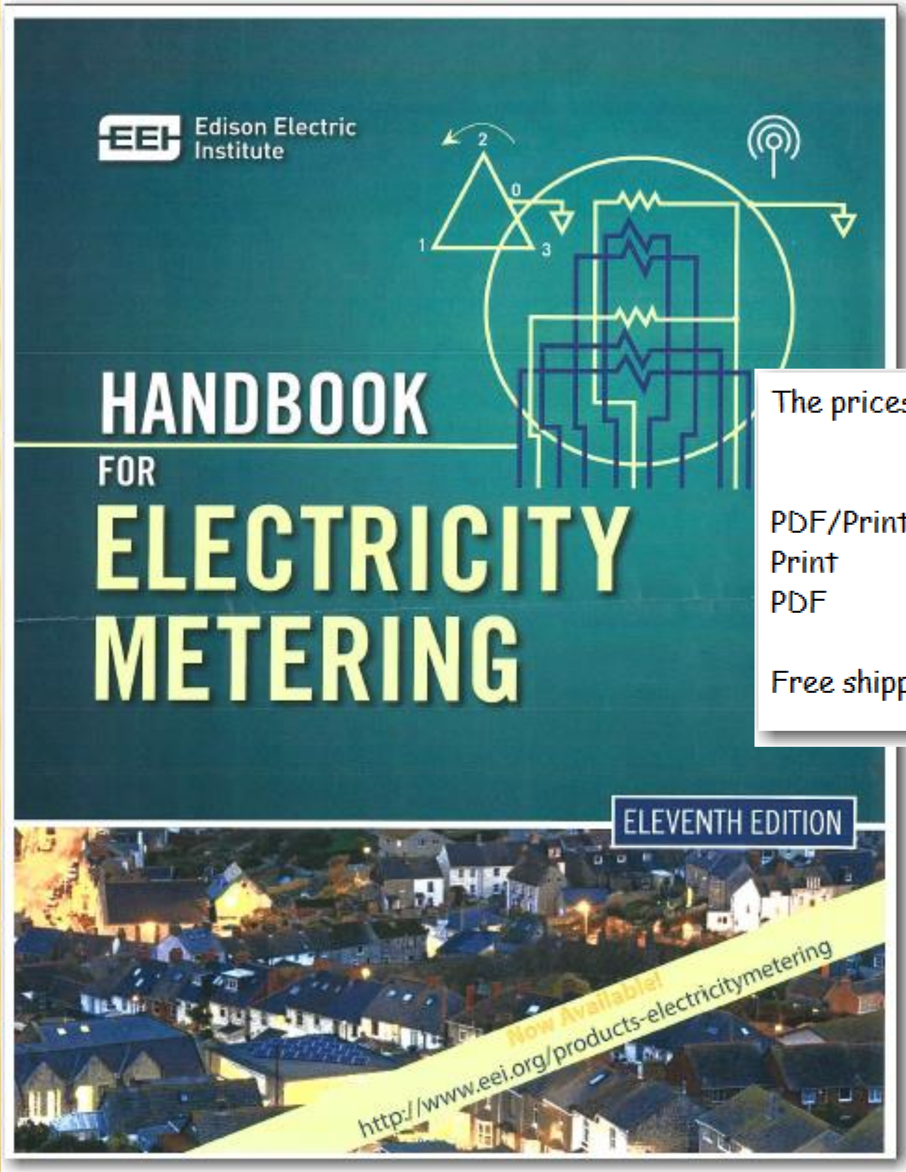
STATUS OF CURRENT ANSI WORK

ANSI C12 Standards Status – Oct 2014					
Designation	**Final Action Date**	**Title**	**Responsible Subcommittee**	**Responsible NEMA Section**	**Project Action**
ANSI C12.1-2008	6/27/2008	Electricity Metering, Code for	SC 1	8EI - 1TC	Revise/Reaffirm 2013 **Working draft ready to ballot Oct. 2014**
ANSI C12.4-1984 (R2002, R2011)	5/19/2011	Registers, Mechanical Demand	SC 1	8EI – 1TC	**Reaffirmed. Published Jan. 6, 2012**
ANSI C12.5-1978 (R2002)	5/19/2011	Meters, Thermal Demand	SC 1	8EI –1TC	**Reaffirmed. Published Oct. 25, 2012**
ANSI C12.6-1987 (R2002, R2012)	5/19/2011	Phase-Shifting Devices Used in Metering, Marking and Arrangement of Terminals for	SC 15	8EI – 3TC	**Reaffirmed. Published 9-26-2012**
ANSI C12.7-2005 (R2014)	4/15/2005	Requirements for Watthour Meter Sockets	SC 15	8EI – 3TC	**Approved August 14, 2014 In Publication now**
ANSI C12.8-1981 (R2002)	5/19/2011	Watthour Meters, Test Blocks and Cabinets for Installation of Self-Contained "A" Base	SC 15	8EI – 3TC	**Published Dec. 18, 2012**
ANSI C12.9-2014	4/15/2005	Test Switches for Transformer-Rated Meters	SC 15	8EI – 3TC	**Approved on Sept. 17, 2014 Publication 4th qtr 2014**
ANSI C12.10-2011	6/28/2011	Physical Aspects of Watthour Meters – Safety Standard	SC 1	8EI –1TC	**Approved June 28, 2011 Published Oct 2011. Revisions in discussion Meter Safety WG**
ANSI C12.11-2006 (R2014)	11/6/2007	Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)	SC 15	8EI – 2TC (work completed by 8EI-3TC)	**Approved May 27, 2014 Published July 29, 2014.**
ANSI C12.14-1982 (R1993)	8/14/2002	Electricity Meters, Magnetic Tape Pulse Recorders for	SC 1	8EI –1TC	Withdrawn 2002
ANSI C12.17-1991	8/14/2002	Cartridge-Type Solid-State Pulse Recorder for Electricity Metering	SC 1	8EI –1TC	Withdrawn 2002

STATUS OF CURRENT ANSI WORK

ANSI C12.18-1996 (R2006)	5/2/2006	Protocol Specification for ANSI Type 2 Optical Port	SC 17 WG4	8EI – 1TC	Revise/reaffirm 2011 **Updated (BSR 11 Extension to 2016)**
ANSI C12.19-2012	**2/24/09**	Utility Industry End Device Data Tables	SC 17 WG2	8EI – 1TC	**Balloted Ballot passed Approved Oct. 2, 2014 To be Published 4th quarter**
ANSI C12.20-2010	8/31/2010	0.2 and 0.5 Accuracy Class	SC 16	8EI – 1TC	Approved on Aug 31, 2010 Published 9-21-10
ANSI C12.21-1999 (R2006)	5/2/2006	Protocol Specification for Telephone Modem Communication	SC 17 WG4	8EI – 1TC	Revise/reaffirm 2011 **Updated (BSR 11 Extension to 2016)**
ANSI C12.22-2008	**1/9/09**	Protocol Specification for Interfacing to Data Communication Networks	SC 17 WG1	8EI – 1TC	**Revise/Reaffirm 2013. Balloted Ballot passed in process comments**
ANSI C12.23-201X	Draft in progress	AMR Device Compliance Test Standards	SC 17 WG3	8EI – 1TC	MOU signed – **Work in progress**
ANSI Registered C12.24 TR-2011	May 29, 2011	Definitions for Calculations of VA, VAh, VAR, and VARh for Poly-Phase Electricity Meters	SC 16 SC24	8EI-1TC	**Published Oct 2011. (Reaffirm or revise)**
~~**ANSI C12.25 (Placeholder)**~~	~~Discussion~~	~~In Service Performance~~	~~SC 25 Lawton~~	~~8EI-1TC~~	~~**Drafting Requirements. May be revision to existing ANSI Std**~~ **Included in C12.1 now**
ANSI C12.26 (Placeholder)		Communication Interface Module	SC17	8EI-1TC	**Inactive**
ANSI C12.27 (Placeholder)		Meter Upgradeability	SC27	8EI-1 TC	**Drafting Requirements-2013**
ANSI C12.29 (Placeholder)		Field Testing of Metering Sites	SC29 Hardy	8EI-1TC	**Discussion Phase Working Group Active**
ANSI Registered C12.30 TR (proposed)	In progress	Test Requirements for: Metering Devices Equipped with Service Switches	SC1	8EI-1TC	**Technical Report reBalloted Sep 24, 2013. Ballot closes Oct 8, 2013. NEMA C&S approval expected April 17th. Registered February 16, 2014.**
ANSI C12.46 (Placeholder)	New SC	OIML	SC46	8EI-1TC	

NEW METERING HANDBOOK IS AVAILABLE



To order contact EEI at

http://wwweei.org/products-electricitymetering

The prices follow:

	List	EEI Member Price
PDF/Print Combo	$285	$170
Print	$150	$90
PDF	$150	$90

Free shipping if EEI Member. Flat shipping rate of $8 for non EEI Members.

METERING HANDBOOK – CHAPTER 21 STANDARDS

- ANSI C12.1 – **Code for Electricity Metering** - This standard establishes acceptable performance criteria for new types of ac watt-hour meters, demand registers, pulse devices, and auxiliary devices. It also describes acceptable in-service performance levels for meters and devices used in revenue metering.
- ANSI C12.7 – **Requirements for Watt-hour Meter Sockets** - General requirements and pertinent dimensions applicable to watt-hour meter sockets rated up to and including 600V, and up to and including 320 A continuous duty per socket opening.
- ANSI C12.9 – **Test Switches for Transformer-Rated Meters** - Covers the dimensions and functions of meter test switches used with transformer-rated watt-hour meters in conjunction with instrument transformers.
- ANSI C12.10 - **Physical Aspect of Electricity Meters** – Safety Standard - This standard covers the physical aspects of both detachable and bottom-connected watt-hour meters and associated registers. It also includes ratings, internal wiring arrangements, pertinent dimensions, markings, and other general specifications.

METERING HANDBOOK – CHAPTER 21 STANDARDS

- ANSI C12.11 – **Instrument Transformers for Revenue Metering**, 10kV BIL through 350kV BIL (0.6kV NSV through 69kV NSV) - This standard covers the general requirements, revenue grade accuracy, thermal ratings, and dimensions applicable to current and inductively coupled voltage transformers for revenue metering.
- ANSI C12.18 - **Protocol Specification for ANSI Type 2 Optical Port** - This document details the criteria required for communications with an electricity metering device by another device via an optical port. This document provides details for a complete implementation of an OSI 7-layer model.
- ANSI C12.19 - **Utility Industry End Device Data Tables** - This standard defines a table structure for utility application data to be passed between an End Device and any other device. It, however, neither defines device design criteria nor specifies the language or protocol used to transport that data.

METERING HANDBOOK – CHAPTER 21 STANDARDS

- ANSI C12.20 - **0.2 and 0.5 Accuracy Classes for Electricity Meters** - This standard establishes the physical aspects and acceptable performance criteria for 0.2 and 0.5 accuracy class electricity meters meeting Blondel's Theorem. Where differences exist between the requirements of this Standard and C12.1 and C12.10, the requirements of this Standard shall prevail. Conversely, requirements NOT specifically addressed within this standard, defer to ANSI C12.1.
- ANSI C12.21– **Protocol Specification for Telephone Modem Communication** - This document details the criteria required for communications between an electric power metering device and a utility host via a modem connected to the switched telephone network.
- ANSI C12.22 – **Protocol Specification for Interfacing to Data Communication Networks** - This standard extends the concepts of the ANSI C12.18, C12.19 and C12.21 standards to allow transport of table data over any reliable networking communications system.

METERING HANDBOOK – CHAPTER 21 STANDARDS

Applicable Standards

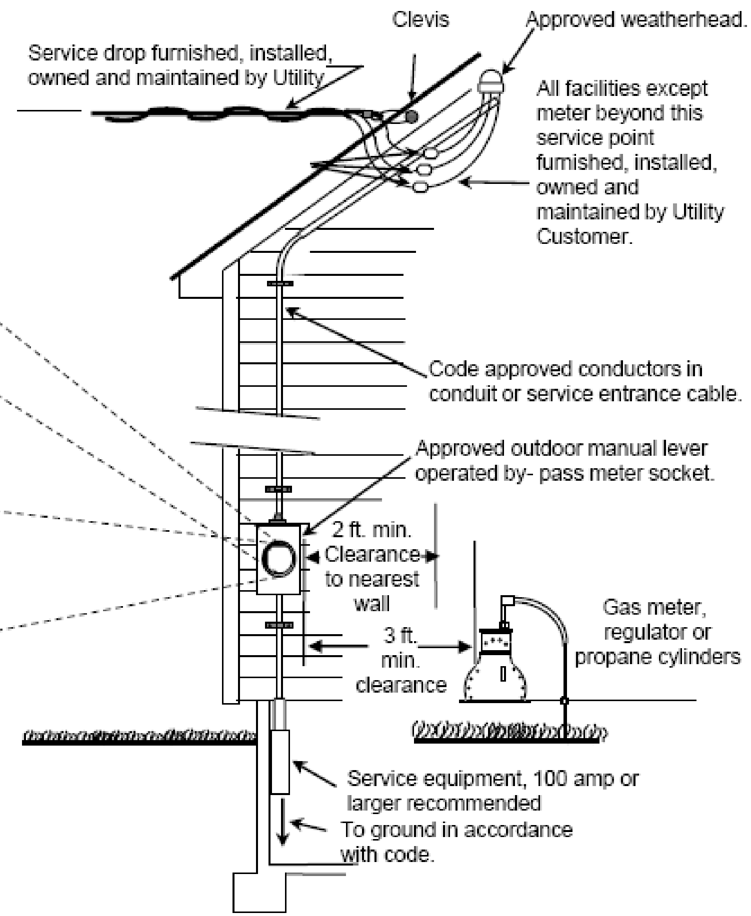
Electric Meter
ANSI C12.1
Code for Electricity Metering

Establishes acceptable performance criteria for new types of ac watthour meters, demand meters, demand registers, pulse devices and auxiliary devices. It also describes acceptable in-service performance levels for meters and devices used in revenue metering.

Electric Meter
ANSI C12.10
Physical Aspects of Watthour Meters Safety Standard

This standard covers the physical aspects of both detachable and bottom-connected watthour meters and associated registers. These include ratings, internal wiring arrangements, pertinent dimensions, markings, and other general specifications. All references to performance requirements are included as part of ANSI C12.1 and ANSI C12.20.

Typical Overhead Service Entrance Facilities



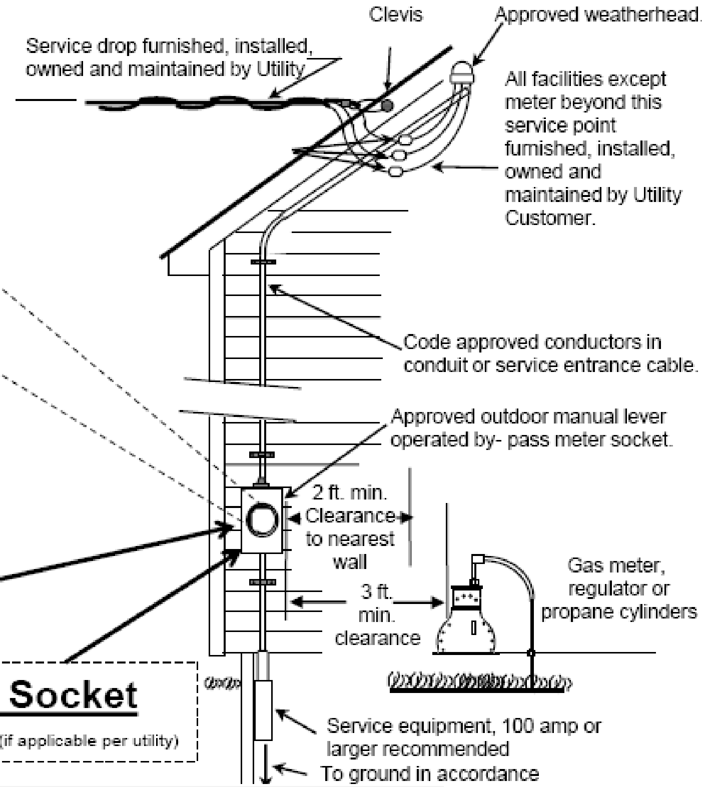
METERING HANDBOOK – CHAPTER 21 STANDARDS

Applicable Standards

Electric Meter
ANSI C12.20
Standard for Electricity Meters
- 0.2 and 0.5 accuracy classes

Establishes acceptable performance criteria for 0.2 and 0.5 accuracy class solid-state electricity meters which follow Blondel's rules, and covers accuracy class designations, current class designations, voltage and frequency ratings, test current values, service connection arrangements, pertinent dimensions, form designations, and environmental tests. Note that in-service qualifications for are included as part of ANSI C12.1 for these meters.

Typical Overhead Service Entrance Facilities



Meter Socket
ANSI C12.7
Requirements for Watthour Meter Sockets

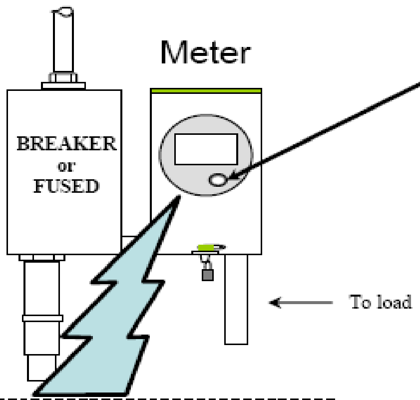
This standard covers the general requirements and pertinent dimensions applicable to watthour meter sockets rated up to and including 600 V and up to and including 320 A continuous duty per socket opening.

Meter Socket
UL 414 (if applicable per utility)

These requirements cover meter sockets for use with:
a) Watthour and similar meters;
b) Test switches;
c) Metering transformer cabinets; and
d) Metering transformer cabinet interiors for installation in accordance with the National Electrical Code, NFPA 70.

METERING HANDBOOK – CHAPTER 21 STANDARDS

Typical Solid-state Meter



Meter Data Interaction
ANSI C12.19
Utility Industry End Device Data Tables

Presents common structures for encoding data in communication between end devices (meters, home appliances, ANSI C12.22 nodes) and utility enterprise collection and control systems using binary codes and XML content. The tables support gas, water, and electric sensors and related appliances. The Standard addresses AMI and Smart Grid requirements in both US and Canada.

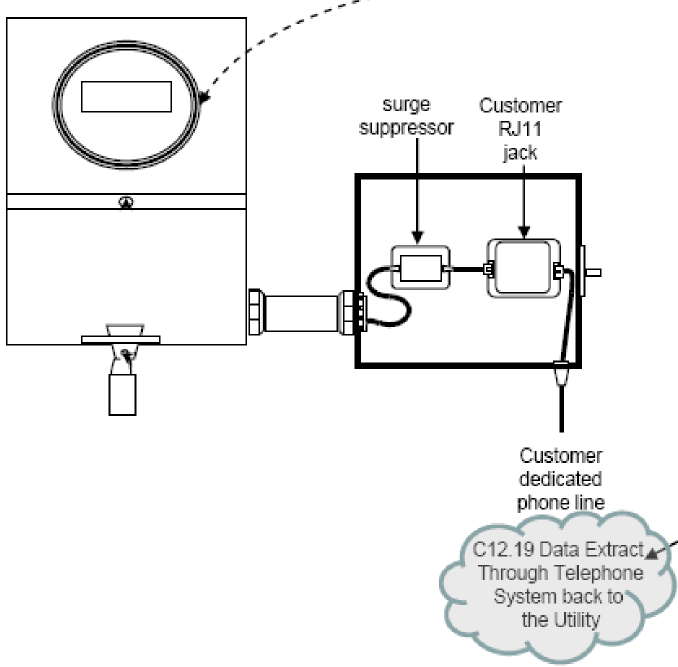
Applicable Standards

Optical Port
ANSI C12.18
Protocol Specifications for ANSI Type 2 Optical Port

ANSI C12.18-2006 details the criteria required for communications between a C12.18 device and a C12.18 client via an optical port. The C12.18 client may be any electronic communications device. This standard establishes protocol specifications and provides an open-platform communications protocol for two-way communication with a metering device through an ANSI Type 2 optical port.

METERING HANDBOOK – CHAPTER 21 STANDARDS

Telephone Metering Equipment Diagram



Applicable Standards

Telephone Modem

ANSI C12.21

Protocol Specifications for Telephone Modem Communications

Details the criteria required for communications between a C12.21 Device and a C12.21 Client via a modem connected to the switched telephone network. The C12.21 Client could be a laptop or portable computer, a master station system or some other electronic communications device.

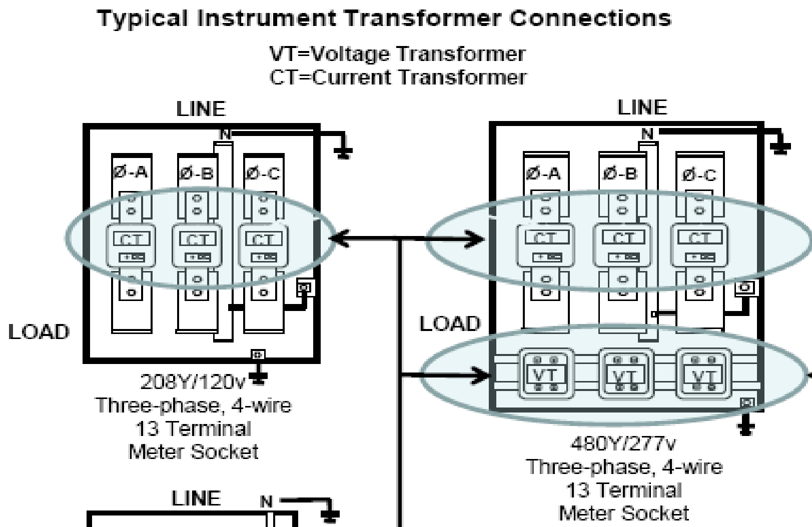
Data Communications

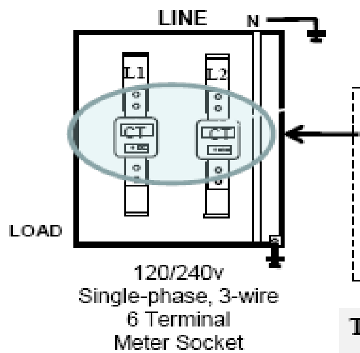
ANSI C12.22

Protocol Specifications for Interfacing to Data Communication Networks

This application-level standard describes the process of transporting C12.19 table data over a variety of networks.

METERING HANDBOOK – CHAPTER 21 STANDARDS





Applicable Standards

Instrument Transformers
(CTs and VTs)
IEEE C57.13
Standard Requirements for Instrument Transformers

This standard covers certain electrical, dimensional, and mechanical characteristics, and takes into consideration certain safety features of current and inductively coupled voltage transformers. The aim is to provide a basis for performance and interchangeability of equipment covered and to assist in the proper selection of such equipment.

Accuracy classes for metering service are provided. The test code covers measurement and calculation of ratio and phase angle, demagnetization, impedance and excitation measurements, polarity determination, resistance measurements, short-time characteristics, temperature rise tests, dielectric tests, and measurement of open-circuit voltage of current transformers.

Instrument Transformers
(CTs and VTs)
ANSI C12.11
Standard Requirements for Instrument Transformers

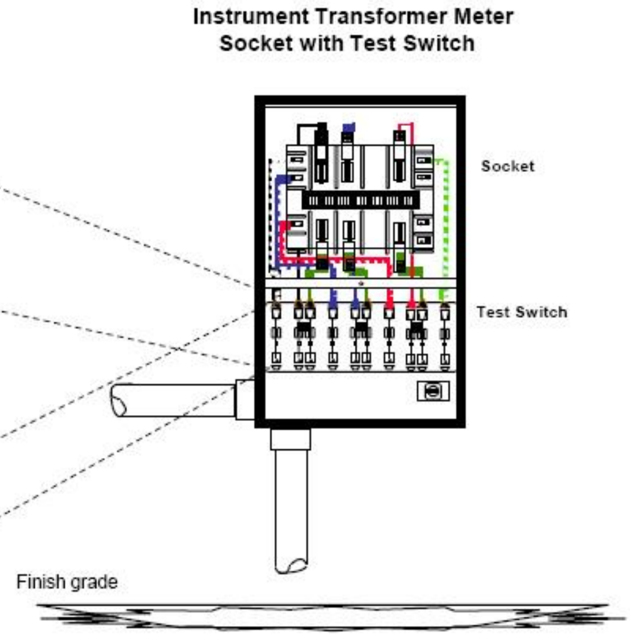
This Standard covers the general requirements, metering accuracy, thermal ratings, and dimensions applicable to current transformers and inductively coupled voltage transformers for revenue metering, 10 kV basic lightning impulse insulation level (BIL) through 350 kV BIL for 0.6 kV nominal system voltage (NSV) through 69 kV NSV.

METERING HANDBOOK – CHAPTER 21 STANDARDS

Applicable Standards

Test Switch
ANSI C12.9
American National Standard for Test Switches for Transformer-Rated Meters

This standard is intended to encompass the dimensions and functions of meter test switches used with transformer-rated watthour meters in conjunction with instrument transformers.



Test Switch
UL 414 (if applicable per utility)

These requirements cover meter sockets for use with:
a) Watthour and similar meters;
b) Test switches;
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Questions?

Thank you!